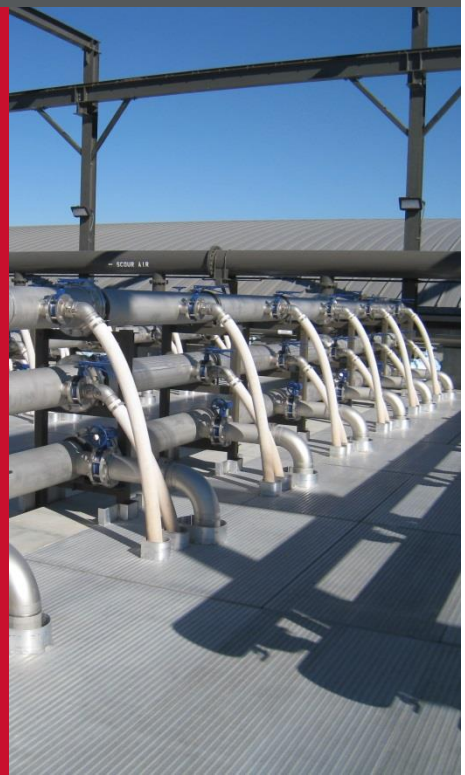


MBR Lessons Learned

Irvine Ranch Water District's Michelson Water Recycling Plant Phase 2 Expansion

Irvine Ranch Water District

Service area of 179 square miles is over 20% of Orange County

- **Potable Water**

  75% Groundwater & 25% Imported Water

- **Wastewater**

  23.5 MGD of Title 22 recycled water capacity

- **Recycled/ Non-potable Water**

  Irrigation, high-rise building toilet flushing, industrial use

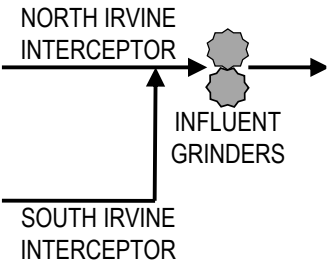
- **Urban Runoff Treatment**

  Man-made wetlands to treat dry weather runoff and first flush

Michelson Water Recycling Plant

- Existing plant produced approximately 18 MGD of Title 22 recycled water for unrestricted landscape irrigation
- Phase 2 Expansion increased capacity to 33 MGD

Michelson Water Recycling Plant
Existing Treatment Process



Phase 2 Expansion

- Increase capacity to approximately 33 MGD
- Completed 2014
- Expansion included
  - New Sewers
  - New Headworks
  - Expanded Primary Sedimentation Tanks
  - Expanded Flow Equalization Facilities
  - Upgrades to Conventional Activated Sludge Process
  - New High Rate Clarifier
  - New Membrane Bioreactor
  - New Ultraviolet Disinfection Process
  - Upgrades to Chlorine Contact Basin
  - Expansion of Recycled Water Pump Station
  - New Chemical Facilities
  - New Electrical Facilities

