POST FIRE IMPACTS ON WATER QUALITY AND TREATMENT

DIVISION OF DRINKING WATER

SANTA BARBARA DISTRICT

SANTA YNEZ RIVER

- WATERSHED IS COMPRISED OF APPROXIMATELY 897 SQUARE MILES. 80% OF IT IS IN THE LOS PADRES NATIONAL FOREST.
- ELEVATION GOES FROM 6,820 FEET TO 4 FEET AT THE OCEAN
- RIVER IS USUALLY DRY IN THE SUMMER
- HIGH PRIORITY STEELHEAD RIVER
    - WAS LARGEST STEELHEAD RUN IN SOUTHERN CALIFORNIA PRIOR TO DAMS BEING BUILT.

SANTA YNEZ RIVER

- THREE DAMS BUILT ON THE RIVER TO SUPPLY WATER TO THE COMMUNITIES ON THE COAST SIDE OF THE SANTA YNEZ MOUNTAIN RANGE.
  - JUNCAL DAM FORMS JAMESON RESERVOIR
  - GIBRALTAR DAM FORMS GIBRALTAR RESERVOIR
  - BRADBURY DAM FORMS LAKE CACHUMA
- THREE TUNNELS WERE CONSTRUCTED THROUGH THE SANTA YNEZ RANGE TO CONVEY WATER FROM THE RESERVOIRS TO THE COASTAL COMMUNITIES
  - DOULTON TUNNEL
  - MISSION TUNNEL
  - TECOLOTE TUNNEL

