Potential Nutrient Reduction by Treatment Optimization and Treatment Upgrades – An Update

BACWA Membership Meeting
Oakland
30 Jan 2015

HDR
Brown AND Caldwell

BACWA
BAY AREA
CLEAN WATER
AGENCIES

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Drivers for Study

Watershed Permit

CALIFORNIA Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

San Francisco Bay Regional Water Quality Control Board

ORDER No. R2-2014-0014
NPDES No. CA0038873

WASTE DISCHARGE REQUIREMENTS FOR NUTRIENTS FROM MUNICIPAL WASTEWATER DISCHARGES TO SAN FRANCISCO BAY

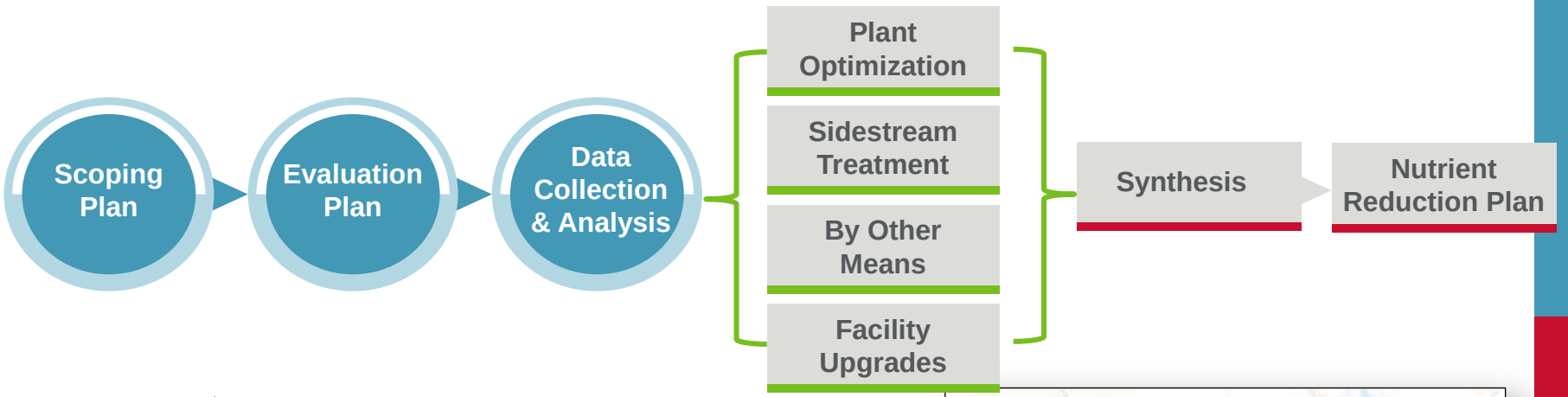
The following dischargers are subject to waste discharge requirements (WDRs) set forth in this Order, for the purpose of regulating nutrient discharges to San Francisco Bay and its contiguous bay segments:

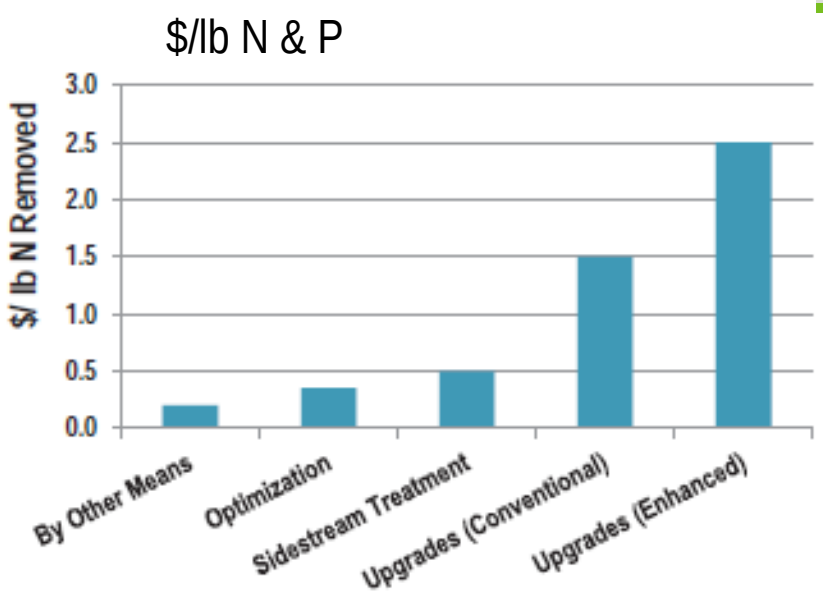
Table 1. Discharger Information

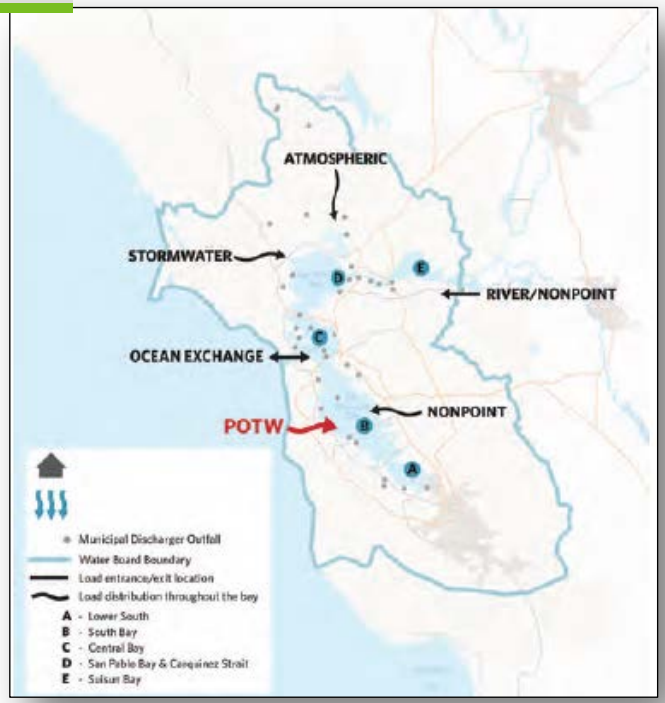
Discharger	Facility Name	Facility Address	Minor/ Major
		151 Mezzetta Court	

April 9, 2014

Study Results will Provide the Basis for Nutrient Reduction Strategies for the Bay







BACWA Group Report

- Consultant Management Group (CMG) oversees project
- Engaged HDR / BC team to conduct the study
- 37 plants
- Study in three phases
  - Scoping and Evaluation Plan
  - Execute plan and report
  - Annual reporting (through 2018)