VOLUME 4A – CONSTRUCTION PLANS
FOR
IRVINE RANCH WATER DISTRICT

MICHELSON WATER RECLAMATION PLANT
PHASE 2 EXPANSION

PROJECT NUMBERS 20214 AND 30214

PREPARED:
HDR ENGINEERING, INC.
PRINCIPAL
BRUCE R. WILLEY R.C.E. 33687 DATE 12/05/08

IRVINE RANCH WATER DISTRICT

APPROVED:
IRVINE RANCH WATER DISTRICT
DIRECTOR OF ENGINEERING AND CONSTRUCTION
KEVIN L. BURTON R.M.E. 28632 DATE

MARCH 2009

CONFORMED DOCUMENTS: DATE: AUG 18, 2009

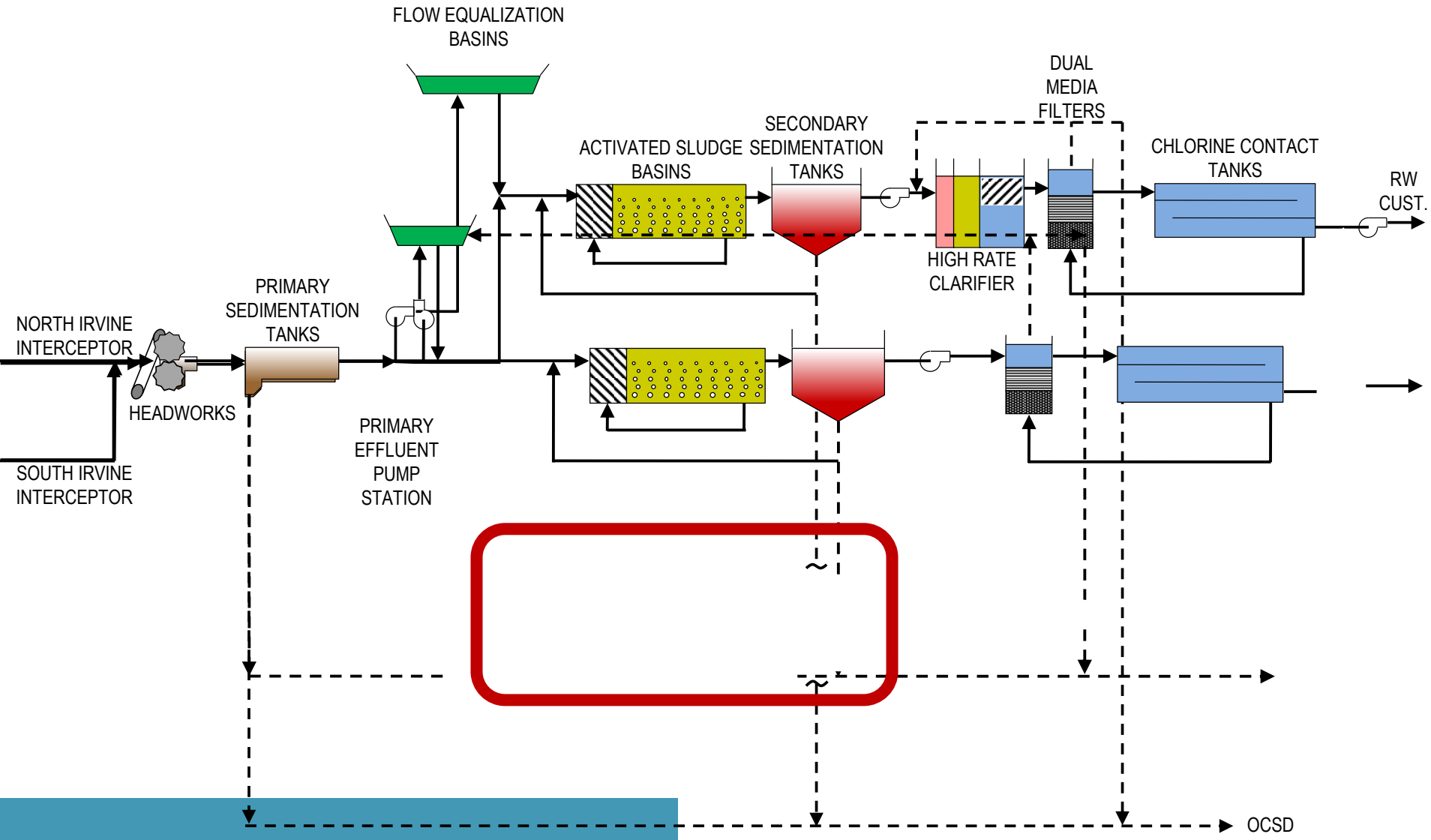
HDR Engineering, Inc.

TETRA TECH INC.