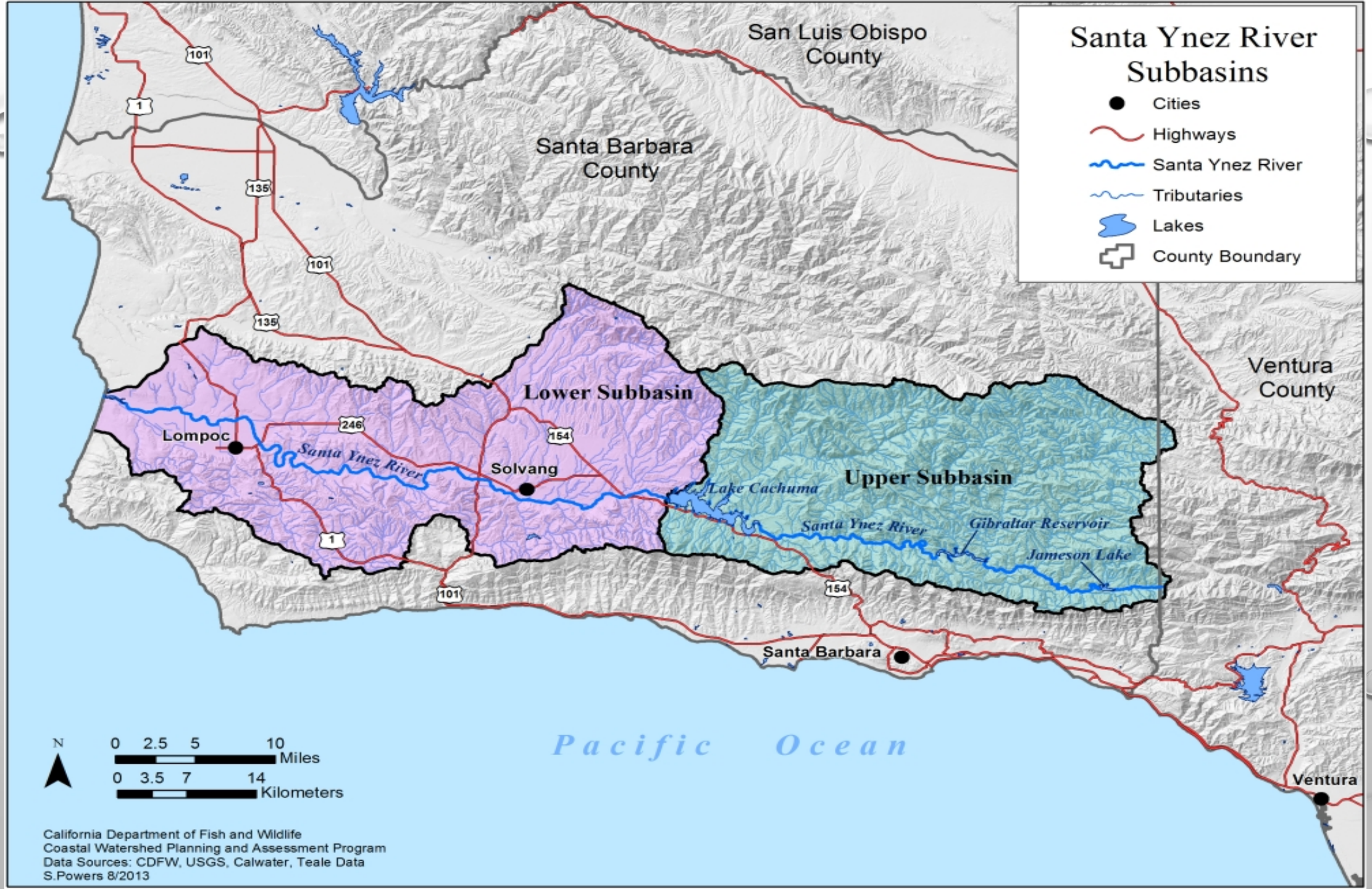

Santa Ynez River Subbasins
Cities
Highways
Santa Ynez River
Tributaries
Lakes
County Boundary
San Luis Obispo County
Santa Barbara County
Ventura County
Lower Subbasin
Upper Subbasin
Lompoc
Solvang
Santa Ynez River
Lake Cachuma
Gibraltar Reservoir
Jameson Lake
Santa Barbara
Ventura
Pacific Ocean
101
1
135
246
154
N
0 2.5 5 10 Miles
0 3.5 7 14 Kilometers
California Department of Fish and Wildlife
Coastal Watershed Planning and Assessment Program
Data Sources: CDFW, USGS, Calwater, Teale Data
S.Powers 8/2013


Figure 2
Santa Ynez River
Sub - Watersheds
Santa Ynez River Watershed
Above Bradbury Dam
Santa Cruz Creek
Cachuma Creek
Lake Cachuma
Bradbury Dam
Santa Ynez River
Tecolote Tunnel
Glen Annie Watershed
Upper Reach SCC
Gibraltar Dam
Gibraltar
Reservoir
Devils Cyn
Mission Tunnel
Indian Creek
Mono Creek
Agua Caliente Canyon
Juncal Dam
Jameson Lake
Alder Cr
Santa Ynez River
Santa Barbara County
Ventura County
Lauro Watershed
Sheffield Reservoir
Ortega Reservoir
Carpinteria Reservoir
Lower Reach SCC
Goleta
Isla Vista
Santa Barbara
Montecito
Carpinteria
246
154
101
N
Lower Reach SCC - Treated Water
Santa Barbara County Highways
Watershed Boundaries
Jameson Sub Watershed
Above Gibraltor Dam Sub Watershed
Lake Cachuma Sub Watershed
Upper Reach SCC - Raw Water
Santa Ynez River Sub - Watersheds Above Bradbury Dam
Including Glen Annie and Lauro Watersheds
Summers Engineering, Inc
Consulting Engineers
Hanford, California

RECENT FIRES IN SANTA YNEZ WATERSHED

- THOMAS FIRE
  - DECEMBER 2017; 281,893 ACRES
- ZACA FIRE
  - JULY 2007; 240,207 ACRES
  - SCORCHED 60% OF THE LAKE CACHUMA WATERSHED, LEAVING A 3-INCH THICK BLANKET OF ASH
- REY FIRE
  - AUGUST 2016; 32,606 ACRES
- WHITTIER
  - JULY 2017; 18,430 ACRES

