Hydrodynamic Issues Related to Options for Through-Delta Conveyance

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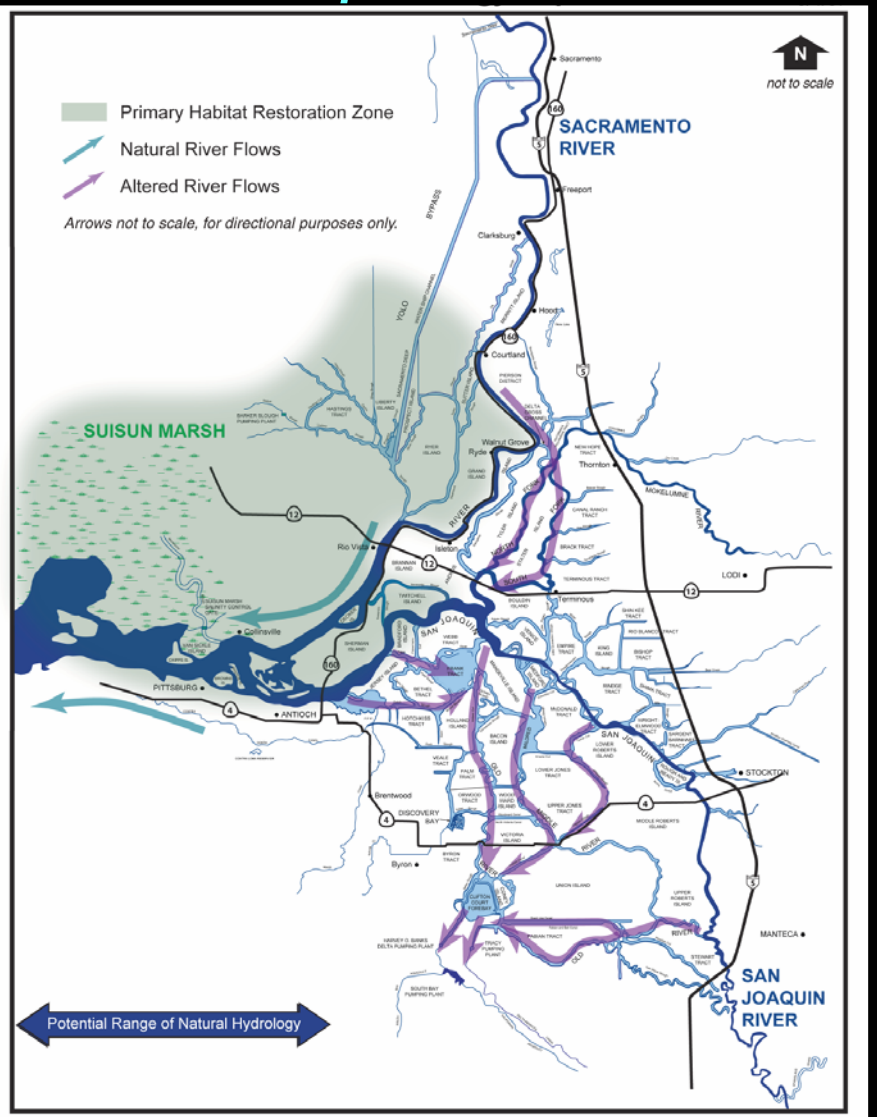
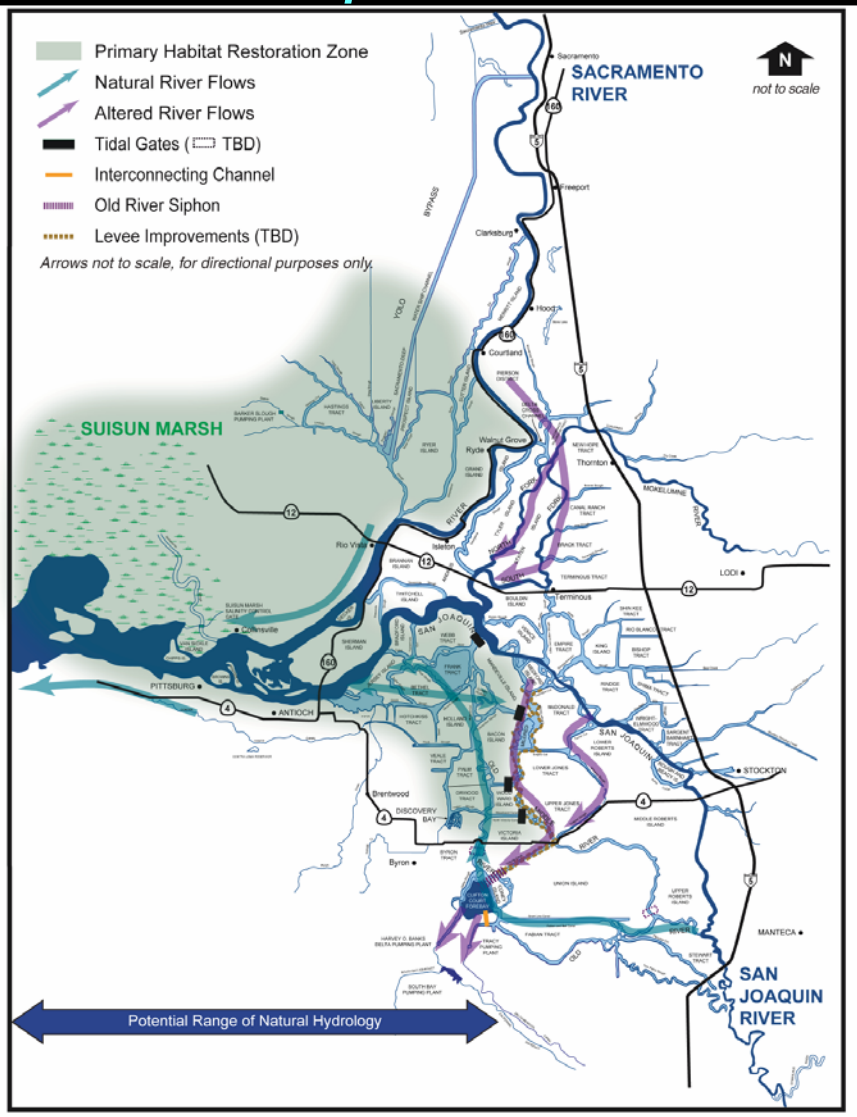
CalFed Science Program Workshop #2
Through-Delta Conveyance
Tuesday September 11, 2007

BDCP Conservation Strategy Options for Through-Delta Conveyance

Option 1



Option 2



Water conveyance methods:

- *Option 1:* Continued conveyance using the existing Delta channels in combination with export operations of the SWP and CVP facilities that draw water at times with the least adverse affects on covered fish species.

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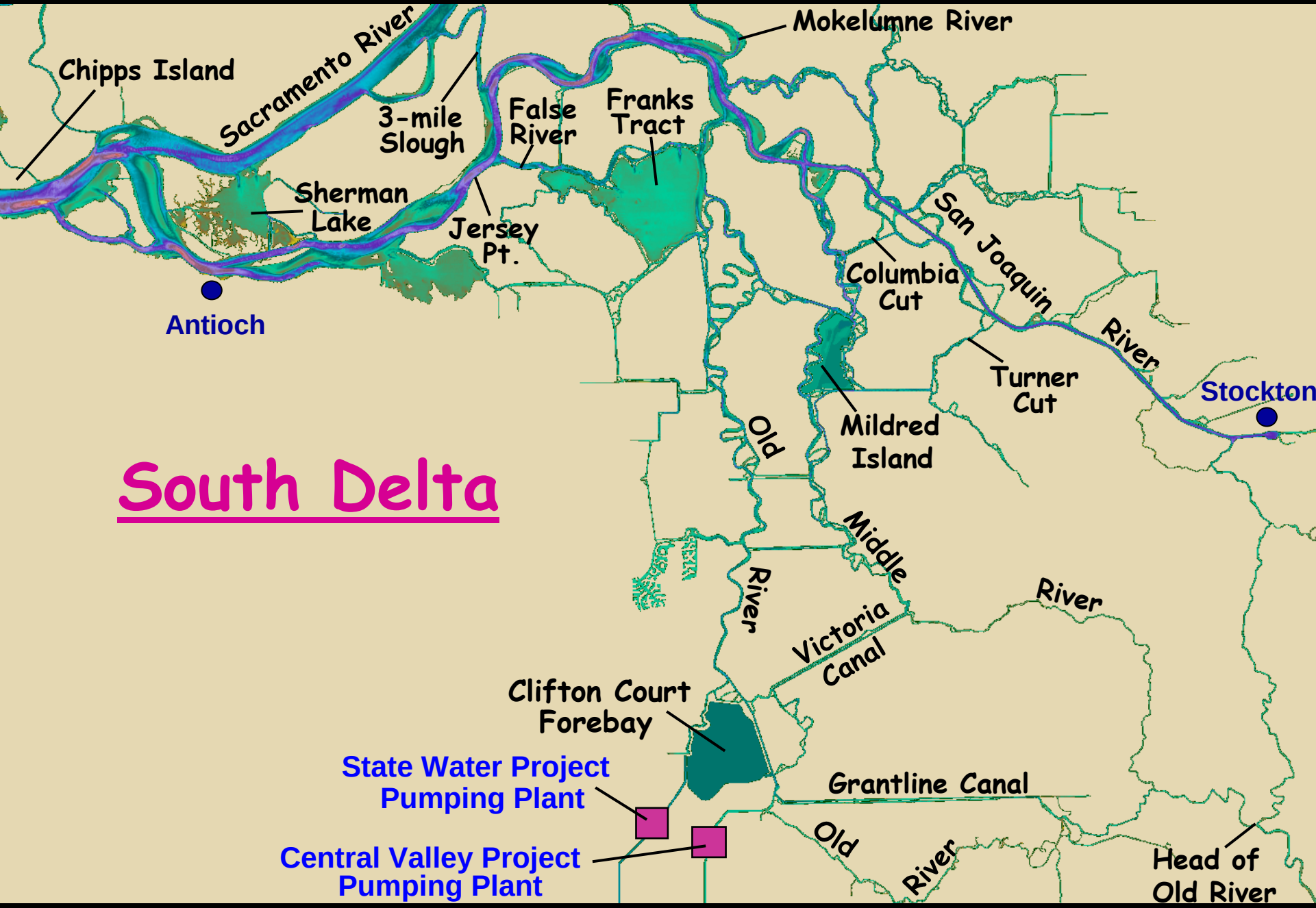
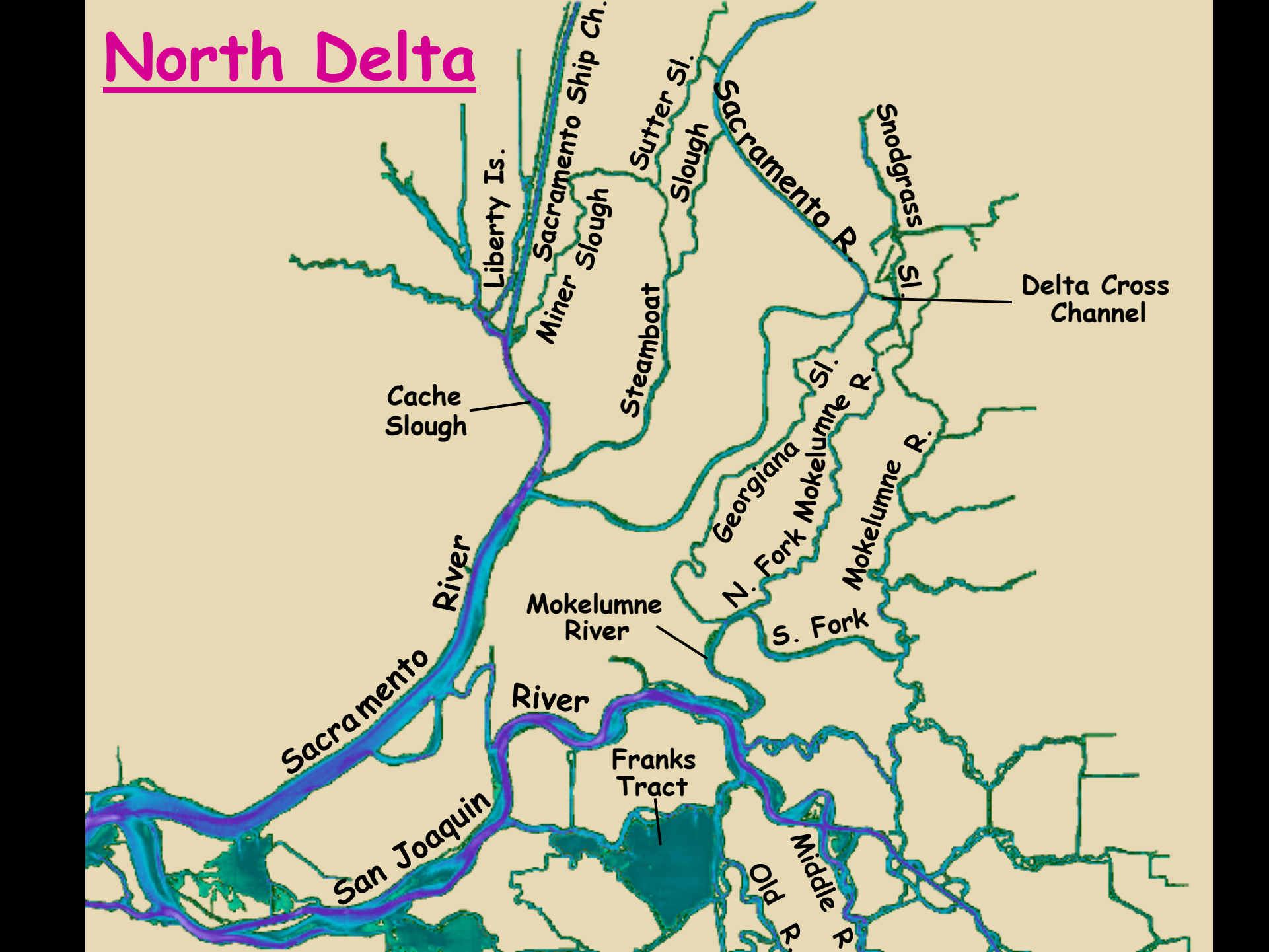
- *Option 1:* Continued conveyance using the existing Delta channels in combination with export operations of the SWP and CVP facilities that draw water at times with the least adverse affects on covered fish species.

