RECLAMATION DISTRICT NO. 1608
LINCOLN VILLAGE WEST
BOARD OF TRUSTEES MEETING
WEDNESDAY, MARCH 4, 2020,
8:00 A.M.
ENGINEER'S REPORT

I. PLAN REVIEW

A. Mr. Charles and Mrs. Farley Staniec residence at **6347 Embarcadero Drive**:

1. 3/02/20 Per Joe Bryson Mr. Staniec has repaired his fence between his property and the Marina property and propped up his dilapidated fence at the landside edge of crown but no removal of the hedge roots along the landside edge of crown.

II. DELTA GRANT II – PROPOSED STORAGE CONTAINER AND SUPPLYS

A. Review and seek approval from the Board of Trustees of the Delta Grant II – Proposed Storage Container and supplies cost estimate for the District.

EXHIBIT A: Cost estimate of materials & separation of reimbursable vs. non-reimbursable items.

III. 5 MILE SLOUGH HYACINTH REMOVAL

A. Removal of the herbicide sprayed water hyacinth in 5 Mile Slough started the week of February 14th. Clean Lakes Inc. has been hired to spray and harvest all of the Water Hyacinth out of 5 Mile Slough as well as to maintain the cleaned-up condition into the future. The removal operation is being performed with a long reach excavator situated on the levee at RD 2115 - Shima Tract and in-water hyacinth harvester. Hyacinth is being loaded into a dump truck and transported for disposal on the land side toe berm at RD 2115.

EXHIBIT B: Photo documentation from KSN Inc. Daily Field Reports

IV. SEDIMENT REMOVAL PROJECT

A. Review progress of permitting process with the Board of Trustees. Seek authorization from the Board of Trustees to execute the State Lands Lease. In addition, review with the Board of Trustees the correspondence that will be sent out to the landowners along the Sediment Removal Project requesting the relocation of their dock appurtenant facilities along with their boats during the Sediment Removal Project this Fall in order to maintain the design alignment of the project.

EXHIBIT C: KSN Inc. Summary of work activities associated with the sediment removal project dated February 27, 2020.

EXHIBIT D: KSN Final State Lands Lease dated February 18, 2020.

EXHIBIT E: RD 1608 _ Board Resolution Authorizing KSN Inc. to File the necessary Permit Application for the Sediment Removal Project Approvals.

EXHIBIT F: KSN Letter to landowners along Sediment Removal Project that have appurtenant facilities outboard of the original dock requiring relocation during the project in order to maintain design alignment dated February 27, 2019.

EXHIBIT G: Plot of a typical Appurtenant Facility attached to a dock.

EXHIBIT H: Photo of a typical Appurtenant Facility attached to a dock.

EXHIBIT I: Acknowledgement and acceptance of relocation of Appurtenant Facility attached to a dock

EXHIBIT J: KSN Letter to landowners along Sediment Removal Project that have their boats moored along their original dock requiring relocation during the project in order to maintain design alignment dated February 27, 2019

EXHIBIT K: Plot of a typical Boat moored to dock.

EXHIBIT L: Photo of a typical Boat moored to dock.

EXHIBIT M: Acknowledgement and acceptance of relocation of typical Boat moored to dock.

V. DESIGN AND CONSTRUCTION AUTHORITY (DCA) – DELTA TUNNELS PROJECT

A. Review recent Independent Technical Review Committee findings of the early technical material provided for the Delta Conveyance (DCA) (Tunnels) Project.

EXHIBIT N: Materials for the February 14, 2020 Regular Board Meeting of the DCA.

EXHIBIT O: Findings of DCA's Independent Technical Review Committee Report dated February 20, 2020.

VI. GOVERNOR NEWSOME'S DRAFT WATER RESILIENCE PORTFOLIO

A. Review Central Delta Water Agencies (CDWA) comments on the Governors Draft Water Resilience Portfolio.

EXHIBIT P: CDWA's comments on "Draft Water Resilience Portfolio" dated February 7, 2020.

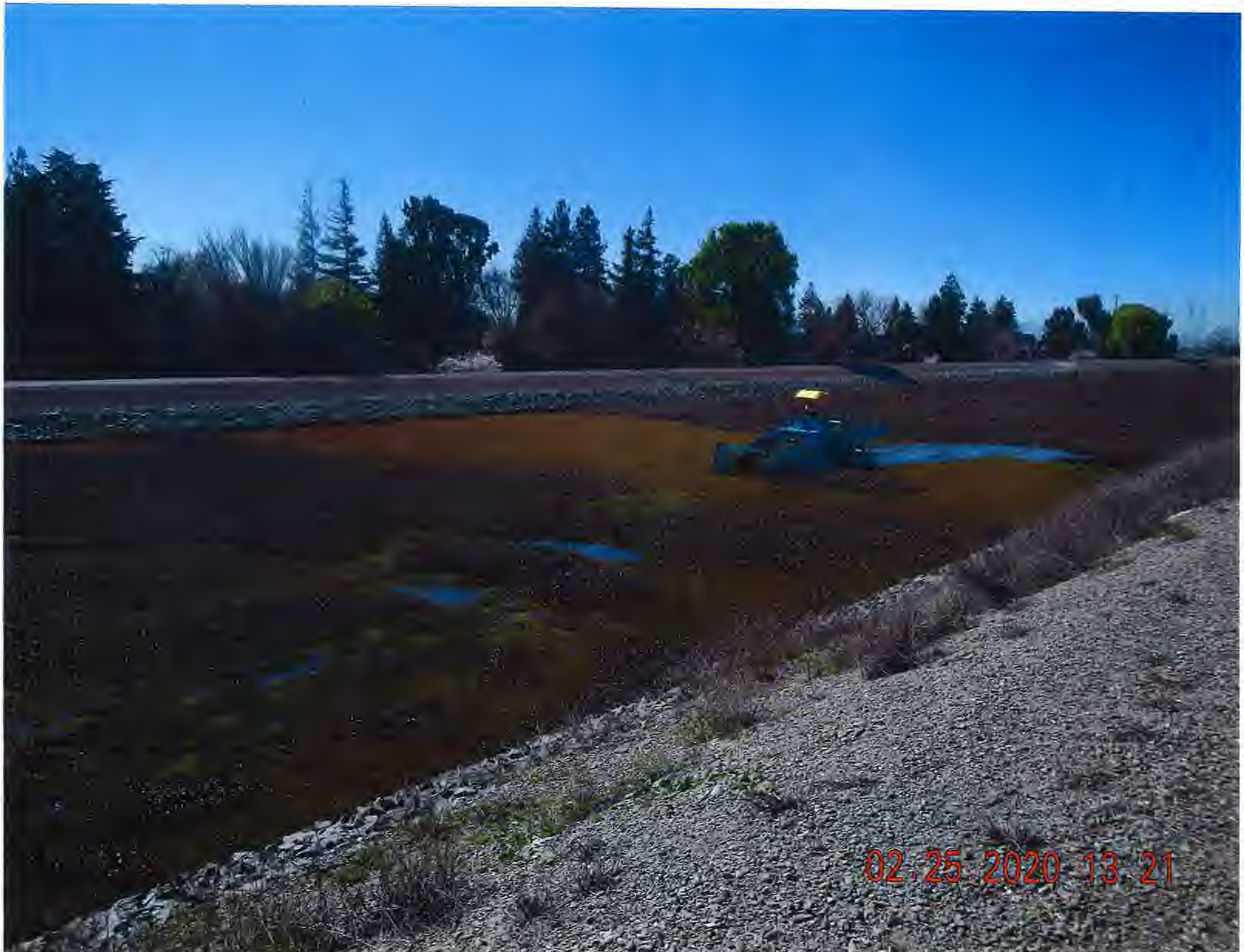
Exhibit A

Delta Grant II - Proposed Storage Container and Supplies Cost Estimate

RD 1608 - Lincoln Village West

Item	LMA Units	Price/Unit	Shipping	Sales Tax (9%)	Total Cost
ConEx Container					
Steel Container	1	$ 4,681.55	$ 375.00	Included	$ 5,056.55
Flood Fight Supplies per DWR List					
Visqueene, roll	20	$ 93.00	$ 297.00	$ 167.40	$ 2,324.40
Sandbags	5,000	$ 0.75	$ 225.00	$ 337.50	$ 4,312.50
Bailing Twine, Each	4	$ 33.89		$ 12.20	$ 147.76
Stakes (1"x2"x24") (25/bundle)	86	$ 8.85		$ 68.50	$ 829.60
Lath (50 pcs Bundles)	4	$ 17.50		$ 6.30	$ 76.30
Permanent Ink Markers (dozen)	1	$ 29.95		$ 2.70	$ 32.65
Survey Ribbon (dozen)	2	$ 14.50		$ 2.61	$ 31.61
High Visibility Spraypaint (dozen)	1	$ 64.00		$ 5.76	$ 69.76
Tie buttons (box of 1,400)	2	$ 770.00		$ 138.60	$ 1,678.60
Lineman Pliers	3	$ 16.97		$ 4.58	$ 55.49
Sledge Hammers	4	$ 36.00	$ -	$ 12.96	$ 156.96
Shovels	4	$ 8.20	$ -	$ 2.95	$ 35.75
Sheet Metal Snips	1	$ 13.97	$ -	$ 1.26	$ 15.23
Loppers	2	$ 33.98		$ 6.12	$ 74.08
McLeod Tool	2	$ 40.09		$ 7.22	$ 87.40
100 cloth tape	1	$ 15.97		$ 1.44	$ 17.41
Patrol Vehichle Identifier Decals	4	$ 40.00		$ 14.40	$ 174.40
Adverse Weather Gear					
Waterproof Muck Boots	5	$ 20.00		$ 9.00	$ 109.00
Life Jackets	5	$ 60.00		$ 27.00	$ 327.00
Vests w/IC Positions	5	$ 13.45		$ 6.05	$ 73.30
Wet Weather Suits	5	$ 15.00		$ 6.75	$ 81.75
Flash Lights (2 pack)	5	$ 30.00		$ 13.50	$ 163.50
Emergency Equipment					
20" Chainsaw	1	$ 400.00	$ 25.00	$ 36.00	$ 461.00
First Aid Kit	4	$ 20.00		$ 7.20	$ 87.20
Mobile Lights with Mount	2	$ 1,925.00		$ 346.50	$ 4,196.50
Emergency Generator	1	$ 979.00		$ 88.11	$ 1,067.11
Receptical Adapter	1	$ 40.00		$ 3.60	$ 43.60
Staging Area Signage (18" x 36")	1	$ 102.00		$ 9.18	$ 111.18
				ConEx Container Total	**$ 5,056.55**
				Flood Fight Supplies Total	**$ 16,841.03**
				GRAND TOTAL	**$ 21,897.58**
				Reimbursible Items Cost	**$ 14,557.35**
				Non-Reimbursible Items Cost	**$ 7,340.23**

Exhibit B


02.25.2020 13:21


02.25.2020 13:22


02.25.2020 13:24


02.25.2020 13:25


02.25.2020 13:28

Exhibit C

Christopher H. Neudeck

From: Jacob Bejarano
Sent: Thursday, February 27, 2020 2:16 PM
To: Christopher H. Neudeck
Cc: Bill Darsie; Wendy L. Fuerte
Subject: RE: RD1608 LVW Sed. Removal Progress Update
Attachments: 5 again.JPG; 18b.JPG

SEDIMENT REMOVAL PROJECT

TASK 1: PROJECT MANAGEMENT & DESIGN
TASK BUDGET STATUS: $78,698 (115% of task budget)

PM:

- Reviewed and Finalized edits to Legal Counsel redraft of the POS Agreement, Legal Counsel to release agreement to POS for negotiations.
- Finalized Project Specifications, Plans and Bid Documents. Undergoing internal QA/QC
- Provided Technical Specs to Permitting Consult. Comments were received and will be incorporated with internal review comments once received and finalize.
- The previous progress report identified numerous dock accessories attached encroaching into the dredge limits (see attached photos). Of the 23 docks within the project area, 12 contain an accessory (Boat hoist, slip, dock extension). Draft Letters and Exhibits were prepared to provide advance residential notice to have the encroachments temporarily removed in preparation of the project. A second draft letter was prepared, requesting other dock owners/residents to keep their boats out of the dredging area footprint during the project.
- The Bid docs are anticipated to be advertised by the first week of March.

TASK 2: SURVEY & MAPPING
TASK BUDGET STATUS: $27,620 (47% of task budget)

- Prepare Project Plan Set and Mapping

TASK 3: ENVIRONMENTAL ASSESSMENTS & DOCUMENTATION
TASK BUDGET STATUS: $90,236 (100% of task budget, working on T&M for permit support)

- No effort to report on this task.

TASK 4: DREDGING OPERATIONS SUPPORT & PERMITTING
TASK BUDGET STATUS: $133,976(72% of task budget)

Permitting:

- Central Valley Flood Control Board: Obtained approval as a Maintenance Dredging Project. **(Status: Completed)**
- Ca. Water Resource Control Board (SWRCB): **(Status: Authorized to Dredge, monitoring and reporting to commence during construction)**
- Ca. Dept. Fish & Wildlife (CDFW): **(Status: Completed)**
- US Army Corps of Engineers (USACE): **(Status: Completed)**
- State Lands Commission (SLC): **(Status: Complete pending execution of agreement)**
    - KSN has received a sample agreement providing their typical requirements for maintenance dredging projects. We will review and provide an update to the January progress report.
    - Upon review of the Draft Dredge Lease, the terms of the agreement appear to be straight forward with the only condition that RD is not authorized to sell the sediment material. RD is not intending the sell the material therefor this condition is satisfied.
    - The SLC meeting was held on February 28th. The Consent item was

KSN inc. KJELDSEN SINNOCK NEUDECK
CIVIL ENGINEERS & LAND SURVEYORS
CELEBRATING 60 YEARS

Jacob Bejarano
Civil Engineer

711 N. Pershing Ave. Stockton CA 95203
209 946-0268 | fax: | 209 946-0296
jbejarano@ksninc.com | https://www.ksninc.com

Exhibit D

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

JENNIFER LUCCHESI, *Executive Officer*
(916) 574-1800 *Fax* **(916) 574-1810**
California Relay Service TDD Phone **1-800-735-2929**
from Voice Phone **1-800-735-2922**

Contact Phone: **(916) 574-0722**
Contact Fax: **(916) 574-1925**

Established in 1938

February 18, 2020

File Ref: A 2117

Reclamation District No. 1608
Attn.: Daniel Schroeder
PO Box 20
Stockton, CA 95201

Subject: General Lease – Dredging of sovereign land located in 14-Mile Slough, near Stockton, San Joaquin County; for maintenance dredging of a maximum of 60,000 cubic yards of sediment material.

Dear Daniel Schroeder:

The enclosed lease document, in duplicate, states the terms and conditions of a General Lease – Dredging, for the above mentioned facilities in 14-Mile Slough, San Joaquin County. If you find these documents to be in order, please execute ***both copies*** of the lease ***before a Notary Public*** and return them to my attention ***by March 12, 2020*** at the above-stated address.

Please provide a resolution from Reclamation District No. 1608 (Lessee) authorizing the Lease execution, or other document(s) granting signatory authority to the individual signing the agreement on behalf of the Lessee.

The application will be scheduled for consideration for approval by the State Lands Commission at the next meeting scheduled for February 28, 2020. Once approved, a fully-executed lease will be returned to you.

Thank you for your attention in this matter. If you have any questions, please feel free to contact me at (916) 574-0722 or by e-mail at Dobri.Tutov@slc.ca.gov.

Sincerely,

Dobri Tutov
Public Land Management Specialist

Enclosure

RECORDED AT THE REQUEST OF
AND WHEN RECORDED MAIL TO:
STATE OF CALIFORNIA
California State Lands Commission
Attn: Title Unit
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

STATE OF CALIFORNIA
OFFICIAL BUSINESS
Document entitled to free recordation
pursuant to Government Code Section 27383

SPACE ABOVE THIS LINE FOR RECORDER'S USE

A.P.N.: 100-320-05, 098-150-02, 03, 04
County: San Joaquin

LEASE _________

This Lease consists of this summary and the following attached and incorporated parts:

Section 1	Basic Provisions
Section 2	Special Provisions Amending or Supplementing Section 1 or 3
Section 3	General Provisions
Exhibit A	Land Description
Exhibit B	Site and Location Map

SECTION 1

BASIC PROVISIONS

THE STATE OF CALIFORNIA, hereinafter referred to as Lessor acting by and through the **CALIFORNIA STATE LANDS COMMISSION** (100 Howe Avenue, Suite 100-South, Sacramento, California 95825-8202), pursuant to Division 6 of the Public Resources Code and Title 2, Division 3 of the California Code of Regulations, and for consideration specified in this Lease, does hereby lease, demise, and let to the **RECLAMATION DISTRICT NO. 1608**, hereinafter referred to as Lessee, those certain lands described in Exhibit A and shown on Exhibit B (for reference purposes only) hereinafter referred to as Lease Premises, subject to the reservations, terms, covenants, and conditions of this Lease.

MAILING ADDRESS: Reclamation District No. 1608
Attn.: Daniel Schroeder
PO Box 20
Stockton, CA 95201

LEASE TYPE: General Lease – Dredging

LAND TYPE: Sovereign

LOCATION: 14-Mile Slough, near Stockton, San Joaquin County as described in Exhibit A attached and by this reference made a part hereof.

LAND USE OR PURPOSE: Maintenance dredging of a maximum of 60,000 cubic yards of sediment material. Dredged material shall be disposed at one of two proposed dredge sediment placement facilities located on Lower Roberts Island.

TERM: 3 years, beginning February 28, 2020; ending February 27, 2023, unless sooner terminated as provided under this Lease.

CONSIDERATION: No monetary consideration is due for the lease because it is for the public use and benefit, there is no commercial benefit from the project and the dredged material may not be sold. Subject to modification by Lessor as specified in Paragraph 2 of Section 3 - General Provisions.

LIABILITY INSURANCE: N/A

SECTION 2
SPECIAL PROVISIONS

BEFORE THE EXECUTION OF THIS LEASE, ITS PROVISIONS ARE AMENDED, REVISED, OR SUPPLEMENTED AS FOLLOWS:

1. In performing the dredging, the Lessee will abide by Best Management Practices to control turbidity to protect marine resources and habitats from excessive siltation in the general vicinity of the project.

2. Lessee shall prepare and maintain accurate records of its operations under this Lease. Lessee shall provide to Lessor detailed report of the volume and placement of dredged materials.

3. In the event of a hazardous spill, Lessee shall immediately contact the 24-Hour Oil Spill Hotline of the California Office of Emergency Services at 1-800-852-7550 and the Mineral Resources Management Division at 1-562-590-5201.

4. All vessels, equipment, machinery, tools or other property moved onto or within the Lease Premises or lands subject to Lessor's jurisdiction shall remain the property of the Lessee and/or its authorized contractors. Such property shall be promptly and properly removed by Lessee, at its sole risk and expense.

5. Lessor accepts no responsibility for any damages to any property, including any vessels, equipment,

machinery, or tools within the Lease Premises or lands subject to Lessor's jurisdiction.

6. Lessee acknowledges that the land described in Exhibit A of this Lease is subject to the Public Trust and is presently available to members of the public for recreation, waterborne commerce, navigation, fisheries, open space, and any other recognized Public Trust uses. Lessee also agrees that any proposed dredging activities and subsequent use of the Lease Premises shall not unreasonably interfere with or limit Public Trust rights, and any temporary interference or limitation of Public Trust rights or public access shall only be to the extent necessary to protect public health and safety during dredging activities authorized by Lessor, or when imminent threats to public health and safety are present.

7. Lessee acknowledges that the Lease Premises and adjacent upland are located in an area that may be subject to effects of climate change, including sea-level rise. To prepare for the potential effects of sea-level rise, including flood damage, erosion damage, tsunamis, and damage from waves and storm-created debris, the Lessee acknowledges and agrees to the following:

   a. Hazards associated with sea-level rise may require additional maintenance or protection strategies regarding the improvements on the Lease Premises.

   b. Consistent with Section 3, Paragraph 7, the Lessee assumes the risks associated with such potential hazards and agrees to be solely responsible for all damages, costs, and liabilities arising as a result of the impacts of such hazards on the Lease Premises. Any additional maintenance or protection strategies necessitated by such hazards may require additional approval by Lessor pursuant to Section 3, Paragraph 4(a) and be subject to environmental review.

In the event of any conflict between the provisions of Section 2 and Section 3 of this Lease, the provisions of Section 2 shall prevail.

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SECTION 3

GENERAL PROVISIONS

1. **GENERAL**
These provisions are applicable to all leases, permits, rights-of-way, easements, or licenses or other interests in real property conveyed by the State Lands Commission.

2. **CONSIDERATION**
(a) **Categories**
(1) **Royalty**
Lessee shall pay the rent or royalty as stated in this Lease to Lessor without deduction, delay, or offset, on or before the beginning date of this Lease and on or before each anniversary of its beginning date during each year of the Lease term.

(2) **Non-Monetary Consideration**
If the consideration to Lessor for this Lease is the public use, benefit, health, or safety, Lessor shall have the right to review such consideration at any time and set a monetary rental if the State Lands Commission, at its sole discretion, determines that such action is in the best interest of the State. Dredged material may not be sold.

(b) **Penalty and Interest**
Any installments of rental accruing under this Lease not paid when due shall be subject to a penalty and shall bear interest as specified in Public Resources Code Section 6224 and the Lessor's then existing administrative regulations governing penalty and interest.

3. **BOUNDARIES**
This Lease is not intended to establish the State's boundaries and is made without prejudice to either party regarding any boundary claims which may be asserted presently or in the future.

4. **LAND USE**
(a) **General**
Lessee shall use the Lease Premises only for the purpose or purposes stated in this Lease and only for the operation and maintenance of the improvements expressly authorized in this Lease. Lessee shall commence use of the Lease Premises within ninety (90) days of the beginning date of this Lease or within ninety (90) days of the date set for construction to commence as set forth in this Lease, whichever is later. Lessee shall notify Lessor within ten (10) days after commencing the construction of authorized improvements and within sixty (60) days after completing them. Lessee's discontinuance of such use for a period of ninety (90) days shall be conclusively presumed to be an abandonment.

(b) **Continuous Use**
Lessee's use of the Lease Premises shall be continuous from commencement of the Lease until its expiration.

(c) **Conservation**
Lessee shall not violate any law or regulation whose purpose is to conserve resources or to protect the environment. Violation of this section shall constitute grounds for termination of the Lease. Lessor, by its executive officer, shall notify Lessee, when in his or her opinion, Lessee has violated the provisions of this section and Lessee shall respond and discontinue the conduct or remedy the condition within 30 days.

(d) **Toxics**
Lessee shall be fully responsible for any hazardous wastes, substances, or materials as defined under federal, State, or local law, regulation, or ordinance that are manufactured, generated, used, placed, disposed, stored, or transported on the Lease Premises during the Lease term and shall comply with and be bound by all applicable provisions of such federal, State, or local law, regulation or ordinance dealing with such wastes, substances, or materials. Lessee shall notify Lessor and the appropriate governmental emergency response agency(ies) immediately in the event of any release or threatened release of any such wastes, substances, or materials.

(g) **Enjoyment**
Subject to the provisions of paragraph 5 (a) (2) below, nothing in this Lease shall preclude Lessee from excluding persons from the Lease Premises when their presence or activity constitutes a material interference with Lessee's use and enjoyment of the Lease Premises as provided under this Lease.

(h) **Discrimination**
Lessee in its use of the Lease Premises shall not discriminate against any person or class of persons on the basis of race, color, creed, religion, national origin, sex, age, or handicap.

5. **RESERVATIONS, ENCUMBRANCES, AND RIGHTS-OF-WAY**
(a) **Reservations**
(1) Lessor expressly reserves all natural resources in or on the Lease Premises, including but not limited to timber and minerals as defined under Public Resources Code Sections 6401 and 6407, as well as the right to grant leases in and over the Lease Premises for the extraction of such natural resources; however, such leasing shall be neither inconsistent nor incompatible with the rights or privileges of Lessee under this Lease.

(2) Lessor expressly reserves a right to go on the Lease Premises and all improvements for any purposes associated with this Lease or for carrying out any function required by law, or the rules, regulations, or management policies of the State Lands Commission. Lessor shall have a right of reasonable access to the Lease Premises across Lessee owned or occupied lands adjacent to the

Lease Premises for any purpose associated with this Lease.

(3) Lessee agrees to allow the State, the State's easement holders, permittees or lessees to enter upon the Leased Lands in order to conduct authorized activities; provided that such parties shall provide Lessee with reasonable advance notice of their entry on the Leased Lands and the contemplated activities while on the Leased Lands. The State shall require such parties to indemnify, defend and hold Lessee harmless from and against any loss, cost, charge, cause of action or other liability of any kind whatsoever that arises out of such parties activities on, in or associated with the Leased Lands.

(4) Lessor expressly reserves to the public an easement for convenient access across the Lease Premises to other State-owned lands located near or adjacent to the Lease Premises and a right of reasonable passage across and along any right-of-way granted by this Lease; however, such easement or right- of-way shall be neither inconsistent nor incompatible with the rights or privileges of Lessee under this Lease.

(5) Lessor expressly reserves the right to lease, convey, or encumber the Lease Premises, in whole or in part, during the Lease term for any purpose not inconsistent or incompatible with the rights or privileges of Lessee under this Lease.

(b) **Encumbrances**
This Lease may be subject to pre-existing contracts, leases, licenses, easements, encumbrances, and claims and is made without warranty by Lessor of title, condition, or fitness of the land for the stated or intended purpose.

6. **RULES, REGULATIONS, AND TAXES**
(a) Lessee shall comply with all applicable laws, regulations and rules of the United States, the State of California and counties or cities now or hereafter enacted or promulgated, including, without limitations, all applicable provisions of the Public Resources Code, the California Administrative Code, and the Statutes of California, regardless of which agency or government body may have jurisdiction with respect to enforcement. Lessee also agrees that in its employment practice hereunder, it shall not discriminate against any person because of race, color, religion, sex, ancestry, national origin physical disability, sexual orientation, AIDS or AIDS related condition(s), marital status or age.

(b) Lessee understands and agrees that a necessary condition for the granting and continued existence of this Lease is that Lessee obtains and maintains all permits or other entitlements.

(c) Lessee accepts responsibility for and agrees to pay any and all possessory interest taxes, assessments, user fees or service charges imposed on or associated with the leasehold interest, improvements or the Lease Premises, and such payment shall not reduce rental due Lessor under this Lease and Lessor shall have no liability for such payment.

(d) In accepting this Lease, Lessee understands that the interest created herein may be subject to a possessory interest tax imposed by a local or county tax assessor. Any such possessory interest tax imposed shall not reduce any royalty due hereunder and payment of the tax shall be the liability of the Lessee.

7. **INDEMNITY**
(a) Lessor shall not be liable and Lessee shall indemnify, hold harmless, and, at the option of Lessor, defend Lessor, its officers, agents, and employees against and for any and all liability, claims, damages or injuries of any kind and from any cause, arising out of or connected in any way with the issuance, enjoyment or breach of this Lease or Lessee's use of the Lease Premises except for any such liability, claims, damage or injury solely caused by the negligence of Lessor, its officers, agents and employees.

(b) Lessee shall notify Lessor immediately in case of any accident, injury, or casualty on the Lease Premises.

8. **INSURANCE**
(a) Lessee shall obtain and maintain in full force and effect during the term of this Lease comprehensive general liability insurance and property damage insurance, with such coverage and limits as may be reasonably requested by Lessor from time to time, but in no event for less than the sum(s) specified, insuring Lessee and Lessor against any and all claims or liability arising out of the ownership, use, occupancy, condition, or maintenance of the Lease Premises and all improvements.

(b) The insurance policy or policies shall name the State of California, its officers, employees and volunteers as insureds as to the Lease Premises and shall identify the Lease by its assigned number. Lessee shall provide Lessor with a certificate of such insurance and shall keep such certificate current. The policy (or endorsement) must provide that the insurer will not cancel the insured's coverage without thirty (30) days prior written notice to Lessor. Lessor will not be responsible for any premiums or other assessments on the policy. The coverage provided by the insured (Lessee) shall be primary and non-contributing.

(c) The insurance coverage specified in this Lease shall be in effect at all times during the Lease term and subsequently until all of the Lease Premises have been either accepted as improved, by Lessor, or restored by Lessee as provided elsewhere in this Lease.

(d) Workers Compensation: Lessee shall at all times in any and all of its operations hereunder and any works in and upon the Leased Lands, carry full and complete workers compensation insurance covering all of its employees.

9. **SURETY BOND**

(a) Lessee shall provide a surety bond or other security device acceptable to Lessor, for the specified amount, and naming the State of California as the assured, to guarantee to Lessor the faithful observance and performance by Lessee of all of the terms, covenants, and conditions of this Lease.

(b) Lessor may require an increase in the amount of the surety bond or other security device to cover any additionally authorized improvements, alterations or purposes and any modification of consideration.

(c) The surety bond or other security device shall be maintained in full force and effect at all times during the Lease term and subsequently until all of the Lease Premises have been either accepted by Lessor, or restored by Lessee as provided elsewhere in this Lease.

(d) Said bond shall require the surety to give at least 120 days written notice of its intention to case acting as guarantor. If a surety gives notice of its intention to cease acting as a guarantor, the Lessee shall provide to State within 30 days of such notice a replacement bond of equal value to become effective upon the expiration of the existing bond. Failure to provide such a replacement bond within the required time shall constitute a default entitling State to levy against the entire amount of the existing bond. Lessee agrees that in no event shall the amount of the bond be construed as a limitation on its liability. This requirement shall be separate from any other bonding provisions of the Public Resources Code and the regulations of the State of California or any other State, local or federal requirement.

10. **ASSIGNMENT, ENCUMBRANCING OR SUBLETTING**

(a) Lessee shall not either voluntarily or by operation of law, assign, transfer, mortgage, pledge, hypothecate or encumber this Lease and shall not sublet the Lease Premises, in whole or in part, or allow any person other than the Lessee's employees, agents, servants and invitees to occupy or use all or any portion of the Lease Premises without the prior written consent of Lessor, which consent shall not be unreasonably withheld. Employment of operators and/or subcontractors by Lessee shall not be considered a sublease or assignment of this Lease; provided, however, that Lessee shall first notify Lessor of any intended operator and/or subcontractors and obtain Lessor's approval of the use of an operator and/or subcontractor. In the event of any subcontracting, Lessee shall remain liable for the operator's and/or subcontractor's activities including the payments of royalties.

(b) The following shall be deemed to be an assignment or transfer within the meaning of this Lease:

(1) If Lessee is a corporation, any dissolution, merger, consolidation or other reorganization of Lessee or sale or other transfer of a percentage of capital stock of Lessee which results in a change of controlling persons, or the sale or other transfer of substantially all the assets of Lessee;

(2) If Lessee is a partnership, a transfer of any interest of a general partner, a withdrawal of any general partner from the partnership, or the dissolution of the partnership.

(c) If this Lease is for sovereign lands, it shall be appurtenant to adjoining littoral or riparian land and Lessee shall not transfer or assign its ownership interest or use rights in such adjoining lands separately from the leasehold rights granted herein without the prior written consent of Lessor.

(d) If Lessee desires to assign, sublet, encumber or otherwise transfer all or any portion of the Lease Premises, Lessee shall do all of the following:

(1) Give prior written notice to Lessor;

(2) Provide the name and complete business organization and operational structure of the proposed assignee, sublessee, secured third party, or other transferee; and the nature of the use of and interest in the Lease Premises proposed by the assignee, sublessee, secured third party or other transferee. If the proposed assignee, sublessee, or secured third party is a general or limited partnership, or a joint venture, provide a copy of the partnership agreement or joint venture agreement, as applicable;

(3) Provide the terms and conditions of the proposed assignment, sublease, or encumbrance or other transfer;

(4) Provide audited financial statements for the two most recently completed fiscal years of the proposed assignee, sublessee, secured party or other transferee; and provide pro forma financial statements showing the projected income, expense and financial condition resulting from use of the Lease Premises; and

(5) Provide such additional or supplemental information as Lessor may reasonably request concerning the proposed assignee, sublessee, secured party or other transferee.

Lessor will evaluate proposed assignees, sublessees, secured third parties and other transferees and grant approval or disapproval according to standards of commercial reasonableness considering the following factors within the context of the proposed use: the proposed party's financial strength and reliability, their business experience and expertise, their personal and business reputation, their managerial and operational skills, their proposed use and projected rental, as well as other relevant factors.

(e) Lessor shall have a reasonable period of time from the receipt of all documents and other information required under this provision to grant or deny its approval of the proposed party.

(f) Lessee's mortgage or hypothecation of this Lease, if approved by Lessor, shall be subject to terms and conditions found in a separately drafted standard form (Agreement and Consent to Encumbrancing of Lease) available from Lessor upon request.

(g) Upon approval of an assignment by State the covenants and conditions contained herein shall apply to and bind the heirs, successors, executors, administrators and assigns of all of the parties hereto; and all parties hereto shall be jointly and severally liable hereunder.

(h) Upon the express written assumption of all obligations and duties under this Lease by an assignee approved by Lessor, the Lessee may be released from all liability under this Lease arising after the effective date of assignment and not associated with Lessee's use, possession or occupation of or activities on the Lease Premises; except as to any hazardous wastes, substances or materials as defined under federal, state or local law, regulation, or ordinance manufactured, generated, used, placed, disposed, stored or transported on the Lease Premises.

(i) If the Lessee files a petition or an order for relief is entered against Lessee, under Chapters 7,9,11 or 13 of the Bankruptcy Code (11 USC Sect. 101, et seq.) then the trustee or debtor-in-possession must elect to assume or reject this Lease within sixty (60) days after filing of the petition or appointment of the trustee, or the Lease shall be deemed to have been rejected, and Lessor shall be entitled to immediate possession of the Lease Premises. No assumption or assignment of this Lease shall be effective unless it is in writing and unless the trustee or debtor-in-possession has cured all defaults under this Lease (monetary and non-monetary) or has provided Lessor with adequate assurances (1) that within ten (10) days from the date of such assumption or assignment, all monetary defaults under this Lease will be cured; and (2) that within thirty (30) days from the date of such assumption, all non-monetary defaults under this Lease will be cured; and (3) that all provisions of this Lease will be satisfactorily performed in the future.

11. **DEFAULT AND REMEDIES**

(a) **Default**

The occurrence of any one or more of the following events shall immediately and without further notice constitute a default or breach of the Lease by Lessee:

(1) Lessee's failure to make any payment of rental, royalty, or other consideration as required under this Lease;

(2) Lessee's failure to obtain or maintain liability insurance or a surety bond or other security device as required under this Lease;

(3) Lessee's vacation or abandonment of the Lease Premises (including the covenant for continuous use as provided for in paragraph 4) during the Lease term;

(4) Lessee's failure to obtain and maintain all necessary governmental permits or other entitlements;

(5) Lessee's failure to comply with all applicable provisions of federal, state or local law, regulation or ordinance dealing with hazardous waste, substances or materials as defined under such law;

(6) Lessee's Failure to commence to construct and to complete construction of the improvements authorized by this Lease within the time limits specified in this Lease; and/or

(7) Failure of the Lessee to comply with any provisions of this Lease or with the laws, regulations, or rules applicable thereto shall immediately and without further notice constitute a default or breach of the Lease by Lessee.

(b) Lessee's failure to observe or perform any other term, covenant, or condition of this Lease or when such failure shall continue for a period of thirty (30) days after Lessor's giving written notice; however, if the nature of Lessee's default or breach under this paragraph is such that more than thirty (30) days are reasonably required for its cure, then Lessee shall not be deemed to be in default or breach if Lessee commences such cure within such thirty (30) day period and diligently proceeds with such cure to completion.

(c) **Remedies**

In the event of a default or breach by Lessee and Lessee's failure to cure such default or breach, Lessor may at any time and with or without notice do any one or more of the following:

(1) Re-enter the Lease Premises, remove all persons and property, and repossess and enjoy such premises;

(2) Terminate this Lease and Lessee's right of possession of the Lease Premises. Such termination shall be effective upon Lessor's giving written notice and upon receipt of such notice, Lessee shall immediately surrender possession of the Lease Premises to Lessor;

(3) Maintain this Lease in full force and effect and recover any rental, royalty, or other consideration as it becomes due without terminating Lessee's right of possession regardless of whether Lessee shall have abandoned the Lease Premises; and/or

(4) Exercise any other right or remedy which Lessor may have at law or equity.

12. **INDEPENDENT SITE ASSESSMENT**

Lessor may at any time during the Lease term require Lessee to conduct at its own expense and by a contractor approved by Lessor an independent environmental site assessment or inspection for the presence or suspected presence of hazardous wastes, substances or materials as defined under federal, State or local law, regulation or ordinance manufactured, generated, used, placed, disposed, stored, or transported on the Lease Premises during the term of the Lease. Lessee shall provide the results of the assessment or inspection to Lessor and the appropriate governmental response agency(ies) and shall further be responsible for removing or taking other appropriate remedial action regarding such wastes, substances or materials in accordance with applicable federal, state or local law regulation or ordinance.

13. **QUITCLAIM**
Lessee shall, within ninety (90) days of the expiration or sooner termination of this Lease, execute and deliver to Lessor in a form provided by Lessor a good and sufficient release of all rights under this Lease. Should Lessee fail or refuse to deliver such a release, a written notice by Lessor reciting such failure or refusal shall, from the date of its recordation be conclusive evidence against Lessee of the termination of this Lease and all other claimants.

14. **HOLDING-OVER**
After expiration or earlier termination of lease, there is no holdover provision. Activities on premises shall constitute trespass without the express consent of the Lessor.

15. **ADDITIONAL PROVISIONS**
(a) **Waiver**
(1) No term, covenant, or condition of this Lease and no default or breach of any such term, covenant or condition shall be deemed to have been waived, by Lessor's acceptance of a late or nonconforming performance or otherwise, unless such a waiver is expressly acknowledged by Lessor in writing.

(2) Any such waiver shall not be deemed to be a waiver of any other term, covenant or condition of any other default or breach of any term, covenant or condition of this Lease.

(b) **Time**
Time is of the essence of this Lease and each and all of its terms, covenants or conditions in which performance is a factor.

(c) **Notice**
All notices required to be given under this Lease shall be given in writing, sent by U.S. Mail with postage prepaid, to Lessor at the offices of the State Lands Commission and the Lessee at the address specified in this Lease. Lessee shall give Lessor notice of any change in its name or address.

(d) **Consent**
Where Lessor's consent is required under this Lease its consent for one transaction or event shall not be deemed to be a consent to any subsequent occurrence of the same or any other transaction or event.

(e) **Changes**
This Lease may be terminated and its term, covenants, and conditions amended, revised, or supplemented only by mutual written agreement of the parties.

(f) **Successors**
The terms, covenants, and conditions of this Lease shall extend to and be binding upon and inure to the benefit of the heirs, successors, and assigns of the respective parties.

(g) **Joint and Several Obligation**
If more than one Lessee is a party to this Lease, the obligations of the Lessees shall be joint and several.

(h) **Captions**
The captions of this Lease are not controlling and shall have no effect upon its construction or interpretation.

(i) **Severability**
If any term, covenant or condition of this Lease is determined by a court of competent jurisdiction to be invalid, it shall be considered deleted and shall not invalidate any of the remaining terms, covenants and conditions.

(j) **Record Keeping and Audits**
(1) Lessee shall prepare and maintain accurate records of its operations under this Lease. On or before the 15th day of the month following the lease year, Lessee shall provide to State a detailed statement (hereinafter "Dredging Report") of the amount of Dredged Materials and copies of reports or contracts with the dredging operator substantiating the volume of Dredged Materials and placement of Dredged Materials.

(2) At the request of the State, the Lessee shall provide additional reasonable information to State to assist it in interpreting and evaluating the contents of Lessee's Dredging Report.

(3) All Dredging Reports and royalty statements shall be subject to audit by State. Upon reasonable advance notice to the Lessee from State, Lessee shall make available to State, during business hours, Lessee's books, records, calculations and other materials that are directly related to the Leased Lands and any other land joined with the Leased Lands under Lessee's plan of operation and the contents of its Dredging Reports.

(4) Lessee waives any rights or objections it may have and consents to the examination, inspection and audit of the books and records of Lessee and any other party associated with the dredging activities.

(5) Lessee shall, within 30 days of the State's request, provide copies of all data arising from Lessee's operation on the Leased Lands including, but not limited to, surveys of the Leased Lands conducted by or for

Lessee before and after dredging under this Lease. All proprietary information and trade secrets shall be held in confidence by the State.

(k) **Limitations**

(1) This Lease does not authorize the construction or placement of any improvements or fixtures, including but not limited to groins, jetties, sea walls, breakwaters, and bulkheads on the Leased Lands.

(2) This Lease does not authorize Lessee to dredge for purposes of commercial resale, environmental mitigation credits or other private benefit without the prior written consent of the Lessor.

(l) **Environmental Concerns**

(1) Lessee hereby agrees to any and all restrictions, mitigation measures and other conditions adopted by the State or Federal agencies related to authorized dredging activities. Furthermore, Lessee agrees to comply with such other terms and conditions or limitations on its operations under this Lease which are considered necessary by the State.

(2) Lessee shall use all reasonable precautions to prevent waste of, damage to, or loss of mineral resources, fisheries, wildlife and the environment on or in the Leased Lands and shall be liable to State for any such waste, damage or loss to the extent that such waste, damage, or loss is caused by:

(a) The intentional or negligent acts of Lessee, its employees, servants, agents, or contractors;

(b) The breach of any provision of this Lease by Lessee, its employees, servants, agents, or contractors; or

(c) The noncompliance of the Lessee, its employees, servants, agents, or contractors, with applicable statutes or rules and regulations of State provided, however, that nothing herein shall diminish any other rights or remedies which State may have in connection with any such negligence, breach or noncompliance.

(m) **Conduct of Operations**

Lessee shall safely conduct all dredging and disposal operations in accordance with accepted dredging and disposal methods and practices and with due regard for the protection of life and property, preservation of the environment and the conservation of natural resources.

(n) **Existing Rights**

This Lease is issued subject to all valid rights, previously granted by the State and existing on the date hereof. Such existing rights shall not be adversely affected by the issuance of this Lease.

(o) **Suspension of Operations**

(1) Lessee shall immediately suspend all operations under this Lease, except those which are corrective or mitigative, when ordered by the State to do so upon the State's determination that Lessee's operations are causing or creating undue harm to public safety or to the environment or are otherwise not in the State's best interests. Lessee shall not resume operations under this Lease until the State has determined that adequate and feasible corrective or mitigative measures will be implemented by Lessee.

(2) No suspension ordered or approved under this paragraph shall relieve Lessee from any obligation under this Lease unless specifically provided in the terms of the suspension.

(p) **No Warranty of Title**

This Lease is issued upon the application of Lessee and is entered into without a formal title determination. This Lease shall in no way be construed as establishing the extent of the State's claim of title to any real property. The State makes no warranty as to title or rights of possession or quiet enjoyments of the Leased Lands.

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Lease _________

This Lease shall become effective only when approved by and executed on behalf of the State Lands Commission of the State of California and a duly executed copy has been delivered to Lessee. The submission of this Lease by Lessor, its agent or representative for examination by Lessee does not constitute an option or offer to lease the Lease Premises upon the terms and conditions contained herein, or a reservation of the Lease Premises in favor of Lessee. Lessee's submission of an executed copy of this Lease to Lessor shall constitute an offer to Lessor to lease the Lease Premises on the terms and conditions set forth herein.

IN WITNESS WHEREOF, the parties hereto have executed this Lease as of the date hereafter affixed.

LESSEE:	**LESSOR:**
RECLAMATION DISTRICT NO. 1608	**STATE OF CALIFORNIA** **STATE LANDS COMMISSION**
By: ______________________	**By:** ______________________ **ROBERT BRIAN BUGSCH**
Title: ______________________	**Title: Chief, Land Management Division**
Date: ______________________	**Date:** ______________________
ATTACH NOTARY ACKNOWLEDGMENT	Execution of this document was authorized by the California State Lands Commission on ______________________ (Month Day Year)

LEASE A 2117

EXHIBIT A

LAND DESCRIPTION

Four parcels of sovereign land lying within the bed of 14-Mile Slough (formerly portions of Mitchell Slough and 12-Mile Slough), located within Sections 24 & 25 of Township 02 North, Range 5 East, and in section 30 of Township 02 North, Range 6 East, MDM, County of San Joaquin, California, more particularly described as follows:

<u>PARCEL 1</u>
9.64 acres of Sovereign land lying in the bed of 14 Mile Slough (formerly Mitchell Slough and 12 Mile Slough) located in Sections 24 & 25, Township 2 North, Range 5 East, MDM, being designated as Assessor's Parcel Number 098-150-04 according to Page 15 of Assessor's Map Book 98 as of February, 2020.

<u>PARCEL 2</u>
4.10 acres of Sovereign land lying in the bed of 14 Mile Slough (formerly 12 Mile Slough) located in Section 30, Township 2 North, Range 6 East, MDM, being designated as Assessor's Parcel Number 098-150-03 according to Page 15 of Assessor's Map Book 98 as of February, 2020.

<u>PARCEL 3</u>
18.40 acres of Sovereign land lying in the bed of 14 Mile Slough (formerly 12 Mile Slough) located in Section 30, Township 2 North, Range 6 East, MDM, being designated as Assessor's Parcel Number 098-150-02 according to Page 15 of Assessor's Map Book 98 as of February, 2020.

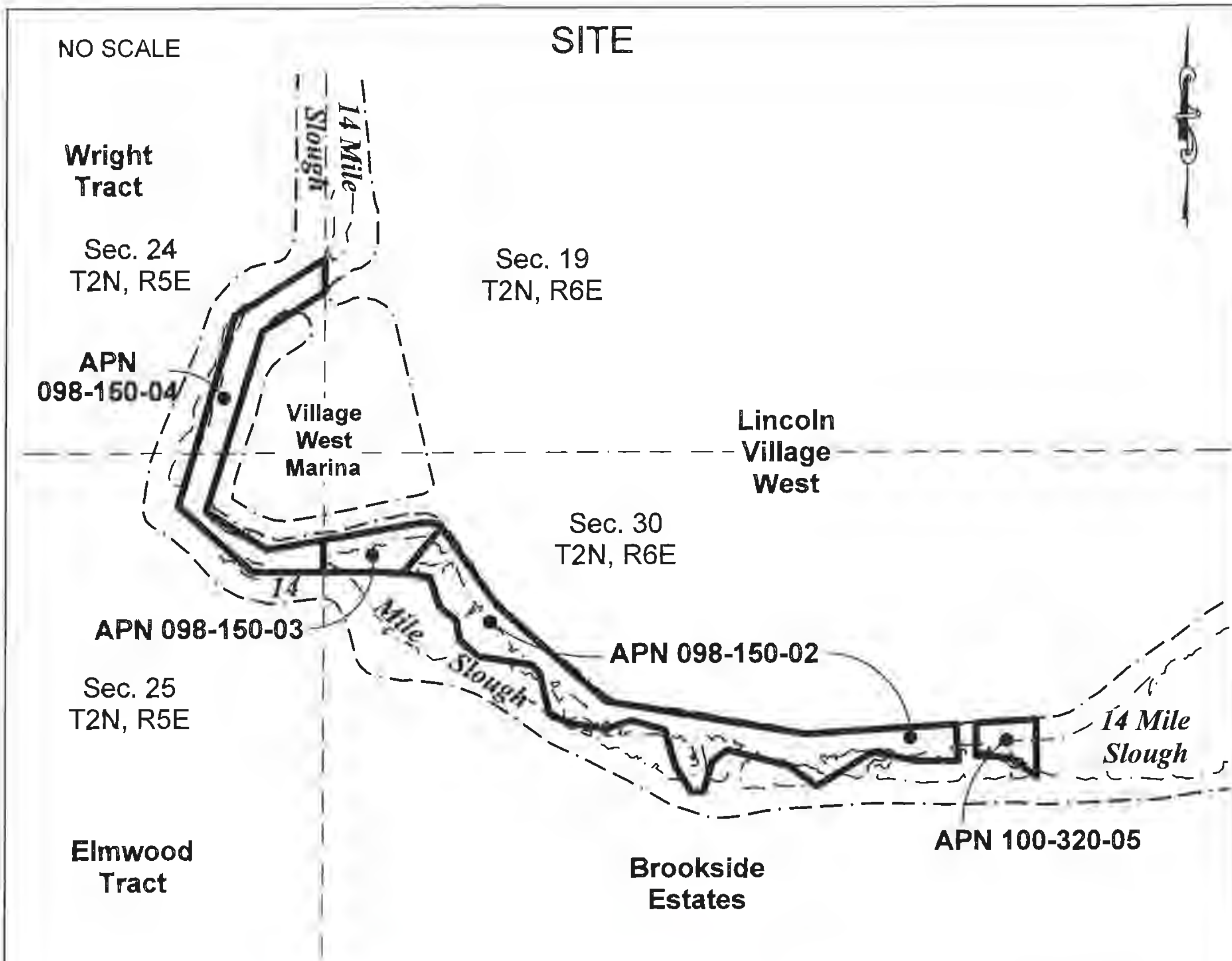
<u>PARCEL 4</u>
2.00 acres of Sovereign land lying in the bed of 14 Mile Slough (formerly 12 Mile Slough) located in Section 30, Township 2 North, Range 6 East, MDM, being designated as Assessor's Parcel Number 100-320-05 according to Page 32 of Assessor's Map Book 100 as of February, 2020.

END DESCRIPTION

FEB 13 2020

NO SCALE

SITE



RECLAMATION DISTRICT 1608 - 14 MILE SLOUGH

NO SCALE

LOCATION

EXHIBIT B

A2117
RECLAMATION DIST, 1608
APN 098-150-02, 03 & 04
and 100-320-05
GENERAL LEASE -
DREDGING
SAN JOAQUIN COUNTY

THIS EXHIBIT IS SOLELY FOR PURPOSES OF GENERALLY DEFINING THE LEASE PREMISES, IS BASED ON UNVERIFIED INFORMATION PROVIDED BY THE LESSEE OR OTHER PARTIES AND IS NOT INTENDED TO BE, NOR SHALL IT BE CONSTRUED AS, A WAIVER OR LIMITATION OF ANY STATE INTEREST IN THE SUBJECT OR ANY OTHER PROPERTY.

EAP 2/12/20

Exhibit E

RECLAMATION DISTRICT NO. 1608
RESOLUTION 2019-02

RESOLUTION DESIGNATING DISTRICT ENGINEER AS AUTHORIZED REPRESENTATIVE TO SIGN AND SUBMIT PERMIT APPLICATIONS FOR, AND ON BEHALF OF, DISTRICT

WHEREAS, the Reclamation District No. 1608 ("District") desires to obtain permits for the Sediment Removal from a portion of 14-Mile Slough Project (the "Project") and designate its District Engineer, Chris Neudeck, as the authorized representative to sign and submit, for and on behalf of the District, any permits and permit applications for the Project.

NOW, THEREFORE, BE IT RESOLVED AS FOLLOWS:

1) That the District Engineer, Chris Neudeck, is hereby authorized and directed to sign and submit, for and on behalf of the District, permits for the Project, including but not limited to:
   a. Central Valley Regional Water Quality Control Board – Dredging Permit Application
   b. United States Army Corps of Engineers – Form 4345
   c. California Department of Fish and Wildlife – Streambed Alteration Agreement Application
   d. State Land Commission – Application for Lease of State Lands
   e. Central Valley Flood Protection Board ("CVFPB") – Application for CVFPB Encroachment Permit

PASSED AND ADOPTED by the Board of Trustees of Reclamation District No. 1608 at a meeting thereof held on this 3rd day of April, 2019, by the following vote, TO WIT:

AYES: 3

NOES: 0

ABSTENTION: 0

ABSENT: 0

RECLAMATION DISTRICT NO. 1608
A Political Subdivision of the
State of California

By: [signature]
MICHAEL PANZER, President

ATTEST:

[signature]
JEAN KNIGHT, Secretary

CERTIFICATION

I, JEAN KNIGHT, Secretary of Reclamation District No. 1608, do hereby certify that the foregoing is a full, true and correct copy of a resolution of Reclamation District No. 1608 duly passed and adopted at a regular meeting of the Board of Trustees thereof held on the 3rd day of April, 2019.

Dated: April 4, 2019

Jean Knight

JEAN KNIGHT, Secretary
Reclamation District No. 1608

1248120-1

Exhibit F

KSN inc. KJELDSEN SINNOCK NEUDECK
CIVIL ENGINEERS & LAND SURVEYORS

Stephen K. Sinnock, P.E.
Christopher H. Neudeck, P.E.
Neal T. Colwell, P.E.
Barry O'Regan, P.E.

2153-0220

February 27, 2019

RD Resident
Add1
Add 2

Re: Reclamation District No. 1608 – Lincoln Village West Sediment Removal Project – Landowner Dock and Appurtenant Features Relocation Request.

Mr. XXX,

Reclamation District 1608 - Lincoln Village West is planning to undertake a sediment removal project along a section of 14 Mile Slough, adjacent to the southwest quadrant of the District's Levee, as shown in the attached Exhibit (s). The District has identified specific boat slips and boat hoists (dock appurtenant features) that are moored beyond the original permitted parallel docks and situated in a manner that will impede the District's ability to dredge along its design alignment.

The sediment removal project is currently planned to occur anytime within the regulated work window of August 1st to November 30th, 2020. You are receiving this letter so that you can review the planned limits of the dredging locations as it relates to your boat dock and attached appurtenances features including boats and boat hoists. The District is seeking your cooperation with the District to temporarily relocate those items from the limits of the sediment removal area. The location of the sediment removal will not require removal of the originally approved dock, therefore if you able to temporarily relocate the appurtenant features behind the existing dock or at a point that they do not extend any farther into the channel than the existing dock, it will be acceptable.

The intent of the project is to deepen the channel to allow waterborne, marine construction equipment access to the District's levee to ensure unobstructed emergency response for repairs.

The District respectfully requests that you review the attached Exhibit(s) and execute the enclosed Acknowledgement form and return to the District to confirm your commitment to detach and relocate the appurtenant features of your dock prior to the start of the project and during the project. It is anticipated that the time frame for this relocation and project should be on the order of 2-3 weeks long

Please note the following dates:

- Latest Date to inform the District you will move your accessory: May 1st, 2020
- Latest Date to moved away your appurtenant features: 1-week prior project.

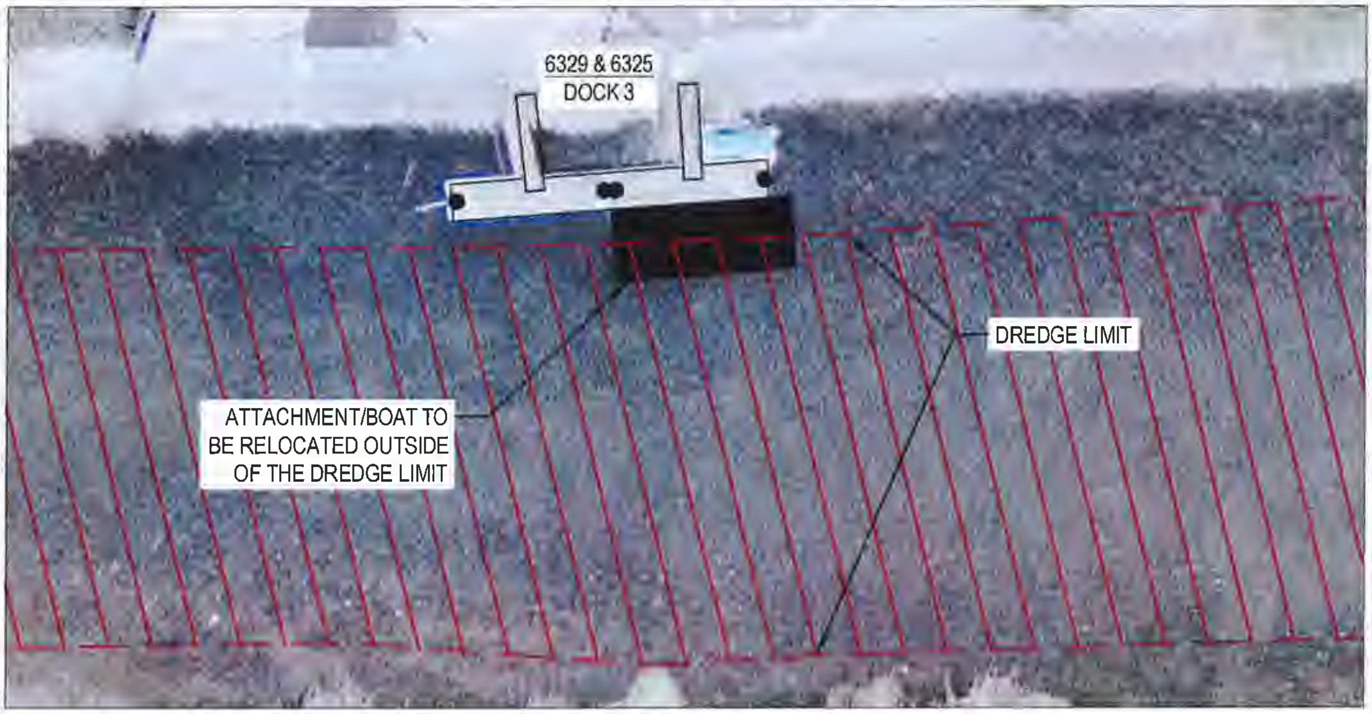
RD 1608 will closely coordinate with you and inform you 30 days in advance of the actual start date of the project. If you do not elect to temporarily relocate your appurtenant features the District will then realign its design alignment to avoid your facilities. Provided you have any questions regarding this project please contact me directly at 209-946-0268 or cneudeck@ksninc.com.

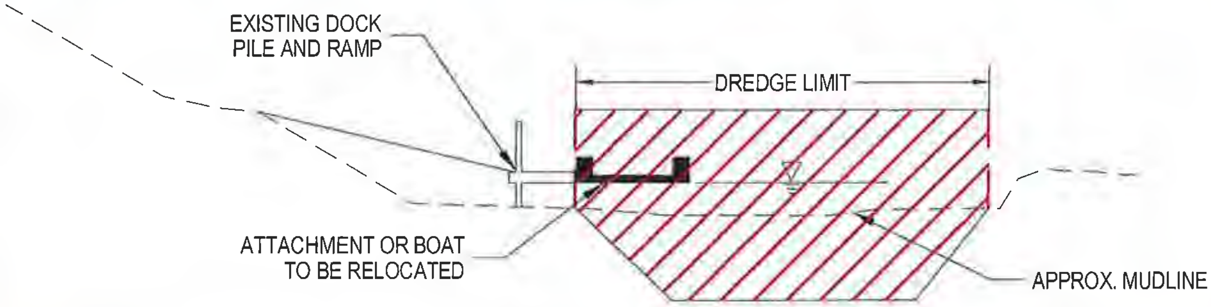
Sincerely,
KJELDSEN, SINNOCK & NEUDECK, INC.

Christopher H. Neudeck, P.E.
Reclamation District 1608 – District Engineer

w/enclosures
cc: Trustees (w/encl)
Daniel J. Schroeder, Esq. (w/encl)
Joe Bryson, Supt. (w/encl)
Elvia Trujillo, Sec. (w/encl)

Exhibit G





TYPICAL CROSS SECTION
N.T.S

KJELDSEN SINNOCK NEUDECK inc.
CIVIL ENGINEERS & LAND SURVEYORS
711 N Pershing Avenue
Stockton, CA 95203
209-946-0268
1550 Harbor Drive, Suite 212
West Sacramento, CA 95691
916-403-5900
www.ksninc.com

RECLAMATION DISTRICT 1608
SEDIMENT REMOVAL PROJECT
STOCKTON, CA
OWNER NOTIFICATION EXHIBIT

DRAWING SCALE	EXHIBIT NO.
NTS	A
ORIG DRAWING SCALE 0 ¼" ½"	PAGE NO

FILE SPEC: P:\2153_Lincoln_Village_West_RD_1608\0220_2017 Sed_Remvl_Project\08_Civil\400_Plans\020_CAD\Exhibits\Dock Owner Exhibit\200122_Dredge_Template_2020_Design_ALT2.dwg
PLOT DATE: Feb 06, 2020 - 4:04pm

Exhibit H

Exhibit I

ACKNOWLEDGMENT AND ACCEPTANCE OF RECLAMATION DISTRICT 1608 – LINCOLN VILLAGE WEST REQUIREMENTS TO TEMPORARIALY RELOCATE DOCK APPURTNENAT FEATURES EXTENDING INTO THE DESIGN ALIGNMENT OF THE SEDIMENT REMOVAL PROJECT

The undersigned hereby acknowledges and accepts that they have reviewed and understand the District's request for the temporary relocation of appurtenant features attached to undersigned owners dock as provided below.

The undersigned understands and agrees to the following

1. The appurtenant structures attached to the undersigned's dock that extend into the design alignment shown on attached Exhibit A will be temporarily relocated.
2. This includes the items shown in Exhibit A, as well as any additional features that have been added since the preparation of Exhibit A that extend into the design alignment.
3. The undersigned owner of the property agrees to temporarily relocate these structures at their own cost and responsibility.
4. The undersigned owner agrees to cooperate with the District and relocate these features, at their cost and responsibility within one (1) weeks' notice during the regulated work window of August 1, 2020 through November 30, 2020.
5. The District will notify you 30 days prior to the actual Project start date and the requested relocation duration should be on the order of 2-3 weeks
6. If this acknowledgement is not provided, and the appurtenances are not removed, the design alignment will be modified.

Name of Owner (print): ___DISTRICT WILL FILL IN ________________

Parcel Number: ___DISTRICT WILL FILL IN ________________

Address: ___DISTRICT WILL FILL IN ________________

Signature: ____________________________________

Date: ____________________________________

If you are not the owner of the appurtenant Structure(s) attached to dock, or you intend not to temporarily remove them from the dredging limits area, please check the box, and sign below.

☐ I am not the owner of the above referenced dock appurtenance.

☐ I do not intend to temporarily remove dock appurtenance. (note that this will require design realignment.)

Name of Owner (print): ______DISTRICT WILL FILL IN ________________

Parcel Number: ______DISTRICT WILL FILL IN ________________

Address: ______DISTRICT WILL FILL IN ________________

Signature: ____________________________________

Date: ____________________________________

Exhibit J

KSN inc.
KJELDSEN
SINNOCK
NEUDECK
CIVIL ENGINEERS & LAND SURVEYORS

Stephen K. Sinnock, P.E.
Christopher H. Neudeck, P.E.
Neal T. Colwell, P.E.
Barry O'Regan, P.E.

2153-0220

February 27, 2018

RD Resident
(MAIL MERGE)
Add 2

Re: Reclamation District No. 1608 – Lincoln Village West Sediment Removal Project – Boat Relocation Request.

Mr. XXX,

Reclamation District 1608 - Lincoln Village West is planning to undertake a sediment removal project along a section of 14 Mile Slough, adjacent to the southwest quadrant of the District's Levee, as shown in the attached Exhibit. You have or may have a boat that is moored in a manner that will impede the District's ability to dredge along its design alignment. If your boat is moored on the outboard side of your dock, it will need to be temporarily relocated.

The sediment removal project is currently planned to occur anytime within the regulated work window of August 1st to November 30th, 2020. You are receiving this letter so that you can review the planned limits of the dredging locations as it relates to the location of any boat that may be moored within the dredge area. The District is seeking your cooperation to temporarily relocate any boat or other items from the limits of the sediment removal area.

The intent of the project is to deepen the channel to allow waterborne, marine construction equipment access to the District's levee to ensure unobstructed emergency response for repairs.

The District respectfully requests that you review the attached Exhibit(s) and execute the enclosed Acknowledgement form and return to the District to confirm your commitment to remove your boat from the dredging area prior to the start of the project and during the project. It is anticipated that the time frame for this relocation and project should be on the order of 2-3 weeks in duration.

Please note the following dates:

- Latest Date to inform the District you will move your boat: May 1st, 2020
- Latest Date to moved away your appurtenant features: 1-week prior project.

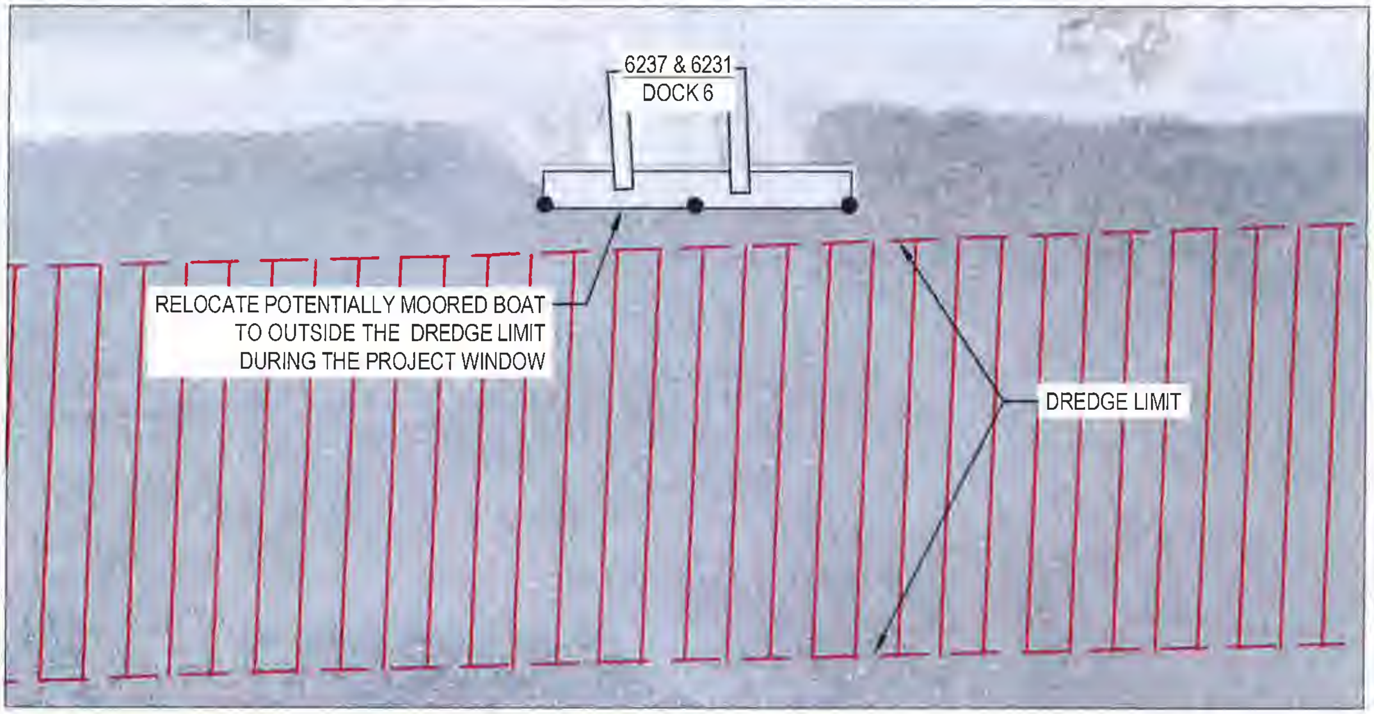
RD 1608 will closely coordinate with you and inform you 30 days in advance of the actual start date of the project. If you do not elect to temporarily relocate your appurtenant features the District will then realign its design alignment to avoid your facilities. Provided you have any questions regarding this project please contact me directly at 209-946-0268 or cneudeck@ksninc.com.

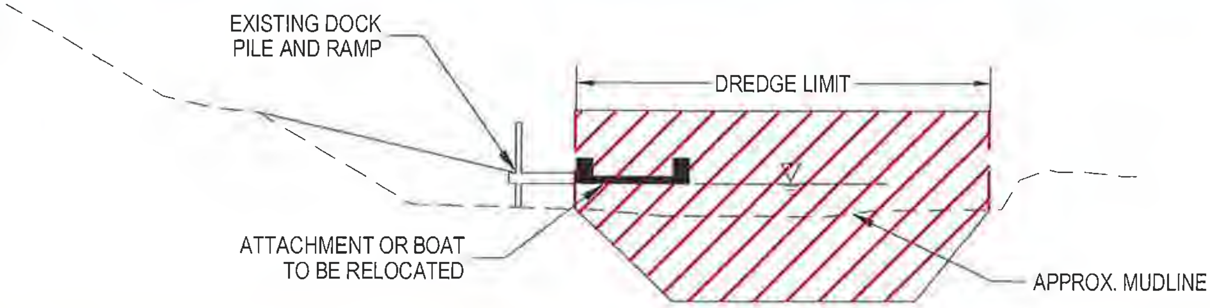
Sincerely,
KJELDSEN, SINNOCK & NEUDECK, INC.

____
Christopher H. Neudeck, P.E.
Reclamation District 1608 – District Engineer

w/enclosures
cc: Trustees (w/encl)
Daniel J. Schroeder, Esq. (w/encl)
Joe Bryson, Supt. (w/encl)
Elvia Trujillo, Sec. (w/encl)

Exhibit K





TYPICAL CROSS SECTION

NTS

KSN inc.
KJELDSEN SINNOCK NEUDECK
CIVIL ENGINEERS & LAND SURVEYORS
www.ksninc.com
711 N Pershing Avenue
Stockton, CA 95203
209-946-0268
1550 Harbor Drive, Suite 212
West Sacramento, CA 95691
916-403-5900

RECLAMATION DISTRICT 1608
SEDIMENT REMOVAL PROJECT
STOCKTON, CA
OWNER NOTIFICATION EXHIBIT

DRAWING SCALE	EXHIBIT NO.
NTS	A
ORIG. DRAWING SCALE 0 ¼" ½"	PAGE NO.

FILE SPEC: P:\2153_Lincoln_Village_West_RD_1608\0220_2017 Sed_Remvl_Project\08_Civil\400_Plans\020_CAD\Exhibits\Dock Owner Exhibit\Dock_Owner_Notification_EXH.dwg
PLOT DATE: Mar 02, 2020 - 10:45am

Exhibit L

Exhibit M

ACKNOWLEDGMENT AND ACCEPTANCE OF RECLAMATION DISTRICT 1608 REQUIREMENTS TO TEMPORARIALY REMOVE MOORED BOATS EXTENDING INTO THE DREDGING LIMITS OF THE SEDIMENT REMOVAL PROJECT

The undersigned hereby acknowledges and accepts that they have reviewed and understand the regarding temporary removal of boats moored to undersigned owners dock as provided below.

The undersigned understands and agrees to the following:

1. The boats moored to the undersigned's dock that extend into the dredging limits shown on attached Exhibit A will be temporarily removed to allow Dredging operations.
2. This includes the items shown in Exhibit A, as well as any additional features that have been added since the preparation of Exhibit A that extend into the shown dredge limits.
3. The undersigned owner of the property agrees to temporarily remove their boats at their own cost and responsibility.
4. The undersigned owner agrees to remove these features, at their cost and responsibility from August 1, 2020 through November 30, 2020 or when the District notifies you of project completion, whichever occurs first.
5. If this acknowledgement is not provided, and the appurtenances are not removed, the limits of dredging will necessarily be modified to avoid dredging in the vicinity of the dock and moored vehicles.

Name of Owner (print): ________DISTRICT WILL FILL IN______________

Parcel Number: ________DISTRICT WILL FILL IN______________

Address: ________DISTRICT WILL FILL IN______________

Signature: ____

Date: ____

If you are not the owner of the appurtenant boat(s) moored to dock, or you intend not to temporarily remove them from the dredging limits area, please check the box, and sign below.

☐ I am not the owner of the above referenced dock appurtenance.

☐ I do not intend to temporarily remove dock appurtenance. (note that this will limit the dredging at your location)

Name of Owner (print): ________DISTRICT WILL FILL IN______________

Parcel Number: ________DISTRICT WILL FILL IN______________

Address: ________DISTRICT WILL FILL IN______________

Signature: ____

Date: ____

Exhibit N

DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

February 14, 2020

Delta Conveyance Design and Construction Authority
Board of Directors

Subject: ***Materials for the February 20, 2020, Regular Board Meeting***

Members of the Board:

The next regular meeting of the Delta Conveyance Design and Construction Authority (DCA) Board of Directors is scheduled for **Thursday, February 20, 2020 at 1:30 p.m.** at the **Sacramento Public Library, East Room, 828 I Street, Sacramento, Ca**.

Enclosed are the materials for the Board meeting in a PDF file, which has been bookmarked for your convenience.

Regards,

Kathryn Mallon

Kathryn Mallon
DCA Executive Director

DELTA CONVEYANCE DESIGN
& CONSTRUCTION AUTHORITY

DELTA CONVEYANCE DESIGN AND CONSTRUCTION AUTHORITY
BOARD OF DIRECTORS MEETING

REGULAR MEETING

Thursday, February 20, 2020
1:30 p.m.

SACRAMENTO PUBLIC LIBRARY, TSAKOPOULOS LIBRARY GALLERIA
828 I Street, Sacramento, CA 95814

AGENDA

Assistance will be provided to those requiring accommodations for disabilities in compliance with the Americans with Disabilities Act of 1990. Interested person must request the accommodation at least two working days in advance of the meeting by contacting the Design and Construction Authority support staff at (916) 347-0486 or info@dcdca.org. Members of the public may speak regarding items on the agenda when recognized by the Chair. Speakers are limited to three minutes each; however, the Chair may limit this time when reasonable based on the circumstances. Persons wishing to speak are requested to complete speaker cards.

1. **CALL TO ORDER**

2. **ROLL CALL**

3. **PLEDGE OF ALLEGIANCE**

4. **CLOSED SESSION – OPEN SESSION TO FOLLOW AT APPROXIMATELY 2:00 P.M.**

   (a) Public Employee Performance Evaluation

   Title: Executive Director

5. **PUBLIC COMMENT**

   Members of the public may address the Authority on matters that are within the Authority's jurisdiction but that are not on the agenda. Speakers are limited to three minutes each; however, the Chair may limit this time when reasonable based on the circumstances. Persons wishing to speak are requested to complete speaker cards.

6. **APPROVAL OF MINUTES: January 16, 2019 Regular Board Meeting and February 6, 2020 Special Board Meeting**

7. CONSENT CALENDAR

Items on the Consent Calendar are considered to be routine by the Board of Directors and will be enacted by one motion and one vote. There will be no separate discussion of these items unless a director so requests, in which event the item will be removed from the Consent Calendar and considered separately.

a. None.

8. DISCUSSION ITEMS

a. Stakeholder Engagement Committee Update

Recommended Action: Information Only

b. Findings of the Independent Technical Review (ITR) Committee Report

Recommended Action: Information Only

c. Intakes Update

Recommended Action: Information Only

d. Launch Shaft Update

Recommended Action: Information Only

e. February DCA Monthly Report

Recommended Action: Information Only

9. STAFF REPORTS AND ANNOUNCEMENTS

a. General Counsel's Report

b. Treasurer's Report

c. DWR Environmental Manager's Report

d. Verbal Reports, if any

10. FUTURE AGENDA ITEMS

11. ADJOURNMENT

* * * * * *

Next scheduled meeting: March 19, 2020 Regular Board Meeting at 2:00 p.m. (1:30 p.m. if there is a closed session) in the Sacramento Public Library, Tsakopoulos Library Galleria, 828 I Street, Sacramento, CA 95814

BOARD OF DIRECTORS MEETING

MINUTES

REGULAR MEETING
Thursday, January 16th, 2020
2:00 PM
(Paragraph numbers coincide with agenda item numbers)

1. CALL TO ORDER

The regular meeting of the Delta Conveyance Design and Construction Authority (DCA) Board of Directors was called to order in the Sacramento Public Library, Tsakopoulos Library Galleria, 828 I Street, Sacramento, CA 95814, at 2:00 p.m.

2. ROLL CALL

Board members in attendance were Tony Estremera, Richard Atwater, Sarah Palmer, and Steve Blois constituting a quorum of the Board.

DCA staff members in attendance were Kathryn Mallon, Carrie Buckman, Joshua Nelson, and Katano Kasaine.

3. PLEDGE OF ALLEGIANCE

President Tony Estremera convened the open session at approximately 2:00 p.m. and led all present in reciting the Pledge of Allegiance.

4. PUBLIC COMMENT

President Estremera opened Public Comment, limiting speaking time to three minutes each.

President Estremera closed Public Comment.

5. APPROVAL OF MINUTES: December 19, 2019 Regular Board Meeting

Recommendation: Approve the December 19, 2019 Regular Board Meeting Minutes

Move to Approve Minutes from December 19, 2019 as Amended: Atwater

Second:	Palmer
Yeas:	Estremera, Atwater, Palmer, Blois
Nays:	None
Abstains:	None
Recusals:	None
Absent:	None
Summary:	4 Yeas; 0 Nays; 0 Abstains; 0 Absent. (Motion passed as MO 20-01-01).

6. CONSENT CALENDAR

a. None.

7. DISCUSSION ITEMS:

a. Report out from Stakeholder Engagement Committee Meeting

Ms. Mallon gave an update on the next SEC meeting schedule which will be January 22, 2020 from 3pm-6pm at Belle Vie Vineyards in Rio Vista. At this meeting there will be a follow up round table discussion regarding the previous meeting topics and to answer any question. Ms. Buckman will be presenting the Notice of Preparation (NOP) and what it means for the DCA. The discussion topics of this meeting will be about the proposed Northern Delta facilities and intakes. Ms. Mallon noted that the committee have been very helpful through this process.

Ms. Palmer commented that she felt the last SEC meeting went well and mentioned that committee members are becoming more comfortable with expressing their feelings.

Mr. Estremera reminded everyone that the SEC meetings are welcome to the public and the meeting is live streamed in case anyone cannot attend in person.

b. January DCA Monthly Report

Ms. Mallon briefly spoke about the budget, forecasting just under 50Mil at the end of this fiscal year. There have been no new requests for permissions for procurement. A task order has just been signed to initiate development of the DCA's new website which will take about 4-6 months. Ms. Palmer requested a demo of the website to learn how to navigate around it.

b. Consider Passing the Resolution to Amend the DCA Bylaws

Recommendation: Pass the Resolution to Amend the DCA Bylaws

Mr. Nelson presented the proposed amendment to the DCA Bylaws to clarify how the Executive Director can delegate her authority. The current Bylaws are silent on this topic therefore we would like to explicitly lay out how authority may be delegated. The proposal is to have Ms. Mallon be able to delegate her authority to any other staff person that she felt was appropriate, as long as the delegation was in writing and forwarded to the Board.

Move to Pass the Resolution to Amend the DCA Bylaws,

as Noted:	Atwater
Second:	Palmer
Yeas:	Estremera, Atwater, Palmer, Blois
Nays:	None
Abstains:	None
Recusals:	None
Absent:	None
Summary:	4 Yeas; 0 Nays; 0 Abstains; 0 Absent. (Motion passed as Resolution 20-01).

d. 980 9th Street DCA Build-out Update

Ms. Mallon briefed the Board on the move in schedule for the new building which is set for January 27th. Ms. Mallon introduced the DCA Facilities Manager, Jennifer Malone, to give a presentation on the new building.

Ms. Malone spoke about the January 27th move in date for the 24th floor as well as the 23rd floor in late February and then the 1st floor in late March. We anticipate the first Board meeting in the new Board room will be for the month of April. Ms. Malone presented some pictures of the space to show the progress including all of the collaboration areas. There are 100 work station, 7 meeting rooms that have different types of technology driven equipment as well as 12 open flexible work spaces. The 23rd floor holds the majority of the meeting rooms including the Engineering War Room with Avicore system that allows for touch screen use. This floor will hold additional desking areas as our team grows. Among these conference rooms there are also phone booths, mud rooms, & a wellness room. The first floor is where the main Board room is and reception area as well as a few additional conference rooms. The dais will seat up to 11 Board members with 65 seats for the public.

Ms. Palmer requested a tour of the new offices which Ms. Mallon indicated that could be arranged.

Ms. Mallon mentioned the purpose for the high-tech facility is to give the capability of integrating staff across the world.

8. STAFF REPORTS AND ANNOUNCEMENTS:

a. General Counsel's Report

A written report was provided in the Board package. Mr. Nelson highlighted that due to it being the year of 2020, there is a new round of form 700's. Mr. Nelson indicated that the Board should have received an email directing them to file this electronically which are due April 1st.

Mr. Blois asked if the FPPC figured out how they can report multiple Boards on one submission. Mr. Nelson responded that he believes you need to file separately for each office.

b. Treasurer's Report

A written report was provided in the Board package. Ms. Kasaine spoke about the December report mentioning the 522K remaining in the DCA funds. Ms. Kasaine referenced the advance that was requested because the DCO could not pay for advanced deposits which is why the funds are low until we receive those advanced funds. We are submitting our annual financial transaction report to the State next week for the DCA.

c. DWR Environmental Manager's Report

A written report was provided in the Board package. Ms. Buckman presented information on the recent release of the Proposed Negative Declaration on Soil Investigation to help inform the geological study on Delta Conveyance and alternatives. The DWR has received 22 comment letters so far on the ISMND that was released in November. These comments are coming from tribes, local governments, state and local agencies, non-governmental organizations and individuals. In addition, the Notice of Preparation (NOP) was released on January 15th for the Delta Conveyance project to initiate the environmental review process. Comments are due on March 20th and there will be scoping meetings in February mostly in the Delta. Ms. Buckman stated that the NOP was filed with the State Clearinghouse and 36 county clerks. Ms. Buckman wanted to signify the amount of people that DWR is trying to reach with this update. 1400 thousand post cards were mailed along with 45 notification letters to State and Federal agencies. 155 notifications letters were sent to disadvantages communities' representatives, 177 letters to tribal representatives, and an electronic distribution list equaling to over 8000 recipients. A press release also came out and the DWR website was updated with this information. There were 7 published legal notices as well as copies of the NOP placed at over 100 libraries. Ms. Buckman discussed how the NOP described the project objective which includes an overview of the proposed project as a basis for comments and seeks input on the scope of the environmental analysis and potential alternatives.

Ms. Palmer found the Q&A very helpful that was released. Ms. Palmer asked why there was no mention of the development of the DCA in the NOP. Ms. Buckman clarified that DWR is the CEQA lead agency and the NOP is describing their action as the potential lead agency. The DCA is acting as the DWR agent.

Ms. Osha Meserve, Local Agencies of the North Delta, commented on the names of the conference rooms that she did not agree with. Ms. Meserve spoke about her disappointed of the NOP having the same intakes and locations as the previous project. She feels that the NOP does not address the operational impacts that they are so concerned about with up to 7500 cfs. Ms. Meserve feels that there has been no interest with addressing better alternative that would meet the export water contractors' concerns.

d. Verbal Reports

Ms. Palmer references the monthly report, pg. 10, regarding the schedule and wanted to have folks take a look at this to see how the project is progressing. Another useful area of the report is slide 8 which is the planned cash flow.

9. FUTURE AGENDA ITEMS:

Ms. Palmer requested to have more of a Board discussion of the NOP. In addition, Ms. Palmer would like to take a look at some succession planning in terms of people moving in and out of the project.

10. ADJOURNMENT:

President Estremera adjourned the meeting at 2:27p.m., in the Sacramento Public Library, Tsakopoulos Library Galleria, 828 I Street, Sacramento, CA.

BOARD OF DIRECTORS MEETING

MINUTES

SPECIAL MEETING
Thursday, February 6th, 2020
4:30 PM
(Paragraph numbers coincide with agenda item numbers)

1. CALL TO ORDER

The special meeting of the Delta Conveyance Design and Construction Authority (DCA) Board of Directors was called to order in the Park Tower, 980 9TH Street, Second Floor Conference Center, Sacramento, CA 95814, at 4:30 p.m. Teleconference Locations: 546 Lagrange Ln. Livermore, CA 94550; 5707 Ocean View Blvd, La Cañada Flintridge, CA 91011; Valley Water, 5500 Almaden Expressway, San Jose, CA 95118

2. ROLL CALL

Board members in attendance were Tony Estremera, Richard Atwater and Sarah Palmer constituting a quorum of the Board. Steve Blois was not in attendance.

DCA staff members in attendance were Kathryn Mallon, Nazli Parvizi and Joshua Nelson.

3. PLEDGE OF ALLEGIANCE

President Tony Estremera convened the open session at approximately 4:30 p.m. and led all present in reciting the Pledge of Allegiance.

4. PUBLIC COMMENT

President Estremera opened Public Comment, however there were no public comments received.

President Estremera closed the Public Comment.

5. DISCUSSION ITEMS:

a. Consider Passing Resolution to Appoint DCA Stakeholder Engagement Committee (SEC) Member

Recommendation: Pass Resolution to Appoint DCA SEC Member

Ms. Parvizi provided a summary of the applications received for the SEC Recreation vacancy. After careful review and consideration of the applications received, Mr. Peter Robertson was selected as the Recreation candidate for the SEC. Ms. Parvizi made the recommendation to the Board to appoint Mr. Robertson as the new SEC Recreation member.

Move to Pass Resolution to Appoint DCA Stakeholder Engagement Committee Member, As Noted:

As Noted:	Palmer
Second:	Atwater

Vote by Roll Call

Yeas:	Estremera, Atwater, Palmer
Nays:	None
Abstains:	None
Recusals:	None
Absent:	Blois
Summary:	3 Yeas; 0 Nays; 0 Abstains; 1 Absent. (Motion passed as MO 20-02-01).

6. FUTURE AGENDA ITEMS

a. None.

7. ADJOURNMENT:

President Estremera adjourned the meeting at 4:42p.m., in the Park Tower, 980 9TH Street, Second Floor Conference Center, Sacramento, CA.

DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

Board Memo

Contact: Nazli Parvizi, Stakeholder Engagement

Date: February 20, 2020 **Item No.** 8a

Subject: Stakeholder Engagement Committee Update

Summary

The Stakeholder Engagement Committee (SEC) convened on February 12th at 3pm in Hood, Ca., at the Willow Ballroom. Members had the opportunity to report out information, updates and feedback from their respective organizations and communities about the Intakes materials provided at the January 22nd meeting. DCA engineering staff provided SEC Members with information about the basics of tunneling, launch shaft siting and the methodology for ranking sites for suitability.

Detailed Report

The proposed topics of discussion for the upcoming meeting are as follows:

- Follow-Up & Roundtable on January 22, 2020 SEC Meeting
- Basics if Tunnel Driving
- Launch Shaft Siting

More information regarding the SEC can be found in section four (4) of the DCA Monthly Board Report and the Meeting Summary attached.

Recommended Action:
Information only.

Attachments:
Attachment 1 – February 12th SEC Meeting Summary

DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

STAKEHOLDER ENGAGEMENT COMMITTEE (SEC)

MEETING SUMMARY

February 12, 2020

This summary is provided as a resource for committee members and the public to have brief highlights following SEC meetings. In addition to this summary, detailed meeting minutes, question and answer documents and full meeting video will be available on the dcdca.org website.

MEETING OVERVIEW

At the fourth meeting of the Stakeholder Engagement Committee (SEC), held February 12:

- Members had the opportunity to report out information, updates and feedback from their respective organizations and communities about the Intakes materials provided at the January 22nd meeting.
- DCA engineering staff provided SEC Members with information about the basics of tunneling, launch shaft siting and the methodology for ranking sites for suitability.
- During the Feb. 26 meeting, the SEC will have a roundtable discussion regarding the Launch Shaft Siting information presented. DCA asked SEC members to specifically provide input regarding the evaluation system, any preferred sites, logistics alternatives, and requests for any additional information related to the launch shaft sites.

The meeting video, agenda, presentation and supplemental materials are available for review on the dcdca.org website.

COMMITTEE THOUGHT EXCHANGE

- Committee members Ms. Mann, Mr. Moran, Mr. Hsia, Ms. Swenson, Ms. Barrigan-Parrilla, Mr. Cosio, Mr. Wallace, Mr. Wirth, Dr. Lytle, Mr. Hardesty, Mr. Cox and Ms. Giacoma provided reports of their conversations with community members. Most comments highlighted concerns about effects on water levels, hydrology and levees as well as other effects including truck traffic, noise, air quality and regional and local economies. Members also want further information and justification regarding the constraints and analysis that determined the potential intake sites.
- Members requested composite information about the cumulative construction work and effects that will be occurring throughout the Delta at the same time. Further, the information should encompass not just the project components but any new infrastructure needed to support construction, such as power lines, rail terminals, etc. DCA will be able to provide this information once siting and logistics have been determined.
- DCA will look into arranging a tour to Red Bluff so SEC members can see a flat panel intake facility of similar magnitude as those proposed for Delta Conveyance. DCA will also arrange a visit to ISI's manufacturing facility in Freeport to see an example of a "Tee Screen". Updates on scheduling will be forthcoming.
- Disposal of water removed from contaminated soil in the dewatering process is a concern for many members. Members requested more detailed information and ongoing discussion. The SEC will include information on dewatering methods and water disposal alternatives for each site in future presentations.
- As a reminder, DWR is currently conducting scoping meetings. SEC members were encouraged to submit comments to DWR about environmental studies, impacts and alternatives since comments made in the SEC meetings are not specifically tracked as part of DWR's CEQA process. More information about DWR's scoping process, meeting locations and how to submit comments can be found at https://water.ca.gov/Programs/State-Water-Project/Delta-Conveyance/Environmental-Planning.

NEXT MEETING

DATE: February 26, 2020

TIME: 3-6pm

LOCATION: Belle Vie Vineyards, 19900 Sherman Island Cross Rd., Rio Vista, CA 94571

PURPOSE: Member roundtable regarding technical information discussed during the Jan. 22 meeting; finalize drive shaft locations; review retrieval and maintenance shaft locations

MORE QUESTIONS?

- Meeting minutes and video will be available at dcdca.org
- Contact us at SEC-info@dcdca.org

HIGHLIGHTS TO SHARE

- Members received new and updated materials to add to their information binders.
  - o The information included updated logistics maps for roadway, rail, and barging feasibility, siting evaluation methodology, siting rankings (after applying methodology), updated staff and member directories, responses to questions and requests from previous meetings, past meeting minutes and summaries, a map showing the existing water facilities in the Delta.
- Members provided reports of the feedback they have heard from their communities regarding the intakes siting discussed at the January meeting.
- Members were reminded that materials shared at SEC meetings is preliminary and changes will be reflected often as the proposed project is designed and engineered.
- **Launch Shafts:** The engineering team presented maps and information identifying zones within the Central and Eastern Corridors where launch shafts could be located based on acceptable drive lengths.
- **Site Ranking Criteria and Results:** DCA created an evaluation system to rank feasible sites within each of these zones, with access logistics and truck traffic sensitivities as primary considerations. Engineers shared information illustrating the ranking of 250-acre areas as more favorable, acceptable, or less favorable for launch shaft siting. Engineers also shared the methodology for determining the rankings and solicited input from SEC members on both the methodology and the results. The DCA has evaluated sites based on engineering considerations while DWR will evaluate sites based on environmental analysis in the CEQA process.
- **Considerations for SEC:** DCA solicited input regarding the ranking methodology and results. SEC members are encouraged to discuss with their communities and report feedback at the next SEC meeting roundtable. DWR staff encouraged SEC members and audience to provide thoughts on impacts and alternatives through DWR's scoping process since comments made in the SEC meetings are not specifically tracked as part of DWR's CEQA process.

DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

Board Memo

Contacts: Kathryn Mallon, Executive Director

Date: February 20, 2020 Board Meeting **Item No.** 8b

Subject:

Findings of the Independent Technical Review Committee Report

Summary:

An Independent Technical Review (ITR) Committee was convened to review early technical material developed by the DCA related to the tunnel design of the Delta Conveyance Program. ITRs are considered best practices in providing expert opinion on the technical studies and design work associated with large infrastructure projects and programs. ITRs are part of the DCA's overall Quality Plan and will continue to be convened throughout the planning and design phase of the program covering the range of technical work performed by the DCA.

The Tunnel ITR was chaired by Dan Adams, President of McMillen Jacobs, a highly experienced design and construction management firm specializing in tunnel infrastructure. Committee members were selected from across the globe and represent a cross section of the most experienced tunnel engineers and builders in the world. The ITR included the following members:

- Werner Burger, Chief Engineer Herrenknecht, German-based Tunnel Boring Machine (TBM) manufacturer
- John Kennedy, Vice President, Dragados, Spanish-based international heavy civil construction firm
- Jeff Petersen, Sr. Vice President, Kiewit Underground Construction Division specializing in tunnel infrastructure
- Dave Rogstad, President and CEO, Frontier-Kemper Constructors, specialize in heavy civil and underground infrastructure
- Kenji Yamauchi, Tunnel Engineer, Obayashi – Japanese-based major international construction firm specializing in heavy civil and underground infrastructure.

The requested scope of their review included the following topics:

- Tunnel Drive Length
- Tunnel Alignment Observations
- Logistics Observations
- Contract Delivery and Packaging
- Stakeholder Concerns (documented in previous WaterFix Testimony)

A copy of the ITR findings is attached to this memorandum as well as a copy of the DCA response to their findings and recommendations. The DCA found the session extremely constructive helping to validate key design approaches while providing insight from the perspective of a large construction firm.

Recommended Action:

Information only.

Attachments:

Attachment 1 – ITR Committee Report

Attachment 2 – DCA Response to ITR Report

Internal Technical Review Panel Memorandum

To:	Kathryn Mallon, DCA Executive Director Tony Meyers, DCO Executive Director	Project:	Delta Conveyance
From:	Werner Burger, Herrenknecht John Kennedy, Dragados Jeff Petersen, Kiewit Dave Rogstad, Frontier-Kemper Kenji Yamauchi, Obayashi Dan Adams, McMillen Jacobs Renée Fippin, McMillen Jacobs		
Date:	January 31, 2020	Job No.:	5226.2
Subject:	ITR December Workshop on Tunnel and Shafts - Report		

1.0 Introduction

The Delta Conveyance Project includes approximately 40 miles of 40-foot diameter tunnels, 8 deep shafts, and intake and outlet facilities required to convey water from south of Sacramento to near Discovery Bay, California. Various tunnel corridors and shaft locations have been under study by the DCA/DCO. The ground conditions can be characterized at the tunnel level by dense to very dense silty sand, poorly graded sand, and very stiff to hard silty clay and clayey silt.