Status

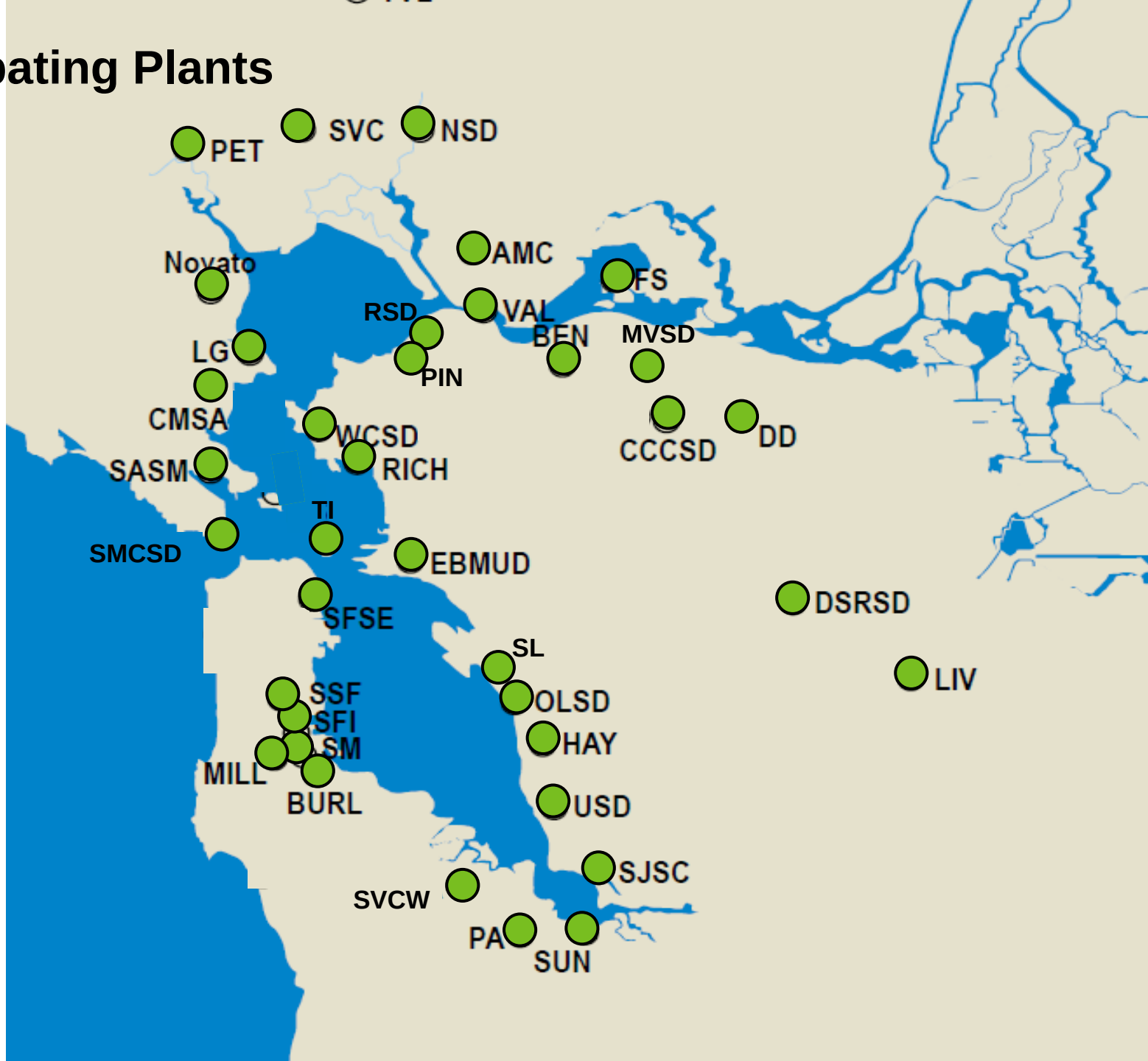
- Draft Scoping and Evaluation Plan
  - Presented to Water Board 15 Dec 2014
  - Responded to WB comments 19 Jan 2015
  - Waiting for final approval
- Initiated Data Collection
  - Questionnaire distributed in two parts
  - Part A due 21 Jan 2015 – Received 36 of 37 surveys
  - Part B due 18 Feb 2015

Scoping and Evaluation Plan

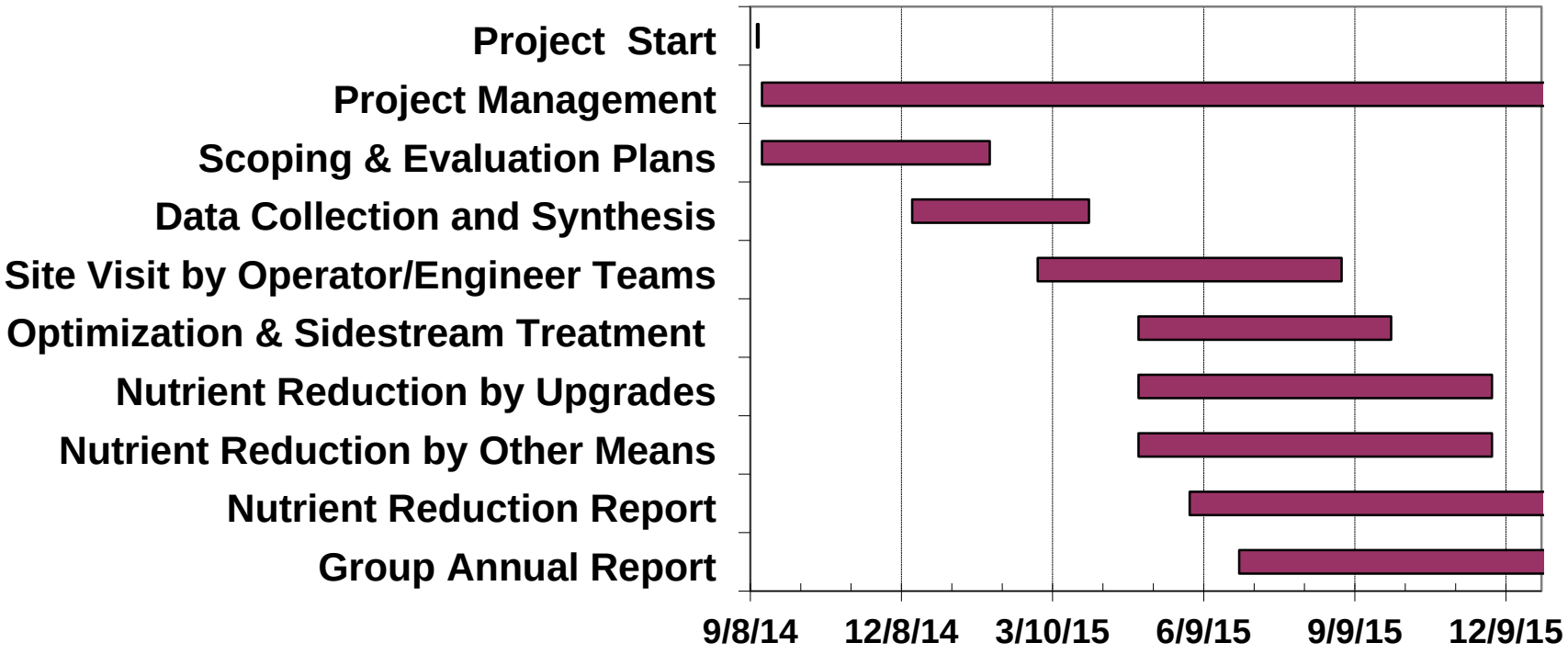
Scoping and Evaluation Plan Discussion Points

- List of participating facilities
- Schedule
- Nutrient Removal Levels
- Questionnaire
- Site Visits
- Plant Optimization
- Sidestream Treatment
- Plant Upgrades
- Nutrient Reduction by Other Means
- Economic Analysis