- *Option 2:* Construction and operation of a series of physical channel barriers or tidal gates, siphons, and a hydraulic inter-tie designed to separate hydrodynamic conditions between Old and Middle Rivers to accomplish greater hydraulic residence time and improve habitat conditions within Old River and portions of the western-central Delta while using the Middle River channels as the primary water conveyance facilities to the existing SWP and CVP export facilities.

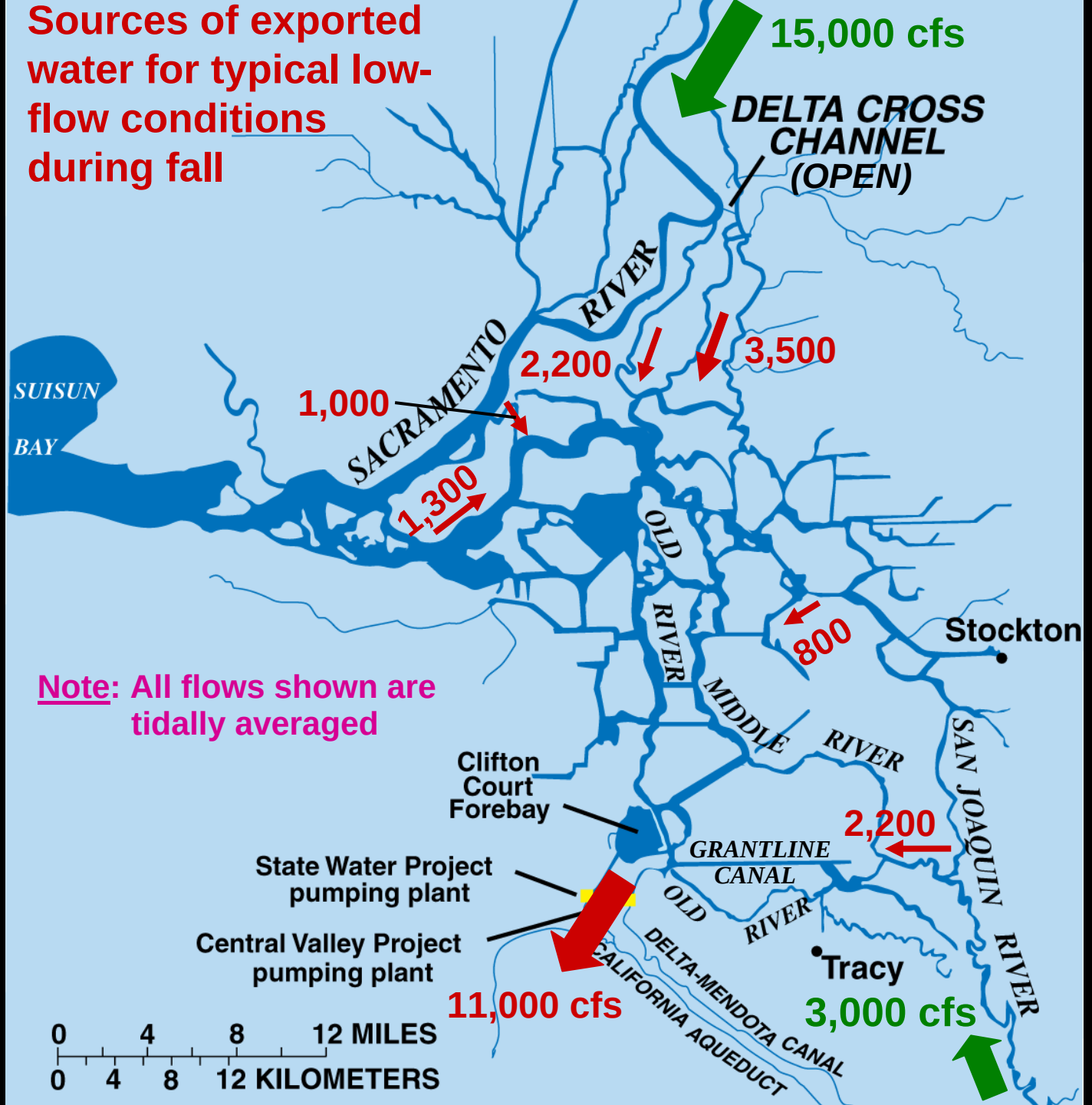
Water conveyance methods: (short form)

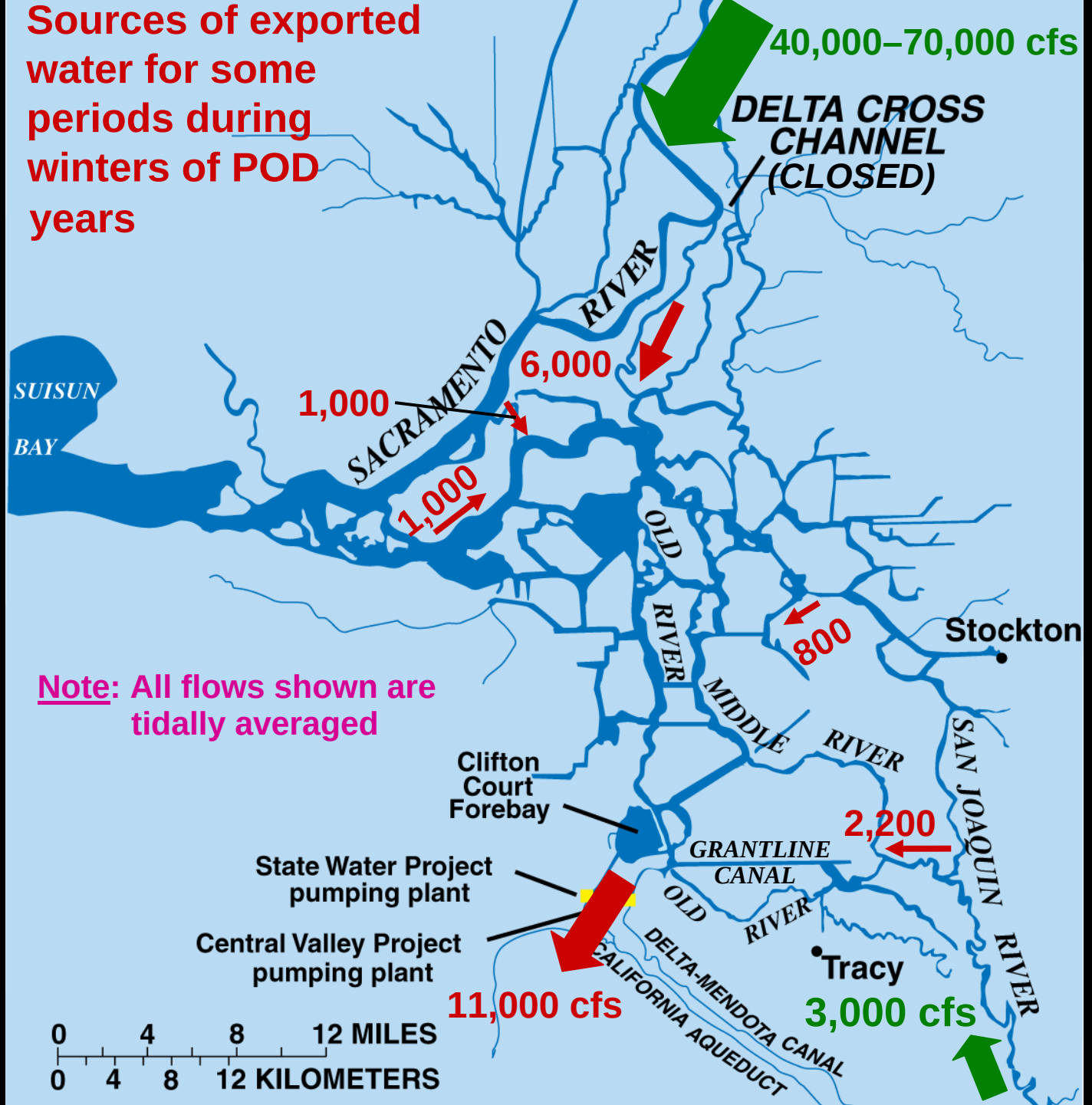
- *Option 1:* Use existing Delta and opportunistic pumping.
- *Option 2:* Use Middle River as a fortified water supply corridor separated from fish habitat. Also use opportunistic pumping.

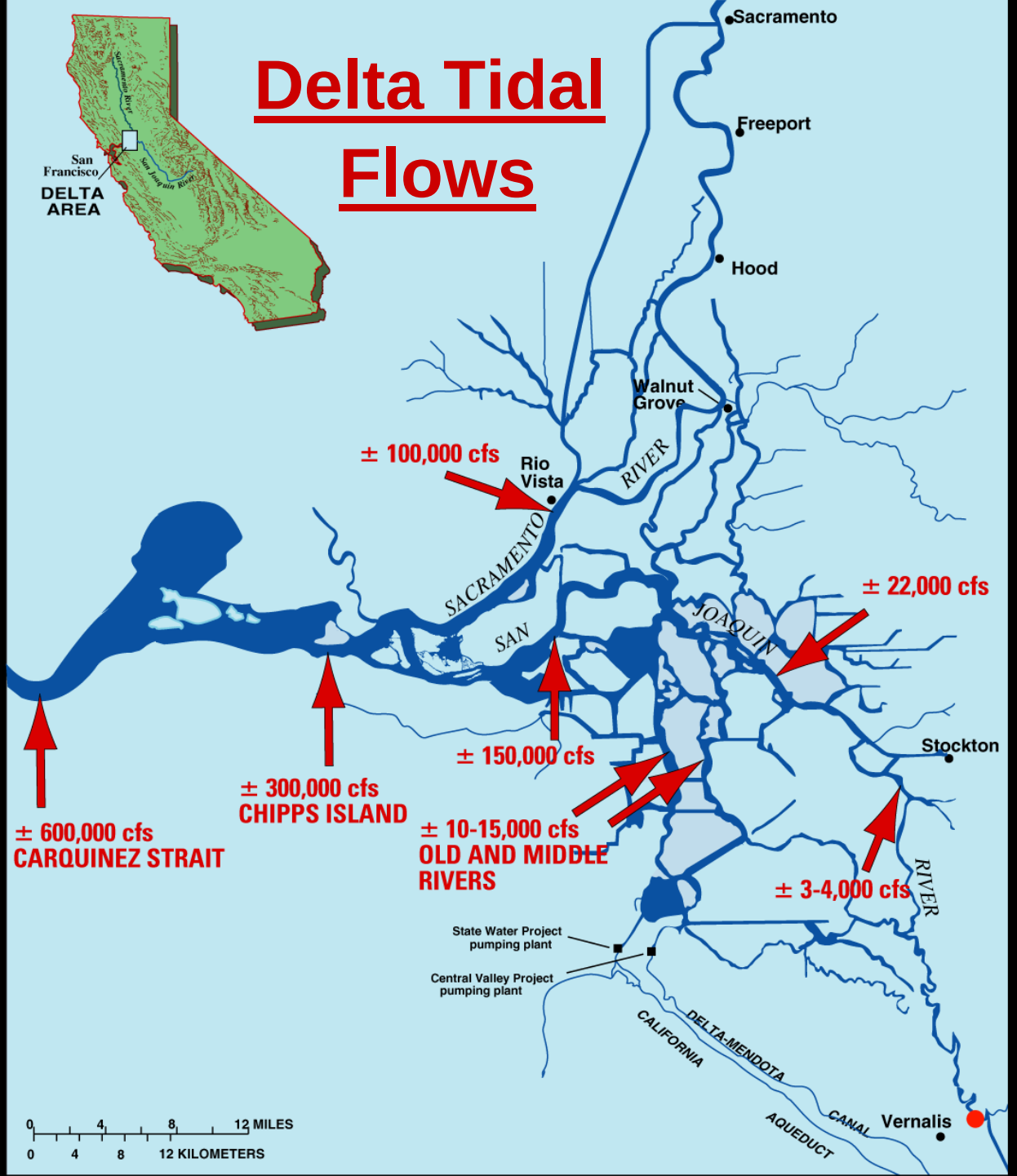

Mokelumne River
Chipps Island
Sacramento River
3-mile Slough
False River
Franks Tract
Sherman Lake
Jersey Pt.
Antioch
San Joaquin River
Columbia Cut
Turner Cut
Stockton
Mildred Island
Old River
Middle River
Victoria Canal
Clifton Court Forebay
State Water Project Pumping Plant
Central Valley Project Pumping Plant
Grantline Canal
Old River
Head of Old River
South Delta


North Delta
Liberty Is.
Sacramento Ship Ch.
Sutter Sl.
Sacramento R.
Snodgrass Sl.
Miner Slough
Slough
Delta Cross Channel
Steamboat
Cache Slough
Georgiana Sl.
N. Fork Mokelumne R.
Mokelumne R.
Sacramento River
Mokelumne River
S. Fork
River
Franks Tract
San Joaquin
Middle R.
Old R.