On December 4th to 6th, 2019, an Independent Technical Review (ITR) Panel met in Sacramento, California to review and provide input on five major issues associated with the Delta Conveyance Project's Tunnels and Shafts:

- Achievable Tunnel Boring Machine (TBM) drive lengths;
- Tunnel alignment;
- Logistic & advanced procurement;
- Contract delivery and packaging; and,
- Stakeholder Concerns

Prior to the workshop, the ITR was provided with the following documents:

- Reconnaissance Alignment Assessment (Draft), October 30, 2019
- Viability of Long Tunnel Boring Machine Tunneling Drives (Draft), November 15, 2019
- Preliminary Draft Reusable Tunnel Material (RTM) Handling and Disposal, November 8, 2019
- Tunnel Corridors Map, Working Draft, November 5, 2019
- Draft Graphical Schedule for Central Corridor, no date
- California WaterFix Conceptual Engineering Report, Byron Tract Forebay Option, July 2018

- Compilation of Comments on Tunnel Construction and Reusable Tunnel Material from Previous Studies, Draft, November 11, 2019

On the morning of Day 1 (December 4), the DCA's Engineering Design Management team (EDM) presented Delta Conveyance background information including background geology, logistics information, project schedule and assumptions, and stakeholder concerns. The remainder of the day was spent driving along both the Central and Eastern corridors under study. The ITR visited each site except for the shared South Tunnel Outlet Structure site, as it was visible in the distance from Clifton Court Forebay site.

Day 2 was spent in a workshop with the ITR brainstorming and discussing the various topics of drive length, alignment, logistics, contract strategy and packaging, reusable tunnel material use and/or disposal, stakeholder considerations, and other various topics until consensus was obtained.

This consensus was shared with the DCA/DCO and EDM team late morning on Day 3. This memorandum summarizes the consensus and recommendation of the ITR for the tunnel and shaft related aspects of Delta Conveyance Project.

2.0 TBM Drive Lengths

The ITR's opinion is that TBM drive lengths up to 15 miles are achievable for this project. The key reasons being that 1) the alluvial deposits are relatively uniform and favorable to tunneling, 2) the inner diameter of the tunnel provides sufficient space to support of operations, and 3) issues that typically jeopardize TBM longevity, including high groundwater pressures, mixed ground conditions, and high boulder frequencies, are not present for this project.

The achievability of long tunnel drives is primarily driven by logistics. The size of the Delta Conveyance tunnel and favorable geology suit an extended drive without substantially raising the risk profile of the project. A summary of long tunnels is presented on Figure 1.

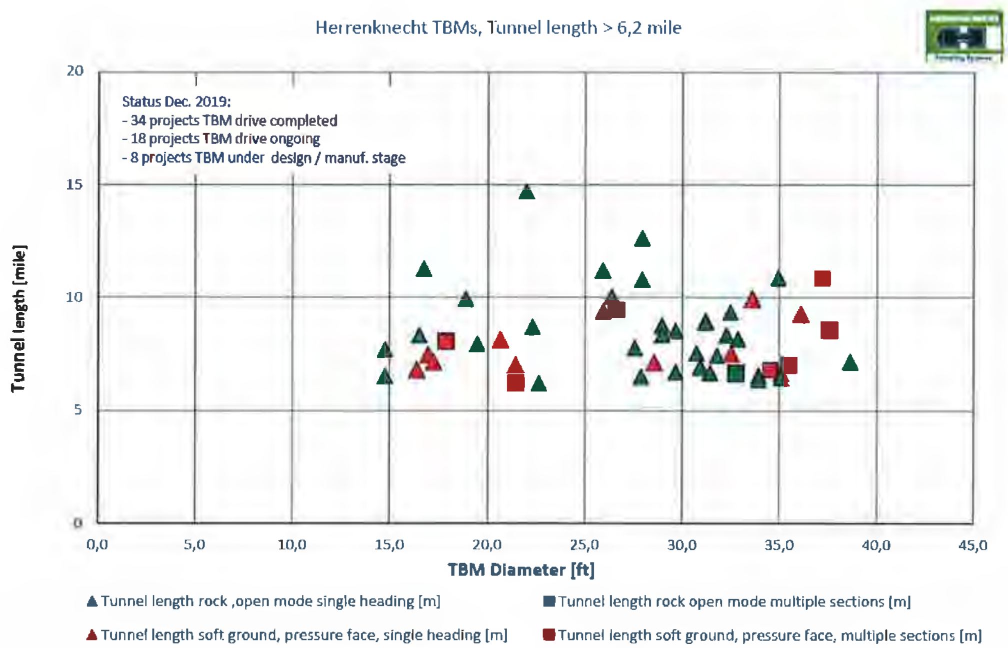


Figure 1. TBM Drive Lengths with Herrenknecht TBMs

For this project, where the ground conditions are favorable for tunneling and the TBM operating pressures are not excessively high, the drive length between shafts can be safely extended by implementing current technologies. Longevity of the TBM main bearing and ring/drive motors are the key as well as the ability to frequently exchange cutting tools along the drive. Cutting tool exchanges may be either through pressurized interventions or under atmospheric conditions if the TBM is equipped with accessible cutterhead technology. While there may not be a comparable soft ground TBM drive length example, the demands on a TBM in rock far exceed those for soft ground in terms of wear and tear on the machine. The durability of the mechanical elements for rock TBMs is typically far more difficult to overcome compared to soft ground TBMs in homogeneous ground conditions. Main bearing seal systems may see a higher load on pressurized TBMs in soft ground due to the face pressure, however, rock TBMs see higher cutterhead speeds. This means rock TBMs typically have main bearing seals that must withstand 2 – 6 times the propagation of soft ground TBMs for the same drive length.

But, more importantly, the critical elements for long tunnel drives are the logistics and safety elements. The drive lengths noted above have either been fully achieved or are currently underway. These projects demonstrated that the solutions currently exist to support extending TBM drive length and will only continue to improve by the time Delta Conveyance breaks ground.

The ITR recognized that longer drives carry additional risks. The mitigations to address the risks of longer drive lengths exist within current technology as described below.

2.1 Risk Mitigation Measures – TBM Drive Length

The following recommendations are made to manage the risk of a longer drive, all of which is current technology:

- Evaluating and/or including an accessible cutterhead option to reduce the need for pressurized interventions and simplify cutting tool maintenance
- Installing cutting tool and cutterhead structure condition monitoring systems
- Installing a camera system for remote chamber inspection
- Preparing the TBM for face and periphery drill pattern for ground consolidation from within the TBM
- Utilizing an engineering solution for tail shield brush replacement
- Requiring a strict maintenance and inspection program in place from the beginning ("industrialized tunneling" philosophy)

Further recommendations are detailed in the following subsections.

2.1.1 Main Bearing Replacement

TBMs have a main bearing that allows the cutterhead to rotate at the tunnel face. Historically, the main bearing has been a primary mechanical point of weakness on the TBM in that it sees significant stresses and, if it fails, it has required an emergency access shaft to replace it with a new one. While engineering solutions to replace a main bearing from within the tunnel exist, an access shaft is oftentimes selected as a simpler solution. Further, current bearing technology supports a main bearing life of 20,000 to 30,000 hours (time spent with the cutterhead rotating). Decisive factors for the main bearing life are the loads and the total number of revolutions. Both factors are significantly higher on rock TBMs compared to soft ground TBMs. Therefore, the experience gained from long distance rock tunnels can be applied to long soft ground tunnels. This would support the longest drive recommended without replacement unless an unanticipated failure occurred. It was noted by Mr. Burger of Herrenknecht that there are many examples of main bearings lasting longer under more strenuous circumstances than exist for this project. The ITR recommends that TBMs used for the longer drives through the Delta be designed to accommodate bearing replacement from within the tunnel as a risk mitigation measure.

2.1.2 Safe Havens

A safe haven is a location where unpressurized access to the TBM face can be achieved for inspection and maintenance purposes. The ITR recommend a minimum of one safe haven per tunnel drive, preferably fairly early in the drive to confirm assumptions and monitoring efforts on wear. The ITR debated the need for a second safe haven. It is prudent to have safe havens, but rarely is a safe haven in the location one needs it. If allowable within the constraints of the environmental documentation, it is recommended that an additional allowance for "unlocated" safe haven(s) (e.g., unplanned intervention) be included. This means, the contractor is allowed to develop a safe haven where necessary to support operations. It's important to point out that certain sites within reason can be excluded – such as in areas of biological resources.

The TBM safe haven can be a low-impact solution. As shown in Figure **2**, the ITR proposed a small 15-foot diameter shaft which could be a drilled shaft, sunken cast-in-place concrete or vertical shaft sinking (VSM) excavation with segmental lining. From within the shaft, ground treatment such as grouting or freezing can be performed in the horizontal direction providing coverage for the cutterhead. This process will minimize surface impacts as well reduce the surface impact schedule for the safe havens.

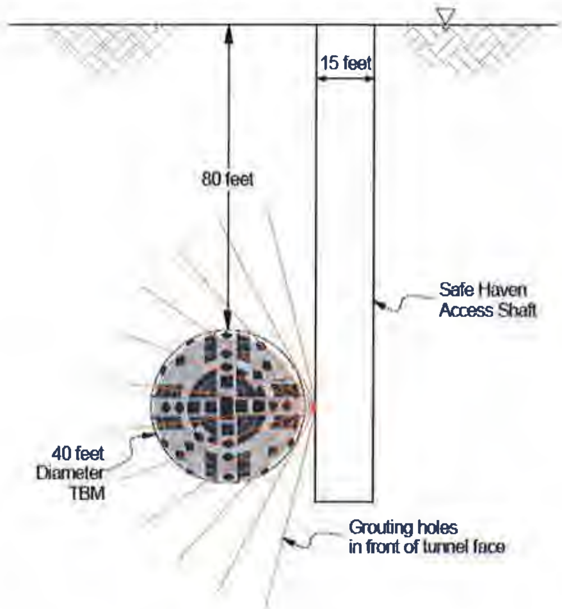


Figure 2. Safe Haven Concept

The ITR offered that knowledge gained from the first drive/contract (or portions thereof) would be quite valuable to have during planning for the next (e.g., 2nd) contract. With respect to the need for safe havens, knowledge gained from the first contract should be incorporated into subsequent ones.

2.1.3 Abrasivity

Soil abrasivity can lead to wear and tear on the TBM from the hardness of soil particles. Minimal soil abrasivity tests have been performed. The prior GDR reported AVS values between 7 and 59.5 with an average of 31 and median of 30. While further study and possible mitigation is recommended, tunneling in the alluvial soils is not going to be a similarly harsh environment when compared to long drives in quartz rock.

It is recommended that, no matter the case, state of the art heavy wear protection for the cutterhead structure should be required in combination with a structure monitoring system as mentioned above under Section 2.1. Heavy wear protection exists in today's technology. The benefits of tool wear sensors and potential use of accessible cutterhead technology enable data to be collected for proactive planning. The data of such wear monitoring systems will support the planning for any required additional safe haven ahead of time so that proper procedures and actions can be taken. The ITR further recommends a strict maintenance program that includes timely cutting tool maintenance and exchange to reduce the risk for structural wear.

All of the above mitigates against unplanned/long-term breakdowns.

3.0 Tunnel Alignment Corridors

The project team discussed and compared the current tunnel alignments under study in the Central (yellow) and Eastern (blue) corridors as shown in Figure 3.

Figure 3. Studied Central (Yellow) and Eastern (Blue) Alignment Corridors

The consensus among the ITR was that the Central Corridor is logistically impractical and the ITR does not recommend this corridor be further studied. The shaft locations are located a significant distance from Interstate 5, accessible by only farm roads with hindrances such as narrow weight-restricted bridges and single lanes. This makes supporting large operations, which requires a constant transfer of materials and people in and out, impractical and expensive as well as difficult to price. In addition, addressing safety, including hospital access and tunnel safety duplication, creates a costly layer or redundancy without definitive costs. While it was recognized that extensive roadway, levee, and likely barge improvements could be constructed as part of the project for the Central Corridor, the ITR offered:

- The cost of improvements to provide reliable and safe access and egress at each site would exceed the cost of additional length of tunnel required for the East alignment.
- Levee re-build, barge, and site preparation & stabilization is temporary work, and much of it (e.g. barge facilities) will require removal;
- Site improvements and prep is driven by means and methods;

- Labor and construction safety costs, regardless of improvements, are too uncertain to price due to the location and distance from any shaft on the Central Alignment to developed land/communities.

For the reasons described above, the ITR recommended adjustments to the alignment as described in Section 3.1 which will facilitate large scale tunneling.

3.1 Recommended Alignment Adjustment

The ITR recommended that between the Terminous Shaft and the Lower Roberts Shaft, the alignment be shifted further to the east and closer to Interstate 5. Specifically, the following recommendations are made:

- Relocate Terminous shaft to the north and east
- Move shaft at Lower Roberts Island, south-east to industrial land in/closer to Stockton
- Eliminate Lower Jones Tract and Canal Ranch shafts

These proposed changes expand and/or shift the East (blue) corridor east as shown below on Figure 4. The longest tunnel drive length would become approximately 13.5 miles.

For the vertical alignment, the ITR recommends raising the tunnel alignment by one tunnel diameter. This will reduce the operating pressures considerably which is beneficial to the overall operation of the machine and safety of the workers.

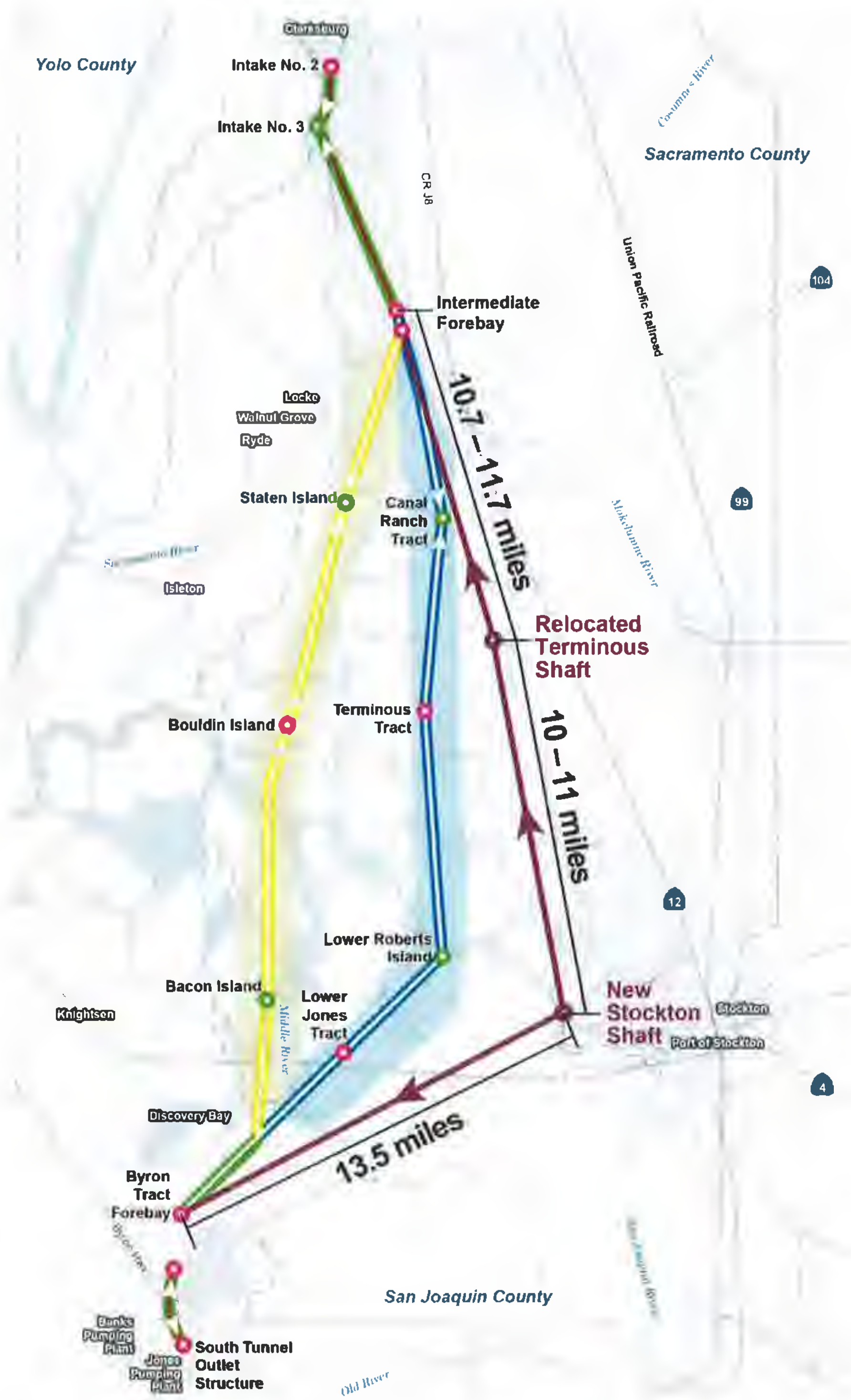


Figure 4. Recommended Far East Alignment Corridor

3.1.1 Terminous Shaft

Figure 5 shows a recommended placement for a relocated Terminous shaft. It is located approximately ½ mile west of the I-5 interchange and one mile north of Highway 12. Shifting the shaft north allows for trucks to enter the shaft site while minimizing impact to traffic on Highway 12. It is recommended that the ½ mile stretch of Highway 12 to the shaft access road be widened and a turn lane and signal be added at the shaft access road.

Figure 5. Relocated Terminous Shaft

3.1.2 New Stockton Shaft

Figure 6 shows the general placement of a New Stockton Shaft. In general, the recommendation is to shift east along the San Joaquin River closer to industrialized Stockton. The pin location shown in Figure 6 is just adjacent to the Port of Stockton and eliminate additional road widening and improvements to get to the Lower Roberts location as well as time. This site allows for segment production if desired and barge facilities to be developed. It is also adjacent to rail. This could be an important advantage, particularly when considering the contract packaging discussed below as a new Stockton Shaft as proposed would have 50% of the tunnel material (supply in, tunnel material out) flowing through that location.

Figure 6. New Stockton Shaft

4.0 Logistics and Advanced Procurement

The recommendations on alignment (above) were almost entirely driven by project logistics. Quite simply, the tunneling through the Central Corridor was considered more of a logistics project than a tunnel project. Moving the alignment east, is thought to greatly simplify the logistics and as such, enhance competition for all materials that are needed to construct the tunnels due to increased modes of transport afforded by the industrialized eastern cities, barge and rail access.

4.1 Segment Manufacture

There was discussion as the most cost-effective way to provide the 40 miles of concrete segments for the project. The ITR considers the difference between on-site and off-site production, in terms of material transport, is insignificant, recommending that despite 80% of the tunnel segments being the same diameter:

- Plan for off-site production of segments, as it lowers cost and provides far more flexibility in the supply and delivery chain.
- Leave the design and construction of the segments to the contractor, as the configuration, length, and reinforcing details/requirements are all means and methods driven; and
- Progress with permitting as if on-site will be used, as a position point for the environmental documentation process (it's more environmentally challenging).

4.2 Tunnel Material

The handling and disposal of tunnel material is a major project driver that will influence the builder's approach to the project (TBM Selection, Site Configuration, sub-contracting, etc.). Based on ITR experience, soft ground tunnel material is not a commodity (has no residual value) and is difficult to dispose or find a use for. These two factors were part of the reasons the ITR recommends (above) moving the alignment closer to industrialized land, close to multiple modes of transport, to handle removal of it in the most economical manner.

As part of the advanced procurement work, the project would benefit from DCA working to find a location and negotiate terms for disposal and or reclamation using it in advance of advertising the tunnel contracts. This could include stockpiles and or temporary storage at the Southern Forebay site for re-use of the material on the site. However, the ITR cautions that the "reusability" of such material should not be over-sold within the project team, as no experience exists (within the ITR members) where material from a soft ground tunnel has been used as structural fill.

There are some projects that have used materials for quarry restoration (e.g., SR 99 in Seattle) or land reclamation (Bay Tunnel and numerous European projects), which were negotiated/established prior to the contract being let. In each case, advance analyses was performed to characterize the natural components and any potential for materials deemed as contaminants. There are several quarries within the project vicinity and early research and conversations with these quarry operators would benefit the project.

4.3 Tunnel Classification and Permissible Equipment

Based on what is known of the geology, it is anticipated that the tunnel will be classified as "gassy" or, at least, "potentially gassy". For both potential and gassy classifications, Cal/OSHA will also implement a list of "special conditions" that add specific detail to existing regulations and add requirements. While it is difficult to predict what details or regulations Cal/OSHA will impose, quite often on large consequential projects, it is important that DCA meet with Cal/OSHA to start early discussion on what may need to be design "into the project" and set the basis for understanding of expectations.

It is likely that these discussions with Cal/OSHA will set forth that all equipment used in the tunnel including the TBM will have to have special gas detection systems and anti-explosion systems (e.g., permissible equipment). The TBM will be required to have a sophisticated gas detection system that will automatically shut down the systems and put it into emergency power mode in the event of detection. Safety trained and certified gas tester employees will have to be on site at the face full time.

4.4 Tunnel Rescue Plan and Communication

A detailed tunnel rescue plan is required by law before underground work can begin. The tunnel rescue plan will be developed by contractor(s) although the owner/engineer can have preliminary discussions on any specialized requirements. Because of the long tunnel drives, the rescue plan as well as the training requirements for workers will be more extensive. The length of tunnel means that it will take longer to get an injured person out of the tunnel. The plan will need to include requirements for practice and documentation.

A trained tunnel rescue team with a minimum of five people will need to be on-site within 30 minutes of the ingress/egress point at all times. This is another advantage of moving the alignment closer to I-5, particularly when you consider the duration (approximately 8 calendar years) of the project.

A refuge chamber (e.g., Figure 7) will be required on the TBM and at intervals along the tunnel. These chambers provide life support systems including primary and secondary oxygen supplies and CO/CO^2 scrubbing systems to regenerate the air. They also maintain positive internal pressure at all times.

Figure 7. Refuge Chamber Example

5.0 Contract Delivery and Packaging

5.1 Contract Delivery Methods

There are various methods by which the DCA/DCO can deliver the project. While explaining each in detail is beyond the scope of this memorandum, three popular contract delivery methods are mentioned herein. The most traditional is Design-Bid-Build (DBB) in which the owner's engineer prepares complete contract documents and the low bidder is awarded the job. There is also Construction Management/General Contractor (CMGC) which allows an owner to engage a construction manager to provide input during the design process. The owner and the construction manager agree on a price for construction of the project, and the construction manager becomes the general contractor. There is also Design-Build (DB) in which the owner released documents at an early design phase (often at 30%) and the contractor completes the design and builds the project. Selection methods for CM/GC and DB contractors vary and are not discussed herein. Each has merits for consideration.

5.2 Recommendation on Contract Delivery

The ITR members held a robust discussion on the merits of one delivery method over another.

Two companies from which the ITR has associated members had previously reviewed the project (when it was twin tunnels) and offered at that time that DBB and/or CMGC were preferred. DBB was previously recommended because it lowers the contractor's risk, and at the time was thought to provide a better opportunity to achieve a lower total project cost. CMGC was preferred because the "use and disposal" of tunnel material was such a large uncertainty; and, CMGC would allow the contractor to be engaged before resolution of material disposal was completed. However, after the site visit, and recognition that this project is "a logistics project with a tunnel in it", the ITR came to consensus recommending Design-Build delivery for the tunnel and shaft work. The key reasons that informed this recommendation for Design-Build include:

- Gives a much higher likelihood of completing the work by the estimated completion date of 2035 through concurrent work and ability to procure items such as the TBM and start-up of segment production;
- Enables the contractor to be engaged in the design, of all elements of the work, including logistics planning (site set-up, etc.); and,
- Nearly all the site work, material handling, and all the large shafts are temporary structures.

If the DCA/DCO establishes the internal diameter of the tunnel and permanent shafts, a horizontal alignment and rights of way/easements associated with it, negotiates power drops at each working shaft, and determines the extent of allowable use and/or locations to dispose of tunnel material, all other elements of the project would be means-and-methods driven, which aligns very well to Design-Build.

5.3 Recommendation on Contract Packaging

The ITR recommends five tunnel design build contracts in order of release as follows and shown in Figure 8:

- Contract 1: Stockton Shaft to Byron Forebay
- Contract 2: Terminous Shaft to Intermediate Forebay Shaft
- Contract 3: Stockton Shaft to Terminous Shaft
- Contract 4A: Intermediate Forebay to Intake 3
- Contract 4B: Intake 3 to Intake 2
- Contract 5: South Outlet Tunnels (twin tunnels)

If the release of contracts begins in Quarter 1 of 2023, completion of the project tunnels by 2035 is achievable. The ITR recommends that each contract be separated by approximately 9 months.

It is recommended that the logistics for each site including shaft height above ground surface, finalization of power drop, etc. be included in the DB contracts as it allows the contractor to set up the sites to suit their means and methods. Any early works contract can include items such as widening of the ½ mile of Highway 12, Twin Cities Road and improvements to the Clifton Court area.

Figure 8. Recommended Tunnel DB Contract Packaging

5.4 Contract Value

The ITR recommends that the packaging of contracts be held at approximately $1.5 to $2 billion in order to ensure enough teams are available and to ensure bonding availability. All major tunnel contractors have capacity to team and to pursue the work. It is also recommended that the DCA/DCO also have initial discussions with bonding agencies.

6.0 Stakeholder and Community Concerns

The ITR was requested to review various stakeholder and community comments from prior phases of the project. All of the current comments were noted to be straightforward and could be answered by sharing engineering information. Each is addressed briefly in the following subsections.

In general, the ITR recommends that the DCA/DCO have a dedicated engineering liaison. They should be capable of translating tunnel engineering and construction to the public at large (e.g., breaking down complex topics into understandable terms with enough information). This person(s) should be supported by a team of people who can prepare graphic materials or other supporting information.

6.1 EBMUD – Mokelumne Aqueduct

East Bay Municipal Utilities District (EBMUD) expressed several concerns with the Delta Conveyance tunnel in terms of their future tunneling plans and potential conflicts. They also indicated the need for a secondary tunnel lining system. The ITR recommends that the DCA/DCO coordinate on some level with EBMUD to understand their tunnel alignment elevations and work jointly to determine an appropriate offset distance with the Delta Conveyance tunnel. The ITR does not concur with EBMUD's comment that the tunnel needs a secondary liner. There are many project examples that use a single pass segmental lining. The precast lining is sufficient to support the anticipated loads including seismic events.

6.2 Natural Gas Wells

There are several community comments with respect to unknown gas wells. The ITR noted that traditionally, the records of gas well installations are quite accurate. However, the team/contractor can perform a magnetometer survey when the final alignment is set (e.g, versus being a corridor), then the team can perform an alignment check/walk/survey to look for unknown wells.

6.3 Seismic Behavior of Tunnels

There are no active fault crossings along the Delta Conveyance alignment and the seismic demands are not extreme compared to other projects. A tunnel, in particular a segmentally lined tunnel, is capable of flexing and thus survival during an earthquake. The primary concern would be at the connection points such as the shaft/tunnel connection. These locations likely need specialized detailing to handle the localized increased stresses. This is not an unusual undertaking in areas of high seismicity.

6.4 Dewatering

There were several comments associated with dewatering caused by tunneling. The TBM will be a "pressurized face machine" meaning that it will balance both the groundwater loads and earth loads. With this type of tunneling, dewatering is not required for tunnel and lining operations. The segments are designed to be gasketed and sealed to handle water pressures and can be constructed to be watertight. The ITR does recommend that a bottom seal be required for shafts to avoid excessive pumping of groundwater out of the excavation. These comments can be answered by simply educating the stakeholders on the process of pressurized face tunneling.

6.5 Settlement

There were several comments associated with "subsidence." In reading these comments, it appeared that there was a general misuse of the word subsidence and that the concerns were related to settlement. The ITR recommends education to correct the terminology usage. Further, modern tunneling and proper face pressures mitigate against settlements.

6.6 Failure and Repair of the Lining

Failure of a segmental tunnel lining is highly unlikely and unprecedented. Segmental linings are fabricated with reinforced precast concrete in a highly controlled environment with strict quality control. A tunnel constructed with precast segments is generally considered by industry to be of higher quality than those lined by the cast-in-place concrete method. The design life is a minimum of 100 year and designed to appropriate standards and loads. We recommend sharing and explaining the calculations to the public.

Repair of the lining is highly unlikely to be necessary if designed for the service life. While transportation tunnels undergo regular maintenance due to their exposure to elements, water conveyance tunnels are not subject to the same stresses-meaning, there is not much that can damage the lining.

6.7 Emergency Response

Contractor's are required by law to have a tunnel rescue plan approved by Cal/OSHA prior to beginning underground work. This job in particular will require a five person on-site dedicated rescue team at a minimum for each tunnel contract. Moving the alignment closer to I-5 significantly improves emergency response. The ITR recommend that the DCA/DCO develop a detailed emergency response plan as well as any specifics that can be passed into contractor protocols.

6.8 Flood Risk

Current plans assume significant overbuilding of the shaft pad areas. The ITR noted that only the shaft walls need to be overbuilt to a height addressing some level of flood risk. The surrounding pad doesn't need to be as high as the shaft wall. Permanent works can be raised to the final elevation as necessary.

7.0 Conclusions

The ITR was asked to review and provide input on five major issues for the Delta Conveyance project with respect to achievable TBM drive lengths; tunnel alignment; logistics & advanced procurement for transport and storage; contract delivery and contract packaging, and stakeholder/community concerns.

The recommendations based on the December 2019 ITR workshop are as follows:

- 15-mile TBM drive lengths are achievable if appropriate mitigations are implemented;
- The tunnel alignment should move closer to Interstate 5 (further east) with shafts located adjacent to major roads and multiple methods of transport where feasible;
- Design-build delivery is preferred; and
- The existing stakeholder comments and community concerns are straightforward with simple answers.

These recommendations and conclusions are the opinion of the ITR members attending the December workshop and may not necessarily represent the unanimous opinion of the companies represented by the

ITR members. Further, the recommendations are based on the project information provided at the time, and knowledge obtained during the workshop.

The ITR thanks the DCA/DCO for their interest in engaging outside expertise and sharing the project information for brainstorming and new ideas.

Respectfully,

Werner Burger, Herrenknecht

John Kennedy, Dragados

Jeff Petersen, Kiewit

Dave Rogstad, Frontier-Kemper

Kenji Yamauchi, Obayashi

Dan Adams, McMillen Jacobs

Renée L Fippin, McMillen Jacobs

DCA Response to December 2019 Tunnel Independent Technical Review Panel Recommendations

Item No.	ITR Recommendation	DCA Response
1. TBM Drive Lengths		
	a. TBM drive lengths up to 15 miles achievable	a. Agree.
	b. TBMs used for the longer drive be designed to accommodate main bearing replacement from within the tunnel.	b. Agree.
	c. A minimum of one maintenance be provided per tunnel drive and that consideration be given to a smaller offset maintenance shaft if more needed.	c. Noted. DCA recommends two inline maintenance shafts spaced 4 to 5 miles apart with the last maintenance shaft used for a major TBM "tune up" (main bearing replacement, cutterhead face replacement, etc.) to reduce risk of TBM breakdown in the final section of long drives. Smaller off-set shafts may reduce flexibility for maintenance.
	d. Further study soil abrasivity and require state of the art heavy wear protection for the cutterhead structure in combination with a cutterhead structure monitoring system.	d. Agree. Studies on going with existing stored samples.
2. Tunnel Alignment Corridors		
	a. Central Corridor is logistically impractical and therefore should not be further studied.	a. Agree that Central corridor poses greater challenges for construction logistics than corridors closer to I-5. However, there are other considerations for siting the tunnel alignment that must be considered.
	b. Between Terminous and Lower Roberts, shift alignment further east and closer to Interstate 5.	b. Agree that proximity to I-5 facilitates construction logistics.
	c. Add new shaft along the San Joaquin River and closer to the industrialized area of Stockton.	c. DCA understands the proximity of port, rail and roadway access in this location but does not believe the alignment would benefit from shifting further east toward Stockton considering a wider range of issues.
	d. Raise vertical alignment by one-tunnel diameter to reduce operating pressures.	d. Noted but requires further study of US Army Corp of Engineers requirements and potential conflicts with the planned new East Bay Municipal Utilities District (EBMUD) Mokelumne Aqueduct tunnel.

3.	**Logistics and Advanced Procurement**	
	a. An option for on-site production of tunnel liner segments may be feasible but the DCA should also plan for off-site production and leave the design and manufacture of the segments to the tunneling contractors.	a. Agree in principle but other factors may drive the decision on liner fabrication strategy.
	b. Based on past experience, soft ground tunnel material is difficult to dispose or find a use for. The Project would benefit from finding a location for disposal and/or reuse of the RTM in advance of advertising the tunnel contracts.	b. Noted. Significant testing will be done as part of the future field work activities to validate the composition and reuse of the tunnel spoils. Previous testing results indicate that the material is suitable for forebay embankment construction and other structural uses.
	c. Based on the known geology, it is anticipated that the tunnel will be classified as "gassy" or "potentially gassy". It is important that DCA meet with Cal/OSHA early to start discussions on what requirements may need to be designed into the project to address this issue.	c. Agree.
	d. A detailed tunnel rescue plan is required by law and because of the long tunnel drives, the rescue plan requirements will be more extensive.	d. Agree.
4.	**Contract Delivery and Packaging**	
	a. Recommend Design-Build (DB) be used as the contract delivery method for the tunnel and shaft work.	a. Agree that D-B offers key benefits to the design and construction of the tunnel and should be explored. Legal hurdles may hinder its use for Delta Conveyance.
	b. Break the tunnel work into five DB contracts separated by 9 months and include work site early works in the DB contract.	b. Noted but subject to further DCA study.
	c. Hold contracts to less than \$1.5-\$2.0 billion in order to ensure enough teams are available and to ensure bonding availability.	c. Noted but subject to further DCA study.
5.	**Stakeholder and Community Concerns**	
	a. Mokelumne Aqueduct – EBMUD expressed concerns that the Delta Conveyance tunnel conflicts with their future tunneling plans and that a secondary tunnel lining system is needed for the Delta Conveyance tunnel. Coordination with EBMUD needs to occur, however, the ITR does not concur with the need for a secondary liner.	a. Agree.

	b. Natural Gas Wells – perform magnetometer survey when the final alignment is set to locate unknown wells.	b. Agree.
	c. Seismic Behavior of Tunnels – as there are no active fault crossings along the Delta Conveyance alignment, a segmentally lined tunnel is capable of flexing and thus surviving during an earthquake. The primary concern would be at the connection points, such as the shaft/tunnel connections, which require specialized detailing to handle the localized increased stresses.	c. Agree.
	d. Dewatering – the TBM will be a pressurized face machine and therefore dewatering is not required for tunnel and lining operations since the segments are designed to be gasketed and sealed to handle the water pressure. A bottom seal should be required for shafts to avoid excessive pumping of groundwater out of the excavation.	d. Agree.
	e. Settlement – modern tunneling techniques and maintaining a proper face pressure will mitigate against settlement.	e. Agree.
	f. Failure and Repair of the Lining – failure and/or repair of a segmental tunnel lining is highly unlikely and unprecedented.	f. Agree.
	g. Emergency Response – Contractors are required to have a tunnel rescue plan. Moving the alignment closer to I-5 significantly improves emergency response. The ITR recommends that the DCA develop a detailed emergency response plan.	g. Agree.
	h. Flood Risk – permanent works need to be raised to protect against predicted flood levels, however only the shaft walls need to be overbuilt to a height addressing some level of flood risk. The surrounding pad doesn't need to be as high as the shaft wall.	h. Agree.

DCA

DELTA CONVEYANCE DESIGN
& CONSTRUCTION AUTHORITY

STAKEHOLDER ENGAGEMENT
COMMITTEE (SEC)

Intakes Update

Siting, Type, Sizing, Construction, and Flow Control

Agenda Item 8c | February 20,2020

NOP - KEY ITEMS FOR DCA

1. Facilities that comprise the proposed Delta Conveyance Project
2. Delta Corridor Map for Tunnel Alignments and Facility Siting
3. Range of Flows for Study

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY | STAKEHOLDER ENGAGEMENT COMMITTEE (SEC)

r Discussion Purposes Only. Subject to Change

Intake Siting

- Siting study area is from the American River to Sutter Slough
- Sites on the east bank viable with the NOP corridors
  - West bank not viable due to poor access
- 1 to 3 intake sites required for likely alternatives

Capacity	Number of Intakes
3000 cfs	1 intake
4500 cfs	2 intakes
6000 cfs	2 intakes
7500 cfs	3 intakes

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY | STAKEHOLDER ENGAGEMENT COMMITTEE (SEC)

Intake Site Investigation

Potential siting informed by Fish Facility Technical Team (FFTT) as well as subsequent efforts

- Outside of bends best
  - Deeper is better (12 feet min)
  - 1 mile spacing
  - Non-shoaling (no sediment accumulation)
  - Adequate straight length for structure
  - Negligible effect on flood levels
- Landside Effects
  - Property effects
  - Proximity to existing development
  - Built environment effects
- Geotechnical Concerns
- Environmental and Habitat Disruption
- Access
  - Roads and traffic effects

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY | STAKEHOLDER ENGAGEMENT COMMITTEE (SEC)

Candidate Sites

- Reach of river has been exhaustively studied
  - Same sites as previously identified
  - Studied new land use, flows, and river bathymetry
  - No additional viable sites on the east side of the river
  - West side is not logistically feasible
- Conceptual position developed at each site as basis for comparison
- Intake sites are feasible for either Central or Eastern Corridors

Evaluation Results

Sites C-E-1 and C-E-4 ranked as least favorable and not recommended for use unless other 3 sites not implementable

- Land use
- Proximity to existing development
- Geotechnical issues

Site C-E-3 is apparent best site

- Lowest effects on existing property and features
- Excellent river conditions

Site C-E-5

- Low effects on existing property and features
- Good river conditions

Site C-E-2

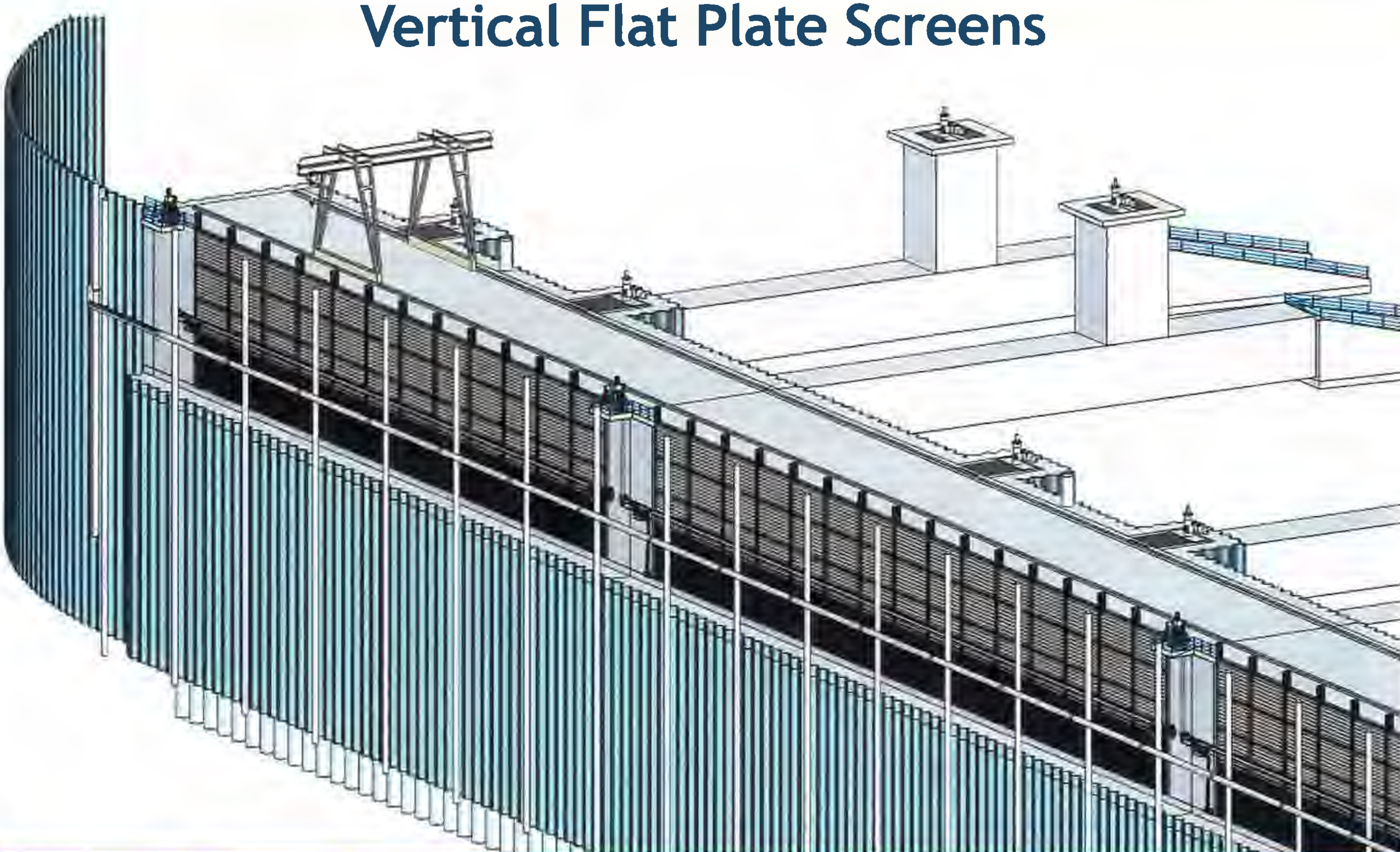
- Longest intake structure
- More substantial property effects
- Adequate river conditions

Intake Structure Types

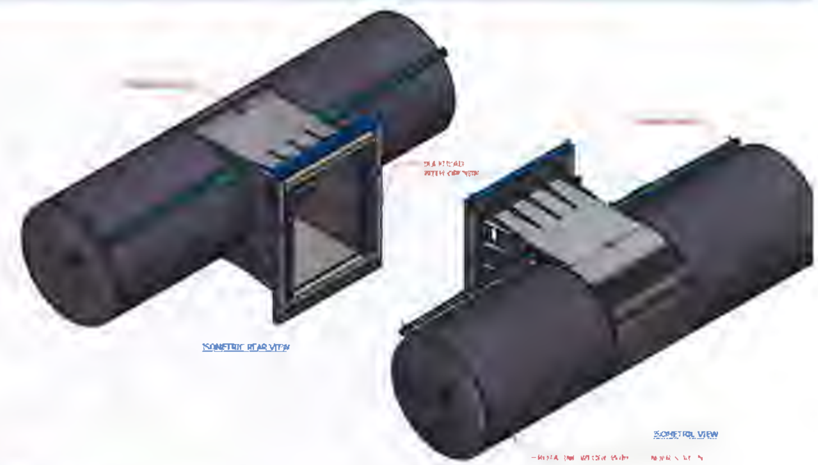
Current Focus:

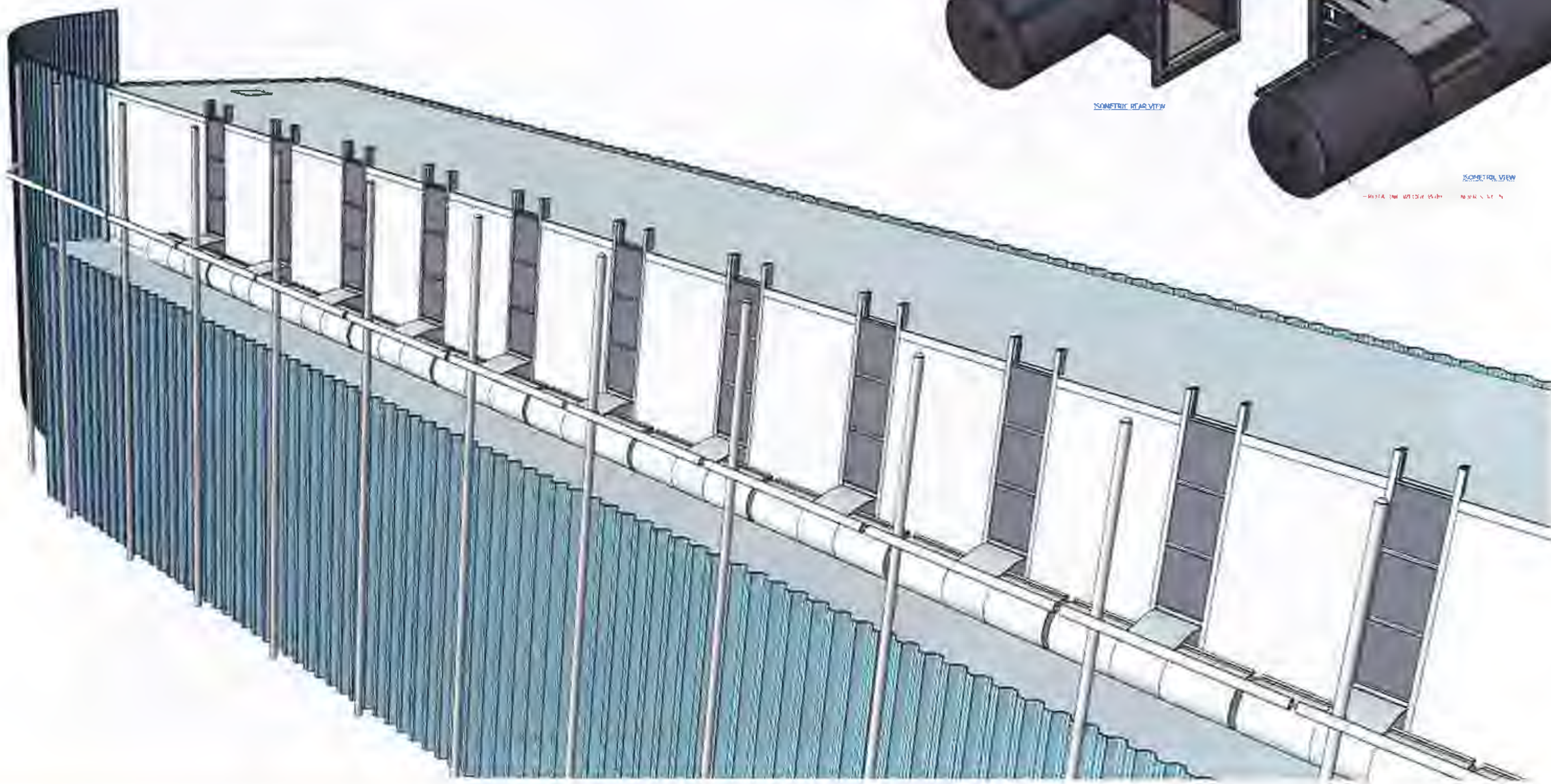
- Vertical Cylindrical Tee with On-Bank Structure
- Vertical Plate with On-Bank Structure

Vertical Flat Plate Screens

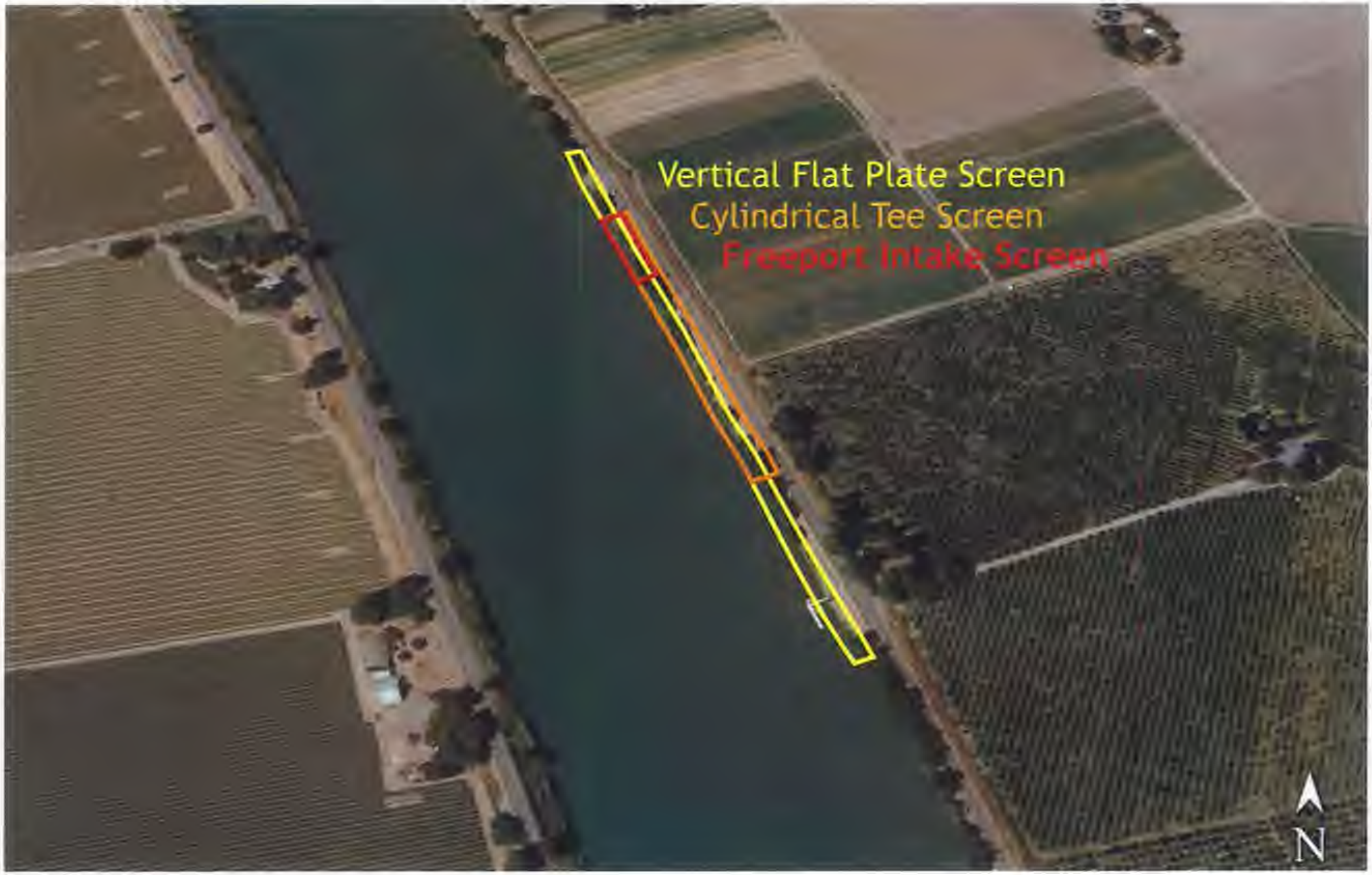


Cylindrical Tee Screens





Intake Type and Sizing - Comparison (Site C-E-2)



Discussion Purposes Only, Subject to Change

Logistics Alternatives

- Modes of Transportation
  - Rail
  - Trucking/Roads
  - Barge

- Trucking/Roads
  - Force traffic to use I-5
  - Avoid 160 and the River Road using new Haul Roads.
  - Possible staging center for consolidation and/or employee parking

- Barge
  - Potential barge landings at Hood or at/near intake sites
- Rail
  - Possible rail staging area and consolidation center off tracks near I-5

Proposed Approach

- Limit access to intake construction sites to I-5 Corridor
- Interchanges:
  - Hood Franklin Rd - Improve I-5 Interchange
  - Lambert – Potential new interchange
  - Twin Cities Road – Improve I-5 Interchange
- Construct haul roads from interchanges to shift traffic off existing roads to extent possible
- Utilize existing haul routes to minimum disturbance

Construction Noise is Key Concern at Intake Sites

Table 1. Typical A-Weighted Sound Levels

Common Outdoor Activities	Noise Level Scale (dBA)	Common Indoor Activities
	110	Rock band
Jet flyover at 1,000 feet		Unmitigated Pile Driving Decibel Level at X ft
	100	
Gas lawnmower at 3 feet		
	90	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawnmower, 100 feet	70	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60	
		Large business office
Quiet urban daytime	50	Dishwasher in next room
Quiet urban nighttime	40	Theater, large conference room (background)
Quiet suburban nighttime		
	30	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20	
		Broadcast/recording studio
	10	
	0	

Source: Caltrans 2009.

Pile Driver without Noise Reduction Equipment
Source: Carpenters Training Institute

Noise Reduction Equipment - Shroud

Noise Control

- Specify lower decibel equipment and methods
- Attach shrouds around pile driving equipment
- Sound barrier walls around elevated decibel construction zones
- Noise reduction measures at receptor locations

Typical Pile Driving with Noise Reduction Equipment

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DELTA CONVEYANCE DESIGN
& CONSTRUCTION AUTHORITY

STAKEHOLDER ENGAGEMENT
COMMITTEE (SEC)

Clarifications?

Launch Shaft Update

Agenda Item 8d | February 20, 2020

Key Components of a Tunnel Drive

Tunnel Launch Shaft
Where the tunnel boring machine (TBM) is lowered into the tunnel. Where the concrete liners are transported into the tunnel. Where the excavated material (RTM) is removed.

Maintenance Shaft
Provides direct access to the TBM for routine maintenance work. Needed approximately every 4 to 5 miles.

Tunnel Retrieval Shaft
Termination point of tunnel drive. Where TBM is disassembled and lifted out of the tunnel.

Main Activities at Launch Site

- Launch tunnel boring machine
- Tunnel boring operations
- Segment liner deliveries, stockpiling and transport into the tunnel for placement
- Reusable Tunnel Material (RTM) production, dewatering, and stockpiling
- Power supply systems
- Tunnel ventilation systems
- Site runoff management
- Tunnel boring machine worker access
- Emergency access

Reusable Tunnel Material (RTM)

- Extracted material from the tunneling process
- Comprised of clays, sands, and silts
- Consistency of toothpaste
- Soil conditioners used for boring operation are also present in low quantities
- Wet material would be dried prior to stockpiling
- Continuous soil and water testing program would be implemented to confirm quality of material for reuse or disposal
- Material suitable for beneficial reuse

RTM and Environmental Test Results

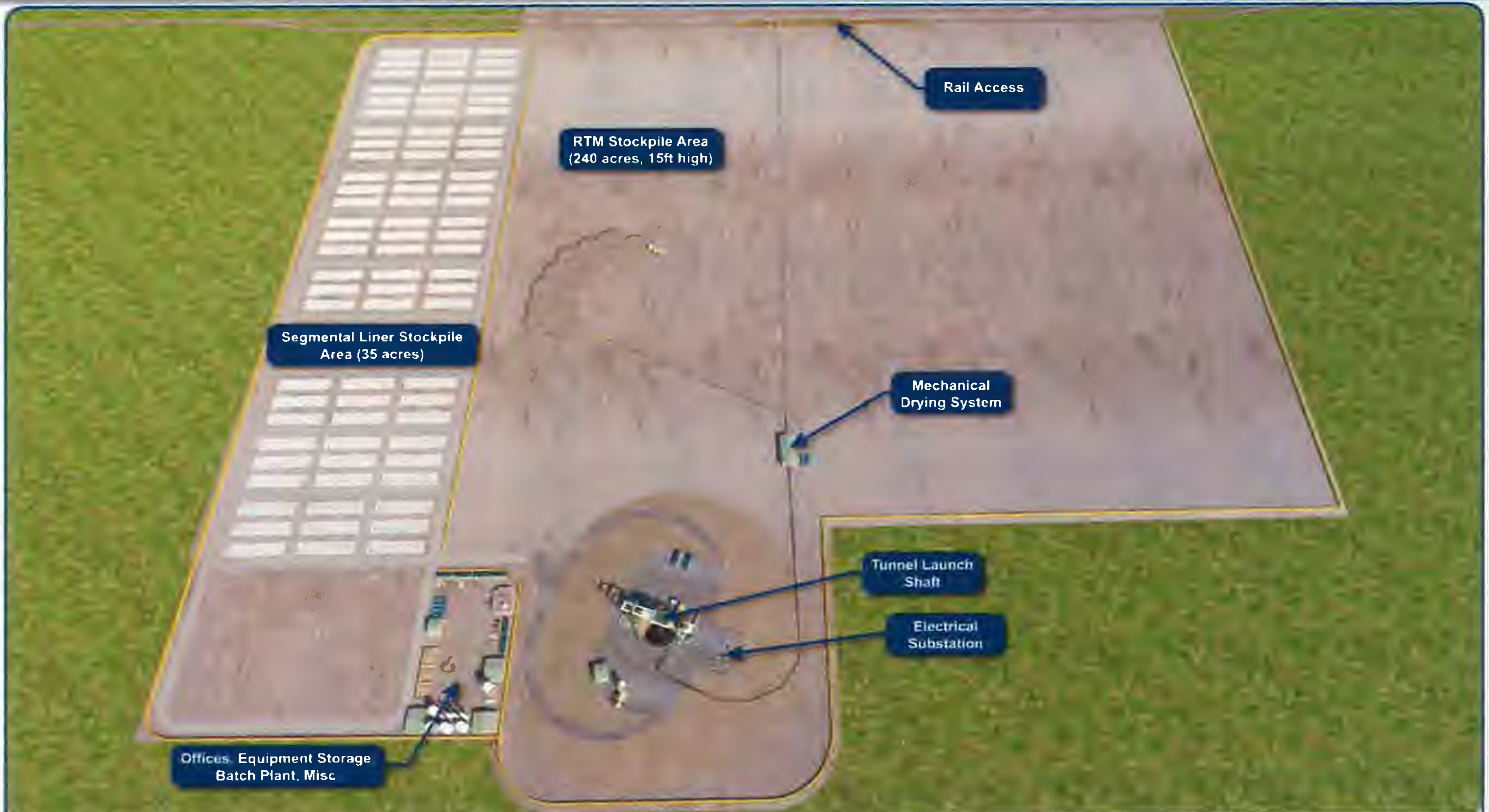
- Reviewed available environmental soil laboratory results
- Initial observations:
  - Metals generally resemble background levels. Cadmium appears slightly elevated in all samples compared with published background, but doesn't appear to represent a human health or ecological risk.
  - Pesticides and total petroleum hydrocarbons (TPH): few detects (no pesticides, TPH in one water sample)
- Additional sampling as part of future soil investigation program
- Developing exposure scenarios to evaluate human health and ecological risks
- Evaluating alternatives to control airborne RTM particulate matter

Possible Local Beneficial Reuse Opportunities (further discussion Feb 26)

- Delta Conveyance Southern Forebay embankment
- Delta Conveyance mitigation projects in Delta
- Delta Reclamation Districts levee maintenance
- Other Delta restoration projects
- Land subsidence
- Road improvements
- Commercial sale

Pre-Cast Liners

- Liners typically provided by tunnel contractor
- Fabricated at existing or new purpose-built pre-cast facility
- Continuous operations at pre-cast facility with on-site stockpiling and batch shipments to tunnel launch sites
- Stockpiled on launch shaft site



290 total acres
Single 15 mile drive
6,000 cfs capacity

Tunnel Launch Shaft Site Plan

DCA
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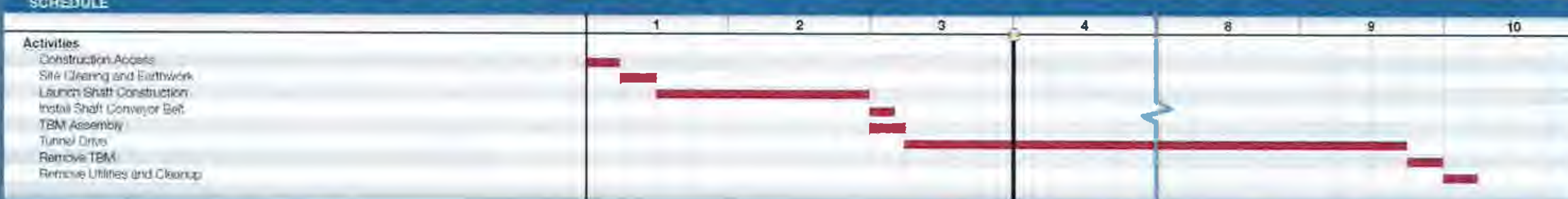
& CONSTRUCTION AUTHORITY

Tunnel Launch Shaft Construction

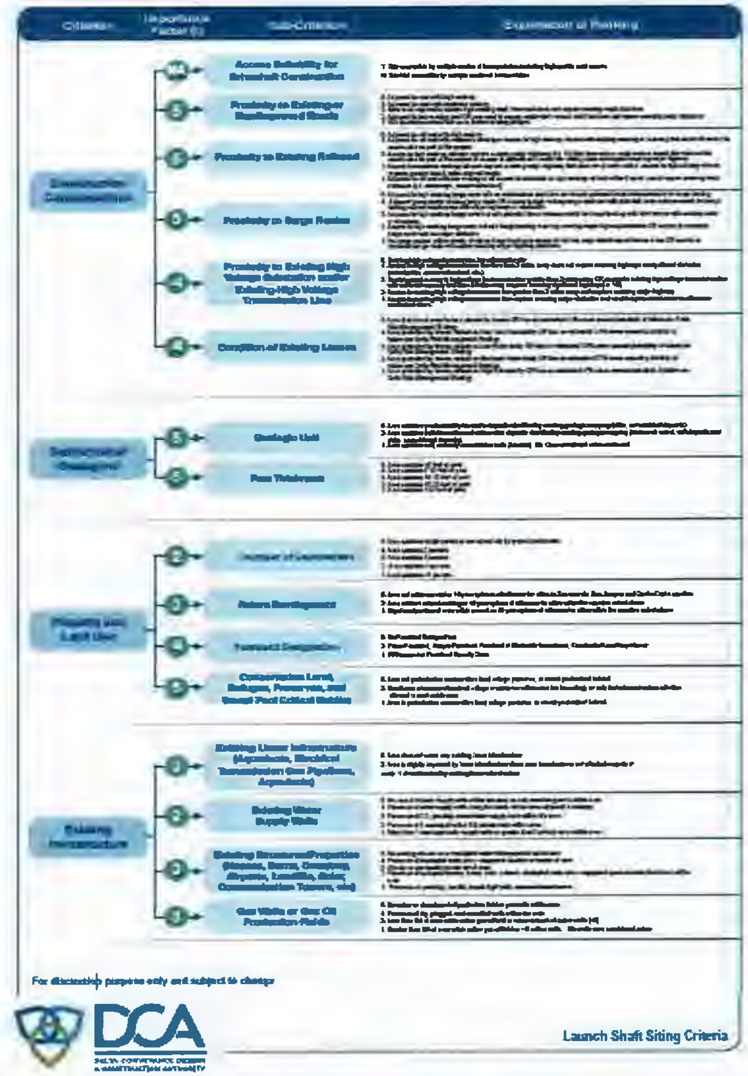
SCHEDULE



For Discussion Purposes Only, Subject to Chang

Siting Methodology

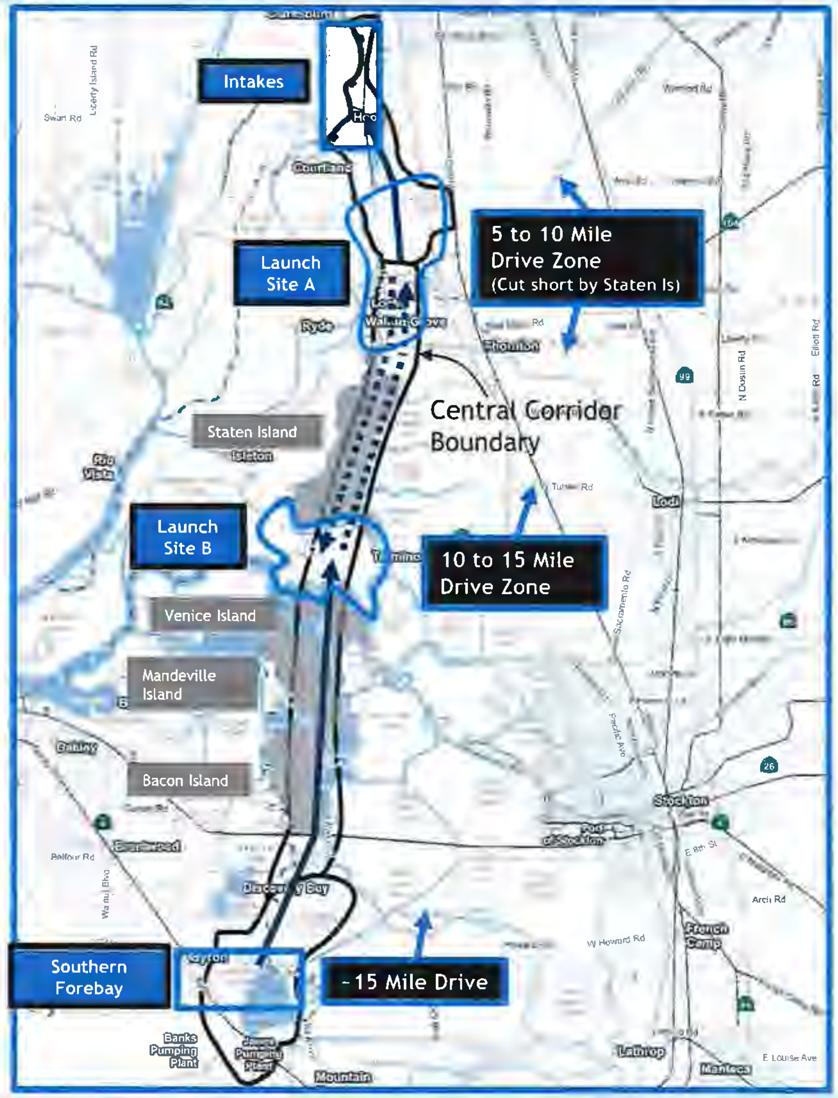
- Siting methodology breakdown is in handout packet
- Methodology is broken out into criteria and sub-criteria
- Sub-criteria are assigned an Importance Factor to reflect their weighting
- Criteria are based on design and construction considerations
  - The CEQA process will study additional environmental considerations



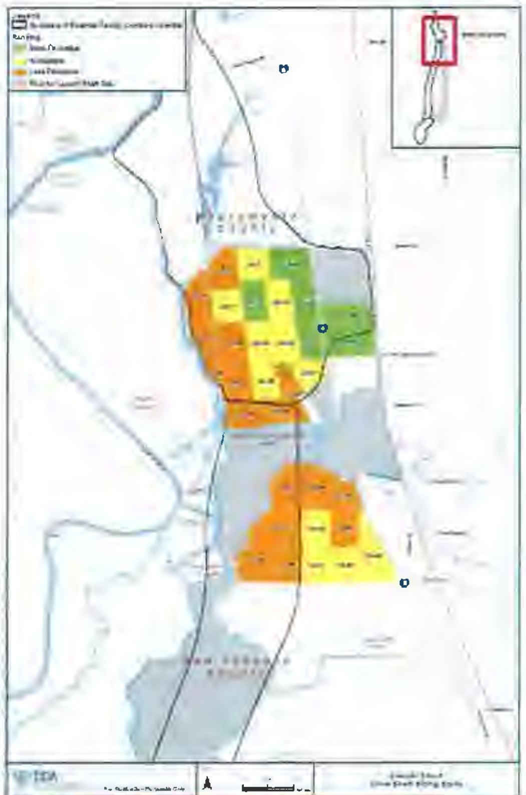
Central Alignment

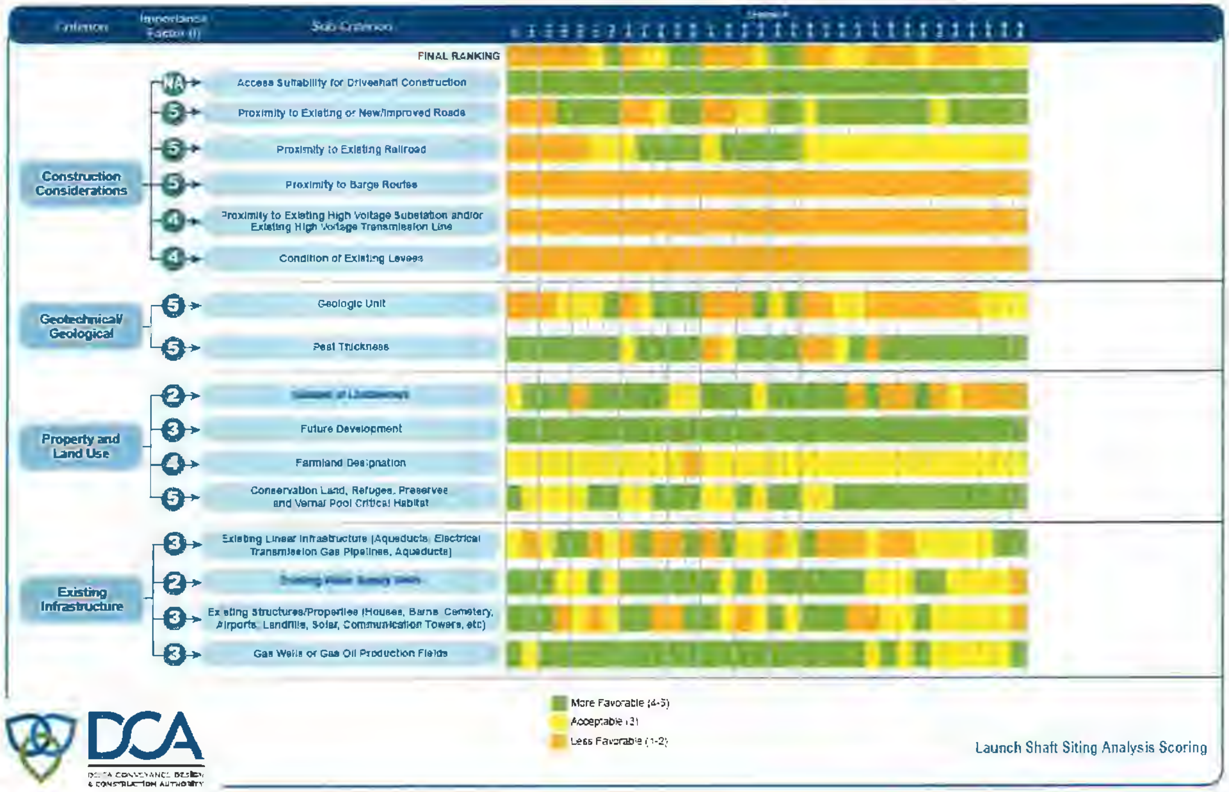
3 Drives:

1. **Intakes to Launch Site A**
   - Drive shorter than desirable to avoid Staten Island
   - Drive north to reduce potential effects at intakes
   - Sites closer to rail preferable for liner and RTM transport
2. **Launch Site A to Launch Site B (Bouldin Island)**
   - Good road (Hwy 12) and barge access (off San Joaquin River)
   - Good location to stockpile RTM for Delta beneficial reuse
   - Launch or receive at this site depending on where RTM desired
3. **Launch Site B to Southern Forebay**
   - Drive north from Southern Forebay to Bouldin - use RTM to build forebay levees
   - Potential for ~100% reuse of material on site



Central Alignment -Shaft Site A





Launch Shaft Siting Analysis Scoring

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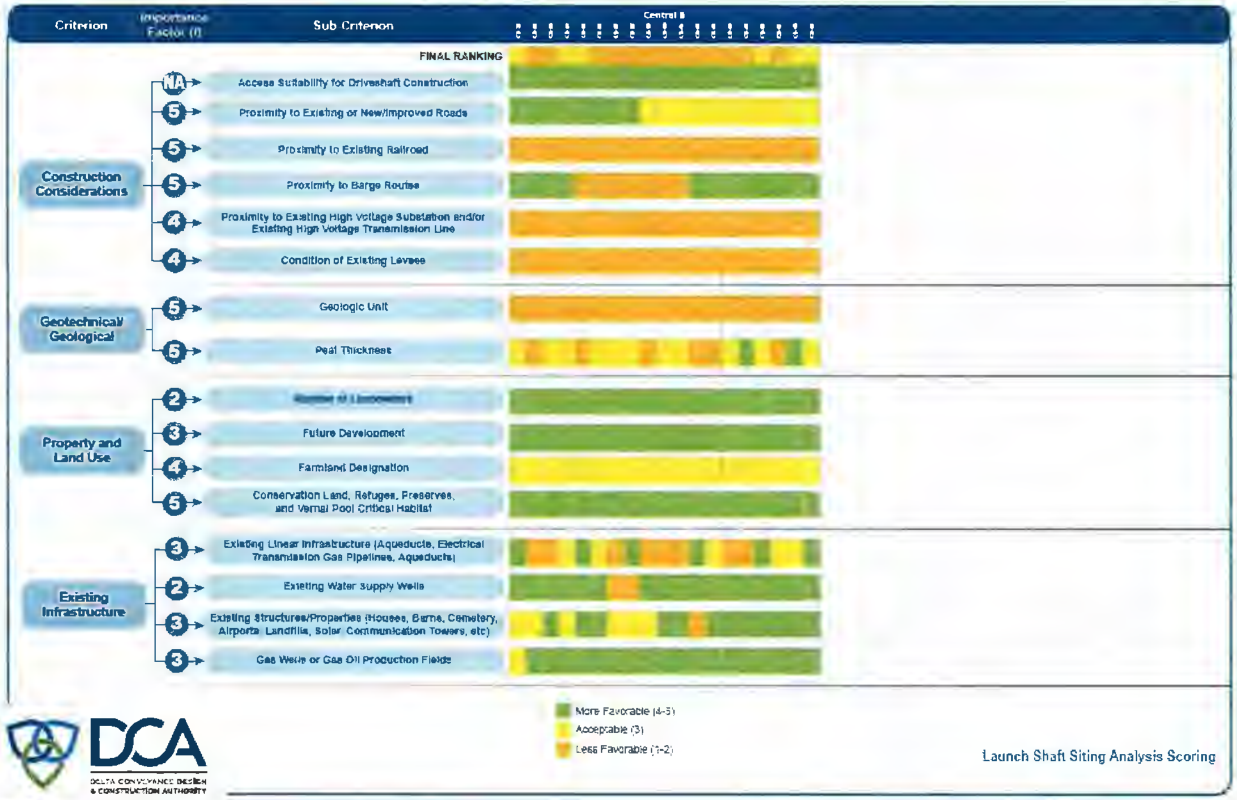
Central Alignment -Shaft Site B



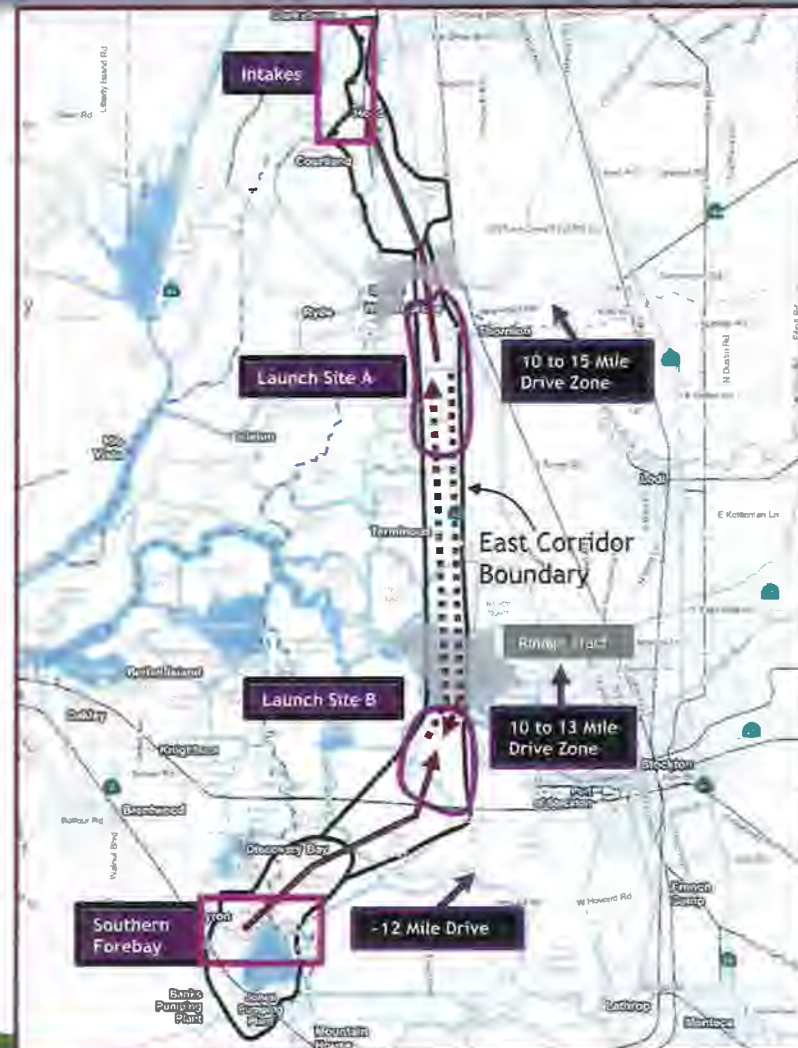
DCA STAKEHOLDER ENGAGEMENT COMMITTEE (SEC)

For Discussion Purposes Only, Subject to Chang

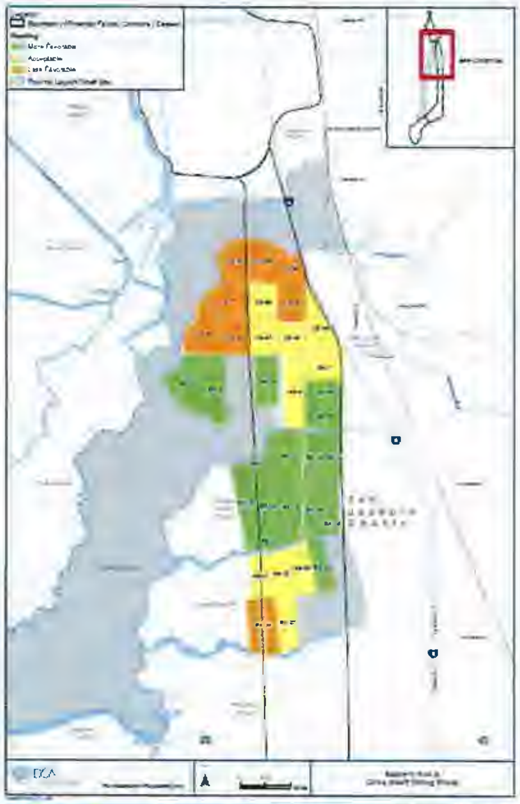
Configurations - East

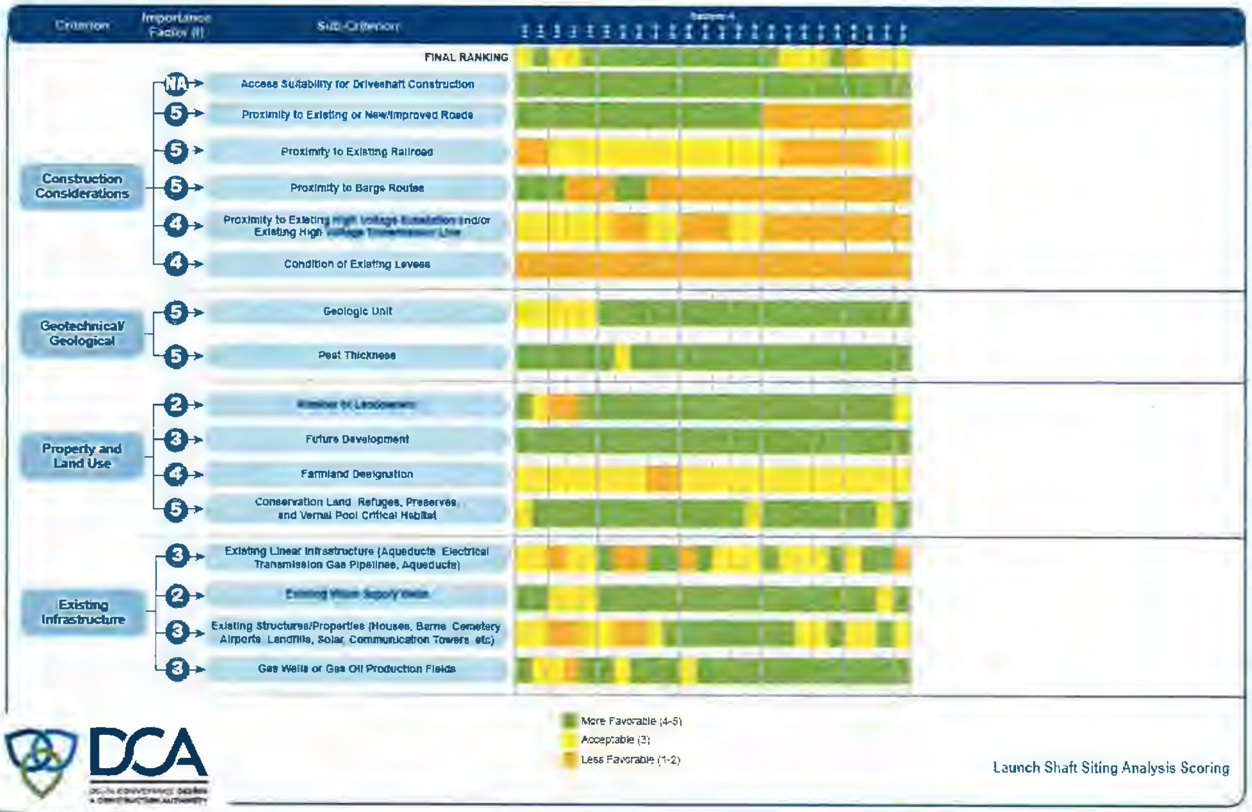
3 Drives:

1. **Intakes to Launch Site A**
   - Drive north to reduce potential effects at Intakes
   - Sites closer to rail preferable for liner and RTM transport
2. **Launch Site A to Launch Site B**
   - Acceptable road (Hwy 4) and barge access (San Joaquin River)
   - Good location to stockpile RTM for Delta beneficial reuse
   - Launch or receive at this site depending on where RTM desired
3. **Launch Site B to Southern Forebay**
   - Drive from Forebay north to Launch Site B - use RTM to build forebay levees
   - Potential for ~100% reuse of material on site



East Alignment – Shaft Site A





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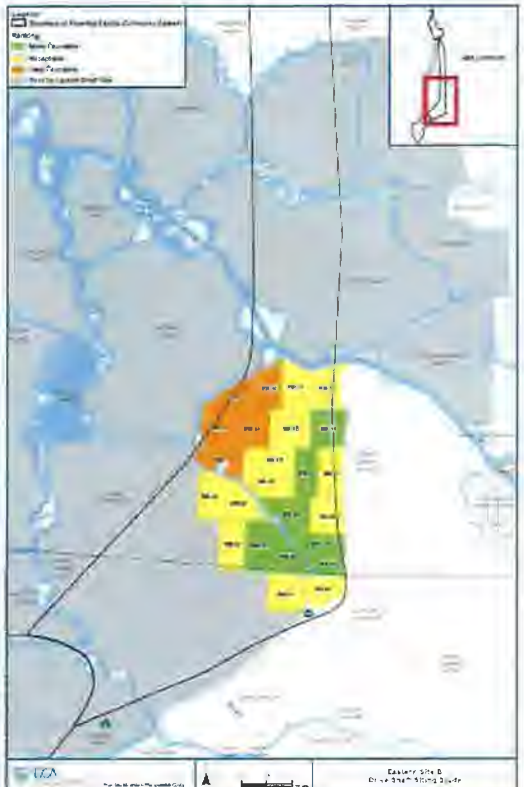
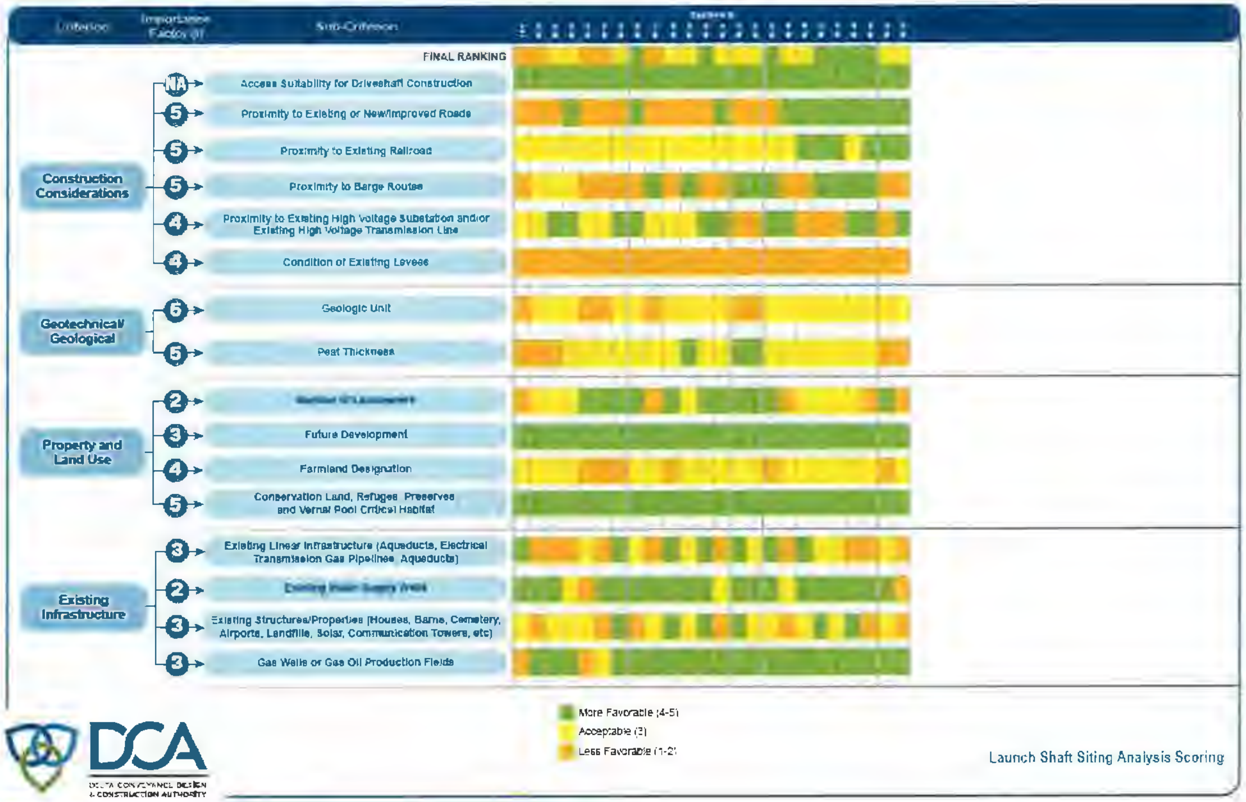
East Alignment - Shaft Site B





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DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

FEBRUARY 2020 Monthly Board Report

(ACTIVITIES IN JANUARY)

This document is fully interactive, use menus to navigate on-screen

Agenda Item 8e

Section 1 | Executive Summary

Program Initiation. The program initiation team continues to focus on finalizing cost enabled business requirements and integrating priority procedures into our E-Builder Project Management Information System. Annual Budget preparation and Task Order Initiation business requirements were completed and configured in the system in the past month.

Engineering. The team continues to complete foundational studies regarding design criteria and alternative siting analyses of the proposed Delta Conveyance Project. Now that the NOP has been released, the focus is on siting facilities within the two proposed corridors and creating facility layouts during construction and the permanent facilities.

Field work has been delayed as we await the completion of the CEQA process for the geotechnical work and gain clarity on the permitting requirements for the program from the on-going litigation with the Delta Counties. In the meantime, we continue to analyze the existing data and enter validated data into our geologic model of the Delta.

Stakeholder Engagement. The DCA held its third Stakeholder Engagement Committee meeting in January where we presented an overview of the proposed Intakes including the results of siting studies, proposed layouts, screen technology alternatives and highlights of key construction effects. Meeting material and minutes from the SEC meetings are available on the DCA website.

Budget. The DCA has committed approximately $72.8M of the Board approved budget of $82M. Our current forecasted Estimate at Completion for FY 2019/20 has remained at approximately $49.2M. Delays in implementation of the Field Work program has significantly reduced our cost forecasts. We continue to remain well below the approved budget.

Schedule. The monthly schedule update continues to show the program running approximately six weeks behind schedule. The team began to ramp up engineering resources in January and are anticipating recovering time over the next two to three months.

Monthly Budget Summary (FY 2019/2020)

Category	Current Budget	Current Contingency	Current Commitments	Incurred To Date	EAC	Variance
Program Management	$ 8,800,000	$ 1,600,000	$ 5,897,767	$ 2,796,394	$ 4,565,000	(4,235,000)
Project Controls	$ 5,250,000	$ 700,000	$ 4,299,635	$ 2,278,882	$ 4,175,000	(1,075,000)
Stakeholder Engagement	$ 4,700,000	$ 700,000	$ 4,884,926	$ 1,200,594	$ 1,800,000	(2,900,000)
Administration	$ 6,930,000	$ 1,500,000	$ 5,629,173	$ 3,471,580	$ 6,110,000	(820,000)
Engineering	$ 31,800,000	$ 5,800,000	$ 29,500,684	$ 7,298,472	$ 23,285,000	(8,515,000)
Field Work	$ 21,460,000	$ 4,900,000	$ 21,423,155	$ 1,330,977	$ 7,200,000	(14,260,000)
Property Access and Acquistion	$ 3,060,000	$ 600,000	$ 1,132,659	$ 172,390	$ 2,040,000	(1,020,000)
	$ 82,000,000	**$ 15,800,000**	**$ 72,767,999**	**$ 18,549,290**	**$ 49,175,000**	**$ (32,825,000)**

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

Section 2 | Engineering & Field Work

The engineering team is continuing to complete various Technical Memorandum that describe the engineering design criteria, analyses and alternatives that will inform the Engineering Design Report that will be submitted to DWR for inclusion in the Draft EIS document.

The field work teams continue to screen and digitize available historic data across the Delta to supplement the project data. The comprehensive soils data will enhance potential future development of a model of subsurface conditions. Geotechnical Consultant, Right of Way Consultants and Surveying Consultants remain on pause

General Work

Completed

- Draft Intake Screen Sizing TM

Look Ahead – Next Month

- Draft TBM Tunneling Evaluations
- Draft Forebay Embankment Conceptual Design Criteria TM
- Draft Tunnels Key Features Summary
- Draft Tunnel Construction Power TM
- Draft Conceptual Tunnel Lining Evaluation
- Draft Shaft Options and Site Layout
- Draft Systemwide Hydraulic and Capacity Study TM
- Draft Hydraulics Design Criteria TM
- Draft Summary of Historical Studies
- Draft Pre-Cast Yard Study
- Draft South Delta Conveyance and Intake O&M Facility Requirements preliminary data

Field Work

Completed

- GeoBIM Selection Procedure and Final Recommendation

Look Ahead – Next Month

- Preparation of Geostatistical Analysis, GeoBIM, Evaluation, and Interpretive Report

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

continued >

Section 3 | Stakeholder Engagement

At the February 12th Meeting the Stakeholder Engagement Meeting members were provided presentation materials regarding the basics of tunnel driving and launch shaft siting. Below are the specific discussion topics covered:

Launch Shafts:

The engineering team presented maps and information identifying zones within the Central and Eastern Corridors where launch shafts could be located based on acceptable drive lengths.

Site Ranking Criteria and Results:

DCA created an evaluation system to rank feasible sites within each of these zones, with access logistics and truck traffic sensitivities as primary considerations. Engineers shared information illustrating the ranking of 250-acre areas as more favorable, acceptable, or less favorable for launch shaft siting. Engineers also shared the methodology for determining the rankings and solicited input from SEC members on both the methodology and the results. The DCA has evaluated sites based on engineering considerations while DWR will evaluate sites based on environmental analysis in the CEQA process.

Considerations for SEC:

DCA solicited input regarding the ranking methodology and results. SEC members are encouraged to discuss with their communities and report feedback at the next SEC meeting roundtable. DWR staff encouraged SEC members and audience to provide thoughts on impacts and alternatives through DWR's scoping process since comments made in the SEC meetings are not specifically tracked as part of DWR's CEQA process.

Upcoming SEC Meeting

Date: February 26, 2020

Time: 3 to 6 PM

Location: Belle Vie Vineyard

Topics:

- Feedback on Launch Shaft Siting
- Introduction to Retrieval and Maintenance Shafts

SEC Meeting Calendar

- March 11, 2020
- March 25, 2020
- April 8, 2020 (if needed)
- April 22, 2020
- May 13, 2020 (if needed)
- May 27, 2020

SEC Meeting Materials & Updates

https://www.dcdca.org/

Section 4 | Program Management/Administration

Program Management/Project Controls

The program management team continues to work on finalizing policies and procedures and expanding the Program Management Information System to include processes for budget management, cost management, and procurement management plans.

Program Controls continues to manage and track costs including budget, commitments, invoicing and payments. We are working on developing a 3-year schedule and budget for the program to take us through the environmental planning phase.

Key Accomplishments

- E-Builder Configuration on 8 new business processes for budget, cost and procurement management are under way.
- The controls team processed and submitted 8 invoices to DWR for approval and payment.

Administration

The team has successfully opened the 23rd & 24th floors of the new DCA Headquarters located at 980 9th Street. The team is now focused on fine-tuning operations.

Information Technology is collaborating with AP42 for the DCA website revamp.

Key Accomplishments

- Opened new DCA Headquarters 24th Floor
- Kicked off AP42 services to design and implement new DCA website
- Management of buildout, design, furniture and vendors for 1st and 23rd floor at 980 9th Street;
- Go-live for Ring Central meetings software

Section 5 | Budget

Budget Summary

Budget Forecast FY 2019/20. The DCA has committed approximately $72.8M of the original budgeted $82M excluding Contingency. Our current estimate at completion (EAC) of the current Fiscal Year is $49.2M which is $33M below our original approved budget exclusive of our contingency budget. See pages 6-7.

Budget Change Requests. During the reporting period, there was no budget changes this month.

Planned Cash Flow. The DCA continues to forecast approximately $52M in expenditure through the end of the Fiscal Year, including May and June of the previous Fiscal Year (Planned Period Restart). Our current cost forecast indicates that we will exceed our existing funding levels in the February to March 2020 timeframe based on earned value (work completed). See page 8.