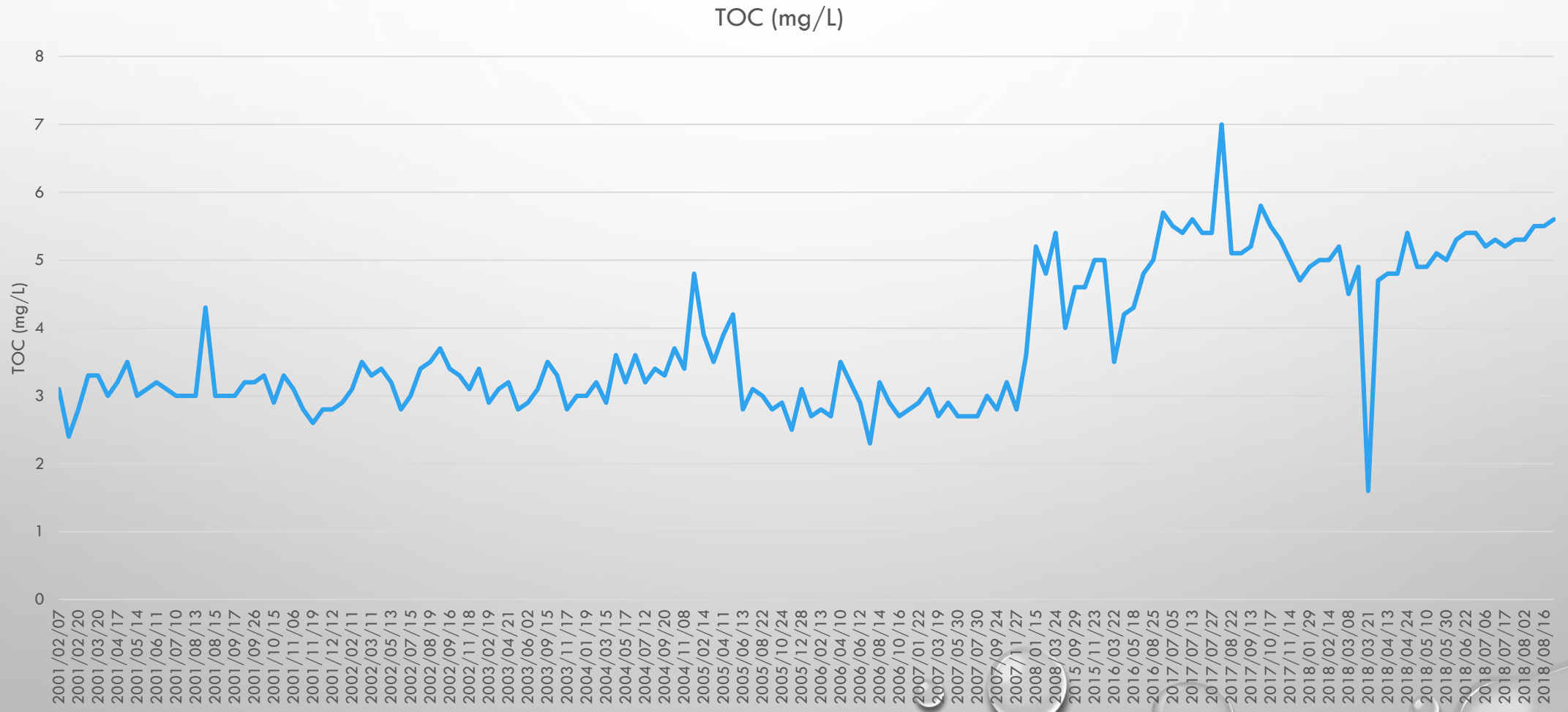

Figure 5
Wildfire History
2006-2010
Santa Ynez River Watershed Above Bradbury Dam
ZACA
Lompoc
Buellton
Santa Ynez
Bradbury Dam
Lake Cachuma
Gibraltar Dam
Gibraltar Reservoir
Juncal Dam
Jameson Lake
Frick Springs Watershed
Glen Annie Watershed
GAP
JESUSITA
Lauro Watershed
Goleta
Isla Vista
Santa Barbara
Montecito
Carpinteria
PACIFIC OCEAN
Watershed Boundaries
Rivers and Creeks
Highway
FIRE NAME
ZACA 2007
GAP 2008
JESUSITA 2009
Source: Cal Fire 5/09, US Department of the Interior, Bureau of Land Management-California,USGS, ESRI 2006
Projection: Lambert Conformal Conic
Miles
0 2.5 5 10
N
Watershed Wildfire History
2006-2010
Summers Engineering, Inc.
Consulting Engineers
Hanford, California
Map created by: K. Costa, 3/2011
GIS Standard Map Disclaimer: This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.