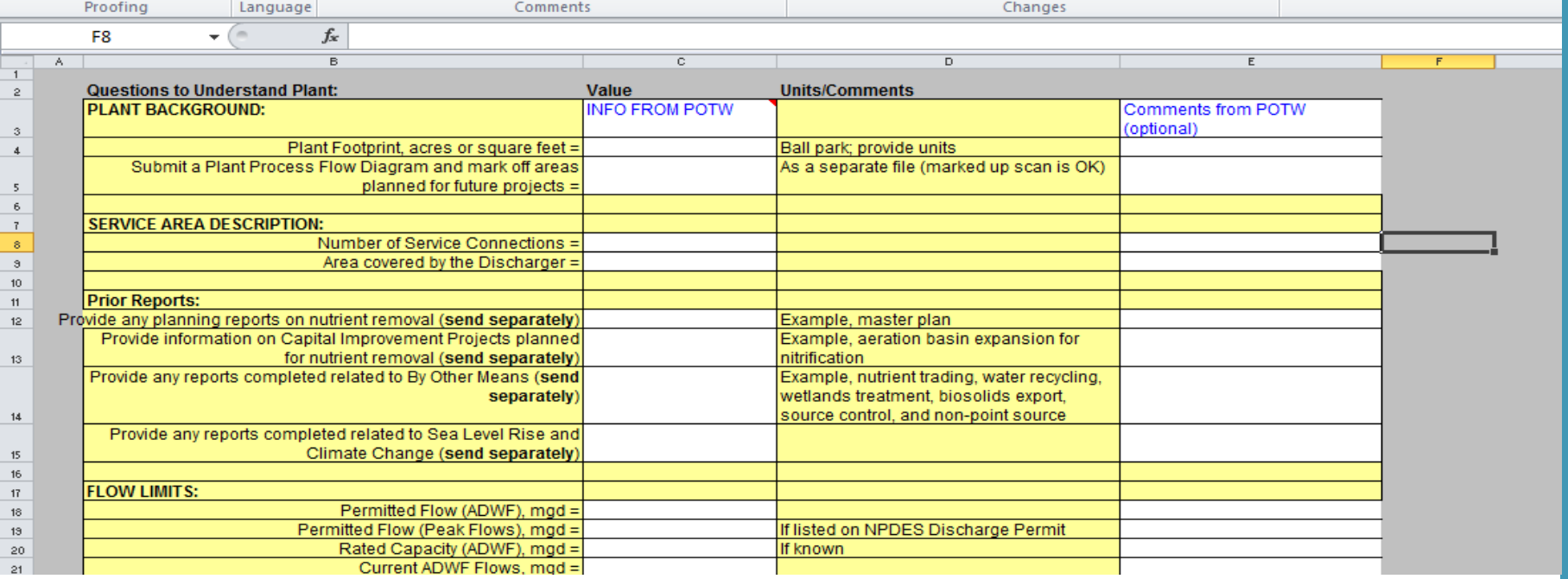
37 Participating Plants



Schedule



Report to Regional Water Board due 1 July 2018



Questions to Understand Plant:	Value	Units/Comments	
PLANT BACKGROUND:	INFO FROM POTW		Comments from POTW (optional)
Plant Footprint, acres or square feet =		Ball park; provide units	
Submit a Plant Process Flow Diagram and mark off areas planned for future projects =		As a separate file (marked up scan is OK)	
SERVICE AREA DESCRIPTION:			
Number of Service Connections =			
Area covered by the Discharger =			
Prior Reports:			
Provide any planning reports on nutrient removal (**send separately**)		Example, master plan	
Provide information on Capital Improvement Projects planned for nutrient removal (**send separately**)		Example, aeration basin expansion for nitrification	
Provide any reports completed related to By Other Means (**send separately**)		Example, nutrient trading, water recycling, wetlands treatment, biosolids export, source control, and non-point source	
Provide any reports completed related to Sea Level Rise and Climate Change (**send separately**)			
FLOW LIMITS:			
Permitted Flow (ADWF), mgd =			
Permitted Flow (Peak Flows), mgd =		If listed on NPDES Discharge Permit	
Rated Capacity (ADWF), mgd =		If known	
Current ADWF Flows, mgd =			

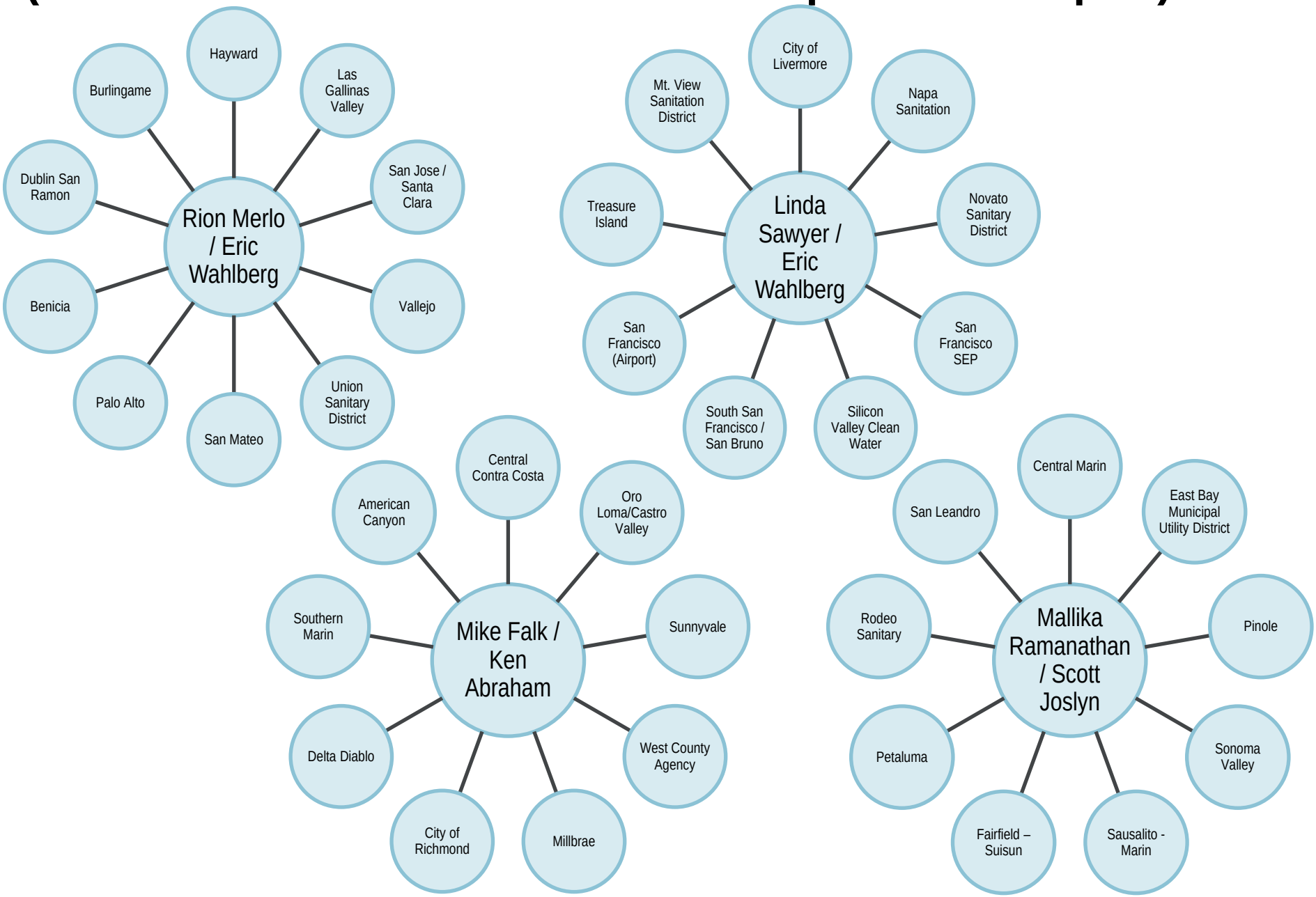
Questionnaire

Questionnaire

- Issued to Plants on 12/2/2014
- Series of webinars to assist plants with filling out
- Worksheet A deadline = 1/21/2015
  - Requests historical Influent, Effluent, and Sidestream data
  - Questions to Identify candidate plants for sidestream treatment
- Worksheet B deadline = 2/18/2015
  - Requests historical plant performance data
  - Series of questions to understand how plant operates
  - Requests prior reports on nutrient removal and by other means

Site Visits

Tactical Site Visits for Each Plant
(Each Visit Includes a Process and Operations Expert)