Budget Detail

WBS	Fiscal Year	Original Budget	Current Budget	Contingency	Commitments	Pending Commitments	Incurred to Date	% Spent	Remaining Budget	% Rem	EAC	Variance
Delta Conveyance	2019/2020	$ 97,800,000	$ 82,000,000	$ 15,800,000	$ 72,767,999	$ -	$ 18,549,290	23%	$ 63,450,710	77%	$ 49,175,000	$ (32,825,000)
Program Management	**2019/2020**	**$ 10,400,000**	**$ 8,800,000**	**$ 1,600,000**	**$ 5,897,767**	**$ -**	**$ 2,796,394**	**32%**	**$ 6,003,606**	**68%**	**$ 4,565,000**	**$ (4,235,000)**
Executive Management	2019/2020	2,000,000	2,000,000	-	1,792,364	-	674,896	34%	1,325,104	66%	1,800,000	(200,000)
Legal Counsel	2019/2020	3,020,000	2,970,000	-	550,000	-	330,597	11%	2,639,403	89%	720,000	(2,250,000)
Audit	2019/2020	100,000	100,000	-	-	-	-	0%	100,000	100%	50,000	(50,000)
Treasury	2019/2020	160,000	160,000	-	153,046	-	121,233	76%	38,767	24%	160,000	-
Health & Safety	2019/2020	100,000	100,000	-	-	-	-	0%	100,000	100%	25,000	(75,000)
Quality	2019/2020	750,000	750,000	-	750,000	-	-	0%	750,000	100%	250,000	(500,000)
Program Initiation	2019/2020	2,130,000	2,180,000	-	2,115,306	-	1,569,938	72%	610,062	28%	1,460,000	(720,000)
Sustainability	2019/2020	540,000	540,000	-	537,052	-	99,730	18%	440,270	82%	100,000	(440,000)
Contingency	2019/2020	1,600,000		1,600,000	-	-	-	0%	-	-	-	-
Program Controls	**2019/2020**	**$ 5,950,000**	**$ 5,250,000**	**$ 700,000**	**$ 4,299,635**	**$ -**	**$ 2,278,882**	**43%**	**$ 2,971,118**	**57%**	**$ 4,175,000**	**$ (1,075,000)**
Cost, Schedule and Document Control	2019/2020	3,950,000	3,950,000	-	3,783,822	-	1,856,523	47%	2,093,477	53%	3,500,000	(450,000)
Procurement	2019/2020	1,020,000	1,020,000	-	287,259	-	191,868	19%	828,132	81%	325,000	(695,000)
Risk Management	2019/2020	280,000	280,000	-	228,553		230,490	82%	49,510	18%	350,000	70,000
Contingency	2019/2020	700,000		700,000	-	-	-	0%	-	0%	-	-
Stakeholder Engagement	**2019/2020**	**$ 5,400,000**	**$ 4,700,000**	**$ 700,000**	**$ 4,884,926**	**$ -**	**$ 1,200,594**	**26%**	**$ 3,499,406**	**74%**	**$ 1,800,000**	**$ (2,900,000)**
Engineering Coordination	2019/2020	1,497,000	1,497,000		1,496,447	-	359,424	24%	1,137,576	100%	800,000	(697,000)
Outreach	2019/2020	2,173,000	1,923,000	-	1,931,929		748,813	39%	1,174,187	61%	500,000	(1,423,000)

Section 5 | Budget *continued*

Budget Detail

WBS	Fiscal Year	Original Budget	Current Budget	Contingency	Commitments	Pending Commitments	Incurred to Date	% Spent	Remaining Budget	% Rem	EAC	Variance
Stakeholder Engagement	**2019/2020**	**$ 5,400,000**	**$ 4,700,000**	**$ 700,000**	**$ 4,884,926**	**$ -**	**$ 1,200,594**	**26%**	**$ 3,499,406**	**74%**	**$ 1,800,000**	**$ (2,900,000)**
Committee Management	2019/2020	-	250,000	-	428,112	-	92,357	37%	157,643	63%	500,000	250,000
Economic Development	2019/2020	1,030,000	1,030,000	-	1,028,438	-	-	0%	1,030,000	100%	-	(1,030,000)
Contingency	2019/2020	700,000		700,000	-	-	-	0%	-	0%	-	-
Administration	**2019/2020**	**$ 8,430,000**	**$ 6,930,000**	**$ 1,500,000**	**$ 5,629,173**	**$ -**	**$ 3,471,580**	**50%**	**$ 3,458,420**	**50%**	**$ 6,110,000**	**$ (820,000)**
Facilities & Operations	2019/2020	3,800,000	3,800,000		2,972,543		2,166,399	57%	1,633,601	43%	3,800,000	-
Human Resources	2019/2020	650,000	650,000	-	210,000	-	84,234	13%	565,766	87%	210,000	(440,000)
Information Technology	2019/2020	2,480,000	2,480,000	-	2,446,630		1,220,947	49%	1,259,053	51%	2,100,000	(380,000)
Contingency	2019/2020	1,500,000		1,500,000	-	-	-	0%	-	-		-
Engineering	**2019/2020**	**$ 37,600,000**	**$ 31,800,000**	**$ 5,800,000**	**$ 29,500,684**	**$ -**	**$ 7,298,472**	**23%**	**$ 24,501,528**	**77%**	**$ 23,285,000**	**$ (8,515,000)**
Engineering Management	2019/2020	2,900,000	2,300,000	-	600,000	-	144,513	6%	2,155,487	94%	825,000	(1,475,000)
Engineering	2019/2020	27,900,000	27,900,000	-	27,883,774	-	6,823,731	24%	21,076,269	76%	21,460,000	(6,440,000)
DWR Engineering Coordination	2019/2020	-	600,000		-		-	0%	600,000	100%	-	(600,000)
Environmental Coordination	2019/2020	1,000,000	1,000,000		1,016,910	-	330,228	33%	669,772	67%	1,000,000	-
Contingency	2019/2020	5,800,000		5,800,000	-	-	-	0%	-	0%		-
Field Work	**2019/2020**	**$ 26,360,000**	**$ 21,460,000**	**$ 4,900,000**	**$ 21,423,155**	**$ -**	**$ 1,330,977**	**6%**	**$ 20,129,023**	**94%**	**$ 7,200,000**	**$ (14,260,000)**
Geotech	2019/2020	20,440,000	20,440,000	-	20,435,957	-	1,233,736	6%	19,206,264	94%	7,100,000	(13,340,000)
Survey	2019/2020	1,020,000	1,020,000	-	987,198	-	97,241	10%	922,759	90%	100,000	(920,000)
Contingency	2019/2020	4,900,000		4,900,000	-	-		0%	-	0%		-
Property Access & Acquisition	**2019/2020**	**$ 3,660,000**	**$ 3,060,000**	**$ 600,000**	**$ 1,132,659**	**$ -**	**$ 172,390**	**6%**	**$ 2,887,610**	**94%**	**$ 2,040,000**	**$ (1,020,000)**
Property Access Management	2019/2020	360,000	360,000	-	358,659	-	121,879	34%	238,121	66%	540,000	180,000
Easements	2019/2020	1,700,000	1,700,000	-	-	-	-	0%	1,700,000	100%	750,000	(950,000)
Temporary Access	2019/2020	1,000,000	1,000,000	-	774,000		50,512	5%	949,488	95%	750,000	(250,000)
Land Purchases	2019/2020	-	-	-	-	-	-	0%	-	100%	-	-
Contingency	2019/2020	600,000		600,000	-	-	-	0%	-	0%		-

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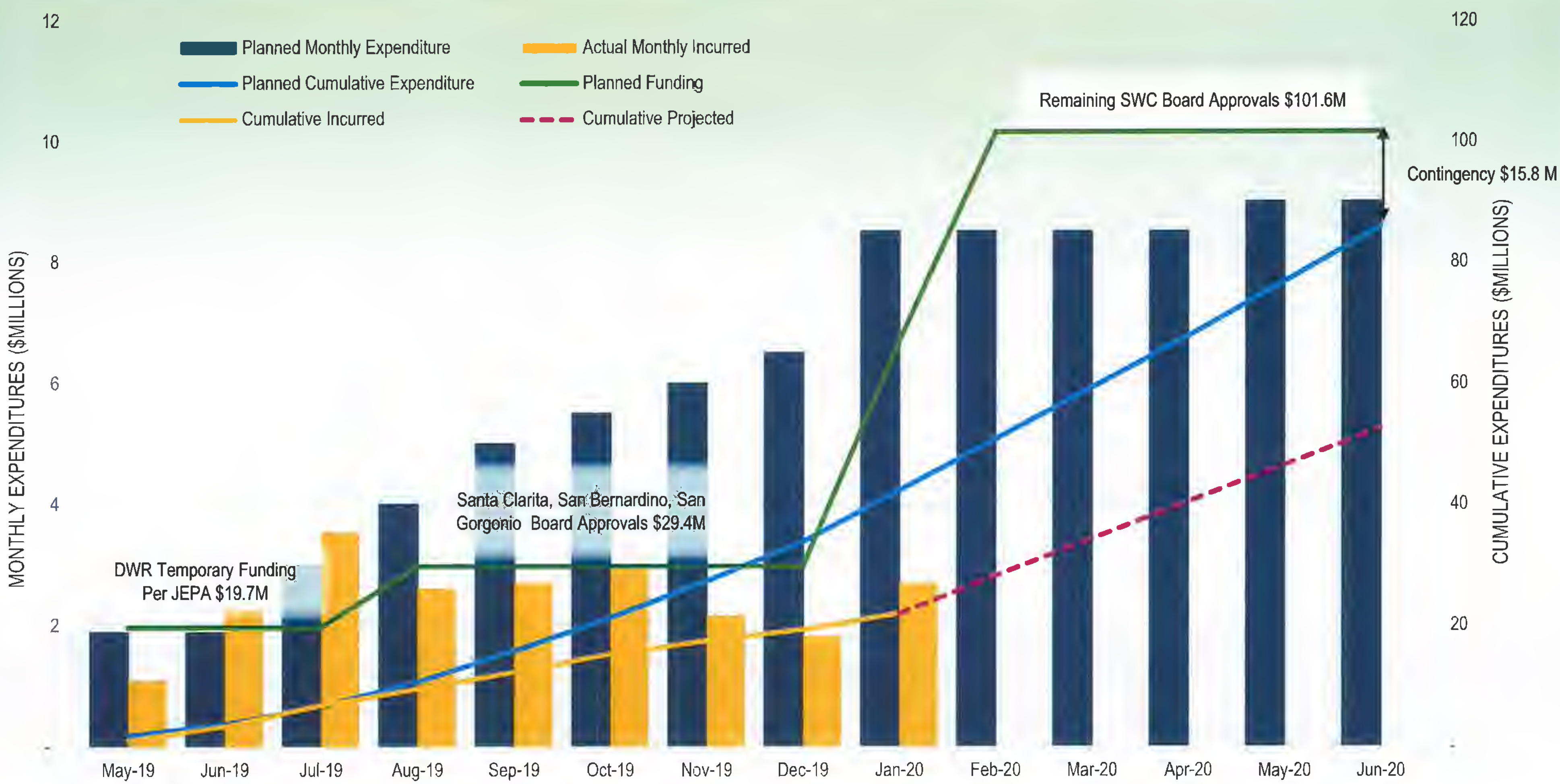
more >

Section 5 | Budget *continued*

Budget Change

No budget changes to be reported this month.

DCA FY18/19 May & June + FY19/20 Planned Cash Flow



[1]Anticipate remaining SWC participants to seek and receive funding approval from respective boards between December 2019 and February 2020

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

Section 6 | Contracts

Contract Summary. The table on pages 9-11 summarize the status of all executed contracts and task orders to date.

New Commitments. DCA executed three (3) new commitments during the reporting period: AP42 for $131,000 in FYE 19-20 providing graphic support services; Matchware (Meeting Booster) for $23,562 for meeting management and action tracking software services; and Foliate for NTE $16,640 for office plant services.

Procurement. The DCA has no pending commitments this month. See page 12.

S/DVBE Participation. The program has committed approximately 10% of the total contract values for FY 2019/20 to S/DVBEs. Based on actual incurred costs for the current Fiscal Year, 3% has been paid to our S/DVBE contractors and subcontractors. See page 13.

Contract Summary

Contracts	Contract Budget	Contingency	Historical Expenditures	Commitments FY19/20	Pending Commitments	Total Committed to Date	Incurred to Date FY19/20	% Spent FY19/20
180001 Best Best & Krieger LLP	$ 900,000	$ -	$ 343,992	$ 550,000		$ 893,992	$ 330,597	60%
180002 Management Partners	$ 375,000	$ -	$ 192,315	$ 192,315		$ 384,630	$ -	0%
180005 e-Builder	$ 855,633	$ -	$ 305,891	$ 113,000		$ 418,891	$ 112,833	100%
180006 Jacobs	$ 93,000,000	$ 17,000,000	$ 4,221,224	$ 38,615,750		$ 42,836,974	$ 9,909,373	26%
180007 Fugro	$ 75,000,000	$ -	$ 1,055,699	$ 18,786,567		$ 19,842,267	$ 881,992	5%
180008 Hamner Jewell Associates	$ 9,000,000	$ -		$ 250,000		$ 250,000	$ 20,088	8%
180009 Bender Rosenthal	$ 9,000,000	$ -		$ 274,000		$ 274,000	$ 13,944	5%
180010 Associated ROW Services	$ 9,000,000	$ -		$ 250,000		$ 250,000	$ 16,479	7%
180011 Michael Baker	$ 8,000,000	$ -		$ 180,000		$ 180,000	$ 3,735	2%
180013 Psomas	$ 15,000,000	$ -		$ 475,000		$ 475,000	$ 1,563	0.3%
180014 CDMSmith	$ 74,999	$ -	$ 34,696	$ -		$ 34,696	$ -	0%
180015 AECOM	$ 15,000	$ -	$ 12,579	$ -		$ 12,579	$ -	0%

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

continued >

Section 6 | Contracts *continued*

Contract Summary *continued*

Contracts	Contract Budget	Contingency	Historical Expenditures	Commitments FY19/20	Pending Commitments	Total Committed to Date	Incurred to Date FY19/20	% Spent FY19/20
180016 PlanNet	$ 77,894	$ -	$ 77,894	$ 9,105		$ 86,999	$ 8,619	95%
180017 Sextant	$ 74,999	$ -	$ 21,889	$ 53,110		$ 74,999	$ 38,397	72%
190001 Bentley Systems ProjectWise	$ 140,860	$ -	$ 100,000	$ 40,850		$ 140,850	$ 25,625	63%
190003 Ron Rakich Consulting	$ 6,000	$ -	$ 5,831	$ -		$ 5,831		
190005 Management Partners	$ 3,135,000	$ -	$ 156,755	$ 627,000		$ 783,755	$ 332,353	53%
190008 RMW Architecture & Interiors	$ 30,594	$ -		$ 30,594		$ 30,594	$ 30,594	100%
190009 Parsons	$ 36,000,000	$ 4,000,000	$ 474,133	$ 5,820,392		$ 6,294,524	$ 3,082,723	53%
190010 Porter Consulting LLC	$ 51,150	$ -		$ 51,150		$ 51,150	$ 28,710	56%
190011 GV/ HI Park Tower	$ 8,122,584	$ -		1,596,124.32		1,596,124.32	1,592,699.60	1.00
190013 Jacqueline Blakeley LLC	$ 25,000	$ -		$ 25,000		$ 25,000	$ 8,500	34%
190014 Direct Technology Gov Solutions	$ 1,840,000	$ -		$ 756,482		$ 756,482	$ 572,013	76%
190015 Audio Visual Innovations, Inc.	$ 310,000	$ -		$ 310,000		$ 310,000	$ 156,485	50%
190016 Consolidatd Communications	$ 108,072	$ -		$ 21,014		$ 21,014	$ -	0%
190017 ATT	$ 70,380	$ -		$ 18,192		$ 18,192	$ -	0%

continued >

Section 6 | Contracts *continued*

Contract Summary *continued*

Contracts	Contract Budget	Contingency	Historical Expenditures	Commitments FY19/20	Pending Commitments	Total Committed to Date	Incurred to Date FY19/20	% Spent FY19/20
190018 AP42	$ 700,000	$ -		$ 131,100		$ 131,100	$ 12,030	9%
190019 VMA	$ 1,200,000	$ -		$ 391,565		$ 391,565	$ 73,362	19%
190020 Miles Treaster & Associates	$ 700,007	$ -		$ 700,007		$ 700,007	$ 280,003	40%
190021 Ring Central	$ 216,932	$ -		$ 23,586		$ 23,586	$ 3,641	15%
190022 Caltronics Business	$ 166,671	$ -		$ 32,051		$ 32,051	$ -	0%
190023 Jambo	$ 69,840	$ -		$ 34,920		$ 34,920	$ 34,920	100%
190025-Sierra Valley Moving & Storage	$ 4,616	$ -		$ 4,616		$ 4,616	$ -	0%
190026-Meeting Booster	$ 23,562	$ -		$ 7,854		$ 7,854	$ 7,854	100%
200001-Foliate	$ 16,640	$ -		$ 16,640			$ 2,012	12%
07252018 Hallmark Group	$ 1,531,360	$ -	$ 1,517,583	$ -		$ 1,517,583	$ -	0%
Department of Water Resources	$ 3,294,035	$ -	$ 3,294,035	$ 125,413		$ 3,419,448	$ 125,413	100%
AO5218 Metropolitan Water District	$ 1,660,048	$ -	$ 1,660,048	$ 2,055,000		$ 3,715,048	$ 710,549	35%
Miscellaneous Vendors	$ 331,004	$ -	$ 131,402	$ 199,602		$ 331,004	$ 132,181	66%

continued >

Section 6 | Contracts *continued*

Contract Procurement

WBS	Description	Contract Type	Company	Pending Contract Value	Pending Commitment (FY2019/20)	Procurement Method	Procurement Start	Status
Program Management								
Legal	General Counsel Services	Professional Services				RFQ - Best Value	Jan-20	RFQ Issued
Human Resources	Payroll Services	Software and Services				Direct Purchase - Existing Agency Contract Price List	Dec-19	Under Analysis
Contract Procurement & Admin.								
Program Controls								
Risk Mgmt.	Risk Register & Risk Analysis	Software as a Service				RFP - Best Value	Dec-19	Under Analysis
eDiscovery	eDiscover & Legal Records Mgmt.	Software as a Service					Mar-20	Not Started
IT Administration								
IT - New Building								
Information Technology	Laptops/docking stations	Material + Installation	Under Analysis			Direct Purchase	Apr-20	In Progress
Information Technology	Monitors	Material + Installation	Under Analysis			Direct Purchase	Apr-20	In Progress
Information Technology	Ancillary devices - keyboards, headsets, webcams	Material + Installation	Under Analysis			Direct Purchase	Dec-19	In Progress
Facilities and Operations	Small Form Factor PC's (Conference Rooms)	Materials + Installation	AVI-SPL			AVI Purchase	Dec-19	In Progress
Facilities and Operations	Beverage Supply Service	On Premise Service	Under Analysis			Executive Director's discretion - Best Value	Jan-20	In Progress

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

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Section 6 | Contracts *Continued*

S/DVBE Status FY 2019/20

Contract/Prime	Prime	Committed	Incurred	Firm Name	SBE / DVBE	SBE/DVBE Committed	% SBE/DVBE Committed	SBE/DVBE Incurred	% SBE/DVBE Incurred
180006-02	**Jacobs**	**$ 38,615,750**	**$ 9,909,372**			**$ 2,467,143**	**6%**	**$ 429,275**	**4%**
				AnchorCM	DVBE	785,652		64,060	
				Babendererde	SBE	24,986		30,842	
				EETS, Inc.	SBE	471,957		29,766	
				JMA Civil, Inc.	SBE	125,110		59,470	
				Kearns & West, Inc.	SBE	35,213		35,213	
				Lettis Consulting Internatio	SBE	416,791		-	
				Nazparv Consulting LLC	SBE	325,600		127,124	
				Wiseman Consulting	SBE	281,834		82,800	
180007-02&03	**Fugro**	**$ 18,934,723**	**$ 1,010,445**			**$ 2,772,364**	**15%**		**0%**
				Dillard Environmental Servi	SBE	408,744		-	
				GeoTech Utility	SBE	121,500		-	
				The LeBaugh Group	SBE	2,242,120		-	
190022-00	**Caltronics**	**$ 32,051**	**$ -**	**Caltronics Government Services**		**$ 32,051**		**$ -**	**0%**
190009-02	**Parsons**	**$ 5,823,296**	**$ 3,083,656**			**$ 923,851**	**16%**	**$ 132,438**	**4%**
				Chaves & Associates	SBE	923,851		132,438	
190019-01	**VMA**	**$ 391,695**	**$ 73,362**	**VMA Communications**	**SBE**	**$ 391,695**		**$ 73,362**	**100%**

DCA DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

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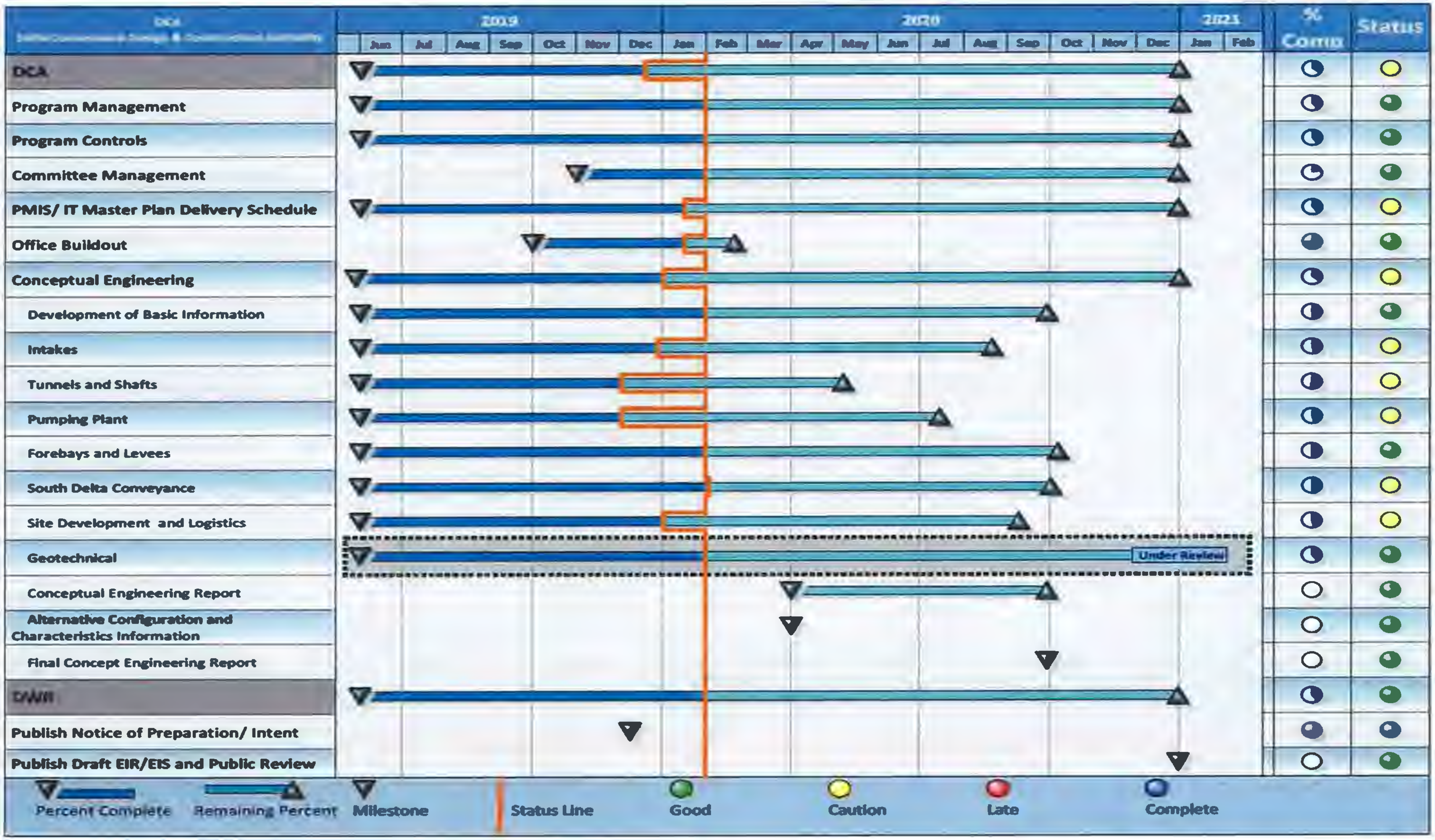
Section 7 | Schedule

The program continues to run six weeks behind schedule based on deliverable status. The engineering team is ramping up their resources and expected to recover the time in the upcoming 2 months to maintain our April 1 Milestone for "Alternative Configuration and Characteristics Information".



Section 8 | Risk (*Note: Same as November Report - Updated Quarterly*)

Risk Summary

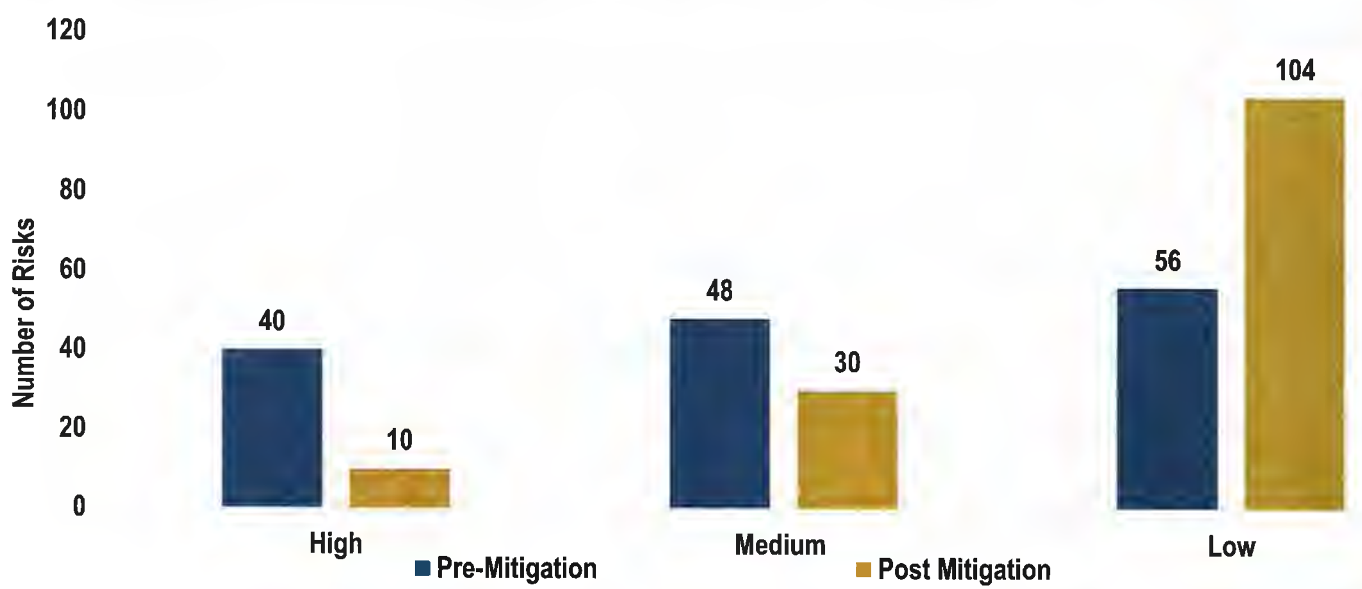
Risk management is a critical component in the overall delivery of the Delta Conveyance Program. In September through November, the DCA Risk Manager completed two rounds of workshops with each of the technical leads to first, identify the primary risks within their respective technical areas, and secondly, identify mitigation measures to reduce risks. The results of the process are summarized in the chart and table to the right.

Overall, the team identified 144 risks distributed in 10 different technical risk categories. The area with the most identified risk was the Construction Logistics category with 36 identified risks and a composite Pre-Mitigated risk score of 300. During the risk mitigation workshops, measures to reduce risk were identified for all medium and high impact risks. The composite risk score was then re-calculated accounting for the mitigation measures ("Post-Mitigated). Overall, the team was able to reduce the risk profile by between 26% to 77% in the various categories for an overall risk reduction of 50%.

The total number of "high" risks were reduced from 40 to 10 and the number of "medium" risks from 48 down to 30 with the mitigation efforts.

During the Conceptual Engineering phase, the DCA Risk team will be performing formal updates to the Risk Profile semi-annually. In the meantime, the engineering team will continue to identify risks for entry in the risk register.

No.	Risk Category	# Risks	Total Pre-Mitigation Score	Total Post-Mitigation Score	% Reduction From Mitigation
1	Tunnels & Shafts	22	155	84.5	45%
2	Intakes	21	144.5	106.5	26%
3	Pumps	6	64	41	36%
4	Levees & Forebays	8	64.5	15	77%
5	South Delta Conveyance	10	44	26	41%
6	Safety	10	123.5	42	66%
7	Construction Logistics	36	300	121	60%
8	Right-of-Way	8	107	43	60%
9	Geotechnical	14	226.5	120.5	47%
11	Contracting & Market Conditions	9	145	90	38%
	Totals	**144**	**1374**	**689.5**	**50%**



DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

General Counsel's Report

Contact: Josh Nelson, Interim General Counsel

Agenda Date: February 20, 2020 **Item No.** 9a

Subject: Status Update

Summary:
The General Counsel continues to assist the DCA on legal matters as requested.

Detailed Report:
The General Counsel assisted with the review and development of materials for the January and first February Stakeholder Engagement Committee meetings. The General Counsel also attended both meetings. The General Counsel assisted staff with coordinating finalizing move-in and lease commencement for the new office space with the landlord.

The General Counsel assisted with questions regarding members of independent technical review panels potentially participating in future DCA work. Given the very limited technical role of these members, no issues are presented. The General Counsel continues to respond to public records requests Lastly, the General Counsel continues to assist with other legal matters as necessary. These matters are confidential and not appropriate for discussion in a public report.

Recommended Action:
Information only.

Item 9b - Treasurer's Report

The report will be available at the DCA Board Meeting

DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

Environmental Manager's Report

Contact: Carolyn Buckman, DWR Environmental Manager

Date: February 20, 2020 **Item No.** 9c

Subject: Environmental Manager's Report

Summary:
The Department of Water Resources (DWR) has initiated the California Environmental Quality Act (CEQA) process for a single-tunnel solution to modernizing and rehabilitating the water distribution system in the Delta.

Detailed Report:
DWR released a Notice of Preparation (NOP) for the proposed Delta Conveyance project on January 15 to document the intent to develop an Environmental Impact Report (EIR) under CEQA. The scoping period started with release of the NOP and continues until March 20, 2020. During the scoping period, DWR is seeking input on the scope of the EIR, including the range of alternatives, the types of impacts, impact methodology, and potential mitigation measures. Scoping meetings are underway from February 3 to March 2.

Recommended Action:
Information only.

Exhibit O

DELTA CONVEYANCE DESIGN & CONSTRUCTION AUTHORITY

Board Memo

Contacts: Kathryn Mallon, Executive Director

Date: February 20, 2020 Board Meeting **Item No.** 8b

Subject:

Findings of the Independent Technical Review Committee Report

Summary:

An Independent Technical Review (ITR) Committee was convened to review early technical material developed by the DCA related to the tunnel design of the Delta Conveyance Program. ITRs are considered best practices in providing expert opinion on the technical studies and design work associated with large infrastructure projects and programs. ITRs are part of the DCA's overall Quality Plan and will continue to be convened throughout the planning and design phase of the program covering the range of technical work performed by the DCA.

The Tunnel ITR was chaired by Dan Adams, President of McMillen Jacobs, a highly experienced design and construction management firm specializing in tunnel infrastructure. Committee members were selected from across the globe and represent a cross section of the most experienced tunnel engineers and builders in the world. The ITR included the following members:

- Werner Burger, Chief Engineer Herrenknecht, German-based Tunnel Boring Machine (TBM) manufacturer
- John Kennedy, Vice President, Dragados, Spanish-based international heavy civil construction firm
- Jeff Petersen, Sr. Vice President, Kiewit Underground Construction Division specializing in tunnel infrastructure
- Dave Rogstad, President and CEO, Frontier-Kemper Constructors, specialize in heavy civil and underground infrastructure
- Kenji Yamauchi, Tunnel Engineer, Obayashi – Japanese-based major international construction firm specializing in heavy civil and underground infrastructure.

The requested scope of their review included the following topics:

- Tunnel Drive Length
- Tunnel Alignment Observations
- Logistics Observations
- Contract Delivery and Packaging
- Stakeholder Concerns (documented in previous WaterFix Testimony)

A copy of the ITR findings is attached to this memorandum as well as a copy of the DCA response to their findings and recommendations. The DCA found the session extremely constructive helping to validate key design approaches while providing insight from the perspective of a large construction firm.

Recommended Action:

Information only.

Attachments:

Attachment 1 – ITR Committee Report

Attachment 2 – DCA Response to ITR Report

Internal Technical Review Panel Memorandum

To:	Kathryn Mallon, DCA Executive Director Tony Meyers, DCO Executive Director	Project:	Delta Conveyance
From:	Werner Burger, Herrenknecht John Kennedy, Dragados Jeff Petersen, Kiewit Dave Rogstad, Frontier-Kemper Kenji Yamauchi, Obayashi Dan Adams, McMillen Jacobs Renée Fippin, McMillen Jacobs		
Date:	January 31, 2020	Job No.:	5226.2
Subject:	ITR December Workshop on Tunnel and Shafts - Report		

1.0 Introduction

The Delta Conveyance Project includes approximately 40 miles of 40-foot diameter tunnels, 8 deep shafts, and intake and outlet facilities required to convey water from south of Sacramento to near Discovery Bay, California. Various tunnel corridors and shaft locations have been under study by the DCA/DCO. The ground conditions can be characterized at the tunnel level by dense to very dense silty sand, poorly graded sand, and very stiff to hard silty clay and clayey silt.

On December 4th to 6th, 2019, an Independent Technical Review (ITR) Panel met in Sacramento, California to review and provide input on five major issues associated with the Delta Conveyance Project's Tunnels and Shafts:

- Achievable Tunnel Boring Machine (TBM) drive lengths;
- Tunnel alignment;
- Logistic & advanced procurement;
- Contract delivery and packaging; and,
- Stakeholder Concerns

Prior to the workshop, the ITR was provided with the following documents:

- Reconnaissance Alignment Assessment (Draft), October 30, 2019
- Viability of Long Tunnel Boring Machine Tunneling Drives (Draft), November 15, 2019
- Preliminary Draft Reusable Tunnel Material (RTM) Handling and Disposal, November 8, 2019
- Tunnel Corridors Map, Working Draft, November 5, 2019
- Draft Graphical Schedule for Central Corridor, no date
- California WaterFix Conceptual Engineering Report, Byron Tract Forebay Option, July 2018

- Compilation of Comments on Tunnel Construction and Reusable Tunnel Material from Previous Studies, Draft, November 11, 2019

On the morning of Day 1 (December 4), the DCA's Engineering Design Management team (EDM) presented Delta Conveyance background information including background geology, logistics information, project schedule and assumptions, and stakeholder concerns. The remainder of the day was spent driving along both the Central and Eastern corridors under study. The ITR visited each site except for the shared South Tunnel Outlet Structure site, as it was visible in the distance from Clifton Court Forebay site.

Day 2 was spent in a workshop with the ITR brainstorming and discussing the various topics of drive length, alignment, logistics, contract strategy and packaging, reusable tunnel material use and/or disposal, stakeholder considerations, and other various topics until consensus was obtained.

This consensus was shared with the DCA/DCO and EDM team late morning on Day 3. This memorandum summarizes the consensus and recommendation of the ITR for the tunnel and shaft related aspects of Delta Conveyance Project.

2.0 TBM Drive Lengths

The ITR's opinion is that TBM drive lengths up to 15 miles are achievable for this project. The key reasons being that 1) the alluvial deposits are relatively uniform and favorable to tunneling, 2) the inner diameter of the tunnel provides sufficient space to support of operations, and 3) issues that typically jeopardize TBM longevity, including high groundwater pressures, mixed ground conditions, and high boulder frequencies, are not present for this project.

The achievability of long tunnel drives is primarily driven by logistics. The size of the Delta Conveyance tunnel and favorable geology suit an extended drive without substantially raising the risk profile of the project. A summary of long tunnels is presented on Figure 1.

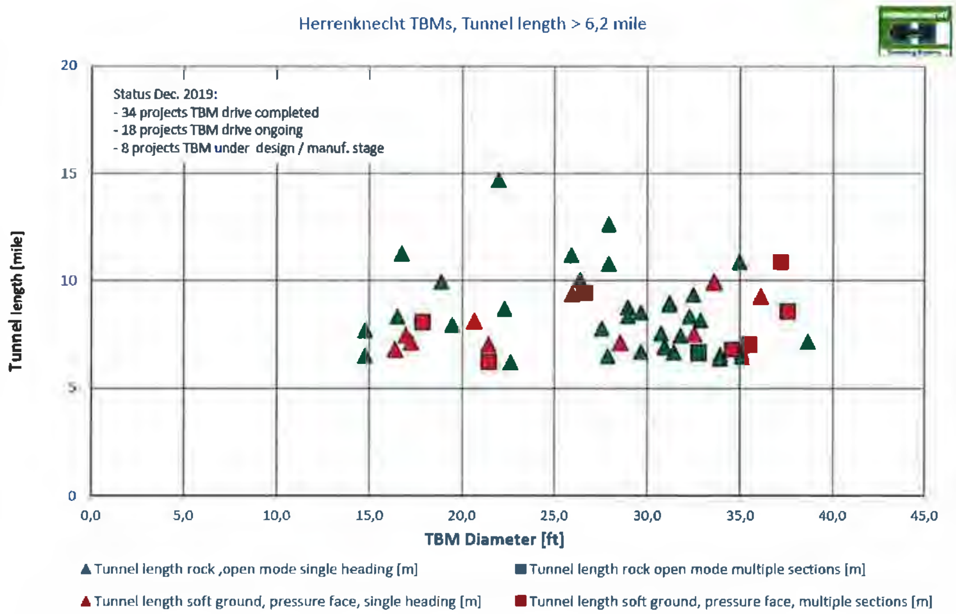


Figure 1. TBM Drive Lengths with Herrenknecht TBMs

For this project, where the ground conditions are favorable for tunneling and the TBM operating pressures are not excessively high, the drive length between shafts can be safely extended by implementing current technologies. Longevity of the TBM main bearing and ring/drive motors are the key as well as the ability to frequently exchange cutting tools along the drive. Cutting tool exchanges may be either through pressurized interventions or under atmospheric conditions if the TBM is equipped with accessible cutterhead technology. While there may not be a comparable soft ground TBM drive length example, the demands on a TBM in rock far exceed those for soft ground in terms of wear and tear on the machine. The durability of the mechanical elements for rock TBMs is typically far more difficult to overcome compared to soft ground TBMs in homogeneous ground conditions. Main bearing seal systems may see a higher load on pressurized TBMs in soft ground due to the face pressure, however, rock TBMs see higher cutterhead speeds. This means rock TBMs typically have main bearing seals that must withstand 2 – 6 times the propagation of soft ground TBMs for the same drive length.

But, more importantly, the critical elements for long tunnel drives are the logistics and safety elements. The drive lengths noted above have either been fully achieved or are currently underway. These projects demonstrated that the solutions currently exist to support extending TBM drive length and will only continue to improve by the time Delta Conveyance breaks ground.

The ITR recognized that longer drives carry additional risks. The mitigations to address the risks of longer drive lengths exist within current technology as described below.

2.1 Risk Mitigation Measures – TBM Drive Length

The following recommendations are made to manage the risk of a longer drive, all of which is current technology:

- Evaluating and/or including an accessible cutterhead option to reduce the need for pressurized interventions and simplify cutting tool maintenance
- Installing cutting tool and cutterhead structure condition monitoring systems
- Installing a camera system for remote chamber inspection
- Preparing the TBM for face and periphery drill pattern for ground consolidation from within the TBM
- Utilizing an engineering solution for tail shield brush replacement
- Requiring a strict maintenance and inspection program in place from the beginning ("industrialized tunneling" philosophy)

Further recommendations are detailed in the following subsections.

2.1.1 Main Bearing Replacement

TBMs have a main bearing that allows the cutterhead to rotate at the tunnel face. Historically, the main bearing has been a primary mechanical point of weakness on the TBM in that it sees significant stresses and, if it fails, it has required an emergency access shaft to replace it with a new one. While engineering solutions to replace a main bearing from within the tunnel exist, an access shaft is oftentimes selected as a simpler solution. Further, current bearing technology supports a main bearing life of 20,000 to 30,000 hours (time spent with the cutterhead rotating). Decisive factors for the main bearing life are the loads and the total number of revolutions. Both factors are significantly higher on rock TBMs compared to soft ground TBMs. Therefore, the experience gained from long distance rock tunnels can be applied to long soft ground tunnels. This would support the longest drive recommended without replacement unless an unanticipated failure occurred. It was noted by Mr. Burger of Herrenknecht that there are many examples of main bearings lasting longer under more strenuous circumstances than exist for this project. The ITR recommends that TBMs used for the longer drives through the Delta be designed to accommodate bearing replacement from within the tunnel as a risk mitigation measure.

2.1.2 Safe Havens

A safe haven is a location where unpressurized access to the TBM face can be achieved for inspection and maintenance purposes. The ITR recommend a minimum of one safe haven per tunnel drive, preferably fairly early in the drive to confirm assumptions and monitoring efforts on wear. The ITR debated the need for a second safe haven. It is prudent to have safe havens, but rarely is a safe haven in the location one needs it. If allowable within the constraints of the environmental documentation, it is recommended that an additional allowance for "unlocated" safe haven(s) (e.g., unplanned intervention) be included. This means, the contractor is allowed to develop a safe haven where necessary to support operations. It's important to point out that certain sites within reason can be excluded – such as in areas of biological resources.

The TBM safe haven can be a low-impact solution. As shown in Figure **2**, the ITR proposed a small 15-foot diameter shaft which could be a drilled shaft, sunken cast-in-place concrete or vertical shaft sinking (VSM) excavation with segmental lining. From within the shaft, ground treatment such as grouting or freezing can be performed in the horizontal direction providing coverage for the cutterhead. This process will minimize surface impacts as well reduce the surface impact schedule for the safe havens.

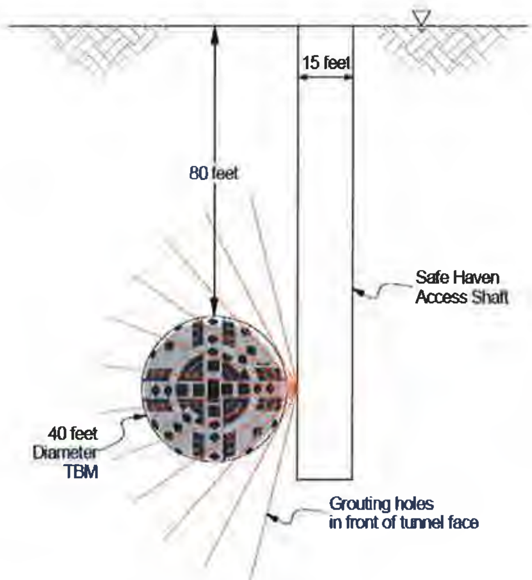


Figure 2. Safe Haven Concept

The ITR offered that knowledge gained from the first drive/contract (or portions thereof) would be quite valuable to have during planning for the next (e.g., 2nd) contract. With respect to the need for safe havens, knowledge gained from the first contract should be incorporated into subsequent ones.

2.1.3 Abrasivity

Soil abrasivity can lead to wear and tear on the TBM from the hardness of soil particles. Minimal soil abrasivity tests have been performed. The prior GDR reported AVS values between 7 and 59.5 with an average of 31 and median of 30. While further study and possible mitigation is recommended, tunneling in the alluvial soils is not going to be a similarly harsh environment when compared to long drives in quartz rock.

It is recommended that, no matter the case, state of the art heavy wear protection for the cutterhead structure should be required in combination with a structure monitoring system as mentioned above under Section 2.1. Heavy wear protection exists in today's technology. The benefits of tool wear sensors and potential use of accessible cutterhead technology enable data to be collected for proactive planning. The data of such wear monitoring systems will support the planning for any required additional safe haven ahead of time so that proper procedures and actions can be taken. The ITR further recommends a strict maintenance program that includes timely cutting tool maintenance and exchange to reduce the risk for structural wear.

All of the above mitigates against unplanned/long-term breakdowns.

3.0 Tunnel Alignment Corridors

The project team discussed and compared the current tunnel alignments under study in the Central (yellow) and Eastern (blue) corridors as shown in Figure 3.

Figure 3. Studied Central (Yellow) and Eastern (Blue) Alignment Corridors

The consensus among the ITR was that the Central Corridor is logistically impractical and the ITR does not recommend this corridor be further studied. The shaft locations are located a significant distance from Interstate 5, accessible by only farm roads with hindrances such as narrow weight-restricted bridges and single lanes. This makes supporting large operations, which requires a constant transfer of materials and people in and out, impractical and expensive as well as difficult to price. In addition, addressing safety, including hospital access and tunnel safety duplication, creates a costly layer or redundancy without definitive costs. While it was recognized that extensive roadway, levee, and likely barge improvements could be constructed as part of the project for the Central Corridor, the ITR offered:

- The cost of improvements to provide reliable and safe access and egress at each site would exceed the cost of additional length of tunnel required for the East alignment.
- Levee re-build, barge, and site preparation & stabilization is temporary work, and much of it (e.g. barge facilities) will require removal;
- Site improvements and prep is driven by means and methods;

- Labor and construction safety costs, regardless of improvements, are too uncertain to price due to the location and distance from any shaft on the Central Alignment to developed land/communities.

For the reasons described above, the ITR recommended adjustments to the alignment as described in Section 3.1 which will facilitate large scale tunneling.

3.1 Recommended Alignment Adjustment

The ITR recommended that between the Terminous Shaft and the Lower Roberts Shaft, the alignment be shifted further to the east and closer to Interstate 5. Specifically, the following recommendations are made:

- Relocate Terminous shaft to the north and east
- Move shaft at Lower Roberts Island, south-east to industrial land in/closer to Stockton
- Eliminate Lower Jones Tract and Canal Ranch shafts

These proposed changes expand and/or shift the East (blue) corridor east as shown below on Figure 4. The longest tunnel drive length would become approximately 13.5 miles.

For the vertical alignment, the ITR recommends raising the tunnel alignment by one tunnel diameter. This will reduce the operating pressures considerably which is beneficial to the overall operation of the machine and safety of the workers.

Figure 4. Recommended Far East Alignment Corridor

3.1.1 Terminous Shaft

Figure 5 shows a recommended placement for a relocated Terminous shaft. It is located approximately ½ mile west of the I-5 interchange and one mile north of Highway 12. Shifting the shaft north allows for trucks to enter the shaft site while minimizing impact to traffic on Highway 12. It is recommended that the ½ mile stretch of Highway 12 to the shaft access road be widened and a turn lane and signal be added at the shaft access road.

Figure 5. Relocated Terminous Shaft

3.1.2 New Stockton Shaft

Figure 6 shows the general placement of a New Stockton Shaft. In general, the recommendation is to shift east along the San Joaquin River closer to industrialized Stockton. The pin location shown in Figure 6 is just adjacent to the Port of Stockton and eliminate additional road widening and improvements to get to the Lower Roberts location as well as time. This site allows for segment production if desired and barge facilities to be developed. It is also adjacent to rail. This could be an important advantage, particularly when considering the contract packaging discussed below as a new Stockton Shaft as proposed would have 50% of the tunnel material (supply in, tunnel material out) flowing through that location.

Figure 6. New Stockton Shaft

4.0 Logistics and Advanced Procurement

The recommendations on alignment (above) were almost entirely driven by project logistics. Quite simply, the tunneling through the Central Corridor was considered more of a logistics project than a tunnel project. Moving the alignment east, is thought to greatly simplify the logistics and as such, enhance competition for all materials that are needed to construct the tunnels due to increased modes of transport afforded by the industrialized eastern cities, barge and rail access.

4.1 Segment Manufacture

There was discussion as the most cost-effective way to provide the 40 miles of concrete segments for the project. The ITR considers the difference between on-site and off-site production, in terms of material transport, is insignificant, recommending that despite 80% of the tunnel segments being the same diameter:

- Plan for off-site production of segments, as it lowers cost and provides far more flexibility in the supply and delivery chain.
- Leave the design and construction of the segments to the contractor, as the configuration, length, and reinforcing details/requirements are all means and methods driven; and
- Progress with permitting as if on-site will be used, as a position point for the environmental documentation process (it's more environmentally challenging).

4.2 Tunnel Material

The handling and disposal of tunnel material is a major project driver that will influence the builder's approach to the project (TBM Selection, Site Configuration, sub-contracting, etc.). Based on ITR experience, soft ground tunnel material is not a commodity (has no residual value) and is difficult to dispose or find a use for. These two factors were part of the reasons the ITR recommends (above) moving the alignment closer to industrialized land, close to multiple modes of transport, to handle removal of it in the most economical manner.

As part of the advanced procurement work, the project would benefit from DCA working to find a location and negotiate terms for disposal and or reclamation using it in advance of advertising the tunnel contracts. This could include stockpiles and or temporary storage at the Southern Forebay site for re-use of the material on the site. However, the ITR cautions that the "reusability" of such material should not be over-sold within the project team, as no experience exists (within the ITR members) where material from a soft ground tunnel has been used as structural fill.

There are some projects that have used materials for quarry restoration (e.g., SR 99 in Seattle) or land reclamation (Bay Tunnel and numerous European projects), which were negotiated/established prior to the contract being let. In each case, advance analyses was performed to characterize the natural components and any potential for materials deemed as contaminants. There are several quarries within the project vicinity and early research and conversations with these quarry operators would benefit the project.

4.3 Tunnel Classification and Permissible Equipment

Based on what is known of the geology, it is anticipated that the tunnel will be classified as "gassy" or, at least, "potentially gassy". For both potential and gassy classifications, Cal/OSHA will also implement a list of "special conditions" that add specific detail to existing regulations and add requirements. While it is difficult to predict what details or regulations Cal/OSHA will impose, quite often on large consequential projects, it is important that DCA meet with Cal/OSHA to start early discussion on what may need to be design "into the project" and set the basis for understanding of expectations.

It is likely that these discussions with Cal/OSHA will set forth that all equipment used in the tunnel including the TBM will have to have special gas detection systems and anti-explosion systems (e.g., permissible equipment). The TBM will be required to have a sophisticated gas detection system that will automatically shut down the systems and put it into emergency power mode in the event of detection. Safety trained and certified gas tester employees will have to be on site at the face full time.

4.4 Tunnel Rescue Plan and Communication

A detailed tunnel rescue plan is required by law before underground work can begin. The tunnel rescue plan will be developed by contractor(s) although the owner/engineer can have preliminary discussions on any specialized requirements. Because of the long tunnel drives, the rescue plan as well as the training requirements for workers will be more extensive. The length of tunnel means that it will take longer to get an injured person out of the tunnel. The plan will need to include requirements for practice and documentation.

A trained tunnel rescue team with a minimum of five people will need to be on-site within 30 minutes of the ingress/egress point at all times. This is another advantage of moving the alignment closer to I-5, particularly when you consider the duration (approximately 8 calendar years) of the project.

A refuge chamber (e.g., Figure 7) will be required on the TBM and at intervals along the tunnel. These chambers provide life support systems including primary and secondary oxygen supplies and CO/CO^2 scrubbing systems to regenerate the air. They also maintain positive internal pressure at all times.

Figure 7. Refuge Chamber Example

5.0 Contract Delivery and Packaging

5.1 Contract Delivery Methods

There are various methods by which the DCA/DCO can deliver the project. While explaining each in detail is beyond the scope of this memorandum, three popular contract delivery methods are mentioned herein. The most traditional is Design-Bid-Build (DBB) in which the owner's engineer prepares complete contract documents and the low bidder is awarded the job. There is also Construction Management/General Contractor (CMGC) which allows an owner to engage a construction manager to provide input during the design process. The owner and the construction manager agree on a price for construction of the project, and the construction manager becomes the general contractor. There is also Design-Build (DB) in which the owner released documents at an early design phase (often at 30%) and the contractor completes the design and builds the project. Selection methods for CM/GC and DB contractors vary and are not discussed herein. Each has merits for consideration.

5.2 Recommendation on Contract Delivery

The ITR members held a robust discussion on the merits of one delivery method over another.

Two companies from which the ITR has associated members had previously reviewed the project (when it was twin tunnels) and offered at that time that DBB and/or CMGC were preferred. DBB was previously recommended because it lowers the contractor's risk, and at the time was thought to provide a better opportunity to achieve a lower total project cost. CMGC was preferred because the "use and disposal" of tunnel material was such a large uncertainty; and, CMGC would allow the contractor to be engaged before resolution of material disposal was completed. However, after the site visit, and recognition that this project is "a logistics project with a tunnel in it", the ITR came to consensus recommending Design-Build delivery for the tunnel and shaft work. The key reasons that informed this recommendation for Design-Build include:

- Gives a much higher likelihood of completing the work by the estimated completion date of 2035 through concurrent work and ability to procure items such as the TBM and start-up of segment production;
- Enables the contractor to be engaged in the design, of all elements of the work, including logistics planning (site set-up, etc.); and,
- Nearly all the site work, material handling, and all the large shafts are temporary structures.

If the DCA/DCO establishes the internal diameter of the tunnel and permanent shafts, a horizontal alignment and rights of way/easements associated with it, negotiates power drops at each working shaft, and determines the extent of allowable use and/or locations to dispose of tunnel material, all other elements of the project would be means-and-methods driven, which aligns very well to Design-Build.

5.3 Recommendation on Contract Packaging

The ITR recommends five tunnel design build contracts in order of release as follows and shown in Figure 8:

- Contract 1: Stockton Shaft to Byron Forebay
- Contract 2: Terminous Shaft to Intermediate Forebay Shaft
- Contract 3: Stockton Shaft to Terminous Shaft
- Contract 4A: Intermediate Forebay to Intake 3
- Contract 4B: Intake 3 to Intake 2
- Contract 5: South Outlet Tunnels (twin tunnels)

If the release of contracts begins in Quarter 1 of 2023, completion of the project tunnels by 2035 is achievable. The ITR recommends that each contract be separated by approximately 9 months.

It is recommended that the logistics for each site including shaft height above ground surface, finalization of power drop, etc. be included in the DB contracts as it allows the contractor to set up the sites to suit their means and methods. Any early works contract can include items such as widening of the ½ mile of Highway 12, Twin Cities Road and improvements to the Clifton Court area.

Figure 8. Recommended Tunnel DB Contract Packaging

5.4 Contract Value

The ITR recommends that the packaging of contracts be held at approximately $1.5 to $2 billion in order to ensure enough teams are available and to ensure bonding availability. All major tunnel contractors have capacity to team and to pursue the work. It is also recommended that the DCA/DCO also have initial discussions with bonding agencies.

6.0 Stakeholder and Community Concerns

The ITR was requested to review various stakeholder and community comments from prior phases of the project. All of the current comments were noted to be straightforward and could be answered by sharing engineering information. Each is addressed briefly in the following subsections.

In general, the ITR recommends that the DCA/DCO have a dedicated engineering liaison. They should be capable of translating tunnel engineering and construction to the public at large (e.g., breaking down complex topics into understandable terms with enough information). This person(s) should be supported by a team of people who can prepare graphic materials or other supporting information.

6.1 EBMUD – Mokelumne Aqueduct

East Bay Municipal Utilities District (EBMUD) expressed several concerns with the Delta Conveyance tunnel in terms of their future tunneling plans and potential conflicts. They also indicated the need for a secondary tunnel lining system. The ITR recommends that the DCA/DCO coordinate on some level with EBMUD to understand their tunnel alignment elevations and work jointly to determine an appropriate offset distance with the Delta Conveyance tunnel. The ITR does not concur with EBMUD's comment that the tunnel needs a secondary liner. There are many project examples that use a single pass segmental lining. The precast lining is sufficient to support the anticipated loads including seismic events.

6.2 Natural Gas Wells

There are several community comments with respect to unknown gas wells. The ITR noted that traditionally, the records of gas well installations are quite accurate. However, the team/contractor can perform a magnetometer survey when the final alignment is set (e.g, versus being a corridor), then the team can perform an alignment check/walk/survey to look for unknown wells.

6.3 Seismic Behavior of Tunnels

There are no active fault crossings along the Delta Conveyance alignment and the seismic demands are not extreme compared to other projects. A tunnel, in particular a segmentally lined tunnel, is capable of flexing and thus survival during an earthquake. The primary concern would be at the connection points such as the shaft/tunnel connection. These locations likely need specialized detailing to handle the localized increased stresses. This is not an unusual undertaking in areas of high seismicity.

6.4 Dewatering

There were several comments associated with dewatering caused by tunneling. The TBM will be a "pressurized face machine" meaning that it will balance both the groundwater loads and earth loads. With this type of tunneling, dewatering is not required for tunnel and lining operations. The segments are designed to be gasketed and sealed to handle water pressures and can be constructed to be watertight. The ITR does recommend that a bottom seal be required for shafts to avoid excessive pumping of groundwater out of the excavation. These comments can be answered by simply educating the stakeholders on the process of pressurized face tunneling.

6.5 Settlement

There were several comments associated with "subsidence." In reading these comments, it appeared that there was a general misuse of the word subsidence and that the concerns were related to settlement. The ITR recommends education to correct the terminology usage. Further, modern tunneling and proper face pressures mitigate against settlements.

6.6 Failure and Repair of the Lining

Failure of a segmental tunnel lining is highly unlikely and unprecedented. Segmental linings are fabricated with reinforced precast concrete in a highly controlled environment with strict quality control. A tunnel constructed with precast segments is generally considered by industry to be of higher quality than those lined by the cast-in-place concrete method. The design life is a minimum of 100 year and designed to appropriate standards and loads. We recommend sharing and explaining the calculations to the public.

Repair of the lining is highly unlikely to be necessary if designed for the service life. While transportation tunnels undergo regular maintenance due to their exposure to elements, water conveyance tunnels are not subject to the same stresses-meaning, there is not much that can damage the lining.

6.7 Emergency Response

Contractor's are required by law to have a tunnel rescue plan approved by Cal/OSHA prior to beginning underground work. This job in particular will require a five person on-site dedicated rescue team at a minimum for each tunnel contract. Moving the alignment closer to I-5 significantly improves emergency response. The ITR recommend that the DCA/DCO develop a detailed emergency response plan as well as any specifics that can be passed into contractor protocols.

6.8 Flood Risk

Current plans assume significant overbuilding of the shaft pad areas. The ITR noted that only the shaft walls need to be overbuilt to a height addressing some level of flood risk. The surrounding pad doesn't need to be as high as the shaft wall. Permanent works can be raised to the final elevation as necessary.

7.0 Conclusions

The ITR was asked to review and provide input on five major issues for the Delta Conveyance project with respect to achievable TBM drive lengths; tunnel alignment; logistics & advanced procurement for transport and storage; contract delivery and contract packaging, and stakeholder/community concerns.

The recommendations based on the December 2019 ITR workshop are as follows:

- 15-mile TBM drive lengths are achievable if appropriate mitigations are implemented;
- The tunnel alignment should move closer to Interstate 5 (further east) with shafts located adjacent to major roads and multiple methods of transport where feasible;
- Design-build delivery is preferred; and
- The existing stakeholder comments and community concerns are straightforward with simple answers.

These recommendations and conclusions are the opinion of the ITR members attending the December workshop and may not necessarily represent the unanimous opinion of the companies represented by the

ITR members. Further, the recommendations are based on the project information provided at the time, and knowledge obtained during the workshop.

The ITR thanks the DCA/DCO for their interest in engaging outside expertise and sharing the project information for brainstorming and new ideas.

Respectfully,

Werner Burger, Herrenknecht

John Kennedy, Dragados

Jeff Petersen, Kiewit

Dave Rogstad, Frontier-Kemper

Kenji Yamauchi, Obayashi

Dan Adams, McMillen Jacobs

Renée L Fippin, McMillen Jacobs

DCA Response to December 2019 Tunnel Independent Technical Review Panel Recommendations

Item No.	ITR Recommendation	DCA Response
1. TBM Drive Lengths		
	a. TBM drive lengths up to 15 miles achievable	a. Agree.
	b. TBMs used for the longer drive be designed to accommodate main bearing replacement from within the tunnel.	b. Agree.
	c. A minimum of one maintenance be provided per tunnel drive and that consideration be given to a smaller offset maintenance shaft if more needed.	c. Noted. DCA recommends two inline maintenance shafts spaced 4 to 5 miles apart with the last maintenance shaft used for a major TBM "tune up" (main bearing replacement, cutterhead face replacement, etc.) to reduce risk of TBM breakdown in the final section of long drives. Smaller off-set shafts may reduce flexibility for maintenance.
	d. Further study soil abrasivity and require state of the art heavy wear protection for the cutterhead structure in combination with a cutterhead structure monitoring system.	d. Agree. Studies on going with existing stored samples.
2. Tunnel Alignment Corridors		
	a. Central Corridor is logistically impractical and therefore should not be further studied.	a. Agree that Central corridor poses greater challenges for construction logistics than corridors closer to I-5. However, there are other considerations for siting the tunnel alignment that must be considered.
	b. Between Terminous and Lower Roberts, shift alignment further east and closer to Interstate 5.	b. Agree that proximity to I-5 facilitates construction logistics.
	c. Add new shaft along the San Joaquin River and closer to the industrialized area of Stockton.	c. DCA understands the proximity of port, rail and roadway access in this location but does not believe the alignment would benefit from shifting further east toward Stockton considering a wider range of issues.
	d. Raise vertical alignment by one-tunnel diameter to reduce operating pressures.	d. Noted but requires further study of US Army Corp of Engineers requirements and potential conflicts with the planned new East Bay Municipal Utilities District (EBMUD) Mokelumne Aqueduct tunnel.

3.	**Logistics and Advanced Procurement**	
	a. An option for on-site production of tunnel liner segments may be feasible but the DCA should also plan for off-site production and leave the design and manufacture of the segments to the tunneling contractors.	a. Agree in principle but other factors may drive the decision on liner fabrication strategy.
	b. Based on past experience, soft ground tunnel material is difficult to dispose or find a use for. The Project would benefit from finding a location for disposal and/or reuse of the RTM in advance of advertising the tunnel contracts.	b. Noted. Significant testing will be done as part of the future field work activities to validate the composition and reuse of the tunnel spoils. Previous testing results indicate that the material is suitable for forebay embankment construction and other structural uses.
	c. Based on the known geology, it is anticipated that the tunnel will be classified as "gassy" or "potentially gassy". It is important that DCA meet with Cal/OSHA early to start discussions on what requirements may need to be designed into the project to address this issue.	c. Agree.
	d. A detailed tunnel rescue plan is required by law and because of the long tunnel drives, the rescue plan requirements will be more extensive.	d. Agree.
4.	**Contract Delivery and Packaging**	
	a. Recommend Design-Build (DB) be used as the contract delivery method for the tunnel and shaft work.	a. Agree that D-B offers key benefits to the design and construction of the tunnel and should be explored. Legal hurdles may hinder its use for Delta Conveyance.
	b. Break the tunnel work into five DB contracts separated by 9 months and include work site early works in the DB contract.	b. Noted but subject to further DCA study.
	c. Hold contracts to less than \$1.5-\$2.0 billion in order to ensure enough teams are available and to ensure bonding availability.	c. Noted but subject to further DCA study.
5.	**Stakeholder and Community Concerns**	
	a. Mokelumne Aqueduct – EBMUD expressed concerns that the Delta Conveyance tunnel conflicts with their future tunneling plans and that a secondary tunnel lining system is needed for the Delta Conveyance tunnel. Coordination with EBMUD needs to occur, however, the ITR does not concur with the need for a secondary liner.	a. Agree.

	b. Natural Gas Wells – perform magnetometer survey when the final alignment is set to locate unknown wells.	b. Agree.
	c. Seismic Behavior of Tunnels – as there are no active fault crossings along the Delta Conveyance alignment, a segmentally lined tunnel is capable of flexing and thus surviving during an earthquake. The primary concern would be at the connection points, such as the shaft/tunnel connections, which require specialized detailing to handle the localized increased stresses.	c. Agree.
	d. Dewatering – the TBM will be a pressurized face machine and therefore dewatering is not required for tunnel and lining operations since the segments are designed to be gasketed and sealed to handle the water pressure. A bottom seal should be required for shafts to avoid excessive pumping of groundwater out of the excavation.	d. Agree.
	e. Settlement – modern tunneling techniques and maintaining a proper face pressure will mitigate against settlement.	e. Agree.
	f. Failure and Repair of the Lining – failure and/or repair of a segmental tunnel lining is highly unlikely and unprecedented.	f. Agree.
	g. Emergency Response – Contractors are required to have a tunnel rescue plan. Moving the alignment closer to I-5 significantly improves emergency response. The ITR recommends that the DCA develop a detailed emergency response plan.	g. Agree.
	h. Flood Risk – permanent works need to be raised to protect against predicted flood levels, however only the shaft walls need to be overbuilt to a height addressing some level of flood risk. The surrounding pad doesn't need to be as high as the shaft wall.	h. Agree.

Exhibit P

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February 7, 2020

Via Email to input@waterresilience.ca.gov

California Natural Resources Agency
California Environmental Protection Agency
California Department of Food & Agriculture

RE: Draft Water Resilience Portfolio

IMPORTANT CALIFORNIA WATER POLICIES ARE IGNORED IN THE DRAFT PORTFOLIO THEREBY CONTINUING THE PATH OF DAMAGING ONE AREA OF THE STATE TO FOSTER DEVELOPMENT IN ANOTHER RATHER THAN DEVELOPING ADDITIONAL FIRM WATER SUPPLIES FOR SUCH DEVELOPMENT

The guiding principle for federal and state development of the Central Valley Project is reflected in Water Code section 11460 which provides:

> **11460. Prior right to watershed water**
>
> In the construction and operation by the department of any project under the provisions of this part a watershed or area wherein water originates, or an area immediately adjacent thereto which can conveniently be supplied with water therefrom, shall not be deprived by the department directly or indirectly of the prior right to all of the water reasonably required to adequately supply the beneficial needs of the watershed, area, or any of the inhabitants or property owners therein. *(Added by Stats. 1943, c. 370, p. 1896. Amended by Stats. 1957, c. 1932, p. 3410, section 296.)*

Water Code section 11128 provides that the limitations also apply to any agency of the State or Federal Government.

Although physically apparent, Water code section 12931 makes it clear that as to state water resources development the Sacramento-San Joaquin Delta shall be deemed to be within the watershed of the Sacramento River

///

LIMITING EXPORT OF WATER TO THAT WHICH IS TRULY SURPLUS TO THE PRESENT AND FUTURE NEEDS OF THE AREA FROM WHICH IT IS TAKEN IS SOUND AND SHOULD GUIDE DEVELOPMENT OF THE PORTFOLIO

In lieu of damaging one area of the state to foster development in other areas, the portfolio should be directed at developing additional sources of surplus water to assist in meeting needs in such other areas while at the same time avoiding creation of new demand in areas importing water which cannot be reliably served.

The state Central Valley Project was planned to construct multiple dams and related facilities to capture surplus flows from watersheds with ample precipitation to meet the present and future needs of watershed areas (including adjacent areas that could be conveniently served) and depending on the hydrology of the watershed produce water for export to arid areas. The areas to be served were defined. There was no plan to serve an unlimited amount of arid land or even meet the needs of all areas which desired supplemental supplies. Due to hydrology and operation the water delivery capability or yield of any particular project varied from year to year. Firm yield was generally based on the estimated capability to deliver water in the sixth year of drought such as occurred in 1929-1934. Delivery of other water was treated as interim supply or surplus. All of the exported project water was subject to recapture to meet the growing needs in the watershed areas generally referred to as areas of origin.

The first elements of the state Central Valley Project were constructed by the federal government in the 1940s originally referred to as the federal Central Valley Project and today as the Central Valley Project or CVP. The state followed in 1960 with the California Water Resources Development Bond Act and the so called Feather River Project (including Oroville Dam), now the State Water Project or SWP. There was early conflict between the feds and state. The CVP projects were first constructed and repayment contracts for delivery of water (with some subsidy) were based on the yield of the constructed facilities. The SWP on the other hand signed entitlement contracts based on the contractors paying the entire costs of the project as the need for additional facilities arose. Construction followed contracting. Early on conflicts arose as to state jurisdiction over the federal projects and the overlap of the state water right filing for Feather River water which was included in a prior filing to support the CVP. The capability of both the CVP and SWP to deliver water was and still is grossly uncertain.

AN INDEPENDENT ANALYSIS OF THE CAPABILITY OF THE CVP AND SWP TO DELIVER WATER IN SIX TO TEN YEAR DROUGHTS AND THE VARIOUS YEAR TYPES IS CRITICAL TO PREPARATION OF A CREDIBLE PORTFOLIO

A summary of the promises made on behalf of the United States to those in the watershed areas is contained in the 84th Congress, 2D Session House Document No. 416, Part One Authorizing Documents 1956 at Pages 797-799 as follows:

> "My Dear Mr. Engle: In response to your request to Mr. Carr, we have assembled excerpts from various statements by Bureau and Department officials relating to the subject of diversion of water from the Sacramento Valley to the San Joaquin Valley through the operation of the Central Valley Project.

A factual review of available water supplies over a period of more than 40 years of record and the estimates of future water requirements made by State and Federal agencies makes it clear that there is no reason for concern about the problem at this time.

For your convenience, I have summarized policy statements that have been made by Bureau of Reclamation and Department of the Interior officials. These excerpts are in the following paragraphs:

On February 20, 1942, in announcing the capacity for the Delta-Mendota Canal, Commissioner John C. Page said, as a part of his Washington D.C., press release:

"The capacity of 4,600 cubic feet per second was approved, with the understanding that the quantity in excess of basic requirements mainly for replacement at Mendota Pool, **will not be used to serve new lands in the San Joaquin Valley if the water is necessary for development in the Sacramento Valley below Shasta Dam and in the counties of origin of such waters**." (Emphasis added)

On July 18, 1944, Regional Director Charles E. Carey wrote a letter to Mr. Harry Barnes, ' chairman of a committee of the Irrigation Districts Association of California. In that letter, speaking on the Bureau's recognition and respect for State laws, he said:

"They [Bureau officials] are proud of the historic fact that the reclamation program includes as one of its basic tenets that the irrigation development in the West by the Federal Government under the Federal reclamation laws is carried forward in conformity with State water laws."

On February 17, 1945, a more direct answer was made to the question of diversion of water in a letter by Acting Regional Director R. C. Calland, of the Bureau, to the Joint Committee on Rivers and Flood Control of the California State Legislature. The committee had asked the question, "What is your policy in connection with the amount of water that can be diverted from one watershed to another in proposed diversions?" In stating the Bureau's policy, Mr. Calland quoted section 11460 of the State water code, which is sometimes referred to as the county of origin act, and then he said:

"As viewed by the Bureau, it is the intent of the statute that no water shall be diverted from any watershed which is or will be needed for beneficial uses within that watershed. The Bureau of Reclamation, in its studies for water resources development in the Central Valley, consistently has given full recognition to the policy expressed in this statute by the legislature and the people. The Bureau has attempted to estimate in these studies, and will continue to do so in future studies, what the present and future needs of each watershed will be. **The Bureau will not**

divert from any watershed any water which is needed to satisfy the existing or potential needs within that watershed. For example, no water will be diverted which will be needed for the full development of all of the irrigable lands within the watershed, nor would there be water needed for municipal and industrial purposes or future maintenance of fish and wildlife resources." (Emphasis added)

On February 12, 1948, Acting Commissioner Wesley R. Nelson sent a letter to Representative Clarence F. Lea, in which he said:

"You asked whether section 10505 of the California Water Code, also sometimes referred to as the county of origin law, would be applicable to the Department of the Interior, Bureau of Reclamation. The answer to this question is: No, except insofar as the Bureau of Reclamation has taken or may take assignments of applications which have been filed for the appropriation of water under the California Statutes of 1927, chapter 286, in which assignments reservations have been made in favor of the county of origin.

The policy of the Department of the Interior, Bureau of Reclamation, is evidenced in its proposed report on a Comprehensive Plan for Water Resources Development Central Valley Basin, Calif., wherein the Department of the Interior takes the position that "In addition to respecting all existing water rights, the Bureau has complied with California's 'county of origin' legislation, which requires that water shall be reserved for the presently unirrigated lands of the areas in which the water originates, **to the end that only surplus water will be exported elsewhere."** (Emphasis added)

On March 1, 1948, Regional Director Richard L. Boke wrote to Mr. A. L. Burkholder, secretary of the Live Oak Subordinate Grange No. 494, Live Oak, Calif., on the same subject, and said:

"**I can agree fully with the statement in your letter that it would be grossly unjust to 'take water from the watersheds of one region to supply another region until all present and all possible future needs of the first region have been fully determined and completely and adequately provided for.**' That is established Bureau of Reclamation policy and, I believe, it is consistent with the water laws of the State of California under which we must operate."(Emphasis added)

On May 17, 1948, Assistant Secretary of the Interior William E. Warne wrote a letter to Representative Lea on the same subject, in which he said:
"The excess water made available by Shasta Reservoir would go first to such Sacramento Valley lands as now have no rights to water."(Emphasis added)

Assistant Secretary Warne goes on to say, in the same letter:

"As you know, the Sacramento Valley water rights are protected by: (1) Reclamation law which recognizes State water law and rights thereunder; (2) the State's counties of origin act, which is recognized by the Bureau in principle; and (3) the fact that Bureau filings on water are subject to State approval. I can assure you that the Bureau will determine the amounts of water required in the Sacramento Valley drainage basin to the best of its ability so that only surplus waters would be exported to the San Joaquin. We are proceeding toward a determination and settlement of Sacramento Valley waters which will fully protect the rights of present users; we are determining the water needs of the Sacramento Valley; **and it will be the Bureau's policy to export from that valley only such waters as are in excess of its needs**." (Emphasis added)

On October 12, 1948, Secretary of the Interior Krug substantiated former statements of policy in a speech given at Oroville, Calif. Secretary Krug said, with respect to diversion of water:

"Let me state, clearly and finally, the Interior Department is fully and completely committed to the policy that no water which is needed in the Sacramento Valley will be sent out of it."
He added:

"There is no intent on the part of the Bureau of Reclamation ever to divert from the Sacramento Valley a single acre-foot of water which might be used in the valley now or later."(Emphasis added)

The California Water Resources Development Bond Act provides in Water Code section 12931 that the Sacramento-San Joaquin Delta shall be deemed to be within the watershed of the Sacramento River.

Exhibit 16 is a copy of the 1960 ballot argument in favor of the California Water Resources Development Bond Act which spawned the State Water Project (SWP). Of particular note are the following representations:

"No area will be deprived of water to meet the needs of another nor will any area be asked to pay for water delivered to another."(Emphasis added)

"Under this Act the water rights of Northern California will remain securely protected."

"A much needed drainage system and water supply will be provided in the San Joaquin Valley."

The Delta Reform Act Water Code section 85031(a) provides:

"(a) **This division does not diminish, impair, or otherwise affect in any**

manner whatsoever any area of origin, watershed of origin, county of origin, or any other water rights protections, including, but not limited to, rights to water appropriated prior to December 19, 1914, provided under the law. This division does not limit or otherwise affect the application of Article 1.7 (commencing with Section 1215) of Chapter 1 of Part 2 of Division 2, Sections 10505, 10505.5, 11128, 11460, 11461, 11462, and 11463, and Sections 12200 to 12220, inclusive." (Emphasis added.)

Water Code sections 11460 et seq. and 12200 et seq. are particularly specific in defining the limitation on the export of water from the Delta by the SWP and CVP. Water Code section 11460 et seq. were added by Statutes 1943, around the time of commencement of the CVP. Water Code section 12200 et seq. was added by Statutes 1959, c. 1766, p. 1766 around the time of commencement of the SWP.

The limitation of the projects to the export of only surplus water and the obligation of the projects to provide salinity control and assure an adequate water supply sufficient to maintain and expand agriculture, industry, urban, and recreational development in the Delta is clear.

Water Code sections 12200 through 12205 are particularly specific as to the requirements to provide salinity control for the Delta and provide an adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban and recreational development.

For ease of reference, the following Water Code sections are quoted with emphasis added:

"12200. Legislative findings and declaration

The Legislature hereby finds that the water problems of the Sacramento-San Joaquin Delta are unique within the State; the Sacramento and San Joaquin Rivers join at the Sacramento-San Joaquin Delta to discharge their fresh water flows into Suisun, San Pablo and San Francisco bays and thence into the Pacific Ocean; the merging of fresh water with saline bay waters and drainage waters and the withdrawal of fresh water for beneficial uses creates an acute problem of salinity intrusion into the vast network of channels and sloughs of the Delta; the State Water Resources Development system has as one of its objectives the transfer of waters from water-surplus areas in the Sacramento Valley and the north coastal area to water-deficient areas to the south and west of the Sacramento-San Joaquin Delta via the Delta; water surplus to the needs of the areas in which it originates is gathered in the Delta and thereby provides a common source of fresh water supply for water-deficient areas. It is, therefore, hereby declared that a general law cannot be made applicable to said Delta and that the enactment of this law is necessary for the protection, conservation, development, control and use of the waters in the Delta for the public good." (*Added by Stats. 1959, c. 1766, p. 4247, '1.)*

"12201. Necessity of maintenance of water supply

The Legislature finds that the maintenance of an adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban, and recreational development in the Delta area as set forth in Section 12220, Chapter 2, of this part, and to provide a common source of fresh water for export to areas of water deficiency is necessary to the peace, health, safety and welfare of the people of the State, except that delivery of such water shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code." (*Added by Stats. 1959, c. 1766, p 4247, '1.*)

"12202. Salinity control and adequate water supply; substitute water supply; Delivery

Among the functions to be provided by the State Water Resources Development System, in coordination with the activities of the United States in providing salinity control for the Delta through operation of the Federal Central Valley Project, shall be the provision of salinity control and an adequate water supply for the users of water in the Sacramento-San Joaquin Delta. If it is determined to be in the public interest to provide a substitute water supply to the users in said Delta in lieu of that which would be provided as a result of salinity control no added financial burden shall be placed upon said Delta water users solely by virtue of such substitution. Delivery of said substitute water supply shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code." (*Added by Stats. 1959, c. 1766, p 4247, '1.*)

"12203. Diversion of waters from channels of delta

It is hereby declared to be the policy of the State that no person, corporation or public or private agency or the State or the United States should divert water from the channels of the Sacramento-San Joaquin Delta to which the users within said Delta are entitled." (*Added by Stats. 1959, c. 1766, p 4249, '1.*)

"12204. Exportation of water from delta

In determining the availability of water for export from the Sacramento-San Joaquin Delta no water shall be exported which is necessary to meet the requirements of Sections 12202 and 12203 of this chapter." (*Added by Stats. 1959, c. 1766, p 4249, '1.*)

"12205. Storage of water; integration of operation and management of release of water

It is the policy of the State that the operation and management of releases from storage into the Sacramento-San Joaquin Delta of water for use outside the area in which such water originates shall be integrated to the maximum extent possible in order to permit the fulfillment of the objectives of this part." (*Added by Stats. 1959, c. 1766, p 4249, '1.)*

The December 1960 DWR Bulletin 76 (Exhibit 14) which includes a contemporaneous interpretation by DWR of Water Code sections 12200 through 12205 provides at page 12:

> "In 1959 the State Legislature directed that water shall not be diverted from the Delta for use elsewhere unless adequate supplies for the Delta are first provided." (Emphasis added.)

Similarly the DWR confirmed its interpretation of law in the contract between the State of California Department of Water Resources and the North Delta Water Agency for the Assurance of a Dependable Water Supply of Suitable Quality dated January 28, 1981, which provides:

> "(d) The construction and operation of the FCVP and SWP at times have changed and will further change the regimen of rivers tributary to the Sacramento-San Joaquin Delta (Delta) and the regimen of the Delta channels from unregulated flow to regulated flow. This regulation at times improves the quality of water in the Delta and at times diminishes the quality from that which would exist in the absence of the FCVP and SWP. The regulation at times also alters the elevation of water in some Delta channels."
>
> "(f) The general welfare, as well as the rights and requirements of the water users in the Delta, require that there be maintained in the Delta an adequate supply of good quality water for agricultural, municipal and industrial uses."
>
> "(g) The law of the State of California requires protection of the areas within which water originates and the watersheds in which water is developed. The Delta is such an area and within such a watershed. Part 4.5 of Division 6 of the California Water Code affords a first priority to provision of salinity control and maintenance of an adequate water supply in the Delta for reasonable and beneficial uses of water and relegates to lesser priority all exports of water from the Delta to other areas for any purpose." (Emphasis added.) (See Exhibit 17)

In United States vs. State Water Resources Control Board 182 Cal.App.3d 82 (1986) at page 139 the appellate court provided:

> "In 1959, when the SWP was authorized, the Legislature enacted the Delta Protection Act. (§§ 12200-12220.) The Legislature recognized the unique water problems in the Delta, particularly 'salinity intrusion,' which mandates the need for such special legislation 'for the protection, conservation, development, control and use of the waters in the Delta for the public good.' (§ 12200.) The act prohibits project exports from the Delta of water necessary to provide water to which the Delta users are 'entitled' and water which is needed for salinity control and an adequate supply for Delta users. (§§ 12202, 12203, 12204.)

In SWRCB D-1485 at page 9 the SWRCB provided:

> "The Delta Protection Act accords first priority to satisfaction of vested rights and public interest needs for water in the Delta and relegates to lesser priority all exports of water from the Delta to other areas for any purpose."

As related to the predetermination to build a single tunnel or any other isolated conveyance facility, the requirements of WC 12205 are particularly relevant.

> "It is the policy of the State that the operation and management of releases from storage into the Sacramento Joaquin Delta of water for use outside the area in which such water originates shall be integrated to the maximum extent possible to permit fulfillment of the objectives of this part." The objectives include salinity control and an adequate water supply. Conveyance facilities which transport stored water to the export pumps with no outlets or releases to provide salinity control and an adequate water supply in the Delta would not comply.

The export projects must additionally fully mitigate their respective impacts and meet the affirmative obligations to the Delta and other watershed areas including those related to flow. Failure to so do results in a shift of the cost of the project to someone else.

The California Water Resources Development Bond Act was intended to preclude such a shift in costs. See also <u>Goodman v. Riverside</u> (1993) 140 Cal.App.3d 900 at 906 for the requirement that the costs of the entire project be paid by the contractors. In footnote 3 the court provided the following:

> "Governor Pat Brown's press comments at the time are also informative:
>
> "Governor, what is your answer to people who say, 'I don't want to pay for somebody else's water.' Like San Franciscans. 'I have already paid for one water project. Why should I be compelled to buy another?'
>
> "Governor Brown: Well, they won't. The plan itself is completely self-supporting. The law provides that the contracts have to provide for the repayment of the cost of the entire Project. That's the real answer to it.

Water Code Section 11912 requires that the costs necessary for the preservation of fish and wildlife be charged to the contractors. The term "preservation" appears to be broader than mitigation and appears to create an affirmative obligation beyond mitigation.

Title 34 of Public Law 102-575 referred to as the Central Valley Project Improvement Act in Section 3406(b) (1) authorizes and directs the Secretary of Interior to enact and implement a program which makes all reasonable efforts to ensure by the year 2002 natural production of anadromous fish (including salmon, steelhead, striped bass, sturgeon and American shad) will be sustainable on a long term basis at levels not less than twice the average levels attained during the period of 1967-1991.

The Delta Reform Act of 2009 includes provisions intended to provide additional protection for the Delta. Such provisions include Water Code §85054 which provides:

"§85054. Coequal goals

'Coequa1.goals' means the two goals of providing a more reliable water supply for California and protecting restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place."

Water Code section 85021 provides:

"§85021. Reduction of reliance on Delta for future water supply needs

The policy of the State of California is to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts."

The Delta and other watershed areas both upstream and downstream are part of California and also need a more reliable water supply. The proposed tunnel is clearly directed only at the ability of the SWP and CVP to export water from the Delta. Restoration and protection of Delta water quality and flows including flushing flows are part of a more reliable water supply for California.

NON-DEGRADATION OF WATER QUALITY AND THE STATUTORY OBLIGATIONS TO PROVIDE ENHANCED WATER QUALITY AND AN ADEQUATE WATER SUPPLY IN THE DELTA ARE ABSENT FROM THE PORTFOLIO

The cumulative impacts of the Portfolio together with the predetermined single tunnel and proposed operation plan will clearly render water supply less reliable in all areas of the Delta downstream of the Sacramento River intakes and those areas along the current routes of Sacramento River flow to the export pumps. The common pool for the interior Delta will be eliminated along with the common interest in protecting the water quality. The single tunnel has no outlets and requirements to protect water quality in dry periods are always circumvented. For areas throughout the watershed, including those along the tributaries upstream of the Delta, curtailment of local water use, and water transfers to increase utilization of the highly expensive tunnel combined with the need for fish flows and high water consumption habitat to mitigate for the construction and operation of the tunnel will greatly add to unreliability.

THE PORFOLIO'S ADVANCEMENT OF THE PREDETERMINED SINGLE TUNNEL TO PROTECT EXPORTS FROM SEA LEVEL RISE EVIDENCES AN INTENT TO ABANDON THE MAINTENANCE OF DELTA WATER QUALITY IN THE WAKE OF SEA LEVEL RISE WHICH IS DIRECTLY CONTRARY TO ALL OF THE ABOVE-REFERENCED STATUTES, POLICIES AND PROMISES

If the goal of the Portfolio was to at all times maintain adequate water quality in the Delta as required by the numerous above-referenced statutes, policies and promises, then there would be no need for the predetermined single tunnel with intakes in the northernmost portion of the Delta to protect exports from sea level rise. With the maintenance of adequate Delta water quality, even in the wake of sea level rise, good quality water that is truly surplus could be exported from the existing intakes located within the south Delta.

The Portfolio's advancement of the predetermined single tunnel to protect exports from sea level rise reveals the administration's underlying and non-disclosed intent to abandon the maintenance of adequate water quality in the Delta in the wake of sea level rise and to export water that is needed to maintain that quality through such a tunnel. Such abandonment and such exports are directly contrary to the numerous above-referenced statutes, policies and promises which are specifically directed at ensuring the maintenance of adequate water quality in the Delta and/or the prohibition of exports of non-surplus water that is needed to maintain that quality.

The advancement of the predetermined single tunnel should therefore be entirely eliminated from the Portfolio. The Portfolio should, instead, focus on advancing projects that will ensure adequate Delta water quality is at all times maintained, even in the wake of sea level rise, and that no water is exported from the Delta that is needed to maintain that quality. Over a half-century of statutes, policies and promises mandate no less.

The present conveyance of water through the Delta channels has functioned well for over 50 years. With reduced water export reliance on the Delta, continued relatively modest funding of the Delta levee programs and recent adjustments in biological opinions the through Delta conveyance will do the job.

The tunnel with locations through the heart of the Delta, ten or more years of construction and reduction of Sacramento River flow into and through the Delta will destroy the Delta and greatly damage the entire Bay Delta Estuary. The ten or more billions of dollars to be expended on the tunnel could be best spent on developing water supply and self-sufficiency in the areas receiving imported water. The continued dependence upon moving water from the Delta hundreds of miles through subsiding canals and related pumping facilities along and across active earthquake faults is unwise, particularly for urban areas. It is likely that some surplus water will continue to be available for export from the Delta. With the long anticipated continuing development in the Delta watershed and now the recognized need to sustain the groundwater basins the availability of surplus water for export from the Delta will greatly diminish.

In planning for the ten feet of mean sea level rise and climate change predicted by DWR investment in the Delta tunnel is unwise. In general the Delta levee system has about 18 inches of freeboard. Mean sea level at the Golden Gate has risen about 8 inches over the last 150 years and at Alameda about 4 inches over the last 100 years. Continued funding of the Delta levee programs as recommended herein will assure that Delta levees can be raised over time to accommodate a significant rise in mean sea level and with emergency measures meet even a short term greater rise. There appear to be many variables and sea level rise and fall varies greatly throughout the globe. The predictions anticipate a significant acceleration in sea level rise. If and when such occurs at the Golden Gate the probability of a 10 foot rise increases and solutions will surely not be focused on the Delta tunnel but on more forward looking solutions including previously considered solutions such as a gated structure on the flats outside the Golden Gate. Measures for self-sufficiency in areas importing water can in most cases be designed and constructed to function regardless of sea level rise.

WATER DEMAND FOR URBAN DEVELOPMENT AND FOR TREE AND VINE CROPS REQUIRES A FIRM SUPPLY WHICH THE DRAFT PORTFOLIO WILL NOT PROVIDE

The portfolio fails to embrace the need to reduce reliance on exports from the Delta and fails to recognize the hydrologic limitations of the Sacramento San Joaquin Delta watershed.

Development within the watersheds of origin and the need to recapture water from SWP and CVP exports will increase. There is evidence that more water will be needed to mitigate for the SWP and CVP damage to fish including meeting the CVPIA anadromous fish restoration requirements of 2 times the average natural production for the years 1967 through 1991. Climate change is also expected to adversely affect water supply. The increasing threat of terrorism, the continuing threat of natural calamities, including earthquakes and the growing need for electricity all gravitate towards less reliance on exports from the Delta and instead concentration on developing local self-sufficiency. The deficit due to the failure to develop North Coast watersheds will not be overcome by efforts at self-sufficiency, however, increased efforts in urban communities can increase the amount of water available for agriculture and the environment.

The hydrology predating the construction of the CVP and SWP reflected that no surplus water would be available for export from the Sacramento-San Joaquin Watershed during a reoccurrence of the 1929-1934 drought.

Exhibit 12 is a copy of the hydrographs from page 116 of the Weber Foundation Studies titled "An Approach To A California Public Works Plan" submitted to the California Legislature on January 28, 1960. The highlights and margin notes are added.

The 1928/29-1933/34 six year drought period reflected on Exhibit 12 shows the average yearly runoff is 17.631 million acre feet with local requirements of 25.690 million acre feet. There is a shortage during the drought period within the Delta Watershed of 8.049 million acre feet per year without any exports. It is questionable whether the groundwater basins can be successfully mined to meet the shortage within the watershed let alone the export demands. A comparable review of the hydrograph for the North Coast area reflects that surplus water could have been developed without infringing on local requirements.

The limited hydrology was clearly recognized in the planning for the SWP which was to develop projects on the rivers in the North Coast watersheds sufficient to import to the Delta by the year 2000 5 million acre feet of water seasonally to meet local needs and for transfer to areas of deficiency. (See Exhibit 14 December 1960 Bulletin 76 page 13). Such areas of deficiency were expected to be both north and south of the Delta pumps. The projects in the North Coast watersheds were never constructed and the projects are woefully short of water.

THE PLAN TO SECURE AN ADDITIONAL SUPPLY OF 5 MILLION ACRE FEET OF WATER FROM NORTH COAST WATERSHEDS BY THE YEAR 2000 WAS ABANDONED AND NO SUBSTITUTE SUPPLY HAS BEEN DEVELOPED

In addition to the lack of precipitation in the Delta watershed to meet local and export needs are the environmental needs. Water is needed for mitigation of project impacts and the affirmative obligations for salinity control and fish restoration.

The original planning for the SWP and CVP appears to have underestimated the needs to protect fish both as to flow requirements and carryover storage required for temperature control. In 2009 after only two (2) dry years, the SWP and CVP violated the SWRCB February outflow requirements claiming that meeting the outflow requirements would reduce storage below the point necessary to meet cold water requirements for salmon later in the year. Although the project operators lied and the real reason for the violation was the ongoing pumping of the unregulated flow to help fill San Luis Reservoir, the incident clearly shows the inability of the projects to provide surplus water for export in the 4th, 5th and 6th years of drought.

In May of 2013 the SWP and CVP again claimed a need to preserve cold water in storage for fish. They requested and were allowed by the SWRCB to reduce outflow so as to exceed the western and interior Delta agricultural water quality objectives to save such cold water in storage. They did not suggest and did not reduce export pumping which would have had the same effect as reducing outflow.

In 2014 the 3rd year of drought, the SWRCB issued curtailment notices to post 1914 water right holders in the areas of origin and reduced exports due to the lack of water.

In the 4th year of drought the SWRCB curtailed post 1914 and some pre-1914 water rights and reduced exports due to lack of water.

Six year droughts can be expected and even longer droughts are possible. The historic occurrence of multi-year droughts was examined in a DWR study of tree rings. Exhibit 13 is Table 3 from such study.

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THE PORTFOLIO SHOULD INCLUDE PLANNING FOR TEN YEAR DROUGHTS

The State Water Project Delivery Reliability Report 2013 shows a long-term (10 year period) average Table A delivery as 2,266,000 acre feet per year; a long-term average (1921-2003) as 2,400,000 acre feet per year; a single dry year (1977) as 453,000 acre feet and a 6-year drought (1987-1992) as 1,055,000 acre feet per year. These figures can be contrasted to the Maximum Possible SWP Table A Delivery of 4,172,000 acre feet per year. See Exhibit 15 excerpts from SWP Delivery Reliability Report 2013.

The failure of the SWP and CVP to carry out the plan for development of water projects to yield sufficient surplus water to meet the needs and obligations within the Delta and other areas of origin and the expectations of the export contractors is at the root of the crisis in the Delta.

The ability of the SWP and CVP to deliver "full contract amounts" never existed and thus cannot be restored or protected. The projects have not been able to meet even the D 1641 requirements.

ABSENT A COMPETENT PORTFOLIO WHICH CAN MEET PROJECTED WATER DEMANDS THE STATE MUST SERIOUSLY ADDRESS THE AMOUNT OF NEW DEVELOPMENT ON ARID LANDS AND EVEN THE REDIRECTION OF DEVELOPMENT TO AREAS WITH WATER OR EVEN NO ADDITIONAL DEVELOPMENT ON SUCH LANDS UNLESS SUPPORTED WITH LOCALLY DEVELOPED NEW SUPPLY

As stated above an impartial evaluation is needed to determine the true capability of the export projects to provide surplus water for export while meeting D1641 over 6 and 10 year droughts, while at the same time meeting listed species requirements, protecting senior water rights, providing salinity control and providing an adequate supply to meet present and future needs in the Delta and other areas of origin.