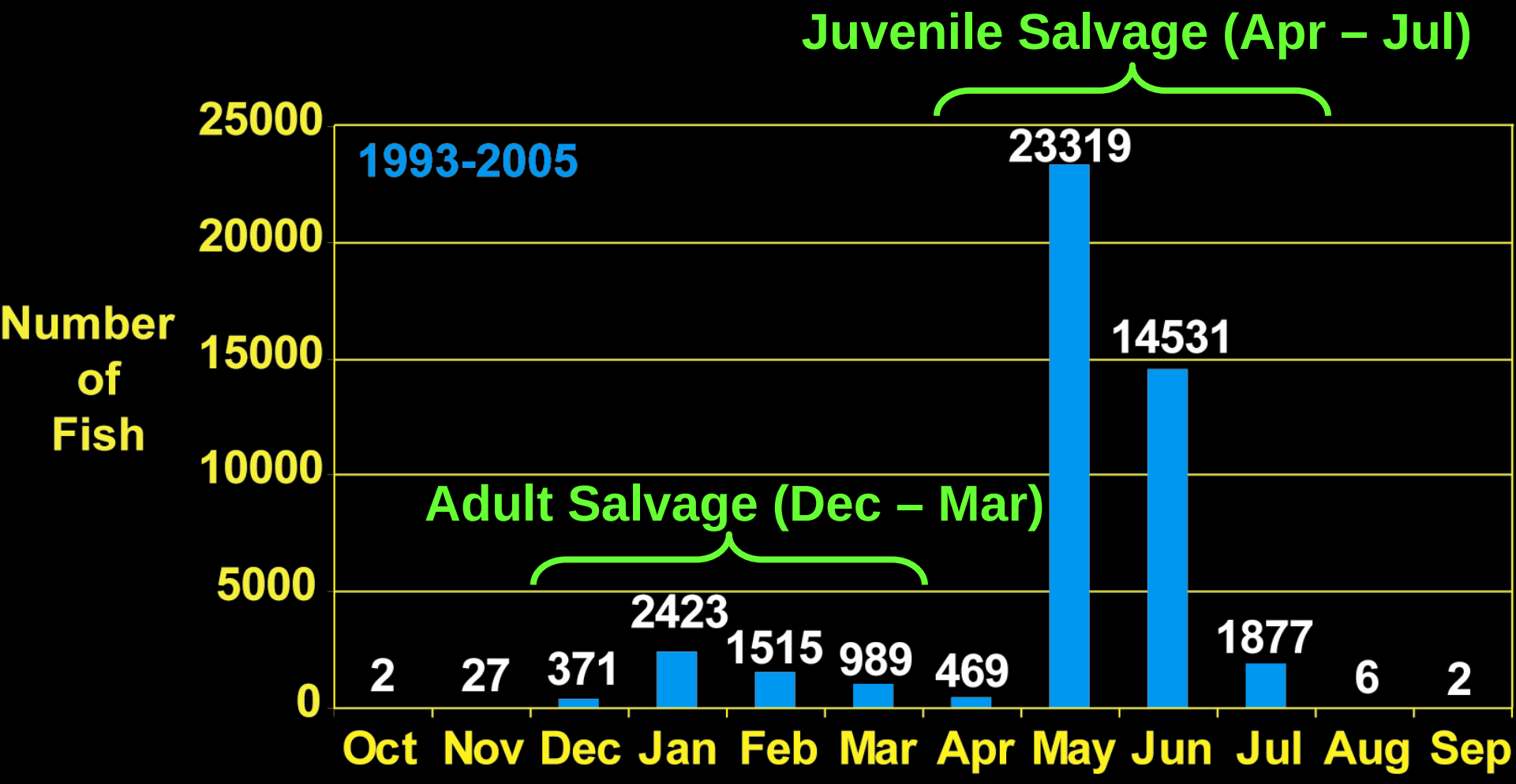
What are the sources of exported water ?


Sources of exported water for typical low-flow conditions during fall
15,000 cfs
DELTA CROSS CHANNEL (OPEN)
RIVER
SACRAMENTO
2,200
3,500
1,000
SUISUN
BAY
1,300
OLD
RIVER
800
Stockton
Note: All flows shown are tidally averaged
MIDDLE
RIVER
SAN JOAQUIN
RIVER
Clifton Court Forebay
2,200
GRANTLINE CANAL
State Water Project pumping plant
OLD
RIVER
Central Valley Project pumping plant
DELTA-MENDOTA CANAL
CALIFORNIA AQUEDUCT
Tracy
11,000 cfs
3,000 cfs
0 4 8 12 MILES
0 4 8 12 KILOMETERS

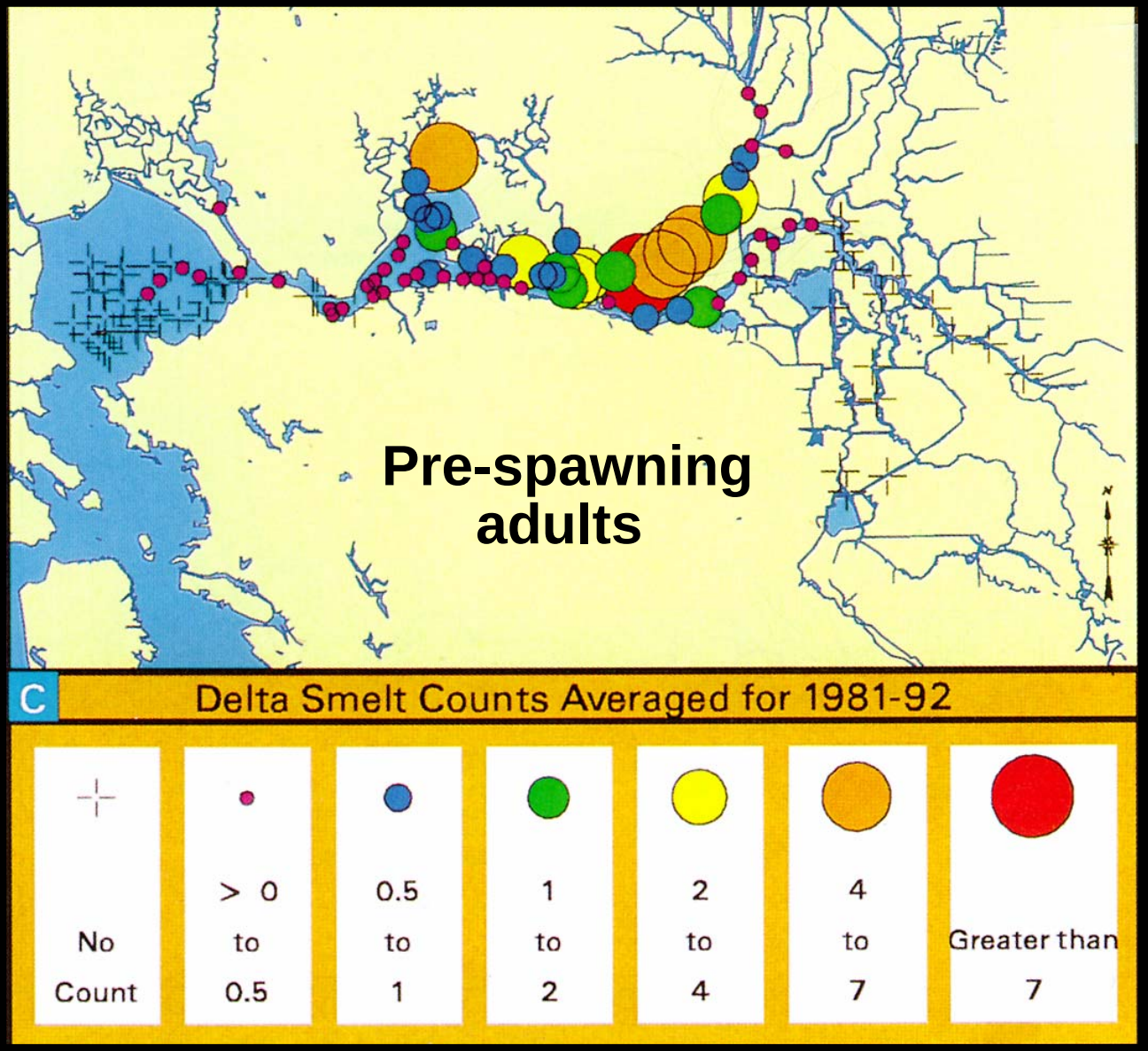

Sources of exported water for some periods during winters of POD years
40,000–70,000 cfs
DELTA CROSS CHANNEL (CLOSED)
RIVER
SACRAMENTO
6,000
1,000
SUISUN BAY
1,000
OLD
RIVER
800
Stockton
Note: All flows shown are tidally averaged
MIDDLE
RIVER
SAN JOAQUIN
Clifton Court Forebay
2,200
GRANTLINE CANAL
State Water Project pumping plant
OLD
RIVER
Central Valley Project pumping plant
DELTA-MENDOTA CANAL
CALIFORNIA AQUEDUCT
Tracy
11,000 cfs
3,000 cfs
RIVER
0 4 8 12 MILES
0 4 8 12 KILOMETERS


Delta Tidal Flows
San Francisco
DELTA AREA
Sacramento
Freeport
Hood
Walnut Grove
± 100,000 cfs
Rio Vista
SACRAMENTO RIVER
SAN JOAQUIN RIVER
± 22,000 cfs
± 150,000 cfs
± 300,000 cfs
CHIPPS ISLAND
± 600,000 cfs
CARQUINEZ STRAIT
± 10-15,000 cfs
OLD AND MIDDLE RIVERS
Stockton
± 3-4,000 cfs
State Water Project pumping plant
Central Valley Project pumping plant
CALIFORNIA AQUEDUCT
DELTA-MENDOTA CANAL
Vernalis
0 4 8 12 MILES
0 4 8 12 KILOMETERS

Average Delta Smelt Salvage by Month



Delta Smelt Distributions in Fall



Source: Jim Arthur (USBR), 1996, San Francisco Bay: The Ecosystem

Why do we not see any delta smelt salvaged in the fall?