Typical Site Visit Schedule

- Site visits schedule: spring through summer
- 2 person Operator/Process Engineer teams
- Spend several hours at each plant
- Meet with operation staff

Site Visit Expectation from Plant

- Team will contact Point of Contact (POC) to set up appointment with appropriate staff
- Team will explain additional information needs (example drawings, flow diagrams, SOPs, etc.)
- Day of visit:
  - Have the key staff available that day (1-2 staff)
  - Plan to spend 3-6 hours – depending size and scope
  - Include other appropriate staff (laboratory, process analysist, etc)

THIS IS A COLLABORATIVE EFFORT – BE PREPARED TO DISCUSS NUTRIENT REDUCTION IDEAS YOU ALREADY HAVE

Post Site Visit Expectations

- Site Visit Report
  - Expect to receive short report within 2 weeks
  - Review and comment
  - Respond to questions noted in report
- Plant Nutrient Reduction Report
  - Schedule: Fall 2015
  - Review and provide written comments on Draft Report
  - Review Final Report
  - Obtain official signatory to acknowledge

Nutrient Removal Levels

Treatment Levels

Level	Study	Ammonia	TN	TP
Level 1 *	Optimization	--	--	--
Level 2 *	Upgrades	2 mg N/L	15 mg N/L	1.0 mg P/L
Level 3 *	Upgrades	2 mg N/L	6 mg N/L	0.3 mg P/L

* The seasonal impacts will be considered for all three treatment levels:
Dry Season = May 1 to September 30
Wet Season = October 1 to April 30

Plant Optimization

Overview of Plant Optimization

- Identify available facilities that can be used for nutrient reduction
  - Facilities not in normal use
  - Abandoned facilities/Empty tankage
- Identify strategies that can reduce nutrient discharge
- Determine cost, implementation requirements & plant impacts
- Consider innovative technologies/techniques
- Discuss ideas with plant staff and get feedback

Optimization Strategies – Low Cost

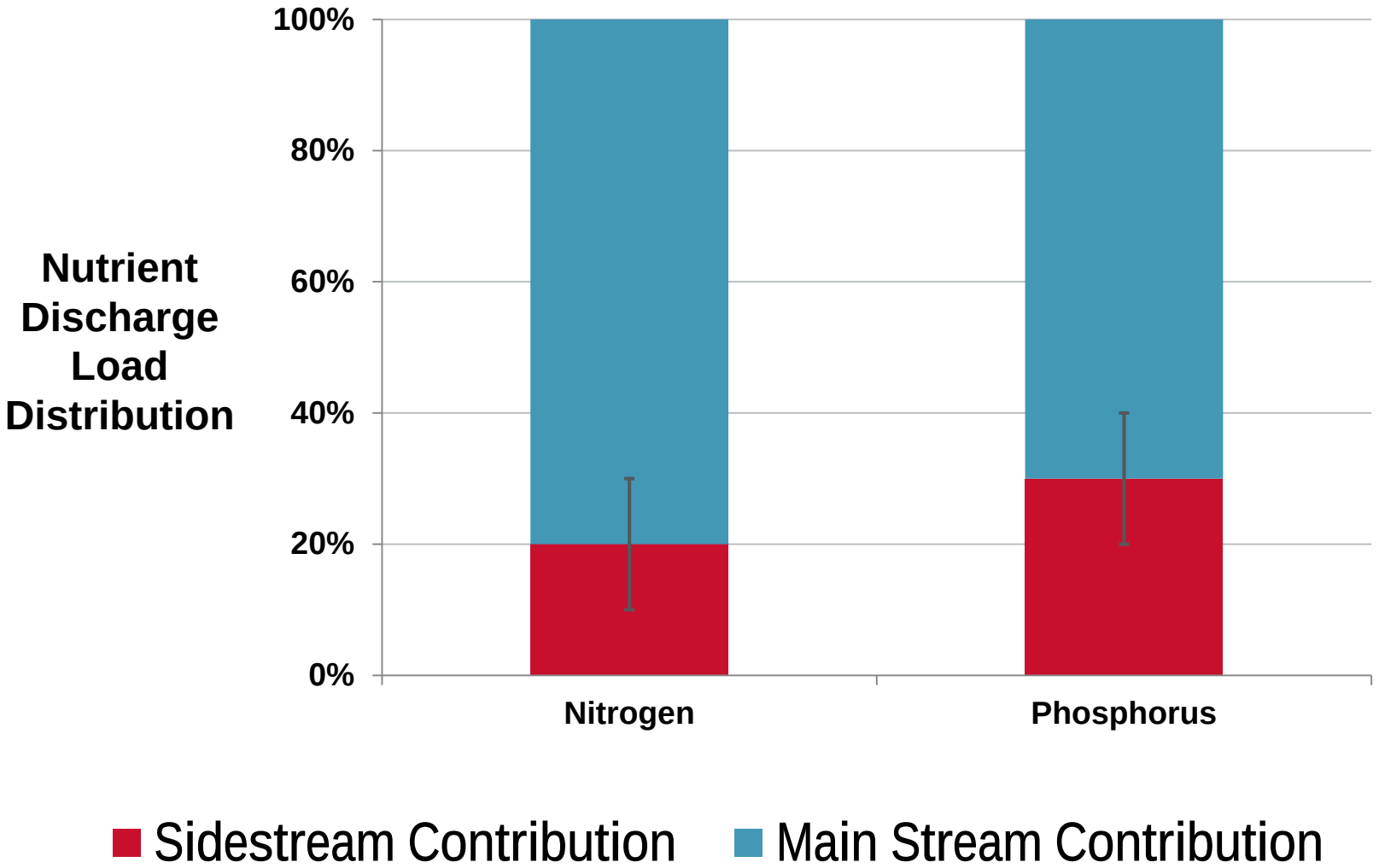
- Use offline tankage
- Modify operational mode, such as raising the solids residence time
- Modify blower operating set points
- Operate in split treatment mode
- Change to simultaneous nitrification/denitrification operation
- Shut down aeration to create anoxic zones

Optimization Strategies – Medium Cost

- Add instruments for nutrient removal in ammonia based aeration control mode
- Add chemicals for phosphorus removal
- Add chemicals to reduce load, unlock capacity
- Add anoxic and/or anaerobic zones for biological nutrient removal
- Add internal recycle for denitrification
- Add mixers for unaerated zones

Side Stream Treatment

Sidestream Nutrient Load Contributions



EPA Sidestream Grant – Piloting Efforts

EBMUD:
Deammonification
- Suspended growth
- Attached growth

Ongoing

SFPUC:
Deammonification
- Suspended growth
- Attached growth
- Biozeolite

Operated for 3-5 months

CCCSD: Zeolite anammox **Started**

DD: CANDO **Schedule extended**

OLSD: Zeolite anammox **Started**

USD: Krüger Anita™ Mox **Completed**

CANDO = Coupled Aerobic-anoxic Nitrous Decomposition Operation process, DD = Delta Diablo, OLSD = Oro Loma Sanitary District
USD = Union Sanitary District; SFPUC = San Francisco Public Utilities Commission

Decision Tree to Identify Candidate Plants

Anaerobic Digestion & Dewatering?