Export of water from the Delta and other areas of origin is counterproductive to minimizing and fully mitigating the take of listed species. The export pumps physically kill fish and the diversion facilities expose others to increased predation. The proposition that export of flow passing into and through the Bay-Delta Estuary by way of a tunnel is consistent with minimizing the take of listed species is unique, bold and unsupportable. Minimizing would appear to require no export. Retention of water flowing into and through the Delta to the Bay would help dilute the harmful toxins and other constituents in the Delta which are harmful to human health and safety and fish.

In 1978 the SWRCB concluded in D-1485 at page 13 that:

"To provide full mitigation of project impacts on all fishery species now would require the virtual shutting down of the project export pumps." (See Exhibit 21)

Water Code section 85021 provides:

"§85021. Reduction of reliance on Delta for future water supply needs

> The policy of the State of California is to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts."

The legislative intent to increase not diminish protection for the Delta and other areas of origin is made especially clear in the adoption of Water Code section 85031(a) which provides:

> "(a) This division does not diminish, impair, or otherwise affect in any manner whatsoever any area of origin, watershed of origin, county of origin, or any other water rights protections, including, but not limited to, rights to water appropriated prior to December 19, 1914, provided under the law. This division does not limit or otherwise affect the application of Article 1.7 (commencing with Section 1215) of Chapter 1 of Part 2 of Division 2, Sections 10505, 10505.5, 11128, 11460, 11461, 11462, and 11463, and Sections 12200 to 12220, inclusive." (Emphasis added.)

The obligation of the projects to provide salinity control and an adequate water supply sufficient to maintain and expand agriculture, industry, urban, and recreational development in the Delta was made clear.

Reliability of water supply for exports from the Delta must be junior to the needs and obligations requiring water in the Delta and other areas of origin including fish and wildlife needs. The modeling and analysis should provide a clear confirmation of the types and numbers of years when no water will be available for export and provide estimates of the amounts that might be available in other years. Care should be taken to model carryover storage requirements with due consideration of meeting temperature, flow and statutory requirements to determine the firm yield available for export.

Reliability of water supply for Northern California requires that water to meet the needs of and obligations to restore and even enhance Delta fish, wildlife and agriculture not be exported.

Both State and Federal laws seek to prevent degradation of water quality. The Proposed tunnel conveyance will remove the higher quality Sacramento River water from the Delta pool thereby reducing the dilution of the poorer quality water returning to the Delta by way of the San Joaquin River from SWP and CVP operations which will deliver more water to the west side of the San Joaquin Valley. The delivery of such water to the San Luis Unit was prohibited by the San Luis Act of 1960 unless there was a Valley Drain with an outlet to the ocean. (See Exhibit 18). The prohibition was circumvented. Even the promise that "A much needed drainage system and water supply will be provided in the San Joaquin Valley" included in ballot argument in favor of the California Water Resources Development Act (SWP) was not kept. (See Exhibit 16). The portfolio unreasonably seeks to maintain and increase exports from the Delta to the west side of the San Joaquin Valley which degrade Delta water quality. The cumulative impact from the predetermined single tunnel conveyance will aggravate such degradation. Adding water with salts to an already saline degraded basin without a real drainage solution is unreasonable, not in the public interest and in violation of the public trust.

THE PORTFOLIO FAILS TO INCLUDE SPECIFIC ACTIONS TO ADDRESS THE SALT BALANCE IN THE SAN JOAQUIN VALLEY

Exports from the Delta and other sources to irrigate the west side of the San Joaquin Valley carry tons of salt which together with the latent salts leached from the soils have been and continue to add salt to the land, the groundwater and the San Joaquin River. The shelving of the plan for a Valley drain with an outlet to the ocean has resulted in there being no real progress on a solution for over 50 years. The meaningful reduction in salt loading from retirement of land programs, which may be flawed, needs to be carefully evaluated in that the delivery of salts through imported water and leaching of latent salts has continued at relatively high levels.

The provision of salinity control and an adequate supply for the Delta was deemed to be of utmost importance, is a primary purpose and obligation of the projects and is a critical feature of a reliable supply for the Delta.

Salinity control for the Sacramento-San Joaquin Delta is a primary purpose for Shasta Dam. Water Code section 11207 provides:

"§11207. Primary purposes

Shasta Dam shall be constructed and used primarily for the following purposes:

(a) Improvement of navigation on the Sacramento River to Red Bluff.
(b) Increasing flood protection in the Sacramento River.
(c) <u>Salinity control in the Sacramento-San Joaquin Delta</u>.
(d) Storage and stabilization of the water supply of the Sacramento River for irrigation and domestic use." *(Added by Stats. 1943, c 370, p. 1896)* (Emphasis added.)

The Delta Protection Act of 1959 in Water Code section 12200 specifically provides: "It is, therefore, hereby declared that a general law cannot be made applicable to said Delta and that the enactment of this law is necessary for the protection, conservation, development, control and use of the waters in the Delta for the public good."

The degradation of water quality in the Delta adversely impacts agricultural, industrial, urban and recreational (including fish and wildlife) uses in the Delta and surrounding areas as well as areas served with exports from the Delta.

Salinity control and the adequacy of the quality of the water supply for the Delta as determined by water quality objectives set by the SWRCB must be provided in priority to exports. Such objectives provide the minimum level deemed necessary to protect beneficial uses. Although the objectives are set for certain uses for certain periods, it is the composite of all objectives which the SWRCB determined would provide the protection for all beneficial uses. Such objectives have at times been violated and it is critical to recognize the pattern of noncompliance, emergency declarations and granting of temporary urgency changes.

Federal law is specific as to the obligations for the CVP. PL99-546 (HR3113) specifically provides:

> "(b) (1) Unless the Secretary of the Interior determines that operation of the Central Valley project in conformity with State water quality standards for the San Francisco Bay/Sacramento-San Joaquin Delta and Estuary is not consistent with the congressional directives applicable to the project, the Secretary is authorized and directed to operate the project, in conjunction with the State of California water project, in conformity with such standards. Should the Secretary of the Interior so determine, then the Secretary shall promptly request the Attorney General to bring an action in the court of proper jurisdiction for the purposes of determining the applicability of such standards to the project.
>
> (2) The Secretary is further directed to operate the Central Valley project, in conjunction with the State water project, so that water supplied at the intake of the Contra Costa Canal is of a quality equal to the water quality standards contained in the Water Right Decision 1485 of the State of California Water Resources Control Board, dated August 16, 1978, except under drought emergency water conditions pursuant to a declaration by the Governor of California. Nothing in the previous sentence shall authorize or require the relocation of the Contra Costa Canal intake."

Section (b) (1) does not allow for the Bureau of Reclamation to operate the CVP without conforming to the State water quality standards for the San Francisco Bay/Sacramento-San Joaquin Delta and Estuary even if the SWRCB is willing to look the other way. A determination by a court of law is required. (See Exhibit 19.)

There are specific processes and procedures for changes to Water Quality Control Plans including review by the United States EPA, which must be considered.

Section (b) (1) is thus applicable and requires USBR and USF&WS compliance unless the Secretary of Interior makes a determination that compliance is inconsistent with congressional directives applicable to the project and then the Attorney General is to be requested to bring a legal action for a court determination of the applicability of the standards. There is no such court determination that would allow the CVP to operate without conforming to the standards.

Section (b) (2) provides an additional constraint with regard to the water quality at the intake to the Contra Costa Canal. Even if the standards were determined by the court to not be applicable to the CVP, then the D-1485 water quality standards would be applicable to the intake of the Contra Costa Canal except under drought emergency water conditions pursuant to a declaration by the Governor of California.

In 2004 Congress passed another law to ensure that Delta water quality standards and objectives would be met.

PL 108-361 (HR 2828) in pertinent part provides:

(D) "Program to Meet Standards. -

> (I) In General. - Prior to increasing export limits from the Delta for the purposes of conveying water to south-of-Delta Central Valley Project contractors or increasing deliveries through an intertie, the Secretary shall, not later than 1 year after the date of enactment of this Act, in consultation with the Governor, develop and initiate implementation of a project to meet all existing water quality standards and objectives for which the Central Valley Project has responsibility." (See Exhibit 20.)

The tunnel project for increasing exports from the Delta which to the extent such are for serving south-of-Delta Central Valley Project contractors would be directly contrary to the direction of Congress which was to assure that all existing (October 25, 2004) water quality standards and objectives would first be met.

RESTORATION OF THE DELTA TO CONDITIONS BASED ON WHAT IS DESCRIBED AS EXISTING IN THE EARLY 1800s WITHOUT RESTORATION OF AREAS BOTH UPSTREAM AND DOWNSTREAM OF THE DELTA IS A FALSE APPROACH WHICH PRECLUDES PROTECTION AND ENHANCEMENT OF THE UNIQUE, CULTURAL, RECREATIONAL, NATURAL RESOURCE, AND AGRICULTURAL VALUES OF THE DELTA

The post 1800 construction of dams on the rivers and streams in the Delta watershed have trapped much of the naturally available sediments, altered the natural flows and water temperature and blocked the passage of native fish to the spawning areas at higher elevations. Suitability of spawning areas and control of temperature for protection of salmon and steelhead is critical to sustainability yet unrelated to habitat in the Delta. The CVP diversion of the San Joaquin River to the south rendering the river as a drain of contaminates and the SWP and CVP exports from the DELTA have adversely impacted fish. The post 1800 mining has contaminated the rivers with mercury that is now converted to detrimental methyl mercury in wetlands. The mining has also added copper to the rivers flowing into the Delta which can be harmful to the environment. The upstream flood control facilities which are part of the State Plan of Flood Control have greatly altered the river systems from the pre-1800 condition. The 1980s SWP substitution of water supply from the Montezuma Gate to the Suisun Marsh to reduce fresh water flow to Suisun Bay significantly altered critical environmental conditions for fish species of current concern.

For protection and enhancement of Delta values a more meaningful focus should be post 1960.

ECOSYSTEM IMPROVEMENTS WHICH CONVERT AGRICULTURAL LAND TO HABITAT AS A SUBSTITUTE FOR REDUCING SWP AND CVP EXPORT OF WATER NEEDED TO PROVIDE ADEQUATE WATER FLOW AND QUALITY FOR FISH AND OTHER DELTA NEEDS ARE IN MANY CASES DAMAGING TO THE DELTA INCLUDING FISH AND WILDLIFE

There is strong evidence indicating that fish need water flowing into and out of the Delta to the Bay. The timing and amounts are the subject of ongoing debate and evaluation.

The SWP and CVP affect flow into and out of the Delta primarily through diversions to storage and direct diversions from the tributaries and from locations in the Delta to areas outside the Delta. The reliability of water supply for fish at times directly conflicts with the reliability of the water supply for SWP and CVP deliveries for other purposes and in particular exports from the Delta. The priorities for providing such reliability are established by law.

Water Code Section 85086 of the Delta Reform Act of 2009 assigned to the SWRCB the task of determining instream flow needs and new flow criteria for the Delta ecosystem necessary to protect public trust resources. Such determinations have not yet been completed, yet the DEIR for the tunnel and the DEIR for operation of the SWP and are moving forward. Without resolution of the flow requirements and water quality control plan for the Delta the portfolio determinations are premature. The rush to decision to go forward with the tunnel in advance of critical evaluations is further evidence of predetermination and lack of a good faith effort to develop a meaningful portfolio to equitably resolve the California water challenges.

Driving the need for ecosystem restoration is the need to address the dramatic decline in fish species and in particular those in danger of extinction. The proposition to facilitate greater exports is to substitute habitat in the Delta and other measures for flow into and through the Delta. The impact of SWP and CVP exports on the amount of flow into and through the Delta from diversion to storage and direct diversion is discounted.

The correlation between SWP and CVP exports and the decline of the fisheries has been a concern for many years. In August of 1978 the State Water Resources Control Board rendered its Water Right Decision 1485. The Decision was the culmination of 32 days of evidentiary hearing initiated on November 15, 1976 and concluded on October 7, 1977. At that time the striped bass index was considered to be the indicator of ecosystem health for the Delta and Suisun Marsh. Striped bass were in effect the "canary in the coal mine" and the focus was on maintaining favorable conditions for the null zone in Suisun Bay. As the years passed and striped bass populations plummeted, the water exporters claimed striped bass to be invasive species, predators on endangered species and a major cause of fish declines wrongfully attributed to the export of water. The canary died and the death was ignored to facilitate greater exports. As Exhibits 22-25 show, striped bass, steelhead, Delta smelt, fall-run Chinook salmon and winter-run Chinook salmon all co-existed at relatively high populations at lower export levels.

In 1978 the SWRCB concluded in D-1485 at page 13 that:

"To provide full mitigation of project impacts on all fishery species now would require the virtual shutting down of the project export pumps." (See Exhibit 21.)

The SWRCB also concluded in D-1485 at page 14 that:

"Full protection of Suisun Marsh now could be accomplished only by requiring up to 2 million acre feet of fresh water outflow in dry and critical years in addition to that required to meet other standards." (See Exhibit 21.)

Exports from the Delta were not curtailed and the additional 2 million acre feet of outflow was not provided for the marsh.

Exhibits 22-25 show that significant declines in fish populations commenced when annual exports reached 2 million acre feet. Increased development in the watersheds and the effects of climate change would indicate that additional surplus water yield would have to be developed to provide a comparable level of fish protection for the future and maintain even the 2 million acre feet of exports much less the full amount of export contracts. Little or no export water in dry years and more in wet years would likely help but the Delta watershed cannot produce the needed water. The planners of the SWP determined that by the year 2000 no water would be available for export without major water development in the North Coast.

An examination of the fish population graphs indicates that restoration of the ecosystem for fish is not correlated with Delta wetland habitat conditions in the 1850's or at all. The likely relationship is to water conditions, including exports from the Delta. Exports remove flow from the Delta. Diversions to storage for the purpose of export remove and impact the timing of flow into and from the Delta.

The Delta was fully leveed and reclaimed by about 1930.

"By 1930 all but minor areas of the swampland had been leveed and were in production." (See page 8 of December 1960 Bulletin 76 - Exhibit 14.)

The USACE completed project levee construction on the San Joaquin River in the early 1960's. There are no significant changes in leveed areas or even riverine habitat which appear to be the cause of the decline of the fisheries. In fact, there have been increases in Delta wetland habitat, including tidal wetland, during the periods of apparent decline. Mildred Island flooded in 1983 and has not been reclaimed. Little Mandeville and Little Frank's Tract flooded in the 1980's and have not been reclaimed. Lower Liberty Island levees were not restored and the area has been in a tidal wetland condition since at least 2002.

The focus on conversion of Delta land to habitat as a substitute for water for fish is misplaced and the result of the inappropriate commitment to increase exports. Adequate analysis has not been done to determine if development of shallow tidal and other wetland habitat in the Delta and other locations is actually detrimental to salmon and other anadromous fish. In particular, stranding and predation from otters, egrets, herons, cormorants, gulls, white pelicans and the like have been identified as a serious concern.

The limited study (Exhibit 26) showing a picture of larger salmon smolts raised for a time in a wetland versus smaller smolts raised in the channel was cited by BDCP/WaterFix proponents as the evidence that shallow seasonal wetland in the Delta would" be a substitute for flow and justification for a 50 year take permit. The study monitored caged smolts in the channel where the fish must constantly swim against the current and compared those smolts to smolts in cages in shallow wetlands where there was little or no current. The experiment did not attempt to evaluate stranding or predation and it is doubtful that the smolts in the channel cages if uncaged would spend as much time swimming against the stronger currents rather than seeking areas of the channel where the velocity is lower. The presentation of results by BDCP including the fat fish/skinny fish photo neglected to show the sizes of the fish from the cages in the channel upstream of the shallow habitat which reportedly were comparable to those in the wetlands. "During periods of low, clear water, fish growth rates in the river site above the floodplain were comparable to those in the floodplain". (Exhibit 26, p. 1.)

<u>Creation of Floodplain Habitat Is Not a Substitute for Flow</u>

The available evidence and studies do not support such a substitution. The floodplain habitat which is suggested as potentially beneficial is that which is inundated by high flows for a limited period; involves a large area of water of a proper depth to help avoid predation; assumes avian predator populations are limited; is properly drained to avoid stranding and avoids increased water temperatures detrimental to salmonids.

The <u>Jeff Opperman Final Report for Fellowship R/SF-4</u> referenced above containing the picture of the fat fish and skinny fish is often shown as support for the proposition that floodplain habitat can be substituted for flow (Exhibit 26.) The study does not put forth that conclusion but suggests "that juvenile Chinook benefit from access to floodplain habitats". (Page 2) It is important to recognize that the test fish were caged and thus predation from birds, fish and other animals was not an issue. Stranding was down-played but admittedly not tested. The test was conducted in and along the Cosumnes River. The skinny fish were in the river swimming against the current and because they were in cages and couldn't move with the current or move to quiet and more productive water. The fat fish obviously saved their energy for growth and apparently benefitted from improved food availability. The report states "During high flows the river offers poor habitat and fish living in this type of habitat will tend to be displaced downstream." High flows and displacement downstream are likely not detrimental. It is generally accepted that the salmon do well in high flow years. The return of adults (escapement) is usually higher two and one-half years after a high flow year. It is recognized that ocean conditions also play a part and may in some cases reduce escapement nullifying the benefit of high flow. The difference in food availability in the high flow channel versus in the quiet water may not be significant in the test given the consumption of energy and lack of opportunity for the skinny fish to move to more favorable parts of the river. Displacement downstream into the cooler and more productive parts of the estuary is likely not bad for displaced salmon smolts.

Floodplain Habitat Not Accompanied by High Flow Does Not Appear to Result in Increased Chinook Salmon Ocean Survival and May Not Improve Survival of Sacramento River Juvenile Chinook Salmon Migrating to the Ocean

In the study titled "Floodplain Rearing of Juvenile Chinook Salmon: Evidence of enhanced growth and survival" by Sommer, et al. (2001), a copy of which is Exhibit 27, tests were conducted in the Yolo Bypass in 1998 and 1999. The study concluded that during such years salmon increased in size substantially faster in the seasonally inundated agricultural floodplain than in the river, suggesting better growth rates. The study, however, provides: "Survival indices for coded-wire-tagged groups were somewhat higher for those released in the floodplain than for those released in the river, but the differences were not statistically significant. Growth, survival, feeding success, and prey availability were higher in 1998 than in 1999, a year in which flow was more moderate indicating that hydrology affects the quality of floodplain rearing habitat". (Exhibit 27, p. 1.)

In the discussion the authors provide:

"Mean length increased faster in the Yolo Bypass during each study year, and CWT fish released in the Yolo Bypass were larger and had higher apparent growth rates than those released in the Sacramento River. It is possible that these observations are due to higher mortality rates of smaller individuals in the Yolo Bypass or of larger individuals in the Sacramento River; however we have no data or reasonable mechanism to support this argument."

"Elevated Yolo Bypass survival rates are also consistent with significantly faster migration rates in 1998, the likely result of which would be reduced exposure time to mortality risks in the delta, including predation and water diversions."

In the study "Habitat Use and Stranding Risk of Juvenile Chinook Salmon on a Seasonal Floodplain" by Sommer, et al. (2004), a copy of which is Exhibit 28, the authors build upon the above study with further testing in 2000 and present their analysis of ocean survival. The author's abstract provides:

"Although juvenile Chinook salmon *Oncorhynchus tshawytscha* are known to use a variety of habitats, their use of seasonal floodplains, a highly variable and potentially risky habitat, has not been studied extensively. Particularly unclear is whether a seasonal floodplain is a net "source" or net "sink" for salmonid production ... Adult ocean recoveries of tagged hatchery fish indicate that seasonal floodplains support survival at least comparable with that of adjacent perennial river channels. These results indicate that floodplains appear to be a viable rearing habitat for Chinook salmon, making floodplain restoration an important tool for enhancing salmon production. (Emphasis added.)

The data provided for ocean survival is as follows:

"Table 1. - Number of coded wire tags recovered in the ocean and commercial fisheries for Chinook salmon released in the Yolo Bypass and Sacramento River. The total number of tagged fish released in each location for each year is shown in parentheses. The survival ration is calculated as the number of Yolo Bypass recoveries divided by the number of Sacramento River recoveries."

Release Group	1998 (53,000)	1999 (105,000)	2000 (55,000)
Yolo Bypass	75	136	27
Sacramento River	35	138	47
Survival Ratio	2.14	0.99	0.57

In 1998 Yolo Bypass looked like a benefit, in 1999 it was a push and in 2000 Yolo Bypass looked like a detriment.

It is assumed that shaded river aquatic habitat is desirable for special status fish. Attention is called to the BDCP Draft Chapter 8 which puts forth the need to control predators by removing structures which affect flow fields and provide shade. The focus appears to be on abandoned docks, pilings and the like, however, shaded river aquatic habitat can provide the same effect on flow and provide shade. The impact of shaded river aquatic habitat on special status fish is unclear.

There are a number of significant adverse impacts associated with so-called restoration of tidal floodplain habitat within the Delta which have not been objectively considered or mitigated.

In the Delta where the waters are tidal the proposed habitat restoration is not necessarily floodplain but rather is tidal wetlands which is inundated most if not all of the time. This condition is favorable to predators.

Increased salinity intrusion could result from the increased tidal prism and/or creation of shortened pathways to the interior Delta and particularly to the large SWP and CVP intakes whether in the north Delta or south Delta.

Setting back, breaching, degrading and/or not restoring levees in the Delta has significant adverse impacts.

Increases in the tidal prism at locations similar to and including the area in and around the lower Yolo bypass results in advection adversely affecting the out migration of salmon smolts some of which are endangered.

The regularly or permanently inundated areas constitute increased habitat for predator species and increase ambush locations affecting the fish species of concern. The increase in water surface and wetland vegetation will greatly increase the evaporation and evapotranspiration of fresh water. In many cases there is an increased threat of flooding to surrounding areas due to increased fetch and wave action across the habitat area and increased seepage into adjoining levees and lands. Other significant adverse impacts include propagation of vectors including disease bearing mosquitoes, production of methyl Mercury and toxic algal blooms.

There is also the harm to and loss of agricultural land and production and harm to terrestrial species.

Exhibit 29-1 contains excerpts from the April 2011 report by Dave Vogel titled "Insights into the Problems, Progress, and Potential Solutions for Sacramento River Basin Anadromous Fish Restoration" prepared for the Northern California Water Association and Sacramento Valley Water Users contains the results of studies which include the Liberty Island Ecological Reserve area. (The entire study can be viewed on the Northern California Water Association website by clicking on "Fisheries")

At pages 112 and 113 the report provides.

> "Subsequent, additional juvenile salmon telemetry studies were conducted by Natural Resource Scientists Inc. on behalf of the USFWS and CALFED in the north Delta (Vogel 2001, Vogel 2004). Triangulating radio-tagged fish locations in real time (Figure 61) clearly demonstrated how juvenile salmon move long distances with the tides and were advected into regions with very large tidal prisms, such as upstream into Cache Slough and into the flooded Prospect and Liberty Islands (Figure 62). During the studies, it was determined that some radio-tagged salmon were eaten by predatory fish in northern Cache Slough, near the levee breaches into flooded islands (discussed below)."

At page 120 the report provides:

> "During recent years, there has been an emphasis to reclaim or create shallow, tidal wetlands to assist in re-recreating the form and function of ecosystem processes in the Delta with the intent of benefitting native fish species (Simenstad et al. 1999). Among a variety of measures to create such wetlands, Delta island levees either have been breached purposefully or have remained unrepaired so the islands became flooded. A recent example is the flooding of Prospect Island which was implemented under the auspices of creating shallow water habitat to benefit native fish species such as anadromous fish (Christophel et al. 1999). Initial fish sampling of the habitat created in Prospect Island suggested the expected benefits may not have been realized due to an apparent dominance of non-native fish (Christophel et al. 1999). Importantly, a marked reduction of sediment load to the Delta in the past century (Shvidchenko et al. 2004) has implications in the long-term viability of natural conversion of deep water habitats on flooded Delta islands into shallow, tidal wetlands. The very low rates of sediment accretion on flooded Delta islands indicate it would take many

years to convert the present-day habitats to intertidal elevations which has potentially serious implications for fish restoration (Nobriga and Chotkowski (2000) due to likely favorable conditions for non-salmonid fish species that can prey on juvenile salmon. Studies of the shallow water habitats at flooded Delta islands showed that striped bass and largemouth bass represented 88 percent of the individuals among 20 fish species sampled (Nobriga et al. 2003)."

"There have likely been significant adverse, unintended consequences of breaching levees in the Delta. There is a high probability that site-specific conditions at the breaches have resulted in hazards for juvenile anadromous fish through the creation of favorable predator habitats. The breaches have changed the tidal prisms in the Delta and can change the degree in which juvenile fish are advected back and forth with the tides (Figure 61; previously discussed). Additionally, many of the breaches were narrow which have created deep scour holes favoring predatory fish. Sport anglers are often seen fishing at these sites during flood or ebb tides. Breaching the levees at Liberty Island is an example (Figure 72 and 73). Recent acoustic-tagging of striped bass in this vicinity confirmed a high presence of striped bass (Figure 74, D. Vogel, unpub. data.)"

The increased loss of fresh water due to creation of tidal and wetland habitat is clear. Exhibit 29-2 is Table A-5 from DWR Bulletin 168, October 1978 which shows the annual Et values for various crops and for Riparian Vegetation and Water Surface. The Riparian Vegetation and Water Surface 67.5 inches can be compared to tomatoes 33.8 inches and alfalfa 46.0 inches. The increased fresh water loss is from 33.7 inches when compared to tomatoes and 21.5 when compared to alfalfa. The increased loss of fresh water is particularly significant in drier years.

The Division of Water Resources (predecessor to The Department of Water Resources) in the Sacramento - San Joaquin Water Supervisor's report for the year 1931 dated August 1932 and designated Bulletin 23 includes the results of studies of water consumption of tules and cat-tails. Exhibit 29-3 includes Tables 69, 74, 75 and 77 from such report. Consumptive use for open water surface is shown as 4.91 acre feet per acre, tules at 9.63 acre feet per acre, and alfalfa at 3.51 acre feet per acre. To examine the relatively high consumptive use for tules the U.S. Department of Agriculture undertook a continuation of the study of consumptive use for asparagus, tules and cattails. The tables show an average of 14.63 acre feet per acre for cat-tails and 13.48 acre feet per acre for tules. Results from cat-tails and tules grown in tanks at Camp 3, King Island for 1931 are shown in Table 77. The results for normal sized tules was 8.0 acre feet per acre.

ADVERSE IMPACTS TO DELTA WATER QUALITY FROM PORTFOLIO ACTIONS VIOLATE ANTI-DEGRADTION POLICIES, THE DELTA REFORM ACT, WATER CODE SECTIONS 12200 ET SEQ. AND WATER CODE SECTIONS 11460 ET SEQ.

Salinity control and an adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban and recreational development in the Delta area is a precondition to the SWP and CVP export of water from the Delta. Additionally the projects must reduce reliance on exports from the Delta and as coequal goals provide a more reliable water supply for California including the Delta and protect, restore and enhance the Delta ecosystem. See Water Code section 85054. The unique cultural, recreational, natural resource, and agricultural values of the Delta are specifically referenced.

For agriculture in much of the Delta including the central Delta salt accumulates in the soil as a result of evapotranspiration and surface evaporation. Due to soil types, shallow groundwater levels and crop limitations increasing leaching fractions by application of greater quantities of irrigation water is not feasible. Salt balance requires application of good quality water during periods of irrigation such that rainfall will achieve the leaching of salts from the soil necessary to achieve salt balance. Control of land use in the Primary zone of the Delta is intended to assure that this area remains in agricultural use including the growing of grain and other forage crops to sustain the wintering waterfowl of the Pacific Flyway and other important wildlife. Typically winter flooding is used to saturate the soil so that winter rains can drive the accumulated salts from the root zone for growing the customary crops. Leaching of salts can be accomplished through special land grading with containment dikes and open drains in close proximity that allow applied water to push salts from the root zone area. The process is very expensive and only applicable to growing high value crops.

Compliance with water quality objectives for agricultural uses rather than avoidance of degradation assumes that the objectives avoid significant harm. There is no supporting analysis for such assumption. The analysis of effects ignores the significant adverse impact to water quality from reduced Delta Outflow and tidal and other wetland habitat. Increased salinity intrusion from increases of the tidal prism, shortening the path for salinity intrusion and increased evaporative losses will result from habitat development. Degradation is the result of the desire to increase exports and is inconsistent with the Delta Reform Act requirements to honor the statutory and water right priorities, enhance Delta agricultural values, reduce reliance on the Delta and make the Delta water supply more reliable. The SWRCB has in the past viewed the water quality objectives for specific uses as a composite providing protection for all beneficial uses. Changes in objectives for a particular use will likely impact protection for other beneficial uses.

The portfolio actions incorrectly minimize the significant adverse impacts from increases in methyl mercury concentration from the creation of habitat purportedly beneficial to fish to justify fish agency accord for export of water that is not surplus to the needs of the Delta and other areas of origin. Improvement of Delta water quality and flow with reduction of exports so as to provide sufficient conditions to protect fish would avoid the need for habitat measures which increase methyl mercury.

Toxic algal blooms and microcystis are already a significant health hazard in the Delta to recreational users, animals, and even fish. The Delta is a source of drinking water for export and local users and possibility of transmission of toxins is real. The proposed project degradation of Delta water quality will substantially increase the Health risk from such algal blooms. Cumulative impacts with likely future projects and actions will greatly increase the adverse impacts. The proposed single tunnel alone will remove substantial quantities of the good quality Sacramento River water from passing through the interior of the Delta. This will reduce velocities in some areas and increase residence time. Elimination of the flushing action and dilution from the cross-delta flow and outflow will increase residence time in many locations and increase the concentration of constituents contributing to algal blooms. Water temperature and clarity increases could also result. Further investigation and implementation of operational measures to manage residence time is clearly not a good faith effort to fully consider all reasonable alternatives. The most obvious of which is to eliminate isolated conveyance, provide adequate flushing flows and export only water which is truly surplus.

The microcystis effects from habitat development could certainly be mitigated by eliminating those projects which create the problem. The impacts to fish which habitat development is intended to mitigate can be greatly mitigated with water flow and other measures including the reduction of export of water which is not truly surplus and sensitivity as to when to run the export pumps.

LEVEE SETBACKS, EXPANDING FLOODWAYS, EXPANDING FLOODPLAINS AND CREATION OF BYPASSES NEED SITE SPECIFIC EVALUATION

A setback levee and expansion of the floodplain may add detriments rather than multi-benefits depending greatly on location. Moving a levee off of the foundation which has been consolidating for over 100 years introduces the risk of instability which could take years to correct. This is a concern particularly in the Delta. Detrimental changes to the hydraulics in the rivers including the flow splits, velocity, scour, sedimentation and changes in flood routing have to be carefully analyzed. Sedimentation could significantly affect channel capacity and even induce meandering. In the current regulatory environment, maintenance of channel capacity is difficult if not impossible and is ignored. Water quality impacts including methylation of Mercury and propagation of algal bloom toxins or other toxins in the added flood plain could adversely impact aquatic species and even humans.

The rerouting of floodwaters into areas near development or critical structures increases the risk to such areas. Seepage into adjoining levees and development can occur by way of through seepage, under seepage or by pressurization of the aquifer which is especially critical if there is a high water table. Wind generated waves across the flooded area are also a problem to be addressed. Stranding and increased predation of protected fish species is a huge problem. The predation is not only by other fish species but by numerous bird species including white pelicans, cormorants, egrets, herons, gulls and king fishers and by other species such as river otters, raccoons, mink and sea lions. Flooding of areas every few years or every 10 or 20 years will drown the animals or damage the habitat for terrestrial species including species of particular concern such as riparian brush rabbits, endangered Garter snakes burrowing owls and the like. Human health and safety impacts from disease bearing vectors such as mosquitoes and the chemical control of the same are particularly significant near developed areas and other areas of substantial human activity. The spreading of contaminants from the flooded area and from the flooding of upstream wastewater pipe systems and treatment facilities and hazardous material sites is also a problem.

Levee setbacks and expanding the flood plain should only be done with careful consideration of the particular location. Benefits and detriments will change dramatically depending on location. Adding to the concerns discussed above, in the lower Delta increased salinity intrusion can result from increasing the tidal prism and or shortening the path to the export pumping facilities. For large setbacks and expansion of floodplains the increased evaporative losses could be significant. Setbacks and expansion of the floodplain would appear to be best placed away from development in areas where the water table is lower and groundwater recharge can be a real benefit. Development of floodplain habitat and spreading of floodwater in areas farther upstream of the Delta will reduce the detriment, increase the possible benefit for recharge of the groundwater and provide greater flood control benefit to downstream areas.

Existing levees in the Delta constitute an interrelated system necessary for the protection of the entire area including evacuation of the entire region in the event of emergency whether it be from flooding, earthquake, terrorist attack or otherwise. With climate change, sea level rise and the desire to increase flood protection for populations and critical infrastructure, improvement of existing Delta levees should be encouraged and not burdened with floodplain restoration concepts.

THE PORTFOLIO ACTIONS FAIL TO INCLUDE CONTINUED FUNDING FOR THE DWR DELTA LEVEE SUBVENTION PROGRAM (WATER CODE SECTION 12980 ET SEQ.) AND DELTA LEVEE SPECIAL PROJECT PROGRAM (WATER CODE SECTION 12310 ET SEQ.)

Preservation of the physical characteristics of the Delta and the system of levees is critical to maintaining 1) an adequate water supply in the delta and for exports, 2) efficient salinity control and conveyance of water, 3) protection and enhancement of the unique cultural, recreational, natural resource and agricultural values of the Delta and 4) protection of critical infrastructure including regional evacuation routes, railroads, urban water delivery systems, water treatment facilities, fuel and electrical transmission lines, natural gas transmission and storage facilities and shipping channels.

The legislative finding and declaration in Water Code section 12981 which was enacted in Statutes 1973 Chapter 717 clearly sets forth the State interest in preserving the physical characteristics of the Delta.

> **"12981 Unique resources with statewide significance; preservation**
>
> a) The Legislature hereby finds and declares that the delta is endowed with many invaluable and unique resources and that these resources are of major statewide significance.
>
> b) The Legislature further finds and declares that the delta's uniqueness is particularly characterized by its hundreds of miles of meandering waterways and the many islands adjacent thereto, that in order to preserve the Delta's invaluable resources, which include highly productive agriculture, recreational assets, and wildlife environment, the physical characteristics of the delta should be preserved essentially in their present form, and that the key to preserving the delta's physical

characteristics is the system of levees defining the waterways and producing the adjacent islands. However, the Legislature recognizes that it may not be economically justifiable to maintain all delta islands.

c) the legislature further finds and declares that funds necessary to maintain and improve the delta's levees to protect the delta's physical characteristics should be used to fund levee work that would promote agricultural and habitat uses in the delta consistent with the purpose of preserving the delta's invaluable resources."

Preservation of the system of levees is critical to achieving the coequal goals. Water Code section 85054 provides:

"'Coequal goals' means the two goals of providing a more reliable water supply for California and protecting, restoring and enhancing the ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place."

The benefits from preservation of the system of levees in the Delta extend statewide. The legislature established the Delta Levee Subvention Program and Delta Levee Special Projects Program to provide funding in addition to the local funding to maintain and improve Delta levees. The two programs are directed to the areas in the Primary Zone of the Delta where development is greatly restricted and to the very small historic communities therein. Past funding for the programs has included some general funds but mostly bond funding from periodic water related state general obligation bonds.

Many of the levees do not yet meet the recommended minimum agricultural standards in DWR Bulletin 192-82 or those in the USACE PL 84-99 Delta standards. Many merit improvement to much higher standards. All require ongoing maintenance and improvement. Since most areas are precluded from development by the primary and secondary zone limitations in the Delta Protection Act and Delta Stewardship Council's Delta Plan, the levee work is dependent upon the agricultural land ability to pay and constrained by Prop 218 requirements. Without levee improvement the risk of levee failure will remain high and increase with state predicted sea level rise, climate change and earthquakes.

When Delta levees fail during the summer or dry periods there has historically been an interruption in exports from the Delta either due to salinity intrusion or difficulty in efficiently meeting Delta standards due to disruption of the expected hydraulics of the delta. There are also issues with contamination, turbidity and increases in salinity due to increased evaporative losses. There can also be a shortening of the path for salinity to intrude into the Delta and reach the export pumps. A resulting increase in the tidal prism could also induce greater salinity intrusion. The Delta Protection Act, Water Code section 12200 et seq., "prohibits project exports from the Delta of water necessary to provide water to which the Delta users are 'entitled' and water which is needed for salinity control and an adequate supply for Delta users." (United States v. State Water Resources Control Bd. (1986) 182 Cal.App.3d 82, 139).

Inconsistency with the referenced coequal goals statute is also evidenced from the system impacts. The Delta overlies sands and gravels which extend beneath numerous islands and tracts. When an area floods seepage usually increases in adjoining lands and levees increasing the risk of levee failure, causing damage to crops and rendering portions of the land unfarmable. Wind across the flooded area generates waves impacting the unprotected interior levee slopes which could break through the flooded island levee causing damage to adjoining lands and levees. Over time the wind will wash away the flooded island levees including riparian habitat and greatly increase the wind wave height and run up on adjoining levees. If the flooded island is not promptly reclaimed the adjoining levees and drainage systems must be substantially improved and some of the damage will persist. If such reclamation is not accomplished additional levee failures and other adverse impacts will result. Franks Tract which flooded in 1938 is an example where the wind wave generation across the flooded area has eroded most of the remnant levee contributing to the levee failure on Holland Tract and requiring substantial improvements on adjoining islands beyond the agricultural standards to resist the increased wave action. Additionally, the loss of the levee along False River caused a more direct path for salinity intrusion to reach the export pumps. This triggered the need for the emergency placement of the temporary rock barrier in False River at a cost of about $40 million.

Loss of the physical characteristics of the Delta includes the loss of farmland, miles of meandering waterways, erosion of channel islands, loss of riparian habitat along the levees, loss of protected areas for recreation, including boating, fishing, sightseeing, swimming and the like. When flooding occurs terrestrial habitat is destroyed, terrestrial species are displaced or drowned, some of which are endangered, fish become stranded and subject to greater predation, waterfowl of the Pacific Flyway lose critical wintering habitat, water quality is degraded due to spreading of contaminates including those from upstream sources such as hazardous sites, flooded waste treatment facilities, broken pipelines and the like, generation of methyl mercury, propagation of harmful algal blooms and the related toxins, increased water temperature, production of undesirable aquatic vegetation, propagation of vectors such as mosquitoes together with the spreading of related diseases and the harmful impact of chemicals used to control the same, increased evaporation of fresh water and the resulting increased concentration of salinity.

The cumulative effect of the elimination of funding for levee maintenance and improvements over such a broad area will essentially destroy the physical characteristics of the Delta with substantial adverse impacts to human health and safety. The cumulative impact of contaminants, toxins, vectors and disruption of the evacuation routes through the Delta could result in significant additional loss of life.

Attached hereto as Exhibit 30 are the cover and pages 32 and 33 from the DWR's June 15, 2007 Technical Memorandum, Delta Risk Management Strategy Phase 1, Impact to Infrastructure. The entire memorandum is available on the web under DRMS Technical Memorandum June 15, 2007. The memorandum provides the estimated replacement costs of Delta Infrastructure within Mean Higher High Water at $6.1 billion (2005 dollars) and $8.5 billion (2050 dollars). The estimated replacement cost within 100-year limits is $56.3 billion (2005 dollars) and $67.1 billion (2050 dollars).

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Preservation of the physical characteristics of the Delta is critical to the preservation and enhancement of the Delta, the maintenance of water quality, and the conveyance of water through the Delta with or without a tunnel.

THE FAILURE TO CONTINUE FUNDING OF THE DELTA LEVEE PROGRAMS WILL JEOPARDISE USACE AND FEMA DISASTER ASSISTANCE TO RESTORE PUBLIC FACILITIES AFTER A FLOOD EMERGENCY IN THE DELTA

The State through the Central Valley Flood Protection Board (formerly the Reclamation Board) is the nonfederal sponsor for federal project levees and is obligated to operate and maintain the project levees in accordance with an Operation and Maintenance Manual incorporating USACE requirements. In most cases the State has contracted with a local agency to maintain the project levee in accordance with the Operation and Maintenance Manual. The local maintaining agency (LMA) in many cases is a Reclamation District. The USACE has become more demanding as to its Operation and Maintenance requirements including enforcement of the no vegetation requirements and has become less willing to proceed with reconstruction assistance. The USACE Operation and Maintenance is in reality the OMRR&R requirement. OMRR&R is Operation, maintenance, repair, rehabilitation and replacement. The Maintenance responsibility for the State includes maintaining the integrity of the flood control system and designated floodways. "Levee inspection reports provided by the USACE indicate severe levee maintenance deficiencies in over 90% of State Plan of Flood Control levee systems." (See Exhibit 31 CVFPB Resolution No. 2018-06) Inability of the LMA to fund the maintenance or lack of agreement to fund as defined will result in State funding or loss of USACE reconstruction assistance. USACE reconstruction assistance could be in the hundreds of millions of dollars.

FEMA assistance for nonproject levee reconstruction after emergencies is dependent upon a good faith State effort to mitigate damages. The general policy question is why should federal money be used to repair damage resulting from the State's deferred action? The general approach in emergencies is locals exhaust their ability and then the State exhausts its ability up to $100 million (a somewhat arbitrary number) and then FEMA will assist unless there is an issue of State deferred maintenance or failure to proceed with mitigation. In the case of repeated emergencies FEMA requires a mitigation plan. As a result of multiple Delta levee breaks in 1980 where the Director of the Department of Water Resources did not provide support but FEMA and State OES did, FEMA required a Flood Hazard Mitigation Plan for the Delta. Attached hereto as Exhibit 32 is the Flood Hazard Mitigation Plan for the Sacramento-San Joaquin Delta dated September 15, 1983. The plan was prepared by the Department of Water Resources for the Office of Emergency Services and accepted by FEMA. The short term mitigation plan was to work towards a levee configuration with 1 foot of freeboard above the 100 year flood elevation, a 16 foot crown width, a 1.5 to 1 waterside slope, a 2 to 1 landside slope and an all-weather access road. (See Exhibit 32, p. 13) This came to be known as the HMP Standard. It was recognized that the HMP Standard was not an engineered standard but merely a gage to reflect good faith improvement. The long term mitigation plan was to implement within 20 years a Delta Levee System plan as "described in the Corp' Draft Feasibility Report, dated October 1982 and in the Department's Bulletin 192-82, Delta Levees Investigation, dated December 1982 ...All islands should be included in the System Plan for stage construction, as recommended in the Corps' plan." (See Exhibit 32, p. 15.) Failure to continue funding the Delta programs will surely jeopardize future federal disaster assistance which could involve hundreds of millions and perhaps billions of dollars of recovery costs.

Currently highways in the Bay Delta region are loaded to capacity during much of the day. In the event of an emergency whether it be flood, earthquake, terrorist attack or other emergency the loss of highways through the Delta will greatly increase the loss of life.

Perhaps most notably, the Administration's currently proposed FY 2020-21 budget does not contain funding for DWR to administer currently functioning Delta levee programs. It is recommended that the portfolio include actions for the Administration, the California Natural Resources Agency and the Department of Water Resources to continue operation and funding of the Delta Levee Subvention Program and the Delta Levee Special Projects Program. A specific allocation for the Delta Levee Programs should be included in each water related General Obligation Bond Proposition, including the Governor's currently proposed Climate Resilience Bond. There should be a priority for meeting the minimum engineering standards. Until the levees meet the minimum engineering standards the funding for habitat should be separately identified and implemented off levee. Integrating habitat with levee work greatly increases the cost thereby delaying progress in meeting the minimum engineering standards. Concentrating habitat in larger blocks where it is less likely to be disturbed and as separately managed projects is more beneficial to wildlife.

It is recognized that program managers would adjust funding levels based on participation and the ability to accomplish work given constrained work windows and other regulatory constraints. Prior recommendations were to fund at $100 million per year with a short term priority of $12 million for the Delta Levee Subvention Program, $44 million for the Delta Levee Special Projects deemed most important or favored by DWR and $44 million for Delta Levee Special Projects to improve the other levees to meet an acceptable minimum engineering standard. Given current predictions for sea level rise and climate change the minimum engineering standard should be the DWR Bulletin 192-82 with 24 feet minimum crown width and 2 feet of freeboard above the 100 year flood elevation. As sea level rise and climate change effects are manifested the freeboard or 100 year flood elevation should be increased. With a 24 foot crown width two way truck traffic can be safely provided even for floodfight and increased height can be expeditiously added.

THE PORTFOLIO'S PROPOSED INCREASE IN TELEMETERED DIVERSION DATA IS MISPLACED, ESPECIALLY IN THE DELTA

Considering the lack of organization, compilation and uniformity of water use data, the administration should pursue and achieve marked progress in actions 22.1-22.7 before pursuing action 22.8. Requiring the onerous and traditionally not locally cost-effective deployment of physical measuring devices with telemetry capabilities for diverters of 500 acre feet per year, well below the current volumetric threshold (10,000 acre-feet a year), seems both punitive and premature. That is a 20-fold decrease in the threshold volume.

The Central and South Delta Water agencies along with other Delta water users, including DWR, currently participate in the Delta Measurement Experiment Consortium (DMEC) convened by the Delta Watermaster's office to cooperatively pursue the newly promulgated regulations for measuring and metering of diversions in the Delta under SB 88. Our collective findings have thus far shown metering of diversions in the Delta to be both costly and inaccurate. In addition, the data produced is bulky, delayed, incongruent and disparate. DMEC has yet to show how any of the data developed thus far would be incorporated to more beneficially operate the SWP on a systemwide basis.

Improved systemwide performance, planning and forecasting is more likely achieved through the improved accuracy, organization and utilization of currently available datasets (such as OpenET), and the improvement and updating of embedded flawed modeling assumptions (e.g., outdated bathymetry of Delta channels in DSM2), as opposed to continuing to rely on inputs that have historically provided demonstrably false projections.

"OpenET" in particular, holds the promise of providing broad geospatial water demand data on a real time scale, and thus should be prioritized ahead of traditional retroactively oriented water use data.

THE PORTFOLIO SHOULD INCLUDE A MULTI-AGENCY EVALUATION OF THE IMPACTS OF WATER TRANSFERS ON SURFACE AND GROUNDWATER SUPPLY AND THE ECONOMY OF THE AREA FROM WHICH THE WATER IS TAKEN

Such evaluation should include examination of the need for additional restrictions and controls. In addition to other requirements water transferred should be limited to water that is truly surplus to the present and future needs of the watershed area from which it is taken. If a watershed area lacks a full water supply to meet present and future needs or overlies a depleted or declining groundwater basin or sub basin transfers to areas outside such area should not be allowed. Transfers of surface water with groundwater substitution should not be allowed. The opportunity for abuse and difficulty in assuring compliance is too great. Transfers based on land fallowing clearly have an adverse impact on the local employment and economy and shouldn't be allowed. Transfers based on crop substitution are too difficult to quantify and shouldn't be allowed. Transfers shouldn't be allowed if the transfer will foster long term demand unless it is clear that the long term demand will be met. Conservation measures which line or pipe earthen canals in areas where there is a resulting reduction in beneficial groundwater replenishment or reduction in return flow to surface water beneficial to other water uses including fish and wildlife should not be allowed as the basis for a water transfer out of general area and certainly not out of the watershed. The portfolio should include an impartial examination of SWP contract provisions and contract administration to assure that transfers of project water or water transferred by way of project facilities do not result in longer term demand unless it is certain that such longer term demand will be met.

Moreover, the directive to "[s]ubstantially reduce approval time for transfers" is misplaced and jeopardizes the established safeguards against harm to current legal users of water and Public Trust resources.

THE PORTFOLIO FAILS TO PROVIDE A PATH TOWARD SOLUTION TO THE ALREADY EXISTING AND GROWING MILLIONS OF ACRE FEET OF WATER SHORTAGE BETWEEN DEMAND AND SUPPLY

It is a great disappointment that the portfolio appears as an embellished political smokescreen for the Delta tunnel carried over from the prior administration. The portfolio lacks new substance except for confirmation of the predetermined commitment to build a Delta tunnel and clear new intent to abandon the Delta.

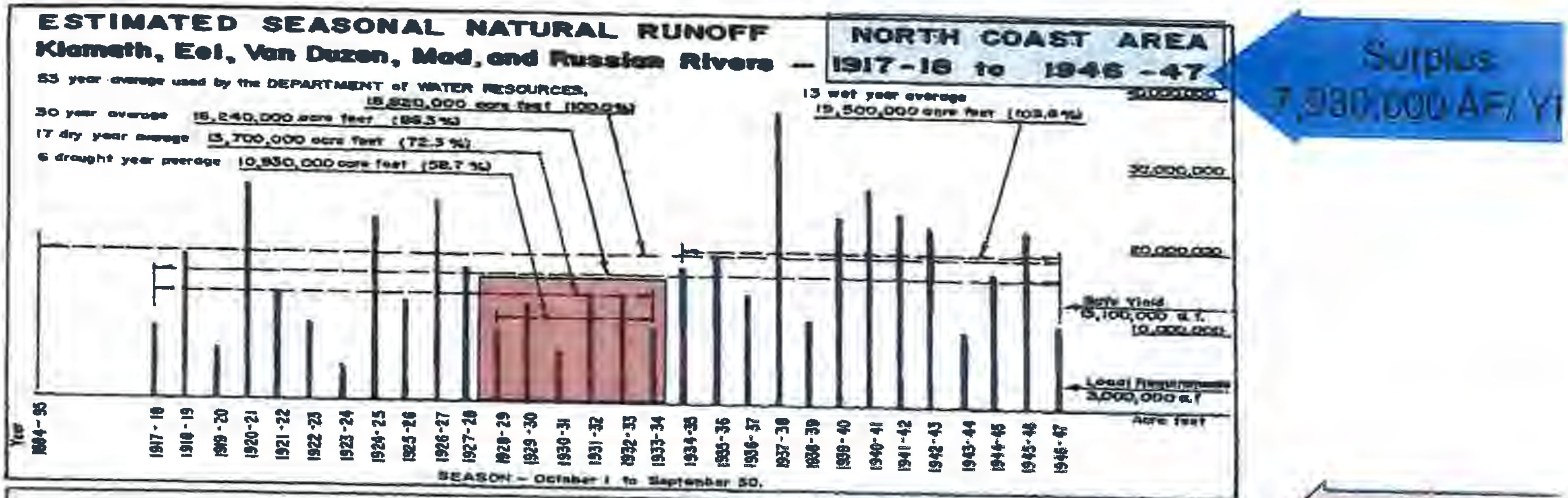
Identification of a path to develop millions of acre feet of surplus water to supply the existing and growing demand is difficult at best and yet the portfolio lacks substance in addressing demand. Water transfers based on paper water, taking water needed in one area of the state to develop another and allowing surplus/interim water to be used in a manner which creates long term or permanent demand are steps in the wrong direction. Climate change and increasing temperature are moving from south to north yet the portfolio and California politics is oriented to move water from north to south at a huge cost in energy and other resources. The hundreds of miles of canals and related facilities which parallel and cross active earthquake faults are vulnerable to subsidence, earthquake damage and terrorist threats. The portfolio should include consideration of measures to preclude new development in arid areas which create demand for imported water. Sustaining development in arid areas particularly with lakes and swimming pools can be expected to result in higher consumptive use of water and energy. The suggestion by some that consideration be given to location of new development closer to the needed resources deserves your attention.

Please be informed that the South Delta Water Agency joins in these comments and they are hereby also being submitted on its behalf.

Thank you for the opportunity to comment.

Dante John Nomellini
Manager and Co-Counsel

WEBER FOUNDATION STUDIES



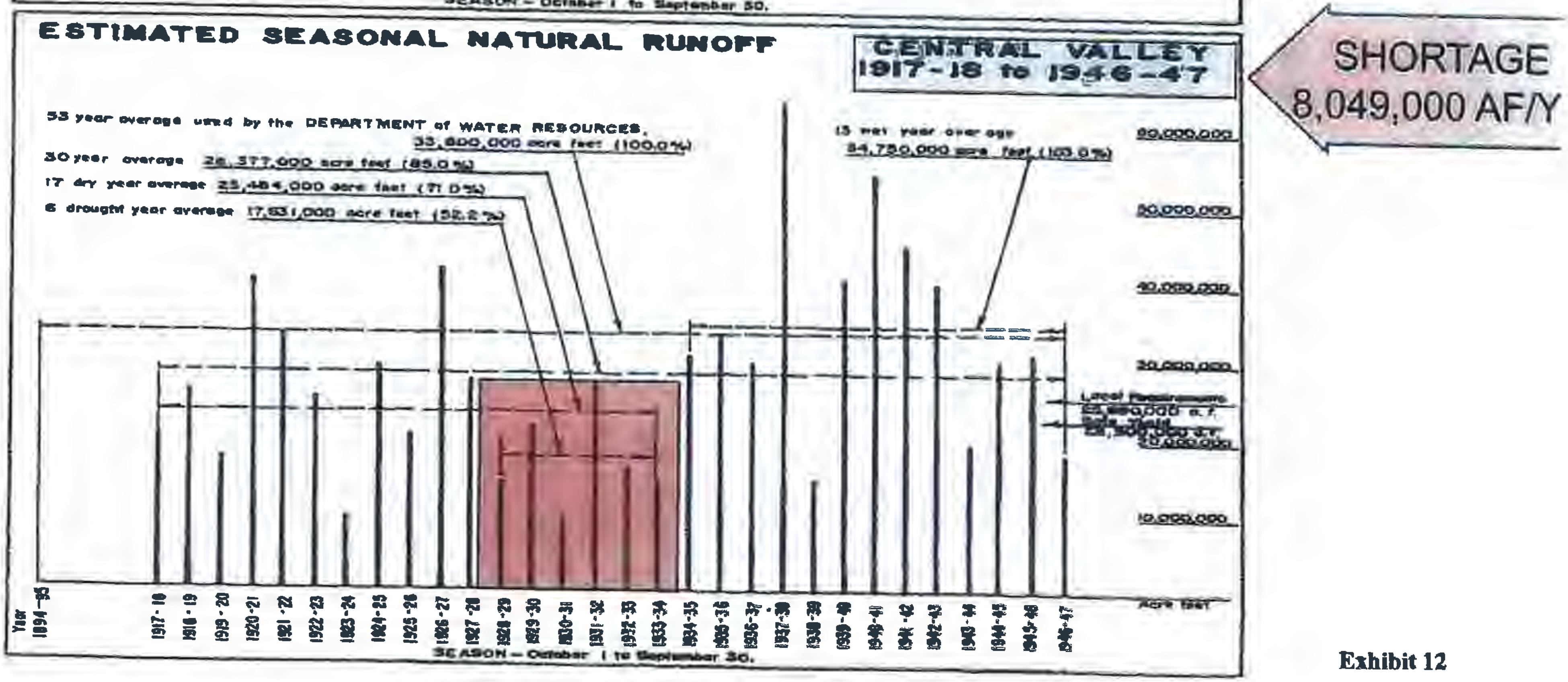


Exhibit 12

Table 3. *Sacramento River Multiyear Droughts* (reconstructed from tree rings prior to 1900)

Period	Length (in years)	Average Runoff (MAF)
1579–82	4	12.4
1593–95	3	9.3
1618–20	3	13.2
1651–55	5	12.3
1719–24	6	12.6
1735–37	3	12.2
1755–61	6	13.3
1776–78	3	12.1
1793–95	3	10.7
1839–41	3	12.9
1843–46	4	12.3
1918–20 (actual)	3	12.0
1929–34 (actual)	6	9.8
1959–62 (actual)	4	13.0
1987–92 (actual)	6	10.0

Exhibit 13

John A. Wilson

Preliminary Edition

Bulletin No. 76

DELTA WATER FACILITIES

Exhibit 14


Courtesy of Los Angeles Times

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

STATEMENT OF CLARIFICATION

This preliminary edition presents a comparison of alternative solutions to the Delta problems. This bulletin shows that the Single Purpose Delta Water Project is the essential minimum project for successful operation of the State Water Facilities. This bulletin also presents, for local consideration, optional modifications of the Single Purpose Delta Water Project which would provide additional local benefits.

The evaluation of project accomplishments, benefit-cost ratios, and costs of project services, are intended only to indicate the relative merits of these solutions and should not be considered in terms of absolute values. Benefits related to recreation are evaluated for comparative purposes. Detailed recreation studies, presently in progress, will indicate specific recreation benefits.

Subsequent to local review and public hearings on this preliminary edition, a final edition will be prepared setting forth an adopted plan. The adopted plan will include, in addition to the essential minimum facilities, those justifiable optional modifications requested by local entities.

Bulletin No. 76

REPORT TO THE
CALIFORNIA STATE LEGISLATURE
ON THE

DELTA WATER FACILITIES

AS AN INTEGRAL FEATURE OF

THE STATE WATER RESOURCES DEVELOPMENT SYSTEM

John A.

EDMUND G. BROWN
Governor

HARVEY O. BANKS
Director

December, 1960

Letters . . . .

HARVEY O. BANKS
Director

EDMUND G. BROWN
Governor

STATE OF CALIFORNIA
Department of Water Resources
SACRAMENTO

December 30, 1960

Honorable Edmund G. Brown, Governor
Members of the Legislature of the
State of California

Gentlemen:

I have the honor to transmit herewith a preliminary edition of Bulletin No. 76, "Delta Water Facilities". This bulletin summarizes the results of investigations conducted pursuant to the Abshire-Kelly Salinity Control Barrier Acts of 1955 and 1957, Chapter 1434, Statutes of 1955, and Chapter 2092, Statutes of 1957, as amended by Chapters 1765 and 2036, Statutes of 1959.

Bulletin No. 76 presents findings and conclusions regarding the feasibility of alternative plans for the Delta feature of the State Water Facilities included in the Burns-Porter Act approved by the electorate on November 8, 1960. The Delta water facilities would (1) provide adequate water supplies throughout the Delta, (2) transport water across the Delta without undue loss or deterioration in quality, (3) provide flood and seepage control to Delta islands, (4) provide improved vehicular transportation access, and (5) minimize effects on existing recreation development and enhance recreation growth. All of the alternative plans would accomplish the first two objectives, and two alternative plans would also accomplish the other objectives.

Further planning for Delta water facilities should include consideration of joint financing and construction by federal, state and local interests. Facilities for flood and seepage control, vehicular transportation and recreation would not have to be constructed unless local governmental agencies desire these works and are willing to share in certain costs thereof. There would be some conflicts of interest in operation of these facilities which must be resolved prior to a decision by local interests regarding the extent of local participation. To this end, it is recommended that a period of a few months be allowed for local review and resolution of differences, after which public hearings should be held by the California Water Commission and the department. Following the public hearings, a final edition of Bulletin No. 76, incorporating any necessary modifications, should be published.

Very truly yours,

HARVEY O. BANKS
Director

BOARD OF CONSULTING ENGINEERS

November 15, 1960

Mr. Harvey O. Banks, Director
Department of Water Resources
Sacramento, California

Dear Mr. Banks:

This Board of Consulting Engineers which was active in 1958 was reconvened in April, 1960 and has met from time to time with your staff. Thus we have followed the preparation of this report and have reported to you following each meeting.

The Delta Water Facilities constitute needed works vital to the transfer of northern water into and across the Delta to provide water for use in the Delta and for export to water deficient areas along the Coast, in the San Joaquin Valley and to Southern California, to be financed under the California Water Resources Development Bond Act. The Board is of the opinion that the gross future water requirements for municipal and industrial purposes in the Delta have been very liberally estimated.

The Board is of the opinion that the engineering studies, designs and estimates are adequate for the purpose of this planning report and we support the conclusions and recommendations embodied therein.

We believe that the Chipps Island Barrier Project should not be authorized or constructed owing to its high cost of nearly $200 million which substantially exceeds project benefits.

The Delta Water Project, including such economically desirable flood control, seepage control, transportation and recreational features as may be agreed upon by local Delta beneficiaries willing to share in costs, would meet all water requirements with maximum net project benefits, and should be constructed under the Bond Act.

Respectfully submitted,

E. A. [illegible]

O. J. Porter

Ray K. Linsley

Samuel B. Morris, Chairman

This bulletin summarizes the engineering and economic conclusions and recommendations concerning the feasibility of providing salinity control, water supply, flood and seepage control, transportation facilities, and recreation development for the Sacramento-San Joaquin Delta, and conserving and making the most beneficial use of a major portion of the water resources of the State. Alternative plans for accomplishing some or all of these objectives are presented and compared to indicate their relative merits and to guide the selection of facilities to be constructed.

Findings presented herein are the result of intensive studies conducted during a five-year period. Previous studies and cooperative investigations by various public and private agencies and individuals were utilized in development of the plans. The cooperation of these individuals and agencies is gratefully acknowledged.

Study procedures and analyses are summarized in six supporting office reports, which are available to interested agencies and individuals. The subjects and titles of these reports are:

- Salinity Incursion and Water Resources
- Delta Water Requirements
- Channel Hydraulics and Flood Channel Design
- Recreation
- Plans, Designs, and Cost Estimates
- Economic Aspects

1879-1880, WM. HAM. HALL

Salinity incursion into the Delta, which was recorded in 1841 and 1871, was recognized by the early settlers as a potential problem to water supplies, and a salt water barrier was proposed in the 1860's. State Engineer Wm. Ham. Hall subsequently studied a barrier in conjunction with flood control and concluded that, while a physical barrier could be constructed, the costs would exceed the benefits.

1924-1928, WALKER YOUNG INVESTIGATION

A series of subnormal water supply years began in 1917 and various proposals for barriers were advanced during the early 1920's. In cooperation with the State of California and the Sacramento Valley Development Association, the U. S. Bureau of Reclamation, under the direction of Walker Young, extensively investigated four alternative barrier sites and concluded that it was ". . . physically feasible to construct a Salt Water Barrier at any one of the sites investigated . . ." It was recognized that without a barrier, ". . . salinity conditions will become more acute unless mountain storage is provided to be released during periods of low river discharge . . ." Economic analyses of barriers were not made by Mr. Young.

1929-1931, BULLETINS NOS. 27 AND 28

Following investigation of the physical feasibility of barriers, the State Division of Water Resources studied the phenomena of salinity incursion and the economics of barriers. In Bulletin No. 27, "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay," it was concluded that ". . . invasion of salinity . . . as far as the lower end of the . . . Delta is a natural phenomenon which, in varying degree, has occurred each year as far back as historical records reveal." It was also concluded that the Delta could be protected from saline invasion and be assured of ample and dependable water supplies if mountain storage were utilized to provide a controlled rate of outflow from the Delta.

In Bulletin No. 28, "Economic Aspects of a Salt Water Barrier," it was concluded that it was not economically justifiable to construct a barrier. With conditions of upstream water use at that time, it was concluded that the most economical solution to salinity incursion and provision of adequate water supplies in the Delta could be achieved by constructing upstream storage and controlling rates of outflow during periods of insufficient natural outflow.

1953, ABSHIRE-KELLY SALINITY CONTROL BARRIER ACT

Shasta Reservoir on the Sacramento River was constructed and began operation in 1944 for salinity control and other purposes. Expanding water requirements in the Central Valley and San Francisco Bay area stimulated reconsideration of barrier plans for water conservation and related purposes. Seven alternative plans for barriers in the Bay and Delta system were investigated by a Board of Consultants and the State Division of Water Resources for the California Water Project Authority. The Board of Consultants concluded that barriers in the San Francisco Bay system would not be functionally feasible due to the uncertainty of the quality of water in a barrier pool. It was recommended by the Division of Water Resources that "Further consideration be given only to . . . barriers . . . at or upstream from the Chipps Island site" at the outlet of the Delta.

1955, ABSHIRE-KELLY SALINITY CONTROL BARRIER ACT

Additional legislation specified study of a system of works in the Delta, referred to as the Junction Point Barrier Plan, and the Chipps Island Barrier Plan. The principal purposes of these studies were to develop complete plans for water supply in the San Francisco Bay area and to provide salinity control and urgently needed flood protection in the Delta.

CHAPTER 1434

An act to provide for a study of the junction point barrier and appurtenant facilities, the Abshire-Kelly Salinity Control Barrier Act of 1955, relating to barriers for salinity and flood control purposes, declaring the urgency thereof, to take effect immediately.

[Approved by Governor June 27, 1955. Filed with Secretary of State June 28, 1955.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby appropriated to the Water Project Authority the sum of one hundred thousand dollars ($100,000), payable from the Flood Control Fund of 1946, to initiate the further investigation and study of the Junction Point Barrier and Chipps Island Barrier and appurtenant facilities, as such barriers and facilities are described in the report of the Water Project Authority to the Legislature entitled "Feasibility of Construction by the State of Barriers in the San Francisco Bay System," dated March, 1955, for the purposes of developing complete plans of the means of accomplishing delivery of fresh water to the San Francisco Bay area, including the Counties of Solano, Sonoma, Napa, Marin, Contra Costa, Alameda, Santa Clara, San Benito, and San Mateo, and the City and County of San Francisco, providing urgently needed flood protection to agricultural lands in the Sacramento-San Joaquin Delta, conducting subsurface exploration work in the delta and designing facilities appurtenant to the cross-delta aqueduct, obtaining more complete information on the hydrology of the delta, and studying integration of the proposed project in the California Water Plan.

SEC. 2. The Water Project Authority may contract with such other public agencies, federal, state, or local, as it deems necessary for the rendition and affording of such services, facilities, studies, and reports to the Water Project Authority as will best assist it to carry out this act. The Water Project Authority may also employ, by contract or otherwise, such private consulting engineering and other technical services as it deems necessary for the rendition and affording of such services, facilities, studies, and reports as will best assist it to carry out this act.

SEC. 3. It is the intent of the Legislature that in conducting the study and investigation the Water Project Authority shall confer and exchange information with and shall seek the participation of the United States Navy, the United States Bureau of Reclamation, the United States Corps of Engineers and the local port districts to the extent possible.

SEC. 4. The Water Project Authority shall report to the Legislature the result of its study and investigation not later than March 30, 1957.

SEC. 5. This act shall be known and may be cited as the Abshire-Kelly Salinity Control Barrier Act of 1955.

SEC. 6. This act is an urgency measure necessary for the immediate preservation of the public peace, health or safety within the meaning of Article IV of the Constitution and shall go into immediate effect. The facts constituting such necessity are:

The areas adjacent to the San Francisco Bay urgently need an adequate supply of fresh water for domestic and industrial uses. It is essential to the public health, safety and welfare that a study of salinity control barriers as a means of securing such a supply of fresh water, be undertaken without delay.

A four-year investigation was contemplated, and an interim report, Bulletin No. 60, "Salinity Control Barrier Investigation", was published in March 1957, by the Department of Water Resources. This report outlined a water plan for the San Francisco Bay area, and recommended that the North Bay Aqueduct be authorized for construction. The North Bay Aqueduct was authorized by the Legislature in 1957. The report also compared the Biemond Plan, a system of works in the Delta, with the Chipps Island Barrier Plan, and recommended that further study be limited to the Biemond Plan.

1957, ABSHIRE-KELLY SALINITY CONTROL BARRIER ACT

The Legislature concurred in limiting further study to the Biemond Plan and stressed the need for improving the quality of water in the Delta and making the most beneficial use of the water resources of the State. A report on the further studies was scheduled for release by March 30, 1959.

CHAPTER 2092

An act relating to barriers for salinity and flood control purposes.

[Approved by Governor July 5, 1957. Filed with Secretary of State July 10, 1957.]

The people of the State of California do enact as follows:

SECTION 1. The Department of Water Resources may limit its studies of salinity control barriers to the Biemond Plan as described in Bulletin No. 60 of the Department of Water Resources entitled "Salinity Control Barrier Investigation," dated March, 1957, subject to such modifications thereof as the department may adopt, said studies being for the purposes of developing complete plans of the means of accomplishing delivery of fresh water to the Counties of Solano, Sonoma, Napa and Marin, providing urgently needed flood protection to agricultural lands in the Sacramento-San Joaquin Delta, accomplishing salinity control, improving the quality of water exported from the delta to the San Francisco Bay area, San Joaquin Valley, and southern portions of California, making the most beneficial use of the water resources of the State, and studying integration of the proposed project in The California Water Plan.

SEC. 2. The department may contract with such other public agencies, federal, state or local, as it deems necessary for the rendition and affording of such services, facilities, studies, and reports to the department as will best assist it to carry out this act.

SEC. 3. It is the intent of the Legislature that in conducting the study and investigation the department shall confer and exchange information with and shall seek the participation of the United States Navy, the United States Bureau of Reclamation, the United States Corps of Engineers, and the local port districts to the extent possible.

SEC. 4. The department shall submit a report to the Legislature stating the result of its study and investigation not later than March 30, 1959.

SEC. 5. This act shall be known and may be cited as the "Abshire-Kelly Salinity Control Barrier Act of 1957."

1959, ADDITIONAL LEGISLATION

The potential expansion of water requirements of the urban and industrial complex in the western Delta area, and greater upstream water use with resultant depletion of inflow to and outflow from the Delta, indicated need for more concentrated study of the water requirements and supplies of the Delta. Legislation was enacted in 1959 to undertake studies of the type and extent of future water requirements of lands which can be served from present channels in the western Delta, effects of upstream water uses on Delta supplies, plans for water service and costs thereof, and economic and financial feasibility of the plans. Additional legislation authorized studies of the most economical and efficient procedures of constructing levees for flood control.

CHAPTER 1765

An act providing for the investigation of water supplies and flood control levees for the Sacramento-San Joaquin Delta and making an appropriation therefor.

[Approved by Governor July 10, 1959. Filed with Secretary of State July 13, 1959.]

The people of the State of California do enact as follows:

SECTION 1. The Department of Water Resources shall investigate the water supplies for the Sacramento-San Joaquin Delta. The investigation shall include, among other things: (1) the type and extent of the future water requirements of lands which can be served from present channels in the western Delta; (2) the extent and nature of effects of upstream water developments on water supply available to such lands; (3) the development of plans for water service to such lands and estimates of costs thereof; and (4) economic and financial analyses of such plans. In carrying out the investigation, the department shall seek the co-operation and assistance of the counties and other local agencies and entities in the Sacramento-San Joaquin Delta and of the United States; may enter into contracts with such entities to assist it in carrying out the purposes of such investigation, and shall consult with and keep appropriate legislative committees informed of the progress of this work.

SEC. 2. There is appropriated from the California Water Fund to the Department of Water Resources the sum of two hundred thousand dollars ($200,000) to be expended for the purposes of this act.

SEC. 3. Section 4.5 is added to the Abshire-Kelly Salinity Control Barrier Act of 1957 (Chapter 2092, Statutes of 1957), to read:

SEC. 4.5. As a part of the studies being performed hereunder and to obtain such information as may be required to implement the plan included in the report referred to in Section 4, the department may conduct studies and investigations to determine the most economical and efficient type and methods and procedures of construction to provide an adequate levee system in the Delta.

SEC. 4. There is hereby appropriated to the Department of Water Resources from the California Water Fund the sum of two hundred thirty thousand dollars ($230,000), of which one hundred eighty thousand dollars ($180,000), may be expended for the studies and investigations authorized by Section 3 hereof, and fifty thousand dollars ($50,000) may be expended for such remedial work as may be necessary in connection with levee tests being performed as a part of the studies and investigations authorized by Section 3 hereof.

Intensive studies were made of the future economic growth of lands which can be served from channels in the western Delta. Particular attention was given to the future municipal and industrial water needs in the area and the future water supplies available in the Delta. Due to the expanded scope of the studies, the report was delayed.

CHAPTER 2036

An act to amend Section 4 of Chapter 2092, Statutes of 1957, relating to barriers for salinity and flood control purposes.

[Approved by Governor July 17, 1959. Filed with Secretary of State July 20, 1959.]

The people of the State of California do enact as follows:

SECTION 1. Section 4 of Chapter 2092, Statutes of 1957, is amended to read:

SEC. 4. The department shall submit a report to the Legislature stating the result of its study and investigation not later than January 2, 1961.

The unique character of the water supply problems of the Delta was recognized by the State Legislature when it amended the California Water Code in 1959 to include general policy regarding the Delta. This legislation calls for provision of salinity control and adequate water supplies in the Delta and states that water to which the users within the Delta are entitled should not be exported. The policy in this act is basic to the planning and operation of all works in the Delta or diversions therefrom.

CHAPTER 1766

An act to add Part 4.5 (commencing at Section 12200) to Division 6 of the Water Code, relating to delivery of surplus water into, and diversions thereof for exportation from, the Sacramento-San Joaquin Delta.

[Approved by Governor July 10, 1959. Filed with Secretary of State July 13, 1959.]

The people of the State of California do enact as follows:

SECTION 1. Part 4.5 (commencing at Section 12200) is added to Division 6 of the Water Code, to read:

PART 4.5. SACRAMENTO-SAN JOAQUIN DELTA

CHAPTER 1. GENERAL POLICY

12200. The Legislature hereby finds that the water problems of the Sacramento-San Joaquin Delta are unique within the State; the Sacramento and San Joaquin Rivers join at the Sacramento-San Joaquin Delta to discharge their fresh water flows into Suisun, San Pablo and San Francisco Bays and thence into the Pacific Ocean; the merging of fresh water with saline bay waters and drainage waters and the withdrawal of fresh water for beneficial uses creates an acute problem of salinity intrusion into the vast network of channels and sloughs of the Delta; the State Water Resources Development System has as one of its objectives the transfer of waters from water-surplus areas in the Sacramento Valley and the north coastal area to water-deficient areas to the south and west of the Sacramento-San Joaquin Delta via the Delta; water surplus to the needs of the areas in which it originates is gathered in the Delta and thereby provides a common source of fresh water supply for water-deficient areas. It is, therefore, hereby declared that a general law cannot be made applicable to said Delta and that the enactment of this law is necessary for the protection, conservation, development, control and use of the waters in the Delta for the public good.

12201. The Legislature finds that the maintenance of an adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban, and recreational development in the Delta area as set forth in Section 12220, Chapter 2, of this part, and to provide a common source of fresh water for export to areas of water deficiency is necessary to the peace, health, safety and welfare of the people of the State, except that delivery of such water shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code.

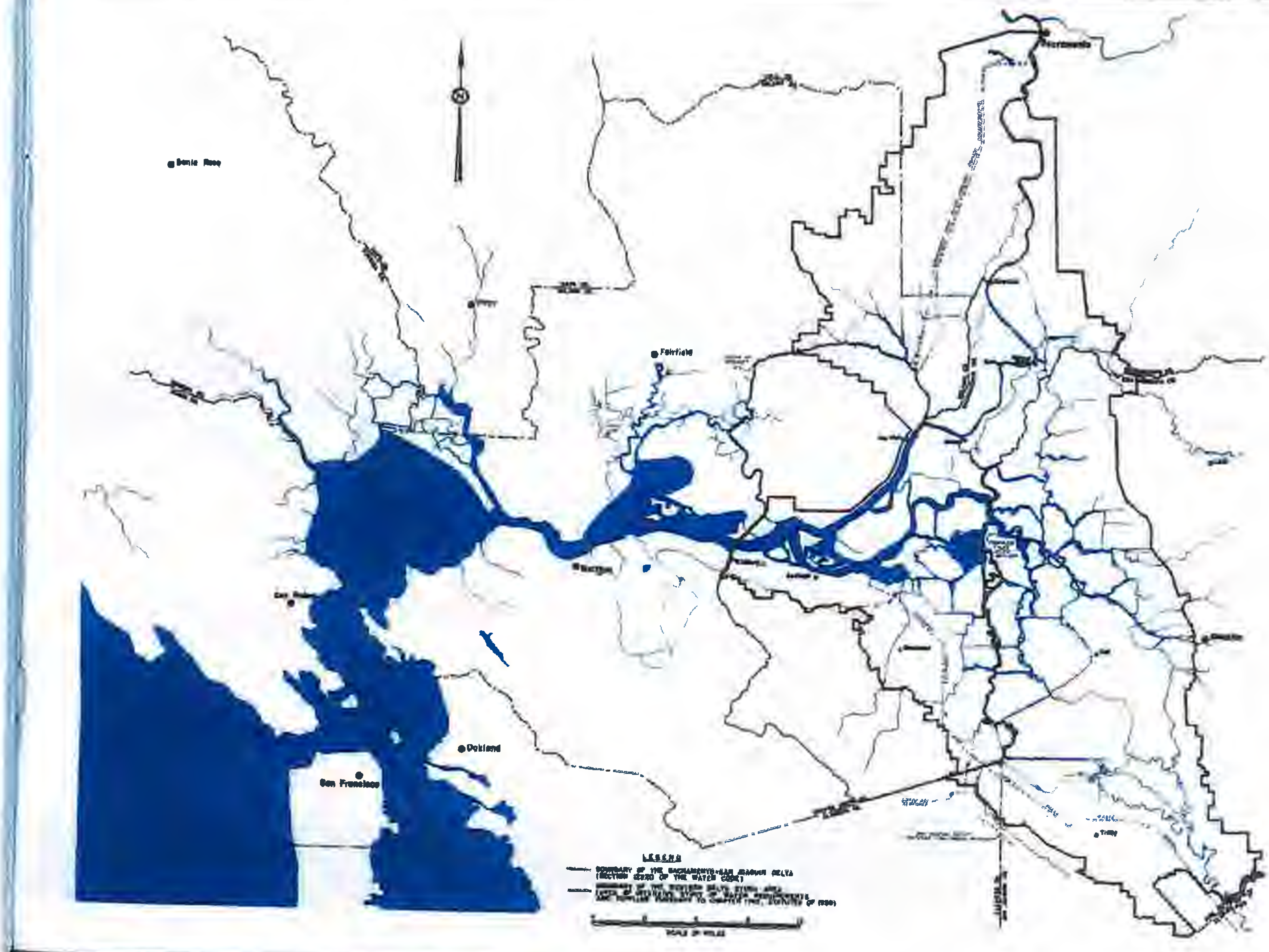
12202. Among the functions to be provided by the State Water Resources Development System, in coordination with the activities of the United States in providing salinity control for the Delta through operation of the Federal Central Valley Project, shall be the provision of salinity control and an adequate water supply for the users of water in the Sacramento-San Joaquin Delta. If it is determined to be in the public interest to provide a substitute water supply to the users in said Delta in lieu of that which would be provided as a result of salinity control no added financial burden shall be placed upon said Delta water users solely by virtue of such substitution. Delivery of said substitute water supply shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code.

12203. It is hereby declared to be the policy of the State that no person, corporation or public or private agency of the State or the United States should divert water from the channels of the Sacramento-San Joaquin Delta to which the users within said Delta are entitled.

12204. In determining the availability of water for export from the Sacramento-San Joaquin Delta no water shall be exported which is necessary to meet the requirements of Sections 12202 and 12203 of this chapter.

12205. It is the policy of the State that the operation and management of releases from storage into the Sacramento-San Joaquin Delta of water for use outside the area in which such water originates shall be integrated to the maximum extent possible in order to permit the fulfillment of the objectives of this part.

This legislation also described the area of the Delta to which the general policy applies. The boundary of the Delta, as described in Section 12220 of the Water Code, is indicated on the facing map. The area considered in the intensive studies of water requirements and supplies is described as the Western Delta Study Area.

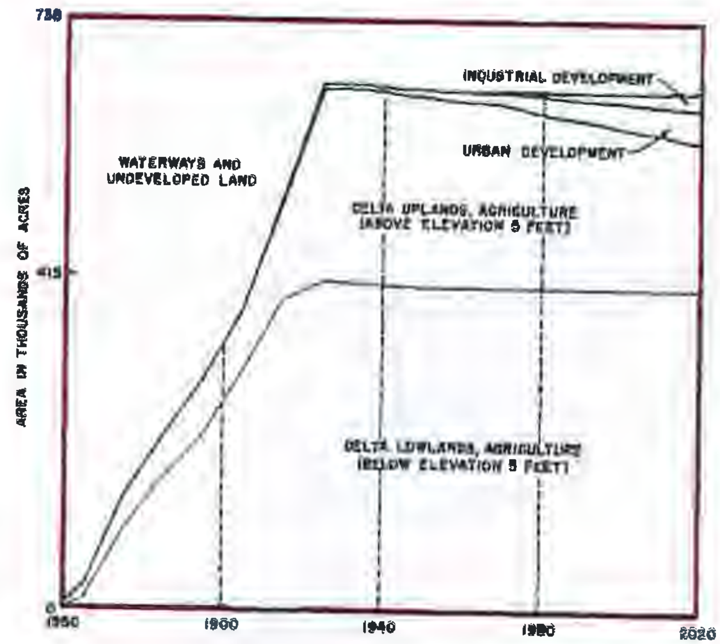

Sacramento
Santa Rosa
Fairfield
Oakland
San Francisco
LEGEND
BOUNDARY OF THE SACRAMENTO-SAN JOAQUIN DELTA (SECTION 12220 OF THE WATER CODE)
SCALE OF MILES

The Delta, located at the confluence of the Sacramento and San Joaquin Rivers system, is a unique feature of the California landscape. The Delta encompasses some 738,000 acres, interlaced with 700 miles of meandering waterways covering 50,000 acres. About 415,000 acres of land, referred to as Delta Lowlands, lie between elevations of 5 feet above and 20 feet below sea level. This area is composed of peat, organic sediments, and alluvium, and is protected from flood water and high tides by man-made levees. The extensive waterways afford opportunity for shipping and provide a wonderland for boating and water sports. These same waterways must safely discharge flood waters of the Central Valley.

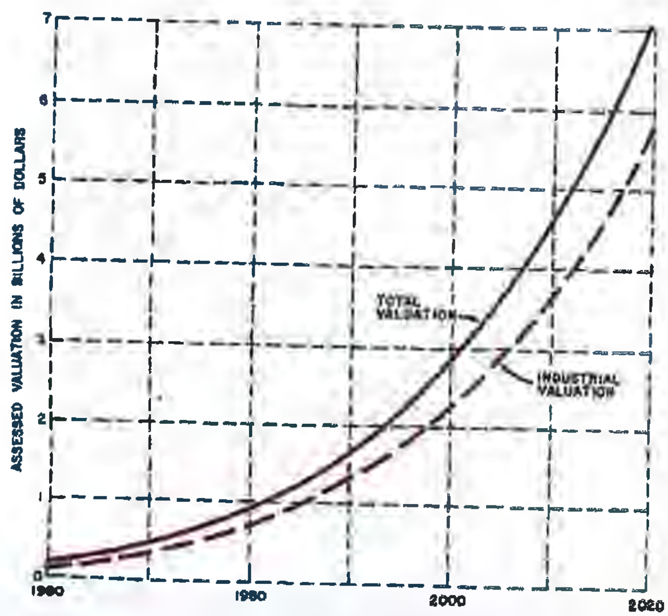
The fortunate combination of fertile soils, convenient water supplies, and shallow-draft shipping to central California markets led to development of an intensified agricultural economy in the Delta. Initial reclamation of the marshlands began slowly in the 1850's, but rapidly expanded after state assistance was provided by a swampland act in 1861. By 1930, all but minor areas of the swamplands had been leveed and were in production.

The Delta has historically been noted for its asparagus, potatoes, celery, and varied truck crops. Recently, greater emphasis has been placed on field corn, milo, grain, and hay, although the Delta still produces most of the nation's canned asparagus. The Delta's agricultural economy for many years was dependent upon repulsion of ocean salinity by fresh water outflow, which fluctuated widely, but during the past sixteen years has been protected largely by releases from upstream reservoirs of the Federal Central Valley Project during summer months.

Several towns and cities are located in the upland areas and an industrial complex is expanding in the western part of the Delta. Early industrial development centered around food and kindred products, steel production, fibreboard, lumber, and ship-building activity. Large water-using industries, such as steel, paper products, and chemicals, have developed in the western area where water, rail, and highway transportation, coupled with water supplies, has stimulated growth. The manufacturing employment in this area was about 10,000 people in 1960.



TRENDS IN LAND USE



PROJECTED ASSESSED VALUATIONS WITHIN THE WESTERN DELTA STUDY AREA

A deep-draft ship channel serving commercial and military installations terminates at Stockton, and another is being constructed to Sacramento. Water-borne shipments in the Delta amounted to about 6,000,000 tons annually in recent years.

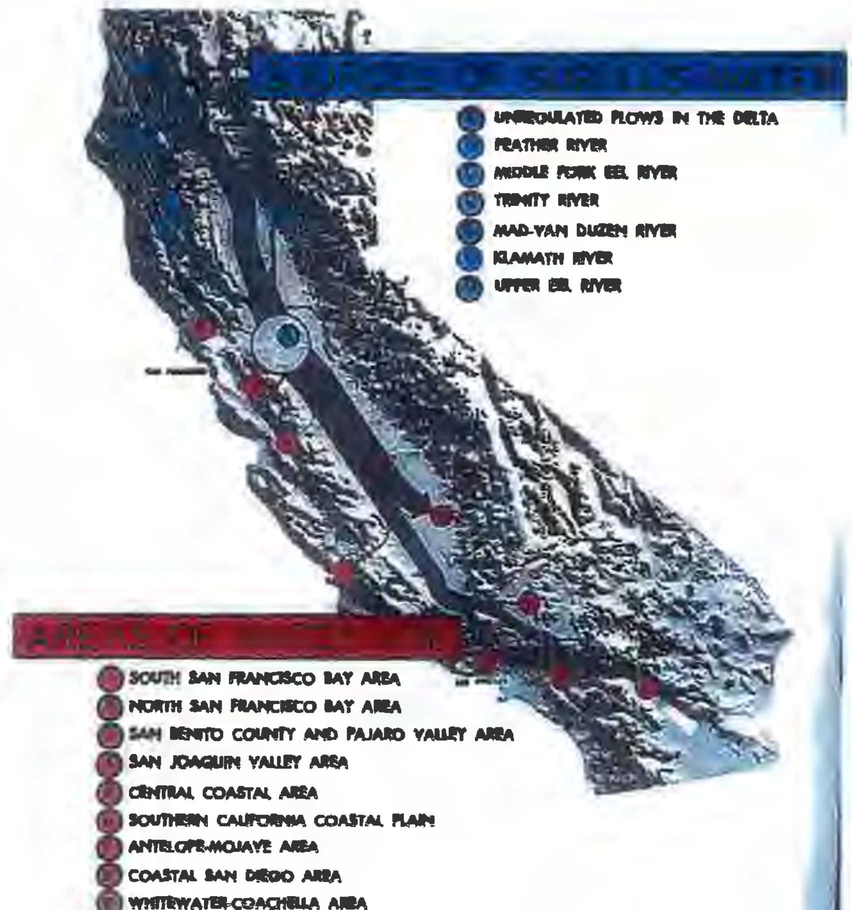
The Delta encompasses one of California's most important high quality natural gas fields. Since 1941 the field has produced about 300,000,000 cubic feet of methane gas for use in the San Francisco Bay area.

With the growing significance of recreation, the Delta has blossomed into a major recreation area at the doorsteps of metropolitan development in the San Francisco Bay area, Sacramento, and Stockton. In 1960, nearly 2,800,000 recreation-days were enjoyed in this boating wonderland.

In 1959, the State Legislature enacted the California Water Resources Development Bond Act to finance construction of the State Water Resources Development System. The bond act was approved by the California electorate in November 1960. The State Water Facilities, the initial features of this system, will complement continuing local and federal water development programs and include the very necessary works in the Delta.

One of the principal objectives of the State Water Resources Development System is to conserve water in areas of surplus in the north and to transport water to areas of deficiency to the south and west. The Delta is important in achieving this objective, since it receives all of the surplus flows of Central Valley rivers draining to the ocean during winter and spring months and is the last location where water not needed in the Delta or upstream therefrom can conveniently be controlled and diverted to beneficial use. Surplus water from the northern portion of the Central Valley and north coastal rivers will be conveyed by the natural river system to the Delta, where it must be transferred through Delta channels to export pumping plants without undue loss or deterioration in quality. Aqueducts will convey the water from the Delta to off-stream storage and use in areas of deficiency to the south and west.

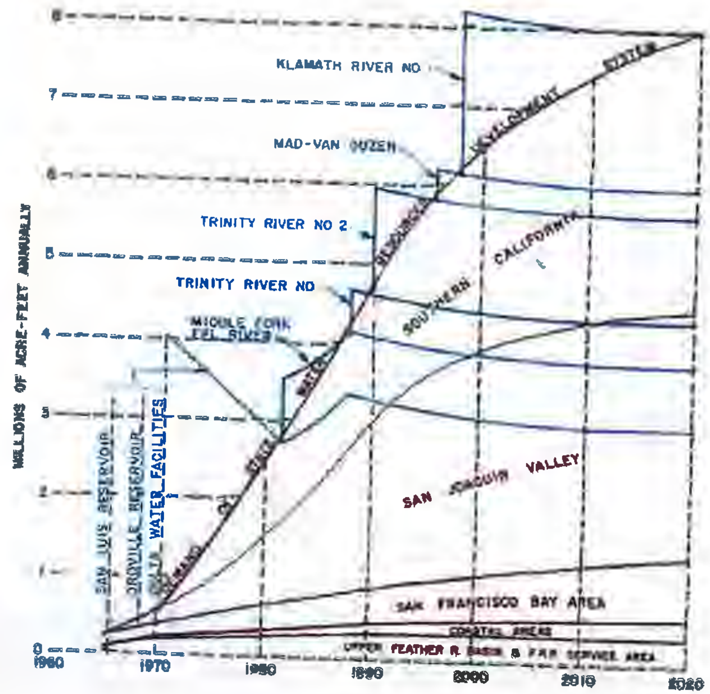
In addition to being an important link in the interbasin transfer of water, the Delta is a significant segment of California's economy, and its agricultural, municipal, and industrial water supply problems, and flood control and related problems, must be remedied. A multipurpose system of Delta water facilities, which will comprise one portion of the State Water Resources Development System, is the most economical means of transferring water and solving Delta problems.



Tracy Pumping Plant

Full demands on the State Water Resources Development system can be met until about 1981 from surplus water in and tributary to the Delta with regulation by the proposed Oroville and San Luis Reservoirs. However, upstream depletions will reduce the available surplus supplies and water will have to be imported from north coastal sources after that year. It is anticipated that coordinated operation of the State Water Resources Development System and the Federal Central Valley Project will afford a limited increase in usable surplus Delta supplies beginning in 1981. As indicated in the chart, upstream depletions will continue to decrease the available surplus supplies.

The coordinated use of surplus water in and tributary to the Delta and of regulated or imported supplements to this supply, as required, is referred to as the Delta Pooling Concept. Under this concept of operation the State will ensure a continued supply of water adequate in quantity and quality to meet the needs of export water users. Advantage will be taken of surplus water available in the Delta, and as the demand for water increases and the available surplus supply is reduced by further upstream uses, the State will assume the responsibility of guaranteeing a firm supply of water, which will be accomplished by construction of additional storage facilities and import works. At the same time, the water needs of the Delta will be fully met.



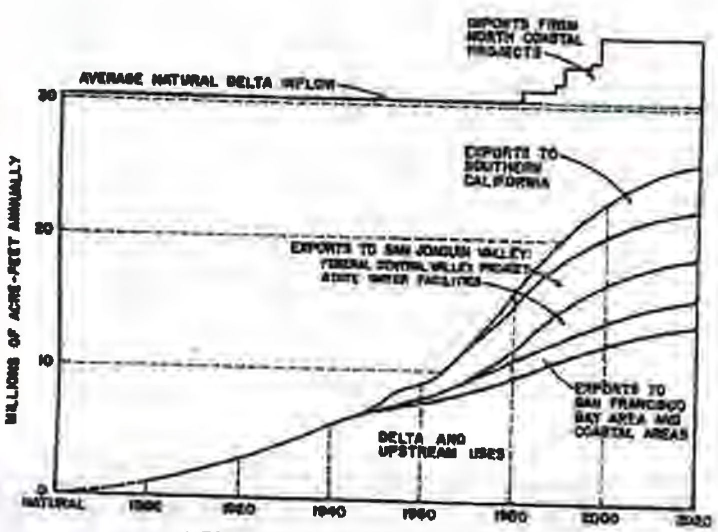
WATER SOURCES AND USES

HISTORICAL SALINITY INCURSION
1920-1960

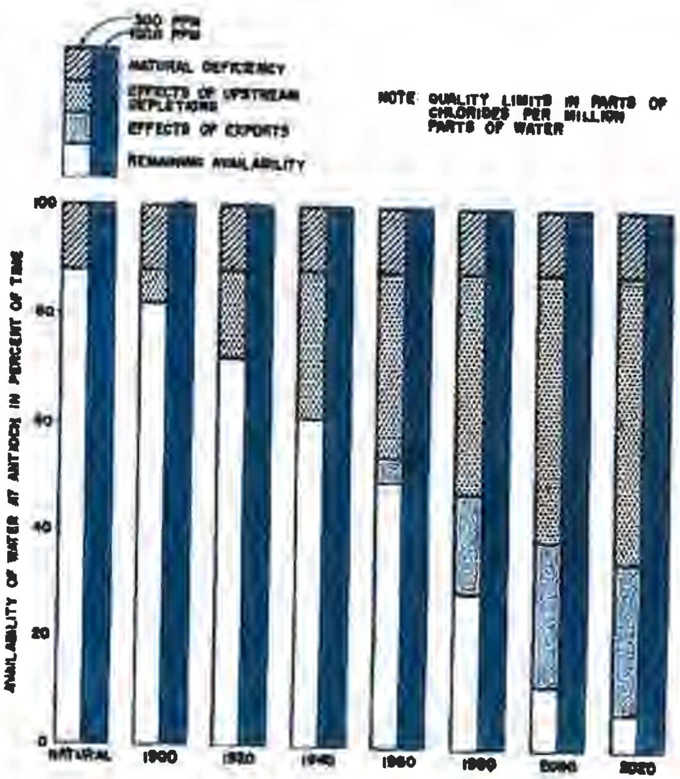
Salinity incursion into the Delta results from the flooding and ebbing of ocean tides through the San Francisco Bay and Delta system during periods when the fresh water outflow from the Delta is insufficient to repel the saline water. The natural fresh water outflow from the Central Valley was historically inadequate to repel salinity during summer months of some years. The first known record of salinity encroachment into the Delta was reported by Cmdr. Ringgold, U. S. Navy, in August 1841, whose party found the water at the site of the present city of Antioch very brackish and unfit for drinking. Since that time, and particularly after the turn of the century, with expanding upstream water use salinity incursion has become an increasingly greater problem in Delta water supplies. The maximum recorded extent of salinity incursion happened in 1931, when ocean salts reached Stockton. Since 1944 extensive incursion has been repulsed much of the time by fresh water releases from Central Valley Project storage in Shasta and Folsom Reservoirs. Without such releases, saline water would have spread through about 90 percent of the Delta channels in 1955 and 1959. Although upstream uses might not have reached present levels in the absence of the Central Valley Project, salinity problems would still have been very serious during most years.