PUBLIC INFORMATION MAP
Thomas Incident
CA VNC 103156
December 13th, 2017
ZACA 2007
PINE 2016
WOLF 2002
DAY 2006
OGILVY 1998
REY 2016
GIBRALTAR RES
JAMESON LAKE
MATILIJA RES
JESUSITA 2009
T.E.A 2008
PIRU 2003
PIRU INCIDENT 1998
GRAND 1996
SLOAN 1999
SCHOOL INCIDENT 2005
SOLIMAR 2015
SIMI FIRE 2003
GUIBERSON 2009
BRADLEY INCIDENT 1999
SHEKELL 2006
SPRINGS 2013
Santa Barbara
Carpinteria
Ojai
Fillmore
Santa Paula
Ventura
Camarillo
Oxnard
Fire Perimeter
Uncontrolled Line
Controlled Line
Historical Fires
USFS Boundary

POST FIRE IMPACTS ON SOURCE WATER

- WATER QUALITY DEGRADATION
  - HISTORICAL CACHUMA LAKE TOC CONCENTRATIONS WERE BETWEEN 2 AND 3 MG/L
  - POST ZACA FIRE TOC CONCENTRATIONS INCREASED 165% IN THE FIRST YEAR. SLOWLY DECREASED.
  - NEVER FULLY RECOVERED TO HISTORICAL TOC LEVELS.
- REDUCTION IN RESERVOIR STORAGE CAPACITY DUE TO SILTATION
  - OVER THE YEARS GIBRALTAR RESERVOIRS INITIAL CAPACITY OF 15,374 ACRE-FT HAS BEEN REDUCED TO 5,250 DUE TO SILTATION.
  - INHERENT ISSUE MADE WORSE BY FIRES