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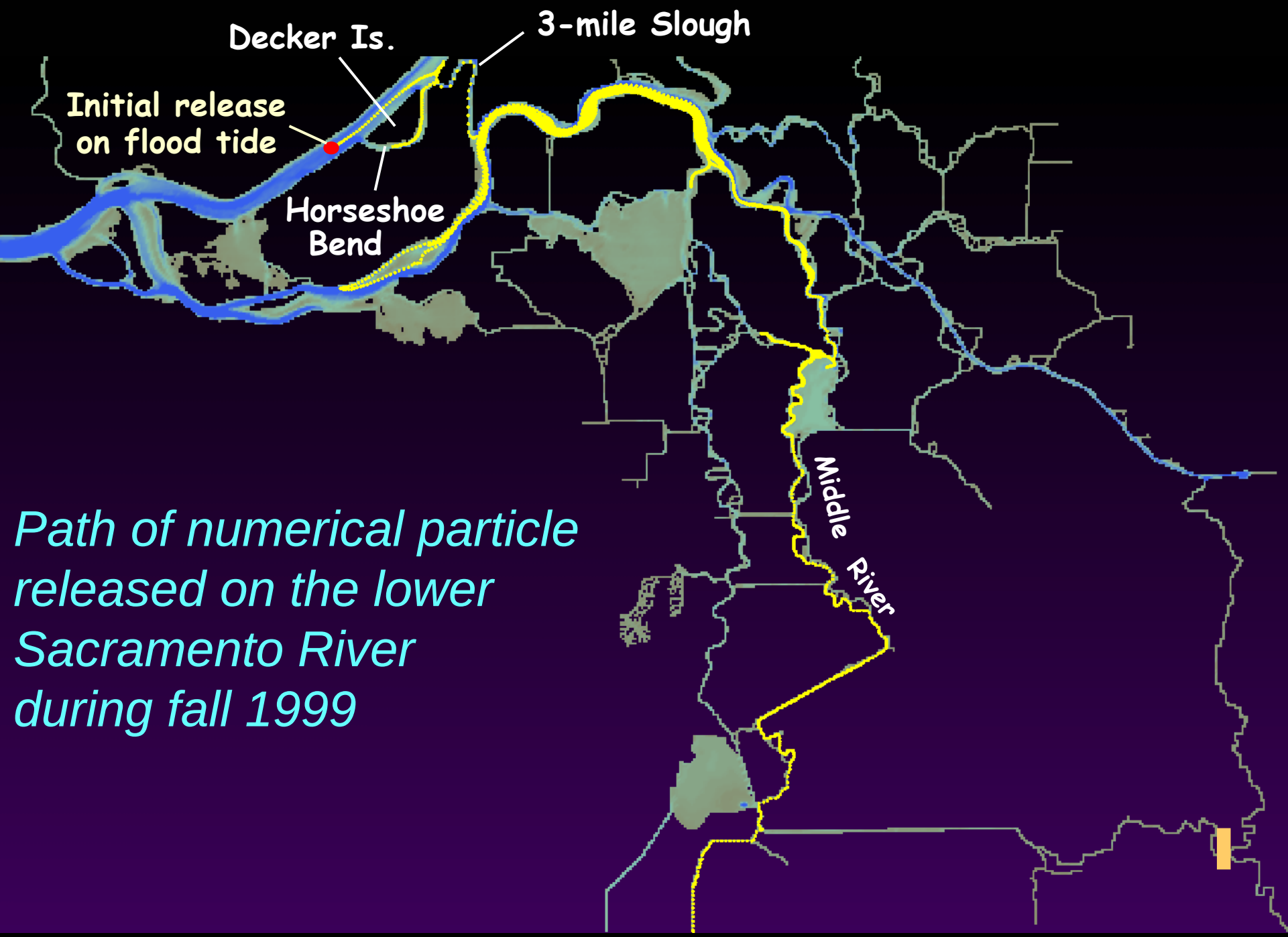
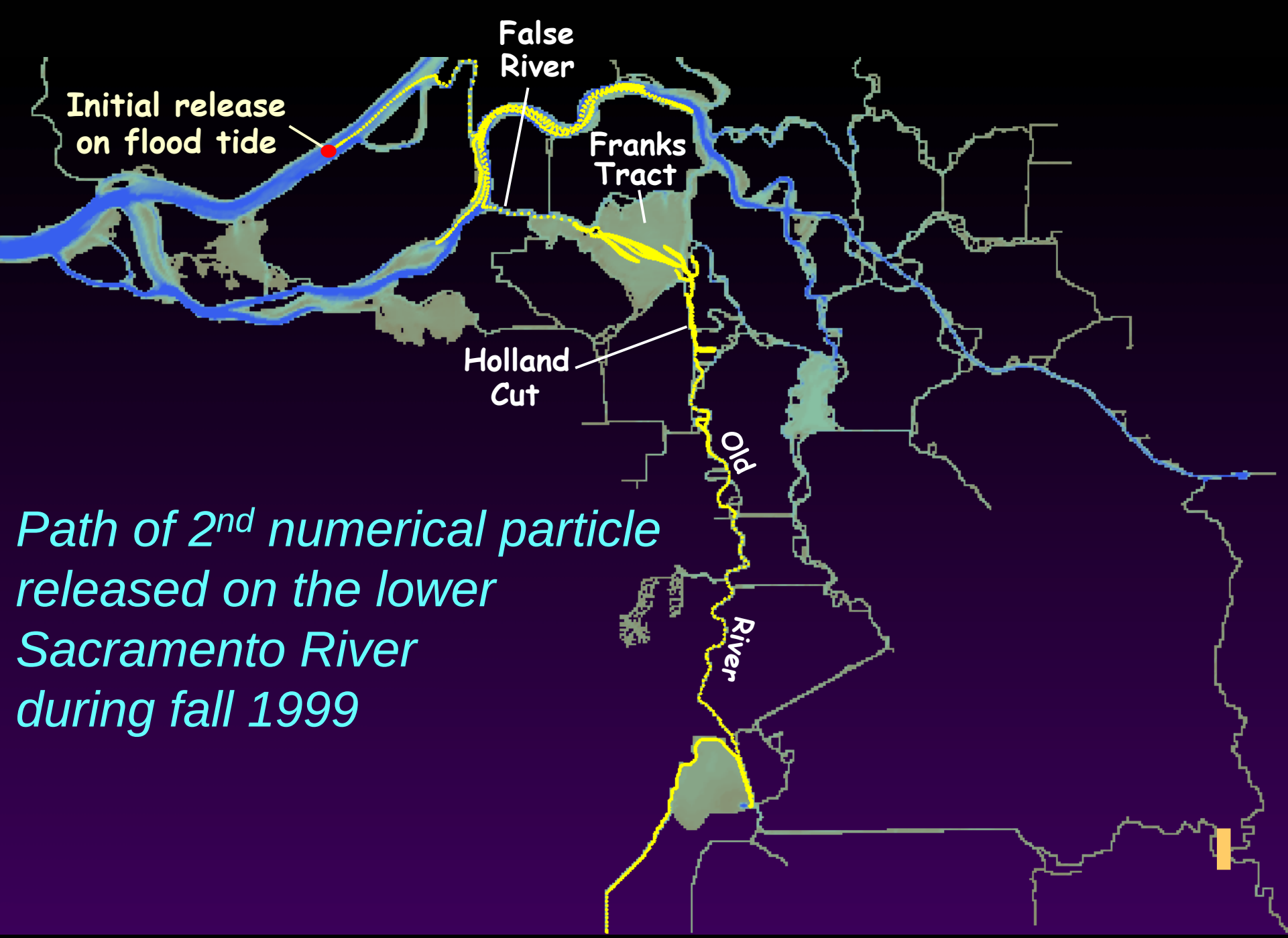
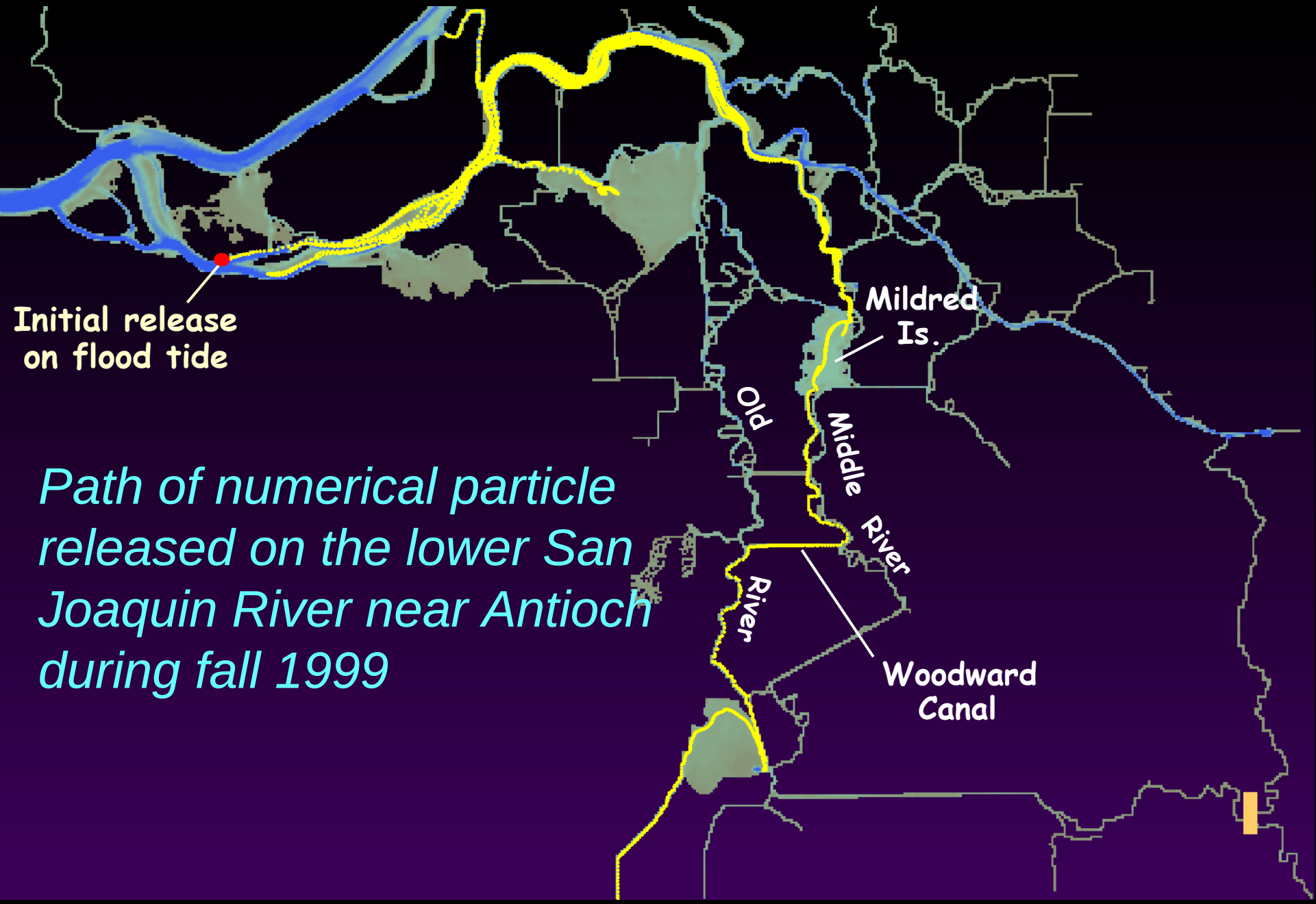
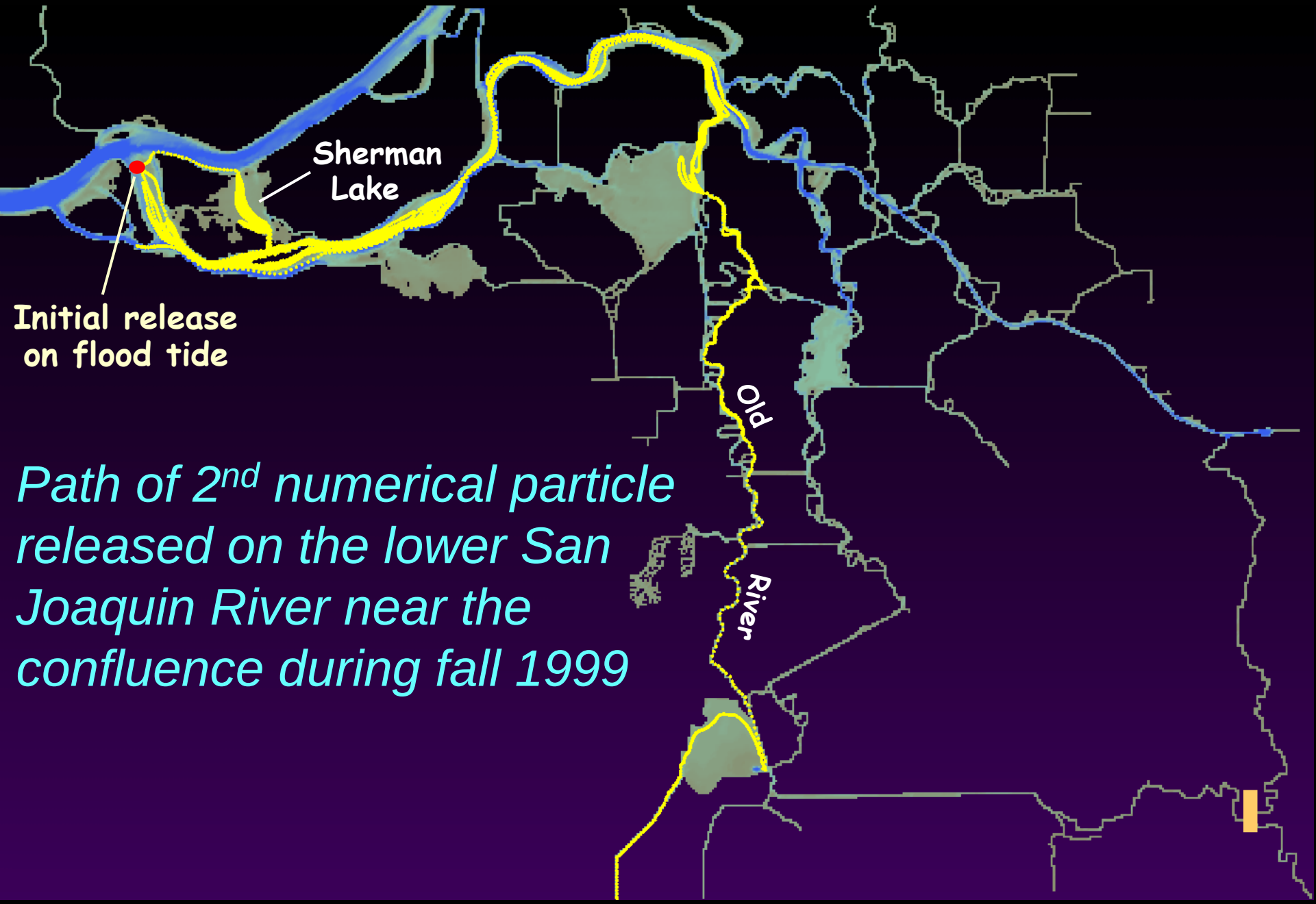
We might expect to see salvage because particle-tracking models tell us the delta smelt are not entirely out of the range of the pumps.



Path of numerical particle released on the lower Sacramento River during fall 1999


False River
Initial release on flood tide
Franks Tract
Holland Cut
Old
River
Path of 2nd numerical particle released on the lower Sacramento River during fall 1999


Initial release on flood tide
Mildred Is.
Old
Middle River
River
Woodward Canal
Path of numerical particle released on the lower San Joaquin River near Antioch during fall 1999



Path of 2nd numerical particle released on the lower San Joaquin River near the confluence during fall 1999

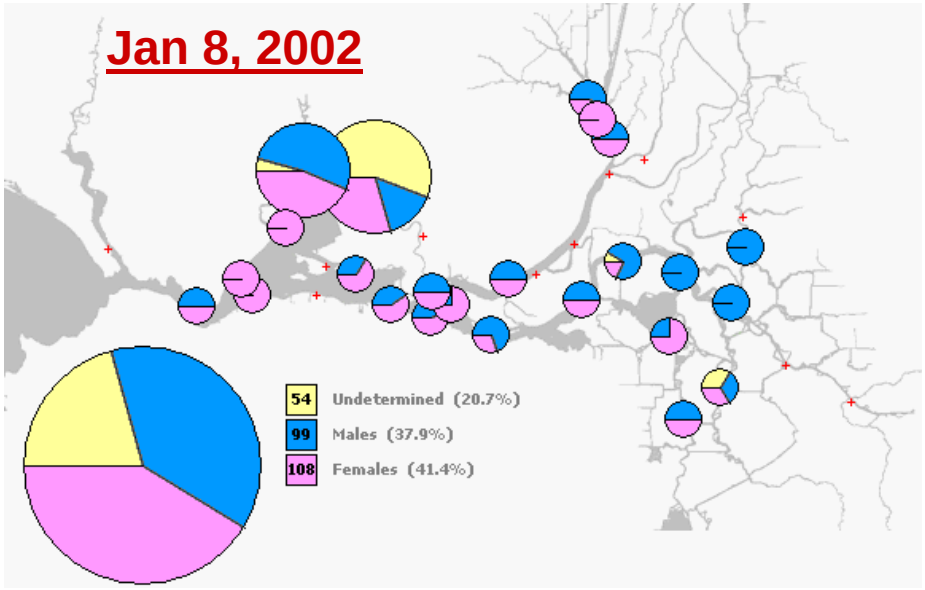
Could low turbidities be the reason delta smelt do not swim, or allow themselves to be transported by the currents, into the south Delta during the fall?

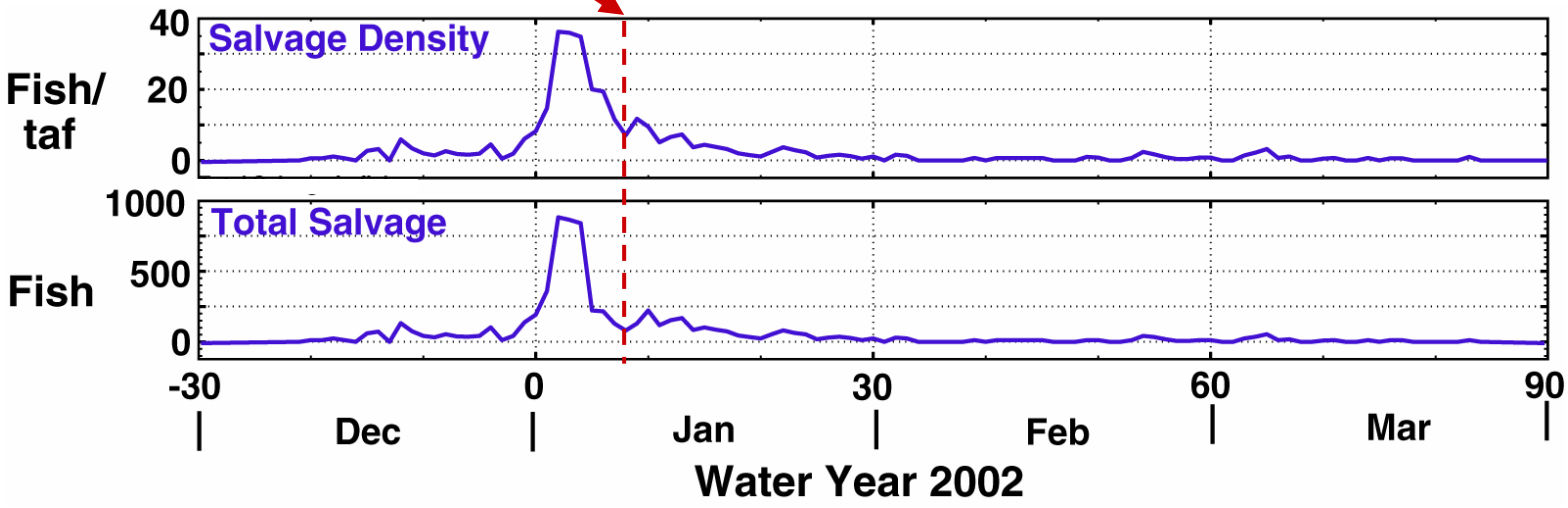
Could low turbidities be the reason delta smelt do not swim, or allow themselves to be transported by the currents, into the south Delta during the fall?