Further increase in water use in areas tributary to the Delta will worsen the salinity incursion problem and complicate the already complex water rights situation. To maintain and expand the economy of the Delta, it will be necessary to provide an adequate supply of good quality water and protect the lands from the effects of salinity incursion. In 1959 the State Legislature directed that water shall not be diverted from the Delta for use elsewhere unless adequate supplies for the Delta are first provided.

The natural availability of good quality water in the Delta is directly related to the amount of surplus water which flows to the ocean. The graph to the right indicates the historic and projected availability of water in the San Joaquin River at Antioch containing less than 350 and 1,000 parts chlorides per million parts water, under long-term average runoff and *without* specific releases for salinity control. It may be noted that even under natural conditions, before any significant upstream water developments, there was a deficiency of water supplies within the specified quality limits. It is anticipated that, without salinity control releases, upstream depletions by the year 2020 will have reduced the availability of water containing less than 1,000 ppm chlorides by about 60 percent, and that exports will have caused an additional 30 percent reduction.



USE OF DELTA WATER SUPPLIES



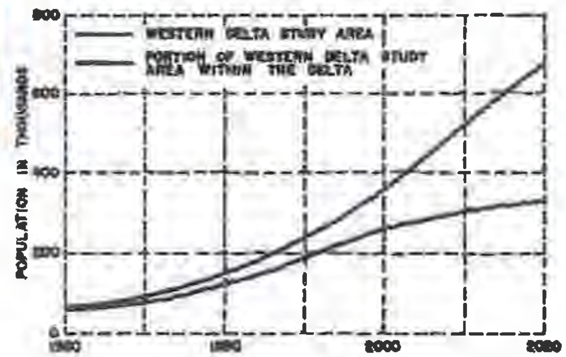
DELTA WATER QUALITY WITHOUT SALINITY CONTROL

The magnitude of the past and anticipated future uses of water in areas tributary to the Delta, except the Tulare Lake Basin, is indicated in the diagram to the left. It may be noted that, while the present upstream use accounts for reduction of natural inflow to the Delta by almost 25 percent, upstream development during the next 60 years will deplete the inflow by an additional 20 percent. By that date about 22 percent of the natural water supply reaching the Delta will be exported to areas of deficiency by local, state, and federal projects. In addition, economical development of water supplies will necessitate importation of about 5,000,000 acre-feet of water seasonally to the Delta from north coastal streams for transfer to areas of deficiency.

Municipalities in the surrounding upland areas of the Delta, except in the western portion, obtain their water supplies from surface or underground sources which are, or will be with further development, adequate to meet their needs. In the western Delta, the principal municipalities rely on supplies from the Contra Costa Canal which are diverted from Delta channels. The main problem relates to quality of the water. At the present time, the mineral quality of the supplies deteriorates during some summer and fall months below standards established by the U. S. Public Health Service. This results from incursion of ocean salts, combined with industrial wastes and poor quality return water from the Central Valley. Assurance of good quality supplies in adequate quantities to meet present requirements and anticipated future growth is one of the most pressing problems in the Delta.

Estimates of future municipal water requirements in the western Delta area were based on projected population and per capita use. Population projections were founded on national, state, and regional forecasts for moderately high economical conditions. Although these conditions result in forecasts which may exceed an anticipated "most probable" projection by about ten percent, it is believed that this approach will assure adequate consideration of Delta water requirements in plans for diversion of surplus water from the Delta.

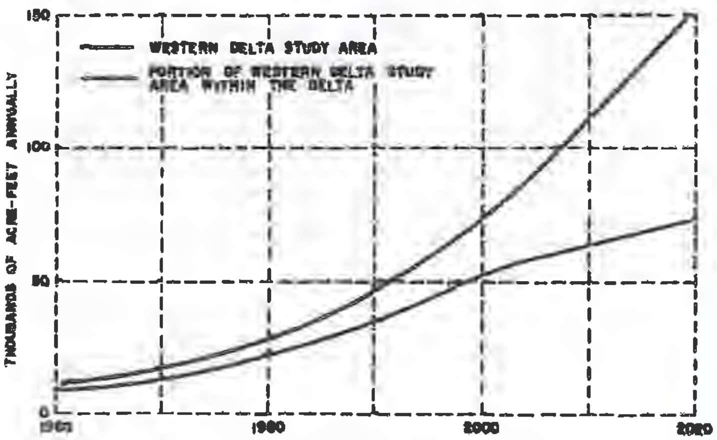
Projected estimates of per capita water uses reflect anticipated increases due to greater emphasis on water-using appliances in homes, additional lawns and landscaping, and the general trend toward higher standards of living. An average municipal water use of about 140 gallons per capita per day at this time reflects the climatic and economic conditions of the area. It is anticipated that the average use in low density residential areas will increase to about 200 gallons per capita per day by 2020. The estimated total annual municipal water requirement in the western Delta area indicates about a fifteenfold increase by 2020.



POPULATION
WESTERN DELTA STUDY AREA

ESTIMATED MUNICIPAL WATER REQUIREMENTS
WESTERN DELTA STUDY AREA
(In thousands of acre-feet annually)

Area	1960	1980	2000	2020
Western Delta Study Area				
Contra Costa Co.	9.6	26.8	62.7	116.4
Solano Co.	0.7	1.4	10.0	35.4
Portion of Western Delta Study Area Within the Delta				
Contra Costa Co.	8.6	22.6	52.0	71.4
Solano Co.	0.0	0.0	0.4	2.5

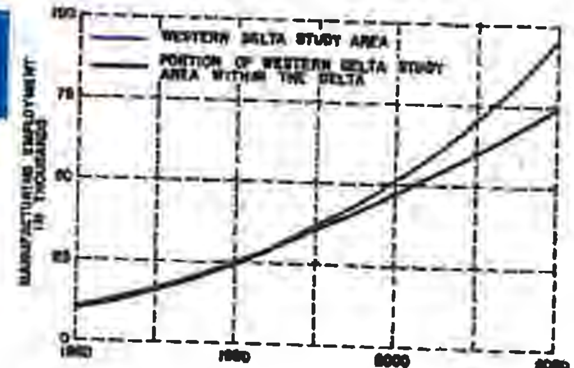


MUNICIPAL WATER REQUIREMENTS
WESTERN DELTA STUDY AREA

The problems of industrial water supply are similar to municipal supply problems in that they are concentrated in the western Delta area and center around quality aspects. Deterioration of water supplies by salinity incursion in 1959 caused curtailment of production in several plants and a production halt in one major industry. As additional upstream development and beneficial use of water takes place, the duration and degree of salinity incursion each year will become more extended. It will become increasingly necessary to provide adequate industrial water supplies in the western Delta area for maintenance and expansion of the present economy.

Estimates of future industrial growth were based on correlation of state and regional manufacturing employment with national projections. Projections to 1980 were based on detailed analyses of the several components of the industrial complex, while projections beyond that date reflect total manufacturing employment. A sevenfold increase in manufacturing employment in the western Delta area is anticipated by 2020. Increasing productivity per employee, due to automation and technical advancements, coupled with projected employment, indicates a thirtyfold increase in production by that date.

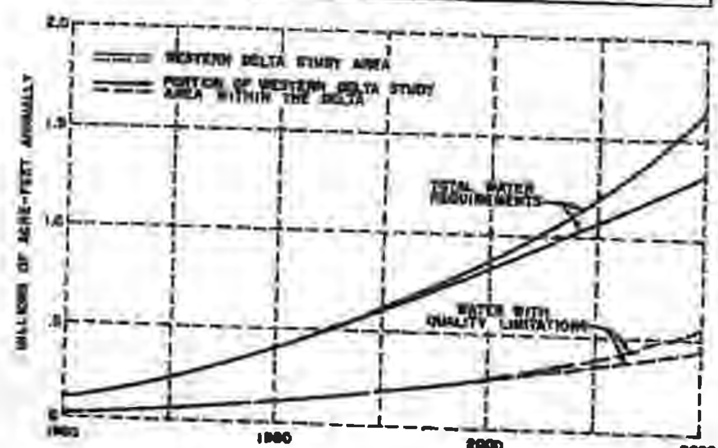
Estimates of future water supplies to enable the production increases were based on six manufacturing categories, and reflect a continuation of the trend of decreasing water use per unit of production. A fifteenfold increase in total industrial water requirements is indicated by 2020. The total requirement includes two types of industrial water. One type is for processing and recirculated cooling with quality limitations, and the second type is for general cooling where good quality water is not required because materials of construction in cooling equipment can satisfactorily withstand a wide range of quality conditions.



MANUFACTURING EMPLOYMENT
WESTERN DELTA STUDY AREA

ESTIMATED INDUSTRIAL WATER REQUIREMENTS
WESTERN DELTA STUDY AREA
(In thousands of acre-feet annually)

Area	[illegible]	[illegible]	[illegible]	[illegible]
Western Delta Study Area				
Total water requirements, Contra Costa Co.	[illegible]	[illegible]	770	1,270 (?)
Total water requirements, Solano Co.	1	7	67	[illegible]
Water with quality limitations, Contra Costa Co.	70	120	251	[illegible]
Water with quality limitations, Solano Co.	–	2	21	[illegible]
Portion of Western Delta Study Area Within the Delta				
Total water requirements, Contra Costa Co.	[illegible]	[illegible]	770	[illegible]
Total water requirements, Solano Co.	–	–	9	[illegible]
Water with quality limitations, Contra Costa Co.	70	120	251	[illegible]
Water with quality limitations, Solano Co.	–	–	3	19



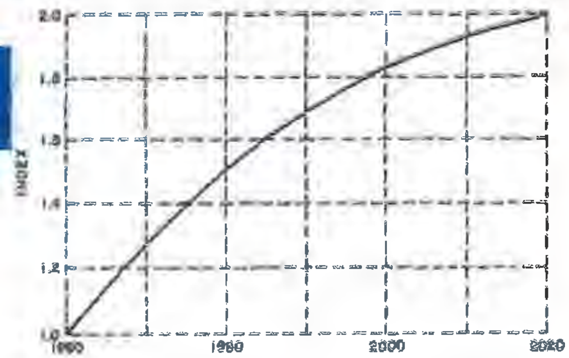
INDUSTRIAL WATER REQUIREMENTS
WESTERN DELTA STUDY AREA

Delta Problems — [illegible]

For many years farmers in the Delta have been confronted with salinity incursion in Delta channels. Since 1944 they have enjoyed partial salinity protection and supplemental water due to releases from Shasta and Folsom Reservoirs. As additional water is utilized in areas tributary to the Delta, there will be further reductions in unregulated late spring runoff to the Delta, which will result in diminishing supplies in the western Delta and greater Delta-wide reliance on regulated fresh water outflow. About 40,000 acres in the western Delta are faced with water supplies of poor quality even if future export projects are not constructed. In the southern portion of the Delta the present water supplies during summer months consist mainly of very poor quality drainage water in the San Joaquin River. Operation of the proposed San Joaquin Valley waste conduit may reduce the amount of return drainage water available in the San Joaquin River. If this occurs, substitute water supplies would have to be provided.

Although most of the suitable land in the Delta is now irrigated, limited additional development in the uplands is anticipated, and more intense use by double-cropping will be made of Delta lowlands. Estimates of expanding water requirements reflect correlations with statewide projections of the economic demand for farm produce. It is anticipated that about 10,000 acres of "new" land will be irrigated in the upland areas, but about 40,000 acres will be converted to urban uses by 2020.

Future water requirements were based on projected crop patterns and unit water requirements of the various crops. Some additional water may be required for leaching of lands surrounded by brackish water. Separate allowance for this purpose was provided in operation studies of plans which result in brackish water in western Delta channels.

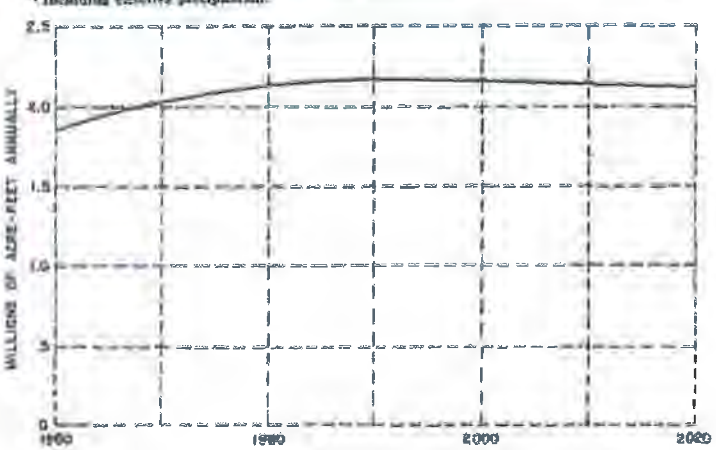


INDEX OF AGRICULTURAL PRODUCTIVITY

ESTIMATED AGRICULTURAL WATER REQUIREMENTS WITHIN THE DELTA [1]
(in thousands of acre-feet annually)

Area	1960	1980	2000	2020
Alameda County	13	15	15	15
Contra Costa County	236	272	275	270
Sacramento County	294	339	342	336
San Joaquin County	838	967	977	958
Solano County	238	264	267	261
Yolo County	244	282	285	279
TOTAL	1,863	2,139	2,161	2,119

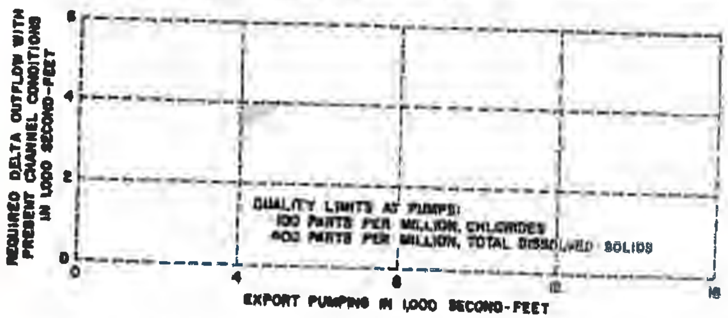
[1] Including effective precipitation.



AGRICULTURAL WATER REQUIREMENTS

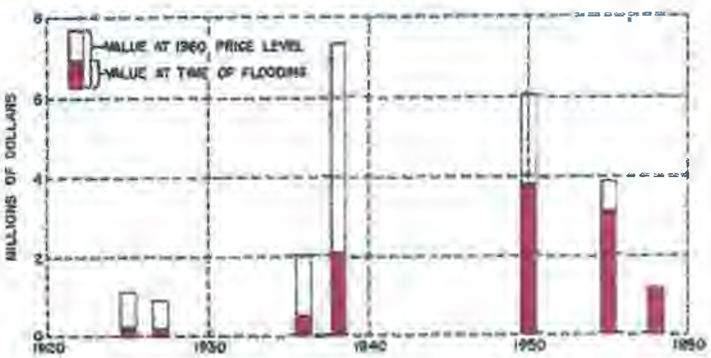
Delta Problems

During winter months of most years, flood flows exceed Delta uses and flush ocean salts from the channel system. Surplus water can be diverted from the Delta under these conditions. During summer and early fall months, the inflow to the Delta is generally limited to regulated flow in the Sacramento River. This supply must meet all uses in the Delta and export therefrom, and prevent salinity incursion from unduly degrading the quality of water in the Delta. Due to the hydraulic characteristics of the complex channel system, the amount of outflow from the Delta necessary for quality control at the export pumping plants increases as the rates of export increase.

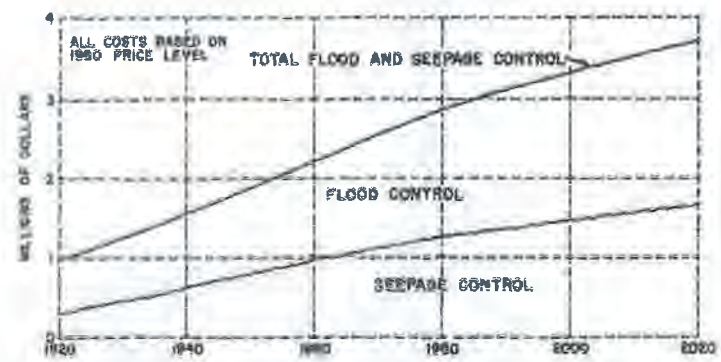


Water in the Sacramento River follows two basic routes to the export pumping plants. It flows from the vicinity of Walnut Grove through several generally parallel channels in a southerly direction across the central portion of the Delta, and also through channels in the western portion around Sherman Island and then upstream into the central area. The quantities transferred by the first route are *not sufficient* to supply the pumps and enroute Delta users during summer months, and water transferred around Sherman Island by the second route is mixed with and carries ocean salts into the Delta. Therefore, greater quantities of water will be necessary to reduce the salinity concentrations in the western Delta, unless a physical barrier is constructed or water is diverted directly southward across the Delta.

SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW WITH PRESENT CHANNEL CONDITIONS



HISTORICAL FLOOD DAMAGE IN THE DELTA

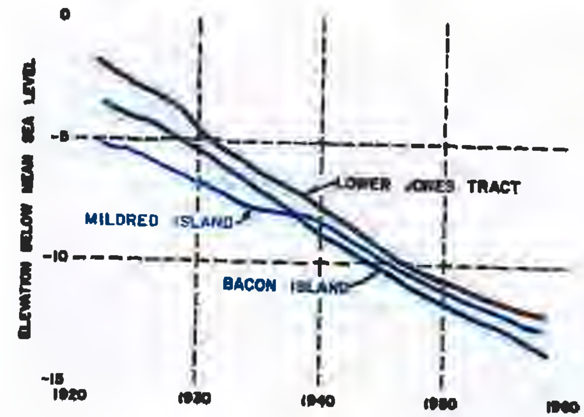


ANNUAL COSTS - FLOOD AND SEEPAGE CONTROL

While the peat soils of the Delta are excellent for growing crops, they cause several difficult levee maintenance and farming problems. Levees along the channels have been constructed on the peat and periodically must be raised and widened as the organic foundation soils are consolidated. During the early stages of land reclamation, islands were frequently flooded by overtopping of the levees. However, under present conditions floods due to overtopping are infrequent in the central portion of the Delta, but numerous islands have been flooded when sections of the levees have suddenly failed. This apparent trend toward decreasing levee stability results from subsidence of the land surface and resultant greater forces on the levees. Despite increasing maintenance work on many existing levees, no significant improvement in protection is achieved.

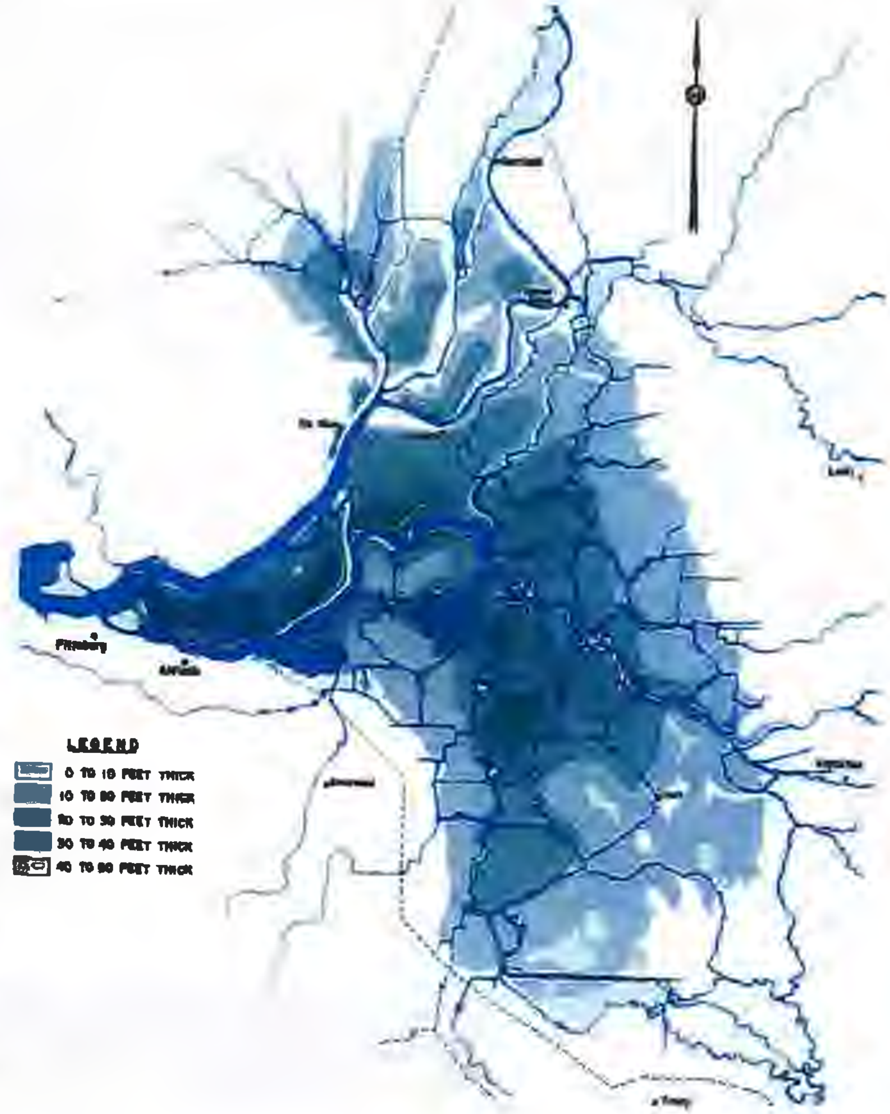
The land surface in areas of peat soils is subsiding at an average rate of about three inches per year. This is generally attributed to oxidation of the peat fibers, wind erosion, compaction by farm equipment, and loss of water in the upper few feet. As a result of land subsidence, future levees in many areas will be 30 to 35 feet high. Work must be initiated soon to gradually increase the stability of the levees for these future conditions. In this connection, it must be recognized that flood protection for the Delta must include works in the Delta. Flood stages in the Delta result from inflow and high tides, frequently amplified by heavy winds on the ocean and Bay system. Although upstream flood control reservoirs will afford some relief, more stable levees are needed to safely resist the high tide and flood stages.

As the peat soils are lost by oxidation and erosion, the seepage problems are compounded. Differences in elevation between water levels in the channels and in the islands will increase, and the resistance by the peat to upward movement of water from



LAND SUBSIDENCE

AREAS OF PEAT AND RELATED ORGANIC SEDIMENTS

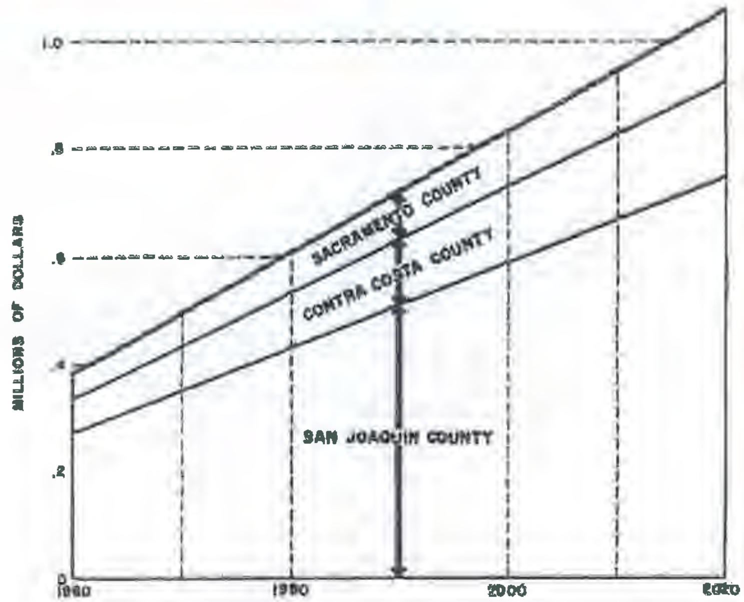


underlying sand aquifers will be reduced. Unless suitable methods of arresting the loss of peat are developed, farming in the Delta will cause continued subsidence. Experience has shown that this subsidence will continue to within about two to three feet above the bottom of the peat. Significant tracts of Delta land will become impractical to farm unless seepage is controlled and the danger of inundation is reduced.

The largest natural gas field in areal extent in the State of California is located in the Delta. The geological structure of this field is strikingly similar to the structure of the oil fields of Wilmington, California, but the gas pressures are dissimilar. Because of the similarity of geologic conditions, studies are being conducted to determine if deep-seated subsidence might occur as the gas is extracted. Estimates based on preliminary data indicate a maximum subsidence of two feet in the Rio Vista area, if all the gas is extracted from the field.

The wooden barges and stern paddle wheelers long ago disappeared from the Delta scene, to be replaced by fast trucks, ocean-going freighters, and tugs towing steel barges. However, despite tremendous technological advances in transportation, the Delta, with its poor foundation soils and miles of open waterways, has hindered the development of a satisfactory highway system.

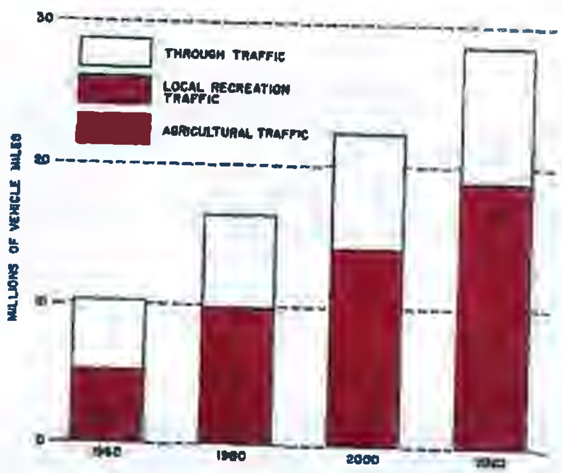
Vehicular transportation, even today, is confined mainly to the crowns of the levees which encircle the farmlands, and inter-island traffic is dependent to a large extent on ferries. Periodic levee reconstruction to compensate for consolidation and land subsidence results in delays and detours for the traveling public and farm-to-market commerce. In winter months much of the area is inaccessible because of muddy roads. There are 950 miles of paved roads in the area, but because of the unstable peat foundation, the costs of maintenance and operation are disproportionately high. For example, in San Joaquin County only 12 percent of the county's 1,780 miles of roads is in the Delta, but almost 30 percent of the county's annual costs of $1,000,000 for highway facilities is expended in the Delta. Future costs will increase due to greater use of the road system.



ANNUAL COST OF MAINTAINING
COUNTY ROADS WITHIN THE DELTA

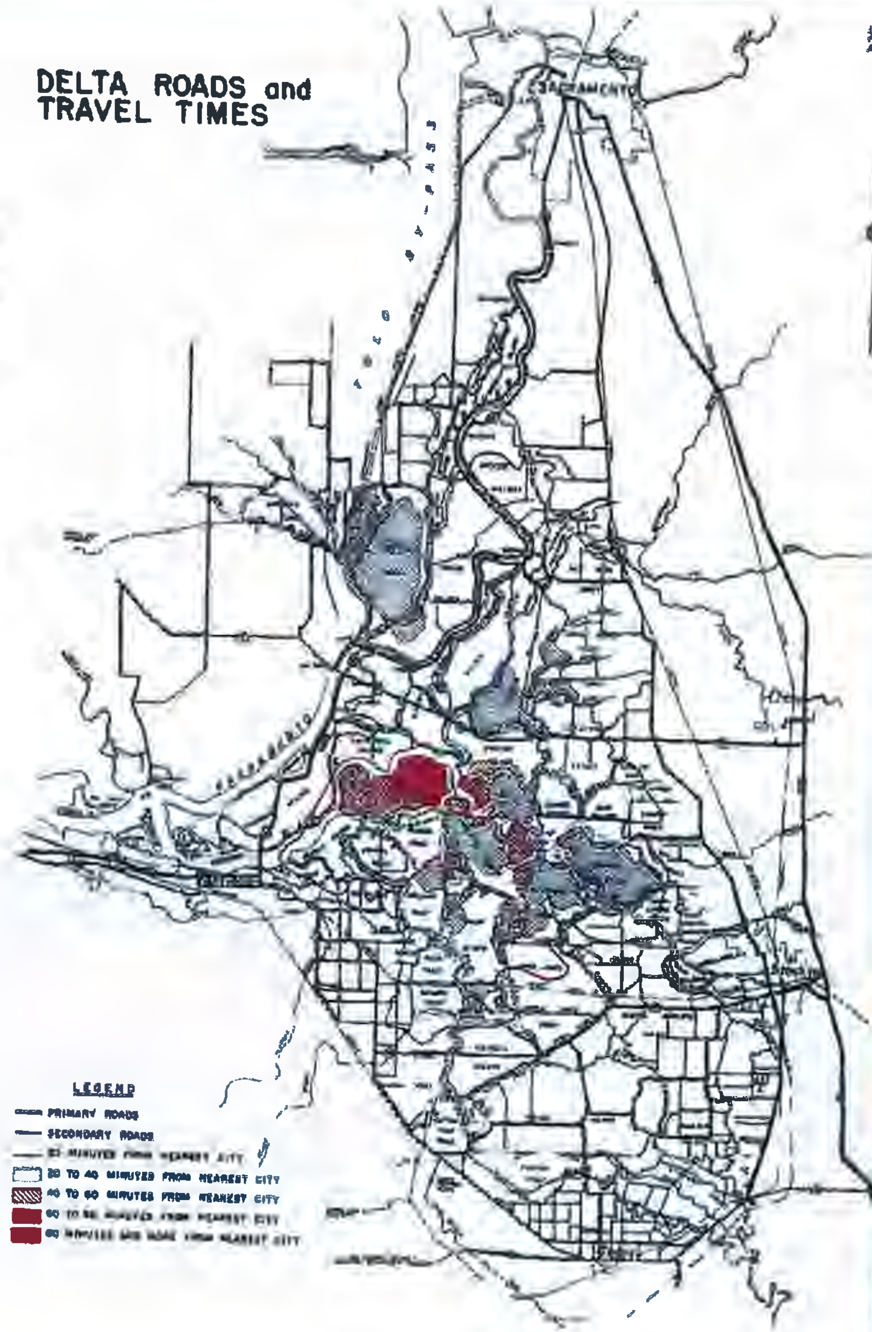
While it is true that today's Delta roads are greatly improved over those of the past, there still remains a serious lack of access to many remote locations of the Delta. Improvements are also needed in roads linked with the state and county highway networks. Travel times to principal cities of Stockton, Tracy, Sacramento, and Antioch are depicted on the map.

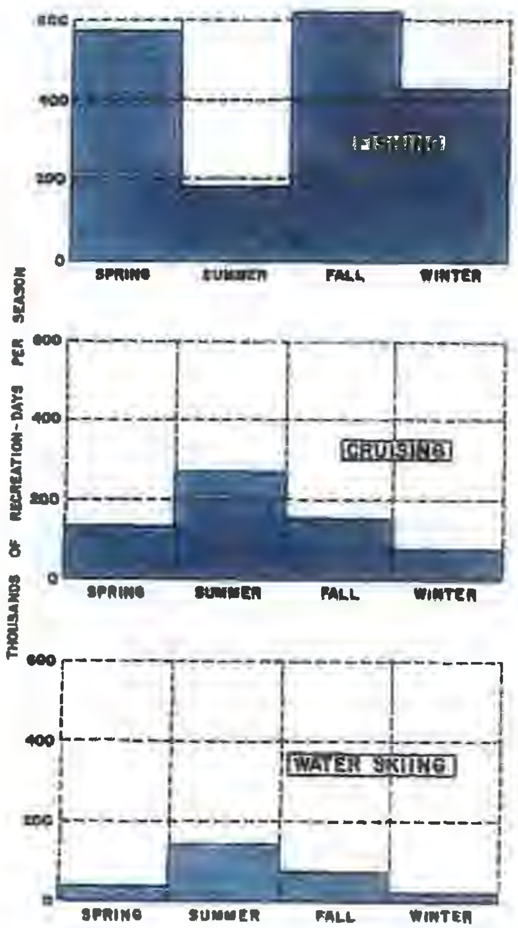
An expanded and improved system of roads would unquestionably make the Delta more attractive to the recreation industry. The new roadways also would benefit many local landowners who are presently at an economic disadvantage in shipment of their crops to markets. Increasing production in the Delta, due to anticipated double-cropping and improvements in farming practices, will increase the amount of agricultural road traffic.



TRENDS IN TRAFFIC

DELTA ROADS and TRAVEL TIMES





RECREATION PATTERNS IN 1960

Courtesy of Los Angeles Times

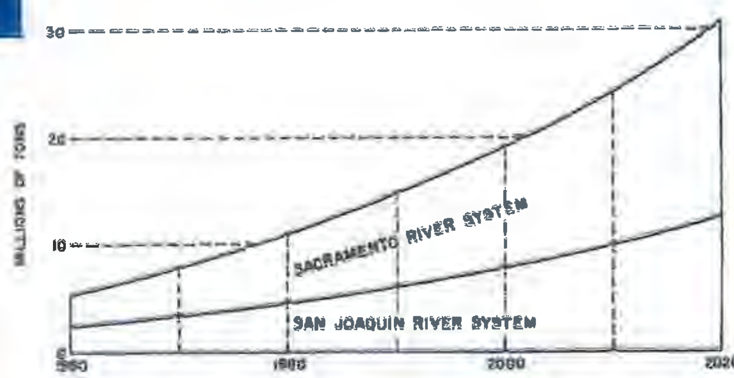
Courtesy of Los Angeles Times

The 50,000 acres of water surface and almost 1,000 miles of shore line in the Delta offer a vast and fascinating area with a great diversity of recreational opportunities. Fishing is the favorite pursuit and striped bass is the leading catch. Salmon, shad, black bass, catfish, and sturgeon are also important in the sportsman's bag. The maze of Delta channels is appealing to boatmen for cruising, and the many miles of calm water are ideal for water skiing and high-speed boating. While many of the channels are not extensively used, due mainly to difficulty of access and lack of service facilities, other areas have become congested and competition is developing between fishermen, boatmen, and skiers. Safety of the recreationists is becoming a significant problem and local law enforcement agencies are increasing their patrols. Levee erosion problems due to speeding boats also have developed in some localities. Picnicking and swimming are becoming more attractive as facilities are developed, and duck and pheasant hunting is very popular. There are now 123 private and public resorts which cater primarily to fishermen and boatmen in the Delta. In addition, many of these resorts are also developing facilities for picnicking and camping.

Courtesy of Hubert Miller

Although the Delta at the present time is a scene of substantial recreation use, there is ample room for expansion. Many miles of shore line and large areas of water are still available for recreational development. As the rapid population growth of the Bay area continues, recreation activity in the Delta will reflect this increase. Based on a future of continued general economic prosperity and population growth, the amount of recreation in the Delta will increase from 2,800,000 recreation-days at the present time to as many as 14,000,000 recreation-days by 2020. Despite the size of the Delta, proper local zoning and control will be essential for public safety and continued enjoyment. If the full recreation potential of the region is to be realized, coordinated planning by state and local agencies will be required.

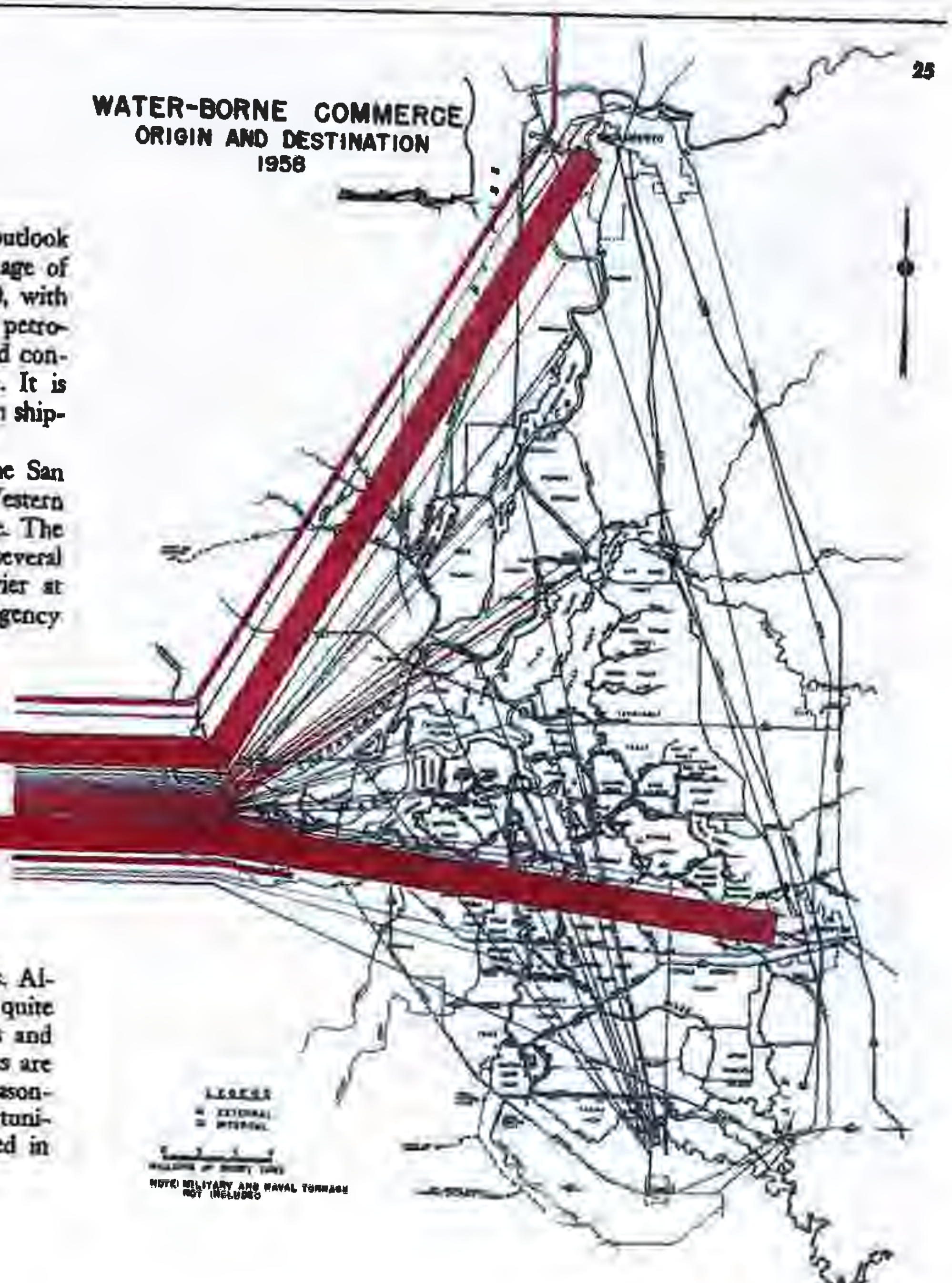
The Delta channels are extensively utilized by vessels ranging in size from rowboats to deep-draft commercial freighters and warships. The significance of navigation in the Delta has risen and fallen in the past, but in the last few decades it has been steadily increasing. The Corps of Engineers maintains many miles of channels in authorized navigation projects, the principal one in recent years being the Stockton Deep Water Channel. Construction is now underway on the Sacramento Deep Water Channel. Petroleum products carried by tugs and barges account for the majority of commercial shipping, but large amounts of farm produce are shipped by barges and deep-draft freighters.



WATER-BORNE COMMERCE

Courtesy of Robert Yelland

WATER-BORNE COMMERCE
ORIGIN AND DESTINATION
1958



Projections of future commerce indicate an optimistic outlook for shipping in the Delta. It is anticipated that the tonnage of commercial shipping will increase about fivefold by 2020, with petroleum being the principal commodity. Projections of petroleum shipments were related to population projections and continuation of the trend toward more vehicles per capita. It is anticipated that the present relationship between petroleum shipments by water and by other means will continue.

In 1955 in conjunction with studies of barriers in the San Francisco Bay system, an opinion was requested of the Western Area Joint Panel on effects of barriers on national defense. The panel, which was composed of representatives of the several branches of the military service, concluded that a barrier at Chipps Island would be permissible, if it contained an emergency access for navigation.

The Delta channels are widely used for recreation boats. Although some areas are relatively unused, other areas become quite congested. Conflicting interests arise between water skiers and cruising parties and the fishermen. In some locations levees are subjected to severe erosion by boat-generated waves. All reasonable measures must be undertaken to preserve boating opportunities, and facilities to enhance recreation can be constructed in certain locations.

Planning and Design Concepts

Planning for solutions to the complex Delta problems necessitates full recognition of the interrelated effects on all phases of the Delta's economy. The best solution should reflect the greatest overall benefits and least detriments, realizing that both objectives cannot be completely achieved when basic interests differ. Economies of construction and operation generally may be effected by multi-use of facilities. Therefore, consideration must be given to multipurpose development.

DELTA WATER SUPPLY

Water users in the Delta enjoy a naturally convenient source of supply in the numerous channels from which water is diverted by siphon or low-lift pumps. The supply problem in portions of the Delta stems from the poor quality of water, due to salinity incursion from the Bay and degradation by agricultural and industrial wastes. Adequate water supplies could be provided either by regulated releases of stored fresh water to repel salinity incursion and flush other wastes, or by constructing a physical barrier [illegible] and conveying [illegible] beyond the barrier [illegible] would involve [illegible] in control in the western [illegible] channels and provision of substitute fresh water supplies to users who could not then divert from the channels containing brackish water. All three alternatives were evaluated, with particular attention to minimizing modifications to existing water supply systems.

The California Water Code specifies that one of the functions of the State Water Resources Development System is to provide salinity control and an adequate water supply in the Delta. If it is in the public interest to provide substitute supplies in lieu of salinity control, no added financial burden shall be placed on the local water users as a result of such substitution. The code also declares that water to which the Delta is entitled shall not be diverted. It is clearly established that supplying water for the Delta must be a primary and integral function of the State Water Facilities.

WATER SALVAGE

Unless physical works are constructed in the Delta, increasingly greater quantities of outflow will be required for quality control as more and more water is transferred across the Delta. However, most of these required outflows could be salvaged by constructing [illegible] directly across the Delta to prevent commingling with brackish water near the outlet of the Delta.

The quality of water available for export, as well as for use in the Delta, must be suitable for various purposes. Standards for mineral quality, adopted by the Department of Water Resources and incorporated in water service contracts, permit not more than 400 parts of total dissolved solids and 100 parts of chlorides per million parts of water.

FLOOD AND SEEPAGE CONTROL

Floodstages in the Delta result from a combination of high tides, amplified by heavy winds on the ocean and Bay system, and inflow to the Delta. Historic inundations have generally resulted from levee failures, rather than overtopping. As the land behind the levees continues to subside, the stability of the levees decreases.

Physical and economic factors dictate an extended construction period for improvement of levees on organic soils. To reduce the extent and cost of levee improvements, it is prudent to pass flood waters through improved flood channels. Additional flood control reservoirs on rivers entering the Delta are contemplated for construction in the near future. [illegible] Delta flood channel [illegible] rates of flow [illegible] [illegible] channels [illegible] additional regulation of the Cosumnes, Mokelumne, Calaveras, Stanislaus, and Tuolumne Rivers. Although the "design" floods reaching the Delta after completion of these works may generally be expected to occur on an average of once every fifty years, the degree of frequency is not particularly meaningful in the tidal channels of the Delta, since protection is largely dependent on levee stability. It should be recognized that complete flood protection generally cannot be assured by construction of control works. Continued emphasis should be placed on flood plain zoning in the Delta for low value improvement uses as generally associated with farming.

Construction of principal flood channels and creation of interior channels would afford an opportunity to regulate water stages in the interior channels. Since the rate of seepage inflow to the island is directly related to the level of water in the surrounding channels, seepage could be reduced by lowering the water levels.

However, project operation might [illegible] increased seepage problems in certain locations. Where these problems are evidenced by [illegible] operation, remedial measures would be necessary. Allowance [illegible] cost of such works were included in planning for areas of [illegible] damage.

VEHICULAR TRANSPORTATION

[illegible] in the road network of the [illegible] recreational [illegible] travel, could conveniently and economically be incorporated in master levee construction for flood and seepage control. Construction of the master levees would involve a wide berm on the landward side of existing levees in most locations. This berm would provide a suitable base for a road. Parking areas off the roadway could also be constructed at many locations. Channel closures in the master levee system would eliminate the need for ferries in certain locations.

Where existing roads would be rendered unusable by construction and operation of the Delta water facilities, equivalent service would be provided. Road improvements which would enhance the existing system, such as better road surfacing or extensions to connect with nearby routes, could be incorporated if local agencies desire these improvements and participate in the costs.

RECREATION

The Delta [illegible] tion at this time, yet its potential [illegible] eral times greater. Planning for any facilities in the Delta should seek to minimize adverse effects on recreation, consistent with sound economics, and to enhance the attractiveness [illegible] of the Delta for further [illegible] development. It is recognized that [illegible] seepage control measures, or other [illegible] movement [illegible] recreation activity. While [illegible] would be [illegible] by providing [illegible] portage facilities, some inconvenience would remain. Where such conflicts occur, local choice will be necessary between flood and seepage control works or open channels for recreation. Additional recreation facilities and joint use of certain lands for recreation and other purposes should be planned to enhance the potential recreational development. Local desires, as evidenced by questionnaires and discussions with county recreation agencies, guided planning for recreation facilities.

NAVIGATION

Principal ship channels in the Delta serve deep-draft commercial and military shipping. Shallow-draft tug and barge traffic utilizes the ship channels and many other channels in the Delta. The effects of alternative plans on commercial navigation can [illegible] and the nature and extent of [illegible] measures [illegible] can be determined. Unfortunately, [illegible] war-damaged facilities on national defense. However, [illegible] of alternative plans must include [illegible] of national [illegible].

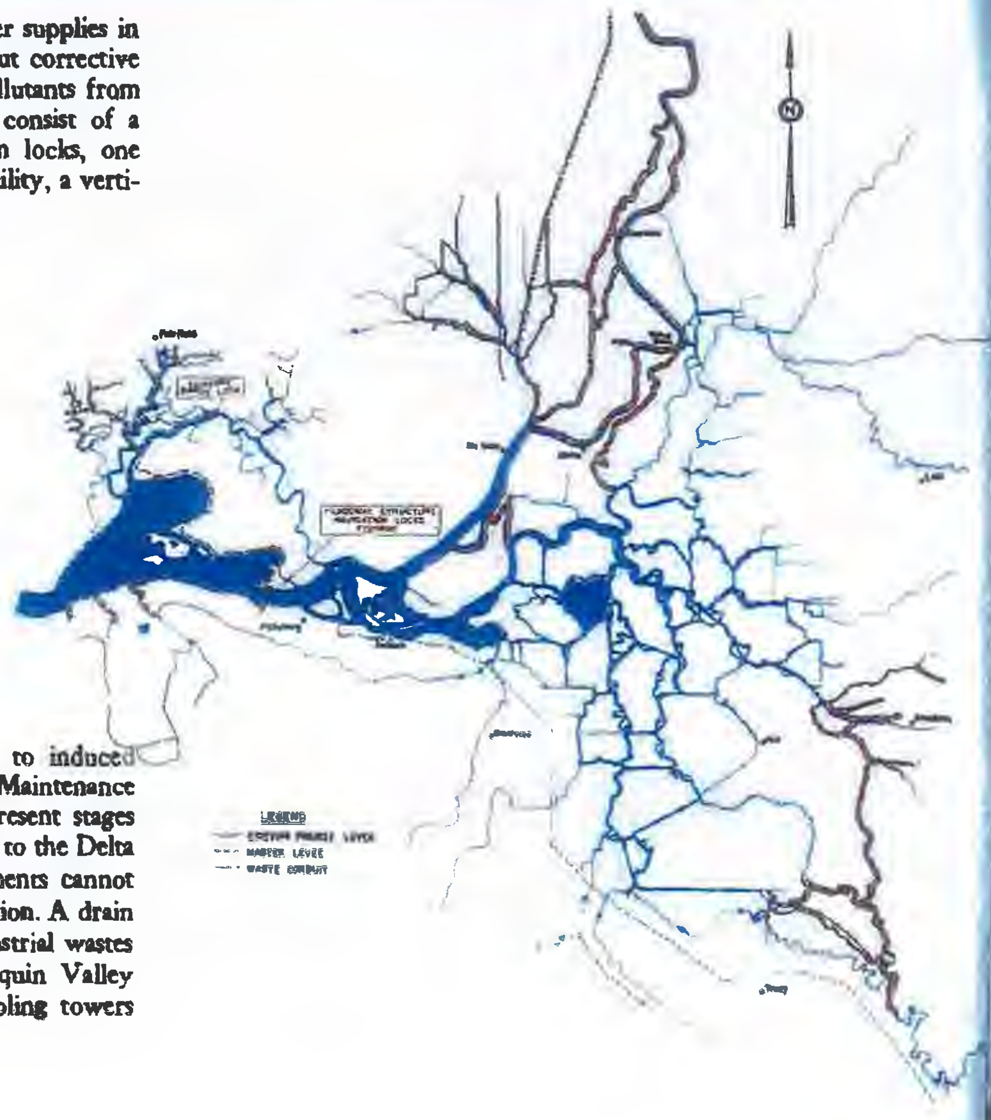
FISH

The Delta is a dominant [illegible] in the habitat of [illegible] California species of fish and [illegible] of several additional species. All reasonable measures must be taken to minimize the adverse effects of planned facilities on the fisheries in the Delta and, when possible, to provide for their enhancement.

Courtesy of Los Angeles Times

Chipps Island Barrier Project — [illegible]

A barrier at Chipps Island would insure the water supplies in the Delta against salinity incursion from the Bay, but corrective features would be necessary to dispose of other pollutants from sources upstream. The principal structure would consist of a gated floodway section, two deep-draft navigation locks, one barge lock, one small craft lock, a tug assistance facility, a vertical baffle fishway, emergency navigation access, and appurtenant operating facilities. The floodway section would have a net area of openings equivalent to the existing channel in order to preclude interference with flood flows. The conventional navigation locks would allow a limited amount of denser saline water to enter the upstream pool, but this water would be removed from a sump by a salt-scavenging system of pipes and pumps. A barge lock would be located on Montezuma Slough near the new Grizzly Island bridge, about ten miles north of Chipps Island.



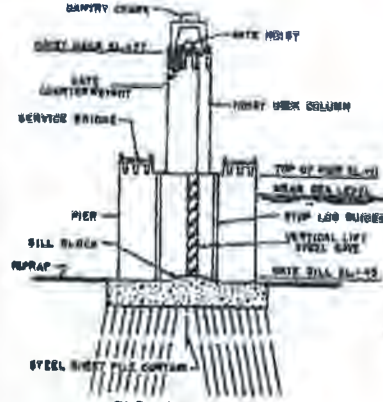
A barrier at the Chipps Island site would require a master levee system along principal channels in Suisun Bay to contain the high tidal stages, which would be higher than the present high stages. Additional dredging of navigation channels also would be necessary, due to induced lower low tidal stages downstream from the barrier. Maintenance of water levels in Delta channels at lower than present stages during summer months would require improvements to the Delta levees, but the nature and extent of the improvements cannot be accurately evaluated without the project in operation. A drain would be constructed to convey municipal and industrial wastes and agricultural drainage water from the San Joaquin Valley into tidal water downstream from the barrier. Cooling towers would be required for the two principal power plants which would discharge warm water into the barrier pool.

The type and design of the facilities described in this report incorporate results of preliminary designs and quantity estimates of the Corps of Engineers in current work on barriers in the San Francisco Bay system. Estimates of the capital cost of the facilities were based on construction costs prevailing in 1960, plus 15 percent for contingencies and 15 percent for engineering and overhead. The anticipated schedule of construction of the facilities is indicated in the tabulation of estimated capital costs.

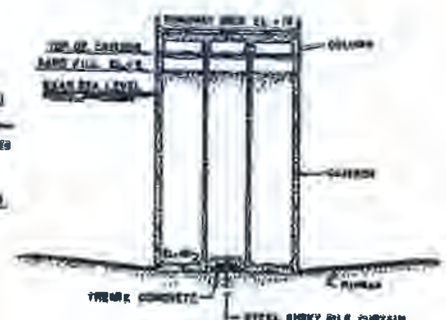
SUMMARY OF ESTIMATED CAPITAL COSTS
CHIPPS ISLAND BARRIER PROJECT

Feature and date of construction	Capital cost
On Site Features	
Floodway structure (1964-70)	$44,119,000
Locks (1964-70)	74,278,000
Salt-scavenging system (1968-70)	3,768,000
Emergency navigation access (1964-66)	6,092,000
South abutment and access facilities (1964-65)	723,000
Fishway (1969)	79,000
Buildings and miscellaneous (1966)	2,062,000
Montezuma Slough closure and barge lock (1968-70)	3,492,000
Subtotal, On Site Features	$134,613,000
Off Site Features	
Waste disposal facilities (1967-70)	$26,914,000
Extension San Joaquin Valley drain (1967-70)	17,356,000
Suisun Bay levee system (1964-71)	21,608,000
Shoreline facilities and dredging (1968-70)	1,481,000
Subtotal, Off Site Features	$67,359,000
TOTAL CAPITAL COST, CHIPPS ISLAND BARRIER PROJECT	$201,972,000

CHIPPS ISLAND BARRIER SITE



TYPICAL SECTION
FLOODWAY STRUCTURE



TYPICAL SECTION
EMERGENCY NAVIGATION ACCESS

TYPICAL SECTION OF FISHWAY AND LOCKS

Chipps Island Barrier Project

A barrier at Chipps Island would provide a definite separation between saline water in the Bay system and fresh water in the Delta channels, thereby preventing salinity incursion and assuring adequate water supplies in the Delta. However, there would be attendant operating problems, and the barrier and appurtenances would not provide flood control and related benefits to the Delta.

With the floodway gates closed, the inflow to the Delta to supply local uses and export pumping plants would be distributed in the channels as shown in the schematic diagram. Large quantities of water would be directed through channels in the western Delta to remove heat wastes and maintain satisfactory water quality conditions. Storage in the channels could be utilized to achieve a limited amount of regulation. However, navigation requirements would prevent controlling the water level lower than one foot below mean sea level, without additional dredging. Seepage and levee stability problems would limit the maximum level for sustained storage to about two feet above mean sea level. Economic analyses of various operating ranges indicate that a three-foot range in water levels for conservation of flood water would be most economical.

Electric analog model studies reveal that the barrier would increase the tidal amplitudes downstream from the structure. An unusually large amplitude of 6.3 feet at Chipps Island under present conditions would be increased to about 12 feet by a barrier. Changes indicated on the electric analog model were generally confirmed by preliminary tests by the U. S. Corps of Engineers on a hydraulic model which indicated slightly smaller increases in tidal amplitudes and a slight decrease in the mean tide level. The lower low water would seriously affect navigation depths, and the higher high water would seriously affect levees along the downstream bays and municipal, industrial, and military installations along the shore lines. Remedial measures would be necessary.

Disposal of cooling water from power plants and other industries would cause an increase in temperature in the nearly quiescent barrier pool. This increase in temperature would reduce the efficiency of cooling equipment and adversely affect fish, and could cause significantly increased corrosion in equipment exposed to the warmer water. The monetary magnitude of these effects would be dependent upon the amount of heat energy dissipated in the pool by existing and future industries, and many other factors which cannot be fully evaluated at this time. Satisfactory conditions could probably be achieved by passing cool-

SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW

ing water from the principal power plants over cooling towers.

To maintain satisfactory water quality conditions in the barrier pool, it would be necessary to convey industrial and municipal wastes to tidal water. Drainage water from the San Joaquin Valley would also have to be discharged into tidal water.

Saline water entering the pool through the locks would be allowed to settle in a sump from which it would be pumped by a salt-scavenging system. Operation of locks would cause delays of about 35 minutes per transit for deep-draft vessels and 20 minutes for tugs and smaller vessels. Assistance would have to be provided to maneuver deep-draft ships through the locks. A tug and operating crew for this purpose would be necessary at all times.

National defense aspects dictate that an emergency navigation access be incorporated in the barrier. This access would consist of concrete bins filled with sand in a section of the barrier. In an emergency, the sand would be pumped out and the bins towed out of the channel.

Anadromous fish would be passed through a vertical baffle fishway, comprising a series of baffles with vertical slots extending to the bottom to provide passages for water and fish. The baffles would dissipate the energy of the water and create a series of bays with a slightly lower water level in each adjacent downstream bay. The bays would provide resting areas for the fish after passing through short distances of high velocity water in the slots. During high tides downstream from the barrier, the fishway would be closed by a gate to prevent saline water from entering the pool.

During flood conditions the gates in the barrier floodway would be opened. Flood stages in the Delta would be essentially the same as under present conditions for comparable flood flows. Since master levees in the Delta are not incorporated in this plan, high flood water would occur in all the channels. Although the flood stages would not be changed, levee stability problems would increase. Tidal fluctuations presently keep the levees saturated a few feet above the mean tide elevation, but under barrier conditions the peat levees would dry out and crack when water levels would be drawn down to about one foot below sea level. Should a sudden flood occur the open barrier gates would permit tidal fluctuations throughout the Delta and sections of some dried-out levees might become unstable and fail as the water levels rapidly rise and fall. Remedial work would be required as problems develop. Allowances for cost of this as yet undefined work are not included in the cost estimate.

SCHEMATIC DISTRIBUTION OF DESIGN FLOOD FLOWS

Single Purpose Delta Water Project—

This system of works would accomplish essentially the same results as a barrier at Chipps Island, that is, adequate water supplies for the Delta and for export therefrom, but would not necessitate costly remedial works. Good quality water supplies for the Delta and export pumps would be separated from saline water by control structures operated with a relatively small rate of fresh water outflow. Water would be supplied in the western Delta area through new supply facilities, and in the rest of the Delta existing irrigation and drainage works would continue in operation. There are no flood control features in this plan.

Control structures with gated openings for discharging flood flows would be located on channels of the Sacramento, Mokelumne, and San Joaquin Rivers. A barge lock and fishway would be incorporated in the Sacramento River control structure. Earth fill channel closures would be constructed at four locations. In 1980-82, additional gates would be constructed at the existing headworks of the Delta Cross Channel of the Central Valley Project. Small craft locks and portage facilities would be incorporated in certain control structures and channel closures. Vertical louver fish screens would be constructed at the head of Georgiana Slough and at the Delta Cross Channel near Walnut Grove, and rotary drum fish screens would be constructed at other diversions.

Water supply facilities would serve areas in the western Delta. The Montezuma Aqueduct would be constructed in about 1968-71 and in subsequent stages to serve water to potential industrial land and some agriculture in central southern Solano County, and to supplement supplies in Contra Costa County. Works would also be included to remedy detrimental effects of project operation, such as seepage alleviation along the Sacramento River channels and modifications to existing irrigation and drainage works made necessary by the project.

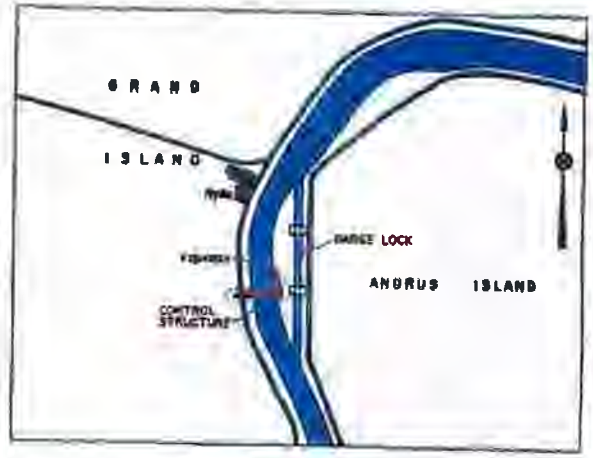
About 1,900 acres of land in the Delta, mostly small unreclaimed islands, would be used for disposal of excess dredged material. Many of these areas would be available and desirable for development as recreation areas.

Additional water could be salvaged by completely separating good quality cross-Delta flows from tidal water, and thereby reducing the amount of fresh water outflow needed for salinity repulsion. These second stage features would include a siphon under the San Joaquin River, additional channel closures, control structures and appurtenances, and water supply facilities. These works may be indefinitely deferred, depending on their need.

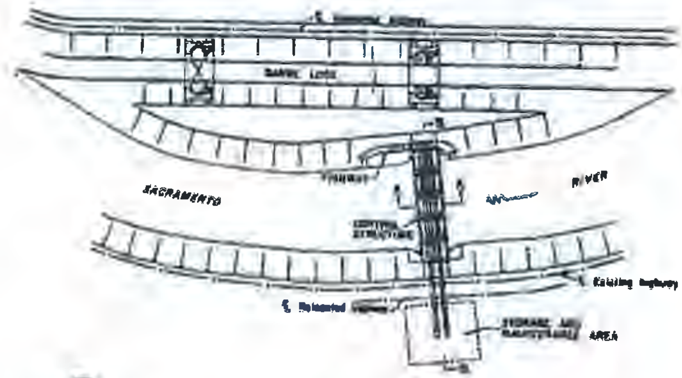
Estimates of the capital costs reflect 1960 construction costs, plus 15 percent for contingencies and 15 percent for engineering and overhead. The anticipated construction schedule is indicated in the following tabulation:

SUMMARY OF ESTIMATED CAPITAL COSTS
SINGLE PURPOSE DELTA WATER PROJECT

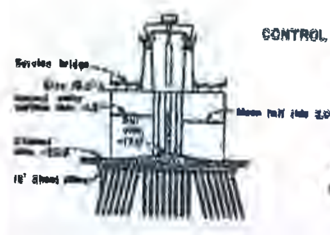
Feature and date of construction	Capital cost
Steamboat Slough control structure (1968-70)	$2,943,000
Miner Slough closure (1970)	108,000
Ryde control structure, barge lock, and fishway (1968-71)	5,653,000
Holland Cut control structure (1973-75)	2,761,000
Mokelumne River control structure and small craft lock (1973-75)	1,951,000
Cross-Delta Canal headworks (1980-82)	1,223,000
Fish screens: Cross-Delta Canal and Georgiana Slough (1968-70)	3,500,000
Closures: Potato Slough, Old River, and Middle River (1974-76)	404,000
Fishermans Cut closures (2) (1964)	133,000
Agricultural water facilities (1963-65)	4,300,000
Municipal and industrial water facilities (1968-71, 1980, 1995, 2010)	13,952,000
Channel dredging (1974-78)	7,154,000
Bank protection (1976-78)	1,880,000
Seepage alleviation facilities (1971)	593,000
TOTAL CAPITAL COST, FIRST STAGE FEATURES	$46,555,000
TOTAL CAPITAL COST, SECOND STAGE FEATURES	$23,765,000



RYDE STRUCTURE SITE



PLAN
CONTROL STRUCTURE, FISHWAY AND LOCK



SECTION A-A
CONTROL STRUCTURE

SECTION B-B
CONTROL STRUCTURE AND FISHWAY

Single Purpose Delta Water Project—operation

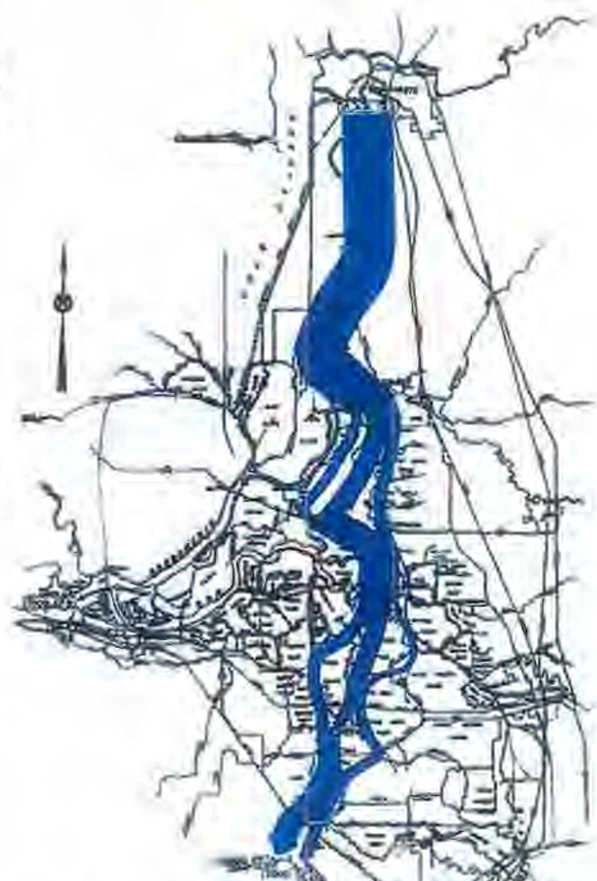
A Single Purpose Delta Water Project would salvage water otherwise wasted to Suisun Bay for salinity control, and would provide water supplies for the Delta and for export and use in areas of deficiency. The project would allow salinity to encroach somewhat farther into the Delta than under present operations; however, the area affected by this controlled incursion would be supplied water by new facilities. Certain aspects of operation described in the following paragraphs would also apply to other variations of the Delta Water Project.

Control structures on the Sacramento River system would divert water southward toward the center of the Delta. Control structures and closures on channels east of Franks Tract would cause the water to flow toward the export pumping plants in channels in the center of the Delta. With this type of operation, it would be necessary to prevent brackish saline water from mixing with fresh water in the center of the Delta. This control could be accomplished by providing fresh water outflow in the Sacramento and San Joaquin Rivers.

The salinity control line, with control to a mean concentration of 1,000 parts of chlorides per million parts of water (1,000 ppm), would be maintained in the San Joaquin River near the mouth of False River, about 7 miles upstream from Antioch and in the Sacramento River at Decker Island, about 1½ miles below Threemile Slough. Salinity control at these locations could be accomplished by maintaining an outflow from the Delta of 1,000 second-feet, of which about 60 percent would be released through the San Joaquin River and the remainder through the Sacramento River.

Good quality water from the cross-Delta flows would be available in existing channels throughout 90 percent of the Delta lowlands. Water would be provided to all agricultural lands downstream of the line of *maximum* salinity encroachment of 500 ppm of chlorides. The mean concentration of chlorides would be about 250 ppm at locations on this line. Research studies by the University of California indicate that seepage of any brackish water from the channels into the Delta islands can be controlled below the plant root zone by application of good quality water on the surface. The supplies diverted from the cross-Delta flows would normally contain between 20 and 80 ppm of chlorides.

Water would also be provided to municipalities and for certain industrial uses in the western Delta area. Most of the required industrial cooling water could be supplied from the adjacent channels. The Contra



SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW

Costa Canal could serve the projected industrial requirements in its service area until about 1970, and significant industrial development in southeastern Solano County is not anticipated before 1980. The Montezuma Aqueduct would be constructed to convey supplemental water from the proposed North Bay Aqueduct and would be linked to the Contra Costa Canal near Pittsburg in 1980. The capacity of the Contra Costa Canal would then be utilized primarily between the Delta and the connection with the Montezuma Aqueduct. The estimated quality of the water would be very good, with a chloride content generally ranging between 15 and 80 ppm, total dissolved solids ranging between 125 and 300 ppm, and with total hardness of between 40 and 160 ppm.

Existing irrigation water supply facilities throughout most of the Delta would not be affected by operation of the export pumps, but the average water level in the southern portion of the Delta would be lowered slightly. Irrigation facilities affected thereby would be modified under the project.

Small increases in tidal amplitudes of about 1.5 feet would occur at the Sacramento River and Steamboat Slough control structure sites, but the mean water level would not significantly change. The effects would be very minor at Rio Vista.

The average water level upstream from the control structures would be gradually raised to a maximum of about 2.5 feet under full project operation in about 30 years. The increase would occur during summer months, and any resultant increased seepage from the channels would be fully consumed by crops on adjoining lands without damage.

During flood periods, the control structures would be opened and flood stages throughout the Delta would be similar to those under present conditions. Flood stages on the Sacramento River would be slightly higher for longer periods due to closing of Miner Slough. This effect would tend to increase seepage conditions during a critical crop planting time, and might necessitate installation of seepage alleviation works. Such works would also alleviate existing seepage problems.

The future value of water and quality considerations might justify construction of the second stage features to permit further reduction in the fresh water outflow from the Delta. The outflow could be reduced to the amount of unavoidable losses, or about 750 second-feet. The value of the additionally salvaged water would probably not justify construction of these works before 1990.

SCHEMATIC DISTRIBUTION OF DESIGN FLOOD FLOWS

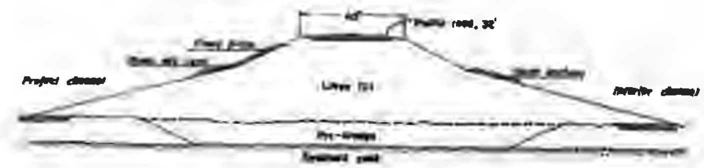
Several additional features can be added to the basic Single Purpose Delta Water Project to provide varying degrees of local benefits, in addition to adequate water supplies. These additional features would be for flood and seepage control, transportation, and recreation. While the economics of construction and operation factors would dictate grouping certain islands within encircling master levee systems, flood protection for any one or more of several groups of islands could be undertaken.

The Typical Alternative Delta Water Project, one of several alternative plans, would include flood protection for the islands in the north central portion of the Delta around Isleton, and for the northeastern islands in the vicinity of Lodi. Fourteen channel closures would be required in addition to those incorporated in the Single Purpose Delta Water Project. Minor modifications and additions would be made in the irrigation water supply and drainage facilities. Rotary drum fish screens would be incorporated where required in all water supply works, and a vertical louver screen would be constructed at the headworks of the Cross-Delta Canal at Walnut Grove. Bear Creek would be diverted into the Calaveras River.

The master levee system would include existing levees of the Sacramento River Flood Control Project. Other existing levees would be improved by constructing a berm on the landward side, and by raising the levee crown where necessary to increase the freeboard. Public roads would be relocated from levee crowns to the berms. A service and maintenance road would be placed on the crown of the levees.

Small craft locks would be constructed at certain channel closures. At locations where rapid transits of boats under 25 feet long would be necessary, a tank elevator boat portage would be installed.

TYPICAL SECTION OF MASTER LEVEE



TYPICAL SECTION OF CHANNEL CLOSURE

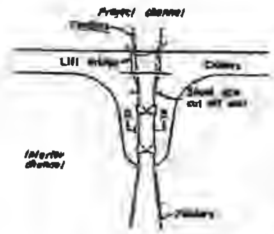
About 1,900 acres of Delta land would be filled with excess dredged material, and most of this land would be available for recreational development. The additional gates on the Cross-Delta Canal headworks and the extensions of the adjacent highway and railroad bridges would be constructed with about 16 feet of clearance above the present average water level to improve small craft access between the Sacramento River and channels of the Mokelumne River system.

The second stage features of this project would be similar to those contemplated for the Single Purpose Delta Water Project.

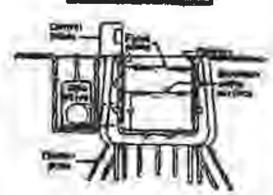
Estimates of capital cost were based on 1960 construction costs plus 15 percent for contingencies and 15 percent for engineering and overhead.

SUMMARY OF ESTIMATED CAPITAL COSTS
TYPICAL ALTERNATIVE DELTA WATER PROJECT

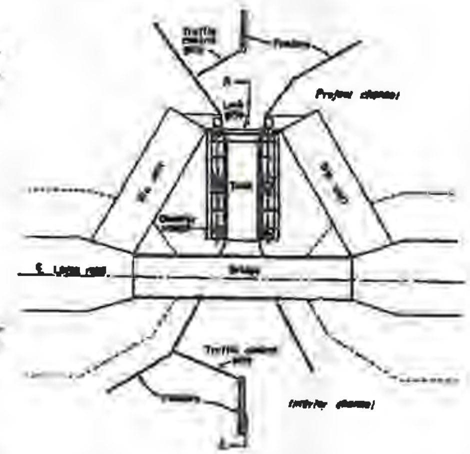
Feature and date of construction	Capital cost
Steamboat Slough control structure (1968-70)	$2,943,000
Miner Slough closure (1970)	108,000
Rydo control structure, barge lock, and fishway (1967-70)	5,653,000
Holland Cut control structure (1971-75)	2,761,000
Cross-Delta Canal headworks (1975-77)	1,998,000
Cross-Delta Canal fish screen (1968-70)	3,500,000
Old River and Middle River closures (1975)	258,000
Fisherman Cut closures (2) (1964)	133,000
Agricultural water facilities (1963-65)	4,282,000
Municipal and industrial water facilities (1968-71, 1980, 1995, 2010)	13,952,000
Channel dredging (1974-78)	7,224,000
Master levee system (small craft locks and portages, irrigation and drainage works)	
Isleton island-group (1964-80)	12,610,000
Lodi island-group (1964-81)	11,439,000
Bear Creek diversion (1967-70)	670,000
TOTAL CAPITAL COST, FIRST STAGE FEATURES	$67,531,000
TOTAL CAPITAL COST, SECOND STAGE FEATURES	$23,635,000



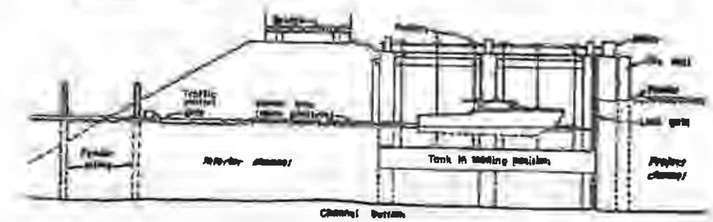
SMALL CRAFT LOCK SITE



SECTION A-A
SMALL CRAFT LOCK



PLAN OF SMALL CRAFT PORTAGE



SECTION A-A OF SMALL CRAFT PORTAGE

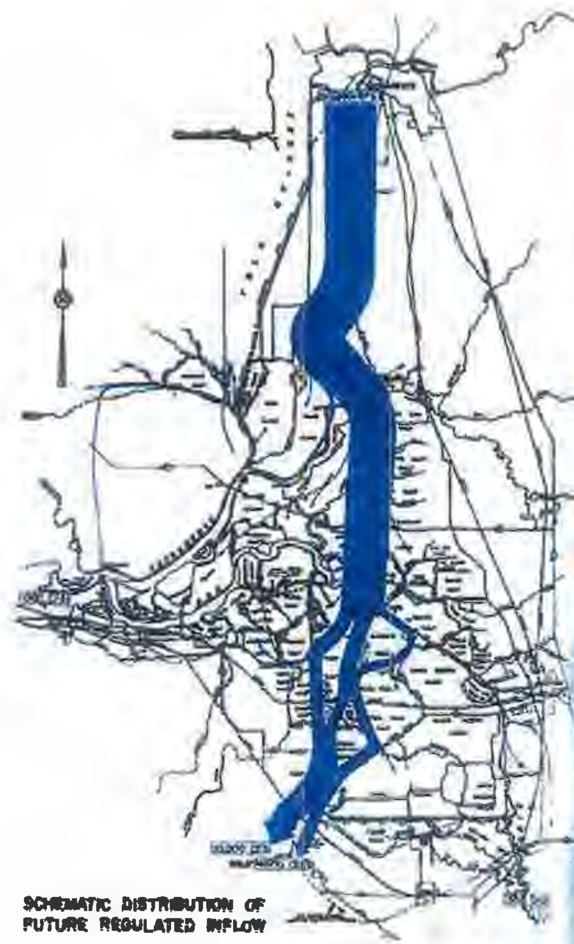
Operation of the Typical Alternative Delta Water Project would be basically the same as with the Single Purpose Delta Water Project. Good quality water would be transferred directly across the Delta and degradation in water quality from salinity incursion would be prevented by limited releases of fresh water with the same degree of control as under the Single Purpose Delta Water Project. Water supplies for the Delta would be distributed from the cross-Delta flows.

Irrigation water for the Isleton island-group and the Lodi island-group would be diverted through siphons from the Cross-Delta Canal into interior channels. Existing diversion works out of the Cross-Delta Canal, which would be rebuilt during construction of the master levees, and diversion works out of the interior channels would continue in operation. Drainage pumping plants at channel closures would have capacity to remove all water pumped from the islands into the interior channels. Under all alternative plans for the Delta Water Project, the irrigation and drainage works would be managed by local districts. Adjustments in costs of operation and maintenance would be made with the districts to reflect costs allocated to interests other than the local districts. Water supply facilities serving several districts or agencies would be operated by the State or by an appropriate master district or agency.

Flood flows would be contained in principal project channels in those portions of the Delta protected by the master levee system, and levees along interior channels would no longer be subject to high flood stages. Levees on interior channels would not need to be as high as for present conditions, and could be allowed to settle. Experience has shown that Delta levees reach a state of equilibrium if they are allowed to settle a limited amount. Thus much of the periodic reconstruction of the interior levees would no longer be necessary. Bank erosion problems due to flood flows also would be eliminated on interior levees.

Storm runoff from upland areas surrounding the Delta would be pumped into flood channels, except in the case of Bear Creek which would be diverted into flood channels.

Water levels in the interior channels could be lowered to achieve reductions in the amount of seepage into the islands. In



SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW

practically all channels the level could be five feet lower than the present average level, or about three feet below sea level, without causing maneuvering problems for small craft. Any resultant shallow depths in specific locations could be increased by dredging.

Small craft locks and portage facilities would be operated without cost to the boating public as the costs would be allocated to beneficiaries of the master levee system. The locks would be operated in a standard manner with pumps for filling and draining. The boat portages would be tank elevators with a gate at one end. The tank would be lowered below the hull of the boat, and the boat would then move between guides over the tank. The counterweighted tank would then be raised to the higher water level and the gate opened to permit the boat to move out under its own power. The time for operation after positioning of the boat over the tank would be less than one minute. The boat would be in the water at all times and there would be no contact with the bottom of the hull.

The operation and maintenance of public roads located on the berm of the master levees would be less costly than for existing roads, which must be periodically reconstructed due to levee settlement and levee rebuilding. Maintenance of the public roads would be by local agencies. Closures in the master levee system of this plan would eliminate the need for continued operation of four ferries.

Reduction of the water surface area under tidal influence would cause limited increases in tidal amplitudes in the Delta, but no significant changes in the average water levels. Such changes on the Sacramento River and Steamboat Slough would be similar to those under the Single Purpose Delta Water Project, and amplitude changes in the San Joaquin River in the heart of the Delta would be less than one foot. However, dredging would be necessary in some navigable channels.

Small islands in bends and side channels, which would be reclaimed and raised by filling, would be available for recreational development after the areas are no longer needed for disposal areas. It is contemplated that arrangements would be made with local governmental agencies for recreational development of the lands, either by direct means or by leasing to concessionaires.

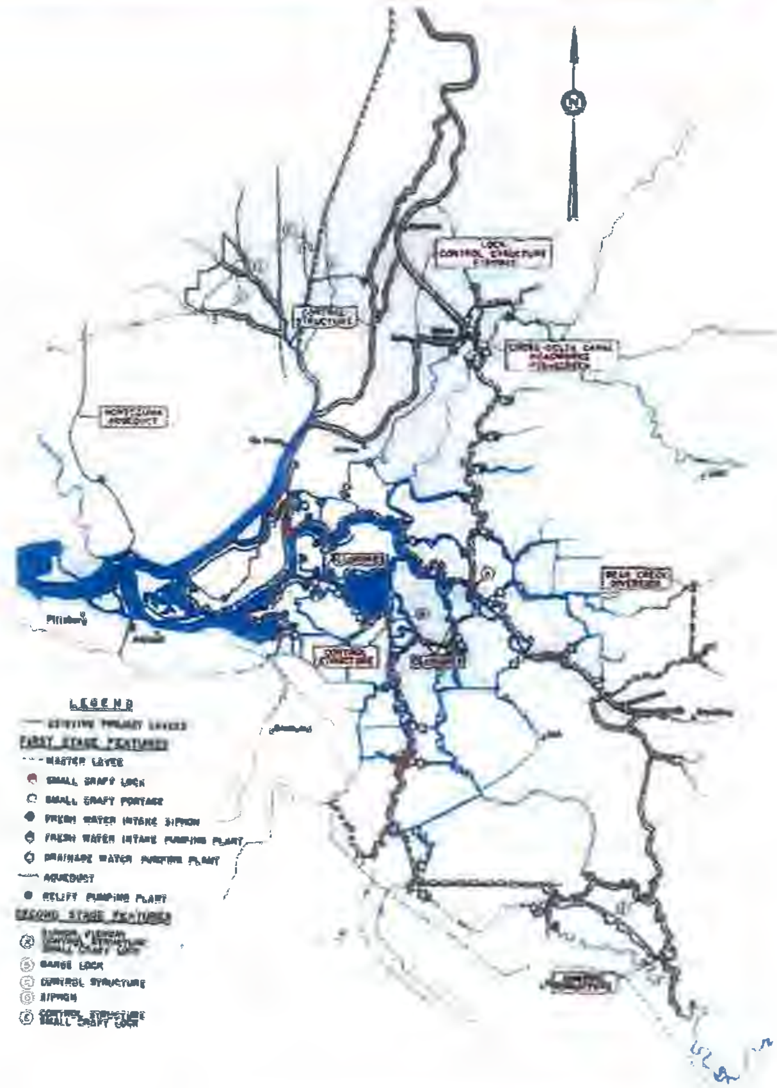
SCHEMATIC DISTRIBUTION
OF DESIGN FLOOD FLOWS

The Comprehensive Delta Water Project would salvage water otherwise needed for salinity control and provide water for the Delta. In addition, the project would provide flood and seepage control, transportation, and recreation benefits for most of the Delta. New master levees would encompass five principal groups of islands and Sherman Island. Works for water supply and drainage in the Delta would include those of the Typical Alternative Delta Water Project, with some modifications, plus other works to serve the newly formed island-groups. Additional small craft facilities would also be constructed.

Flood waters of the San Joaquin River would be divided between the main channel and an improved chain of distributary channels to the west, the two branches coming together in the western Delta. Improved channels of the Lower San Joaquin River Tributaries Flood Control Project would be incorporated.

The master levee along Piper Slough east of Bethel Island would be constructed on old levees on Franks Tract to minimize interference with existing developments on the Bethel Island levee.

The additional interior channels created by the project in northeastern Contra Costa County would contain good quality water, and would serve as a fresh water distribution system for the adjacent islands. Intensive small craft traffic in the vicinity of Bethel Island would necessitate the construction of four small craft portage facilities in adjacent channels and one small craft lock at Sand Mound Slough.

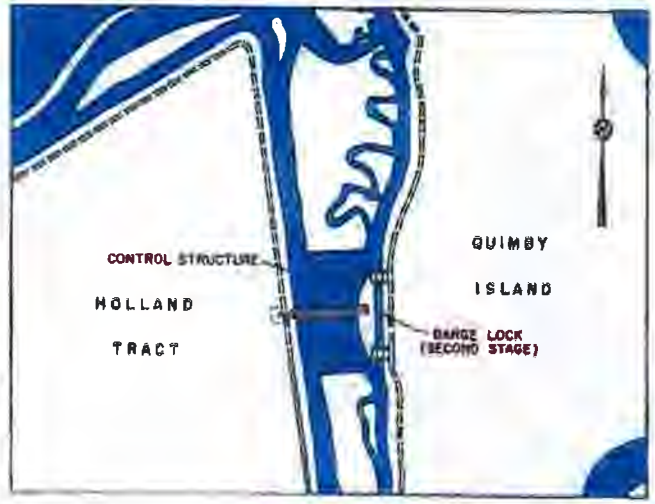


The second stage features of the Comprehensive Delta Water Project would be similar to those in other variations of the Delta Water Project.

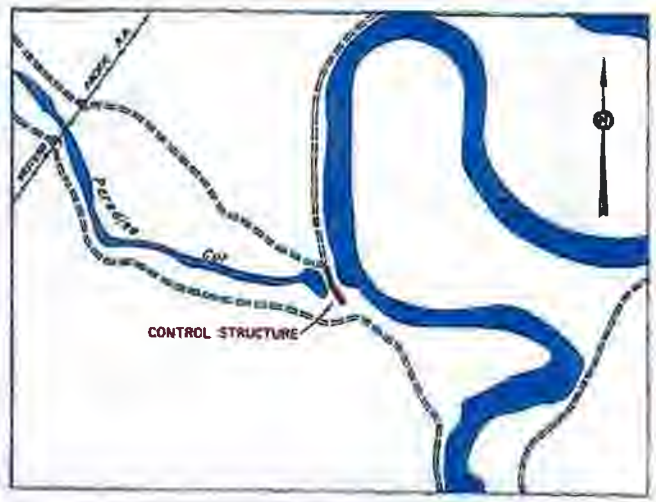
Estimates of the capital costs reflect 1960 construction costs, plus 15 percent for contingencies and 15 percent for engineering and overhead.

SUMMARY OF ESTIMATED CAPITAL COSTS
COMPREHENSIVE DELTA WATER PROJECT

Feature and date of construction	Capital cost
Steamboat Slough control structure (1968-70)	$2,943,000
Miner Slough closure (1970)	108,000
Ryde control structure, barge lock and fishway (1967-70)	5,653,000
Holland Cut control structure (1973-75)	2,761,000
Cross-Delta Canal headworks (1975-77)	1,998,000
Cross-Delta Canal fish screen (1968-70)	3,500,000
Old River and Middle River closures (1975)	258,000
Fishermans Cut closures (2) (1964)	133,000
Agricultural water facilities (1963-65)	2,520,000
Municipal and industrial water facilities (1968-71, 1980, 1995, 2010)	13,952,000
Channel dredging (1968-78)	8,950,000
Master levee system (small craft locks and portages, irrigation and drainage works)	
Isleton island-group (1964-80)	12,610,000
Lodi island-group (1964-81)	11,439,000
Holt island-group (1964-80)	13,810,000
Tracy island-group (1968-74)	4,722,000
Brentwood island-group (1964-79)	9,802,000
Sherman Island (1964-79)	2,030,000
Paradise Cut control structure (1969-71)	121,000
Bear Creek diversion (1967-70)	670,000
Kellogg Creek diversion (1971)	79,000
TOTAL CAPITAL COST, FIRST STAGE FEATURES	$98,059,000
TOTAL CAPITAL COST, SECOND STAGE FEATURES	$21,560,000



HOLLAND CUT STRUCTURE SITE



PARADISE CUT STRUCTURE SITE

Integrated operation of the multipurpose facilities of the Comprehensive Delta Water Project would enhance all principal phases of the Delta's economy, salvage water otherwise needed for salinity control, and provide very good quality water throughout the Delta. Although the project would have some adverse effects on certain segments of the Delta's economy, such as recreation and navigation, the multipurpose works would afford opportunity for enhancement of these same segments in other ways.

Operation of the water supply and transfer facilities during summer months would be similar to that described for the Single Purpose and Typical Alternative plans. Where representative districts or agencies are organized, the facilities could be locally operated and maintained, and appropriate adjustments in costs thereof could be made to achieve equitable distribution of costs to all beneficiaries.

Creation of interior and project channels in the southern portion of the Delta would separate irrigation water supplies from drainage water originating on lands east of the San Joaquin River. Good quality water from cross-Delta flows would be available throughout most of the southern Delta. Lands adjacent to the San Joaquin River upstream from Stockton would continue to divert from the river, but the quality of the water in this area could be improved by upstream flow in the San Joaquin River past Stockton induced by the pumping plants. A small net upstream flow occurs during summer months under present conditions. The quality of water in Paradise Cut could also be improved with circulation induced by pumping from the upper end into the San Joaquin River. Diversions from the river in this vicinity might be affected by operation of a San Joaquin Valley waste conduit. If current studies indicate that substitute supplies would then be necessary, or if further improvement of the quality of the supplies is desired even in the absence of adverse effects of a waste conduit, such supplies could be readily diverted from Delta channels without affecting works described herein.

Lands in the Holt island-group in the south central portion of the Delta range in elevation from several feet below sea level to a few feet above sea level. Irrigation water for the higher islands is pumped from the channels, while siphons are utilized for the lower islands. To achieve seepage control benefits for the lower islands, water

SCHEMATIC DISTRIBUTION OF FUTURE REGULATED INFLOW

levels in the channels could be lowered. This could be accomplished locally without detriment to the higher lands by constructing low dams with pumping plants in the channels and maintaining different water levels in the interior channel system.

Large volumes of small craft and fishing boats move between marinas and resorts in the Bethel Island area and Franks Tract or more distant points in the Delta and San Francisco Bay system. Peak small boat traffic would be served by three small craft portages on Piper Slough, and by one small craft lock on Sand Mound Slough. Lock or portage service for small craft would be provided at various other locations in the Delta when dictated by construction of channel closures. It should be recognized that subsequent developments and changes in patterns of use may necessitate revisions in the planned local service. While the lock and portages would cause some inconvenience to recreationists, creation of interior channels not subject to flood and tidal stages would benefit shore line installations. An expected great increase in boating in the future would intensify problems of patrolling and safety enforcement. Opportunities would be available to local public agencies to designate certain waterways for specific uses, and problems of regulation would be reduced under controlled access.

Master levees of the project in the southern half of the Delta would cause increased tidal amplitudes in the project channels. The maximum increase in the San Joaquin River system would be about one foot at Stockton. There would be no significant change in the mean water level. Some dredging in navigation channels would be necessary.

Tug and barge shipments into the southern Delta would be limited to the Cross-Delta Canal. Most of the present traffic involves beet shipments to a sugar refinery near Tracy, and the Holland Cut channel east of Franks Tract is generally used. The Cross-Delta Canal would be open to the San Joaquin River, and a barge lock at the Holland Cut control structure would not be economically justified. Although a slightly greater travel distance from northern and western Delta points would be involved under the project, the channel to the vicinity of the sugar refinery would be dredged. This would permit use of larger barges, which are presently precluded by shallow channel depths.

SCHEMATIC DISTRIBUTION
OF DESIGN FLOOD FLOWS

Project Accomplishments—Delta Water Supply

Over 90 percent of the Delta lowlands now has adequate water supplies during summer months due in part to operation of the Central Valley Project. However, ten percent of the Delta in the western portion, including lands occupied by large water-using industries and municipalities, does not have adequate good quality water supplies at all times. Moreover, additional regulation and use of water in areas tributary to the Delta, exclusive of Delta exports, will lengthen the average period each year when salinity incursion from the Bay causes increased operating costs, plant shutdowns, and decreased farm production. The concentrations of dissolved minerals in water from the Contra Costa Canal now approach upper limits of acceptable quality during several months of most years, and significant sums of money are expended by industries for demineralization and water softening.

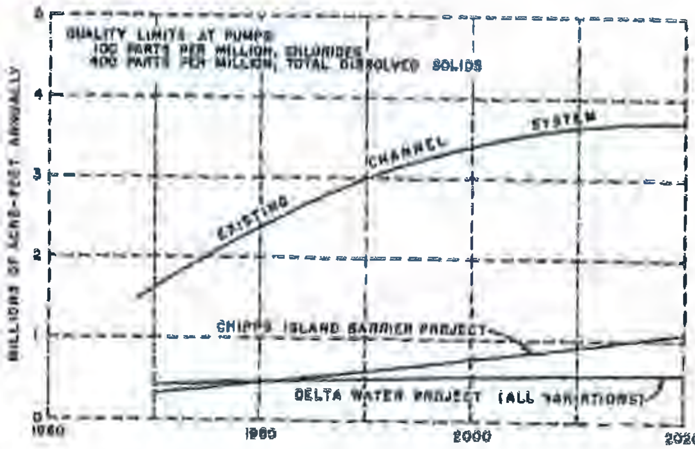
Under any of the foregoing projects, water of very good quality would continue to be supplied to about 90 percent of the Delta lowlands through existing facilities. It is estimated that the mineral quality of the supplies would generally range between about 15 to 80 parts of chlorides and between 100 and 350 parts of total dissolved solids per million parts water. The quality of water in the southern portion of the Delta would be improved.

The quality of water in the Pittsburg-Antioch area with the Chipps Island Barrier Project in operation would be uncertain. Although downstream disposal of local municipal and industrial wastes and drainage from the San Joaquin Valley would eliminate the majority of the mineral pollutants, the effects of cooling water and mineral and organic wastes of the Delta might result in water supplies of questionable quality, particularly during critical dry periods. Elimination of the tidal effects in this area by construction of the barrier would also reduce the supply of dissolved oxygen in the water, which is now partly replenished from Suisun Bay.

All of the alternative plans for the Delta Water Project would involve dual water supplies with different water quality characteristics. While the concentrations of minerals in water in certain western channels would increase due to greater ocean salinity incursion, the quality of water from the Contra Costa Canal and from proposed water supply facilities would be excellent. It is estimated that substitute industrial water supplies would generally contain between 15 and 80 parts of chlorides per million parts of water. Similarly, the total dissolved solids would generally range between 125 and 300 parts per million. Irrigation water supplies would be of similar quality. The Contra Costa Canal would annually supply about 195,000 acre-feet of water, including some substitute water in northeastern Contra Costa County. All additionally required supplemental and substitute water would be supplied from the Montezuma Aqueduct. This annual quantity would amount to about 120,000 acre-feet in 1990 and 330,000 acre-feet in 2020. Brackish water supplies in the western Delta channels would vary in quality with location. The mean quality would be about 3,000 parts of chlorides per million parts water at Antioch during summer months. Water containing this much salinity is not necessarily damaging to cooling equipment involving alloy metals. A composite of several factors, most of which would not be modified by alternative plans for the Delta Water Project, controls the rate of corrosion of cooling equipment.

Unless physical works are constructed in the Delta to prevent salinity incursion from the Bay system, or to channelize fresh water directly across the Delta channels, it will be necessary to release increasingly greater amounts of fresh water from upstream storage to maintain satisfactory quality conditions. Greater rates of fresh water outflow will be necessary as the rate of export pumping from the Delta increases, and greater quantities of stored water will have to be released as the amount of surplus water for outflow is reduced by upstream depletions and export from the Delta. If Delta works are not constructed, the yield of other features of the State Water Facilities would be reduced and subsequent features for importation of water from north coastal sources would be needed at an earlier date. Any such modifications in the program would increase the cost of water in the Delta.