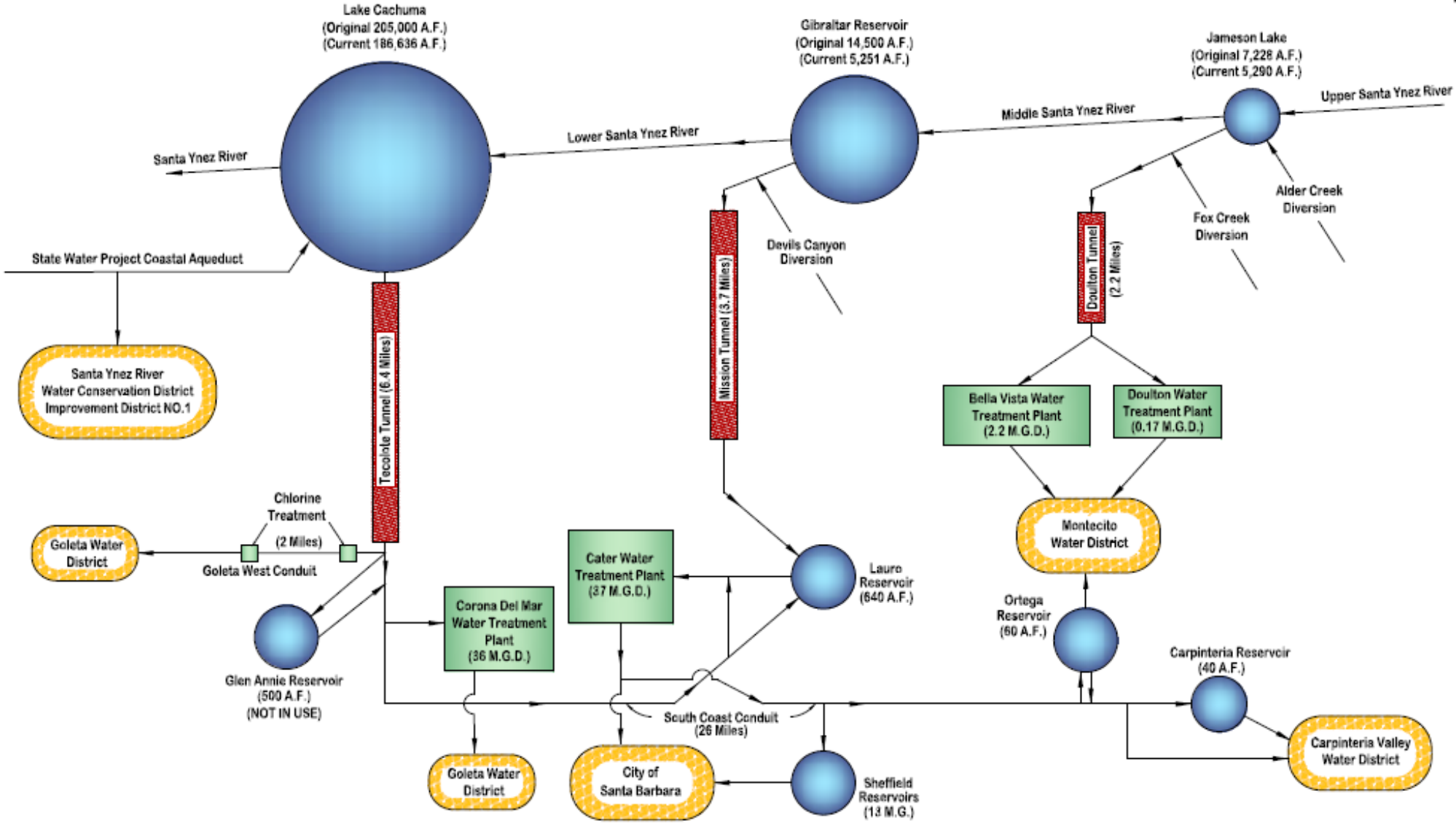
LAKE CACHUMA TOC



SURFACE WATER TREATMENT

- GOLETA WATER DISTRICT OPERATES CORONA DEL MAR WATER TREATMENT PLANT
  - CONVENTIONAL, FREE CHLORINE
  - 24 MGD (DESIGN); 36 MGD (PEAK CAPACITY).
- SANTA BARBARA ALSO OPERATES WILLIAM B. CATER WATER TREATMENT PLANT
  - 37 MGD
  - CONVENTIONAL, FREE CHLORINE
  - ALSO SUPPLIES MONTECITO AND CARPINTERIA
- MONTECITO WATER DISTRICT OPERATES BELLA VISTA AND DOULTON TUNNEL SWTPS
  - TWO TRIDENT PACKAGE PLANTS
  - LARGEST IS 2.2 MGD
  - FREE CHLORINE