- *Recent research has suggested that water turbidity could be an important environmental variable that affects delta smelt feeding success and predator avoidance behavior.*

Jan 2002 Spring Kodiak Trawl Survey and Salvage

Catch of adult delta smelt





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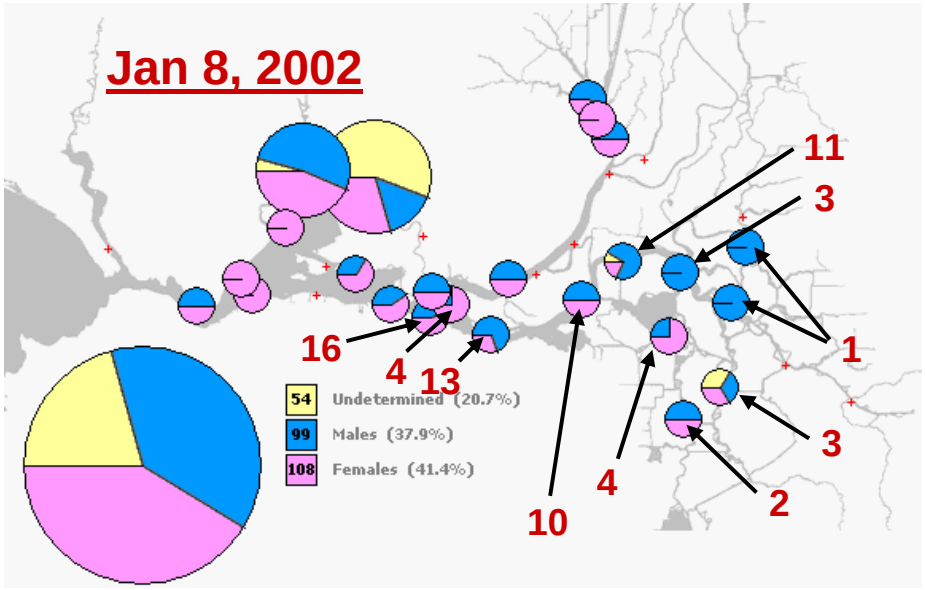
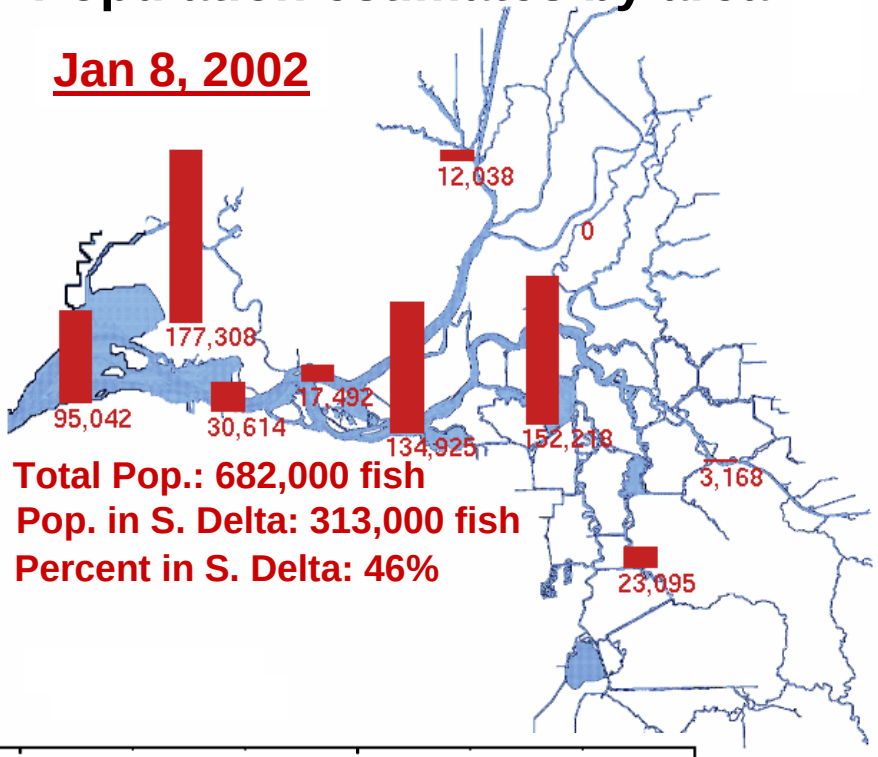
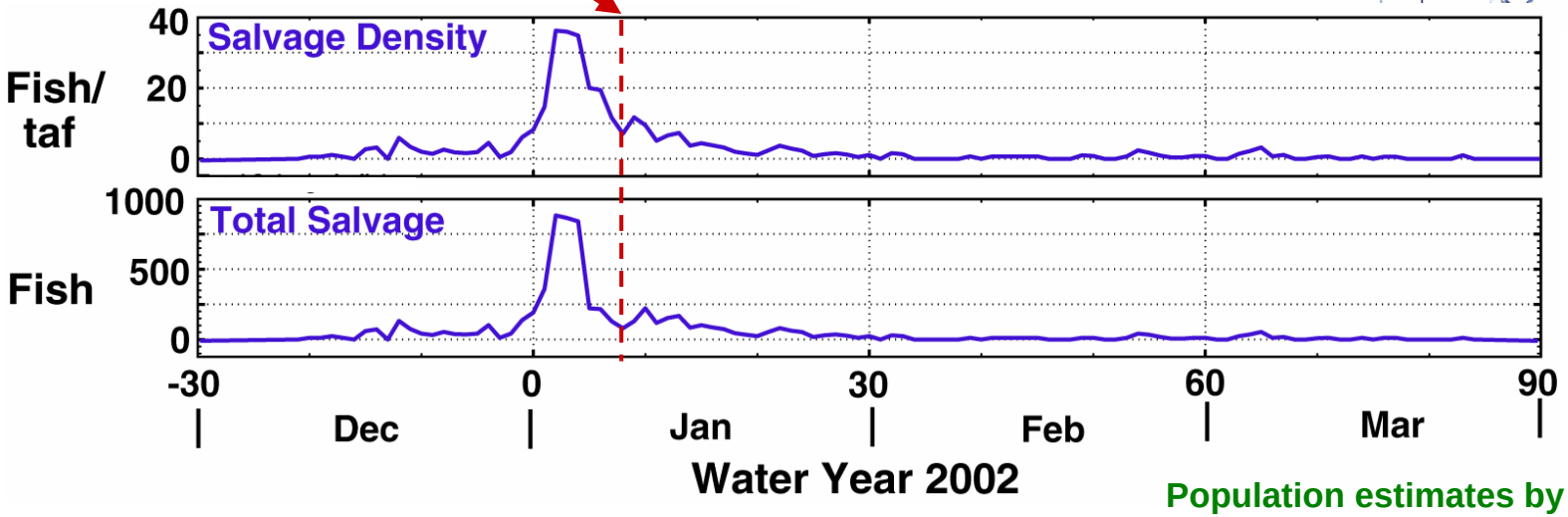


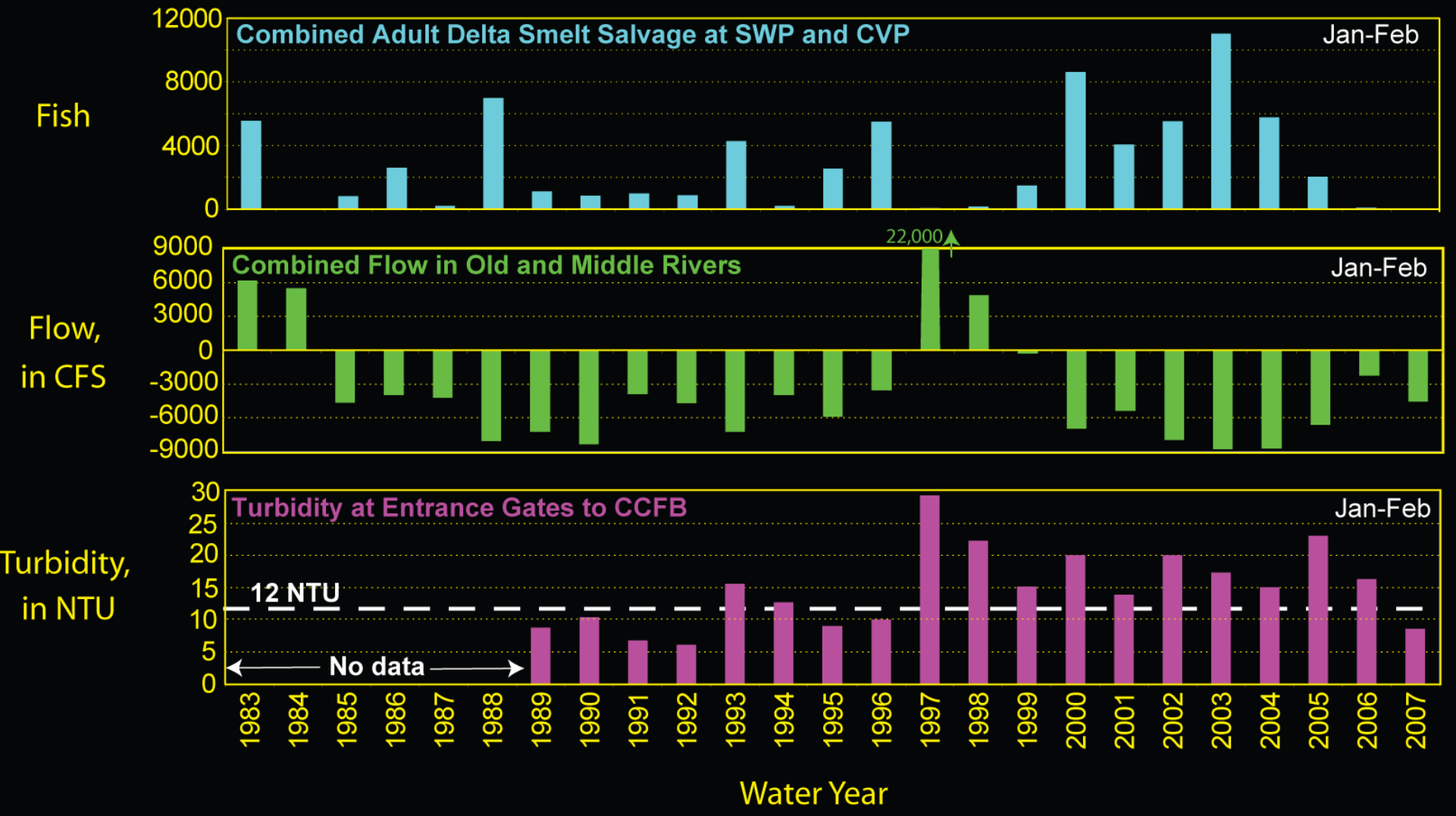
Population estimates by area





Population estimates by Miller (2005)