With any of the plans for the Delta water facilities, the amount of outflow from the Delta otherwise necessary for salinity control would be greatly reduced. It would still be necessary to dispose of municipal and industrial wastes from the western Delta, and drainage from the San Joaquin Valley, into channels downstream from points of usable good quality water. All of the plans are comparable in this respect, except that these wastes would aid in repulsion of ocean salinity incursion with any of the alternatives of the Delta Water Project. Fresh water required for operation of locks and the fishway would be lost with a barrier at Chipps Island, but would be available for use downstream of the control structures with any of the alternatives of the Delta Water Project. A small amount of conservation yield could be obtained from limited storage in Delta channels with a barrier at Chipps Island, but alternatives of the Delta Water Project would not provide conservation storage.



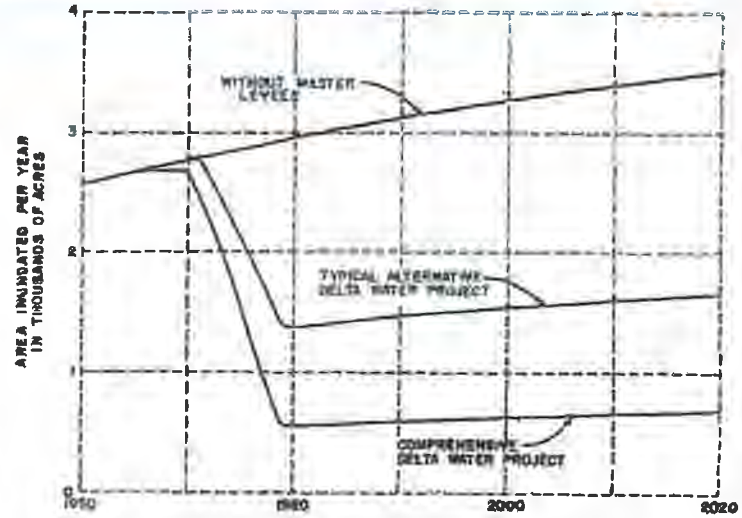
UPSTREAM STORAGE RELEASES FOR PROJECT OPERATION

The amount of water otherwise necessary for salinity control which could be salvaged by Delta water facilities would vary with time, as indicated by the above graph. The amount of salvaged water would be the difference between demands on upstream storage for outflow without any works in the Delta, and demands with such works in operation. The estimated average annual salvage during the next 60 years would be 1,900,000 acre-feet with the Chipps Island Barrier Project, and 2,050,000 acre-feet with any of the alternative plans for the Delta Water Project.

Only the Typical Alternative Delta Water Project and the Comprehensive Delta Water Project would provide flood and seepage control benefits to the Delta. However, all plans would include remedial works made necessary by adverse effects of flood or tidal water stages changed by project operation. These would be particularly necessary with the Chipps Island Barrier Project.

Project flood control benefits would result from reduction in the frequency of flooding, and from reductions in costs of maintaining Delta levees. It is emphasized that complete flood protection could not be assured, as the inflow to the Delta could exceed the designed capacity of the channels. Furthermore, although the stability of the master levees would be significantly greater than the stability of existing levees, the character of organic foundation soils is such that unforeseen stability problems might develop in some areas. For these reasons, emphasis should be given to zoning Delta lands lying below flood levels for uses involving low-value improvements such as farming, and precluding residential development. While complete flood protection for the Delta lands could not be assured under project conditions, there would be a marked improvement in protection over existing conditions which will worsen as land elevations in the Delta continue to subside.

About 103,000 acres would be benefited by master levees included in the Typical Alternative Delta Water Project, and about 143 miles of levees along interior channels would no longer require costly maintenance for high flood stages. The estimated average annual benefit of reduced flooding and operation and maintenance costs would be about $4.65 per acre. Master levees of the Comprehensive Delta Water Project would benefit about 252,000 acres and would reduce expensive maintenance on 295 miles of interior channel levees. The estimate of average annual flood control benefits is about $3.60 per acre.



PROJECTED AVERAGE ANNUAL AREA OF FLOODING

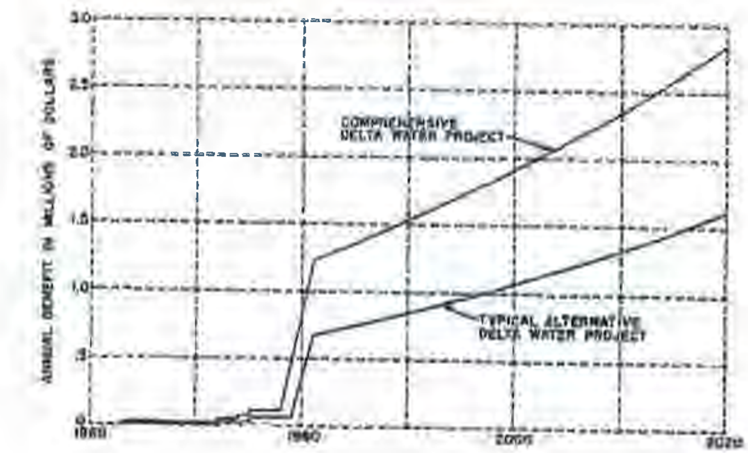
Seepage control benefits would be made available by lowering water levels in interior channels created by the Typical Alternative Delta Water Project or by the Comprehensive Delta Water Project. In addition, lower water levels would prolong the economic life of certain islands. These benefits and the extent of increased economic life would depend upon lowering average water levels in the interior channels. A general lowering of five feet could be made without adversely affecting depths for small craft, except in isolated locations, or the majority of water supply siphons. Based upon a five-foot lowering of water levels, seepage control benefits, averaging an estimated $0.50 per acre for 103,000 acres, would be available with the Typical Alternative Delta Water Project. The Comprehensive Delta Water Project would afford seepage benefits to 252,000 acres, and the estimated average annual benefit would be $0.45 per acre.

The two basic problems of the existing road system in the Delta are (1) inadequate channel crossings and circuitous routes, with resultant excessive travel times, and (2) disproportionately high costs of maintenance. Projects involving master levees for flood control in the Delta would afford means for reducing both of these problems. However, the Chipps Island Barrier Project would provide no benefits to vehicular transportation, and the Single Purpose Delta Water Project would provide only incidental benefits of this kind.

The master levee system of the Typical Alternative Delta Water Project would include twenty-two channel closures upon which roads could be placed, and operation of four existing ferries could be terminated. The Comprehensive Delta Water Project would include thirty-nine channel closures providing new access and would eliminate the need for six ferries.

Roads on the landward berms of the master levees would be more stable and less difficult to maintain than existing roads on levee crowns. Driving on present levee roads is hazardous, as evidenced by frequent drownings when vehicles run off levees into adjacent channels. Passing clearance is often limited by parked vehicles. In addition to improved safety with roads on the levee berms, there would be ample width for parking off the roadways.

To realize the anticipated and needed development of recreation in the Delta, it will be necessary to greatly improve vehicular access. Realization of about 7,000,000 recreation-days each year by 1990, and almost 14,000,000 by 2020 will, in large degree, be dependent upon the improved vehicular access that could be provided by multipurpose use of the master flood control levees.



BENEFITS OF VEHICULAR TRANSPORTATION IMPROVEMENTS

The project benefits from enhancement of the road system would be a combination of savings in maintenance costs and savings in costs to Delta traffic associated with farming and to the recreationists. Savings to Delta interests reflect reduced costs of general travel and produce shipments through decreased travel times and distances. Savings to the recreationists were based upon projected recreation use and decreased travel times and distances.

While some detriments to recreation are inherent in construction of any facilities in the Delta, substantial benefits would also be achieved. As has been stated, improvements in the road network would make more of the Delta accessible to recreationists. Land areas reclaimed by spoiling material from dredging of channels onto small islands would afford space for development of recreation service facilities and picnic areas. Project works at the head of the Cross-Delta Canal would be constructed to provide clearance for the majority of pleasure craft, thereby connecting the Sacramento and Mokelumne River systems. Elimination of flood and tidal effects from interior channels would make it possible to control water levels in those channels, reducing costs of maintaining waterfront recreation facilities. Furthermore, costs of new facilities would be less than for present conditions. The safety of the boating public is becoming a significant problem, and the incompatibility of high-speed boating, cruising, and skiing with fishing and swimming creates related safety problems. Local authorities will find it desirable and even necessary to designate certain Delta channels for specified types of recreation use. The interior project channels would lend themselves to this type of zoning and also to simplified enforcement.

Planning and construction of recreational developments in the Delta should involve local governmental agencies. Most project channel closures would not be constructed for eight or more years, and changing recreation patterns should be considered in future selection of remedial and enhancement facilities. Needs for small craft locks and boat portages should be re-evaluated at the time closures are constructed.

The most important form of recreation in the Delta is fishing. In terms of recreation-days, fishing is three times as important as the next most popular sport—cruising. A project which would cause a major reduction in fish populations might also cause very adverse effects on the recreation. In this connection the Chipps Island Barrier Project would result in losses of striped bass several times as great as those anticipated with any of the alternative plans for the Delta Water Project.

It is recognized that cruising, sailing, and water skiing are rapidly gaining in popularity in the Delta, and that construction of master flood control levees and channel closures would interfere with unrestricted boating access to certain channels. However, access would be provided through small craft locks or portage facilities at many of the channel closures, thus reducing the detriment primarily to short delays. Studies in other areas indicate that lockage delays are not too important to the majority of pleasure boatmen.

The following tabulation summarizes physical features of the several alternative projects which would affect recreational activity and growth in the Delta.

Item	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Control structures	1	4	3	4
Channel closures	1	10	23	41
New master levees (miles)	0	0	90	185
Fishways	1	1	1	1
Principal fish screens	0	2	1	1
Barge locks	1	1	1	1
Small craft locks	0	0	2	5
Small craft portage facilities	0	0	5	17
Open navigable area (acres)	49,500	49,400	45,800	42,600
Navigable interior area (acres)	0	100	3,700	6,900
Open navigable channels (miles)	700	695	590	450
Navigable interior channels (miles)	0	5	110	250
Project roads (miles)				
Paved	0	0	33	70
Graveled	0	1	47	109
State and county levee roads (miles)	295	295	279	265
New inter-island accesses (closures)	0	6	22	39
New public waterfront land (acres)				
From master levees	0	0	1,900	3,600
From dredge spoils	0	1,900	1,900	2,300
Normal overhead clearance through Delta Cross Channel (feet)	6	16	16	16

Project Accomplishments — fish and wildlife

Any Delta water facilities would affect the habitat of fish in the Delta, but would have little effect, if any, on Delta wildlife. While it is known that the Delta plays an important role in the life cycle of migratory fish, and also supports resident sport fish, insufficient biological information is available with which to clearly define the potential effects of Delta water facilities. Nevertheless, relative comparisons of the alternative projects can be made.

Studies of effects of the Delta water facilities and export pumping plants were made by the California Department of Fish and Game in co-operation with the Department of Water Resources. Cooperative experiments with a full-scale vertical baffle fishway indicate that all migratory species would use this type of fishway. The conclusions of the Department of Fish and Game regarding the alternative projects are as follows:

"*Chipps Island Barrier*

"This project would be the most damaging of the four studied. It would probably cause a disastrous reduction of almost all species of fish found in the Delta. These losses would be brought about by the rapid salinity and temperature change across the barrier, loss of current in the fresh-water pool for migration direction, striped bass spawning eliminated due to lack of current behind the barrier, loss of important food items, and a threefold increase in pumping of water at Tracy. The amount of Sacramento River water being drawn around the tip of Sherman Island to the pumping plant would be greatly increased. Downstream migrants of the Sacramento River would be diverted to the pumps in large numbers. These fish would have to be screened at the pumps and returned to the river channel below the influence of this current. This condition would be a serious detriment to all fish using the Delta.

"*Single Purpose Delta Water Project*

"This project would be the least detrimental of the four projects studied. The reversal of flow around Sherman Island would be eliminated. Major fish screens would be installed at the Cross-Delta Canal headworks and at the head of Georgiana Slough. Therefore, downstream migrants in the Sacramento River would be guided down the western side of the Delta out of the influence of the pumps. In general, fish and eggs in the western portion of the Delta would no longer be affected by the pumps. The replacement of the hundreds of existing small irrigation siphons in the western Delta by screened irrigation supply systems would further reduce losses of small fish. In these respects conditions for fish in the Delta would be improved.

"Fish habitat would not be reduced in the Delta. The one channel that would be isolated under this project would be insignificant. An important effect of the project would be the increased reversal of flow in the San Joaquin River above the Cross-Delta Canal crossing. This reversal of flow would occur during an average of seven months of the year under full project operation. We were unable to evaluate the effect of the reversal. However, it could result in serious losses to salmon that now spawn in San Joaquin River tributaries south of the Mokelumne River. Most seriously affected would be upstream migrating salmon. The amount of water pumped from the Delta would be increased threefold. This increased withdrawal of water would divert proportionately more fish than is presently being diverted.

"*Typical Alternative Delta Water Project*

"This project would be the second least detrimental. Losses would be expected to be greater than the Single Purpose Project because of the reduction of 8 percent of the fish habitat through channel closures, and partial channelization of the Cross-Delta Canal. The channelization would cause a detriment by channeling the fish toward the pumps by a more direct route. Water diversions into isolated channels would be screened and loss of fish would be reduced. However, loss of eggs and fry would be unavoidable. Other project conditions would be the same as the Single Purpose Project.

"*Comprehensive Delta Water Project*

"This project would be the third least detrimental. It would cause greater loss than the Typical Alternative Project because of the reduction of 14 percent of the fish habitat, and the complete channelization of the Cross-Delta Canal. This would channel the fish directly to the pumps. Other project conditions would be the same as in the Single Purpose Project.

"From the foregoing, if one of the above-named projects is to be built in the Delta, the Department of Fish and Game would favor the Single Purpose Delta Water Project. However, all projects will cause serious fisheries problems and an intensive study would be required to solve these problems."

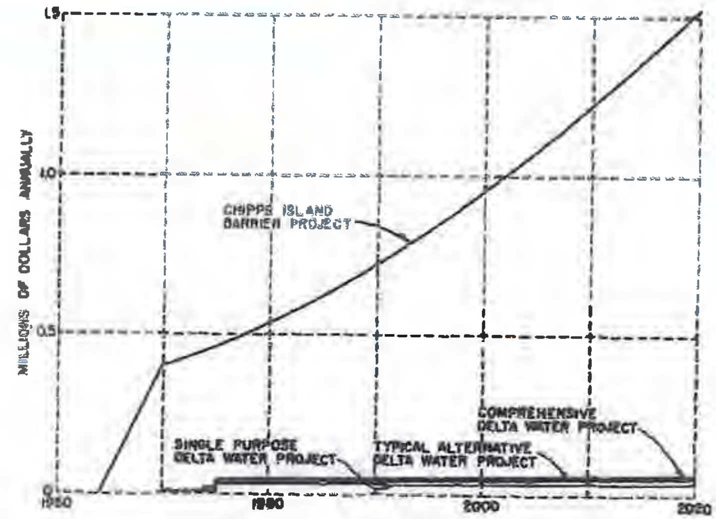
Formulation of project plans reflects comments and recommendations of the Department of Fish and Game. Fish screens would be installed at the heads of channels diverting water southward from the Sacramento River. Such screens would reduce the present rates of fish losses at the Tracy Pumping Plant and in numerous other diversions in the Delta. Project pumping plants would also be screened. Hundreds of diversion siphons and pumping plants in the Delta are not screened at this time. However, project diversions into interior channels would be screened, and the fish populations enhanced thereby.

Project Accomplishments—Navigation

Commercial and military navigation in the Delta would be adversely affected in varying degrees by any Delta water facilities, but some potential benefits would also be realized through increases in channel depths and widths.

The Chipps Island Barrier Project would cause the greatest detrimental effect to navigation, since all traffic between the San Francisco Bay system and Delta points would have to pass through locks. At present, an average of about 570 deep-draft commercial vessels, and 10,300 tug and barge tows and small vessels pass Chipps Island each year. It is estimated the annual transits would increase to 2,800 and 40,000, respectively, by 2020. The volume of future military traffic cannot be realistically estimated, nor is it possible to place a reasonable value on its lost time. The increased tidal amplitude downstream from a barrier at Chipps Island would necessitate additional dredging in some areas to provide the required minimum navigation depth. This increased depth might cause additional maintenance dredging which frequently results from deepening navigation channels.

Completion of the Sacramento Deep Water Channel will divert most of the tug and barge traffic away from the Sacramento River between the vicinities of Rio Vista and Sacramento. The traffic which would pass the site of the Sacramento River control structure would generally be limited to that originating from or destined to points of call downstream from the vicinity of Freeport. It is anticipated that the volume of this traffic would increase from 600 transits per year after completion of the Sacramento Deep Water Channel to about 900 transits per year by 2020.



DETRIMENTS TO COMMERCIAL NAVIGATION

Construction of control structures and closures on channels south of the San Joaquin River in the heart of the Delta would increase time and distance for tug and barge travel to a sugar refinery near Tracy. However, channel improvements would permit use of larger barges, if shipping concerns should elect to do so. As this advantage would be subject to many factors in an operator's business which cannot be readily predicted, benefits were not claimed for possible use of larger barges.

Construction of a master levee system would necessitate relocation of some sugar beet loading docks in the Delta. However, improved roads would tend to compensate for increased hauls to relocated docks.

Only direct, tangible benefits and detriments to the initial recipient were evaluated for comparison with direct costs. However, it must be recognized that direct, intangible benefits and detriments would also result from project operation. The ratios of benefits to costs provide a guide to project selection, but consideration should also be given to the net benefits in making the final project selection. Although variations in benefit-cost ratios can result from different basic economic premises, the relative comparison of alternative projects would not change.

Certain significant benefits and detriments were not evaluated. All alternative plans would improve the quality of water exported to the San Joaquin Valley and reduce the drainage problems there. Only direct benefits of flood protection to agriculture were evaluated, but this protection would also benefit principal highways and urban developments. The estimated recreation benefits from land made available for development were considered to be equivalent to the value of the land. Intangible benefits would also accrue to recreation, and intangible detriments would result from reduced convenience of access into some channels. Only detriments to commercial fishing are shown, but intangible detriments to sport fishing would also accrue.

All estimates of benefits, detriments, and costs, including amortization, operation, and maintenance, reflect annual equivalent values for the period 1960-2020. An interest rate of four percent per annum was used in the analysis.

Attention is invited to the net benefits of the Comprehensive Delta Water Project which are less than the net benefits of the Typical Alternative Delta Water Project. This condition results from inclusion of economically unjustified flood control for large areas south of the San Joaquin River wherein the direct benefits would be less than the costs. However, flood control for some of the critical areas south of the San Joaquin River warrants further study.

ESTIMATED ANNUAL BENEFITS, DETRIMENTS, AND COSTS
(In thousands of dollars)

Item	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Benefits				
Water salvage (for export)	8,337	8,963	8,963	8,963
Improved water quality—municipal, industrial, and irrigation	880	880	880	880
Supplemental municipal and industrial water supply	503	1,343	1,343	1,343
Flood and seepage control	—	--	530	1,022
Vehicular transportation	—	--	410	734
Recreation	—	19	37	58
Total Benefits	9,720	11,205	12,163	13,000
Detriments				
Commercial navigation	617	18	24	27
Commercial fisheries	844	203	254	287
Total Detriments	1,461	221	278	314
BENEFITS MINUS DETRIMENTS	8,259	10,984	11,885	12,686
Costs				
Capital amortization	6,825	1,358	1,965	2,846
Annual operation and maintenance	2,077	691	884	1,136
Total Costs	8,902	2,049	2,849	3,982
NET BENEFITS	—643	8,935	9,036	8,704
BENEFIT—COST RATIO	0.93:1	5.36:1	4.17:1	3.19:1

The capital and operational costs of each of the alternative projects were allocated among the project functions by the Separable Costs-Remaining Benefits method. In this method, all costs assignable to single functions are identified, and the remaining multipurpose costs are distributed among the functions in proportion to the benefits provided by the project, or in proportion to the lowest cost alternative means of providing equivalent benefits. The lowest value of either the benefits or alternative means is used as a limit.

The basic allocations were made in terms of present worth values (1960) of all costs and benefits. This procedure properly accounts for the time-value of money (interest) and the wide variation in dates of expenditure of money and realization of benefits. Allocations of the capital and operational costs in terms of actual expenditures, rather than present worth, are indicated in the accompanying tabulations to permit convenient comparisons with total amounts of these costs.

Attention is invited to the allocated costs of the Chipps Island Barrier Project. The costs which would be allocated to water salvage and western Delta water supply were limited by the lowest cost alternative means of providing equivalent benefits, which would be the Single Purpose Delta Water Project. The values

ALLOCATION OF ESTIMATED CAPITAL COSTS
(In thousands)

Item	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Water salvage (for export)	$38,384	$38,444	$38,662	$41,655
Western Delta water supply [1]	8,098	8,111	8,156	8,788
Flood and seepage control	none	none	11,900	25,159
Vehicular transportation	none	none	8,132	18,083
Recreation land	none	none	681	1,429
Unassigned local costs	155,490	none	none	2,945
TOTALS	$201,972	$46,555	$67,531	$98,059

[1] For improvement in quality and supplemental water supplies. Allocated costs include portions properly attributable to upstream water users for future effects on the western Delta area due to increased water use in areas tributary to the Delta. Definite values attributable to upstream water users would be dependent upon resolution, negotiated or otherwise, of water rights problems.

shown for the Chipps Island Barrier Project are slightly less than those for the lowest cost alternative, since the funds for the former would be expended at an earlier date. The allocations to both projects in present worth values would be the same. As the costs which may be properly allocated to water salvage and western Delta water supply are less than the total cost, a portion of the costs of the Chipps Island Barrier Project are shown as unassigned local costs. If these costs are not repaid from sources other than water users, the Chipps Island Barrier Project would be financially infeasible.

Attention is also invited to the allocated costs of the Comprehensive Delta Water Project which indicate certain unassigned local costs. In this case the costs of flood and seepage control in areas south of the San Joaquin River exceed the direct benefits of flood and seepage control in these areas. Therefore, the allocation to flood and seepage control for these areas was limited to the benefits. These flood and seepage control features of the Comprehensive Delta Water Project are not economically justified.

After the costs were allocated to principal project functions, it was necessary to make suballocations among particular groups of beneficiaries. These suballocations, which are indicated on the following pages, were also made by the Separable Costs-Remaining Benefits method and were the basis for computing the average annual costs to beneficiaries throughout a 60-year period. In the adjoining tabulations the amounts allocated to vehicular transportation include some costs which would be suballocated to recreation access to reflect the benefits to the public for improved access to recreation areas of the Delta. It is estimated that about $7,075,000 of the capital costs and $92,000 of the annual operational costs for vehicular transportation under the Typical Alternative Delta Water Project would be suballocated to recreation access. Under the Comprehensive Delta Water Project these respective amounts would be $15,123,000 and $176,000. These foregoing amounts would be in addition to the basic allocation to recreation land, which reflects the value of lands made available for recreational development.

ALLOCATION OF ESTIMATED AVERAGE ANNUAL OPERATIONAL COSTS
(In thousands)

Item	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Water salvage (for export)	$395	$571	$506	$483
Western Delta water supply [1]	83	120	107	102
Flood and seepage control	none	none	156	292
Vehicular transportation	none	none	106	210
Recreation land	none	none	9	16
Unassigned local costs	1,599	none	none	34
TOTALS	$2,077	$691	$884	$1,137

[1] For improvement in quality and supplemental water supplies. Allocated costs include portions properly attributable to upstream water users for adverse effects in the western Delta area due to increased water use in areas tributary to the Delta. Definite values attributable to upstream users would be dependent upon resolution, negotiated or otherwise, of water rights problems.

Economic Aspects — [illegible]

It was assumed that all project costs not specifically declared nonreimbursable would be repaid by all beneficiaries of project functions. In accordance with the contracting principles established for water service under the State Water Resources Development System, the conservation features of the Delta water facilities will be financially integrated with other conservation features of the system. The cost of supplemental water required by Delta water users will include the Delta Water Charge and an allocated transportation charge.

Estimates of present and future costs of water supply in the western Delta area were predicated on continuation of current federal salinity control policy, which limits the minimum regulated outflow from the Delta to 1,500 second-feet, considered necessary to afford satisfactory quality control at the Central Valley Project pumping plants. Estimates of increased future costs without the State Water Facilities reflect continued upstream depletion of surplus water in the Delta, and represent average costs during the next 60 years. Estimates of costs shown for project conditions also reflect average costs during the next 60 years. It is emphasized that the estimates are comparative average annual *costs* during a 60-year period and do not reflect estimates of year by year *prices* which may be established.

The amounts allocated for repayment were limited by the lowest cost alternative means of accomplishing equivalent benefits. It may be noted that the costs of water supply in the western Delta area would be the same for the Chipps Island Barrier Project, Single Purpose Delta Water Project, and Comprehensive Delta Water Project. The Single Purpose Delta Water Project would be the lowest cost alternative means of providing water supplies and it limits the amount which may be allocated under the other two projects.

The costs of the Typical Alternative Delta Water Project allocated to water salvage would amount to an average of $0.64

COMPARATIVE SUMMARY OF ESTIMATED AVERAGE ANNUAL COSTS OF WATER SUPPLY IN WESTERN DELTA AREA WITH AND WITHOUT STATE WATER FACILITIES DURING 1960-2020[1]

Item	Future cost without State Water Facilities	Chipps Island Barrier Project	Single Purpose Delta Water Project	Typical Alternative Delta Water Project	Comprehensive Delta Water Project
Contra Costa Canal service, $/acre-foot[2]	14.52[3]	11.66	11.66	11.64	11.66
Substitute municipal and industrial water supply, $/acre-foot	[4]	[4]	3.45	3.33	3.45
Supplemental water supply[5]					
Contra Costa County, $/acre-foot	15.20	9.06	9.06	8.92	9.06
Solano County, $/acre-foot	17.00	8.82	8.82	8.68	8.82
Agricultural water supply, $/acre[6]	7.91[7]	1.50	1.50	1.45	1.50

[1] Average of estimated costs during a 60-year period. Values do not necessarily reflect prices for project services.
[2] For all municipal and industrial water served from the Contra Costa Canal. All costs include $11 per acre-foot for water from the canal. Allocated costs reflect benefits from improved quality.
[3] Includes estimated excess water treatment due to salinity degradation.
[4] Estimated future cost of high quality water from Delta channels will vary between $2.00 and $5.00 per acre-foot, depending upon plant locations and operations.
[5] All supplemental project water available through operation of the Montezuma Aqueduct.
[6] Costs reflect average for about 34,600 acres in the western Delta lowlands.
[7] Cost expressed as loss per acre due to salinity incursion.

per acre-foot for all water exported from the Delta by the State Water Facilities. Similar costs with the other projects would be about $0.66 per acre-foot.

It is anticipated that a federal contribution would be provided for flood and seepage control. This contribution, tentatively estimated at $10,123,000 for the Typical Alternative Delta Water Project and $16,020,000 for the Comprehensive Delta Water Project, would probably reflect current federal policy for allocation of costs of levee improvements, and would be based on reduced flood damages and net savings from reduced levee maintenance costs. Local costs of maintaining existing levees incorporated in the master levee system probably would not be directly met by local districts. Maintenance would be included in the total project costs, and a portion of these costs would be allocated to local beneficiaries.

The total project costs allocated to vehicular transportation were suballocated to the benefited counties and to the general public. The allocation to the general public reflects enhancement of recreation, and was considered nonreimbursable.

COMPARATIVE SUMMARY OF ESTIMATED ANNUAL COSTS OF FLOOD AND SEEPAGE CONTROL WITH AND WITHOUT DELTA WATER FACILITIES DURING 1960-2020[1]

(Per acre)

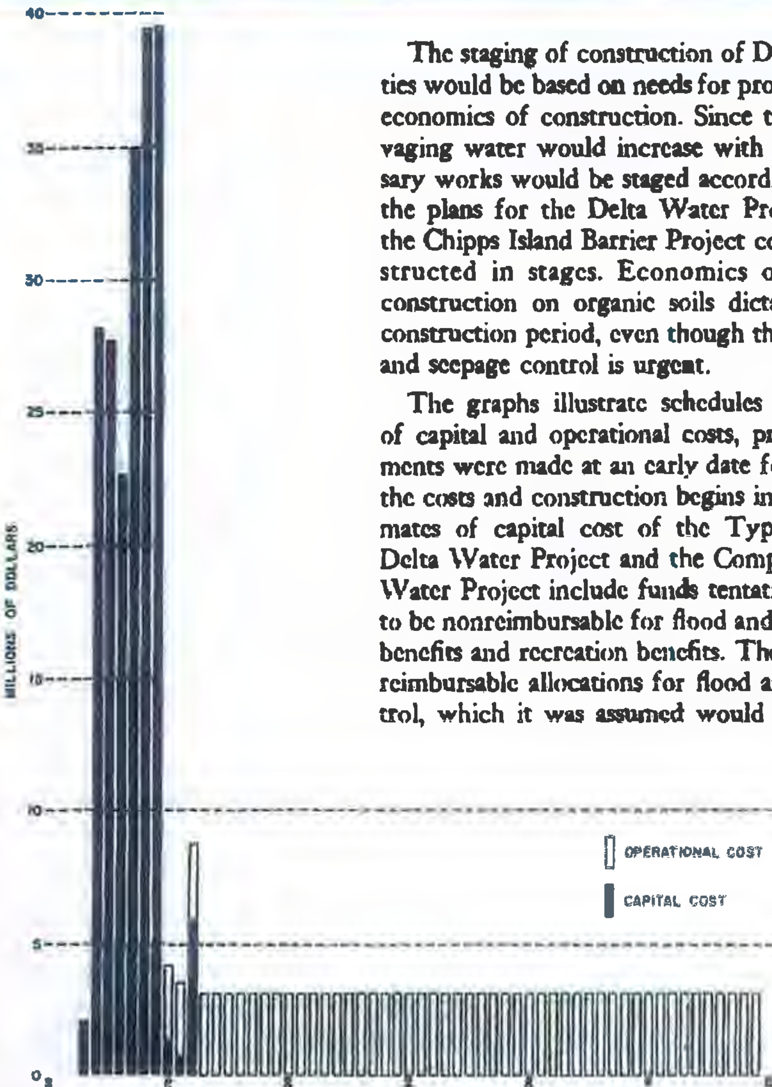
Item	Island-group					
	Isleton	Lodi	Holt	Tracy	Brentwood	Sherman
Present control cost	$8.00	$8.00	$7.50	$6.50	$7.50	$9.00
Future control cost without a project	10.85	10.29	9.16	7.50	8.83	13.10
Annual damage savings with a project	2.80	1.65	0.35	0.20	1.32	3.12
Typical Alternative Delta Water Project						
Allocated project cost	2.04	2.17				
Interior levees and pumping cost	7.96	7.34				
Total control cost	$10.00	$9.51				
Net savings	3.65	2.43				
Comprehensive Delta Water Project						
Allocated project cost	2.15	2.29	2.09	2.29	2.38	2.53
Interior levees and pumping cost	7.96	7.34	6.66	4.97	6.04	10.57
Total control cost	$10.11	$9.63	$8.75	$7.26	$8.42	$13.10
Net savings	3.54	2.31	0.76	0.44	1.73	3.12

[1] Average of estimated costs during a 60-year period. Values do not necessarily reflect prices for project services.

COMPARATIVE SUMMARY OF ESTIMATED ANNUAL COSTS AND SAVINGS WITH VEHICULAR TRANSPORTATION IMPROVEMENTS DURING 1960-2020[1]

Item	Contra Costa County	San Joaquin County	Sacramento County
Typical Alternative Delta Water Project			
Allocated project cost	$—	$41,400	$4,500
Operational savings to present road system	—	38,500	1,100
Savings to road users	—	265,700	105,200
Net savings	—	268,800	101,800
Comprehensive Delta Water Project			
Allocated project cost	13,300	95,700	11,200
Operational savings to present road system	2,900	59,300	5,000
Savings to road users	82,000	465,600	119,700
Net savings	71,600	429,200	113,500

[1] Average of estimated costs during a 60-year period. Values do not necessarily reflect prices for project services.
NOTE: There would not be any vehicular transportation improvements in portions of other counties within the Delta.



CHIPPS ISLAND BARRIER PROJECT

The staging of construction of Delta water facilities would be based on needs for project services and economics of construction. Since the need for salvaging water would increase with time, the necessary works would be staged accordingly for any of the plans for the Delta Water Project. However, the Chipps Island Barrier Project could not be constructed in stages. Economics of master levee construction on organic soils dictate an extended construction period, even though the need for flood and seepage control is urgent.

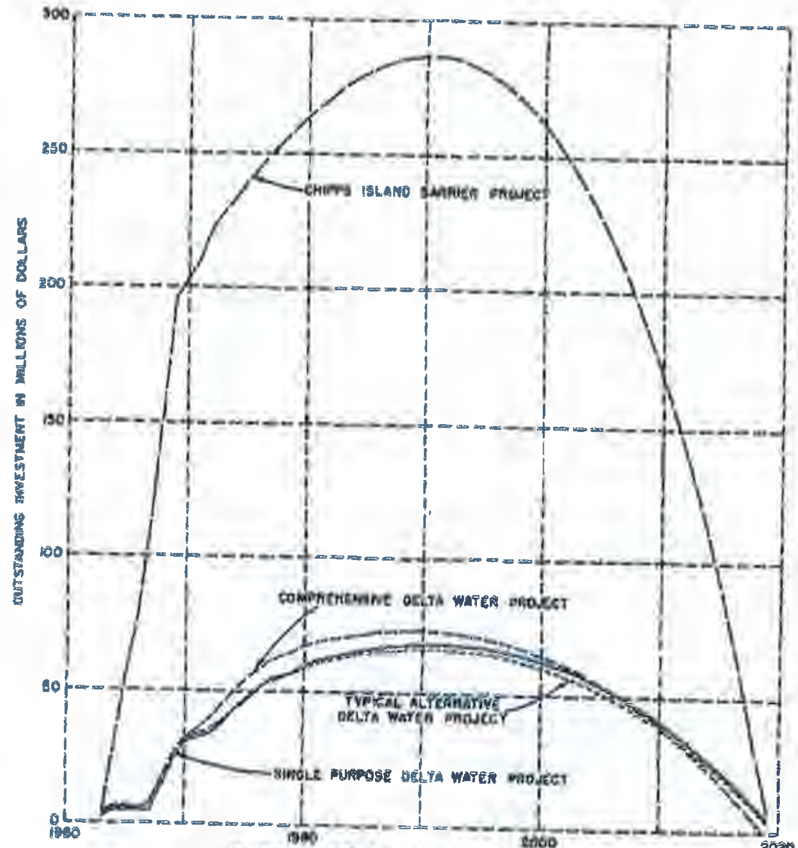
The graphs illustrate schedules of expenditures of capital and operational costs, provided arrangements were made at an early date for repayment of the costs and construction begins in 1963. The estimates of capital cost of the Typical Alternative Delta Water Project and the Comprehensive Delta Water Project include funds tentatively considered to be nonreimbursable for flood and seepage control benefits and recreation benefits. The estimated nonreimbursable allocations for flood and seepage control, which it was assumed would be provided by the Federal Government, amount to about $10,123,000 for the Typical Alternative Delta Water Project and $16,020,000 for the Comprehensive Delta Water Project. The estimated allocation of capital costs to recreation land and access would be $7,756,000 with the Typical Alternative Delta Water Project and $16,552,000 with the Comprehensive Delta Water Project. The corresponding allocations of annual operational costs would be $101,000 and $192,000, respectively. It was assumed that the allocated capital costs for recreation land and access would be nonreimbursable and be borne by the State of California. It was also assumed that the annual operational costs would be reimbursable from gas tax funds and nominal rental charges on land made available for recreation development.

The allocated reimbursable costs for water salvage and western Delta water supply would be repaid by water charges. The charges would be based on integrated repayment of other necessary State Water Facilities. The reimbursable costs of flood

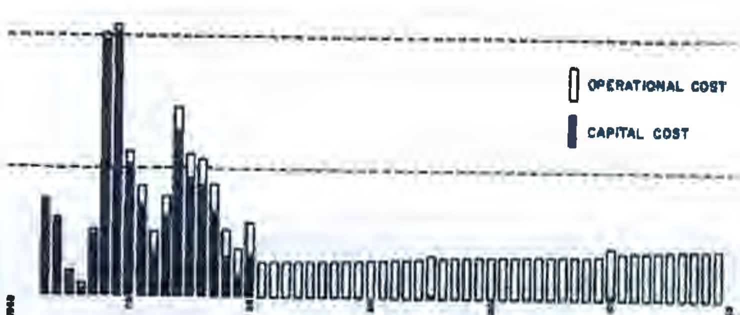
SINGLE PURPOSE DELTA WATER PROJECT

and seepage control and vehicular transportation improvements would be repaid by annual payments from the beneficiaries of flood and seepage control and from the counties, respectively. It was assumed that unassigned local costs of the Chipps Island Barrier Project would be recovered in annual payments in proportion to the projected industrial tax base. This assumed method of repayment would necessitate a rate of about $1.19 per $100 of assessed valuation throughout a 60-year period. It was also assumed that unassigned local costs of the Comprehensive Delta Water Project would be recovered in annual payments based upon the total acreage of land south of the San Joaquin River which would benefit from flood and seepage control. An annual payment of $0.86 per acre would be required.

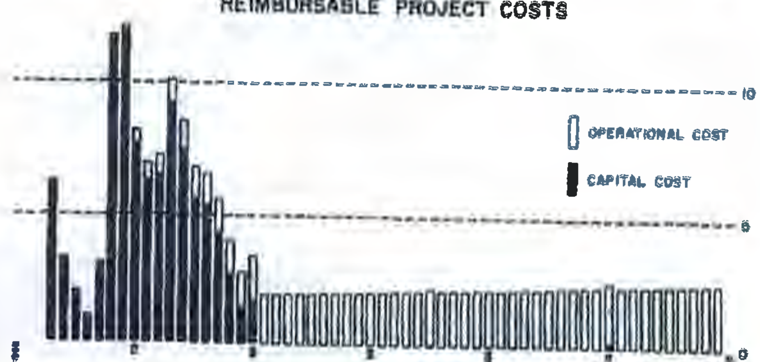
The comparative investment requirements for allocated reimbursable costs, including interest and operational costs, of the several projects are shown in the accompanying graph.



COMPARISON OF OUTSTANDING INVESTMENT REIMBURSABLE PROJECT COSTS



TYPICAL ALTERNATIVE DELTA WATER PROJECT



COMPREHENSIVE DELTA WATER PROJECT

Conclusions and Recommendations

CONCLUSIONS

GENERAL

The plans for Delta water facilities described in this report are consistent with and would accomplish the water development purposes embraced in the California Water Resources Development Bond Act approved on November 8, 1960. Additional features could be incorporated to provide flood and seepage control, transportation, and recreation benefits.

WATER SUPPLY

Problems of water quality in the western portion of the Delta necessitate early construction of facilities to provide suitable water supplies for present and future uses.

WATER SALVAGE

Without physical control works in the Delta, increasingly greater quantities of fresh water from upstream storage will be required to repel ocean salinity and maintain good quality water for use within and export from the Delta. Water salvage will be dependent upon coordinated operation of regulatory storage, export works, and Delta water facilities.

FLOOD AND SEEPAGE CONTROL

The magnitude of flood damage and the costs of flood and seepage control will become increasingly greater as the land surface of many Delta islands continues to subside. A master levee system would reduce these costs. Early initiation of construction is necessary to economically provide stable levees.

VEHICULAR TRANSPORTATION AND RECREATION

Improvements to the road system in the Delta are needed to reduce costs of vehicular shipment and to develop the recreation potential to accommodate an estimated 7,000,000 recreation-days in 1990, and 14,000,000 recreation-days in 2020.

DELTA WATER FACILITIES

1. The Chipps Island Barrier Project would be functionally feasible, would provide adequate water supplies of acceptable quality for the Delta, and would salvage water otherwise needed for salinity control amounting to an estimated annual average of 1,900,000 acre-feet based on a 60-year period. However, the net benefits would be less than the project costs in a ratio of 0.93:1. Therefore, the project would not be economically justified. The project would not be financially feasible, unless revenues could be obtained from local taxes in addition to revenues derived from water sales.

2. The alternative plans of the Delta Water Project would be functionally feasible, would permit export of full water demands on the State Water Facilities, and would provide adequate water supplies, both in quality and quantity, for the Delta. The project would salvage water otherwise needed for salinity control amounting to an estimated annual average of 2,050,000 acre-feet based on a 60-year period.

3. The Chipps Island Barrier Project would probably cause disastrous reductions in the fisheries resource of the Delta. The Single Purpose Delta Water Project would be the least detrimental of all projects and would reduce some losses of fish and

It is anticipated that the results of the planning studies summarized in this bulletin and described in detail in the supporting office reports will be the basis for selection of a general plan for the Delta Water Project. However, it is recognized that definite plans, designs, and operation programs will be dependent upon further studies and negotiations on certain aspects of the project plans.

LOCAL ACTION

Early consideration should be given by local agencies to the extent of their interest in facilities which could be constructed to provide local benefits. Acute water supply problems in the western Delta, particularly in the agricultural lowlands, warrant early resolution of interest in plans for water supply facilities. Consideration should be given to creation of master districts to represent related areas of interest in flood and seepage control benefits.

UNITED STATES CORPS OF ENGINEERS

Studies for flood and seepage control benefits and estimates of the federal contribution were based on methods and preliminary studies of the Corps of Engineers. Conditions in the Delta do not precisely fit standard procedures, and it will be necessary for the Corps of Engineers to make a detailed review of these studies to determine the extent of federal interest.

UNITED STATES BUREAU OF RECLAMATION

The Delta Water Project would enhance the operation of the Federal Central Valley Project by improving and insuring the quality of water exported from the Delta and by providing good quality water in the western Delta area in lieu of salinity control. The extent of federal interest in these benefits should be jointly analyzed by the Bureau of Reclamation and the Department of Water Resources.

HIGHWAYS

The channel closures and wide landward berms of the master levee system offer excellent opportunities for enhancing the road network in the Delta. Studies should be made by the State Division of Highways and county highway departments of transportation enhancement features, such as better road surfacing and connecting roads, which might be incorporated in the project plans.

FISHERY RESOURCES

To more definitely predict the anticipated project effects on fisheries and to design the fish screens and other remedial measures, it will be necessary to study certain biological aspects of the Delta fisheries. Joint studies of the anticipated project effects should be undertaken by the Department of Fish and Game and the Department of Water Resources.

OTHER STUDIES

Advance planning studies of flow distribution, salinity incursion, water quality, and sedimentation should continue throughout the design and early operation phases of project construction.

Test levee construction now being conducted pursuant to legislative directives will be continued to determine the most economical and efficient means of construction to provide an adequate levee system.

A general plan for remedial recreation facilities and recreation enhancement has been developed. Specific plans for facilities and development of land which can be made available for recreation uses should be prepared by county agencies, the Department of Water Resources, and other appropriate state agencies.

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U. S. Corps of Engineers
Sacramento District—flood control and navigation aspects
San Francisco District—preliminary designs, Chipps Island Barrier Project

U. S. Coast and Geodetic Survey—subsidence surveying

California Department of Fish and Game—fish and game studies

Contra Costa County Water Agency—industrial water use studies

University of California
Berkeley—electric analog model of Delta channels
Davis—organic soil salination research

Stanford University—salinity incursion analyses

Parsons, Brinckerhoff, Hall and Macdonald—recreation studies

A special Western Delta Advisory Committee was established at the suggestion of the Director of Water Resources to advise the department, primarily on studies of water requirements and plans in the western Delta. Committee membership, which has not endorsed all aspects of this report, included:

Contra Costa County

W. G. Buchanan, Chairman
Thomas M. Carlson
William J. O'Connell

Sacramento County

Arthur L. Kiefer
Jack Mingo
Weber Rothwell, Secretary

San Joaquin County

L. H. Bradley
Clifford B. Bull, Vice-Chairman
Richard G. Salter

Solano County

Lowell F. Bunn
Albert M. Jongeneel
Howard Stoddard

U. S. Bureau of Reclamation

Richard J. Shukle

U. S. Corps of Engineers

William A. Doyle

Harvey O. Banks, Director
Department of Water Resources
James F. Wright, Deputy Director
Department of Water Resources
William L. Berry, Chief Engineer
Division of Resources Planning
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Project Development Branch
Albert J. Dolcini, Chief
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Langdon W. Owen, Planning and Design
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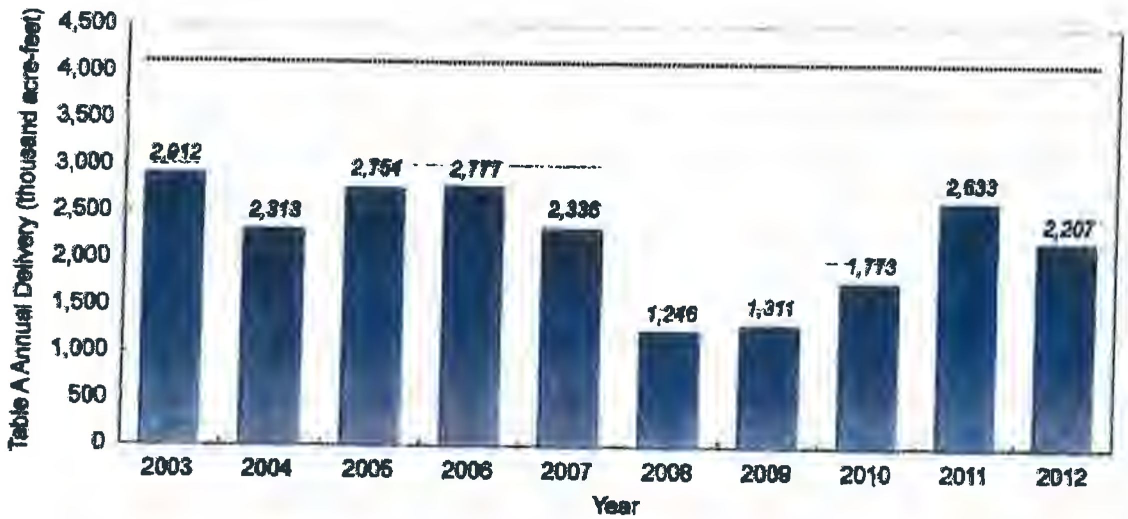
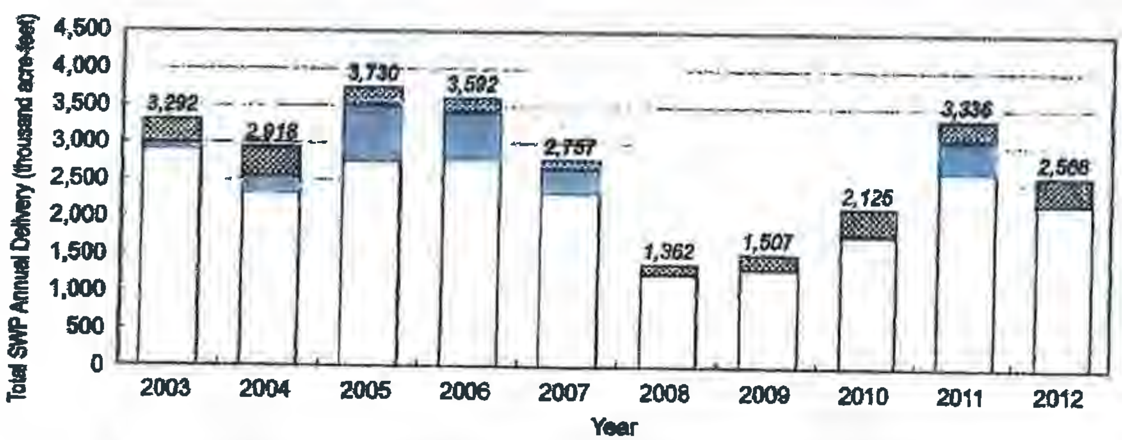


Note: The differences in historical deliveries from the State Water Project Delivery Reliability Report 2011 are due to reclassification of the various components of water delivered to SWP contractors.

Figure 2-3. Historical Deliveries of SWP Table A Water, 2003–2012



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Carryover	290	370	207	160	95	110	188	333	251	350
Turnback	30	17	38	34	16	3	2	11	31	8
Article 21	60	218	731	621	310	3	6	8	421	1
Table A	2,912	2,313	2,754	2,777	2,336	1,246	1,311	1,773	2,633	2,207

Note: The differences in historical deliveries from the State Water Project Delivery Reliability Report 2011 are due to reclassification of the various components of water delivered to SWP contractors.

Figure 2-4. Total Historical SWP Deliveries, 2003–2012 (by Delivery Type)

Exhibit 15

Dry-Year Deliveries of SWP Table A Water under Future Conditions

Table 6-3 and Figure 6-3 present estimates of future SWP Table A water deliveries during possible drought conditions and compare these estimates with the corresponding delivery estimates calculated for the 2011 Report. Drought scenarios for future conditions are analyzed using the historical drought-period precipitation and runoff patterns from 1922–2003 as a reference, while accounting for future conditions (e.g., land use, climate change).

The results of modeling future conditions under potential drought-year scenarios provide an estimated range of Table A deliveries that can be expected during drought periods.

The 2-year drought period (1976–1977) shows significantly lower Table A deliveries in the 2013 Report than in the 2011 Report (see Figure 6-3), because of modeling refinements (see the technical addendum at http://baydeltaoffice.water.ca.gov/) and reclassification of 1975 into a wet year rather than an above-normal year, as was used in the 2011 Report (due to the change in the assumed climate change model). Because 1975 is now considered a wet year in this 2013 Report's model, there are higher fall X2 requirements to meet and more Delta outflow is required in September. This leads to lower reservoir levels at the start of the new water year and smaller deliveries during the upcoming 2-year dry period.

	Long-term Average (1921-2003)		Single Dry Year (1977)		Dry Periods							
					2-Year Drought (1976-1977)		4-Year Drought (1931-1934)		6-Year Drought (1987-1992)		6-Year Drought (1929-1934)	
2011 Report	2,465	60%	441	11%	1,457	35%	1,401	34%	1,226	30%	1,365	33%
2013 Report	2,400	58%	453	11%	978	24%	1,263	31%	1,055	26%	1,251	30%

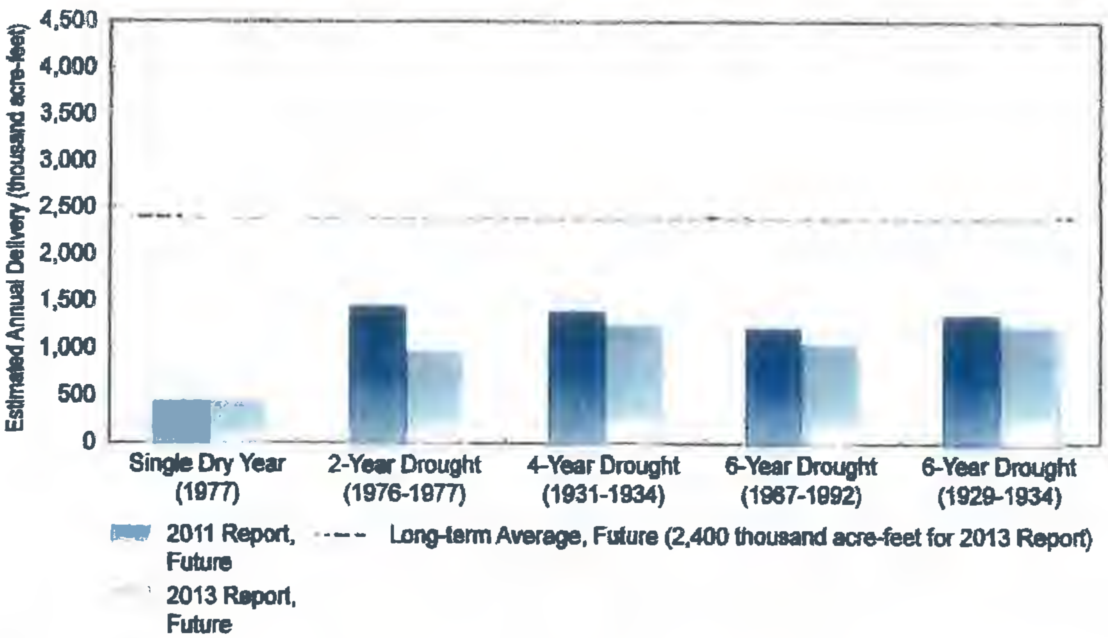


Figure 6-3. Estimated Dry-Period SWP Table A Water Deliveries (Future Conditions)

Title	**THE CALIFORNIA WATER RESOURCES DEVELOPMENT BOND ACT**
Year/Election	**1960 general**
Proposition type	bond (leg)
Popular vote	Yes: 3,008,328 (51.5%); No: 2,834,384 (48.5%)
Pass/Fail	Pass
Summary	This act provides for a bond issue of one billion, seven hundred fifty million dollars ($1,750,000,000) to be used by the Department of Water Resources for the development of the water resources of the State.

For

Argument in Favor of California Water Resources Development Bond Act

Your vote on this measure will decide whether California will continue to prosper.

This Act, if approved, will launch the statewide water development program which will meet present and future demands of all areas of California. The program will not be a burden on the taxpayer; no new state taxes are involved; the bonds are repaid from project revenues, through the sale of water and power. In other words, it will pay for itself. The bonds will be used over a period of many years and will involve an approximate annual expenditure averaging only $75 million, as compared, for example with $600 million a year we spend on highways.

Existing facilities for furnishing water for California's needs will soon be exhausted because of our rapid population growth and industrial and agricultural expansion. We now face a further critical loss in the Colorado River supply. Without the projects made possible by this Act, we face a major water crisis. We can stand no more delay.

If we fail to act <u>now</u> to provide new sources of water, land development in the great San Joaquin Valley will slow to a halt by 1965 and the return of cultivated areas to wasteland will begin. In southern California, the existing sources of water which have nourished its tremendous expansion will reach capacity by 1970 and further development must wholly cease. In northern California desperately needed flood control and water supplies for many local areas will be denied.

This Act will assure construction funds for new water development facilities to meet California's requirements now and in the future. No area will be deprived of water to meet the needs of another. Nor will any area be asked to pay for water delivered to another.

To meet questions which concerned, southern California, the bonds will finance completion of all facilities needed, as described in the Act. Contracts for delivery of water may not be altered by the Legislature. The tap will be open, and no amount of political maneuvering can shut it off.

Under this Act the water rights of northern California will remain securely protected. In addition, sufficient money is provided for construction of local projects to meet the pressing needs for flood control, recreation and water deliveries in the north.

A much needed drainage system and water supply will be provided in the San Joaquin Valley.

Construction here authorized will provide thousands of jobs. And the program will nourish tremendous industrial and farm and urban expansion which will develop an ever-growing source of employment and economic prosperity for Californians.

Our Legislature has appropriated millions of dollars for work in preparation, and construction is now underway. It would be tragic if this impressive start toward solution of our water problems were now abandoned.

If we fail to act <u>now</u> to insure completion of this constructive program, serious existing water shortages will only get worse. The success of our State is at stake. <u>Vote "Yes" for water for people, for progress, for prosperity!</u>

Exhibit 16

CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND THE NORTH DELTA WATER AGENCY FOR THE ASSURANCE OF A DEPENDABLE WATER SUPPLY OF SUITABLE QUALITY

THIS CONTRACT, made this 28th day of Jan, 1981, between the STATE OF CALIFORNIA, acting by and through its DEPARTMENT OF WATER RESOURCES (State), and the NORTH DELTA WATER AGENCY (Agency), a political subdivision of the State of California, duly organized and existing pursuant to the laws thereof, with its principal place of business in Sacramento, California.

RECITALS

(a) The purpose of this contract is to assure that the State will maintain within the Agency a dependable water supply of adequate quantity and quality for agricultural uses and, consistent with the water quality standards of Attachment A, for municipal and industrial uses, that the State will recognize the right to the use of water for agricultural, municipal, and industrial uses within the Agency, and that the Agency will pay compensation for any reimbursable benefits allocated to water users within the Agency resulting from the Federal Central Valley Project and the State Water Project, and offset by any detriments caused thereby.

(b) The United States, acting through its Department of the Interior, has under construction and is operating the Federal Central Valley Project (FCVP).

(c) The State has under construction and is operating the State Water Project (SWP).

(d) The construction and operation of the FCVP and SWP at times have changed and will further change the regimen of rivers tributary to the Sacramento-San Joaquin Delta (Delta) and the regimen of the Delta channels from unregulated flow to regulated flow. This regulation at times improves the quality of water in the Delta and at times diminishes the quality from that which would exist in the absence of the FCVP and SWP. The regulation at times also alters the elevation of water in some Delta channels.

(e) Water problems within the Delta are unique within the State of California. As a result of the geographical location of the lands of the Delta and tidal influences, there is no physical shortage of water. Intrusion of saline ocean water and municipal, industrial and agricultural discharges and return flows, tend, however, to deteriorate the quality.

(f) The general welfare, as well as the rights and requirements of the water users in the Delta, require that there be maintained in the Delta an adequate supply of good quality water for agricultural, municipal and industrial uses.

(g) The law of the State of California requires protection of the areas within which water originates and the watersheds in which water is developed. The Delta is such an area and within such a watershed. Part 4.5 of Division 6 of the California Water Code affords a first priority to provision of salinity control and maintenance of an adequate water supply in the Delta for reasonable and beneficial uses of water and relegates to lesser priority all exports of water from the Delta to other areas for any purpose.

(h) The Agency asserts that water users within the Agency have the right to divert, are diverting, and will continue to divert, for reasonable beneficial use, water from the Delta that would have been available therein if the FCVP and SWP were not in existence, together with the right to enjoy or acquire such benefits to which the water users may be entitled as a result of the FCVP and SWP.

(i) Section 4.4 of the North Delta Water Agency Act, Chapter 283, Statutes of 1973, as amended, provides that the Agency has no authority or power to affect, bind, prejudice, impair, restrict, or limit vested water rights within the Agency.

(j) The State asserts that it has the right to divert, is diverting, and will continue to divert water from the Delta in connection with the operation of the SWP.

(k) Operation of SWP to provide the water quality and quantity described in this contract constitutes a reasonable and beneficial use of water.

(l) The Delta has an existing gradient or relationship in quality between the westerly portion most seriously affected by ocean salinity intrusion and the interior portions of the Delta where the effect of ocean salinity intrusion is diminished. The water quality criteria set forth in this contract establishes minimum water qualities at various monitoring locations. Although the water quality criteria at upstream locations is shown as equal in some periods of some years to the water quality at the downstream locations, a better quality will in fact exist at the upstream locations at almost all times. Similarly, a better water quality than that shown for any given monitoring location will also exist at interior points upstream from that location at almost all times.

(m) It is not the intention of the State to acquire by purchase or by proceeding in eminent domain or by any other manner the water rights of water users within the Agency, including rights acquired under this contract.

(n) The parties desire that the United States become an additional party to this contract.

AGREEMENTS

1. Definitions. When used herein, the term:

(a) "Agency" shall mean the North Delta Water Agency and shall include all of the lands within the boundaries at the time the contract is executed as described in Section 9.1 of the North Delta Water Agency Act, Chapter 283, Statutes of 1973, as amended.

(b) "Calendar year" shall mean the period January 1 through December 31.

(c) "Delta" shall mean the Sacramento-San Joaquin Delta as defined in Section 12220 of the California Water Code as of the date of the execution of the contract.

(d) "Electrical Conductivity" (EC) shall mean the electrical conductivity of a water sample measured in millimhos per centimeter per square centimeter corrected to a standard temperature of 25° Celsius determined in accordance with procedures set forth in the publication entitled "Standard Methods of Examination of Water and Waste Water", published jointly by the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation, 13th Edition, 1971, including such revisions thereof as may be made subsequent to the date of this contract which are approved in writing by the State and the Agency.

(e) "Federal Central Valley Project" (FCVP) shall mean the Central Valley Project of the United States.

(f) "Four-River Basin Index" shall mean the most current forecast of Sacramento Valley unimpaired runoff as presently published in the California Department of Water Resources Bulletin 120 for the sum of the flows of the following: Sacramento River above Bend Bridge near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River at Smartville; American River, total inflow to Folsom Reservoir. The May 1 forecast shall continue in effect until the February 1 forecast of the next succeeding year.

(g) "State Water Project" (SWP) shall mean the State Water Resources Development System as defined in Section 12931 of the Water Code of the State of California.

(h) "SWRCB" shall mean the
trol Board.

Exhibit 17

(i) "Water year" shall mean the

Public Law 86-488

June 3, 1960
[S. 44]

AN ACT

To authorize the Secretary of the Interior to construct the San Luis unit of the Central Valley project, California, to enter into an agreement with the State of California with respect to the construction and operation of such unit, and for other purposes.

Central Valley Project, Calif. San Luis unit. Construction.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) for the principal purpose of furnishing water for the irrigation of approximately five hundred thousand acres of land in Merced, Fresno, and Kings Counties, California, hereinafter referred to as the Federal San Luis unit service area, and as incidents thereto of furnishing water for municipal and domestic use and providing recreation and fish and wildlife benefits, the Secretary of the Interior (hereinafter referred to as the Secretary) is authorized to construct, operate, and maintain the San Luis unit as an integral part of the Central Valley project. The principal engineering features of said unit shall be a dam and reservoir at or near the San Luis site, a forebay and afterbay, the San Luis Canal, the Pleasant Valley Canal, and necessary pumping plants, distribution systems, drains, channels, levees, flood works, and related facilities, but no facilities shall be constructed for electric transmission or distribution service which the Secretary determines, on the basis of an offer of a firm fifty-year contract from a local public or private agency, can through such contract be obtained at less cost to the Federal Government than by construction and operation of Government facilities. The works (hereinafter referred to as joint-use facilities) for joint use with the State of California (hereinafter referred to as the State) shall be the dam and reservoir at or near the San Luis site, forebay and afterbay, pumping plants, and the San Luis Canal. The joint-use facilities consisting of the dam and reservoir shall be constructed, and other joint-use facilities may be constructed, so as to permit future expansion; or the joint-use facilities shall be constructed initially to the capacities necessary to serve both the Federal San Luis unit service area and the State's service area, as hereinafter provided. In constructing, operating, and maintaining the San Luis unit, the Secretary shall be governed by the Federal reclamation laws (Act of June 17, 1902 (32 Stat. 388), and Acts amendatory thereof or supplementary thereto). Construction of the San Luis unit shall not be commenced until the Secretary has (1) secured, or has satisfactory assurance of his ability to secure, all rights to the use of water which are necessary to carry out the purposes of the unit and the terms and conditions of this Act, and (2) received satisfactory assurance from the State of California that it will make provision for a master drainage outlet and disposal channel for the San Joaquin Valley, as generally outlined in the California water plan, Bulletin Numbered 3, of the California Department of Water Resources, which will adequately serve, by connection therewith, the drainage system for the San Luis unit or has made provision for constructing the San Luis interceptor drain to the delta designed to meet the drainage requirements of the San Luis unit as generally outlined in the report of the Department of the Interior, entitled "San Luis Unit, Central Valley Project," dated December 17, 1956.

43 USC 371 and note.
Preliminary measures.

Conditions.

(b) No water provided by the Federal San Luis unit shall be delivered in the Federal San Luis service area to any water user for the production on newly irrigated lands of any basic agricultural commodity, as defined in the Agricultural Act of 1949, or any amendment thereof, if the total supply of such commodity as estimated by the Secretary of Agriculture for the marketing year in which the bulk

63 Stat. 1051.
7 USC 1421 note.

Exhibit 18

PL 99-546, October 27, 1986, 100 Stat 3050

UNITED STATES PUBLIC LAWS
99th Congress - Second Session
Convening January 21, 1986

DATA SUPPLIED BY THE U.S. DEPARTMENT OF JUSTICE. (SEE SCOPE)
Additions and Deletions are not identified in this document.

PL 99-546 (HR 3113)
October 27, 1986

An Act to implement the Coordinated Operations Agreement, the Suisun Marsh Preservation Agreement, and to amend the Small Reclamation Projects Act of 1956, as amended, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I -- COORDINATED OPERATIONS
PROJECT OPERATION POLICY

SEC. 101. Section 2 of the Act of August 26, 1937 (50 Stat. 850) is amended by --

(a) inserting at the beginning "(a)"; and
(b) inserting the following new subsection:
"(b)(1) Unless the Secretary of the Interior determines that operation of the Central Valley project in conformity with State water quality standards for the San Francisco Bay/Sacramento-San Joaquin Delta and Estuary is not consistent with the congressional directives applicable to the project, the Secretary is authorized and directed to operate the project, in conjunction with the State of California water project, in conformity with such standards. Should the Secretary of the Interior so determine, then the Secretary shall promptly request the Attorney General to bring an action in the court of proper jurisdiction for the purposes of determining the applicability of such standards to the project.
"(2) The Secretary is further directed to operate the Central Valley project, in conjunction with the State water project, so that water supplied at the intake of the Contra Costa Canal is of a quality equal to the water quality standards contained in the Water Right Decision 1485 of the State of California Water Resources Control Board, dated August 16, 1978, except under drought emergency water conditions pursuant to a declaration by the Governor of California. Nothing in the previous sentence shall authorize or require the relocation of the Contra Costa Canal intake.".

REIMBURSABLE COSTS

SEC. 102. Section 2 of the Act of August 26, 1937 (50 Stat. 850) is amended by inserting the following new subsection:

"(c)(1) The costs associated with providing Central Valley project water supplies for the purpose of salinity control and for complying with State water quality standards identified in exhibit A of the 'Agreement Between the United States of America and the Department of Water Resources of the State of California for Coordinated Operation of the Central Valley Project and the State Water Project' dated May 20, 1985, shall be allocated among the project purposes and shall be reimbursed in accordance with existing Reclamation law and policy. The costs of providing water for salinity control and for complying with State water quality standards above those standards identified in the previous sentence shall be nonreimbursable.
"(2) The Secretary of the Interior is authorized and directed to undertake a cost allocation study of the Central Valley project, including the provisions of this Act, and to implement such allocations no later than January 1, 1988.".

COORDINATED OPERATIONS AGREEMENT

Exhibit 19

SEC. 103. Section 2 of the Act of August 26, 1937 (50 Stat. 850) is amended by inserting the following new subsection:

"(d) The Secretary of the Interior is authorized and directed to execute and implement the 'Agreement Between the United States of America and the Department of Water Resources of the State of California for Coordinated Operation of the Central Valley Project and the State Water Project' dated May 20, 1985: Provided, That --
"(1) the contract with the State of California referred to in subarticle 10(h)(1) of the agreement referred to in this subsection for the conveyance and purchase of Central Valley project water shall become final only after an Act of Congress approving the execution of the contract by the Secretary of the Interior; and
"(2) the termination provisions of the agreement referred to in this subsection may only be exercised if the Secretary of the Interior or the State of California submits a report to Congress and sixty calendar days have elapsed (which sixty days, however, shall not include days on which either the House of Representatives or the Senate is not in session because of an adjournment of more than three days to a day certain) from the date on which said report has been submitted to the Speaker of the House of Representatives and the President of the Senate for reference to the Committee on Interior and Insular Affairs of the House of Representatives and the Committee on Energy and Natural Resources of the Senate. The report must outline the reasons for terminating the agreement and, in the case of the report by the Secretary of the Interior, include the views of the Administrator of the Environmental Protection Agency and the Governor of the State of California on the Secretary's decision.".

REFUGE WATER SUPPLY INVESTIGATION

SEC. 104. The Secretary of the Interior shall not contract for the delivery of more than 75 percent of the firm annual yield of the Central Valley project not currently committed under long-term contracts until one year after the Secretary has transmitted to the Congress a feasibility report, together with his recommendations, on the "Refuge Water Supply Investigations, Central Valley Basin, California.".

ADJUSTMENT OF RATES AND ABILITY TO PAY

SEC. 105. The Secretary of the Interior shall include in all new or amended contracts for the delivery of water from the Central Valley project a provision providing for the automatic adjustment of rates by the Secretary of the Interior if it is found that the rate in effect may not be adequate to recover the appropriate share of the existing Federal investment in the project by the year 2030. The contracts shall also include a provision authorizing the Secretary of the Interior to adjust determinations of ability to pay every five years.

OPERATION AND MAINTENANCE DEFICITS

SEC. 106. The Secretary of the Interior shall include in each new or amended contract for the delivery of water from the Central Valley project provisions ensuring that any annual deficit (outstanding or hereafter arising) incurred by a Central Valley project water contractor in the payment of operation and maintenance costs of the Central Valley project is repaid by such contractor under the terms of such new or amended contract, together with interest on any such deficit which arises on or after October 1, 1985, at a rate equal to the average market yields on outstanding marketable obligations of the United States with remaining periods to maturity comparable to the applicable reimbursement period of the project, adjusted to the nearest one-eighth of 1 percent.

TITLE II -- SUISUN MARSH PRESERVATION AGREEMENT
AUTHORITY TO ENTER AGREEMENT

SEC. 201. The Secretary of the Interior is authorized to execute and implement the agreement between the Department of the Interior, the State of California and the Suisun Resources Conservation District (dated November 1, 1985).

COST-SHARING PROVISIONS

(iii) evaluation of lower Mokelumne River floodway improvements.

(C) INTERTIES.—Activities under this subparagraph consist of—

(i) evaluation and construction of an intertie between the State Water Project California Aqueduct and the Central Valley Project Delta Mendota Canal, near the City of Tracy, as an operation and maintenance activity, except that the Secretary shall design and construct the intertie in a manner consistent with a possible future expansion of the intertie capacity (as described in subsection (f)(1)(B)); and

(ii) assessment of a connection of the Central Valley Project to the Clifton Court Forebay of the State Water Project, with a corresponding increase in the screened intake of the Forebay.

(D) PROGRAM TO MEET STANDARDS.—

(i) IN GENERAL.—Prior to increasing export limits from the Delta for the purposes of conveying water to south-of-Delta Central Valley Project contractors or increasing deliveries through an intertie, the Secretary shall, not later than 1 year after the date of enactment of this Act, in consultation with the Governor, develop and initiate implementation of a program to meet all existing water quality standards and objectives for which the Central Valley Project has responsibility. Deadline.

(ii) MEASURES.—In developing and implementing the program, the Secretary shall include, to the maximum extent feasible, the measures described in clauses (iii) through (vii).

(iii) RECIRCULATION PROGRAM.—The Secretary shall incorporate into the program a recirculation program to provide flow, reduce salinity concentrations in the San Joaquin River, and reduce the reliance on the New Melones Reservoir for meeting water quality and fishery flow objectives through the use of excess capacity in export pumping and conveyance facilities.

(iv) BEST MANAGEMENT PRACTICES PLAN.—

(I) IN GENERAL.—The Secretary shall develop and implement, in coordination with the State's programs to improve water quality in the San Joaquin River, a best management practices plan to reduce the water quality impacts of the discharges from wildlife refuges that receive water from the Federal Government and discharge salt or other constituents into the San Joaquin River.

(II) COORDINATION WITH INTERESTED PARTIES.—The plan shall be developed in coordination with interested parties in the San Joaquin Valley and the Delta.

(III) COORDINATION WITH ENTITIES THAT DISCHARGE WATER.—The Secretary shall also coordinate activities under this clause with other entities that discharge water into the San Joaquin River to reduce salinity concentrations discharged into

Exhibit 20

the River, including the timing of discharges to optimize their assimilation.

(v) ACQUISITION OF WATER.—The Secretary shall incorporate into the program the acquisition from willing sellers of water from streams tributary to the San Joaquin River or other sources to provide flow, dilute discharges of salt or other constituents, and to improve water quality in the San Joaquin River below the confluence of the Merced and San Joaquin Rivers, and to reduce the reliance on New Melones Reservoir for meeting water quality and fishery flow objectives.

(vi) PURPOSE.—The purpose of the authority and direction provided to the Secretary under this subparagraph is to provide greater flexibility in meeting the existing water quality standards and objectives for which the Central Valley Project has responsibility so as to reduce the demand on water from New Melones Reservoir used for that purpose and to assist the Secretary in meeting any obligations to Central Valley Project contractors from the New Melones Project.

(vii) UPDATING OF NEW MELONES OPERATING PLAN.—The Secretary shall update the New Melones operating plan to take into account, among other things, the actions described in this title that are designed to reduce the reliance on New Melones Reservoir for meeting water quality and fishery flow objectives, and to ensure that actions to enhance fisheries in the Stanislaus River are based on the best available science.

(3) WATER USE EFFICIENCY.—

(A) WATER CONSERVATION PROJECTS.—Activities under this paragraph include water conservation projects that provide water supply reliability, water quality, and ecosystem benefits to the California Bay-Delta system.

(B) TECHNICAL ASSISTANCE.—Activities under this paragraph include technical assistance for urban and agricultural water conservation projects.

(C) WATER RECYCLING AND DESALINATION PROJECTS.—Activities under this paragraph include water recycling and desalination projects, including groundwater remediation projects and projects identified in the Bay Area Water Plan and the Southern California Comprehensive Water Reclamation and Reuse Study and other projects, giving priority to projects that include regional solutions to benefit regional water supply and reliability needs.

(D) WATER MEASUREMENT AND TRANSFER ACTIONS.—Activities under this paragraph include water measurement and transfer actions.

(E) URBAN WATER CONSERVATION.—Activities under this paragraph include implementation of best management practices for urban water conservation.

(F) RECLAMATION AND RECYCLING PROJECTS.—

Applicability.

(i) PROJECTS.—This subparagraph applies to—

(I) projects identified in the Southern California Comprehensive Water Reclamation and Reuse Study, dated April 2001 and authorized by

Water Right Decision 1485

In the Matter of Permit 12720 (Application 5625) and Other Permits of United States Bureau of Reclamation for the Federal Central Valley Project and of California Department of Water Resources for the State Water Project.

DECISION IN FURTHERANCE OF JURISDICTION RESERVED IN DECISIONS D 893, D 990, D 1020, D 1250, D 1275, D 1291, D 1308, D 1356, and PERMIT ORDER 124

Sacramento-San Joaquin Delta and Suisun Marsh

August 1978

STATE WATER RESOURCES CONTROL BOARD

Exhibit 21

executed. The criteria in the draft agreement were recommended by Fish and Game and endorsed by the Department, and were extensively analyzed by the Board staff. Based on our most current assessment, the fishery standards provide significantly higher protection than existing basin plans. The Striped Bass Index is a measure of young bass survival through their first summer. The Striped Bass Index would be 71 under without project conditions (i.e., theoretical conditions which would exist today in the Delta and Marsh in the absence of the CVP and SWP), 63 under the existing basin plans, and about 79[3/] under this decision.

D 1485
1978

While the standards in this decision approach without project levels of protection for striped bass, there are many other species, such as white catfish, shad and salmon, which would not be protected to this level. To provide full mitigation of project impacts on all fishery species now would require the virtual shutting down of the project export pumps. The level of protection provided under this decision is nonetheless a reasonable level of protection until final determinations are made concerning a cross-Delta transfer facility or other means to mitigate project impacts.

NO SHUT DOWN
INSTEAD
INCREASED EXPORT

3/ There is some indication that factors other than those considered in the Board's analysis of without project levels may also affect striped bass survival. The effects of these factors are such that the without project levels would be greater than 71. However, the magnitude of this impact is unknown and cannot be quantified at this time.

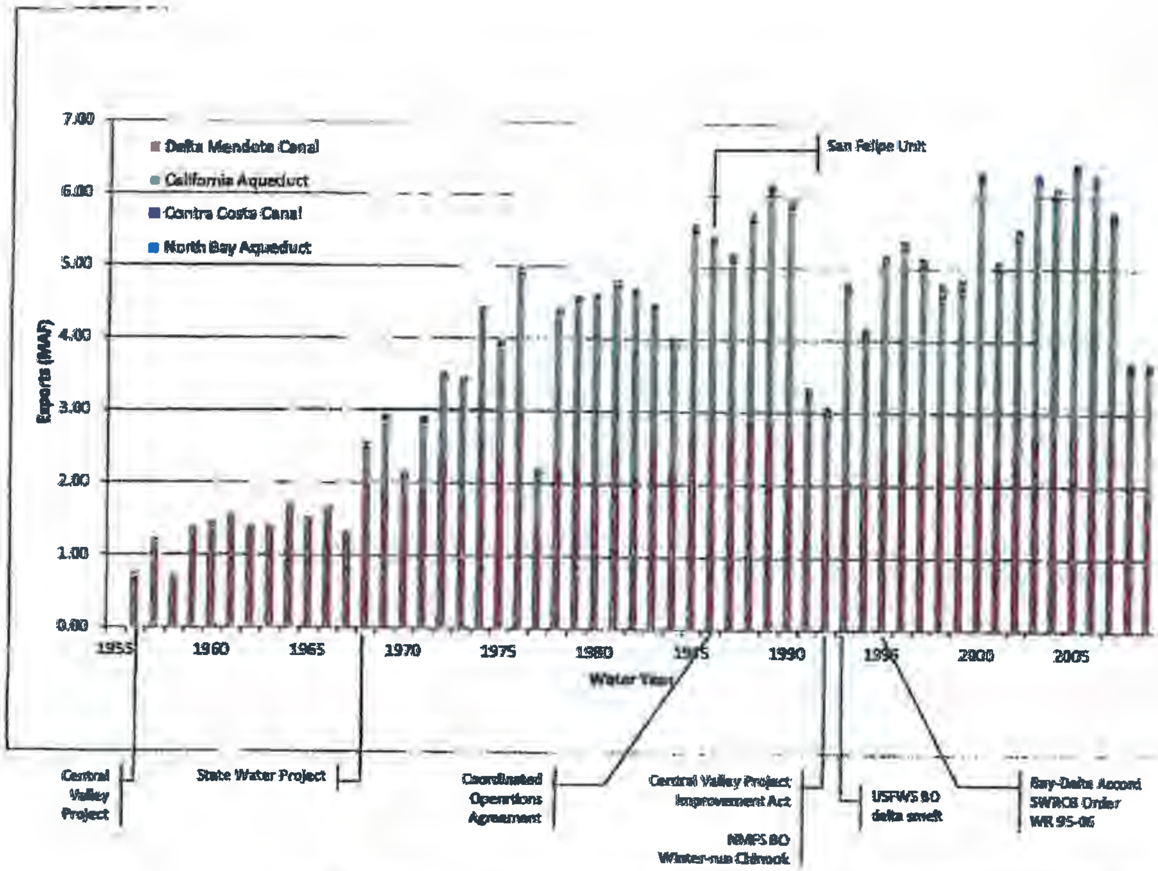
D 1485
1978

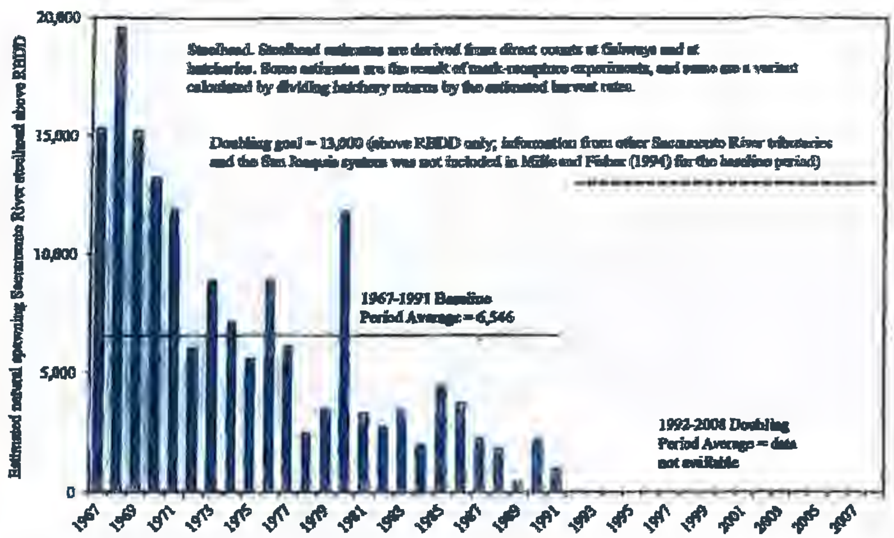
051837

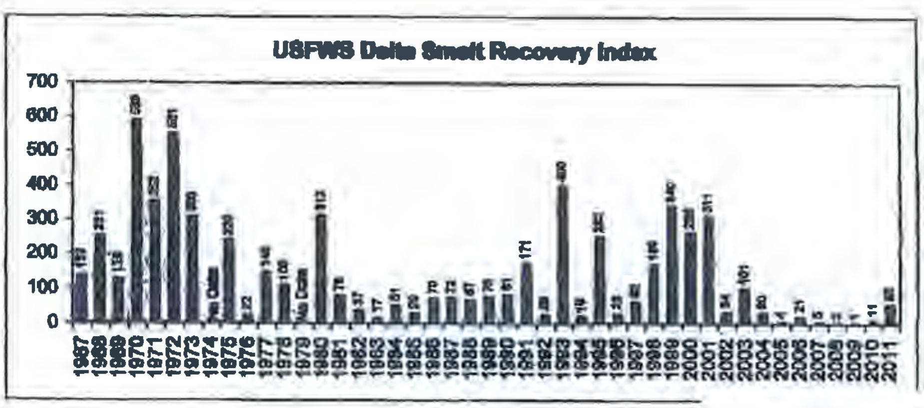
NOT PROVIDED

Suisun Marsh. Full protection of Suisun Marsh now could be accomplished only by requiring up to 2 million acre-feet of freshwater outflow in dry and critical years in addition to that required to meet other standards. This requirement would result in a one-third reduction in combined firm exportable yield of State and federal projects. In theory, the existing Basin 5B Plan purports to provide full protection to the Marsh. However, during the 1976-77 drought when the basin plan was in effect, the Marsh received little if any protection because the system almost ran out of water and emergency regulations had to be imposed. This decision balances the limitations of available water supplies against the mitigation responsibility of the projects. This balance is based on the constitutional mandate "...that the water resources of the State be put to beneficial use to the fullest extent of which they are capable..." and that unreasonable use and unreasonable diversion be prevented (Article 10, Section 2, California Constitution).

The Bureau, the Department, Fish and Game, and U. S. Fish and Wildlife Service are working together to develop alternative water supplies for the Marsh. Such alternative supplies appear to represent a feasible and reasonable method for protection of the Marsh and mitigation of the adverse impacts of the projects. Under this decision the Department and Bureau are required, in cooperation with other agencies, to develop a plan for Suisun Marsh by July 1, 1979. The Suisun Marsh plan should ensure that the


Delta Mendota Canal
California Aqueduct
Contra Costa Canal
North Bay Aqueduct
Exports (MAF)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Water Year
San Felipe Unit
Central Valley Project
State Water Project
Coordinated Operations Agreement
Central Valley Project Improvement Act
NMFS BO Winter-run Chinook
USFWS BO delta smelt
Bay-Delta Accord SWRCB Order WR 95-06


Steelhead. Steelhead estimates are derived from direct counts at fishways and at hatcheries. Some estimates are the result of mark-recapture experiments, and some are a variant calculated by dividing hatchery returns by the estimated harvest rates.
Doubling goal = 13,000 (above RBDD only; information from other Sacramento River tributaries and the San Joaquin system was not included in Mills and Fisher (1994) for the baseline period)
1967-1991 Baseline Period Average = 6,546
1992-2008 Doubling Period Average = data not available
Estimated natural spawning Sacramento River steelhead above RBDD
20,000
15,000
10,000
5,000
0
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007


USFWS Delta Smelt Recovery Index
700
600
500
400
300
200
100
0
No Data
No Data
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
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2011

Exhibit 22

2-1-13

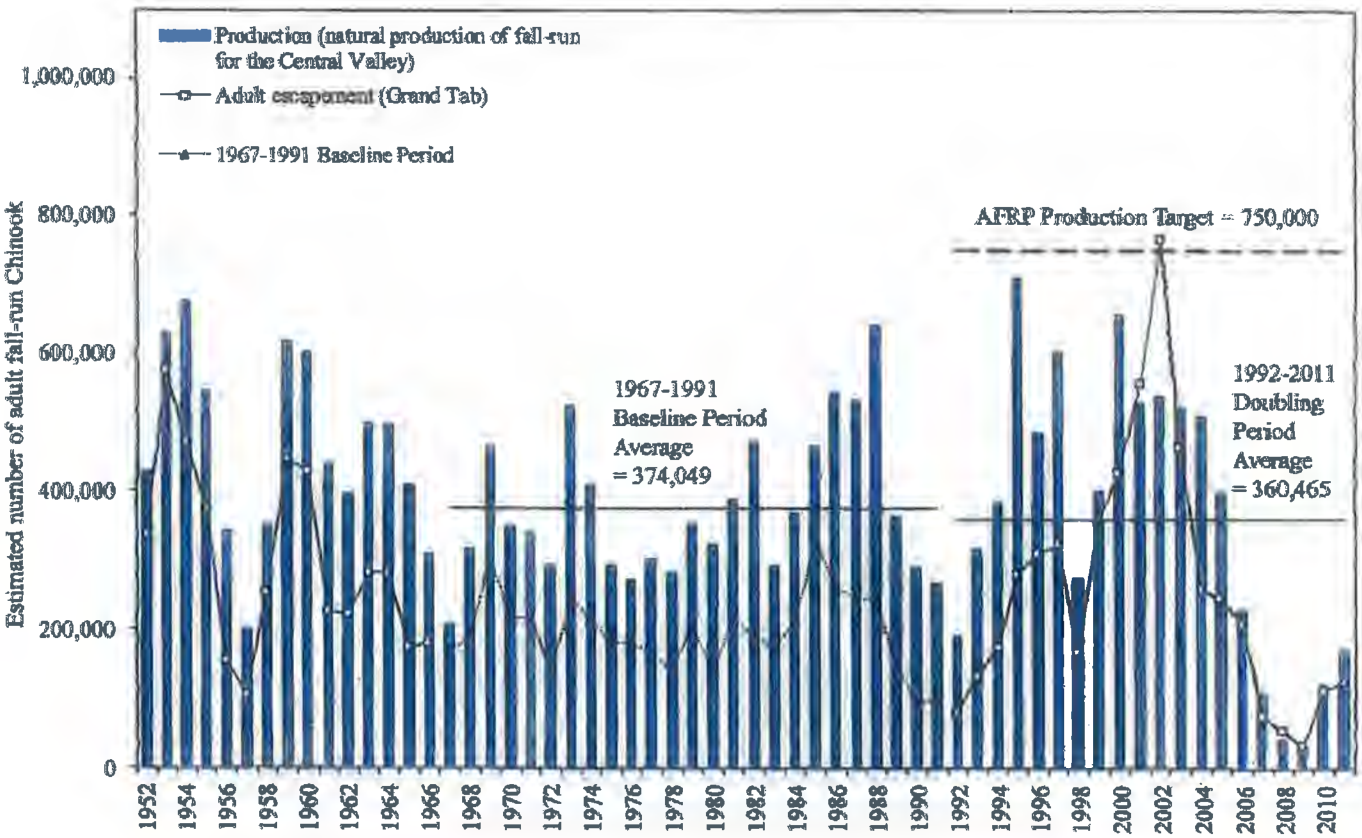


Figure 2. Estimated yearly natural production and in-river escapement of adult fall-run Chinook salmon in the Central Valley rivers and streams. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

Exhibit 23

2-1-13

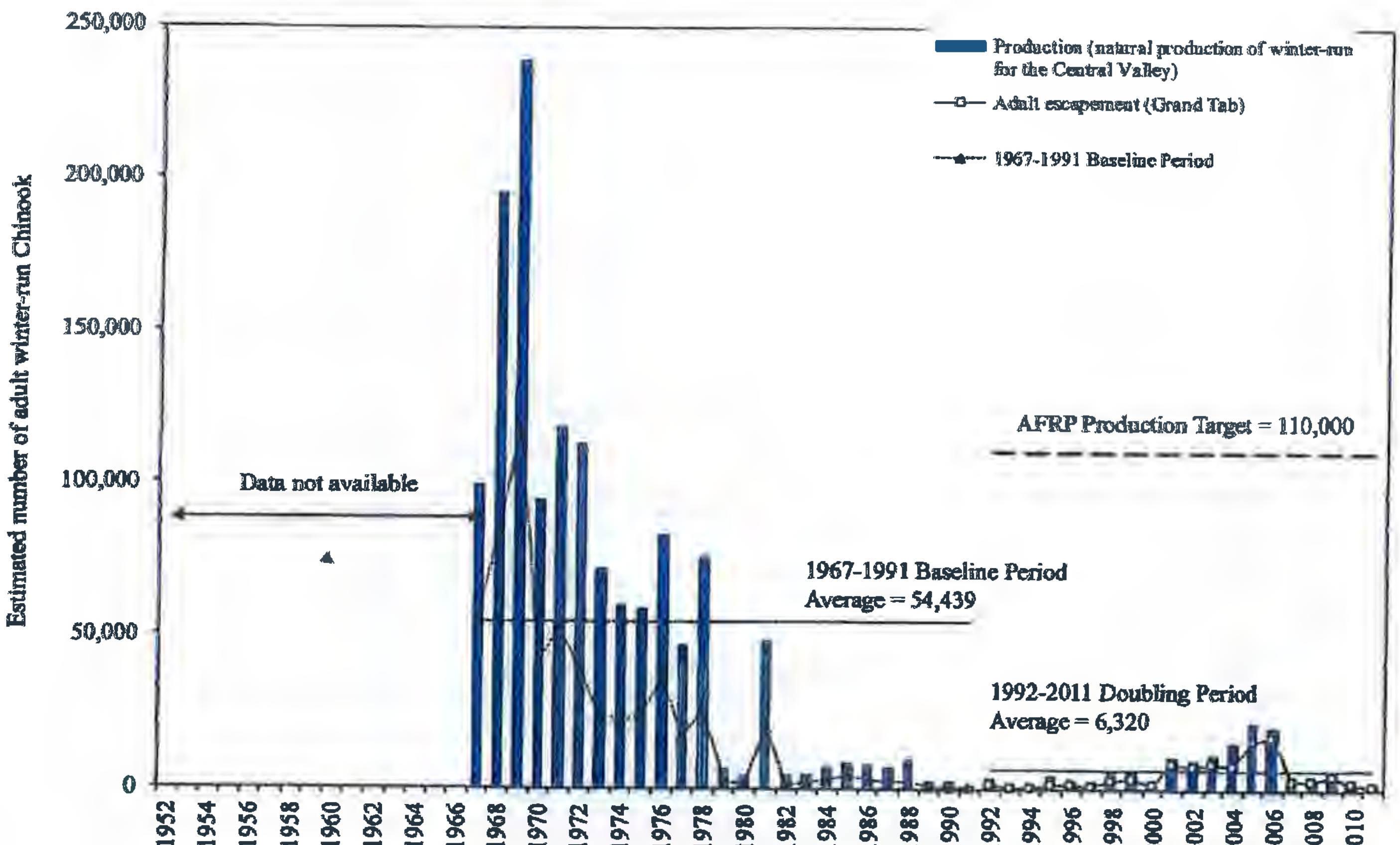
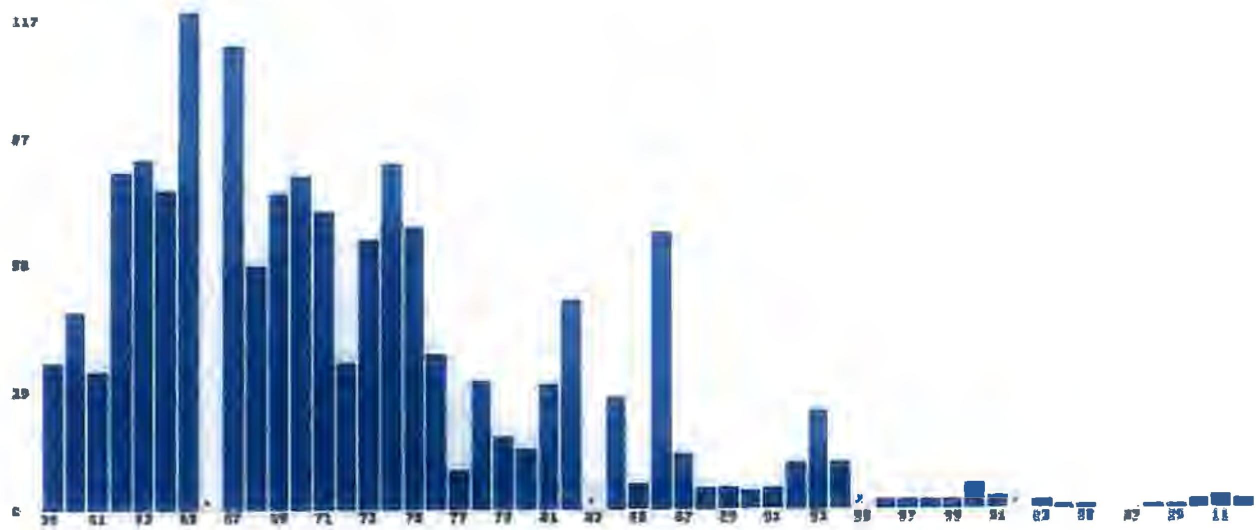


Figure 4. Estimated yearly adult natural production, and in river adult escapements of winter-run Chinook salmon in the Central Valley rivers and streams. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

Exhibit 24

CALIFORNIA DEPARTMENT OF
FISH and WILDLIFE

Striped Bass Indices



Striped Bass Indices

YEAR	INDEXDATE	DELTA INDEX	SUISUN BAY INDEX	TOTAL INDEX
1959	12-Jul	30.7	3.0	33.7
1960	16-Jul	32.0	13.6	45.6
1961	21-Jul	25.2	6.4	31.6
1962	26-Jul	46.8	32.1	78.9
1963	3-Aug	38.2	43.5	81.7
1964	1-Aug	54.7	20.7	75.4

Exhibit 25

Jeff Opperman
Final Report for Fellowship R/SF-4

My CALFED fellowship (R/SF-4) had three primary research areas: (1) how native fish use California floodplains; (2) developing a method to identify and quantify a particular type of floodplain in the Sacramento Valley; and (3) a white paper for CALFED that reviews, summarizes, and synthesizes research on floodplains generally, and Central Valley floodplains specifically.