Figure 3



SCHEMATIC

SANTA YNEZ RIVER SURFACE WATER DIVERSIONS & TREATMENT FACILITIES

SUMMERS ENGINEERING, INC.
Consulting Engineers
HANFORD CALIFORNIA

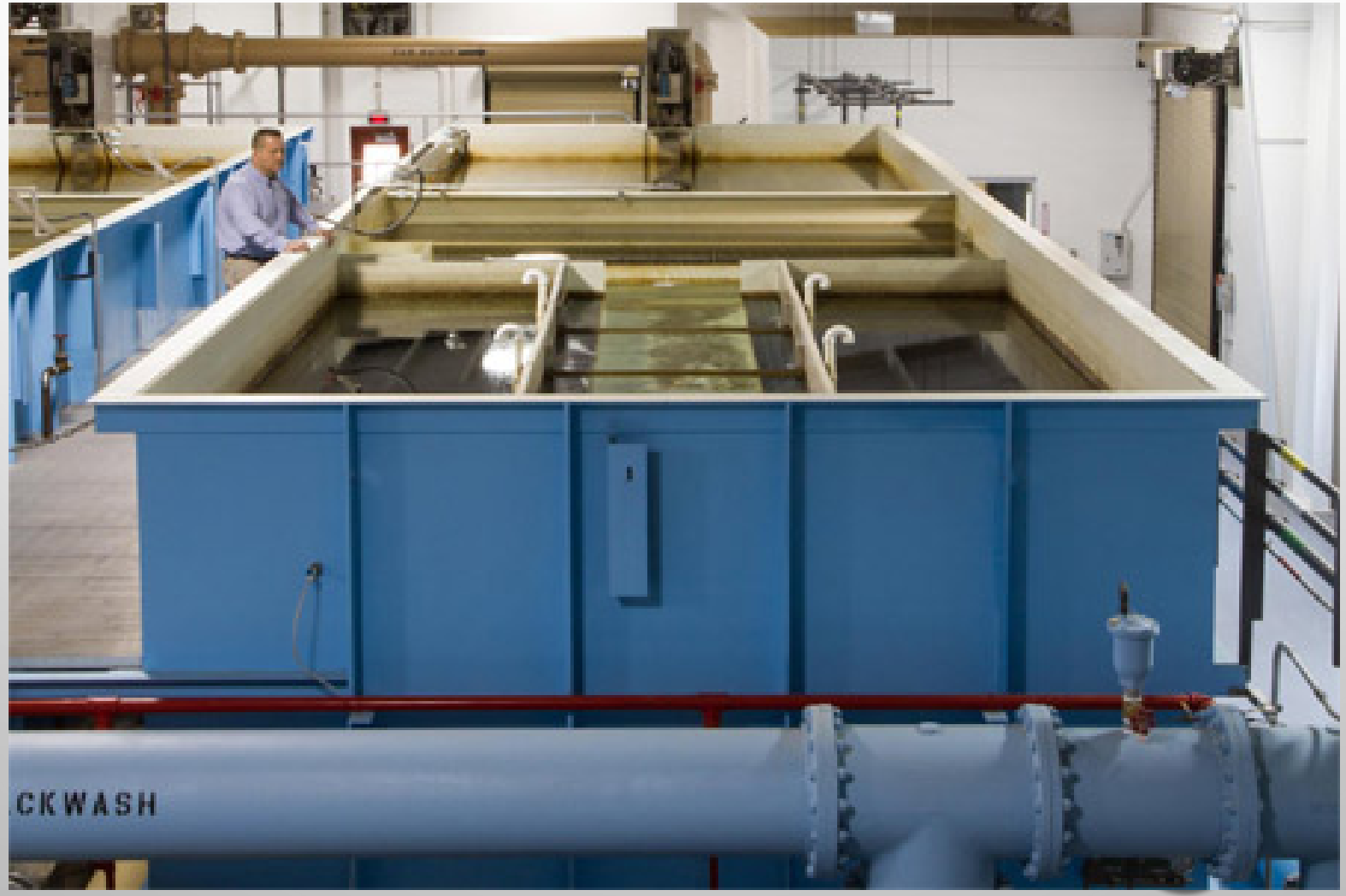
February 2011

Msc00003.dwg

SANTA BARBARA'S SURFACE WATER TREATMENT PLANT

GOLETA'S SURFACE WATER TREATMENT PLANT

ALTHOUGH NOT MONTECITO'S PLANT THEIRS IS SIMILAR TO THE PICTURE BELOW



TREATMENT STRATEGIES TO REDUCE DBPS

- SANTA BARBARA EVALUATED CONVERTING FROM FREE CHLORINE TO CHLORAMINES
  - REGIONAL WATER SUPPLIER
  - RETAILERS UTILIZE FREE CHLORINE FOR GROUNDWATER AND SURFACE WATER TREATMENT AT NUMEROUS LOCATIONS.
  - EVALUATION ELIMINATED THIS AS AN OPTION BECAUSE RETAILERS WOULD ALSO HAVE TO CONVERT TO CHLORAMINES AT ALL OF THEIR INDIVIDUAL CHLORINATION SYSTEMS.