Adult Delta Smelt Salvage, Flows and Turbidities



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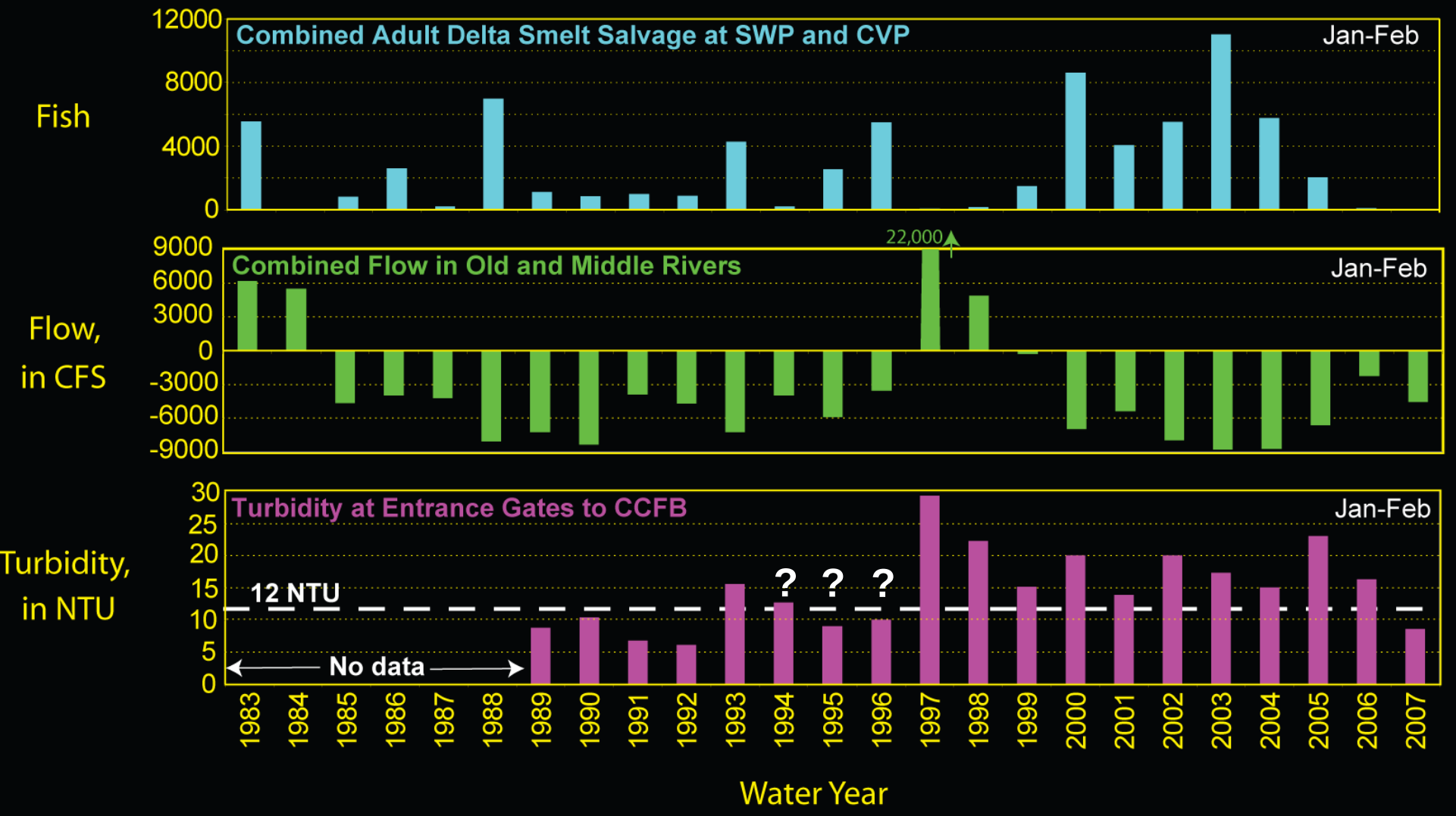
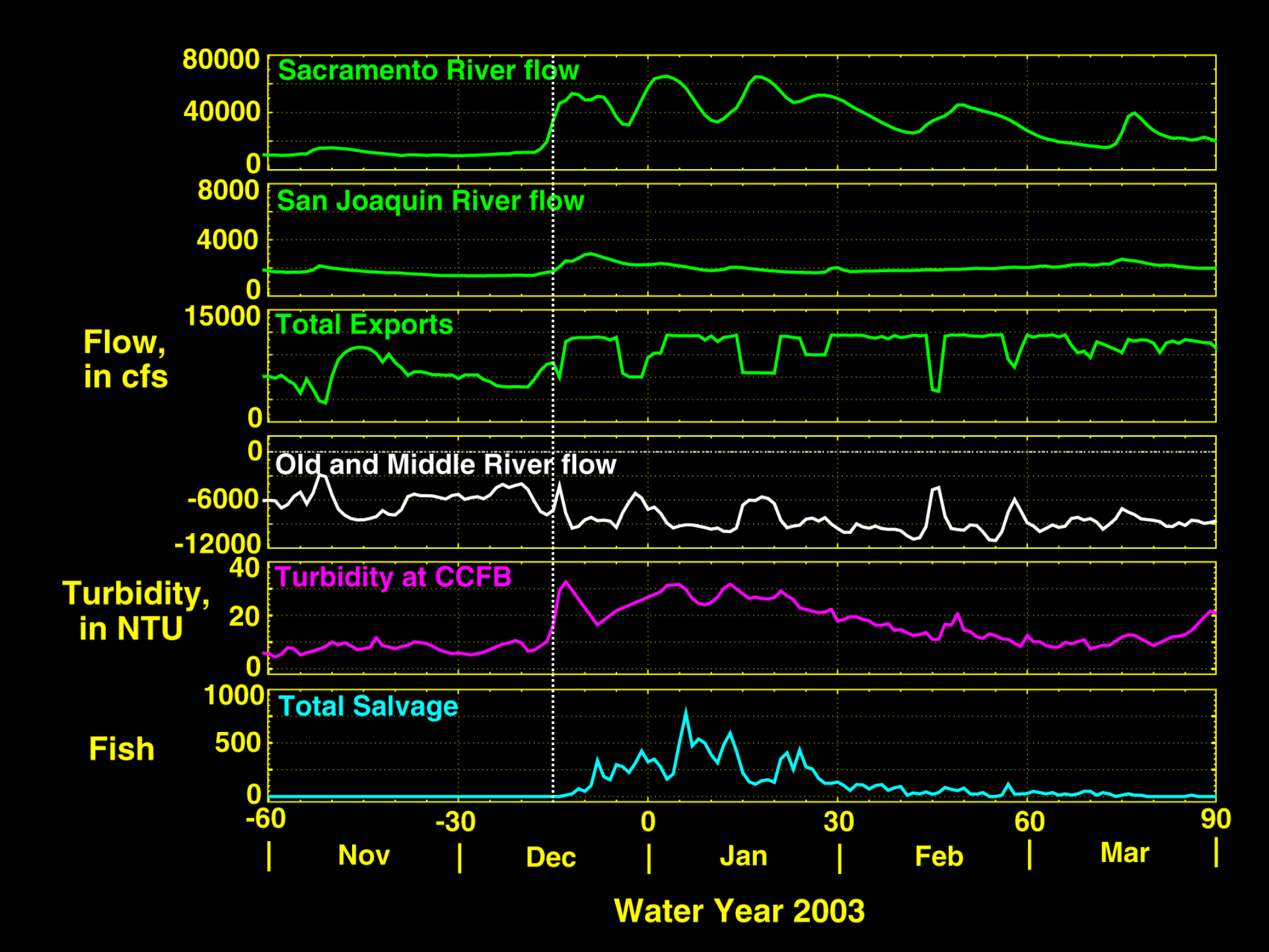
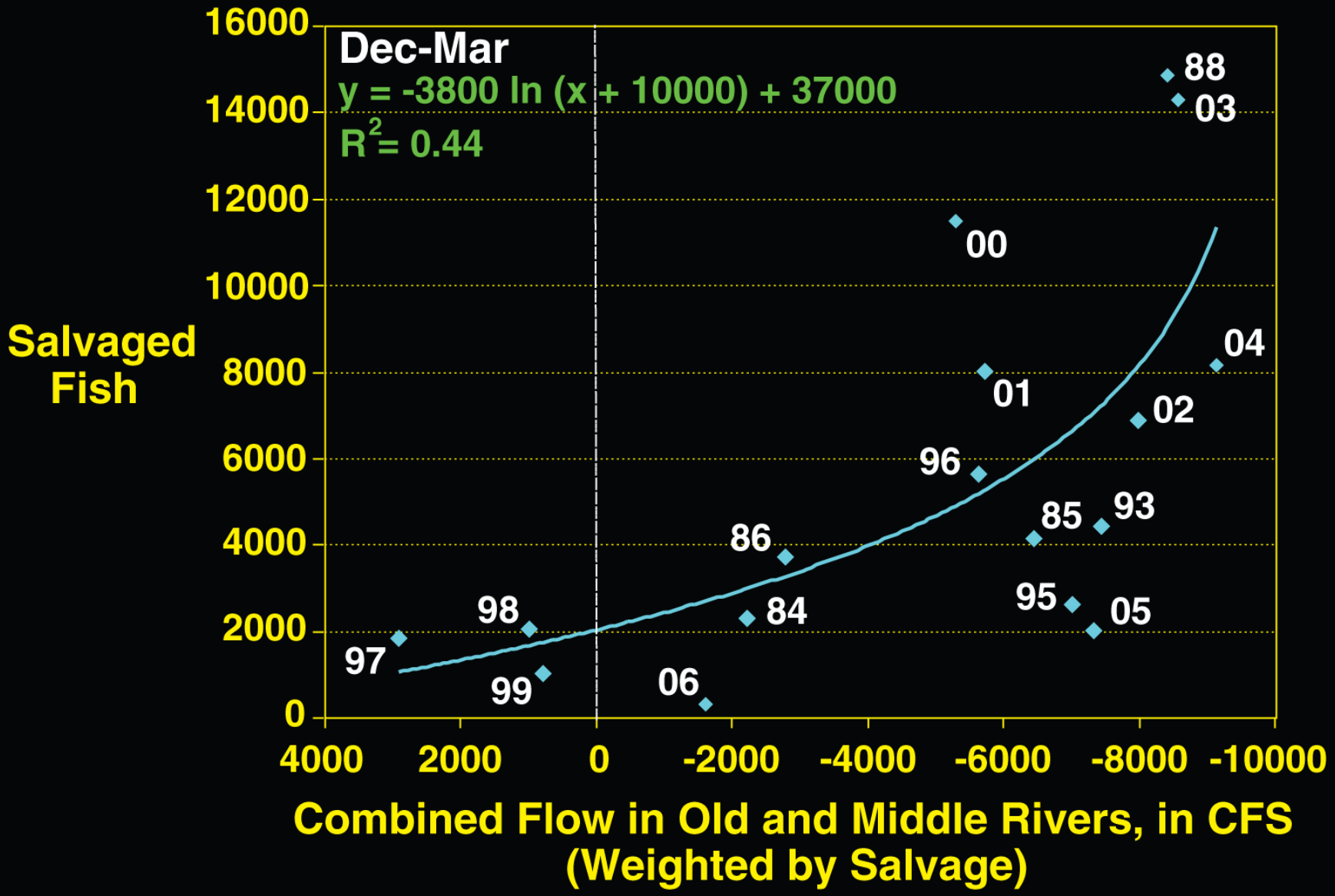



Sacramento River flow
80000
40000
0
San Joaquin River flow
8000
4000
0
Total Exports
15000
0
Flow, in cfs
Old and Middle River flow
0
-6000
-12000
Turbidity at CCFB
40
20
0
Turbidity, in NTU
Total Salvage
1000
500
0
Fish
-60
-30
0
30
60
90
Nov
Dec
Jan
Feb
Mar
Water Year 2003

Regression of Adult Delta Smelt Salvage and Combined Flow In Old and Middle Rivers



Water conveyance methods: (short form)

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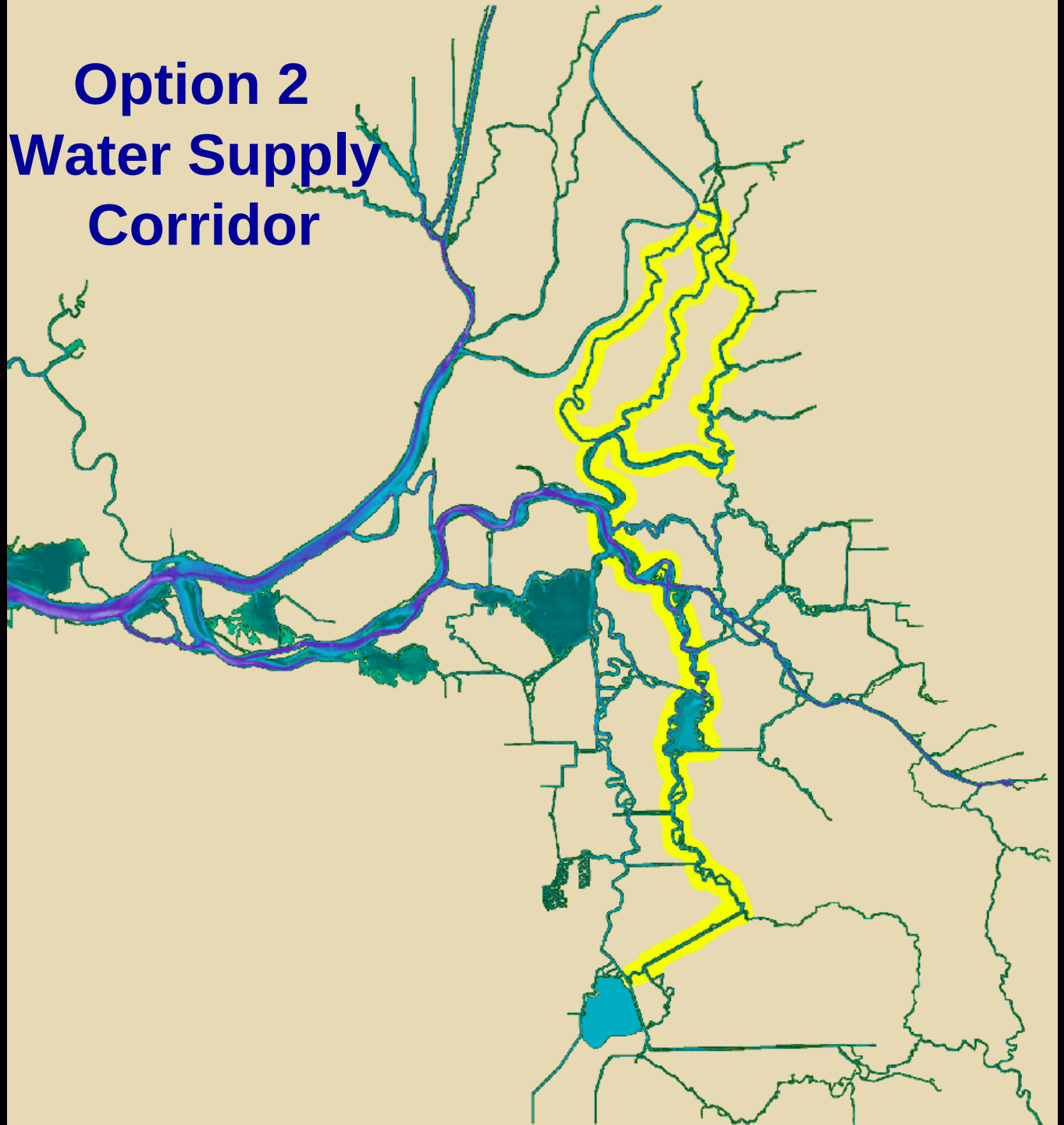
Option 2 Water Supply Corridor



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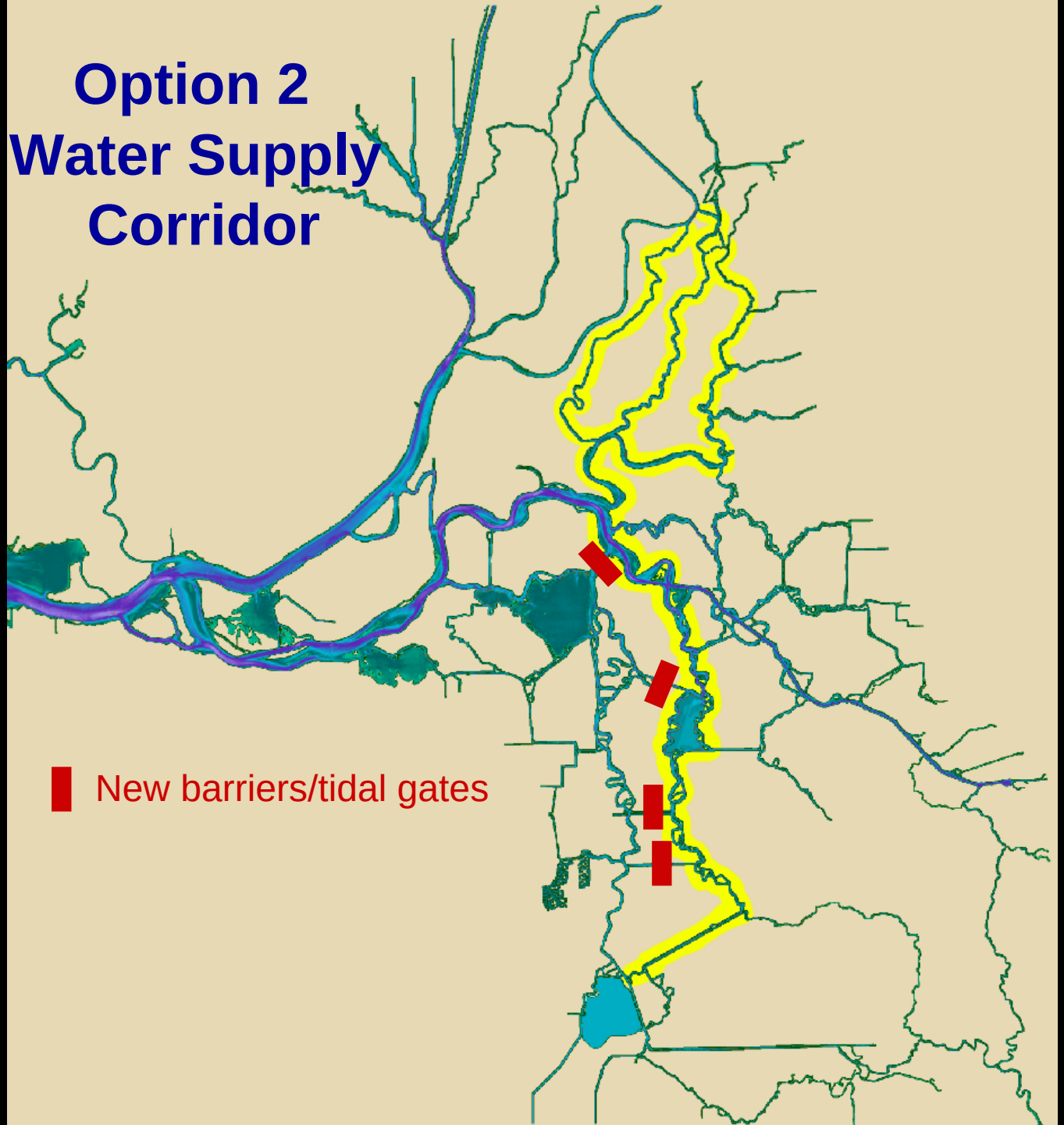