No → Not Applicable

Yes ↓

Water Quality
Temperature > 30 C
NH4 > 500 mg/L
Alk ~ 50% needed

No → Ammonia Recovery Process (ARP)
Conventional Nitrification to NO3 *
Conventional Nit/Denit*

Yes ↓

Deammonification
Nitrite Shunt
CANDO
Ammonia Recovery Process (ARP)
Conventional Nitrification to NO3*
Conventional Nit/Denit*

* May require alkalinity and/or carbon addition

Plant Upgrades

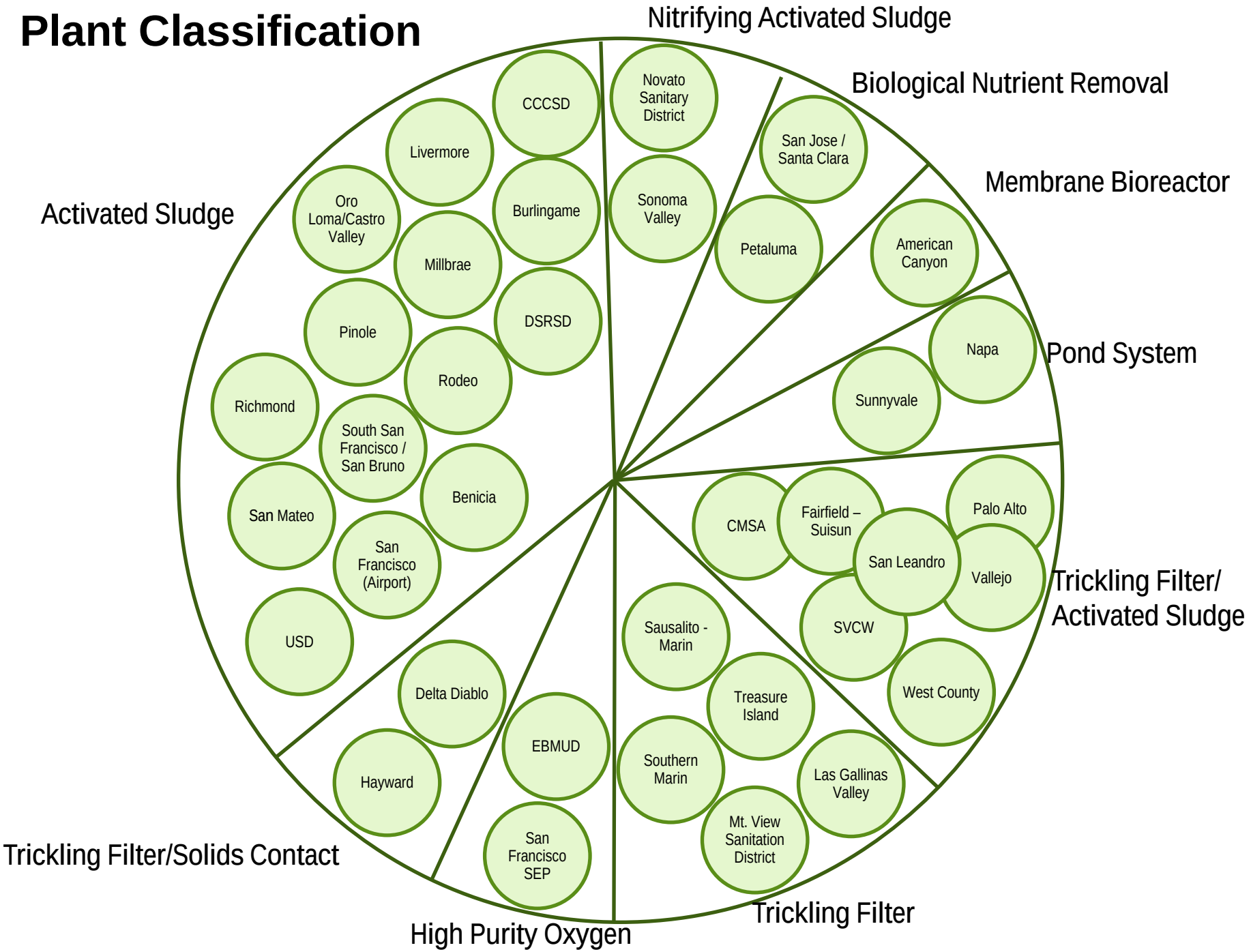
Overview of Plant Upgrades

- Evaluate masterplan and CIP for future upgrades
- Identify strategies that can reduce nutrient discharge to Level 2 and Level 3
- Select appropriate technology (next slides)
- Determine cost, implementation requirements & plant impacts
- Consider innovative technologies/techniques
- Discuss ideas with plant staff and get feedback

Determining Requirements for Plant Upgrades

- Determine capital and O&M costs as well as footprint requirements
- Summary of adverse and ancillary benefits (e.g., GHG emissions impacts)
- Estimates of nutrient reduction and unit costs (e.g., $/lb nutrient; lb GHG/lb nutrient)
- Existing evaluations (e.g. Master Plans) will be used, where appropriate
- Provide recommendations for consideration of emerging technologies in the future

Plant Classification



Distilling Complexity Down to Simplicity

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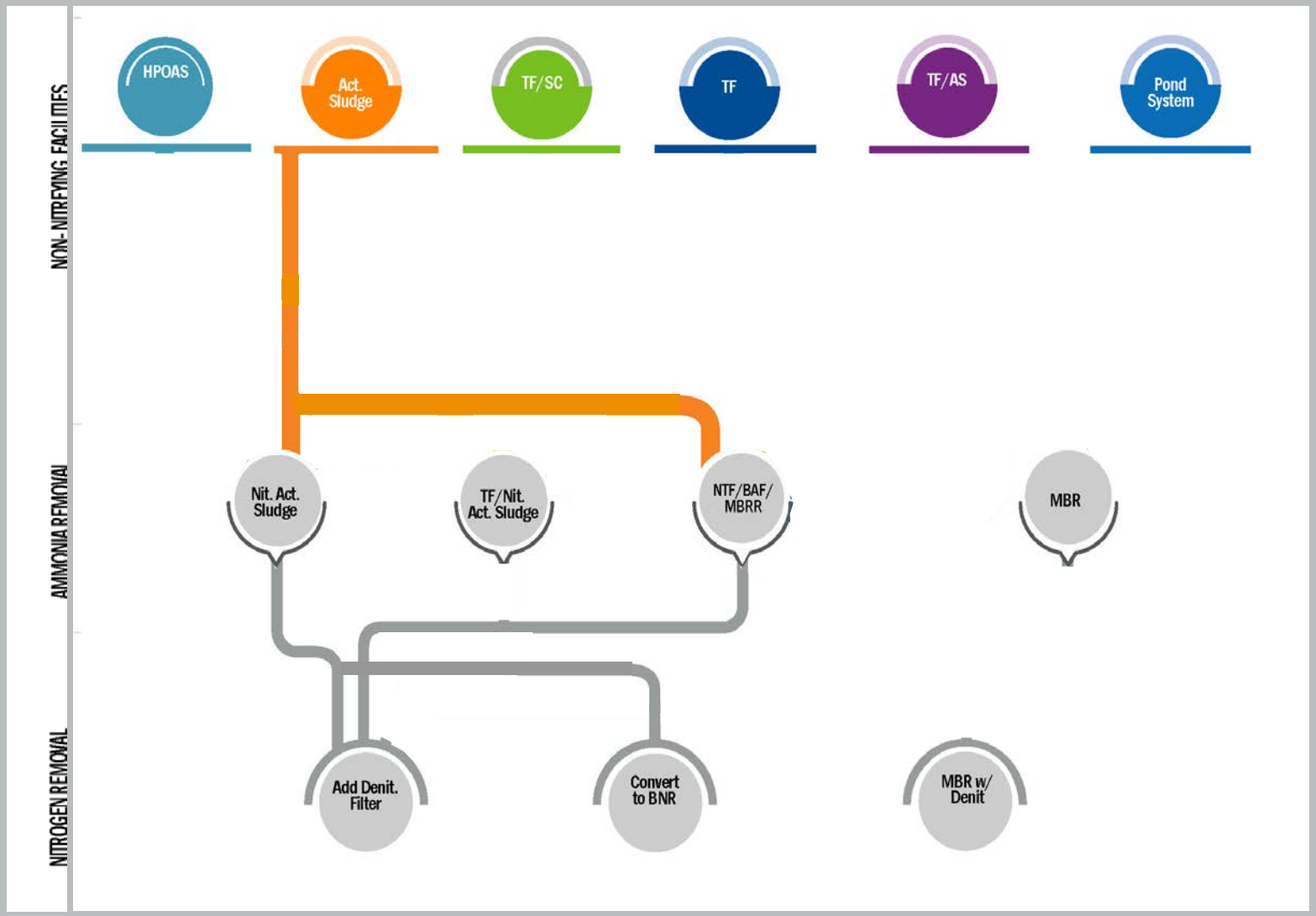