IRWD CODE 5184

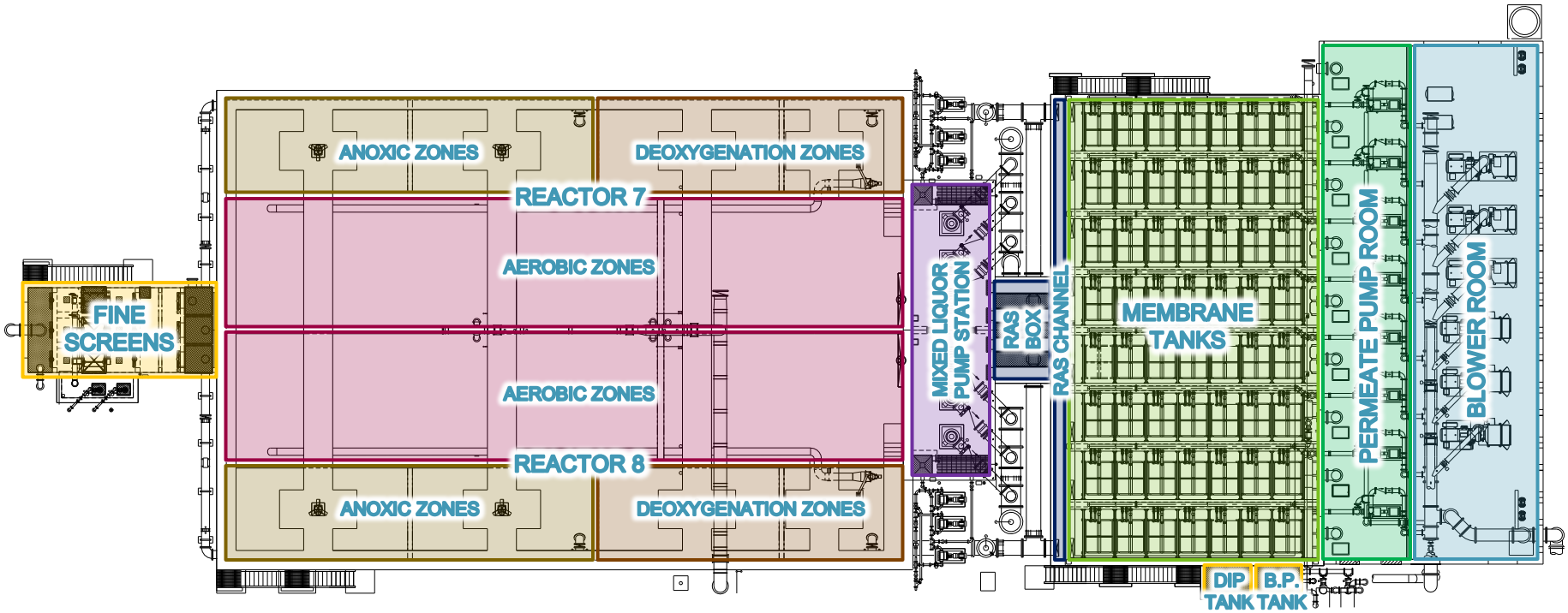
NO.	DATE	REVISIONS	APPROVED

Michelson Water Recycling Plant
Phase 2 Treatment Process



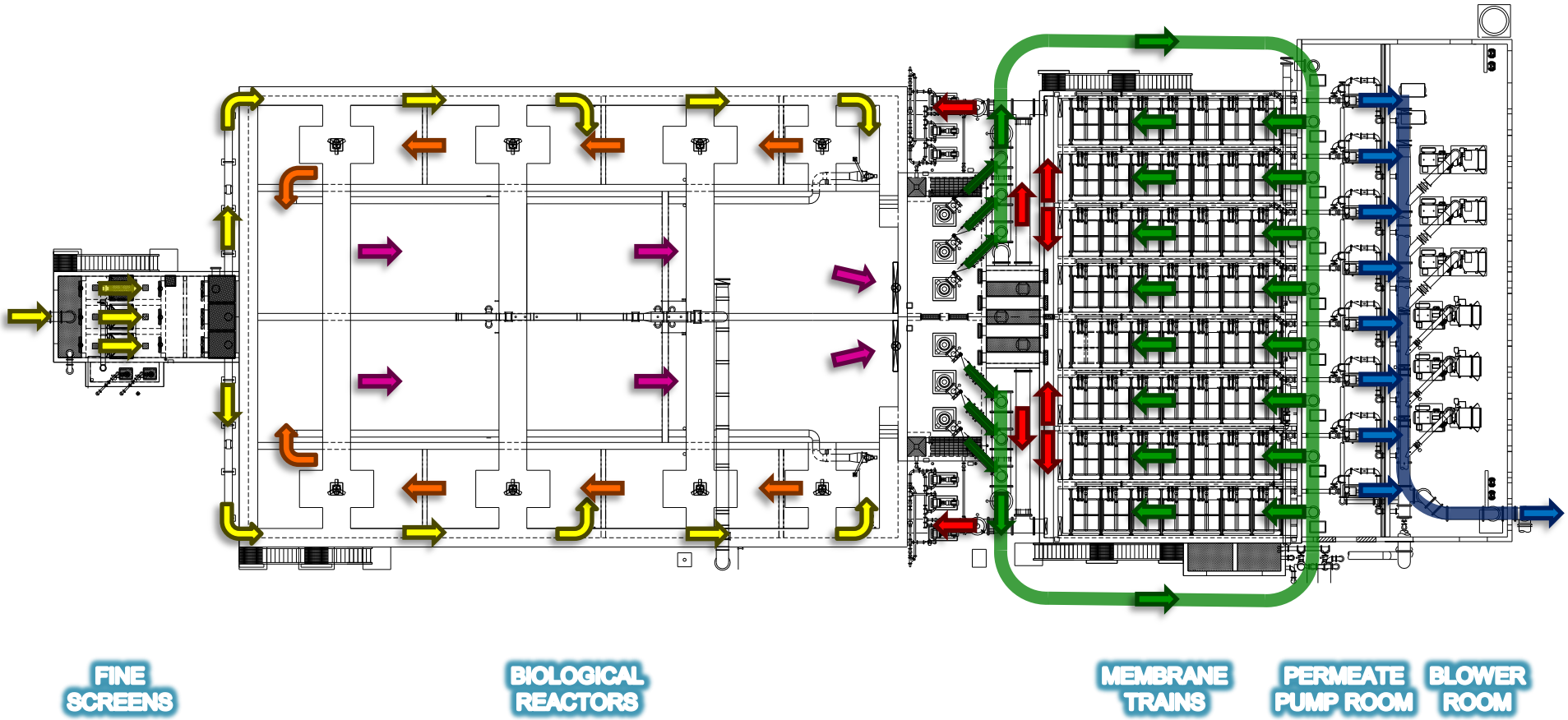
Membrane Bioreactor Design

- Evaluation and selection of membrane manufacturer
- Pre-purchase of membrane equipment
- Design around GE/Zenon ZeeWeed 500D Wastewater Membranes
- $9M for 10.6 MGD flow or 1,080,000 sq ft of membranes



Membrane Bioreactor

Michelson Water Recycling Plant



Membrane Bioreactor

Michelson Water Recycling Plant

Construction Sequencing

- Maintain existing plant capacity and operation
- Identify hydraulic and electrical tie-ins
- Set limits on shutdown durations
- General sequence of construction
- Detailed sequence for establishing biomass
- Detailed functional testing

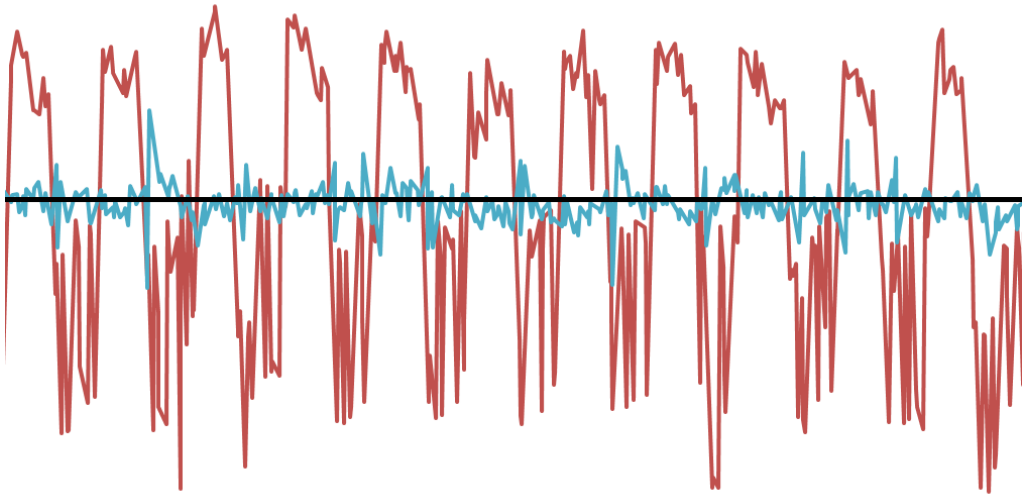
Foam and Mixed Liquor Management

- Create continuous unobstructed path for foam. Avoid traps/dead ends.
- Foam removal is continuous, which results in additional WAS.
- Solids concentration of Foam/WAS mixture is highly variable.
- Need means to measure flow and sample foam to accurately track solids inventory.

- Mixed Liquor internal bypass
- Mixed Liquor Re-screening

Permeate Flow Variation

- GE's standard programming results in a pulsed flow pattern.
- Discovered during commissioning.
- Impacts to downstream processes.



Membrane Handling and Tracking

- Proper storage - conditioned space.
- Educate crew on sensitive nature of the membranes.
- Membrane Tracking Tool
  - Serial Number
  - Moisture / Temperature history
  - Installed location
  - Damaged strands
  - Permeability history
- Training during startup
- Membrane Tank Access
- Bridge Crane Design

GE-Specific Lessons

- Permeate Pumps
- Cyclic Valves – LEAP Conversion

Questions

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