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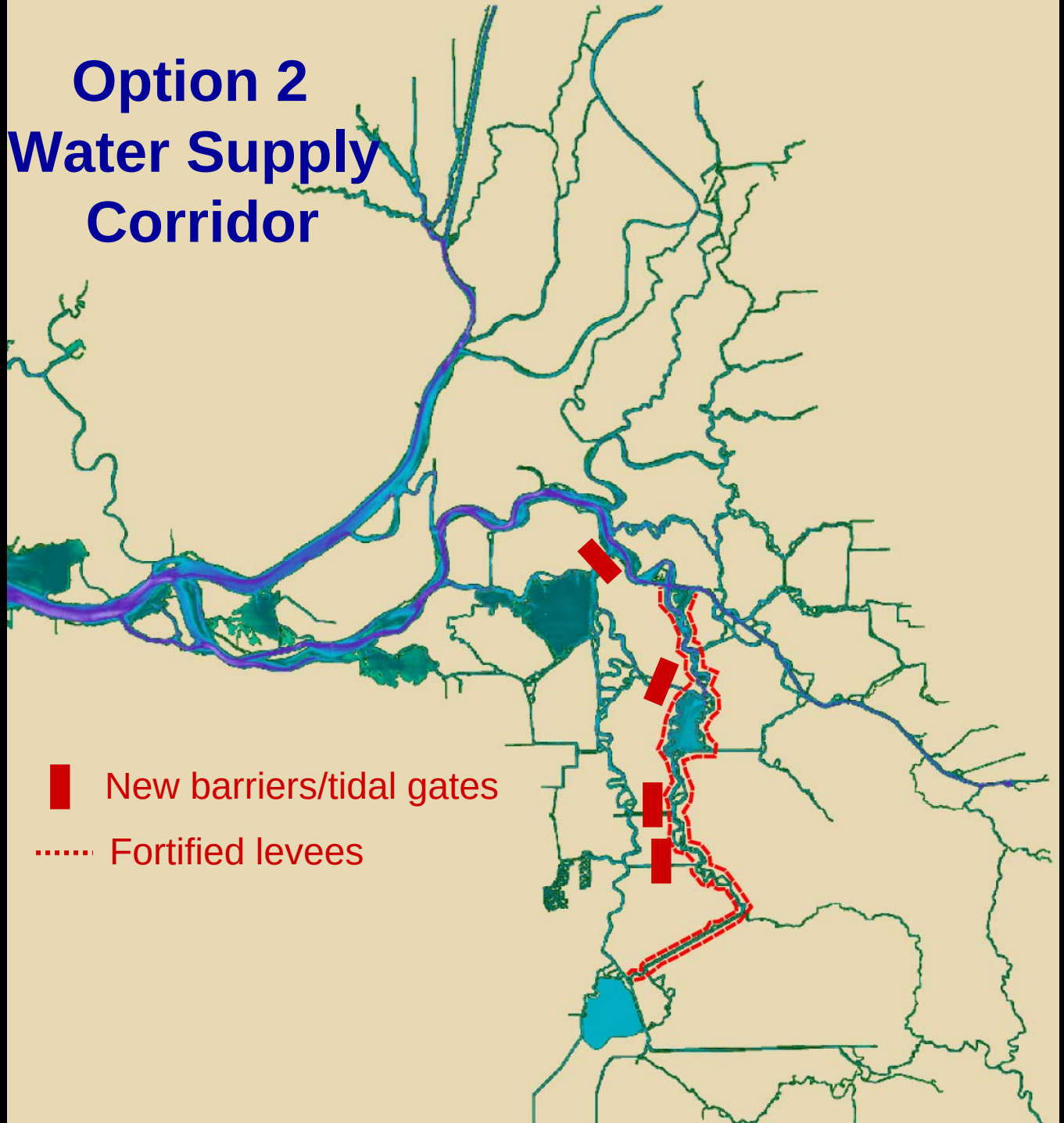
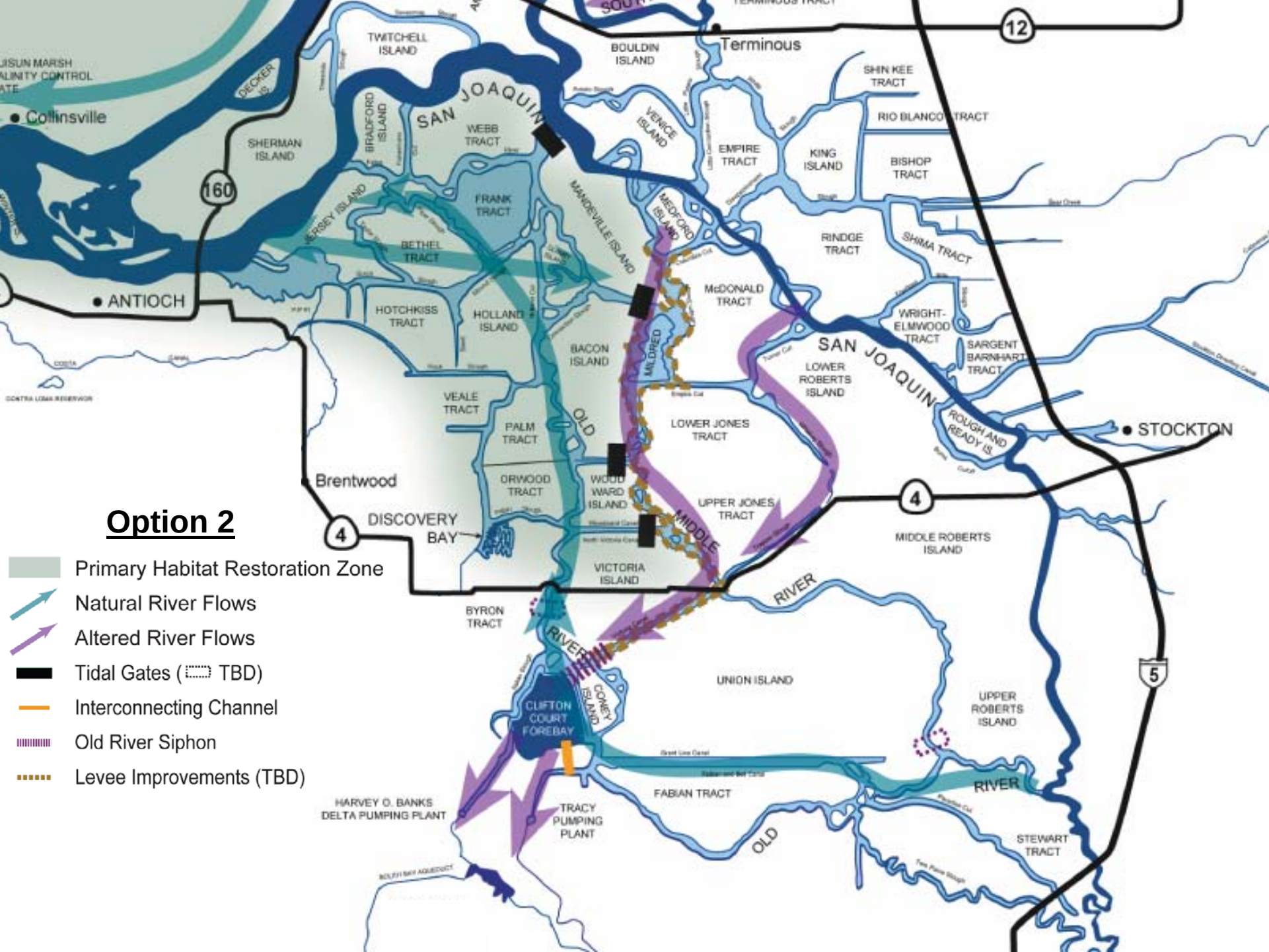
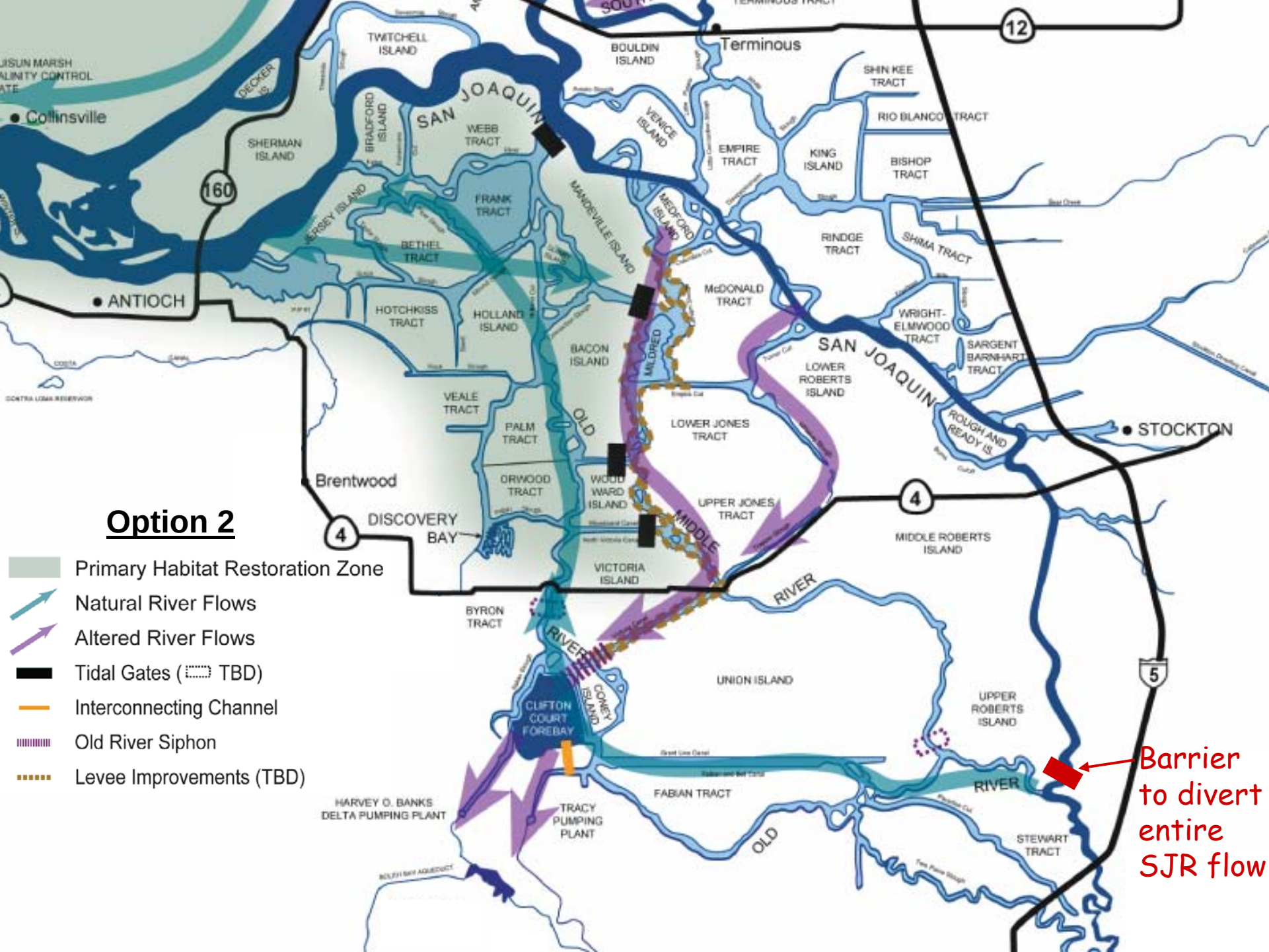



Option 2
Primary Habitat Restoration Zone
Natural River Flows
Altered River Flows
Tidal Gates (TBD)
Interconnecting Channel
Old River Siphon
Levee Improvements (TBD)
Collinsville
ANTIOCH
Brentwood
DISCOVERY BAY
Terminous
STOCKTON
SAN JOAQUIN
SAN JOAQUIN
OLD
MIDDLE
RIVER
OLD
RIVER
RIVER
TWITCHELL ISLAND
BOULDIN ISLAND
SHIN KEE TRACT
RIO BLANCO TRACT
VENICE ISLAND
EMPIRE TRACT
KING ISLAND
BISHOP TRACT
SHERMAN ISLAND
BRADFORD ISLAND
WEBB TRACT
JERSEY ISLAND
FRANK TRACT
MANDEVILLE ISLAND
MEDFORD ISLAND
RINDGE TRACT
SHIMA TRACT
BETHEL TRACT
McDONALD TRACT
HOTCHKISS TRACT
HOLLAND ISLAND
BACON ISLAND
MILDRED
WRIGHT-ELMWOOD TRACT
SARGENT BARNHART TRACT
LOWER ROBERTS ISLAND
VEALE TRACT
PALM TRACT
LOWER JONES TRACT
ROUGH AND READY IS
ORWOOD TRACT
WOODWARD ISLAND
UPPER JONES TRACT
MIDDLE ROBERTS ISLAND
VICTORIA ISLAND
BYRON TRACT
UNION ISLAND
CLIFTON COURT FOREBAY
CONEY ISLAND
UPPER ROBERTS ISLAND
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
FABIAN TRACT
STEWART TRACT
160
12
4
4
5