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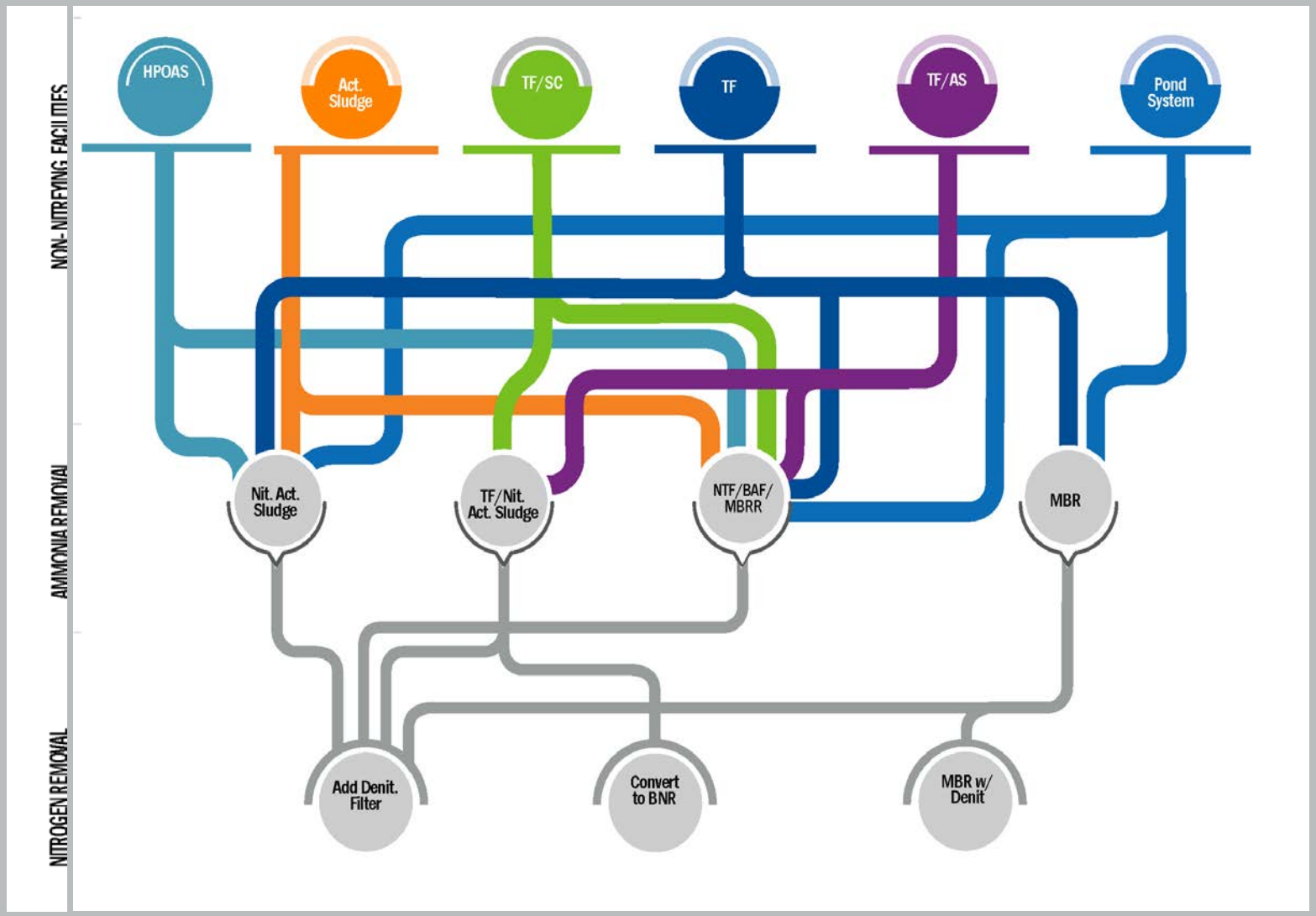
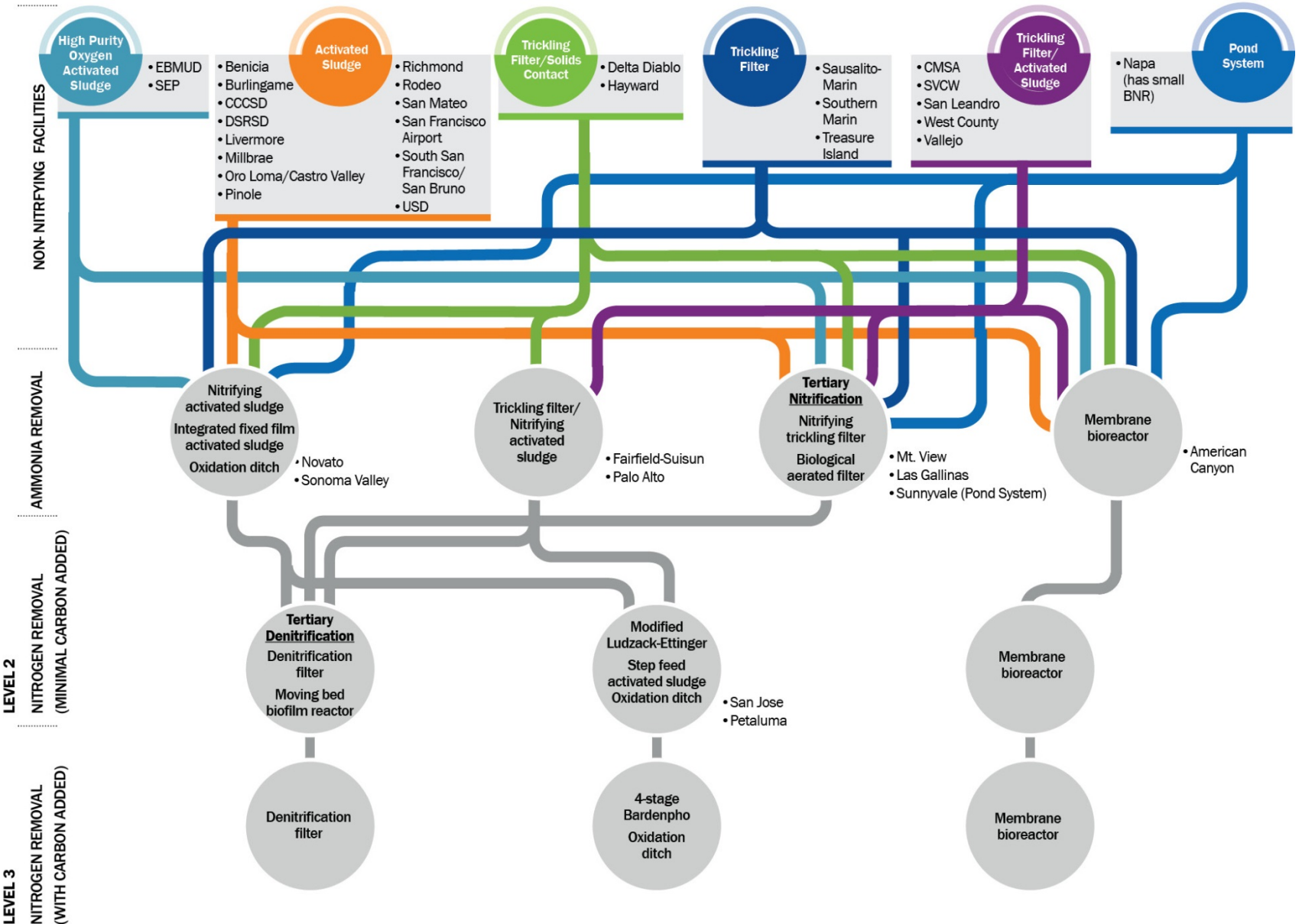
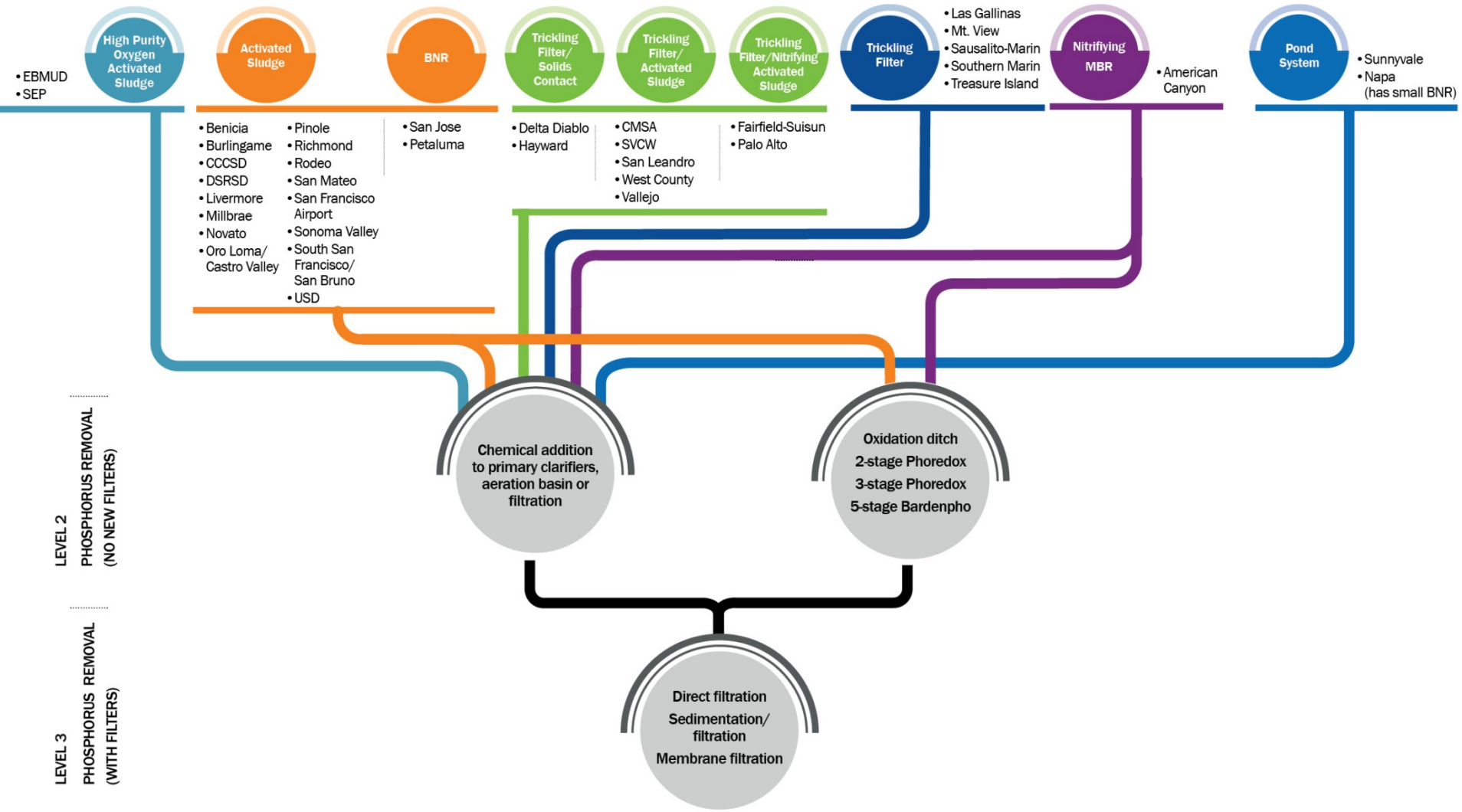