I. Native fish and floodplains.
For this research I collaborated with Carson Jeffres, a graduate student at UC Davis (this research was his Master's thesis). We compared the growth rates of juvenile Chinook salmon between various floodplain and riverine habitats. This study built on previous work; (1) in the Yolo Bypass that found that juvenile Chinook grew faster in the flooded Bypass than in the nearby Sacramento River and; (2) in the Cosumnes Preserve which showed that native, wild juvenile Chinook salmon appeared to use the Cosumnes floodplain for rearing when it was inundated.

Juvenile salmon were obtained from a hatchery on the Mokelumne River and placed in enclosures within the Cosumnes River and floodplain (ten fish per enclosure). For two flood seasons (2004 and 2005), six enclosures were placed in each of three different habitat types in the floodplain and two locations in the river (30 enclosures total). Floodplain habitats included an ephemeral pond, flooded terrestrial herbaceous vegetation, and a pond that was permanent during the first year of the study and ephemeral during the second. The river locations were the river channel above the floodplain and the river channel below the floodplain.

The fish were measured at one week intervals, although measurement frequency declined during large flood events that made access difficult. In 2004 fish were measured three times over 4.5 weeks and in 2005 they were measured four times over 8 weeks. After the final measurement the fish were sacrificed and a sub-set were saved for a gut-content analysis.

In general, fish had faster growth rates in floodplain habitats than in the river. During periods of low, clear water, fish growth rates in the river site above the floodplain were comparable to those in the floodplain. However, during higher flows, with more turbid water, growth in the river above the floodplain was significantly lower than on the floodplain. Fish in the river below the floodplain, which was representative of intertidal delta habitat, were consistently low.

The main channel of the Cosumnes River, like those of many Central Valley rivers, is incised and lacks complexity. There are few side channels, backwaters, or accessible floodplain habitats (other than the Cosumnes Preserve). Thus, juvenile fish will tend to be displaced downstream during high flow events. In the Cosumnes, juvenile fish will be flushed downstream to either the intertidal delta or the floodplain. Among these two

Exhibit 26

habitats, the floodplain appears to provide significantly better habitat for rearing (Figure 1).

Figure 1. Juvenile Chinook on the right were reared within an enclosure within the Cosumnes River floodplain while those on the left were reared within an enclosure in the river below the floodplain (intertidal Delta habitat).

This study confirms that juvenile Chinook benefit from access to floodplain habitats. While river habitats comparable to those above the floodplain can support similar growth rates as the floodplain, this habitat is more variable. During high flows the river offers poor habitat and fish living in this type of habitat will tend to be displaced downstream. The floodplain can provide optimal growing conditions during such floods and likely offers superior habitat conditions to the downstream Delta.

The risk of fish stranding on the floodplain merits further research. However, initial research on the Cosumnes suggests that native fish tend to respond to cues that facilitate emigration from the floodplain during draining and that primarily non-native fish become stranded. This work further supports the concept that floodplain restoration can be an important strategy for restoring Central Valley salmon populations.

This research is summarized in:

Jeffres, C., J. Opperman, and P. B. Moyle. *Submitted.* Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river. Submitted to Environmental Biology of Fishes.

This work has also been presented at the following conferences:

1. Floodplain Management Association 2005
2. Society for Ecological Restoration 2005
3. Riverine Hydroecology (Stirling, Scotland) 2006

2. Identifying and mapping the floodplain inundated by the Floodplain Activation Flood.

Working in collaboration with Phil Williams and Associates (PWA), we worked to define, identify, and quantify a particular type of floodplain: that which is inundated by a Floodplain Activation Flood (FAF). The FAF is a relatively frequent, long duration, spring-time flood that has particular value for native fish and food web productivity (see text on floodplain conceptual model below for further description of a Floodplain Activation Flood).

The FAF was defined as follows:

1. occurs in two out of three years (67% exceedance probability)
2. duration of at least one week
3. occurs between March 15 and May 15.

These criteria were applied to a series of paired gauges along the Sacramento River and within the Yolo Bypass. This process derived a flood stage elevation that corresponded to the FAF criteria. This flood stage was then used to develop a water surface that was applied to topography for the Sacramento River and surrounding floodplain (from US Army Corps of Engineers' Sacramento-San Joaquin Comprehensive Study), estimating the area of floodplain inundated during the FAF.

We found that there is very little floodplain area inundated by the FAF in the current Sacramento Valley. Nearly all floodplain that corresponds to the FAF is found within the Yolo Bypass.

This work is further described in:

Philip Williams & Associates, L., and J. J. Opperman. 2006. The frequently activated floodplain: quantifying a remnant landcape in the Sacramento Valley, San Francisco, CA.

Williams, P., J. Opperman, E. Andrews, S. Bozkurt, and P. Moyle. Quantifying activated floodplain on a lowland regulated river. *In preparation for* San Francisco Estuary and Watershed Science.

3. The Central Valley Floodplain White Paper

I am continuing to work on the floodplain white paper along with my co-author, Peter Moyle. A central part of the white paper is a conceptual model for Central Valley floodplains, briefly described below.

This work has been presented at the following conferences:

1. Floodplain Management Association, 2005
2. American Geophysical Union and the North American Benthological Society, 2005
3. Society for Ecological Restoration, 2005

4. State of the Estuary Conference, 2005
5. CALFED Science Conference, 2006
6. Riverine Hydroecology (Stirling, Scotland), 2006
7. State of Washington, the Ecological Value of High Flows, 2006

<u>Brief overview of conceptual model:</u>

Floodplains support high levels of biodiversity and are among the most productive ecosystems in the world. They provide a range of ecosystem services to human society, including storage and conveyance of flood flows, groundwater recharge, open space, recreational opportunities, and habitat for a diversity of species, many of them of economic importance. Among the world's ecosystem types, Costanza et al. (1997) ranked floodplains second only to estuaries in terms of the ecosystem services provided to society. In the Central Valley, the most important ecosystem services provided by floodplains include reduction of flood risk and habitat for numerous species, including commercially and recreationally valuable species (e.g., chinook salmon and waterfowl) and for endangered species. Recent research has demonstrated that floodplains provide necessary spawning habitat for the Sacramento splittail, an endemic minnow (Sommer et al. 1997) and that juvenile chinook salmon grow faster on floodplains than in main-stem river channels (Sommer et al. 2001b) (Figure 1). Productivity from floodplains can be exported to the Sacramento-San Joaquin Delta, where food limitation is likely one of the factors contributing to the decline of fish species (Jassby and Cloern 2000, Schemel et al. 2004). Further, in places such as the Yolo Bypass, ecologically valuable floodplains can be compatible with productive agriculture (Sommer et al. 2001a).

Recognizing these valuable services, state and federal agencies have expressed policy goals to restore floodplains in the Central Valley (CALFED Bay-Delta Program 2000). Further, flood management projects in the Central Valley now generally include a floodplain restoration component. To guide these restoration efforts, we convened a floodplain working group, composed of floodplain experts drawn from academia, agencies, NGOs, and the private sector, to define ecologically functional floodplains. This group described three primary components of ecologically functional floodplains:

- ***Connectivity*** between river and floodplain.
- ***Hydrological variability***
- ***Sufficient geographic scale*** for associated ecological benefits to be meaningful on a system- or population-scale.

We developed a conceptual model of floodplain processes based on the scientific literature, our collective experiences studying floodplains, and guidance from the floodplain working group (Figure 2). This conceptual model illustrates the linkages between physical and biological processes in floodplains and can be used to inform floodplain restoration projects.

Organization of the conceptual model.
A diverse range of flows influence floodplain geomorphic and ecological processes, ranging from flows below bankfull to large, rare, and highly erosive floods. Numerous aspects of these flows have geomorphic and ecological significance, including magnitude, frequency, duration, rates of change, and seasonality, as well as antecedent conditions on the floodplain. To simplify, our conceptual model focuses on three types of 'representative floods,' characterized by their frequency and magnitude, which are found in the blue boxes in the Hydrology portion of the model. These floods perform geomorphic work, described in the brown-outline boxes in the Geomorphology portion of the model. Hydrologic and geomorphic processes create the conditions for Ecosystem Responses and Processes to occur (green-outlined boxes). The Ecosystem Responses and Processes produce Ecological Benefits, the magnitudes of which are influenced by the geographic scale of floodplain. Two representative floods, the Floodplain Activation Flood and the Floodplain Reorganization Flood are illustrated in Figures 2 and 3 and described below.

Two representative floods
Floodplain Activation Flood. The floodplain activation flood (FAF) is a small-magnitude flood that occurs relatively frequently (e.g., almost every year) (Figure 3). The FAF can be further defined in terms of seasonality and duration—for example a flood that lasts at least one week and occurs in the Spring. The following article by Betty Andrews defines a FAF in terms of frequency, season, and duration and then describes a process to map the floodplain that corresponds to the FAF in the Sacramento Valley. A long duration flood produces characteristic ecological benefits such as habitat for native fish spawning and rearing (Figure 1) and food web productivity. The duration of the flood is important as these processes cannot occur during a short event. The seasonality of the flood also influences which ecological processes occur (see the temporal scale bar (Winter Late spring) in one of the ecological process boxes). The importance of duration and seasonality for a FAF is indicated by the question mark adjacent to the flood occurring in late January on the hydrograph in Figure 2 (a short, winter-time flood). Because floodplains can remain inundated for a period of time after the loss of direct connection with river flows, a series of short connections can also function as a floodplain activation flood.
Floodplain Reorganization Flood. The floodplain reorganization flood is a greater magnitude flood that occurs less frequently (Figure 3). This higher energy flood produces geomorphic work including extensive erosion and deposition on the floodplain which creates heterogeneous floodplain topography. In turn, these dynamic events and heterogeneous topography create a diverse ecosystem with vegetation patches of varying age, species composition and structure, and floodplain water bodies of varying successional stage and connectivity to the river. The ecosystem processes that occur during a Floodplain Activation Flood take place within the mosaic of habitat features created during Floodplain Reorganization Floods.

Conclusions
The model illustrates the importance of hydrological variability for an ecologically functional floodplain. For example, a floodplain that rarely is inundated by a Floodplain

Activation Flood will not produce the ecological benefits of food web productivity or spawning and rearing habitat for native fish. A floodplain that is not subject to Floodplain Reorganization Floods will not maintain the mosaic of habitats (e.g., vegetation and water bodies of varying successional stages) that help support floodplain biodiversity. Therefore, floodplain restoration projects should not only focus on reintroducing connectivity between rivers and floodplains. Floodplain managers should also ask the following questions about this connectivity: how often, for how long, in what season, and of what magnitude? The answers to these questions will strongly influence the range of ecological benefits that the restored floodplain can provide.

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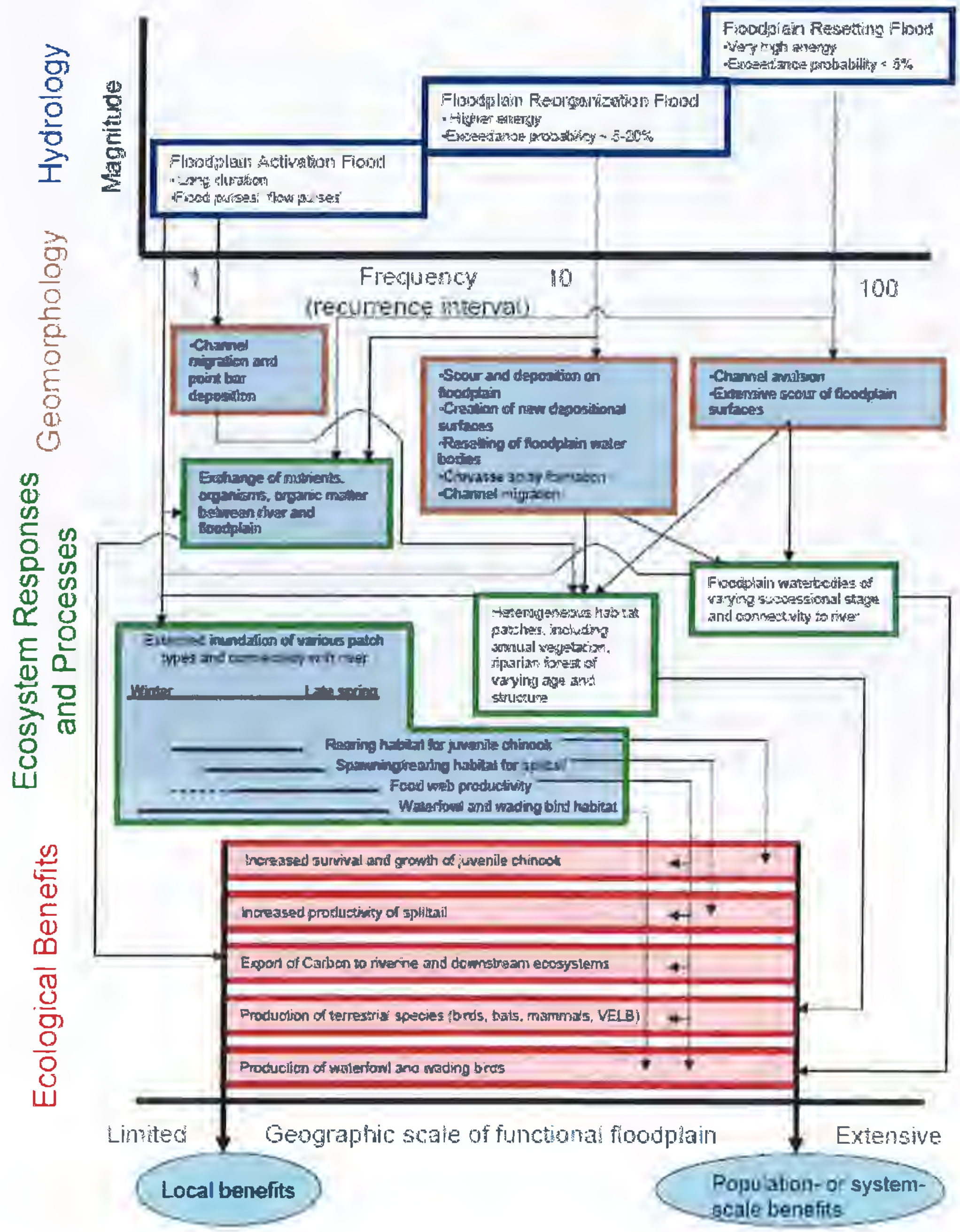
Figure 2. Floodplain Conceptual Model



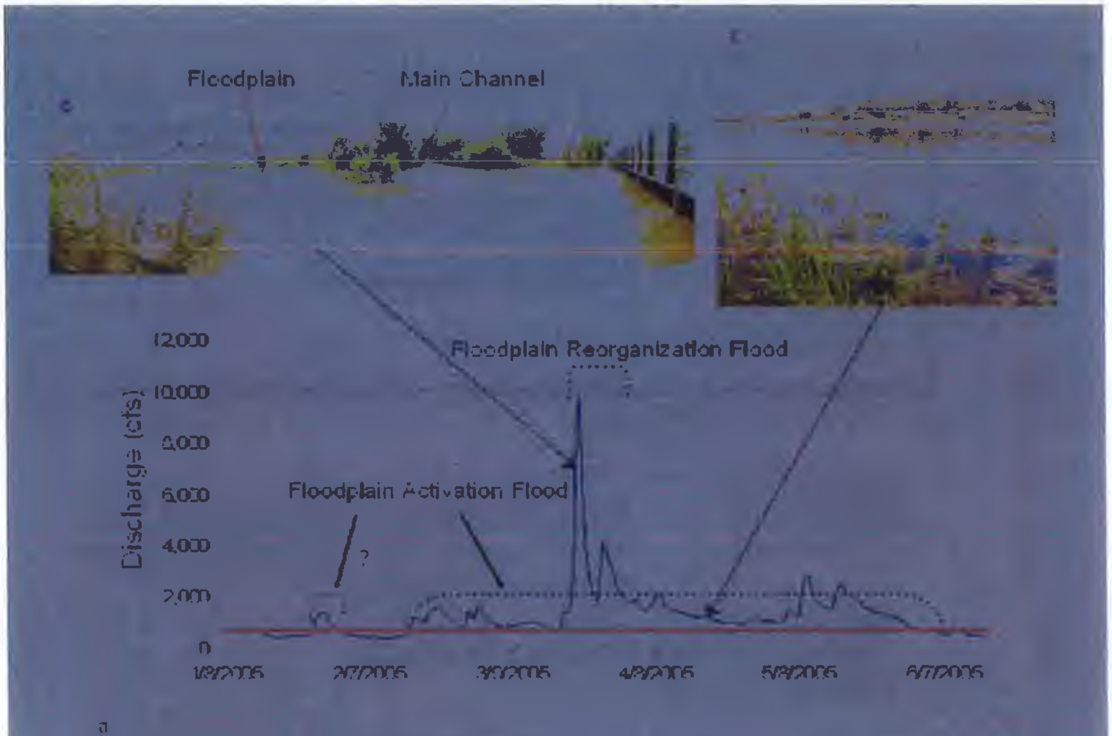


Figure 3. (a) Hydrograph from the Cosumnes River, winter and spring 2005. The red line indicates the approximate discharge at which the river and floodplain are connected. The importance of duration and seasonality for a floodplain activation flood (FAF) is indicated by the question mark adjacent to the flood occurring in late January (i.e., this short, winter-time flood may not provide the ecological benefits associated with a FAF). (b) A floodplain reorganization flood on the Cosumnes River floodplain, March 22, 2005. (c) A floodplain activation flood on the Cosumnes River floodplain, April 2005. Note the development of algal mats in the water and on the vegetation.

Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival

T.R. Sommer, M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer

Abstract: In this study, we provide evidence that the Yolo Bypass, the primary floodplain of the lower Sacramento River (California, U.S.A.), provides better rearing and migration habitat for juvenile chinook salmon (*Oncorhynchus tshawytscha*) than adjacent river channels. During 1998 and 1999, salmon increased in size substantially faster in the seasonally inundated agricultural floodplain than in the river, suggesting better growth rates. Similarly, coded-wire-tagged juveniles released in the floodplain were significantly larger at recapture and had higher apparent growth rates than those concurrently released in the river. Improved growth rates in the floodplain were in part a result of significantly higher prey consumption, reflecting greater availability of drift invertebrates. Bioenergetic modeling suggested that feeding success was greater in the floodplain than in the river, despite increased metabolic costs of rearing in the significantly warmer floodplain. Survival indices for coded-wire-tagged groups were somewhat higher for those released in the floodplain than for those released in the river, but the differences were not statistically significant. Growth, survival, feeding success, and prey availability were higher in 1998 than in 1999, a year in which flow was more moderate, indicating that hydrology affects the quality of floodplain rearing habitat. These findings support the predictions of the flood pulse concept and provide new insight into the importance of the floodplain for salmon.

Résumé : Notre étude démontre que le canal de dérivation Yolo, la principale plaine d'inondation de la région aval de la rivière Sacramento (Californie, É.-U.), offre de meilleurs habitats pour l'alevinage et la migration des jeunes Saumons Quinnat (*Onchorhynchus tshawytscha*) que les bras adjacents de la rivière. En 1998 et 1999, la taille des saumons a augmenté plus rapidement dans la plaine d'inondation agricole, sujette aux débordements saisonniers de crue, que dans la rivière, ce qui laisse croire à de meilleurs taux de croissance. De plus, des jeunes saumons marqués à l'aide de fils de métal codés et relâchés dans la plaine d'inondation étaient plus gros au moment de leur recapture et avaient des taux de croissance apparente plus élevés que des poissons relâchés dans la rivière en même temps. L'amélioration des taux de croissance dans la plaine de débordement résultait en partie d'une consommation significativement plus importante de proies, le reflet d'une plus grande disponibilité des invertébrés de la dérive. Un modèle bioénergétique laisse croire que le succès de l'alimentation a été meilleur dans la plaine d'inondation que dans la rivière, en dépit du coût métabolique d'alevinage significativement plus grand dans les eaux plus chaudes de la plaine d'inondation. Les indices de survie des poissons marqués et relâchés dans la plaine d'inondation étaient quelque peu plus élevés que ceux des poissons de la rivière, mais les différences n'étaient pas statistiquement significatives. La croissance, la survie, le succès de l'alimentation et la disponibilité des proies étaient tous supérieurs en 1998 par comparaison avec 1999, une année à débit plus modéré, ce qui indique que l'hydrologie affecte la qualité des habitats d'alevinage dans la plaine d'inondation. Nos résultats appuient les prédictions du concept de pulsion de crue (flood pulse concept) et mettent en lumière l'importance de la plaine d'inondation pour le saumon.

[Traduit par la Rédaction]

Introduction

Although the trophic structure of large rivers is frequently dominated by upstream processes (Vannote et al. 1980), there is increasing recognition that floodplains plays a major role in the productivity and diversity of riverine communities (Bayley 1995). Based largely on observations from relatively undisturbed river–floodplain systems, Junk et al. (1989) proposed the flood pulse concept, which predicts that annual inundation is the principal force determining productivity and biotic interactions in river–floodplain systems. Floodplains can provide higher biotic diversity (Junk et al. 1989) and increased production of fish (Bayley 1991; Halyk and Balon 1983) and invertebrates (Gladden and Smock 1990). Potential mechanisms for floodplain effects include increased habitat diversity and area (Junk et al. 1989), large inputs of

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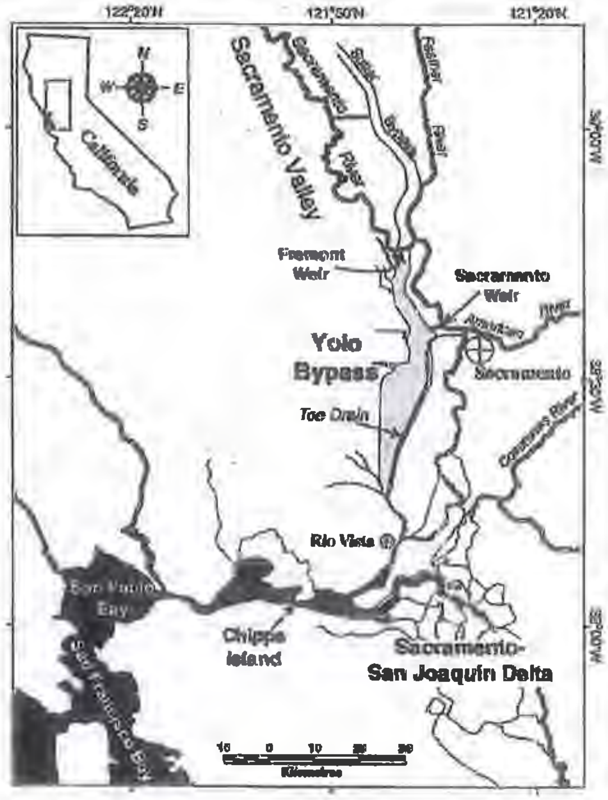
terrestrial material into the aquatic food web (Winemiller and Jepsen 1998), and decreased predation or competition due to intermediate levels of disturbance (Corti et al. 1997). Nonetheless, the degree to which floodplains support riverine ecosystems remains poorly understood, particularly in regulated and temperate rivers. Uncertainties about river–floodplain relationships are due, in large part, to the difficulty in separating the relative contribution of floodplain versus channel processes and sampling problems in seasonal habitats, which are frequently subject to extreme environmental variation.

In the this study, we examined the relative importance of floodplain and riverine habitat to juvenile chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River (California, U.S.A.), a large regulated river (Fig. 1). The system is particularly well suited to a comparative study, because young salmon migrating down the lower Sacramento River to the San Francisco Estuary in wet years have two alternative paths: they may continue down the heavily channelized main river or they may pass through the Yolo Bypass, an agricultural floodplain bordered by levees. We had two reasons to believe that the floodplain might be important habitat for young salmon. First, years of high flow are known to enhance populations of a variety of species in the San Francisco Estuary (Jassby et al. 1995) and the survival of chinook salmon (Kjelson et al. 1982). However, the specific mechanisms for these benefits have not been established. Possible reasons for the positive effects of flow on fish include increased habitat availability, migration cues, food supply, larval transport, and reduced predation rates (Bennett and Moyle 1996). Floodplain inundation is one of the unique characteristics of wet years, during which the Yolo Bypass is likely to be a significant migration corridor for young chinook salmon in the Sacramento Valley. During high-flow events, the Yolo Bypass can convey >75% of the total flow from the Sacramento River basin, the major producer of salmon among tributaries of the San Francisco Estuary. Second, floodplains are known to be among the most important fish-rearing areas in a variety of river systems, yet in developed regions, the availability of this habitat has been greatly reduced by channelization and levee and dam construction (Rasmussen 1996). A high degree of habitat loss may greatly enhance the biological significance of remnant floodplains in heavily modified systems, such as the San Francisco Estuary and its tributaries.

This study tests the hypothesis that the agricultural floodplain provides better habitat quality than the adjacent river channel. For the purpose of this analysis, we focus on salmon growth, feeding success, and survival as indicators of habitat quality. Obviously, there are many other possible measures of habitat quality, such as reproductive output of adults or physiological indicators. However, we believe that the chosen suite of parameters is reasonably representative of habitat quality. For example, Gutreuter et al. (2000) successfully used growth as a factor to test the hypothesis that floodplain inundation had a major effect on fish production.

The San Francisco Estuary is one of the largest estuaries on the Pacific Coast (Fig. 1). The system includes downstream bays (San Pablo and San Francisco) and a delta, a broad network of tidally influenced channels that receive inflow from the Sacramento and San Joaquin rivers. The estuary and its tributaries have been heavily altered by levees, dams, land reclamation activities, and water diversions. The primary floodplain of the Sacramento River portion of the delta is the Yolo Bypass, a 24 000-ha leveed basin that conveys excess flow from the Sacramento Valley, including the Sacramento River, Feather River, American River, Sutter Bypass, and westside streams. The 61 km long floodplain floods seasonally in winter and spring in about 60% of years, and is designed to convey up to 14 000 $m^3 \cdot s^{-1}$. During a typical flooding event, water spills into the Yolo Bypass via the Fremont Weir when Sacramento Basin flows surpass approximately 2000 $m^3 \cdot s^{-1}$. Except during extremely high flow events, the mean depth of the floodplain is generally less than 2 m, creating broad shoal areas. During dry seasons, the Toe Drain channel, a permanent riparian corridor, remains inundated as a result of tidal action. At higher levels of Sacramento Basin flow (e.g., >5000 $m^3 \cdot s^{-1}$), the Sacramento Weir is also frequently operated. Agricultural fields are the dominant habitat type in Yolo Bypass, but approximately one-third of the floodplain area is natural vegetation, including riparian habitat, upland habitat, emergent marsh, and permanent ponds.

Fig. 1. The location of Yolo Bypass in relation to the San Francisco Estuary and its tributaries. The San Francisco Estuary encompasses the region from San Francisco Bay upstream to Sacramento. Feather River Fish Hatchery is located on the Feather River approximately 112 km upstream of Yolo Bypass.



There are four races of chinook salmon in the Sacramento Valley: winter, spring, late fall, and fall run (Yoshiyama et al. 2000). Historical data indicate that all races have decreased in abundance since the 1950s, but the spring, winter, and late-fall runs have shown the most pronounced declines. There are multiple causes for these long-term reductions, including habitat loss, habitat degradation, water diversions, and oceanic conditions. In the present study, we focused on the fall run, the numerically dominant race in the Sacramento Valley. The typical life-history pattern for these salmon is for young to migrate from the tributaries to the bay–delta area at the "fry" stage (Brandes and McLain 2001), when most individuals are approximately 35- to 70-mm fork length (FL). In low flow years, there may be substantial upstream rearing in the Sacramento River. Peak juvenile emigration from the tributaries occurs during winter and spring (Kjelson et al. 1982).

Materials and methods

Physical conditions

During 1998–1999, flow measurements in Yolo Bypass and the adjacent stretch of the Sacramento River were obtained from gauges operated by the U.S. Geological Survey (USGS). Daily water temperatures for each site were calculated as the mean of maximum and minimum daily measurements for single stations in the Sacramento River (USGS) and a temperature recorder (Onset Corp.) installed in the Yolo Bypass Toe Drain channel (Fig. 1). However, from 1 February to 26 March 1998, these data were not available for Yolo Bypass. During this period, before the recorder was installed, discrete measurements were taken at the same location, typically during mid or late morning.

Fish sampling

Salmon FL (mm) was measured during January–April in 1998 and 1999 on samples collected with 15-m beach seines (4.75-mm mesh). Samples were collected weekly at five core locations located around the perimeter of the Yolo Bypass, during periods when the basin was flooded. After the bypass drained, additional samples were collected at random locations around the perimeter of ponds near the core locations. Comparative data on salmon size in the adjacent reach of the Sacramento River were collected by the U.S. Fish and Wildlife Service (USFWS) at five beach-seine sites, using techniques similar to those used when the the bypass was flooded.

FLs of salmon obtained from beach-seine sampling were compared to determine whether there was evidence of major differences in salmon size between the Yolo Bypass and the Sacramento River. However, these data were not considered unambiguous evidence of growth differences, because the two systems were open to immigration and emigration during much of the study, and migrating salmon include multiple races of salmon that cannot be readily separated. We addressed this issue by using paired releases of coded-wire-tagged (CWT) juvenile salmon in Yolo Bypass and the Sacramento River. This approach allowed comparisons of growth among fish of similar origin and provided a relative estimate of migration time and survival. The salmon were produced and tagged at the Feather River Fish Hatchery and released on 2 March 1998 and 11 February 1999. The release sites were in Yolo Bypass below Fremont Weir (52 000 in 1998; 105 000 in 1999) and in the adjacent reach of the Sacramento River (53 000 in 1998; 105 000 in 1999). The fish had a mean FL of 57.5 ± 0.5 mm (SE) in 1998 and of 56.8 ± 0.4 mm (SE) in 1999. A small portion of each group was subsequently collected by trawling at the seaward margin of the delta at Chipps Island, which is located downstream of the confluence of the Yolo Bypass and the Sacramento River (Fig. 1). The USFWS Chipps Island survey samples a single channel location with a midwater trawl towed at the surface (Baker et al. 1995; Brandes and McLain 2001). Ten 20-min tows were made each day, except during March in 1998 and 1999, when sampling was conducted every other day. Data on migration time (days) and FL (mm) were recorded for fish recaptured from each release group. Apparent growth rate was also calculated for each fish, as: (FL of individual at Chipps Island – mean FL of CWT release group) × (migration time)$^{-1}$. Survival indices of the paired CWT releases were calculated by USFWS by dividing the number of fish recovered for each release group at Chipps Island by the number released, corrected for the fraction of time and channel width sampled (Brandes and McLain 2001).

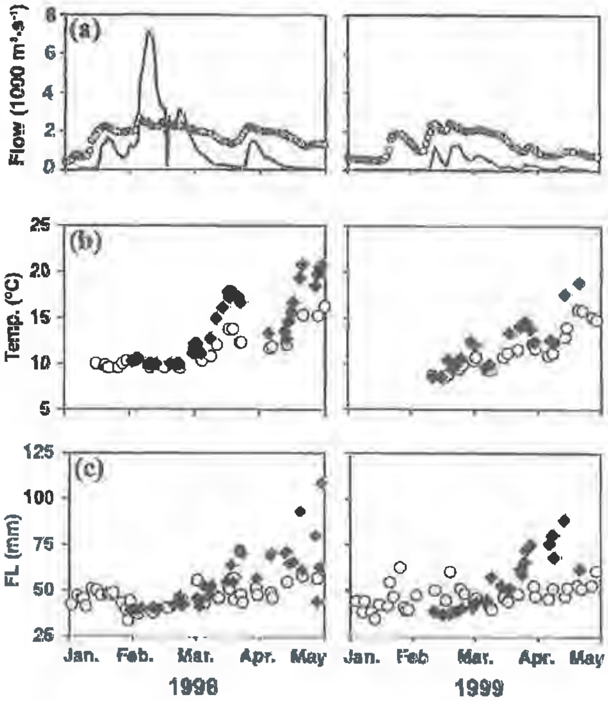
Diet

We performed diet comparisons on fall-run juvenile salmon (33–81 mm) collected in beach-seine samples during February–March of 1998 and 1999 from the Yolo Bypass (103 individuals) and the Sacramento River (109 individuals). Fish samples were tagged and stored individually in a deep freeze. After thawing, stomachs were removed from the fish and the contents were identified (using a dissecting microscope) to order (insects and arachnids), genus (crustaceans), or phylum (rarely eaten taxa such as oligochaetes). To develop average invertebrate length estimates, up to 10 individuals of each prey type encountered were measured. Prey dry weight estimates were calculated from average lengths, using regression equations for delta crustaceans obtained from J. Orsi (California Department of Fish and Game, Stockton, CA 95205, unpublished data) and from literature sources. Diet results were compared as an index of relative importance (IRI) (Shreffler et al. 1992) for each month. The index was calculated as: IRI = (% numeric composition + % weight composition) × % frequency of occurrence.

Prey availability

Invertebrates were sampled in February–March of 1998 and 1999, to examine prey availability in the Yolo Bypass and the Sacramento River. Sampling was not designed as a comprehensive evaluation of spatial and temporal variation of prey. Rather, it was intended to provide information on whether variation in salmon diets between the two locations was consistent with gross differences in prey type or relative abundance. We focused on Diptera (adults, pupae, and larvae) and crustacean zooplankton, which comprised over 90% of the diets of Yolo Bypass and Sacramento River juvenile salmon. Weekly drift samples were collected at fixed stations on the Yolo Bypass and the Sacramento River during periods when the floodplain was inundated. The sampling points were located away from overhanging vegetation and bank eddies, in water velocities of approximately 15–60 cm·s^{-1}, depending on flow. Net (500-μm mesh) dimensions were 0.46 × 0.3 m mouth and 0.91 m length. The nets were fished for approximately 30 min during mid-morning, to coincide with the time period when most fish-stomach samples were taken. Sample volume was calculated using a flowmeter (General Oceanics Model 2030R) and net dimensions. Drift samples were stored in ethanol or formaldehyde, then identified to family or order using a dissecting microscope. In 1998, zooplankton were collected in the Yolo Bypass at two fixed stations with battery-operated rotary-vane pumps with a mean flow rate of 17 L·min^{-1}. Samples were taken via pipes with outlets at multiple locations beneath the water surface. Discharge was directed into a 150 μm mesh net held in a basin on the bank. Flow rate was recorded at the beginning and end of the sample period, which varied from 1 to 6 h. No samples were taken in the Sacramento River during a comparable period in 1998. In 1999, zooplankton samples were taken with a Clarke–Bumpus net (160-μm mesh, diameter 0.13 m, length 0.76 m) placed in surface flow in the Yolo Bypass and Sacramento River. Sample volume was recorded as for the drift net. Zooplankton samples were concentrated and stored in 5%

Fig. 2. Chinook salmon size versus physical conditions in Yolo Bypass and the Sacramento River during winter and spring in 1998 and 1999. (*a*) Mean daily flow ($m^3 \cdot s^{-1}$) in Yolo Bypass (solid line) and the Sacramento River (circles). (*b*) Mean water temperature (°C) in Yolo Bypass (solid symbols) and the Sacramento River (open symbols). (*c*) Mean daily chinook salmon FL for Yolo Bypass (solid symbols) and Sacramento River (open symbols) beach-seine stations. For presentation purposes, only the daily mean FLs are shown; however, individual observations for February–March were used for statistical analyses.



formaldehyde, for later identification to genus using a dissecting microscope.

Bioenergetics

Feeding success was examined in two ways: (1) prey biomass estimated from stomach contents and (2) prey biomass estimated as a function of maximum theoretical consumption. For the first measure, we used the previously described stomach-content data to calculate total-prey biomass for individual fish.

A limitation of using prey biomass as a measure of feeding success between locations is that thermal history affects how consumption alters growth rate (Hewett and Kraft 1993). As will be discussed in further detail, water temperatures were significantly higher in the Yolo Bypass floodplain than in the Sacramento River. To correct for this problem, our second approach used bioenergetic modeling to incorporate the metabolic effects of water temperature. We used methods similar to those of Rand and Stewart (1998) to calculate a wet weight ration index, which uses prey biomass for each sampled individual as a proportion of the theoretical maximum daily consumption. The stomach-content data were used as our estimate of prey biomass for individual fish. The theoretical maximum daily consumption rate (C_{max}) was modeled using Fish Bioenergetics 3.0 (Hanson et al. 1997), using observed body size and water temperature at the time each beach-seine sample was collected. The model input also required fish mass, which we estimated from FL data, using length–weight relationships from Sacramento River juvenile salmon (Petrusso 1998). The caloric value of the prey was taken from weight conversion factors provided by Hanson et al. (1997). Model parameters were derived from those of Stewart and Ibarra (1991) for chinook salmon. The model was run for individual fish collected at each sampling location in 1998 and 1999.

Table 1. Robust regression statistics for Yolo Bypass and Sacramento River salmon FLs for 1998 and 1999.

	1998		1999	
	Parameter ± SEM	t	Parameter ± SEM	t
Intercept	29.4±0.6	46.8	23.5±0.5	43.7
Location	6.4±0.6	10.2	11.1±0.5	20.6
Day	0.3±0.01	34.5	0.3±0.01	48.5
Location:day	−0.14±0.01	−18.4	−0.21±0.01	−33.6

Note: The t values are all highly significant ($p < 0.0001$).

We emphasize that the second approach provides an *index*, rather than an *absolute* measure of feeding success. The wet weight ration index is conceptually analogous to "P" in Hanson et al. (1997), a model parameter that indicates what fraction of C_{max} is obtained over the course of the day. The major difference is that P is based on prey consumption over a 24-hour period, whereas our wet weight ration index is based on instantaneous measurements of stomach contents, which may not represent mean trends over the entire day. An additional limitation is that the Stewart and Ibarra (1991) model parameters were developed for adult salmon and we applied the model to juveniles. We did not have sufficient field or laboratory data to develop bioenergetic-model parameters specific to the earliest life stages. Nonetheless, other studies (Rand and Stewart 1998) have demonstrated that similar wet weight ration indices can provide an effective technique for comparing relative salmonid feeding success between seasons and years.

Statistical analysis

Overlapping temperature measurements from continuous recorders and the discrete measurements during 26 March – May 1998 were analyzed with Wilcoxon's matched-pairs test, to determine whether the two methods yielded different results. Mean water temperature for Yolo Bypass and the Sacramento River during the primary period of floodplain inundation (February–March) was analyzed with a generalized linear model with a variance function that increased with the mean squared, since variances were not homogeneous (Venables and Ripley 1997). Salmon FL measurements for Yolo Bypass and the Sacramento River during February–March of 1998 and 1999 were compared with a robust iteratively reweighted least squares regression procedure ("rlm"; Venables and Ripley 1997), because we detected substantial numbers of outliers in preliminary graphical evaluations of the data. Initial analyses revealed a substantial difference in the effects of location between years, so years were analyzed separately. Results from the CWT and bioenergetic studies were analyzed using a factorial-design analysis of variance, to evaluate the effects of location (Yolo Bypass, Sacramento River) and year (1998, 1999). Residuals from each model were examined graphically, to confirm that they met the assumption of normality and homogeneity of variance. Cochran and Levene's tests were also used, to test the assumption of homogeneity of variance. Logarithmic transformation was performed where necessary.

Results

Physical conditions

Yolo Bypass was inundated in 1998 and 1999 but the hydrology was substantially different in the two years (Fig. 2).

Table 2. Results of salmon collections at Chipps Island for 1998 and 1999 coded-wire-tagged groups released concurrently in Yolo Bypass and the Sacramento River.

	1998		1999	
	Yolo Bypass	Sacramento River	Yolo Bypass	Sacramento River
Fork length (mm)	93.7±2.0	85.7±1.4	89.0±2.6	82.1±1.7
Migration time (days)	46.2±2.3	55.4±3.5	58.2±2.8	58.6±4.1
Apparent growth rate (mm·day^{-1})	0.80±0.06	0.52±0.02	0.55±0.06	0.43±0.03
Survival index	0.16	0.09	0.09	0.07
Sample size	9	10	9	8

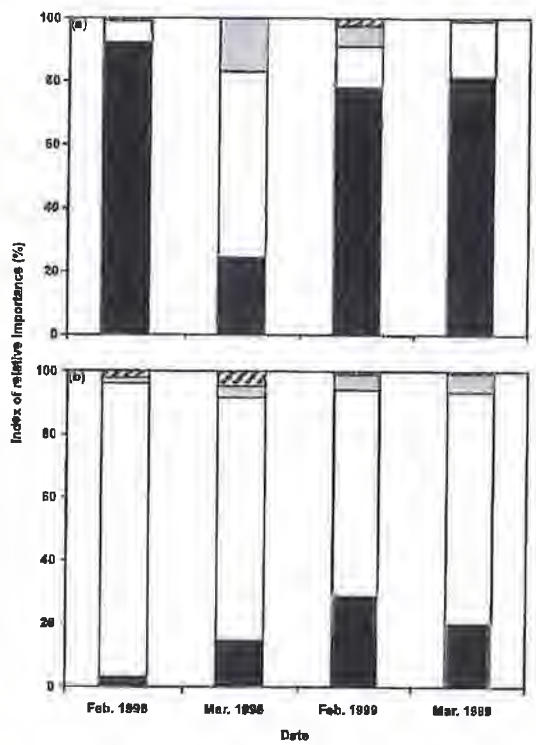
Note: Values for FL, migration time, and apparent growth rate are mean ± standard error (SEM).

The first year was extremely wet, with multiple flow pulses and a peak flow of 7200 m^3·s^{-1}. In 1999, floodplain hydrology was more moderate, with a peak of 1300 m^3·s^{-1}. Flows in the Sacramento River were much less variable than in the floodplain and generally remained at or below 2000 m^3·s^{-1}, a level within the design capacity (3100 m^3·s^{-1}) of the channel. Overlapping sampling between the continuous-temperature recorders and the discrete measurements during March–May 1998 showed a mean difference of 0.9°C between the two approaches, but this disparity was not statistically significant (Wilcoxon's matched-pairs test, $p > 0.25$). In 1998 and 1999, temperatures increased fairly steadily throughout the study period; however, in both years, temperature levels in Yolo Bypass were up to 5°C higher than those in the adjacent Sacramento River during the primary period of inundation, February–March. Temperature in the Yolo Bypass was described in 1998 by $T_y = -7.7 \pm 2.1 + (1.9 \pm 0.2)T_s$ and in 1999 by $T_y = -3.5 \pm 1.2 + (1.5 \pm 0.1)T_s$, where T_y is the temperature of the Yolo Bypass, T_s is the temperature of the Sacramento River, and the range for each value is the 95% confidence limit.

Fish growth, migration time, apparent growth rate, and survival

Salmon increased in size substantially faster in the Yolo Bypass than in the Sacramento River during each of the study years (Fig. 2). Robust regression results showed that the effect of location was highly significant ($p < 0.00001$) in each year (Table 1). This result is consistent with the CWT data (Table 2), which showed that the 1998 and 1999 Yolo Bypass CWT release groups had significantly larger mean length ($F = 14.34$, $p = 0.0006$) and higher apparent growth rates ($F = 20.67$, $p = 0.0007$) than the Sacramento River release groups. There was also a statistically significant effect of year: both release groups had larger mean sizes ($F = 4.42$, $p = 0.04$) and higher apparent growth rates ($F = 16.47$, $p = 0.0002$) in 1998 than in 1999. The 1998 Yolo Bypass CWT group showed the fastest migration time, arriving an average of at least 9 days ahead of any other release group. However, there was no statistically significant ($F = 2.22$, $p = 0.15$) effect of release location on migration time in the analysis of variance (ANOVA). As for fish size and apparent growth rate, mean migration time was slower in 1999 than in 1998 ($F = 5.60$, $p = 0.02$). There was no statistically significant interaction between location and year for salmon size ($F = 0.07$, $p = 0.78$), apparent growth rate ($F = 1.62$, $p = 0.21$), or migration time ($F = 1.8$, $p = 0.18$). The survival indices were somewhat higher for CWT groups released in the Yolo Bypass than for those released in the Sacramento River for both 1998 and 1999. However, the lowest coefficient of variation based on a Poisson distribution of the CWT recaptures is 32%, and the actual (unknown) distribution of counts is likely to have higher variance than a Poisson distribution. Clearly the confidence limits of the paired survival indices would overlap, so the differences are not statistically significant.

Fig. 3. Chinook salmon diet during February and March of 1998 and 1999 in Yolo Bypass (*a*) and the Sacramento River (*b*). The index of relative importance (*y*-axis) is defined in the text. Diptera (solid bars), zooplankton (open bars), other aquatic prey (shaded bars), and other terrestrial prey (striped bars) are shown for each month.



Diet

The diet of young salmon in the Yolo Bypass was dominated by dipterans, principally chironomid pupae and adults (Fig. 3). The second most common prey item was zooplank-

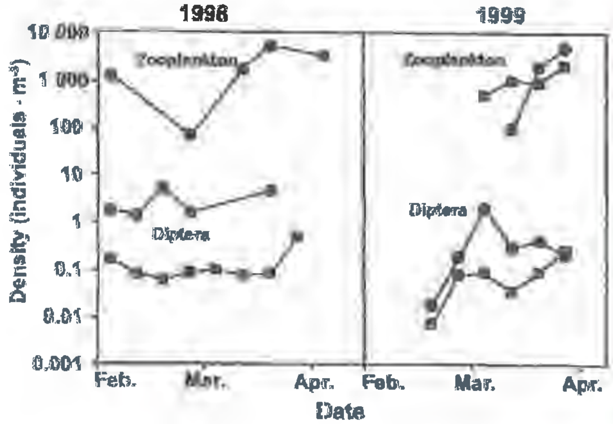


Fig. 4. Log_{10}-scaled weekly abundance (individuals·m^{-3}) of zooplankton and Diptera in Yolo Bypass (circles) and the Sacramento River (squares) during 1998 and 1999. Note that 1998 zooplankton data were not available for the Sacramento River.

ton, mostly cladocerans and copepods. Except for March 1998, zooplankton comprised less than 15% of the Yolo Bypass diets. Other aquatic (mainly amphipods and collembola) and terrestrial (mainly ants and arachnids) prey were relatively minor diet items. As for the floodplain samples, dipterans and zooplankton comprised over 90% of the diets of Sacramento River salmon; however, zooplankton were the dominant prey item in all months. Other aquatic (mostly amphipods, oligochaetes, and collembola) and terrestrial (mostly ants and other terrestrial insects) prey were consumed infrequently.

Prey availability

The drift samples contained many of the same taxa observed in the salmon diets, with Diptera (principally chironomids) as the major type at both sampling locations. However, the density of Diptera was much higher in the Yolo Bypass than in the Sacramento River (Fig. 4), particularly in 1998, when densities were consistently an order of magnitude higher. In general, dipteran drift densities were higher at each location in 1998 than in 1999. There was little difference in zooplankton density in the Yolo Bypass between 1998 and 1999 or between Yolo Bypass and the Sacramento River in 1999.

Bioenergetics

Young salmon from the Yolo Bypass had higher total-prey weights ($F = 39.2$, df = 1, $p < 0.0001$) than those from the Sacramento River (Fig. 5). The bioenergetic-modeling results showed that Yolo Bypass salmon also had higher wet weight ration indices than those from the Sacramento River ($F = 19.3$, df = 1, $p < 0.0001$). The interaction between location and year was significant for both the wet weight ration indices ($F = 10.0$, df = 1, $p = 0.02$) and the prey weights ($F = 4.7$, df = 1, $p = 0.03$).

Discussion

Chinook salmon that rear in the Yolo Bypass floodplain have higher apparent growth rates than those that remain in the adjacent Sacramento River channels. Mean length increased faster in the Yolo Bypass during each study year, and CWT fish released in the Yolo Bypass were larger and had higher apparent growth rates than those released in the Sacramento River. It is possible that these observations are due to higher mortality rates of smaller individuals in the Yolo Bypass or of larger individuals in the Sacramento River; however we have no data or reasonable mechanism to support this argument.

Apparent growth differences between the two areas are consistent with water temperature and stomach-content results. We found that the Yolo Bypass floodplain had significantly higher water temperatures and that young salmon from the floodplain ate significantly more prey than those from the Sacramento River. The wet weight ration indices calculated from bioenergetic modeling suggest that the increased prey availability in Yolo Bypass was sufficient to offset increased metabolic requirements from higher water temperatures. Higher water temperatures in the Yolo Bypass are expected as a result of the shallow depths on the broad floodplain. Increased feeding success in the Yolo Bypass is consistent with trends in prey availability. While Yolo Bypass and the Sacramento River had similar levels of zooplankton, Yolo Bypass had more dipteran prey in the drift, particularly in 1998. Studies of juvenile chinook salmon diets by Rondorf et al. (1990) showed that zooplankton were the least-favored prey items. Therefore, the dominance of zooplankton in the diets of Sacramento River salmon probably reflects a relatively low availability of other more energetically valuable prey items.

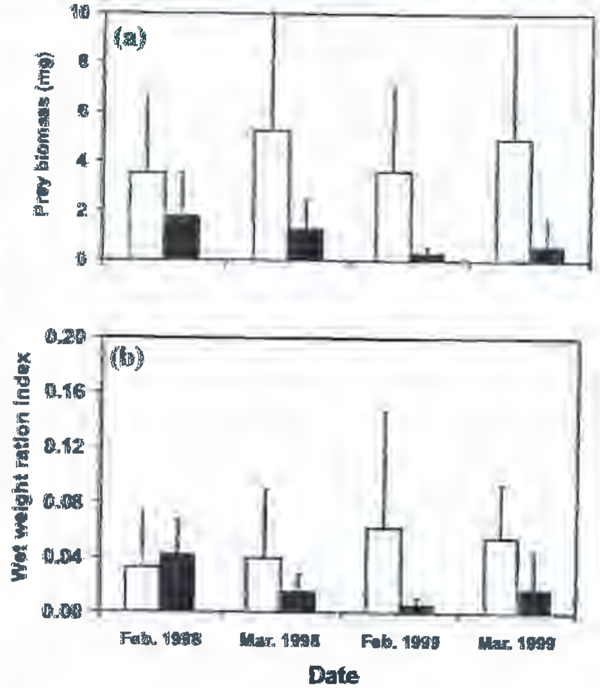
Recoveries of paired releases were too few to determine whether the higher survival indices for the Yolo Bypass release groups represent actual survival differences or random variation. Additional validation is needed from new release studies and from CWT recoveries in the adult ocean fishery and escapement. Nonetheless, the hypothesis that floodplain rearing could improve survival is substantiated by the growth data and bioenergetic modeling. Faster growth rates reflect improved habitat conditions, which would be expected to lead to improved survival, both during migration and later in the ocean. Elevated Yolo Bypass survival rates are also consistent with significantly faster migration rates in 1998, the likely result of which would be reduced exposure time to mortality risks in the delta, including predation and water diversions.

Improved survival is consistent with other habitat differences between the Yolo Bypass floodplain and the Sacramento River channel. We estimate that complete inundation of the Yolo Bypass creates a wetted area approximately 10 times larger than the reach of the Sacramento River we studied. This level of inundation is equivalent to a doubling of the wetted area of the entire delta portion of the San Francisco Estuary. Much of the floodplain habitat consists of broad shoals composed of soil and vegetation that are typical of the low-velocity conditions selected by young salmon (Everest and Chapman 1972). An increase in rearing area should reduce competition for food and space and perhaps reduce the probability of encountering a predator. In contrast, the Sacramento River channel is relatively narrow, with steep rock-reinforced banks and little shallow habitat. Migration through the Yolo Bypass corridor would also prevent fish from entering the channels of the central delta, in which there are various risks, including major water diversions (Brandes and McLain 2001). However, the Yolo Bypass is a less-stable environment, with stranding risks when flood waters recede. The relatively well-drained topography of the Yolo Bypass floodplain may help to reduce the magnitude of this problem. This is not to say, however, that access to floodplain rearing habitat represents the only mechanism to account for possible improvements in juvenile salmon survival in wetter years. Other covariates, such as reduced water temperature (Baker et al. 1995), reduced predation losses from higher turbidity (Gregory and Levings 1998), and reduced water diversion effects (Kjelson et al. 1982), also contribute to improved wet-year survival of salmon that migrate through the San Francisco Estuary.

The results from this study suggest that hydrology may affect salmon feeding success, migration, and survival in both floodplain and river habitat. The CWT results indicate that salmon grew faster, migrated faster, and may have had better survival rates in 1998 than in 1999. One clear difference between the years is that the flow pulses were higher and of longer duration in 1998 than in 1999. Higher flow could directly increase migration rates through higher water velocities and have multiple indirect effects on growth through factors such as food supply or water temperature. The abundance of Diptera in drift samples was substantially higher in 1998 than in 1999 in both locations. The significant interaction between location and year for both prey weights and the wet weight ration index indicates that the combined effects of diet and water temperature under 1998 hydrology should have resulted in higher growth rates. Higher growth rates and faster migration times in 1998 may, in turn, have improved survival by reducing predation risk. Higher-flow conditions in 1998 increased the quantity and duration of floodplain rearing area, perhaps reducing resource competition and predator encounter rates. Increased flow duration and magnitude in 1998 could also have improved survival on the floodplain by reducing stranding risks.

These results provide new insight into the significance of seasonal floodplain habitat for salmon rearing, which has been studied primarily in perennial waterways such as estuaries and rivers (Healey 1991; Kjelson et al. 1982). Indeed, this is the first study we are aware of demonstrating that off-channel floodplain provides major habitat for chinook salmon. We do not believe that the benefits of the floodplain to chinook salmon are unique to Yolo Bypass. Initial results from the Cosumnes River, an undammed watershed in the delta, show similar growth enhancements for juvenile chinook salmon that rear on the floodplain rather than in adjacent river channels (Peter Moyle, University of California, Davis, CA 95616, personal communication). Moreover, the benefits of the floodplain to salmon are consistent with findings for other fish species. Sommer et al. (1997) found that the Yolo Bypass provides major spawning, rearing, and foraging habitat for the native cyprinid Sacramento splittail (*Pogonichthys macrolepidotus*). The spawning and rearing of fish on floodplains has been reported in diverse locations that range from small streams (Halyk and Balon 1983; Ross and Baker 1983) to large rivers (Copp and Penaz 1988) in both temperate (Gehrke 1992; Turner et al. 1994) and tropical (Winemiller and Jepsen 1998) locations. The growth effects of floodplain habitat have been described for several tropical locations (Welcomme 1979); however, the present study and the results of Gutreuter et al. (2000) represent the only examples from temperate rivers of which we are aware.

Fig. 5. Feeding success results for Yolo Bypass (open bars) and Sacramento River (solid bars) juvenile salmon during 1998 and 1999. (*a*) Estimated prey weights in stomach contents. (*b*) Wet weight ration indices. Means and standard errors are shown.



Differences between the invertebrate communities in floodplains versus river channels have been reported by Castella et al. (1991). The exceptional production of drift invertebrates on the Yolo Bypass floodplain is consistent with the results of Gladden and Smock (1990), who found that invertebrate production was one to two orders of magnitude greater on the floodplain than in adjacent streams. Although we did not monitor benthic invertebrates, results from other studies of large rivers indicate that benthic biomass may be up to an order of magnitude higher in the floodplain (Junk et al. 1989). The Yolo Bypass drift invertebrate results contrast with the results for zooplankton, which were not particularly abundant on the floodplain. This finding is comparable with that of Welcomme (1979), who reported that densities of zooplankton in natural floodplains are frequently low, except for low-water periods and localized concentrations near habitat interfaces such as shorelines.

The mechanism for greater abundance of drift invertebrates in the Yolo Bypass remains unclear, but is unlikely to be an artifact of land use on the floodplain. Possible explanations for increased drift abundance include increased food supply (e.g., primary production or detritus), more habitat, and longer hydraulic residence times. For each of these mechanisms, Yolo Bypass probably provides functions similar to more "natural" floodplains. Improved food supply is supported by the work of Jassby and Cloern (2000), whose modeling studies suggest that the Yolo Bypass should have enhanced phytoplankton production as a result of its large surface area and shallow depth. Inputs of fertilizers from agriculture in the Yolo Bypass would not be important contributing factors, as nitrogen and phosphorous are rarely limiting to phytoplankton production in the delta (Ball and Arthur 1979). Like less-disturbed floodplains in other regions (Junk et al. 1989), invertebrate production in the Yolo Bypass may be stimulated by an increased availability of detritus in the food web. Alternatively, the trends in invertebrate abundance we observed may be a consequence of physical differences between floodplain and channel habitat. Inundation of the floodplain may increase the amount of habitat for benthic invertebrates, a major source of drift biomass. Given the larger surface area and lower velocities in Yolo Bypass, the floodplain probably has a much longer hydraulic residence time than the Sacramento River, reducing the rate at which drift invertebrates would be flushed out of the system. Increased habitat area and hydraulic residence time would also have been functional characteristics of the historical floodplain.

In the broader context, the results for salmon and drift invertebrates are consistent with the flood pulse concept, which predicts that floodplains should yield greater fish and invertebrate production than channel habitat (Junk et al. 1989). This finding is significant in that the flood pulse concept was developed primarily on the basis of relatively undisturbed rivers, whereas our study was conducted in a regulated river with a floodplain dominated by agricultural uses. Gutreuter et al. (2000) showed similar enhancements to fish growth from floodplain inundation in the Upper Mississippi River, another large regulated river. These studies suggest that floodplains can maintain important functional characteristics even in heavily modified rivers. In the case of the San Francisco Estuary and its tributaries, we do not claim that floodplain inundation is the primary factor regulating the productivity of the system. The Yolo Bypass floodplain may be seasonally more productive than the Sacramento River for some fish and invertebrates, but we have no data regarding its contribution during dry months or years. Nonetheless, the results of the present study and of Sommer et al. (1997) are sufficient to demonstrate that the floodplain represents one of the most biologically important habitat types in the region. We believe that proposed large-scale restoration activities in the San Francisco Estuary and its tributaries (Yoshiyama et al. 2000) that would increase the area and connectivity of the floodplain offer particular promise for native fish populations such as chinook salmon and Sacramento splittail.

Acknowledgements

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[Article]

Habitat Use and Stranding Risk of Juvenile Chinook Salmon on a Seasonal Floodplain

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Abstract.—Although juvenile Chinook salmon *Oncorhynchus tshawytscha* are known to use a variety of habitats, their use of seasonal floodplains, a highly variable and potentially risky habitat, has not been studied extensively. Particularly unclear is whether a seasonal floodplain is a net "source" or a net "sink" for salmonid production. To help address this issue, we studied salmon habitat use in the Yolo Bypass, a 24,000-ha floodplain of the Sacramento River, California. Juvenile salmon were present in the Yolo Bypass during winter–spring; fish were collected in all regions and substrates of the floodplain in diverse habitats. Experimental releases of tagged hatchery salmon suggest that the fish reared on the floodplain for extended periods (mean = 33 d in 1998, 56 d in 1999, and 30 d in 2000). Floodplain rearing and associated growth are also supported by the significantly larger size of wild salmon at the floodplain outlet than at the inlet during each of the study years. Several lines of evidence suggest that although the majority of young salmon successfully emigrated from the floodplain, areas with engineered water control structures had comparatively high rates of stranding. Adult ocean recoveries of tagged hatchery fish indicate that seasonal floodplains support survival at least comparable with that of adjacent perennial river channels. These results indicate that floodplains appear to be a viable rearing habitat for Chinook salmon, making floodplain restoration an important tool for enhancing salmon production.

A large downstream movement of fry to provide dispersal to rearing areas is typical of ocean-type Chinook salmon *Oncorhynchus tschawytcha* (Healey 1991). Rearing areas include channel and off-channel habitat in natal and nonnatal streams and their estuaries (Bjornn 1971; Kjelsen et al. 1982; Levy and Northcote 1982; Swales et al. 1986; Swales and Levings 1989; Healey 1991; Shreffler et al. 1992). Recently, Sommer et al. (2001b) observed that juvenile Chinook salmon also live on seasonal floodplains. Large rivers and streams typically have dynamic floodplains varying in size from several to thousands of hectares, unless their channels are heavily confined by topography (e.g., streams at high elevation or confined by canyons or levees). Floodplains are known to be of major importance to aquatic ecosystems in most regions; large rivers typically favor the development of a fauna adapted to colonize this habitat (Welcomme 1979; Junk et al. 1989; Sparks 1995). As a result, it is reasonable to expect dispersing salmonid fry show some ability to use seasonal habitat. In support of this hypothesis, Sommer et al. (2001b) reported that food resources and water temperatures on the seasonal floodplain of a large river were superior to those in an adjacent perennial channel, resulting in enhanced growth rates of young salmon. Despite some evidence that enhanced growth on the floodplain improved fry–smolt survival in the estuary, Sommer et al. (2001b) did not address any effects on adult production.

Intuitively, rearing in seasonal floodplains or intermittent streams seems risky because these habitats are among the most dynamic on earth (Power et al. 1995). It is still unknown whether seasonally dewatered habitats are a net "source" or a "sink" for salmonid production relative to production in permanent stream channels (Brown 2002). In particular, the high degree of seasonal flow fluctuation characteristic of floodplain habitat could cause major stranding events and increase mortality rates of young salmon (Bradford 1997; Brown 2002). For resident taxa in intermittent streams, the benefits of very large flow fluctuations appear to outweigh costs associated with a variable environment (Spranza and Stanley 2000). This issue continues to be a key concern for regulatory agencies that evaluate off-channel restoration projects or proposed flow fluctuations for possible effects on fishes (Brown 2002; Bruce Oppenheim, NOAA Fisheries, personal communication).

Here, we describe spatial and temporal trends in juvenile Chinook salmon habitat use and stranding in a large California river floodplain. Our study was conducted in the Yolo Bypass, the primary floodplain of the Sacramento River, the major pro-

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Exhibit 28

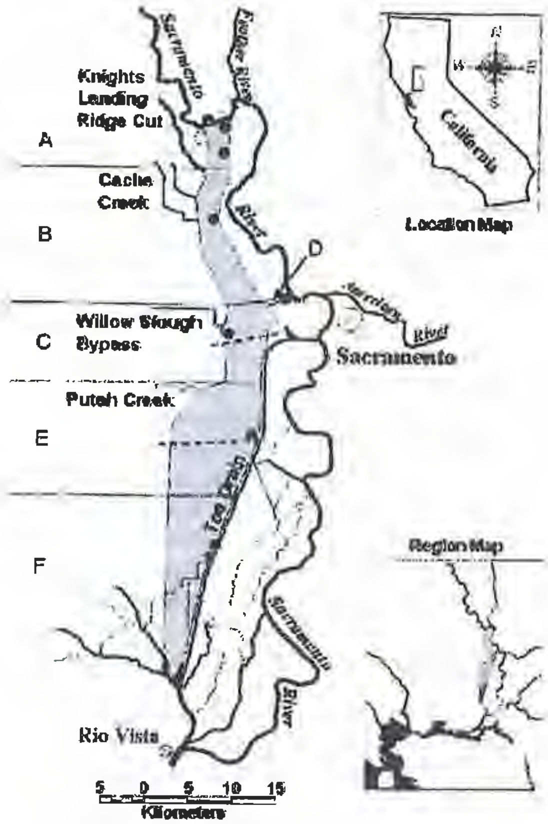

FIGURE 1.—Location of Yolo Bypass in relation to the San Francisco Bay–Delta and its tributaries. Fremont Weir is the upper (northern) edge of the Yolo Bypass. The major regions of the floodplain are delineated from north to south and correspond to the following codes: (A) Fremont Weir; (B) Cache Creek sinks; (C) Yolo Bypass Wildlife Area; (D) Sacramento Bypass; (E) Putah Creek Sinks; and (F) Liberty Island. The sampling locations are identified as follows: beach seine sites (solid circles); screw trap (star); and purse seine transects (dotted lines).

ducer of salmon in the San Francisco estuary (Figure 1). Because the Yolo Bypass can convey 75% or more of the total flow from the Sacramento River basin (Sommer et al. 2001a), this floodplain can be expected to be a migratory pathway for a substantial number of juvenile Chinook salmon. A major objective of our study was to collect basic information about the timing, duration, and habitat use of salmon on floodplains. We hoped that these data would provide insight into whether a floodplain is a net source (i.e., with rearing benefits) or a net sink (i.e., with high mortality because of stranding or predation) for salmon populations. The major hypotheses evaluated were as follows: (1) salmon occur in all major habitat types and geographic regions; (2) floodplains provide rearing habitat for salmon and are not simply a migration corridor; and (3) stranding of juvenile salmon does not have a major population-level effect on survival of the fish that use floodplain habitat. We addressed these hypotheses by sampling wild fish throughout the floodplain, experimentally releasing tagged fish, and using hydrologic modeling and measurements of physical conditions to describe how habitat varied over the study period.

Study Area

The San Francisco Estuary and its two component regions, Sacramento–San Joaquin Delta and downstream bays (Figure 1), make up one of the largest estuaries on the Pacific coast of North America. Major changes to the system have included diking and isolation of about 95% of the wetlands, introduction of exotic species, channelization, sediment inputs from hydraulic mining, and discharge of agricultural and urban chemicals (Nichols et al. 1986; Kimmerer 2002). The Estuary receives most freshwater via the Delta, which drains approximately 100,000 km^2. Most precipitation occurs upstream of the Delta during winter and spring, resulting in a greater than 10-fold seasonal range of daily freshwater flow into the estuary. However, the hydrograph is substantially altered by dams on each of the major rivers. Peak flow pulses typically occur during winter, but dam operations can reduce the magnitude of the pulses, particularly in dry years, when much of the inflow is captured behind reservoirs (Mount 1995; Kimmerer 2002). The historically prominent spring flow pulse from snowmelt is at present muted except during heavy, late-season storms. For the past several decades, much of the spring snowmelt has been stored in reservoirs and released during summer and autumn, periods of historically lower flow. As much as 65% of the net Delta flow during summer and autumn is diverted from the channels by two large water diversions (the State Water Project and the Central Valley Project); additional water is diverted by 2,200 pumps and siphons for irrigation (Kimmerer 2002).

The 24,000-ha Yolo Bypass is the primary floodplain of the Delta (Sommer et al. 2001a). The majority of the floodplain is leveed to protect surrounding cities from floodwaters, but levees confine flow through the bypass only under very high flow events. The Yolo Bypass currently floods an average of every other year, typically under high-flow periods in winter and spring. The Yolo Bypass has a complex hydrology, with inundation possible from several different sources. The floodplain typically has a peak inundation period during January–March but can flood as early as October and as late as June. The primary input to the Yolo Bypass is through Fremont Weir in the north, which conveys floodwaters from the Sacramento and Feather rivers. During major storm events (e.g., >5,000 m^3/s), additional water enters from the east via the Sacramento Weir, adding flow from the American and Sacramento rivers. Flow also enters the Yolo Bypass from several small streams on its western margin, including Knights Landing Ridge Cut, Cache Creek, and Putah Creek. During much of the winter, water-suspended sediment levels in the Yolo Bypass and Sacramento River are high, generally resulting in secchi depths of less than 0.25 m. However, hydraulic residence times are typically longer in the Yolo Bypass than in the Sacramento River (Sommer et al. 2004). Floodwaters recede from the northern and western portions of the bypass along relatively even elevation gradients of 0.09% west–east and 0.01% north–south into a perennial channel on the eastern edge of the Bypass; they then rejoin the Sacramento River near Rio Vista. The majority of the Yolo Bypass is at present managed for wildlife in a mosaic that includes riparian, wetland, upland, and perennial pond habitats; however, a dominant land use during the past two decades, agriculture has decreased in recent years because of habitat restoration activities.

Our data collection focused on the fall-run juvenile Chinook salmon, currently the numerically dominant race in the Sacramento Valley (Yoshiyama et al. 2000). There are four races of Chinook salmon in the Sacramento Valley: winter, spring, late-fall, and fall-run. Like many other native fish, Chinook salmon in the San Francisco estuary and its tributaries have been adversely affected by such factors as habitat loss, water diversions, and species introductions (Bennett and Moyle 1996); as a result, the Sacramento River winter and spring run Chinook salmon are protected under the Federal Endangered Species Act. The typical life history pattern is for young fall-run salmon fry (approximately 35–70 mm fork length) to migrate from the tributaries during winter and spring to the estuary (Brandes and McLain 2001).

Methods

Physical habitat.—Because seasonal hydrologic variability is a key characteristic of floodplain habitat, we reasoned that detailed data on changes in physical habitat would be necessary to evaluate the responses of young salmon. Daily flow data were obtained from gauging stations in the floodplain, and temperature data were collected using continuous temperature recorders (Sommer et al. 2001b). However, the vast area of Yolo Bypass made it impractical to directly measure other parameters, such as depth and surface area. As an alternative, we used a hydrologic model to estimate these parameters (Sommer et al. 2004). To summarize, the model treated Yolo Bypass as a "reservoir" described by (1) basin geometry and (2) flow and stage time series. The Yolo Bypass floodplain geometry was developed from 200 cross-sections with data collected at 300-m intervals by standard rod and level survey techniques. Mean daily stage and flow data were obtained from five gauging stations in the Yolo Bypass. For each date in the time series, we used linear interpolation between the gauging stations to estimate the stage at each cross-section. The estimated stage value was then used to calculate conveyance characteristics of each cross-section: area, width, and wetted perimeter. The daily results for each cross-section were used to estimate total surface area and mean depth. The large scale of the study reach did not allow validation of the depth estimates. As a partial validation of the model, Sommer et al. (2004) estimated total inundated area for the Yolo Bypass by using aerial photographs on days when the floodplain was inundated (February 8 and March 2, 1998) and when the floodplain was draining (April 28, 1998). To provide additional information about areas where fish stranding and consequent losses could occur, we estimated the portion of the area that was isolated ponds versus inundated area that was actively draining to the Delta (i.e., perennial channels and adjacent inundated area) on April 28, 1998.

Fish habitat use.—We used beach seine sampling to examine which regions and substrates of the floodplain were used by young salmon (hypothesis 1). During January through April of each year, a 15-m seine (3.2-mm mesh) was used to sample six regions of the Yolo Bypass (Figure 1). Fixed stations were used in each region during flooded periods. After floodplain drainage, samples were collected randomly within each region. For all periods, the primary substrate type of the habitat (sand, mud, gravel, pavement, or vegetation), fish species and size, and an estimate of the surface area swept by the seine were recorded. Habitat use during flood events was summarized in terms of the percentage of samples that contained salmon for each region and substrate type.

To provide additional information about habitat use, we conducted purse seine sampling along two transects (Figure 1). This sampling, performed in 1998 when the Yolo Bypass flow was relatively high (>850 m^3/s), used purse seines (30.5 m × 4.6 m, 4.75-mm mesh) set from a jet boat. Purse seining was conducted at 1–2 transects up to five times weekly, depending on hydrology. Hauls were made at random points in each of three habitat types (riparian, agricultural fields, and wetlands), the boundaries of which were established from aerial photographs taken before the Bypass was inundated. In the case of riparian habitat, hauls were made in clearings adjacent to trees to avoid snagging. We also recorded transect side (east or west half) for each haul because the western side of the Yolo Bypass was shallower and flow was dominated by inputs from westside streams rather than from Fremont or Sacramento weirs (Sommer et al. 2004). Most of these hauls were performed in areas exposed to at least a modest current. Additional limited paired sampling was conducted to examine possible differences between areas with and without velocity refuges. Low-velocity habitats sampled included downstream edges of levees, islands, and clusters of trees. Water velocities in randomly selected areas were approximately 0–0.05 m/s compared with greater than 0.33 m/s in adjacent exposed areas. Water depths were similar for each sampling pair. Differences in salmon densities for each habitat type were examined by using a Kruskal–Wallace test. A randomization *t*-test with 1,000 iterations (Haddon 2001) was used to compare salmon density on the east and west sides of the floodplain.

Migration trends.—To examine temporal trends in salmon migration through the floodplain (hypotheses 2 and 3), we operated a rotary screw trap (EG Solutions, Corvallis, Oregon) near the base of the Yolo Bypass during each study year. This technique was intended to provide an indication of the timing and duration of migration, rather than an absolute measure of the number of salmon emigrating the floodplain. During much of the sampling period the inundated width of the floodplain was 1–5 km, an area we considered too large for the traditional mark–recapture evaluations required to measure trap efficiency and total emigration (Roper and Scarnecchia 1996). A 1.5-m-diameter trap was used for the first 3 weeks of sampling in February 1998, after which a 2.4-m trap was used for all other sampling. We operated traps as often as 7 days each week, the daily effort varying from 1 to 24 h, depending on debris load and safety considerations. Fish number and size were recorded in all years. In 1998, young salmon were classified as fry (prominent parr marks) or transitional fish/smolts (faded parr marks, silver appearance).

Floodplain residence time and growth.—We used experimental releases of salmon with coded wire tags (CWTs) as our primary method to evaluate fish residence time on the floodplain (hypothesis 2). Fry (mean size = 57 mm fork length) from the Feather River Fish Hatchery (Figure 1) were tagged by using coded-wire half tags (Northwest Marine Technologies) and released in the Yolo Bypass below the Fremont Weir on March 2, 1998 (53,000 fry); February 11, 1999 (105,000 fry); and February 22, 2000 (55,000 fry). We assessed residence time in the Yolo Bypass from recoveries of tagged fish in the screw trap at the base of the floodplain.

We also examined, using the previously described beach seine data, whether there was evidence of long-term rearing of wild salmon in the floodplain. We compared the slopes of weekly fork length measurements for the two northern beach seine regions ("North") to the southernmost region ("South"), using a generalized linear model (GLM) with a Poisson distribution and log link variance function. We reasoned that major significant differences between the sizes of fish in the two areas provided evidence of extended rearing and growth of fish in the floodplain.

Salmon survival and stranding.—We used several independent data sources to examine whether salmon successfully emigrated from the floodplain (hypothesis 3). First, we compared survival of each of the Yolo Bypass CWT hatchery-reared salmon release groups with the survival of parallel CWT groups containing the same number of fish released into the Sacramento River (Sommer et al. 2001b). Recapture rates at the smolt stage of the 1998 and 1999 release groups had previously been analyzed by Sommer et al. (2001b); in the present study, we evaluated adult recoveries in the commercial and recreational ocean fisheries through 2003. Second, we examined stranding by using beach seine data (described previously) collected within a few weeks after the Sacramento River stopped flowing into the Yolo Bypass. Densities of salmon were compared with a randomization *t*-test (Haddon 2001) for (1) isolated earthen ponds (2) perennial channels, and any sites immediately adjacent to these water sources. The results for all years were pooled because of relatively low sample sizes for individual years. Data for each year

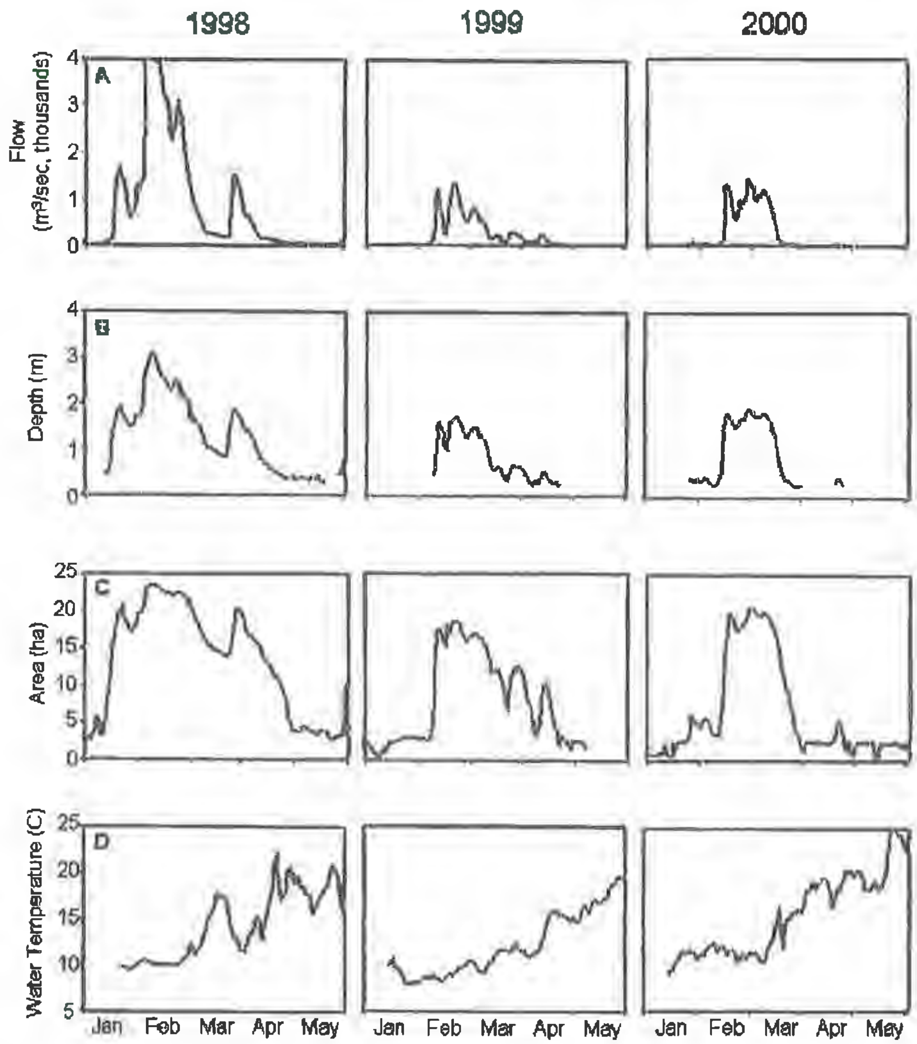

FIGURE 2.—Trends in physical variables for January–June 1998–2000: (A) mean daily flow in the Yolo Bypass; (B) simulated mean daily depth; (C) surface area; and (D) daily mean water temperature. The surface area data for 1998 and 2000 are from Sommer et al. (2004).

were first standardized for possible annual differences in abundance by conversion to z-scores; we then ran the randomization analysis using 1,000 iterations. We hypothesized that abundance of salmon would be equal in isolated ponds and contiguous water sources; that is, they would show no distinct "preferences." Our reasoning was that similar abundance levels would indicate successful emigration, because most of the water drains from the floodplain. To further understand factors that could affect stranding, we also used a randomization t-test to compare densities of fish in two types of isolated ponds: isolated earthen ponds and concrete weir scour ponds at Fremont and Sacramento weirs (Figure 1). Sampling effort was much greater in the isolated earthen ponds, so the randomization t-test was performed after randomly subsampling the earthen pond data from throughout the floodplain to provide equal sample sizes. We predicted that flood control structures would cause higher stranding than "natural" ponds. In addition, we examined trends in the catch of salmon in the screw trap data. We predicted that salmon catch would increase substantially during drainage because fish successfully emigrated the floodplain.

Results

Physical Habitat

The hydrographs varied substantially during the years of study (Figure 2A). In 1998 the hydrology was wet (4.4-year recurrence flood event) and the Yolo Bypass was inundated during mid-January through mid-April and again in early June. The flow was lower in the other 2 years, when inundation occurred between mid-February and mid-March, peak flood events being at the 1.7-year recurrence interval in 1999 and at the 2.4-year recurrence interval in 2000. Surface area in the Yolo Bypass closely followed the flow peaks, the amounts of inundated area being successively smaller in each of the study years (Figure 2C). For the April 28, 1998, photographs, the total surface area of 5,050 ha was slightly lower than the model estimate of 6,700 ha. Based on the aerial photographs, we estimated that only 600 ha of the 5,050 ha comprised isolated ponds, the remainder being water that drained to the Delta. For all but peak flood events, mean water depth remained less than 1 m (Figure 2B). During peak flood events, mean depths did not exceed 2 m except in February 1998. Water temperature showed gradual increases throughout each study year (Figure 2D).

Fish Habitat Use

We captured salmon in all regions of the floodplain and on all substrate types. During 1998–2000 flood events, salmon were captured in a high percentage of samples in each region (Figure 1) of the floodplain: (1) Fremont Weir (100%, n = 13 samples); (2) Cache Creek Sinks (50%, n = 16 samples); (3) Yolo Bypass Wildlife Area (77%, n = 22 samples); (4) Sacramento Bypass (100%, n = 7 samples); (5) Putah Creek Sinks (94%, n = 11 samples); and (6) Liberty Island (100%, n = 7 samples). Similarly, during 1998–2000 flood events we collected salmon on a high percentage of substrate types: (1) mud (70%, n = 47 samples); (2) sand (100%, n = 3 samples); (3) pavement (100%, n = 8 samples); (4) vegetation (97%, n = 32 samples); and 5) gravel (89%, n = 9 samples).

Salmon densities as estimated by purse seine sampling were not significantly different between riparian (mean abundance = 46.9/ha, SE = 10.4, n = 23), agricultural (mean abundance = 20.9/ha, SE = 6.1, n = 35), or natural vegetated habitat types (mean abundance = 27.5/ha, SE = 5.6, n = 31) based on a Kruskal–Wallis test (H = 4.38, df = 2, P = 0.112). There was also no statistically significant difference between the east (mean abundance = 29.5/ha, SE = 6.0, n = 53) and west (mean abundance = 29.9/ha, SE = 6.7, n = 36) sides of the Bypass as shown by a randomization t-test (P = 0.95). Salmon were collected in six hauls in low-velocity habitat (mean abundance = 189/ha, SE = 24/ha), but none were collected in adjacent areas exposed to a current.

Floodplain Migration Trends

Salmon migration as indicated by trends in screw trap catch was highly variable over the course of the study, but there were prominent peaks in Chinook salmon catch coincident with floodplain drainage during late March–April (Figure 3B). Additional smaller peaks in salmon catch also paralleled flow, mostly during February and March. The life history stage of salmon during 1998 was exclusively parr through the end of March, after which the majority showed signs of smoltification.

Floodplain Residence Time

Based on recoveries of tagged fish in the screw trap, the mean residence time of CWT salmon was 33 d (range, 16–46 d; n = 10) in 1998, 56 d (range, 4–76 d; n = 49) in 1999, and 30 d (range, 28–37 d; n = 25) in 2000. The size of fish was significantly larger (P<0.001; GLM) at the outlet of the floodplain than at the top (Figure 3C) during each of the study years.

Salmon Survival and Stranding

The numbers of CWT fish recovered for the Yolo Bypass were higher than in the Sacramento River in 1998, similar in 1999, and lower in 2000 (Table 1). Densities of wild Chinook salmon were highly variable during floodplain drainage events, with no statistically significant difference between densities in isolated earthen ponds and contiguous water sources (Table 2). However, densities of salmon were significantly higher (P < 0.0001; randomization t-test) in concrete weir scour ponds than in isolated earthen ponds (Table 3).

Discussion

Research on migratory fishes reveals that these species frequently have alternative life histories that may be influenced by habitat use at early life stages (Clark 1968; Secor 1999). Under Clark's (1968) "contingent hypothesis," migratory taxa have divergent migration pathways that could help the species deal with environmental variability and heterogeneity. This theory is consistent with our understanding of Chinook salmon, which are adapted to the extreme hydrologic variability in western North America and show a range of life histories (Healey 1991; Bottom et al. 2005). In this context, the use of multiple habitats—including natal and nonnatal streams (Bjornn 1971; Scriv-

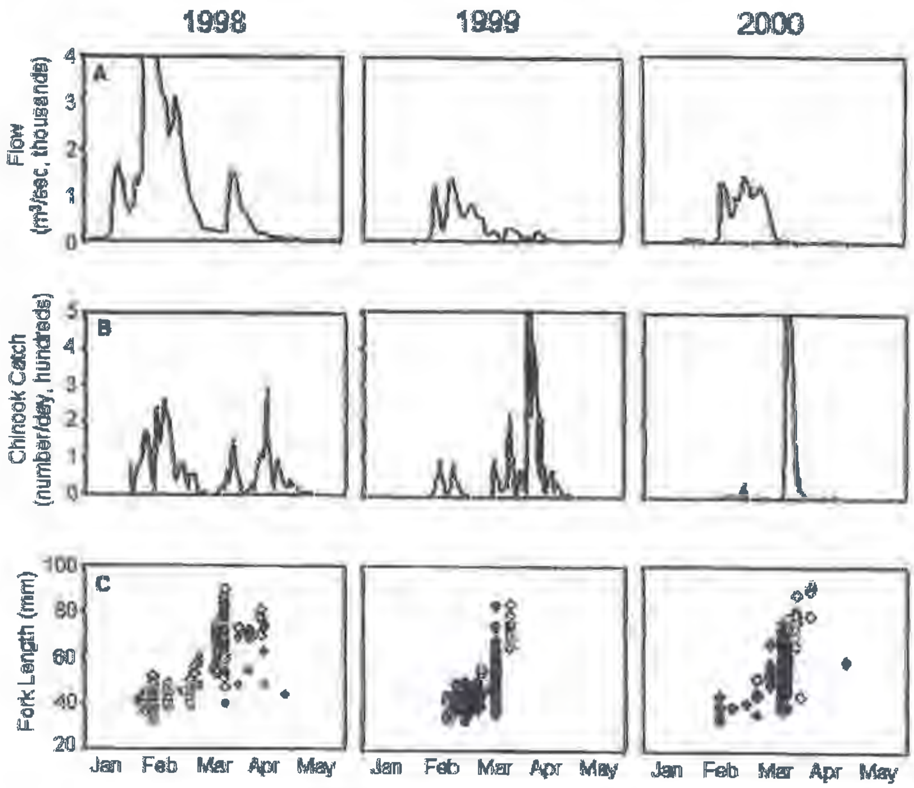

FIGURE 3.—Chinook salmon results during winter and spring 1998–2000: (A) mean daily flow; (B) salmon catch rates in screw trap sampling; and (C) salmon size for beach seine samples near the Yolo Bypass intake (solid symbols) and outlet (clear symbols).

ener et al. 1994), side channels and off-channel ponds (Swales et al. 1986; Swales and Levings 1989), low-elevation rivers (Kjelsen et al. 1982; Brown 2002), and estuaries (Healey 1991; Shreffler et al. 1992)—can be considered as part of an overall "bet-hedging" strategy that spreads risk across a variable environment. Despite the fact that seasonal floodplain represents perhaps the single most variable habitat available to salmon, our study suggests that floodplains are a viable rearing location for young fish.

TABLE 1.—Number of coded wire tags recovered in the ocean and commercial fisheries for Chinook salmon released in the Yolo Bypass and Sacramento River. The total number of tagged fish released in each location for each year is shown in parentheses. The survival ratio is calculated as the number of Yolo Bypass recoveries divided by the number of Sacramento River recoveries.

Release group	1998 (53,000)	1999 (105,000)	2000 (55,000)
Yolo Bypass	75	136	27
Sacramento River	35	138	47
Survival ratio	2.14	0.99	0.57

At the beginning of our study, our conceptual model for floodplain habitat use was that young salmon move into the floodplain during high-flow events and spread throughout the broad expanse of seasonally inundated habitat. Among the wide variety of suitable substrates and habitat types for rearing, young salmon appear to seek out low-velocity areas. Moreover, floodplain habitat apparently is not simply a migration corridor; many young salmon actively rear on the highly productive floodplain habitat for extended periods of time, resulting in high growth rates. Our findings suggest that salmon emigrate from the seasonally inundated habitat both during flood events and during drainage. Juvenile Chinook salmon do not appear to be especially prone to stranding mortality; indeed, survival may actually be enhanced by floodplain rearing in some years. Our conceptual model was supported by our results and has a variety of management implications.

Salmon were present in a broad range of habitat and substrate types and were collected in all regions and sides of the Yolo Bypass floodplain. The

TABLE 2.—Densities of Chinook salmon (number/ha ± SE, with sample size in parentheses) collected in beach seine sampling during drainage events in 1998–2000. The sample locations are divided into isolated earthen ponds and contiguous water sources. Density differences were not statistically significant between the two pond types based on a randomization t-test of the pooled data for all years ($P = 0.79$; $n = 43$ for isolated ponds; $n = 59$ for contiguous water sources).

Location type	1998	1999	2000
Isolated ponds	206 ± 112 (30)	890 ± 491 (8)	126 ± 65 (5)
Contiguous water sources	167 ± 79 (33)	310 ± 104 (13)	463 ± 123 (13)

fact that they were present on the western half of the Bypass, where flows are dominated by Knights Landing Ridge Cut and Cache and Putah creeks, suggests that salmon spread throughout the floodplain after entering the basin by way of Fremont and Sacramento weirs. A few of these fish may have originated from a modest spawning population in Putah Creek (Marchetti and Moyle 2001). The fact that salmon were present in a wide range of habitat and substrate types and in different regions of the Yolo Bypass indicates that many areas of habitat were suitable, although this does not mean that there were no habitat preferences. Like many young fishes, much of the distribution of juvenile Chinook salmon can be explained by their association with shallow depths and low velocities (Everest and Chapman 1972; Roper et al. 1994; Bradford and Higgins 2001). The physical modeling indicated that mean depths were generally 1 m or less during all but peak flood periods, so much of the thousands of hectares of inundated habitat was probably within the shallow range typically preferred by young Chinook salmon (Everest and Chapman 1972). Our limited purse seine sampling suggested that young salmon were most abundant in low-velocity areas, which is consistent with previous studies in river and stream habitat (Everest and Chapman 1972; Roper et al. 1994; Bradford and Higgins 2001). We did not directly simulate water velocity in the present study; however, the relatively shallow water depth during flood events reflects the broad area of low-velocity rearing habitat created during flood events. We expect that this increase in rearing habitat in the Yolo Bypass provides foraging opportunities (Sommer et al. 2001b), reduced energy expenditure, and perhaps reduced probability of encounter with a predator (Ward and Stanford 1995).

Our results also suggest that fish rear in the system for extended periods rather than simply using it as a migration corridor. The mean residence time of 30–56 d for the 44-km reach between the floodplain release location and the screw trap is substantially longer than one would expect, given that (1) fingerlings are capable of migrating at rates of at least 6–24 km/d in low-elevation reaches of other large rivers (Healey 1991) and (2) one of our 1999 CWT fish was recovered just 4 days after being released, having traveled an estimated rate of 11 km/d. The fish were significantly larger at the base of the Yolo Bypass, suggesting that their period of residence in the floodplain was long enough to support substantial growth. Similarly, Sommer et al. (2001b) found that salmon showed higher growth rates in the Yolo Bypass than in the adjacent Sacramento River, primarily because of higher levels of invertebrate prey in the floodplain. A long period of rearing is also supported by the screw trap data, which showed that the densities of salmon were greatest during drainage of the floodplain. We believe that these peaks are a result of rearing salmon being forced off of the floodplain by receding flows. Temperature and salmon life history stage do not provide good alternative explanations for the emigration trends. In 1998, for example, water temperatures were relatively high by late March and salmon began smoltification shortly thereafter; yet the screw trap data indicate

TABLE 3.—Densities of Chinook salmon (number/ha ± SE, with sample size in parentheses) collected in beach seine sampling for earthen ponds and adjacent concrete weir ponds. Density differences were statistically significant between the two pond types based on a randomization t-test of the pooled data for all years ($P < 0.0001$; $n = 26$ for each pond type). Note that we used a randomly sampled subset of the earthen pond data to provide equal sample sizes for the comparison.

Location type	1998	1999	2000
Earthen ponds	186 ± 67 (63)	531 ± 200 (21)	369 ± 97 (18)
Concrete weir ponds	2,717 ± 1,115 (14)	14,208 ± 3,898 (12)	4,181 ± 1,275 (3)

that emigration did not peak until the end of April, when the floodplain drained. Perhaps the emigration trends are partially confounded by seasonal variation in salmon abundance. In the absence of trap efficiency data, we cannot estimate the proportion of the population that emigrated in winter versus spring events.

Several lines of evidence suggest that the majority of fish successfully emigrated from the floodplain. One important observation was that the area of isolated ponds was small relative to the overall area of the floodplain during both peak flood and drainage periods. As an example, in 1998, the wettest year we studied, the peak area of inundation was 24,000 ha, but the total inundated area dropped to 5,000 ha by late April. Of the 5,000 ha remaining at this point, our estimates from aerial photographs showed that isolated ponds took up only 600 ha. Put another way, isolated ponds represented just 12% of the wetted area in April and only 2.5% of the peak inundated area in winter. The same trend is evident in the area simulations for 1999 and 2000, when the peak area was 20,000 ha, but dropped to about 2,000 ha within a month. These results demonstrate that the Yolo Bypass drains fairly efficiently, leaving little isolated area where stranding can occur. This finding was somewhat unexpected, because many parts of the Yolo Bypass have natural topographic features or agricultural levees that could potentially impede drainage and fish emigration. Even if the area of isolated ponds is low, stranding could still be a substantial source of mortality if densities of fish in the remaining ponds were very high. However, we found no evidence that densities of fish stranded in isolated ponds were significantly higher than those in contiguous water sources that were draining to the Delta. The key point here is that most of the water drains from the floodplain and apparently the majority of the fish are leaving with the receding floodwaters. To help illustrate this issue, if we assume that mean densities of fish observed in Table 2 were representative of the entire wetted area of floodplain in April 1998, then the total number of fish in the 600 ha of isolated ponds would have been 123,600 salmon, lower than an estimate of 835,000 fish in the 5,000 ha of contiguous water sources. This conservative estimate also does not include the large numbers of fish that emigrated from the floodplain before April.