Option 2
Primary Habitat Restoration Zone
Natural River Flows
Altered River Flows
Tidal Gates (TBD)
Interconnecting Channel
Old River Siphon
Levee Improvements (TBD)
Barrier to divert entire SJR flow
Collinsville
ANTIOCH
Brentwood
DISCOVERY BAY
Terminous
STOCKTON
SAN JOAQUIN
OLD
MIDDLE
RIVER
SHERMAN ISLAND
TWITCHELL ISLAND
BOULDIN ISLAND
BRADFORD ISLAND
WEBB TRACT
VENICE ISLAND
SHIN KEE TRACT
RIO BLANCO TRACT
EMPIRE TRACT
KING ISLAND
BISHOP TRACT
JERSEY ISLAND
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MANDEVILLE ISLAND
MEDFORD ISLAND
BETHEL TRACT
RINDGE TRACT
SHIMA TRACT
McDONALD TRACT
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HOLLAND ISLAND
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WRIGHT-ELMWOOD TRACT
SARGENT BARNHART TRACT
LOWER ROBERTS ISLAND
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WOODWARD ISLAND
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MIDDLE ROBERTS ISLAND
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160
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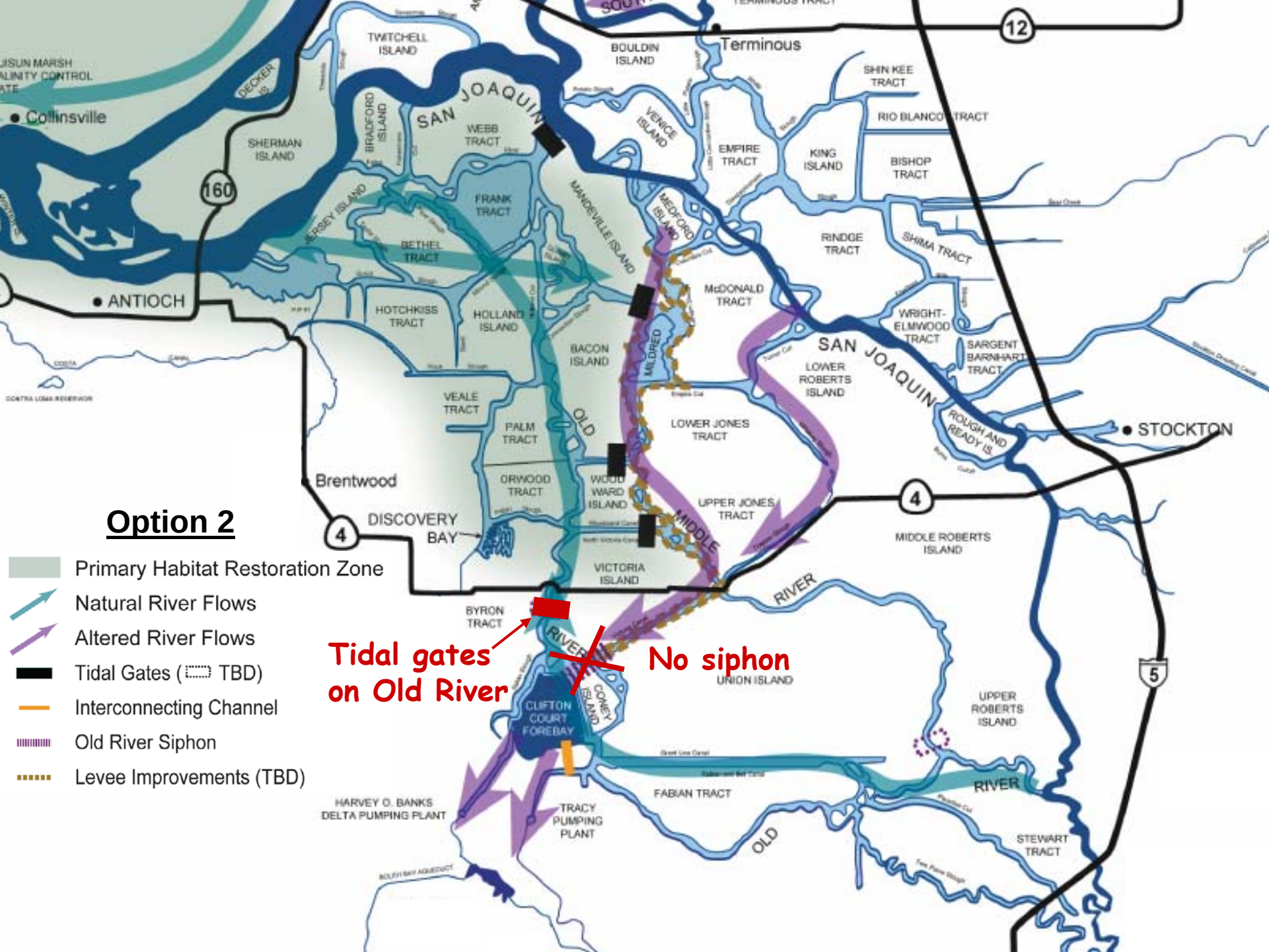
Option 2
Primary Habitat Restoration Zone
Natural River Flows
Altered River Flows
Tidal Gates (TBD)
Interconnecting Channel
Old River Siphon
Levee Improvements (TBD)
Tidal gates on Old River
No siphon
Collinsville
ANTIOCH
Brentwood
DISCOVERY BAY
Terminous
STOCKTON
TWITCHELL ISLAND
BOULDIN ISLAND
SHERMAN ISLAND
BRADFORD ISLAND
WEBB TRACT
VENICE ISLAND
SHIN KEE TRACT
RIO BLANCO TRACT
EMPIRE TRACT
KING ISLAND
BISHOP TRACT
JERSEY ISLAND
FRANK TRACT
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WOODWARD ISLAND
UPPER JONES TRACT
MIDDLE
MIDDLE ROBERTS ISLAND
VICTORIA ISLAND
RIVER
BYRON TRACT
UNION ISLAND
CLIFTON COURT FOREBAY
CONEY ISLAND
UPPER ROBERTS ISLAND
FABIAN TRACT
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
STEWART TRACT
CONTRA LOMA RESERVOIR
160
4
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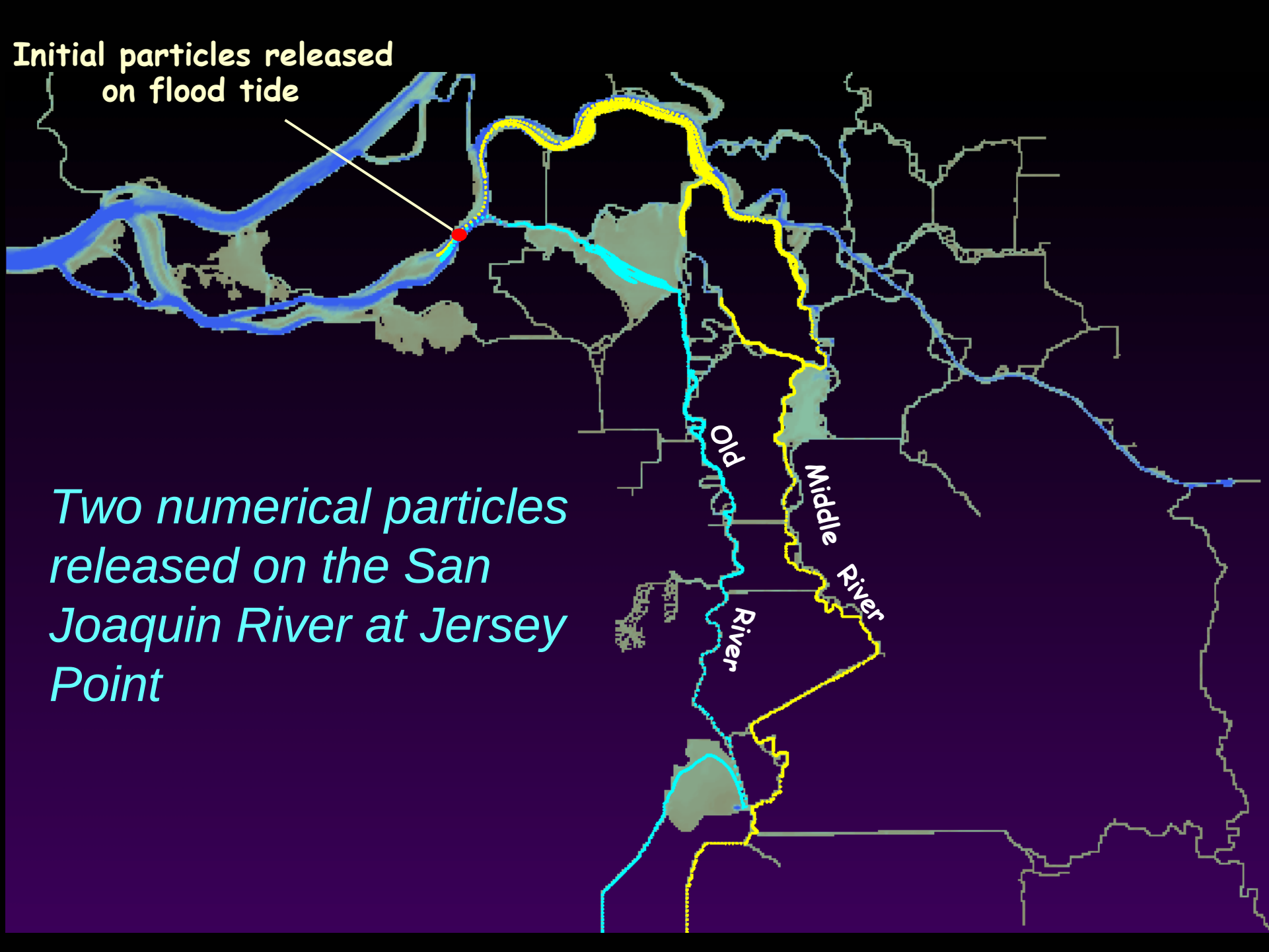
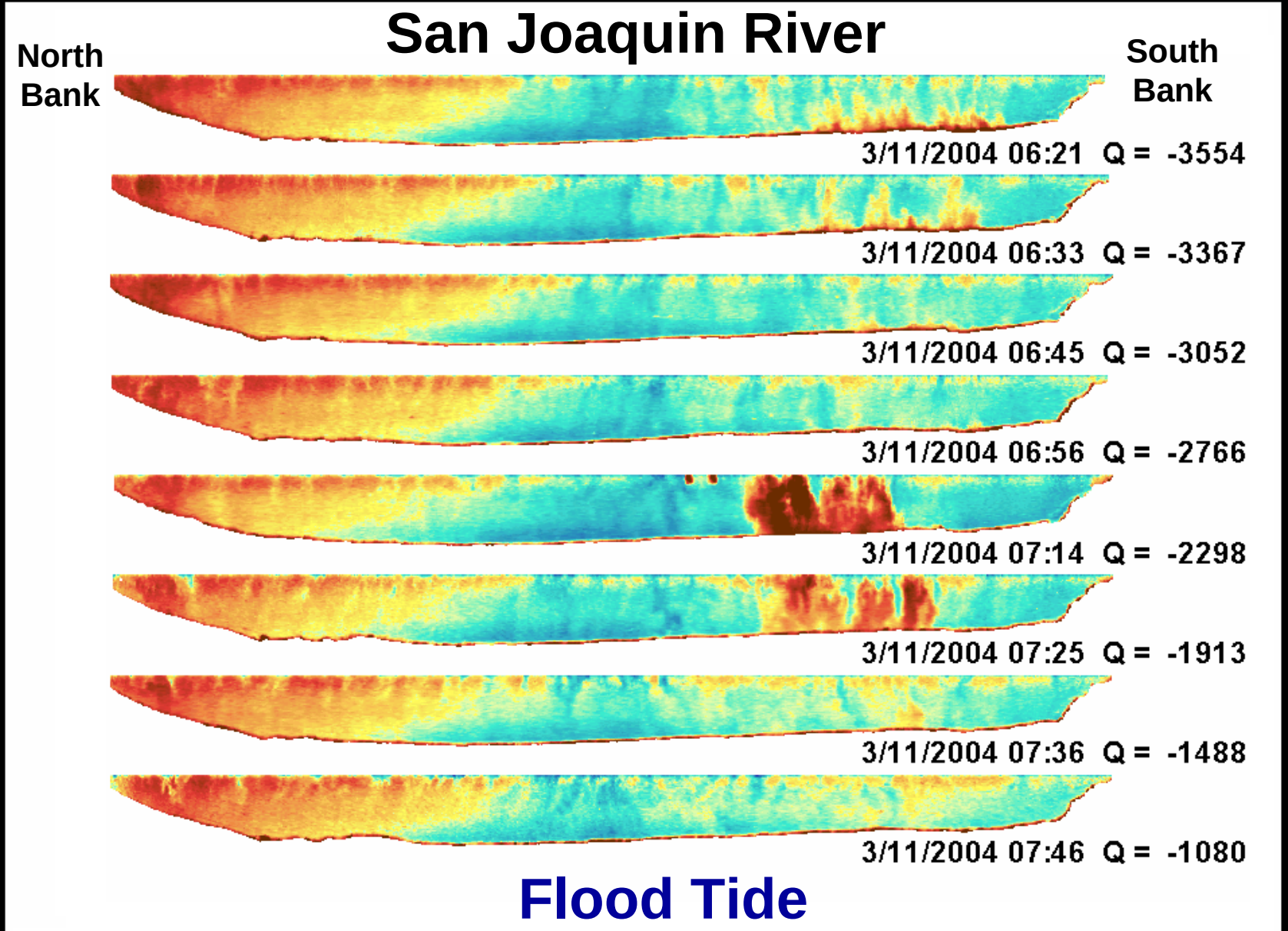

Initial particles released on flood tide
Old River
Middle River
Two numerical particles released on the San Joaquin River at Jersey Point

Backscatter Intensity at Jersey Point



Summary

- Real-time measurements of Delta turbidity will be used in 2008 to assist in drawing export water at times with the least adverse affects on delta smelt.

- There are some new ideas for re-routing flows in the Delta and fortifying Middle River levees that will improve water supply reliability in the event of certain levee failures. The cost, however, could be very high to fully protect the Middle River levees against a catastrophic earthquake.

Summary (cont'd)

- The benefits to covered fish species of using Middle River as a water supply corridor and Old River/ Franks Tract as ecological habitat is not easy to evaluate. The details of how it will be done could make a big difference. As a first step, hydrodynamic model studies should be carried out.