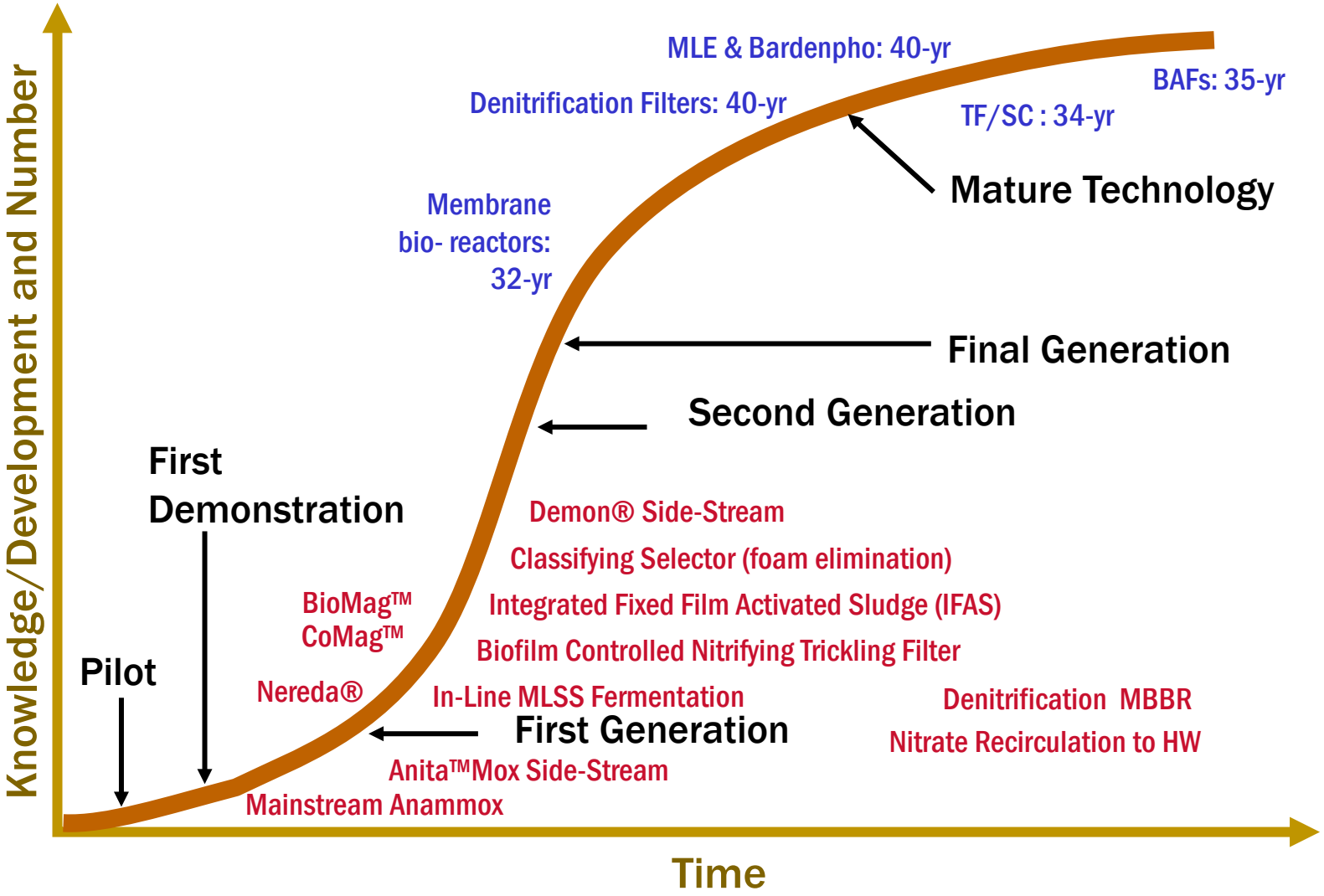
A Step-Wise Approach to Nitrogen Removal