TREATMENT STRATEGIES TO REDUCE DBPS

- ELIMINATION OR REDUCTION OF PRECHLORINATION
  - HISTORICALLY CHLORINATION AT THE HEADWORKS OF THE PLANT PROVIDED A RESIDUAL THROUGHOUT THE TREATMENT TRAIN.
  - HIGHER TOC IN THE SOURCE WATER RESULTED IN ELEVATED DISINFECTION BYPRODUCTS LEAVING THE TREATMENT PLANT.
    - INCREASED THE LIKELIHOOD OF EXCEEDING TTHM STANDARD IN THE DISTRIBUTION. ESPECIALLY SANTA BARBARA'S DOWNSTREAM RETAILERS.
  - GOLETA TRIMMED THE PRECHLORINATION DOSAGE TO PROVIDE A TRACE RESIDUAL GOING ONTO THE FILTERS.
  - SANTA BARBARA ELIMINATED PRECHLORINATION AND REPLACED IT WITH OZONE.
  - APPROACH REDUCTION/ELIMINATION OF PRECHLORINATION CAUTIOUSLY
    - IT MAY AFFECT THE EFFICIENCY OF THE COAGULATION PROCESS.
    - CHLORINE CONTACT TIME NEEDS TO BE REEVALUATED.

TREATMENT STRATEGIES TO REDUCE DBPS

- ADDING CARBON (PAC OR GAC) TO THE TREATMENT PROCESS
  - ADDING GAC TO THE FILTERS WILL REDUCE TOC… BUT NOT FOR VERY LONG
    - MONTECITO REPLACED FILTER MEDIA IN THEIR PACKAGE PLANT WITH GAC
    - GREAT REDUCTION FOR A SHORT PERIOD OF TIME .
      - ONLY FIRST MONTH HAD SIGNIFICANT DECREASE, LIMITED REDUCTION SECOND MONTH. AFTER THAT, NO MEASURABLE REDUCTION.
  - CONTINUOUS PAC ADDITION TO PRETREATMENT
    - EXPENSIVE
    - GENERATES A SIGNIFICANT AMOUNT OF SOLIDS.
      - SANTA BARBARA BUILT A SOLIDS HANDLING FACILITY AS A RESULT
    - SHORTENS RUN TIMES ON FILTERS
      - MAY IMPACT BACKWASH RECOVERY CAPACITY DUE TO MORE FREQUENT BACKWASHES
    - LIMITED TO CERTAIN TREATMENT PLANTS. NOT LIKELY FEASIBLE FOR A PACKAGE PLANT.

DISTRIBUTION STRATEGIES

- STAGE 2 DBPR WAS BEING ROLLED OUT AROUND THE SAME TIME AS THE WQ ISSUES ASSOCIATED WITH THE ZACA FIRE
- SANTA BARBARA AND MONTECITO COMPLETED DISTRIBUTION HYDRAULIC MODELS.
- WATER AGE DETERMINATIONS HELPED IDENTIFY WHERE IMPROVEMENTS COULD BE MADE.
  - LOOPED PIPE SYSTEMS WHERE POSSIBLE.
  - OPTIMIZE RESERVOIR OPERATION BY ALTERING FILL AND FULL SETPOINTS
    - ALLOWING AS MUCH OF THE TANK VOLUME TO CYCLE AS FREQUENTLY AS POSSIBLE.
- MIXING AND/OR AERATION IN LONG RESIDENCE TIME RESERVOIRS

DISTRIBUTION STRATEGIES

- TTHMS CAN BE SIGNIFICANTLY REDUCED IN THE DISTRIBUTION SYSTEM THROUGH AERATION. NOT AS EFFECTIVE ON HAA5S
- HENRY'S LAW CONSTANTS PROVIDE INFORMATION ON WHICH TTHMS ARE MOST EASILY REMOVED WITH AERATION. IF LARGE PERCENTAGE OF TTHMS ARE CHLOROFORM AND/OR BROMODICHLOROMETHANE, AERATION CAN BE VERY EFFECTIVE. THESE HAVE THE HIGHEST HENRY'S CONSTANT OF ALL FOUR TTHMS.
- CHLORINE RESIDUAL MONITORING DURING AERATION DID NOT SHOW A SIGNIFICANT REDUCTION IN CHLORINE RESIDUAL.
- MAY NEED TO ADD A BLOWER TO VACATE THE HEADSPACE IN THE RESERVOIR SO VOLATILIZED TTHMS ARE NOT REINTRODUCED INTO THE STORED WATER.
- DAILY REPORTING OF AERATION SYSTEM OPERATION TO SHOW ROUTINE TREATMENT IS BEING PROVIDED

THANK YOU

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