In addition to the beach seine and surface area data, we believe that trends in screw trap data support the hypothesis that stranding is not consistently a major problem on the floodplain. The screw trap data are somewhat ambiguous, because the large area of the floodplain makes it unreasonable to measure the efficiency of the trap. Therefore, we cannot accurately estimate the absolute number of salmon emigrating from the floodplain. However, we can at least examine the patterns of trap catch to evaluate likely mechanisms. Some of the possible patterns that we would expect to see for different factors are summarized in Figure 4. First, under the "trap efficiency" model, we would have expected dual peaks in the earliest and latest portions of flood events, when the screw trap would be sampling the highest portion of total flow (Figure 4A). If young salmon follow the "go with the flow" model, catch and flow peaks should be well-correlated (Figure 4B). Alternatively, if floodplains represent an important rearing habitat, we would expect catch trends to follow the "loitering" model, in which catch does not increase until drainage, when fish are forced from their rearing habitat by receding floodwaters (Figure 4C). Finally, if stranding were a major factor controlling catch trends, we would expect an early increase in catch as fish moved through the floodplain during inundation, but then catch should drop earlier than flow as young salmon became isolated from draining floodwaters (Figure 4D; "bathtub" model). Of these patterns, our data for the Yolo Bypass provide the strongest support for both the "go with the flow" and "loitering" models. In each year we saw obvious screw trap catch peaks associated with flow events, and additional prominent peaks associated with drainage. To summarize, apparently some of the fish move

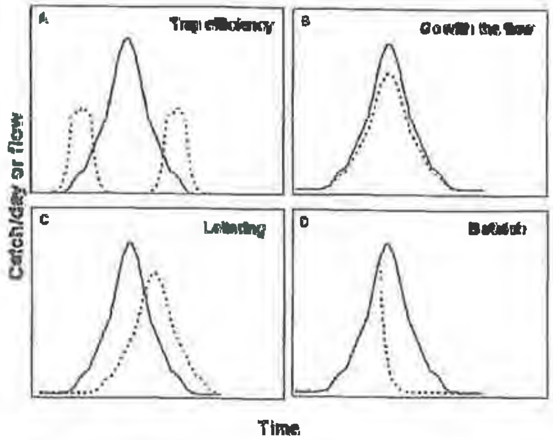

FIGURE 4.—Four conceptual models of expected screw trap catch (dotted line) relative to flow (solid line). See the Discussion for further details about each model.

through the floodplain in direct association with flow, whereas others remain as long as possible to rear on the floodplain. The screw trap trends show no evidence that stranding had a major influence on patterns of emigration.

Relatively low stranding rates on the Yolo Bypass floodplain are supported by observations from other seasonal floodplain habitat in the San Francisco estuary (Peter Moyle, University of California–Davis, personal communication) and other studies. Higgins and Bradford (1996) and Bradford (1997) report that juvenile salmonids are relatively mobile and that most avoid being stranded during moderate rates of stage change. Higgins and Bradford (1996) state that maximum recommended stage reduction levels for gravel bars of regulated rivers are typically 2.5–5 cm/h, much more than the 1 cm/h or less rates of change in mean water depth we observed during drainage in the present study. In his review of the ecology of fishes in floodplain rivers, Welcomme (1979) noted that the majority of fish emigrate from floodplain habitat during drainage.

Even if stranding is not a major source of mortality, this does not necessarily mean that floodplains are not sinks for salmon production. Of the possible sources of mortality, birds and piscivorous fishes may have benefited from stranded salmon (Brown 2002). As noted by Sommer et al. (2001a), major avian predation is unlikely because densities of wading birds are low relative to the thousands of hectares of rearing habitat available during flood events. We did not measure densities of fish predators, but believe that the creation of large areas of rearing habitat should create more refuges for young fish and decrease the probability of encounter with a predator.

Ultimately, it is survival data that allow us to differentiate source from sink habitat. The size and complexity of the San Francisco estuary made it very difficult to directly measure survival rates with statistical rigor (Newman and Rice 2002); however, our CWT release studies at least provide an indication of whether survival rates in the Yolo Bypass were substantially different from those in the Sacramento River, the adjacent migration corridor. The limited results suggest that fry–adult survival rates were at least comparable in the Yolo Bypass and the Sacramento River. Moreover, the 1998 results suggest that in some years, survival may actually be substantially higher for salmon that migrate through the floodplain. Although none of these CWT releases were replicated, the fact that Sommer et al. (2001b) reported similar results for fry-to-smolt survival for the same releases in 1998 and 1999 increases our confidence that the survival data are not spurious.

Our data indicate that floodplains are a viable rearing habitat for juvenile Chinook salmon. Hence, the most important management implication of our study is that seasonal habitat should be considered as part of restoration plans for this species. Despite frequent concerns that off-channel habitat could increase stranding mortality (Brown 2002; Bruce Oppenheim, NOAA Fisheries, personal communication), our results for a hydrologically variable seasonal floodplain suggest that one should be able to design restoration projects that do not create a population sink because of excessive mortality. This is not to say, however, that stranding mortality is never an issue on floodplain habitat. For example, in the Yolo Bypass we saw significantly higher stranding rates in the concrete weir scour ponds of Fremont and Sacramento weirs than in earthen ponds. This finding suggests that artificial water control structures can create unusual hydraulics that promote stranding. However, the total area of these concrete weir ponds was only 3 ha, much smaller than our estimate of 600 ha for total isolated pond area for April 1998 and insignificant compared with the peak inundated area of 24,000 ha area. Fixing the poor hydraulics at these water-control structures may, nonetheless, be an attractive option, particularly if the cost of the solution is relatively low or if it helps to address other fisheries issues such as adult fish passage. In the Yolo Bypass, the concrete weirs not only create stranding problems for juveniles but also frequently block upstream passage of adult salmon, sturgeon, and steelhead trout (Sommer et al. 2001a), thus creating an incentive to resolve both issues simultaneously.

Finally, we wish to acknowledge that even natural floodplain or well-designed restored floodplain habitat could at least occasionally be a population sink because of stranding or predation losses. Our study was conducted over 3 years for a single, large floodplain; we cannot rule out the possibility that floodplains may not have net benefits in other years or locations. As an example, fish densities in the Yolo Bypass were relatively low compared with those reported in some other studies (Levy and Northcote 1982; Swales et al. 1986; Swales and Levings 1989); perhaps young salmon behavior could be different at higher densities. However, the potential for such losses can still be consistent with effective management of salmon populations. Diverse life history strategies provide bet-hedging for salmon populations in the highly variable environment of coastal tributaries (Secor 1999; Bottom et al. 2005). We therefore expect that young salmon will not thrive in all habitats in every year. In the case of highly variable seasonal environments such as floodplains, stranding losses might cause excessive mortality in some years, but the risks may be offset by increased rearing habitat and food resources in other years (Sommer et al. 2001b; Brown 2002).

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Insights into the
Problems, Progress, and Potential Solutions
for Sacramento River Basin Native Anadromous Fish Restoration

Spring-Run Chinook Salmon in Mill Creek, California (Photo by Dave Vogel)

April 2011

Prepared for:

Northern California Water Association
and
Sacramento Valley Water Users

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Exhibit 29-1

Figure 60. Schematics of DIDSON™ imaging at the base of a flat-plate fish screen. Bottom diagram shows orientation of sonar beams from the acoustic camera off the side of a boat and submerged objects at the fish screens. Top diagram shows the resultant corresponding sonar imaging of objects ensonified with acoustic shadows from the objects. (from Vogel 2008b)

From 1996 through 2010, Natural Resource Scientists, Inc. conducted 22 separate research projects on juvenile salmon (including four studies of predatory fish) in the Delta using acoustic or radio telemetry as a means to gain an improved understanding of fish movements and mortality (Vogel 2010a). The reason juvenile salmon telemetry studies were initiated in the Delta was to acquire detailed data on fish behavior, fish route selection through complex channels, and estimate fish survival in discrete reaches. Past efforts using traditional coded-wire tagging could not answer those critically important questions. Research findings from the telemetry investigations indicate that smolt survival assumptions and models must incorporate these new conclusions to avoid misinterpretation of data and improve quantitative estimates of fish survival and movements (Vogel 2010a).

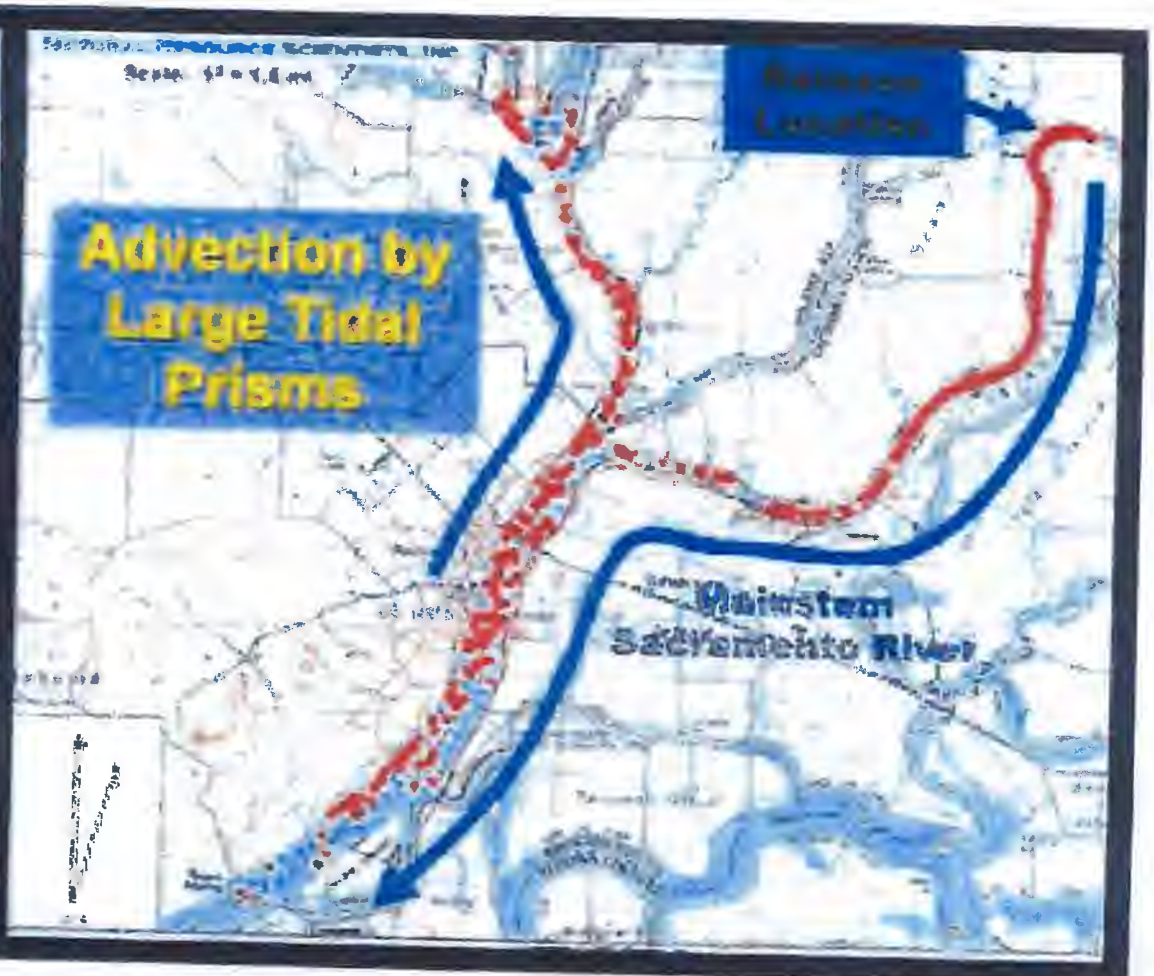
The first successful use of telemetry on juvenile salmon in the Central Valley was conducted by Natural Resource Scientists, Inc. on behalf of EBMUD in 1996 and 1997. At that time, the specific behavior of juvenile salmon in the Delta was largely unknown. The initial studies quickly determined that the fish did not move as a school, but instead, dispersed, exhibiting a wide range in migratory behaviors in the complex Delta environment. Salmon moved many miles back and forth each day with the ebb and flood tides and the side channels (where flow was minimal) were largely unused. Site-specific hydrodynamic conditions present at flow splits when the fish arrived had a major affect in initial route selection. Importantly, some of the salmon were believed to have been preyed upon based on very unusual behavior patterns (Vogel 2010a).

Subsequent, additional juvenile salmon telemetry studies were conducted by Natural Resource Scientists Inc. on behalf of the USFWS and CALFED in the north Delta (Vogel 2001, Vogel 2004). Triangulating radio-tagged fish locations in real time (Figure 61) clearly demonstrated how juvenile salmon move long distances with the tides and were advected into regions with very large tidal prisms, such as upstream into Cache Slough and into the flooded Prospect and Liberty Islands (Figure 62). During the studies, it was determined that some radio-tagged salmon were eaten by predatory fish in northern Cache Slough, near the levee breaches into flooded islands (discussed below). Also, monitoring telemetered fish revealed that higher predation occurred in Georgiana Slough as compared to the lower Sacramento River (Figure 63). As discussed previously, past coded-wire tagging studies found that salmon released into northern Georgiana Slough were found to have a higher mortality rate than fish released downstream of the slough in the Sacramento River (Brandes and McLain 2001).


Figure 61. Left picture, mobile telemetry conducted in the north Delta. Photo by Dave Vogel.
Figure 62. Right picture, telemetered locations of approximately 100 radio-tagged salmon smolts released in the lower Sacramento River near Ryde (data from Vogel 2001 and Vogel 2004).

Figure 63. Estimated mortality rate for groups of radio-tagged salmon released at two locations in the north Delta and locations where radio-tagged salmon smolts were detected to have been preyed upon (Vogel 2001, Vogel 2004).

More recently, a 2007 study conducted by releasing acoustic-tagged juvenile salmon in the San Joaquin River found 116 motionless juvenile salmon transmitters in the lower San Joaquin River near the Stockton Waste Water Treatment Plant and a nearby bridge (Figure 64) (Vogel 2007b). This was an all-time record for the largest number of dead radio- or acoustic-telemetered juvenile



ducted in the north Delta. Photo by Dave Vogel.

ns of approximately 100 radio-tagged salmon smolts released in the vegetation at some sites in the Delta and water clarity. Increased water clarity for sight predators such as black bass and striped bass would presumably favor predatory fish over prey (e.g., juvenile salmon). Fewer native fish species are found in *Egeria* stands compared to introduced fish species (Grimaldo and Hymanson 1999). Additionally, it has been hypothesized that high densities of *Egeria* in portions of the Delta may restrict juvenile salmon access to preferred habitats, forcing salmon to inhabit deep water or channel areas where predation risks may be higher (Grimaldo *et al.* 2000).

During recent years, there has been an emphasis to reclaim or create shallow, tidal wetlands to assist in re-recreating the form and function of ecosystem processes in the Delta with the intent of benefitting native fish species (Simenstad *et al.* 1999). Among a variety of measures to create such wetlands, Delta island levees either have been breached purposefully or have remained unrepaired so the islands became flooded. A recent example is the flooding of Prospect Island which was implemented under the auspices of creating shallow water habitat to benefit native fish species such as anadromous fish (Christophel *et al.* 1999). Initial fish sampling of the habitat created in Prospect Island suggested the expected benefits may not have been realized due to an apparent dominance of non-native fish (Christophel *et al.* 1999). Importantly, a marked reduction of sediment load to the Delta in the past century (Shvidchenko *et al.* 2004) has implications in the long-term viability of natural conversion of deep water habitats on flooded Delta islands into shallow, tidal wetlands. The very low rates of sediment accretion on flooded Delta islands indicate it would take many years to convert the present-day habitats to intertidal elevations which has potentially serious implications for fish restoration (Nobriga and Chotkowski (2000) due to likely favorable conditions for non-salmonid fish species that can prey on juvenile salmon. Studies of the shallow water habitats at flooded Delta islands showed that striped bass and largemouth bass represented 88 percent of the individuals among 20 fish species sampled (Nobriga *et al.* 2003).

There have likely been significant adverse, unintended consequences of breaching levees in the Delta. There is a high probability that site-specific conditions at the breaches have resulted in hazards for juvenile anadromous fish through the creation of favorable predator habitats. The breaches have changed the tidal prisms in the Delta and can change the degree in which juvenile fish are advected back and forth with the tides (Figure 61; previously discussed). Additionally, many of the breaches were narrow which have created deep scour holes favoring predatory fish. Sport anglers are often seen fishing at these sites during flood or ebb tides. Breaching the levees at Liberty Island is an example (Figure 72 and 73). Recent acoustic-tagging of striped bass in this vicinity confirmed a high presence of striped bass (Figure 74, D. Vogel, unpub. data).

Figure 72. Liberty Island in the north Delta before and after flooding.

Figure 73. Liberty Island in the north Delta before and after flooding showing locations of narrow breaches in the levee.

Figure 74. Locations (squares) where predatory striped bass were acoustic-tagged with transmitters during the winter of 2008 – 2009 in the north Delta near Liberty Island (D. Vogel, unpublished data).

TABLE A-5
1976-77 Estimated Crop Et Values
Delta Service Area
(in inches)

Land Use Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Total Oct.76-Sep.77	Oct.77	Total Nov.77-Oct.77
Sacramento-San Joaquin Delta															
Irrigated Pasture	3.2	1.5	1.0	0.7	1.5	3.6	5.4	4.8	6.9	7.7	6.4	4.7	47.4	3.4	47.6
Alfalfa	3.2	1.5	1.0	0.7	1.5	3.2	4.9	4.4	6.5	7.5	6.5	4.9	45.6	3.4	46.0
Deciduous Orchard (Fruits & Nuts)	2.6	1.5	1.0	0.7	1.5	2.7	3.8	4.0	6.1	7.4	6.1	4.3	41.7	2.6	41.7
Tomatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.6	4.0	8.2	6.0	2.3	34.3	1.9	33.8
Sugar Beets	2.4	1.5	1.0	0.7	1.5	1.9	2.2	3.7	7.6	8.3	6.4	4.4	41.6	2.4	41.6
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.0	5.9	7.3	4.3	2.5	33.2	1.9	32.7
Field Corn	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.3	5.7	6.9	5.1	2.6	33.8	1.8	33.3
Dry Beans	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	5.7	6.2	2.7	2.5	30.0	1.9	29.5
Safflower	2.4	1.5	1.0	0.7	1.5	1.9	2.5	4.8	8.7	7.7	4.4	2.5	39.6	1.9	39.1
Asparagus	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.0	3.5	7.7	6.4	4.7	34.5	2.4	34.5
Potatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	4.3	7.4	5.5	2.8	32.9	1.9	32.4
Irrigated Grain	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	1.0	1.0	1.6	26.1	1.6	24.7
Vineyard	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.8	5.3	6.5	5.3	3.4	34.5	2.4	34.5
Rice	3.2	1.5	1.0	0.7	1.5	1.9	2.8	5.5	8.8	9.8	8.1	5.5	50.4	3.4	50.6
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	4.8	6.9	7.7	4.9	4.7	46.6	2.4	46.6
Misc. Truck	2.4	1.5	1.0	0.7	1.5	1.9	3.2	4.6	6.7	7.4	5.2	3.7	39.8	1.9	39.3
Misc. Field	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.4	6.1	7.4	5.0	1.9	34.0	1.9	33.5
Double Cropped with Grain															
Sugar Beets	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.2	5.2	5.8	37.7	3.4	38.7
Field Corn	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.3	6.3	6.1	39.2	2.7	39.5
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	2.7	6.1	5.2	36.5	1.9	36.0
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.6	7.7	4.9	4.7	41.6	1.9	41.1
Dry Beans	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.1	7.6	3.5	1.5	36.4	1.9	35.9
Tomatoes	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	1.9	40.3
Lettuce	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	2.4	42.4
Misc. Truck	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	2.4	40.8
Misc. Field	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	3.4	43.4
Fallow Lands 1/	2.4	1.5	1.0	0.7	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	14.0	1.0	12.6
Native Vegetation 2/	2.4	1.5	1.0	0.7	1.4	3.7	3.8	2.1	2.3	2.6	2.3	2.0	25.8	1.6	25.0
Riparian Veg. & Water Surface	4.6	2.4	1.4	0.8	1.9	4.5	7.4	6.6	9.7	11.8	9.7	7.0	67.8	4.3	67.5
Urban	1.6	0.8	0.6	0.7	1.0	1.0	1.9	2.4	2.4	2.5	2.4	1.9	19.2	1.6	19.2

1/ Applies also to nonirrigated grain.
2/ Applies also to nonirrigated orchards and vineyards

Metric conversion: inches times 25.4 equals millimetres

Exhibit 29-2

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

PUBLICATIONS OF THE
DIVISION OF WATER RESOURCES
EDWARD HYATT, State Engineer

S A C R A M E N T O - S A N   J O A Q U I N

W A T E R   S U P E R V I S O R ' S

R E P O R T

FOR YEAR

1 9 3 1

By
HARLOWE M. STAFFORD
Water Supervisor

Under the supervision of
HAROLD CONKLING
Deputy State Engineer

August, 1932

Exhibit 29-3

TABLE 69

UNIT CONSUMPTIVE USE OF WATER IN SACRAMENTO-SAN JOAQUIN DELTA**
Acre-feet per Acre

Crop or Classification	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total Seasonal Use	Total Annual Use
Alfalfa	(.06)	(.08)	.10	.30	.40	.50	.65	.55	.50	.20	(.10)	(.07)	3.20	3.51
Asparagus	.05	.05	.05	.05	.08	.14	.40	.60	.55	.42	.12	.10	2.69	2.69
Beans	(.06)	(.08)	(.08)	(.16)	(.20)	.14	.24	.58	.37	(.09)	(.07)	(.05)	1.33	2.12
Beets	(.06)	(.08)	(.08)	.13	.32	.51	.61*	.53*	.20*	(.13)	(.10)	(.07)	2.30	2.82
Celery	(.04)	(.04)	(.04)	(.08)	(.10)	.10	.10	.20	.25	.30	.20	.05	1.20	1.50
Corn	(.04)	(.04)	(.04)	(.08)	(.10)	.24	.85	.84*	.40*	.10	(.10)	(.07)	2.49	2.90
Fruit	(.04)	(.04)	(.04)	.18	.32	.50	.57	.40	.25	.07	(.07)	(.05)	2.27	2.51
Grain and Hay	(.04)	(.04)	.07	.60	.83	.20	(.14)	(.23)	(.21)	(.14)	(.07)	(.05)	1.70	2.62
Onions	(.04)	(.04)	.08	.13	.27	.49	.43	.20	(.16)	(.13)	(.10)	(.07)	1.60	2.14
Pasture	.08	.10	.20	.25	.25	.25	.25	.25	.20	.15	.10	.08	2.16	2.16
Potatoes	(.06)	(.08)	(.08)	(.16)	.15	.38	.52	.30	.15	(.09)	(.07)	(.05)	1.50	2.09
Seed	(.06)	(.08)	(.08)	.10	.25	.50	.50	.50	.35	.10	(.10)	(.07)	2.30	2.69
Truck	(.06)	(.08)	.10	.10	.25	.50	.45	.45	.30	.15	.10	(.07)	2.40	2.61
Tules	.16	.09	.30	.74	1.10	1.28	1.53	1.32	1.18	.98	.59	.36	9.63	9.63
Willows	.05	.03	.09	.22	.33	.38	.46	.40	.35	.29	.18	.10	2.88	2.88
Bare Land	.04	.04	.04	.08	.10	.13	.14	.13	.11	.09	.07	.05	1.02	1.02
Idle Land with Weeds***	.06	.08	.08	.16	.20	.26	.28	.24	.16	.13	.10	.07	1.82	1.82
Open Water Surfaces	.08	.13	.23	.34	.60	.76	.84	.73	.60	.33	.14	.08	4.91	4.91

NOTE: Figures shown in brackets ( ) represent estimated consumptive use on cropped areas before planting and after harvest. (Evaporation from bare land, use by weeds, etc.).

* Includes estimated additional use by weeds during these months.

** These are the data as determined for and published in Bulletin No. 27 - "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay" - Table 1.

*** Average for land below elevation 5.0 U.S.G.S. datum. Use on unirrigated lands above elevation 5.0 is considered zero.

TABLE 74

USE OF WATER BY CAT-TAILS GROWN IN TANKS, NEAR CLARKSBURG,
RECLAMATION DISTRICT 999, 1931

TANK NO.	USE OF WATER — ACRE-FEET PER ACRE												
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
2	0.22	0.22	0.58	1.08	2.28	2.28	2.96	2.51	1.66	0.91	0.43	0.23	15.36
3	0.21	0.20	0.49	1.12	1.94	2.11	2.51	1.92	1.36	0.83	0.51	0.22	13.42
4	0.20	0.21	0.52	1.30	2.51	2.78	3.34	2.78	1.90	1.04	0.54	0.29	17.41
5	0.23	0.25	0.50	1.15	1.98	1.83	2.04	1.82	1.28	0.76	0.37	0.13	12.34
6	0.22	0.24	0.60	1.44	2.80	2.77	3.51	—UNDER TEST FOR LEAKAGE—					
MEANS	0.22	0.22	0.54	1.22	2.30	2.35	2.87	*2.26	*1.55	*0.94	*0.46	*0.22	*14.63

*MEAN OF FOUR TANKS

TABLE 75

USE OF WATER BY TULES GROWN IN TANKS, NEAR CLARKSBURG,
RECLAMATION DISTRICT 999, 1931

TANK NO.	USE OF WATER — ACRE-FEET PER ACRE												
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
7	0.21	0.23	0.54	1.32	3.02	2.88	4.35	—UNDER TEST FOR LEAKAGE—					
8	0.20	0.24	0.48	1.18	2.45	2.39	3.02	2.59	1.78	1.01	0.51	0.20	16.05
9	0.20	0.26	0.48	1.12	2.14	2.20	2.76	1.98	1.37	0.82	0.41	0.20	13.94
10	0.19	0.24	0.51	1.08	2.07	2.26	2.88	1.71	1.23	0.66	0.43	0.23	13.49
11	0.21	0.19	0.40	0.90	1.84	1.65	1.63	1.32	1.16	0.72	0.39	0.19	10.60
12	0.20	0.20	0.25	0.84	1.75	1.26	2.75	2.36	1.72	1.09	0.61	0.27	13.30
MEANS	0.20	0.23	0.44	1.07	2.21	2.11	2.90	*1.99	*1.45	*0.86	*0.47	*0.22	*13.48

*MEAN OF FIVE TANKS

TABLE 77

USE OF WATER BY CAT-TAILS AND TULES GROWN IN TANKS AT CAMP 3, KING ISLAND
1931

TANK NUMBER	PLANT	WATER SURFACE ABOVE GROUND SURFACE FEET	USE OF WATER — ACRE-FEET PER ACRE JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC. (3)	YEAR (4)	COMPARATIVE PLANT SIZE (2)
1	CAT-TAILS	0.0	0.14	0.13	0.25	0.52	0.32	0.31	0.33	0.18	0.13	0.15	0.07		2.8	UNDERSIZE
2	CAT-TAILS	1.0	—	NO USABLE	RECORD	—	(1)0.72	0.82	0.92	0.82	0.67	0.53	0.26		6.2	UNDERSIZE
3	TULES	1.0	—	NO USABLE	RECORD	—	(1)1.33	1.13	1.32	1.16	0.80	0.51	0.19		8.0	NORMAL
4	TULES	0.0	0.17	0.15	0.45	0.58	1.00	0.88	0.88	0.71	0.53	0.15	0.07		5.7	UNDERSIZE

(1) INCLUDES APRIL 29TH AND 30TH.
(2) THE COMPARISON FOR SIZE IS WITH SURROUNDING PATCH PLANTS OF THE SAME KIND. PLANTS IN TANKS NUMBERS 1 AND 2 WERE UNDERSIZE ALL SEASON. PLANTS IN TANK NUMBER 4 WERE NORMAL SIZE AT BEGINNING OF SEASON.
(3) HEAVY RAINS DERANGED CONDITIONS SO THAT NO RELIABLE RECORD FOR DECEMBER WAS OBTAINED.
(4) ESTIMATED. CLOSELY FOR TANKS NUMBERS 1 AND 4. ROUGHLY FOR TANKS NUMBERS 2 AND 3.

– – 0 – –

TABLE 78

USE OF WATER BY TULES GROWN IN TANKS AT SIMMONS ISLAND, NEAR BAY POINT, 1931

TANK NO.	WATER SURFACE ABOVE GROUND SURFACE FEET	USE OF WATER — ACRE-FEET PER ACRE JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR APPROX.	NUMBER OF STALKS IN JULY*
1	1.0	0.11	0.15	0.23	0.28	0.38	0.48	0.61	0.48	0.43	0.21	0.11	(0.11)	3.58	11
2	0.0	(0.11)	(0.11)	(0.12)	0.14	0.94	0.80	0.59	0.52	0.36	0.22	0.11	(0.11)	4.23	19
3	1.0	(0.11)	(0.15)	(0.28)	0.34	1.01	0.87	0.84	0.67	0.60	0.45	0.29	(0.11)	5.73	35
4	0.0	(0.11)	(0.15)	(0.24)	0.29	0.96	0.89	0.78	0.59	0.54	(0.30)	0.14	(0.11)	5.10	30
MEANS		(0.11)	(0.14)	(0.22)	0.26	0.82	0.76	0.73	0.57	0.48	(0.30)	0.16	(0.11)	4.66	

NOTE: FIGURES IN PARENTHESES ARE ESTIMATED.
* THERE WERE SOME NEW SPROUTS IN ALL TANKS IN JULY.

Technical Memorandum:

Delta Risk Management Strategy (DRMS) Phase 1

Topical Area:
Impact to Infrastructure
Final

Prepared by:
URS Corporation/Jack R. Benjamin & Associates, Inc.

Prepared for:
California Department of Water Resources (DWR)

June 15, 2007

Exhibit 30

7.2 Summary

The total estimated replacement costs for infrastructure assets within the Delta are summarized in Table 7-8 for the current (2005) and 2050 conditions, for MHHW and 100 year inundation levels. This table accounts for infrastructure assets that could be damaged as a result of levee breaching and island flooding (see Section 1.2). The costs are based on the results presented in Tables 7-1, 7-2, 7-4 and 7-5.

Table 7-8 Comparison of Total Replacement Costs of Delta Infrastructure - Current and 2050[a]

Inundation Level	Current (2005)[c]	2050	Cost Ratio: 2050/Current
Within Mean Higher High Water (MHHW) Limits [b]	$6.7 billion	$8.5 billion [e]	1.3
Within 100-year Flood Limits [b,c]	$56.3 billion	$67.1 billion [e]	1.2

[a] Costs in this table are for infrastructure assets and their contents that could be damaged as a result of levee breaching and island flooding.
[b] See Section 4.1.2 and Figure 4-1 for limits of inundation.
[c] Flood plain limits were developed from FEMA Flood Insurance Rate Maps.
[d] Costs are in 2005 dollars.
[e] Costs are in 2005 dollars; not escalated to 2050.

As indicated in Table 7-8, the total replacement cost of assets within the 100-year flood limits significantly exceeds (about 8 times) these costs for assets within the MHHW limits. The reason for this large difference is explained by referring to Figure 4-1. This figure shows that the 100-year flood event has the potential to inundate major urban areas such as Sacramento and Stockton that have a large inventory of infrastructure assets. However, the MHHW limits do not extend to these large urban areas. Smaller towns and rural/agricultural areas mainly fall within the MHHW limits. The largest differences between damages for the 100-year flood event and other events would be for infrastructure that is located near the edge of the floodplain in urban areas (areas with topographic relief).

Table 7-8 also indicates that over the next 50 years, the total replacement cost of assets could increase by about 20 to 30 percent within the MHHW limits and the 100-year flood plain limits. Likewise, the overall damage repair costs of assets as a result of levee failure are also expected to increase over the next 50 years due to the (1) increase in the amount of infrastructure assets as a result of population growth, (2) Delta water level rise due to climate change, and corresponding increase in MHHW and 100-year flood levels, and (3) decrease in island elevation levels due to subsidence. The increase in water levels, coupled with the decreasing island elevations, would increase the amount of inundation of Delta assets in the future. The damage would therefore increase, resulting in greater future repair costs and repair times.

The repair costs for infrastructure assets will be based on the number of island failures and resulting inundation, and the repair costs will vary from island to island. For both current and 2050 conditions, the overall results of the repair and replacement costs presented in the asset tables indicate that the repair costs due to inundation could be on the order of 30 percent (for MHHW) and 50 percent (for the 100-year food) of the asset replacement costs, considering all Delta islands and tracts.

7.3 Limitations

As stated in Section 1.2, we consider damage to infrastructure assets that could result from levee breaching and island flooding. Infrastructure assets that would not be damaged by levee failure (e.g., pumping plants and power plants) are beyond the scope of the TM.

As stated in Section 3, because some asset types lack attribute information, it was not always possible to estimate asset costs from the GIS data. In these cases, there is insufficient definition of quantitative attributes to evaluate reliable replacement and repair costs and assumptions had to be made so that damage loss could be estimated. Also, some assets were not available in the GIS database. Further characterization of the Delta infrastructure assets would reduce the uncertainty in the damage estimates.

Because of the lack of information on repair times (due to the absence of historic experience), especially for multi-island failures, judgment was used to estimate repair times.

8. References

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STATE OF CALIFORNIA
THE NATURAL RESOURCES AGENCY
CENTRAL VALLEY FLOOD PROTECTION BOARD
RESOLUTION NO. 2018-06 FOR
ACCEPTABLE OPERATION AND MAINTENANCE OF THE
STATE PLAN OF FLOOD CONTROL

BACKGROUND:

A. **WHEREAS**, in 1911 the Legislature created the Reclamation Board. The Reclamation Board was given regulatory authority over the Sacramento Valley's levee system and levee maintaining agencies with the objectives of (1) assuring a logical, integrated system for controlling flooding along the Sacramento and San Joaquin Rivers and their tributaries in cooperation with the United States Army Corps of Engineers (USACE), (2) cooperating with various agencies in planning, constructing, operating, and maintaining flood control works, and (3) maintaining the integrity of the flood control system and designated floodways. In 1913 the Reclamation Board was given regulatory authority over the San Joaquin Valley's levee system and levee maintaining agencies. In 2007 the Legislature restructured the Reclamation Board and renamed it as the "Central Valley Flood Protection Board"; and

B. **WHEREAS**, as the non-federal sponsor of the State-federal flood control system in California's Central Valley, the Central Valley Flood Protection Board (Board) has provided the federal government with assurances that the flood control system would be operated and maintained as prescribed by regulations of the Secretary of the Army that require compliance with the USACE Standard Operation and Maintenance (O&M) manuals for the Sacramento River Flood Control Project (1955) and for the Lower San Joaquin River Levees – Lower San Joaquin River and Tributaries Project (1959) pursuant to the authority in California Water Code Section 8617; and

C. **WHEREAS**, pursuant to Section 3 of the Flood Control Act of 1936 and Section 103 of the Water Resources Development Act of 1986 (WRDA 86), non-Federal interests are required to pay 100 percent of the costs of operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of structural flood damage reduction projects. In addition, the USACE has issued a policy guidance memorandum dated August 16, 2005 which states that a project is only eligible for reconstruction assistance from the USACE if a non-federal sponsor has performed adequate maintenance; and

D. **WHEREAS**, the USACE has issued Engineering Regulation (ER) 1110-2-401, dated September 30, 1994 which defines "repair, replacement, and rehabilitation" for projects managed by non-federal sponsors. "Repair" is considered to entail those activities of a routine nature that maintain the project in a well-kept condition. "Replacement" covers those activities taken when a worn-out element or portion thereof is replaced. "Rehabilitation" refers to a set of activities as necessary to bring a deteriorated project back to its original condition; and

E. **WHEREAS**, the legislature granted the Board jurisdiction and authority over the State Plan of Flood Control (SPFC) as denoted in California Water Code, including Section 8534, which requires the Board to enforce on behalf of the State the erection, maintenance and protection of the SPFC which in its judgment will best serve the interests of the State and Section 8608 which requires the Board to establish and enforce standards for the operations and maintenance of the SPFC; and

F. **WHEREAS**, California Water Code Section 12642 states "In all cases where the Federal Government does not maintain and operate projects, it is the responsibility and duty of the county, city, state agency, or public district affected to maintain and operate flood control and other works, constructed pursuant to Chapters 1 and 2 of this part, after their completion and hold and save the State and the United States free from damages."; and

G. **WHEREAS**, California Water Code Section 12828 states "Except where the co-operation required by the United States in addition to the costs of all lands, easements, and rights-of-way, has been authorized to be assumed by the State prior to March 12, 1946, the department shall not reallocate the funds allocated to it, nor shall the Reclamation Board expend any funds appropriated directly to it, for acquisition of property rights or contributions to the United States, for any project for which the Reclamation Board is directed to give assurances to the United States unless and until a public agency other than the Reclamation Board has either assumed the obligations of maintenance and holding the United States harmless from damages due to the construction of works, directly with the United States, or has by binding agreement with the Reclamation Board agreed to assume such obligations and to hold the State and the Reclamation Board harmless from any claims therefor…"; and

H. **WHEREAS**, many local maintaining partners provided assurances to the Board and signed agreements with the Board for continued operation and maintenance prescribed by regulations of the Secretary of the Army for the flood control system in the Central Valley; and

I. **WHEREAS**, in 2005, Hurricane Katrina caused portions of the federal levee system to fail in New Orleans, resulting in significant loss of life and property and subsequently, the USACE embarked upon a nationwide scrutiny of the federal levee system; and

J. **WHEREAS**, after Hurricane Katrina, the people of California recognized the Sacramento-San Joaquin Valley as an area significantly at risk for similar devastation suffered by New Orleans and passed Proposition 1E, which provided $4 billion for flood protection for the Central Valley, which has been utilized over the past 11 years to significantly improve the SPFC facilities in the Central Valley; and

K. **WHEREAS**, the Central Valley Flood Protection Act of 2008 (2008 Act) directed that the Department of Water Resources (DWR) prepare a Central Valley Flood Protection Plan (CVFPP) to be adopted by the Board by July 1, 2012 (CWC § 9612(b)); and

L. **WHEREAS**, DWR prepared a 2017 update to the CVFPP pursuant to the requirements of the 2008 Act. The 2017 update was adopted by the Board through Resolution of Adoption 2017-10 on August 25, 2017; and

M. WHEREAS, through Resolution of Adoption 2017-10, the Board stated the following:

i. That in order to successfully implement the 2017 CVFPP Update, essential and adequate funding is necessary to continue to operate and maintain the flood system, that additional funding is required to correct identified deferred maintenance issues, and that further funding is essential to continue to make vital improvements to California's aging flood system.

ii. That since the adoption of the 2012 CVFPP, the levee inspection reports provided by the USACE indicate severe levee maintenance deficiencies in over 90% of State Plan of Flood Control levee systems.

iii. That it is committed to working with the local maintaining agencies to correct these operation and maintenance deficiencies in order to obtain or regain eligibility for the Public Law 84-99 Rehabilitation Program.

iv. That it acknowledges the importance of all eight key policy issues identified in the 2017 CVFPP Update and will facilitate resolution of these interrelated policy issues with the understanding that the Board has identified funding and operation and maintenance of the flood system as the highest priorities to advance prior to the 2022 CVFPP Update.

N. WHEREAS, through multiple successful Coordinating Committee meetings, the Board has facilitated a discussion regarding the definitions of OMRR&R, including valuable participation by the USACE, maintaining agencies, and stakeholders.

NOW, THEREFORE THE BOARD FINDS:

1. That the above recitals are true and correct.

2. That this Resolution 2018-06 is being adopted by the Board as confirmation of the State's standards for OMRR&R for SPFC facilities. It is also intended to notify all interested parties that the Board will enforce its standards as necessary to fulfill its mandates pursuant to California Water Code and its federal assurances.

3. That the USACE requires that all SPFC facilities be operated and maintained in accordance with the Code of Federal Regulations, Title 33, Section 208.10 (33 CFR 208.10), with federal O&M manuals, in accord with ER 1110-2-401 and that all levee systems pass periodic inspections with acceptable ratings to be eligible for the federal Public Law 84-99 Rehabilitation Program.

4. That except as noted below, the State's priority and long-term goal is for maintaining agencies to substantially improve operation and maintenance practices to reach compliance with all requirements of applicable federal regulations and O&M manuals ensuring eligibility for the federal Public Law 84-99 Rehabilitation Program under current federal interim guidelines. The State does not believe that compliance with the USACE vegetation standards is appropriate or practical within the SPFC in light of

competing interests under the Endangered Species Act and therefore has promoted alternative levee vegetation objectives that require maintaining agencies to instead comply with the State's current levee vegetation management strategy.

5. That the obligation to perform routine operation and maintenance did not change with the addition of 33 U.S.C. 2213 from WRDA1986.

6. That the required operations and maintenance as identified in existing O&M manuals includes "repair, replacement, and rehabilitation" as described in ER 1110-2-401, but does not include reconstruction of a project or project segment that has reached the end of its design service life or is deficient due to a design or construction defect.

7. That many local maintaining agencies have advised the State that lack of sustainable funding is a major hurdle to adequately operate and maintain SPFC facilities.

8. That identifying and securing a sustainable funding source for operation and maintenance of the SPFC is a State priority.

9. That the State is committed to working with the maintaining agencies to correct operation and maintenance deficiencies that will reduce risk to the people and property of the Central Valley, and obtain, regain, and maintain eligibility for the federal Public Law 84-99 Rehabilitation Program.

10. That the State acknowledges the value of maintaining agencies and applauds those agencies which received acceptable ratings. The State appreciates those maintaining agencies that have developed and submitted System Wide Improvement Framework (SWIF) plans.

11. That the State encourages all other maintaining agencies currently not meeting federal Public Law 84-99 Rehabilitation Program eligibility criteria to develop, submit, and adhere to SWIFs as an initial phase to regain eligibility for the federal Public Law 84-99 Rehabilitation Program. As an interim phase of compliance with the requirements of 33 CFR 208.10 and federal O&M manuals, the maintaining agencies may address the unacceptable items identified in the USACE inspection reports that fall within the list of items used to determine Public Law 84-99 eligibility, currently described in the USACE memorandum dated March 21, 2014 with subject line "Interim Policy for Determining Eligibility Status of Flood Risk Management Projects for the Rehabilitation Program Pursuant to Public Law (P.L.) 84-99".

12. The Board will seek to update or execute assurance agreements with local maintaining agencies to standardize such agreements in a manner that explicitly recognizes operation and maintenance requirements include repair, rehabilitation, and replacement as defined in ER 1110-2-~~404~~.
401

NOW, THEREFORE, BE IT RESOLVED, THAT THE BOARD ESTABLISHES THE FOLLOWING POLICIES:

I. Maintaining agencies who have not received acceptable ratings from recent Department inspections, shall make every effort to receive "acceptable" ratings from annual Department inspections.

II. Maintaining agencies shall make every effort to obtain or regain, and maintain, eligibility for the federal Public Law 84-99 Rehabilitation Program, including participating in the federal SWIF program as an initial phase while working toward an interim phase of compliance by addressing the unacceptable items within the USACE's list described in the USACE's interim policy.

III. Maintaining agencies shall make every effort to comply with the State's long-term requirement of full compliance with 33 CFR 208.10 and federal O&M manuals consistent with the State's current levee vegetation management strategy.

IV. Maintaining agencies that are unable to meet OMRR&R requirements shall seek necessary funding to comply with OMRR&R requirements or participate in the federal SWIF program.

V. The State is committed to improving operation and maintenance of SPFC facilities in all areas. Where the State is required to perform OMRR&R, the State shall continue to obtain, regain, and maintain eligibility in the Public Law 84-99 Rehabilitation Program. The State shall also make every effort to address non-compliant encroachments systemwide.

VI. The State will investigate all remedies available to it as authorized by California Water Code, in areas where local maintaining agencies are unable or unwilling to fund proper operation and maintenance practices in compliance with 33 CFR 208.10 and federal O&M manuals.

This resolution shall constitute the written decision of the Board in the matter of acceptable operation and maintenance of the State Plan of Flood Control.

PASSED AND ADOPTED by vote of the Board on Month XX, 2018

William H Edgar

William H. Edgar, President

Jane Dolan, Secretary

State of California

FLOOD HAZARD MITIGATION PLAN

FOR THE

SACRAMENTO-SAN JOAQUIN DELTA

Covering Portions of Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties

---

Disaster Declarations

FEMA [illegible], FEMA [illegible], FEMA [illegible],

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Exhibit 32

State of California

FLOOD HAZARD MITIGATION PLAN

FOR THE

SACRAMENTO-SAN JOAQUIN DELTA

Covering Portions of Contra Costa, Sacramento,
San Joaquin, Solano, and Yolo Counties

Disaster Declarations

FEMA-633-DR, FEMA-651-DR, FEMA-669-DR

FEMA-677-DR

Prepared by

Department of Water Resources
for
Office of Emergency Services

September 15, 1983

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State of California
GEORGE DEUKMEJIAN, GOVERNOR

The Resources Agency
GORDON K. VAN VLECK, Secretary for Resources

Department of Water Resources
DAVID N. KENNEDY, Director

Alex R. Cunningham Deputy Director	Arthur C. Gooch Acting Deputy Director	Howard H. Eastin Acting Deputy Director

CENTRAL DISTRICT

Robert G. Potter . . . . District Chief

This report was prepared under the direction of

Lee W. Carter Chief, Data and Operations Branch

Special thanks are extended to the following people
for their cooperation and expertise given
during the preparation of this report

H. Roger Pulley . . . . Office of Emergency Services
A. J. Brown . . . . Department of Water Resources

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Dante John Nomellini John Wright	Steve Sinnock	Tim Wilson Bill Dutra

Legislative Assistants

Gladys Ikeda . . . . Representing Senator John Garamendi
Salle Jantz . . . . Representing Senator Jim Nielsen

Counties

Jim Dixon . . . . Sacramento County
Peggy Keranen . . . . San Joaquin County

PART I. SUMMARY AND RECOMMENDATIONS

A summary of the State Hazard Mitigation Plan for the Sacramento-San Joaquin Delta is as follows:

A. Short-Term Mitigation Plan

1. By February 1, 1984, the State will give the U. S. Army Corps of Engineers a Letter of Intent to sponsor a federal-state flood control project.

2. The Department of Water Resources will request an increase in funding for the Delta Levee Maintenance Subventions Program from Tidelands Oil revenue beginning in 1984-85 and continuing until a major federal levee rehabilitation project can be implemented.

3. The Department of Water Resources, in cooperation with local districts, will use appropriate construction and maintenance standards for nonproject levees to upgrade these levees to the standards described in the "Short-Term Rehabilitation Plan".

4. The local districts will implement a levee inspection program and file a report by June 1 of each year with the Director of the Department of Water Resources for 1983-84 and 1984-85. The Department of Water Resources will develop a state levee inspection program and request funding for the program beginning in 1984-85.

5. The local districts should complete their annual levee maintenance by November 1.

6. The Department of Water Resources will develop a program to reevaluate land subsidence rates in the Delta and request funding to begin the study in the 1984-85 fiscal year.

7. The local districts should develop and file with the Office of Emergency Services (copy to the Department of Water Resources) an emergency response and evacuation plan by June 1, 1984.

8. The State of California should continue to request emergency declarations for federal assistance for serious levee failures and severe storm damage that occur prior to implementation of a federal-state-local flood control project.

B. Long-Term Mitigation Plan

The State intends to develop a comprehensive federal-state-local flood control project that would consider all islands in the Delta and to seek legislation to finance the nonfederal share.

PART II. INTRODUCTION

A. Background

On February 9, 1983, President Reagan determined that damage resulting from severe storms, flooding, high tides, and wave action in certain areas of California warranted a major disaster declaration under provisions of the Federal Disaster Relief Act of 1974 (Public Law 93-288). This declaration included damage resulting from storms and flooding that took place from November 27, 1982, through March 30, 1983. In a letter dated February 16, 1983, the Federal Emergency Management Agency (FEMA) outlined the terms of the FEMA-State Disaster Assistance Agreement for the major disaster designated FEMA-677-DR. This agreement was executed by the FEMA Regional Director and the Governor. By letter dated March 17, 1983, Amendment No. 1 was added to the agreement to include that portion of the Sacramento-San Joaquin Delta (see Figure 1) located within the counties of Contra Costa, Sacramento, and San Joaquin.

B. Requirement for a Plan

Section 406 of Public Law 93-288 requires, as a condition to receiving federal disaster aid, that repairs be done in accordance with applicable codes, specifications, and standards. It also requires the state or local government recipient of federal aid to evaluate the natural hazards of the area in which the aid is to be used and, if appropriate, take mitigating action.

C. Interagency Flood Hazard Mitigation Report

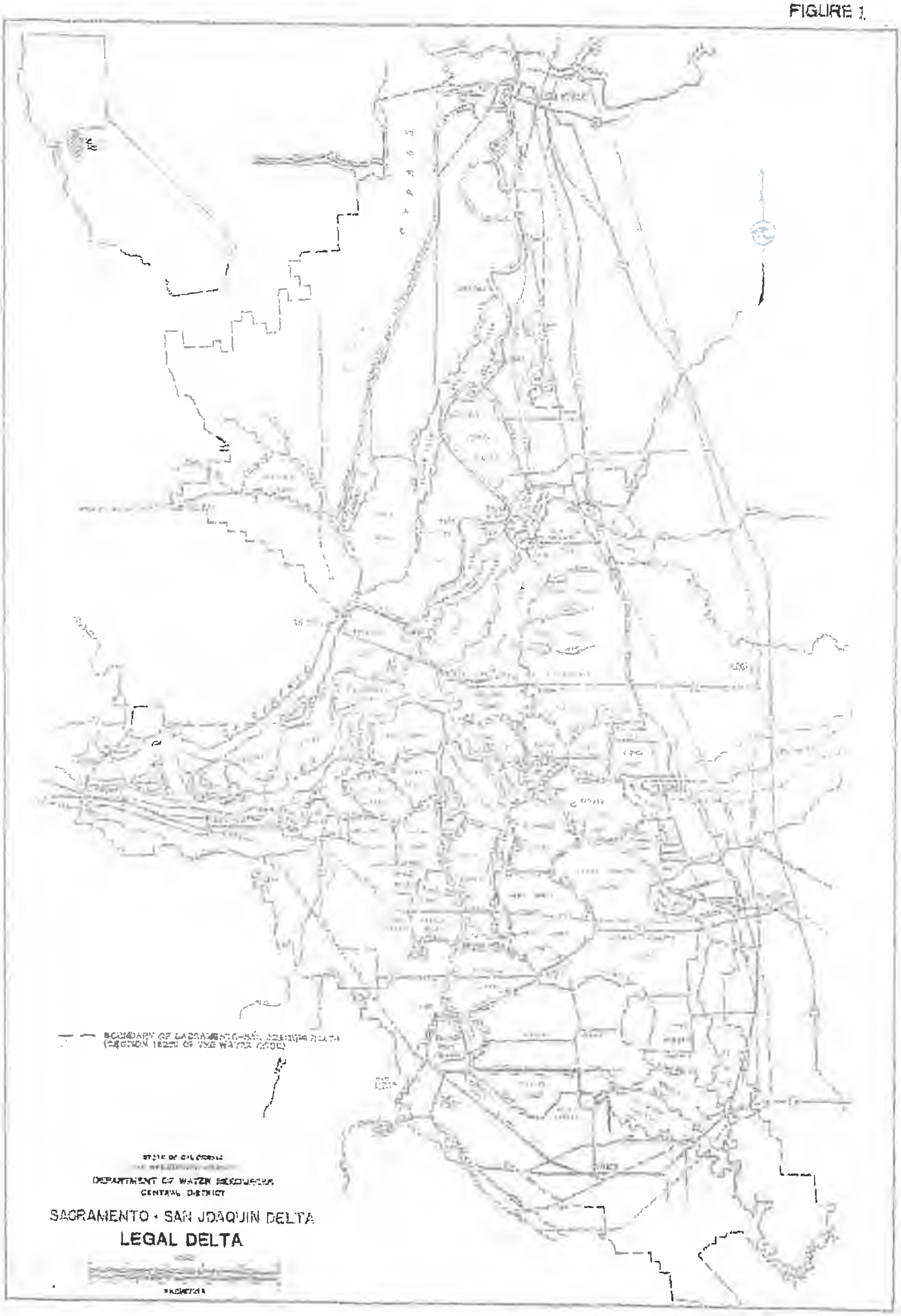
A Federal Interagency Flood Hazard Mitigation Report is prepared by the (federal) Region IX Interagency Flood Hazard Mitigation Team within 15 to 30 days following each presidentially declared major flood disaster. A report covering the recent major disaster, FEMA-677-DR, was dated March 11, 1983. Supplement No. 1 to this report, dated March 24, 1983, made specific recommendations and provided a framework for a State Flood Hazard Mitigation Plan for the Sacramento-San Joaquin Delta.

D. Objective of This Plan

The objectives of this plan are to:

1. Follow up, in detail, recommendations of the Interagency Flood Hazard Mitigation Report.

FIGURE 1


DEPARTMENT OF WATER RESOURCES
CENTRAL DISTRICT
SACRAMENTO - SAN JOAQUIN DELTA
LEGAL DELTA

2. Recommend hazard mitigation alternatives for local, state, and federal agencies.

3. Establish immediate and long-term planning frameworks for implementation of hazard mitigation efforts.

E. Purpose of This Plan

The purpose of this plan is to implement the requirements of Section 406 and the requirements of Amendment No. 1 to the FEMA-State Agreement. Amendment No. 1, Paragraph 10(b), states in part:

> "The State ... will prepare and submit, not later than August 1, 1983, to the Regional Director for concurrence, a comprehensive hazard mitigation plan for the entire Sacramento-San Joaquin Delta area. This plan shall address state, local, private and federal activities and interests as they currently exist, are currently being developed, or are planned. This plan shall also identify major hazard mitigation measures to be taken for each district (applicant), by whom, sources of funding, and schedules for accomplishment. Such measures shall include: (1) establishment of applicable codes, specifications and standards for new construction, repair, and maintenance; (2) upgrading of levees and other related facilities to applicable codes, specifications, and standards; (3) periodic inspections, reports, and follow-up of all levee and related facilities; and (4) correction of maintenance deficiencies."

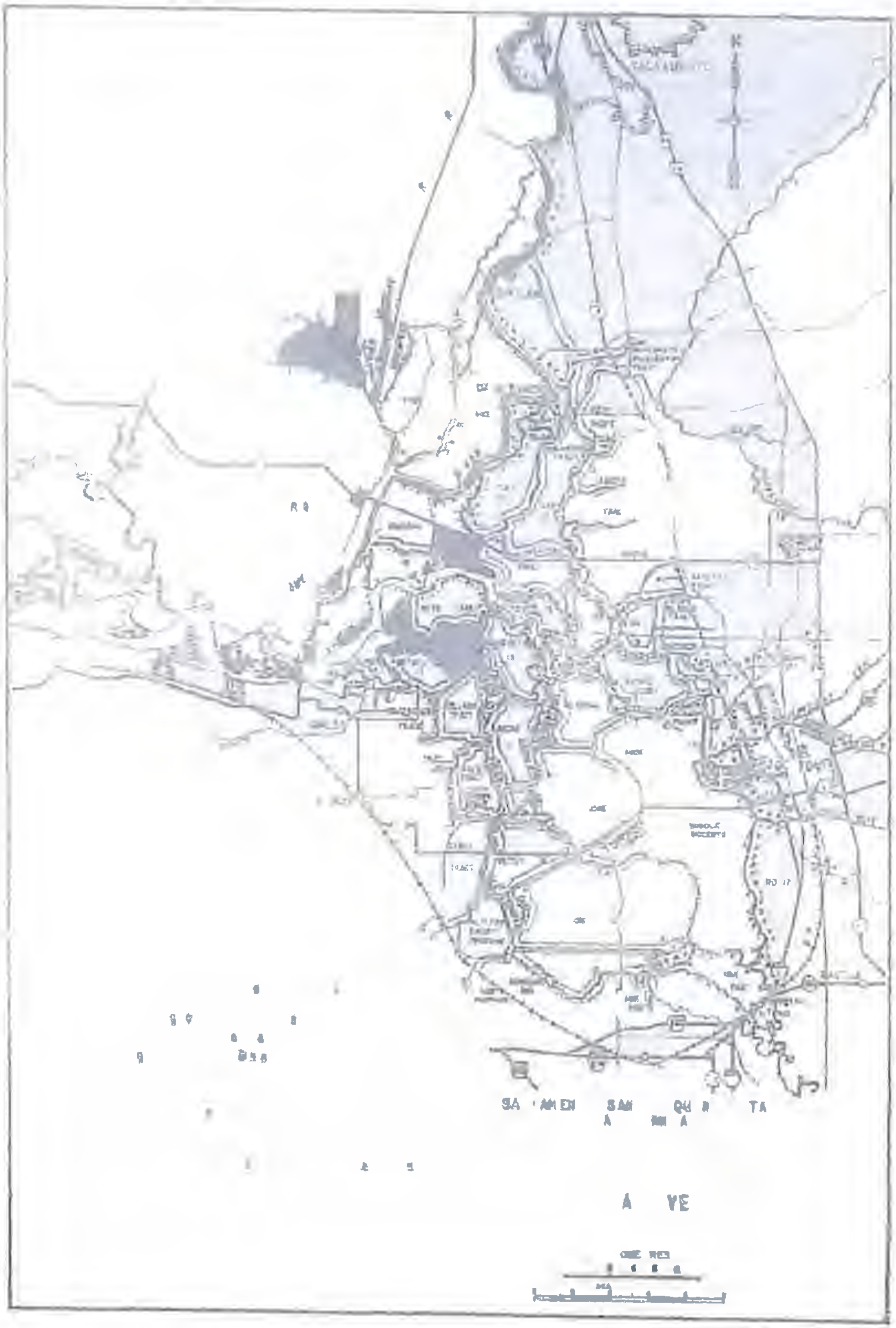
Amendment No. 1, Paragraph 10(b), further states:

> "It is understood that one plan will be submitted which will incorporate the requirements of Section 406 of the Act and which will also satisfy the requirements for major disaster declarations FEMA-633-DR, FEMA-651-DR, FEMA-669-DR, and FEMA-677-DR."

This mitigation plan fulfills these requirements for both nonproject and direct agreement levees in the Delta (see Figure 2).

F. Flood Hazard Mitigation

Flood hazard mitigation is a management strategy in which current actions and expenditures to reduce the occurrence or severity of potential flood disasters are balanced with potential losses from future floods. Flood hazard mitigation can reduce the severity of the effects of flood emergencies on people and property by reducing the cause or occurrence of the hazard, reducing exposure to the hazard, or reducing the effects through preparedness, response, and recovery measures.



Flood hazard mitigation includes such actions as:

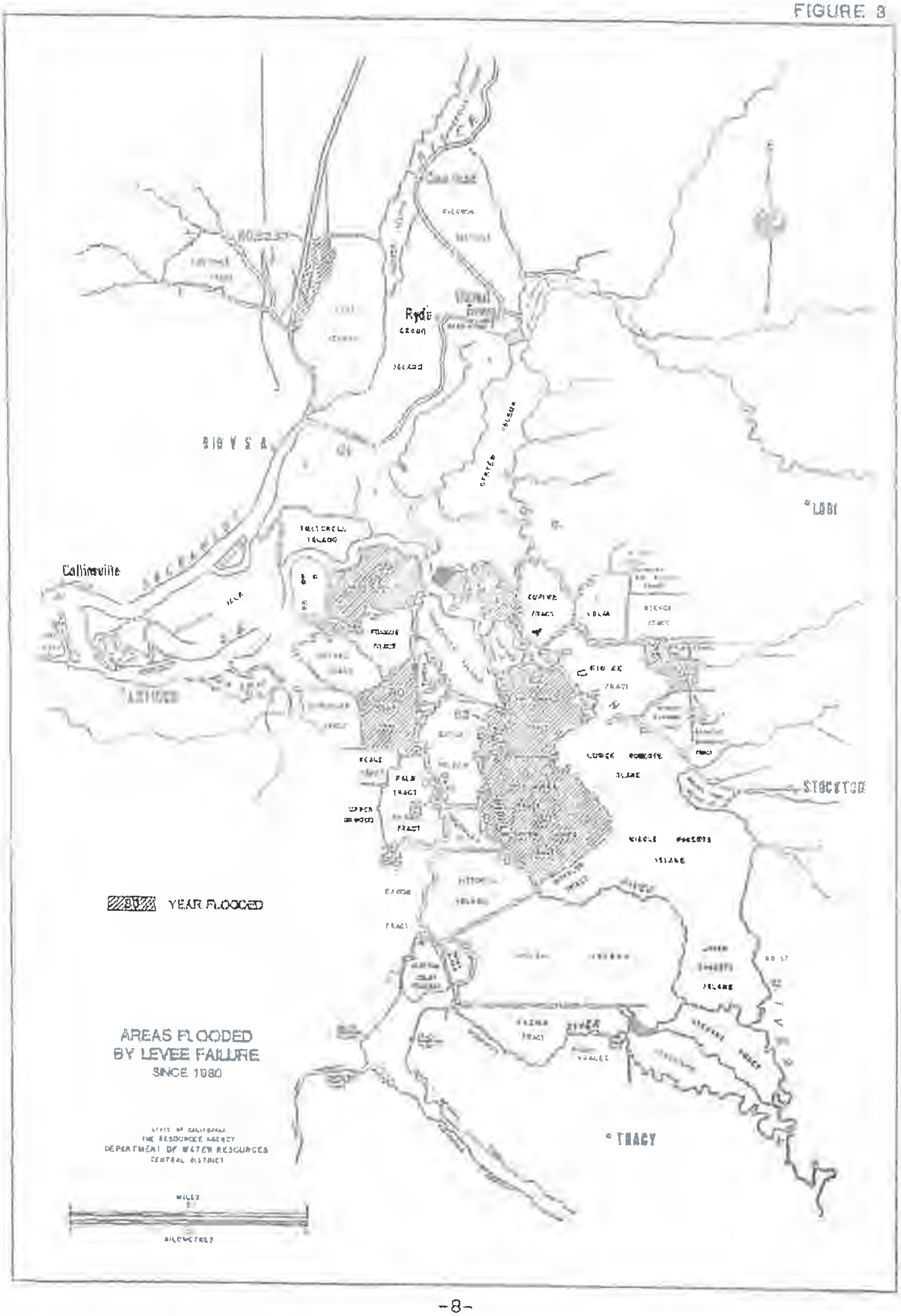
- Minimizing probability of flood occurrence (e.g., restoration of damaged dams and levees, dam safety measures).
- Improving structures and facilities at risk (e.g., flood-proofing, restoring damaged public facilities to meet applicable codes and specifications).
- Identifying hazard-prone areas and standards for prohibited or restricted use (e.g., flood plain regulations, structural and nonstructural floodproofing, hazard mitigation plans).
- Providing loss recovery and relief (e.g., insurance, disaster grants and housing, low interest loans).
- Providing hazard warning and population protection (e.g., procedures for warning, emergency public information, direction and control, protective measures, shelter, relocation, training).
- Considering opportunities for sharing the cost of levee improvements in connection with water transfer plans (see Appendix A).

G. Hazards

Since 1980, levee failures have occurred on 12 of about 60 Delta islands (see Figure 3). Factors that contribute to levee failures include: instability of the levee section and foundation materials; subsidence; rodent burrows; erosion from wind waves and boat wakes; inadequate height (freeboard); seismic activity; and seepage.

Specific locations of levee instability and foundation weakness are difficult to identify because weak areas are not readily apparent from visual inspections. Beaver dens often are not apparent until a portion of the levee collapses. Erosion is more readily apparent and can be corrected if identified. Increased moisture from seepage through and under levees, which reduces the shear strength of the soils and thereby contributes to instability of the levees, may or may not be apparent. It is suspected that, in some areas, dredging soil from the channels as a source of material for bolstering levees has contributed to increased instability, subsidence, and seepage.

Flooding of islands can have several adverse impacts, including temporary detriments to water quality due to ocean water intrusion, increased loss of water by evaporation, increased seepage on islands adjacent to the flooded areas, loss of agricultural land, damage to urban and recreational developments, and fish and wildlife losses.


Ryde
Collinsville
STOCKTON
LODI
TRACY
YEAR FLOODED
AREAS FLOODED
BY LEVEE FAILURE
SINCE 1980
DEPARTMENT OF WATER RESOURCES

PART III. GOVERNMENTAL AND REGULATORY STRUCTURES

A. General

The existing governmental structure could provide necessary assurances to implement a Delta levees mitigation plan, both on a short-term and long-term basis. However, development of a Delta-wide reclamation district with authority to collect revenues, set maintenance standards, provide assurances, set priorities, and carry out maintenance would facilitate completion of a comprehensive Delta levees rehabilitation plan.

B. Local Districts

Essentially all of the islands and tracts in the Delta have an organized district to administer levee maintenance and restoration. Reclamation and levee districts currently have authority to raise funds from three major sources:

1. The districts are empowered under specific Water Code sections to create and update assessment rolls of the lands within their boundaries on which the governing boards can periodically levy assessments.

2. Water Code sections also allow the governing boards of reclamation districts to establish a schedule of charges and fees for services and benefits provided by the districts.

3. Those districts that use county assessment rolls to levy special taxes for levee maintenance continue to receive an allocation under the post-Proposition 13 tax collection by the county, which includes not only property revenues but also state subventions.

Until 1980, funds made available for levee maintenance and restoration from these sources had been relatively small -- less than $1 million per year. Because of the many levee failures since 1980, the local districts have been assessed up to their capability to pay. In fact, because many districts are in debt for money borrowed to repair and restore their levees, their funding capabilities may not be sufficient to accomplish the flood hazard mitigation obligations requested by FEMA.

C. Counties and Cities

The Delta area includes land in five counties: Contra Costa, Sacramento, San Joaquin, Solano and Yolo. These counties are members of a Delta Advisory Planning Council (DAPC); the objective is to provide a unified county position with regard to Delta matters. All five counties are participating in the National Flood Insurance Program.

Counties have the necessary authority to control land use. This authority has been exercised to control urban development in the Delta. Under this plan, counties would continue to exercise land use control as part of their general plan.

A number of cities are located on the periphery of the Delta, including Sacramento, Tracy, Rio Vista, Pittsburg, and Antioch. Their involvement with the nonproject levees in the Delta is minimal. Isleton and the western portion of Stockton are within the Delta and are protected by nonproject levees. The cities, like the counties, have authority to control land use, and all are participating in the National Flood Insurance Program.

D. State of California

Many state agencies have regulatory powers covering the Delta area. The two principal agencies involved in flood control activities are The Reclamation Board and the Department of Water Resources. Other state agencies with vested interests in the Delta include, but are not limited to: Department of Boating and Waterways; Department of Fish and Game; Department of Parks and Recreation; State Lands Commission; and the State Water Resources Control Board, including the Central Valley and San Francisco Bay Regional Water Quality Control Boards.

The Office of Emergency Services administers funds made available under the Natural Disaster Assistance Act, which have been used for flood damage repair in the Delta.

E. Federal Government

Many federal agencies are involved and have some regulatory powers concerning the 700 miles of navigable waterways in the Delta. The principal federal interests in the Delta are with the following agencies: U. S. Army Corps of Engineers; U. S. Bureau of Reclamation; U. S. Department of Commerce, including the National Marine Fisheries Service, U. S. Fish and Wildlife Service, and the U. S. Coast Guard.

The Federal Emergency Management Agency (FEMA) administers disaster relief funds, made available under Public Law 93-288, which have been used for repair of flood damage in the Delta.

PART IV. SHORT-TERM MITIGATION PLAN

A. Policy

Water Code Section 12981 declares State policy to preserve the Delta in essentially its current configuration. Many bills (summarized in Appendix B) have been introduced during the current legislative session to reaffirm or modify this policy. Action on these bills will give legislative direction concerning activities in the Delta.

Rehabilitation of levees around individual islands is still the approach desired by most Delta interests. When practical, this course of action should be pursued.

A two-prong program is needed to reduce levee failures: rehabilitation of levees by adding materials; and improved maintenance of existing levees.

B. Maintenance

1. Responsibilities

The local districts are responsible for the expense and the work involved in correcting maintenance deficiencies. Each district should:

a. Prepare a plan of annual levee maintenance by June 1 of each year describing planned maintenance work and a schedule for its accomplishment.

b. Make a profile of the levee crown not less than every fifth year, or more often if determined necessary by the Board of Trustees of the district (i.e. following severe storms).

c. Adopt an emergency response and evacuation plan to be put into effect when flooding is imminent.

d. Complete annual levee maintenance by November 1 of each year.

2. Mitigation Actions

In general, district maintenance includes, but is not limited to:

a. Controlling encroachments on the levee that might endanger the levee or hinder levee construction and maintenance.

b. Exterminating burrowing rodents and filling their burrows with compacted material.

c. Shaping the levee crown for proper drainage.

d. Repairing minor slipouts, erosion, and subsidence of the levee section.

e. Cleaning drain and toe ditches adjacent to the landside levee toe that intercept seepage.

f. Minor repairing of revetment work or riprap that has been displaced, washed out, or removed.

g. Repairing and shaping patrol and access roads.

h. Controlling the weight and speed of vehicles using roads on levee crowns so as to not exceed the strength of the structural section.

i. Cutting, removing or trimming vegetation such as weeds, brush, and trees to the extent necessary to maintain a safe levee.

j. Removing debris and litter from the levee and berm where it interferes with levee maintenance.

k. Inventorying and inspecting pipes and conduits through the levee (and gates on such facilities) to ensure that they are in working condition.

l. Repairing and maintaining gates necessary to control vehicular traffic on the levees.

C. Rehabilitation

1. Policy

Short-term responsibility for levee rehabilitation remains with the local districts. The cost, however, will be shared by the state and federal agencies and possibly by other beneficiaries of the Delta. Until increased funding is available, the local districts will continue to use funds from their own revenues, the Delta Levee Maintenance Subventions Program, and federal and state disaster assistance programs to rehabilitate the Delta levees.

Dredging material for levee repair or restoration will not be permitted within 135 feet of the centerline of any levee below a depth of minus 35 feet mean sea level. (Ship channels will be considered separately.)

Materials used to repair or restore the levees must allow enough consolidation to minimize erosion during wave and tidal action and rain runoff. Districts will take and record soundings before dredging to be sure depths are adequate for the materials required.

2. Short-Term Levee Rehabilitation Plan

a. Local Districts

Local districts should:

(1) Rehabilitate levees as rapidly as possible, considering engineering, fiscal, and environmental restraints, to the following minimum standards:

(a) Levees shall have 1 foot of freeboard above the flood expected once in 100 years. (It is important to recognize that 1 foot of freeboard at a 100-year flood does not mean 100-year flood protection. Common levee design practice calls for 3 feet of freeboard at project design flood. Also, the uncertainties of Delta levee foundations and unpredictability of Delta tide levels suggest that even with 3 feet of freeboard, the degree of protection would be far less than the design flood frequency.)

(b) The minimum crown width shall be at least 16 feet.

(c) Waterside slopes shall be at least 1.5 horizontal to 1 vertical, with revetment in areas where erosion has been a problem. The size of the revetment material shall be appropriate for the slope.

(d) Landside slopes shall be at least 2 horizontal to 1 vertical, with flatter slopes in the lower portion of the levee in areas where soil stability and seepage have been problems.

(e) The levees shall have all-weather access roads.

(2) Prepare a plan for annual rehabilitation work by June 1 of each year describing rehabilitation work and a schedule for its accomplishment.

b. State of California

(1) By February 1, 1984, the State will give the U. S. Army Corps of Engineers a Letter of Intent to sponsor a federal-state flood control project.

(2) The Department of Water Resources will recommend to the State Legislature increased funding of the Delta Levee Maintenance Subventions Program to $10 million per year from Tidelands Oil revenues, to begin in the 1984-85 fiscal year and continue until a federal-state flood control project is implemented. The Department will also recommend to the State Legislature that the cost sharing formula be changed so that the State would pay 75 percent and the local districts 25 percent of the cost of levee rehabilitation work done under the program.

(3) The Department of Water Resources will request funding for an annual Delta levee inspection program to begin in the 1984-85 fiscal year. Until funds are made available for a state inspection program, the local district's engineer should make a joint inspection with district representatives and submit a summary of work to be completed for the year, present condition of the levees, mitigation measures to be performed the following year, and a reevaluation of natural hazards affecting the district. This summary report should be submitted to the Director of the Department of Water Resources by June 1 of each year.

(4) By April 1984, the Department of Water Resources, working with representatives of local districts, will develop criteria for using soils from the channels as a source of material for bolstering levees. These criteria will reduce the hazard to levees due to this practice.

(5) The Department of Water Resources will request funds in the 1984-85 fiscal year to initiate a program to reevaluate the rate of subsidence in the Delta.

PART V. LONG-TERM MITIGATION PLAN

A. Policy

The long-term mitigation plan is to implement a major levee rehabilitation project within 20 years. The State supports the concept of a System Plan as described in the Corps' Draft Feasibility Report, dated October 1982, and in the Department's Bulletin 192-82, Delta Levees Investigation, dated December 1982, with the understanding that the local districts may complete construction necessary to comply with Federal flood control standards on some islands before a federal flood control project is implemented. All islands should be included in the System Plan for stage construction, as recommended in the Corps' plan.

B. Long-Term Levee Rehabilitation Plan

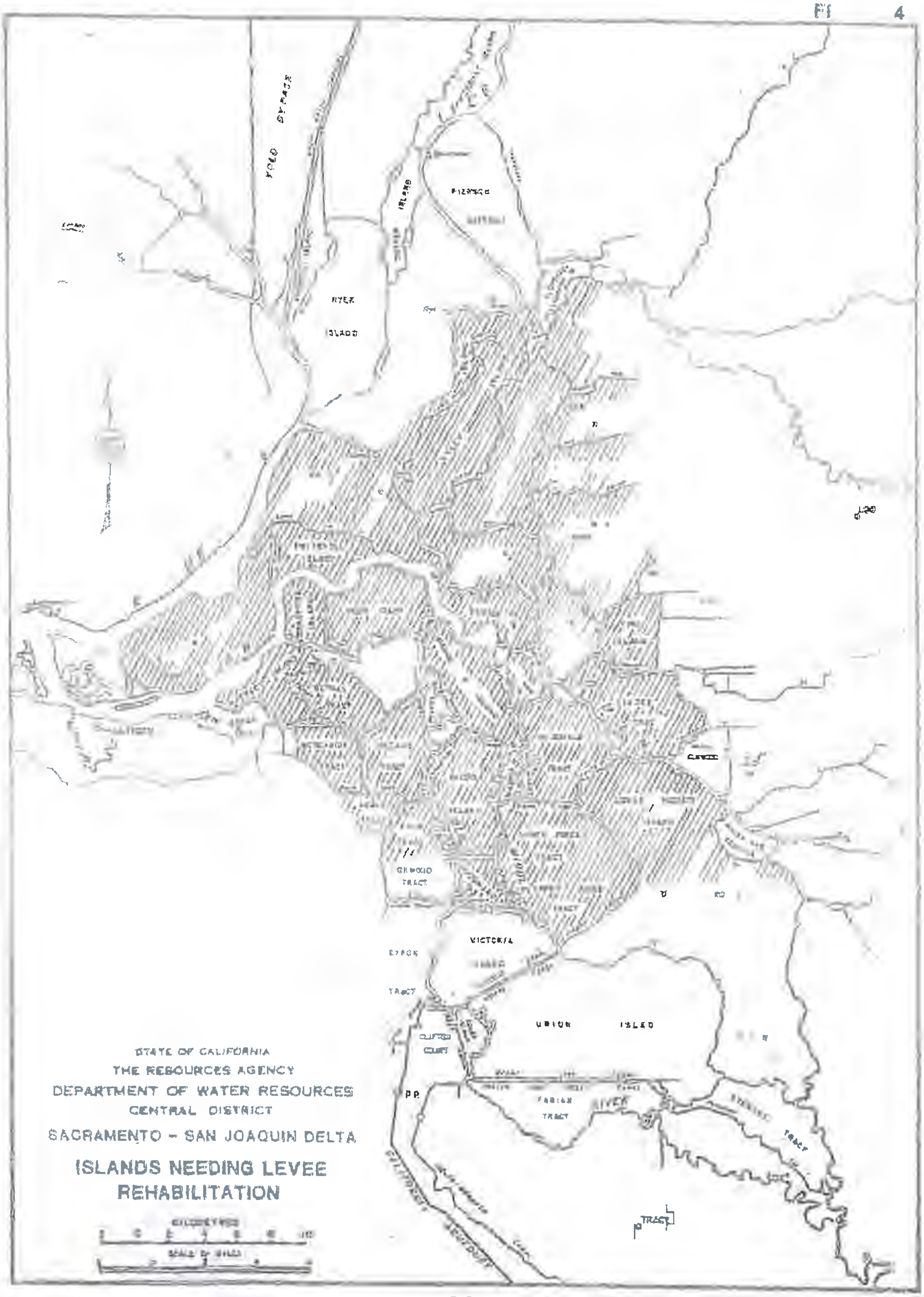
Based on current information, the following islands and tracts are considered to have the most urgent need of levee rehabilitation:

Andrus-Brannan	Hotchkiss	Rindge
Bacon	Jersey	Roberts, Lower
Bethel	Jones, Lower/Upper	Sherman
Bouldin	King	Staten
Brack	Mandeville	Terminous
Bradford	McDonald	Twitchell
Canal Ranch	Medford	Tyler
Dead Horse	Mildred	Venice
Empire	New Hope	Webb
Holland	Palm	Woodward

This list will probably change during the advanced planning stages of the project. (These tracts are shown in Figure 4.)

A joint state-federal levee rehabilitation project requires state legislative and congressional authorizations, funding for detailed planning, and funding for construction. Completion of these actions is expected to take from six to ten years. It is assumed that the funding would be at least 65 percent federal and that the nonfederal funding requirements would be shared 50 percent state and 50 percent local.

In some instances, individual districts have an insufficient economic base to provide even 15 to 20 percent of the cost of modernizing and protecting the island system. In these situations, consideration will be given to a greater State share of such costs, to be reimbursed from subsequent sale or transfer of property rights or value to the State. As an example, public acquisition of land for use in a wildlife management or


STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
CENTRAL DISTRICT
SACRAMENTO – SAN JOAQUIN DELTA
ISLANDS NEEDING LEVEE
REHABILITATION
VICTORIA
UNION ISLAND
FABIAN
TRACT
RYER
ISLAND

recreational program or acquisition of a flooded area for use as a reservoir as part of the State Water Project and Central Valley Project.

Cost sharing and funding must be resolved by the Congress and the State Legislature. The local share would be assigned to the individual districts in proportion to the cost to provide flood control to the island represented by the particular district.

PART VI. FUNDING SOURCES

A. General

All plans to preserve the Delta will require large increases in funding for levee rehabilitation.

B. Short-Term Levee Rehabilitation Plan

1. Local Districts

For the 1983-84 fiscal year, the local districts will continue to use their own revenues, supplemented by State contributions under the Delta Levee Maintenance Subventions Program (presently budgeted at $1.5 million per year), and funds made available under the federal and state disaster assistance programs.

2. State of California

A number of legislative bills under consideration include proposals for increases in funding for the Delta Levee Maintenance Subventions Program. Pending action on these bills, the Department of Water Resources will recommend to the Legislature:

a. An increase in funding for this program, beginning with the 1984-85 fiscal year, to a level of $10 million per year from Tidelands Oil revenues; and

b. A change in the formula for State participation to allow 75 percent State funds with 25 percent local matching funds to upgrade existing Delta levees.

3. Department of Water Resources

The Department of Water Resources will also request special language in a federal-state flood control project authorization that would allow credit to the State and to local districts for work done toward upgrading levees to federal standards before implementation of a federal-state-local flood control project.

C. Long-Term Levee Rehabilitation Plan

A U. S. Army Corps of Engineers report, "Draft Feasibility Report and Draft Environmental Impact Statement, Sacramento-San Joaquin Delta, California", October 1982, indicates federal interest in a Delta flood control project. Although the percentage of federal participation must be determined by the

Congress, the long-term mitigation plan for the Delta contemplates a federal-state-local sharing of costs for levee rehabilitation.

California has traditionally shared in the costs of federal flood control projects. The State is now contributing 75 percent and local flood control agencies are required to contribute 25 percent of the land, easement, and right-of-way costs of federal projects.

The federal government has traditionally paid 100 percent of the construction costs for flood control. Local agencies have been responsible for 100 percent of the cost of operating and maintaining flood control facilities. The Corps of Engineers' Draft Feasibility Report assumes the traditional federal-nonfederal cost sharing relationships.

Chapter 5 of the Emergency Delta Task Force report, dated January 12, 1983, also recommends a cost sharing plan that follows the traditional relationships, but it suggests that boating and commercial shipping should share in the nonfederal flood control costs. The report found that local districts are capable of raising from 15 to 20 percent of the necessary funds for levee rehabilitation projects. It is planned that the State and the local districts will equally share the nonfederal cost of a federal flood control project.

D. Nonfederal Funding

Without federal participation in a Delta levees flood control project, the state would be the logical level of government to implement a levee rehabilitation program. Special bond issues might be necessary to supplement the available Tidelands Oil and other State revenues to finance a long-term Delta levees rehabilitation project.

APPENDIX A

RELATIONSHIP OF DELTA LEVEES PLAN TO A WATER TRANSFER PLAN

The Delta is a point of diversion for both the Federal Central Valley Project and the State Water Project for exporting water to areas in California south and west of the Delta. The State's proposal for a Peripheral Canal to move water in an isolated channel across the Delta was rejected by the voters in June 1982. The State must now develop alternative methods for transferring water across the Delta. Some alternative Delta water transfer plans would require channel enlargements and levee setbacks in the South Fork Mokelumne River and channel enlargements near Clifton Court Forebay. To the extent that these enlargements and levee setbacks coincide with plans for levee rehabilitation, there would be an opportunity for cost sharing between the two projects.

In some areas, levee failures could be detrimental to water transfer operations. In these situations, cost sharing among various beneficiaries should be considered, up to an equitable amount of the benefits derived from the levee improvements.

APPENDIX B

LEGISLATIVE BILLS

Bill and Author	Subject
AB484 - Isenberg	Approve plan set forth in Bulletin 192-82
AB758 - Costa	Include New Hope Cross Channel in State Water Project Facilities
AB857 - Bradley	Immune State from liability in repairing Delta levees
AB1300 - Isenberg	Require exporters of water to enter into contracts with public agencies in Delta
AB1325 - Bradley	Prohibit expenditure for levee repair until cross-Delta water facilities are authorized
AB1607 - Waters	Approve Corps' System Flood Control Plan and authorize DWR to undertake work in advance of federal authorization
AB1612 - Waters	Require DWR to be project sponsor of federal flood control plan; request adoption of Modified System Plan
AB1712 - Johnson	Require plans compatible with Emergency Delta Task Force plan; appropriate $10 million from ERF funds to DWR for program
AB1731 - Costa	Nonsubstantive change in Central Valley Project Act
AB2112 - Isenberg	Require DWR to develop and submit to Reclamation Board recommended levee reconstruction standards and establish a yearly levee inspection program
AB2124 - Campbell	Create Delta Levee Maintenance Fund and deposit a percentage of fishing and hunting license fees, vessel registration fees, and motor vehicle fuel license taxes attributable to vessels
SB15 - Ayala	Authorize additional State Water Project facilities; create a Delta Levee Maintenance Fund; allocate $25 million from Long Beach Oil and Dry Gas revenues to the fund
SB834 - Nielson	Convey title to swamp and overflow lands to purchaser of land including berms and borrow pits

MARCH 2020 LEVEE SUPERINTENDENT 1608 JOE BRYSON

1. Levee patrol and inspection 00+ thru 180+, removed trash from Plymouth gate. Started pumps four times and cleaned area.
2. Many calls from home owners regarding docks during the sediment removal project Five Mile Slough and Nutra.
3. Mr. Staniec, 6347 Embarcadero Drive, rebuilt the fence from his yard to the Marina.
4. The cement pad looks great. We are waiting for flood fight container.
5. PG&E sent a crew out to remove large palm tree at the last house on Five Mile Slough. It caused a fire last year.
6. We repaired homemade steps Seagull fence.
7. We have a market for our empty five gallon buckets. Farmers
8. The bike we keep at the storage area was stolen.
9. We have gophers North West and North East levee.
10. PG&E pruned trees Seagull and Swain, East of I-5. A.H. Call
11. Dino working on gates South West levee.
12. Children are still doing damage at the weird.
13. They are removing hyacinth from Five Mile Slough, looks good. Should be done this month.
14. I removed a 4'x5' white plastic, what I thought was a table cloth from North East Plymouth gate. It was the cover to my neighbor stolen golf cart
15. We have a young fox on North West levee.
16. KSN called. We are starting our annual inspection.

Reclamation District 1608
List of Bills for Approval at March 4, 2020 Meeting

NAME	Date	INVOICE #	AMOUNT	TOTAL $	WARRANT #	CHECK #	SUBVENTION FUND
Michael Panzer (3/4/20 Board Mtg)		Trustee Fee	$246.75				
SJAFCA/RD Meeting Attendance	2/19/2020		$246.75				
				$493.50	6297		
Brett Tholborn (3/4/20 Board Mtg)		Trustee Fee	$246.75				
				$246.75	6298		
Dan MacDonnell (3/4/20 Board Mtg.)		Trustee Fee	$246.75				
				$246.75	6299		
Elvia Trujillo	February 2020	Secretary Fee	$935.00				
				$935.00	6300		
Jean Knight	February 2020	Consultant Secretary	$242.95				
				$242.95	6301		
Neumiller & Beardslee	2/18/2020	305444	$2,639.90				
				$2,639.90	6302		
Kjeldsen, Sinnock & Neudeck	2/24/2020	27140	$1,636.73				
	2/24/2020	27141	$1,295.00				
	2/24/2020	27142	$2,030.60				
	2/24/2020	27143	$1,665.43				
	2/24/2020	27144	$397.50				
	2/24/2020	27145	$26,855.50				
	2/24/2020	27146	$750.00				
	2/24/2020	27147	$813.00				
				$35,443.76	6303		
PG&E (Landview & Seagull)	3/2/2020	0950847867-5	$11.15				
PG&E (Stone River)	2/21/2020	2999432760-8	$10.45				
				$21.60	6304		
CCVFCA (2020 Flood Forum Registration Fee for D MacDonnell)	2/26/2020	3662	$55.00				
				$55.00	6305		

Reclamation District 1608

List of Bills for Approval at March 4, 2020 Meeting

Reclamation District 1608			$40,000.00				
(Transfer to Checking Account)				**$40,000.00**	6306		
State of California Payroll Taxes			$463.56				
				$463.56		online	
Federal Government Payroll Taxes			$2,119.31				
				$2,119.31		online	
Bank of Stockton Visa	2/18/2020	12/28/2019 - 1/27/2020	$8,910.96				
				$8,910.96		online	
William M. Lipp	Payroll	2/1/2020 - 2/15/2020	$690.61				
				$690.61		1452	
Hector Bryan Kendall	Payroll	2/1/2020 - 2/15/2020	$75.36				
				$75.36		1453	
William M. Lipp	Payroll	2/16/2020 - 2/29/2020	$501.51				
				$501.51		Direct Deposit	
Joe L. Bryson (Payroll)	Payroll	2/1/2020 - 2/29/2020	$4,407.84				
				$4,407.84		Direct Deposit	
		WARRANT TOTAL:		**$80,325.21**			
		CHECKING TOTAL:		**$17,169.15**			
		TOTAL BILLS PAID		**$97,494.36**			

Reclamation District 1608

List of Bills for Approval at February 14, 2020 Meeting

NAME	Date	INVOICE #	AMOUNT	TOTAL $	WARRANT #	CHECK #	SUBVENTION FUND
Michael Panzer (2/14/20 Board Mtg)		Trustee Fee	$246.75				
				$246.75	6287		
Brett Tholborn (2/14/20 Board Mtg)		Trustee Fee	$246.75				
				$246.75	6288		
Dan MacDonnell (2/14/20 Board Mtg.)		Trustee Fee	$246.75				
				$246.75	6289		
Elvia Trujillo	January 2020	Secretary Fee	$972.50				
				$972.50	6290		
Jean Knight	January 2020	Consultant Secretary	$125.00				
				$125.00	6291		
Neumiller & Beardslee	1/15/2002	304748	$4,704.15				
				$4,704.15	6292		
Kjeldsen, Sinnock & Neudeck	1/27/2020	26944	$1,500.00				
	1/27/2020	26945	$1,224.75				
	1/27/2020	26946	$1,439.00				
	1/27/2020	26947	$971.25				
	1/27/2020	26948	$1,810.00				
	1/27/2020	26949	$14,067.58				
	1/27/2020	26950	$695.00				
	1/27/2020	26951	$2,086.50				
				$23,794.08	6293		
PG&E (Landview & Seagull)	1/30/2020	950847867-5	$10.45				
PG&E (Stone River)	1/22/2020	2999432760-8	$12.57				
				$23.02	6294		
California Association of Mutual	1/15/2020	1253	$100.00				
Water Companies (Membership Dues)				**$100.00**	6295		
Halverson Concrete	Jan-20	767702	$16,999.00				
				$16,999.00	6296		

Reclamation District 1608

List of Bills for Approval at February 14, 2020 Meeting

State of California Payroll Taxes			$641.57				
				$641.57		online	
Federal Government Payroll Taxes			$1,898.18				
				$1,898.18		online	
Bank of Stockton Visa			$3,362.04				
				$3,362.04		online	
Hector Bryan Kendall	Payroll	1/1/2020 - 1/15/2020	$349.41				
				$349.41		1450	
Hector Bryan Kendall	Payroll	1/16/2020 - 1/31/2020	$349.42				
				$349.42		1451	
Joe L. Bryson (Payroll)	Payroll	1/1/2020 - 1/31/2020	$4,430.90				
				$4,430.90		Direct Deposit	
		WARRANT TOTAL:		**$47,458.00**			
		CHECKING TOTAL:		**$11,031.52**			
		TOTAL BILLS PAID		**$58,489.52**			

RECLAMATION DISTRICT 1608
FINANCIAL REPORT - MARCH 4, 2020
% OF FISCAL YEAR ELAPSED THROUGH FEBRUARY 29, 2020 - 66.67%

Budget Item	Budget Amount	Expended MTD	Expended YTD	% YTD
Operations & Maintenance Expenses				
Levee Superintendent	$70,500.00	$6,240.00	$50,473.80	71.59%
Part Time Employees	23,000.00	1,387.50	10,389.00	45.17%
Payroll Taxes and Expenses	23,000.00	630.69	7,753.49	33.71%
Fences & Gates	50,000.00	0.00	25,534.07	51.07%
Locks & Signs	1,500.00	443.86	443.86	29.59%
Weed and Rodent Control & Clean up	14,000.00	0.00	887.64	6.34%
Levee Repair Fund (General Operations & Maintenance)	50,000.00	1,303.89	50,383.92	100.77%
Levee Repair Fund (Levee Capital Improvement Projects)	100,000.00	0.00	0.00	0.00%
Special Projects (Sediment Removal Project)	0.00	0.00	0.00	0.00%
Pump System Maintenance	2,000.00	21.60	204.32	10.22%
Wireless Services (Cell and Mobile Computer)	1,800.00	120.08	1,885.77	104.77%
Emergency Equipment & Supplies	1,000.00	0.00	0.00	0.00%
Garbage Service	5,500.00	594.98	2,191.08	39.84%
District Vehicle (Fuel, Maintenance and Repairs)	3,500.00	320.57	2,854.14	81.55%
TOTAL	**$345,800.00**	**$11,063.17**	**$153,001.09**	**44.25%**
General Expenses				
Trustee Fees	$9,500.00	$987.00	$6,662.25	70.13%
Secretary Fees	10,000.00	1,177.95	8,194.47	81.94%
Office Expenses (incudes storage facility)	1,000.00	0.00	563.74	56.37%
General Legal	55,000.00	2,639.90	23,698.79	43.09%
Audit	4,200.00	0.00	185.00	4.40%
County Administration Costs	7,250.00	0.00	4,618.36	63.70%
Property and Liability Insurance	9,500.00	0.00	100.00	1.05%
Workers Compensation Insurance	8,000.00	472.92	3,783.36	47.29%
Election Costs	26,000.00	0.00	17,956.43	69.06%
Newsletters & Public Communications	12,000.00	55.00	7,634.66	63.62%
TOTAL	**$142,450.00**	**$5,332.77**	**$73,397.06**	**51.52%**
Engineering Expenses				
General Engineering	$22,000.00	$2,034.23	$13,986.79	63.58%
Plan Review Engineering	40,000.00	1,665.43	12,922.80	32.31%
Administration of Delta Levee Subventions Program	25,000.00	1,295.00	15,489.64	61.96%
Periodic Levee Property Inspections and Surveys	25,000.00	0.00	0.00	0.00%
Routine Levee Maintenance Consultation	10,000.00	813.00	9,218.55	92.19%
Engineering, Mgmnt & Inspection of Capital Imp. Projects	35,000.00	2,030.60	2,030.60	5.80%
DWR 5 Year Plan	50,000.00	750.00	4,463.75	8.93%
Miscellaneous Expenses (e.g. travel)	0.00	0.00	0.00	0.00%
Assessment Engineering	2,100.00	0.00	1,226.44	58.40%
Sediment Removal Project	200,000.00	26,855.50	56,517.82	28.26%
TOTAL	**$409,100.00**	**$35,443.76**	**$115,856.39**	**28.32%**
Warrant Interest Expenses				
Warrant Interest Expense	$0.00	$0.00	$0.00	0.00%
TOTAL	**$0.00**	**0.00**	**$0.00**	**0.00%**
TOTAL EXPENDITURES	**$897,350.00**	**$51,839.70**	**$342,254.54**	**38.14%**

Budget Item	Anticipated Income	Income MTD	Income YTD	% YTD
Income				
Property Taxes	$208,120.00	$0.00	$129,824.67	62.38%
Interest Income	23,000.00	0.00	31,834.00	138.41%
Interest Income - DWR - 5 Year Plan		0.00	352.00	
Assessments	298,000.00	0.00	164,069.59	55.06%
Subvention Reimbursement	200,000.00	0.00	0.00	0.00%
Other Reimbursable Expenses	50,000.00	0.00	0.00	0.00%
Totals	**$779,120.00**	**$0.00**	**$326,080.26**	**41.85%**
Cash On Hand				
Cash Balance as of July 1, 2019			$2,188,490.31	
Revenues (YTD), as of January 31, 2020			327,446.26	
Bank of Stockton Account Balance - February 29, 2020			24,355.97	
Expenses (YTD), as of January 31, 2020			343,257.73	
TOTAL CASH			**$2,197,034.81**	
Cash On Hand (Exclusive of Reserves)			**$2,197,034.81**	
Reserves				
Capital Improvement Reserve			$500,000.00	
Board-Designated Reserve			900,000.00	
5-Year Plan PFA			**$37,500.00**	
Progress Billing No. 1 Transfer fo Funds		**$4,323.73**	**$33,176.27**	

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