Step-Wise Approach for Phosphorus Removal



Utilize Established Technologies to Determine Cost and Footprint Sizing



Nutrient Reduction by Other Means

Approach to Reduction by other Means

- Nutrient Removal by Other Means Includes
- Compile results from prior utility reports
- Summarize from reports
  - Reduction
  - Secondary impacts

<u>Other Means (examples)</u>

- Effluent Management (e.g. water recycling, trading)
- Effluent Polishing: (wetlands treatment)
- Nutrient recovery
- Source Control: (e.g. urine separation)

Impacts of Sea Level Rise

Impacts of Sea Level Rise and Climate Change

- Adaptation Plan: Identify the planned upgrades or modifications to address sea level rise and climate change for each discharger
- Plant Upgrades: Consider the impacts of planned nutrient upgrades on the Adaptation Plan
- Plant Optimization: Consider how any recommended nutrient optimization strategies might conflict with the Adaptation Plan
- By Other Means: Consider how any identified nutrient reduction strategies by other means strategies might conflict with the Adaptation Plan

Economic Evaluation

Capital/Construction Costs

- Class 4 Estimate: -20% to +40%
- Use Several Sources in Combination:
  - HDR Water Cost Model (Parametric estimate)
  - Equipment cost and layout estimates
  - Estimates from existing reports
  - Estimates from comparable projects
- Add Contingencies
  - Undefined items
  - Professional services
  - Soil conditions, etc.
- Exclude: Real estate

Operating Costs

- Chemical usage (lb/yr)
- Power consumption (kWh/yr)
- Labor (hr/yr)
- Assign unit rates

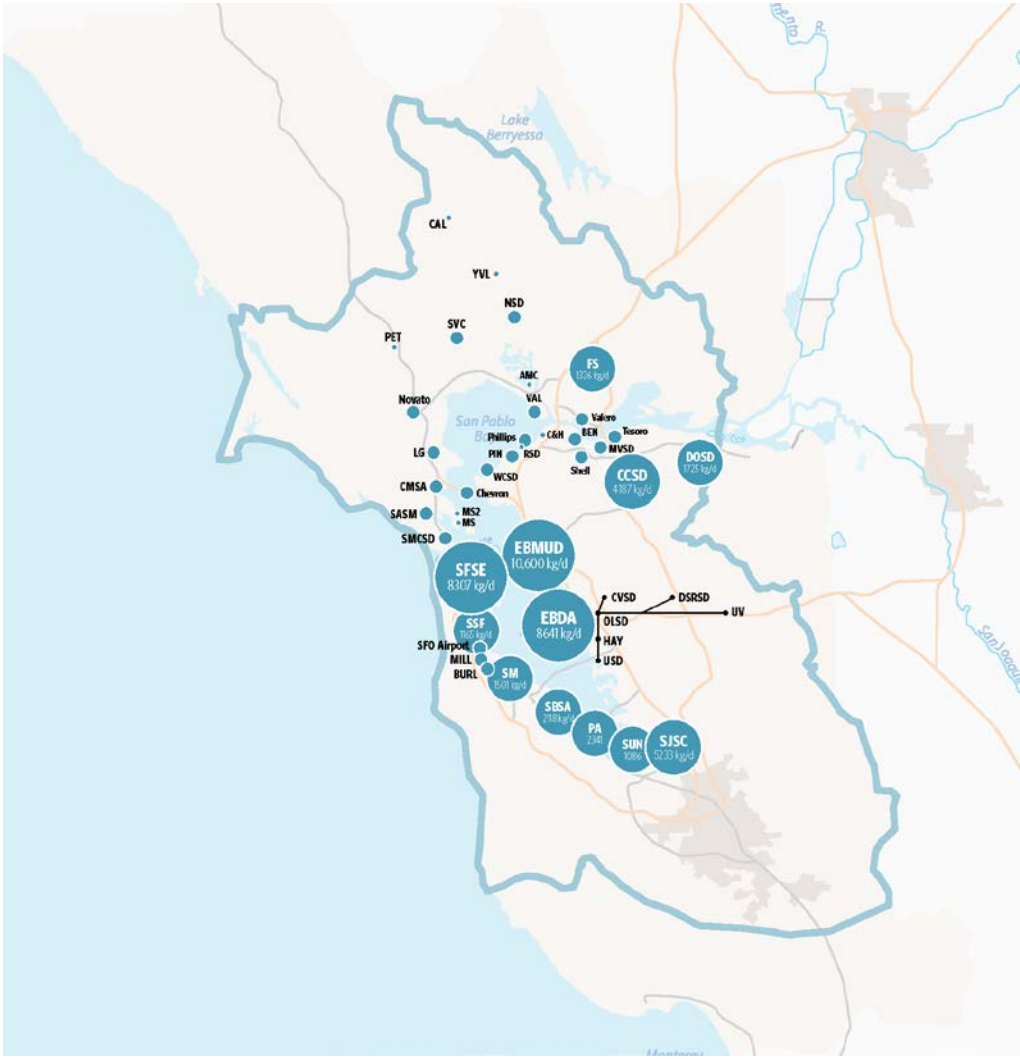
Life Cycle Cost

- Present worth of Capital and Operating Costs
- Inflation rate
- Interest rate
- Period

Annual Reporting

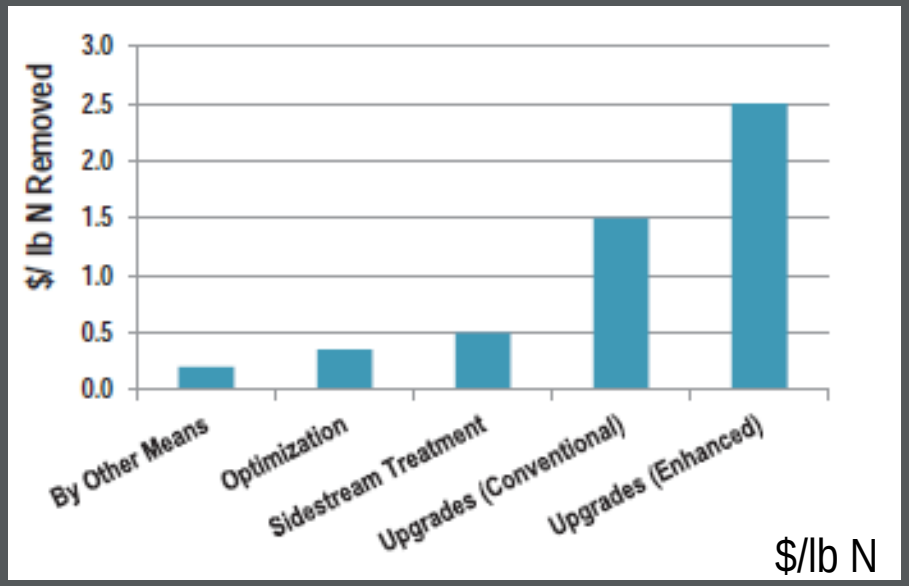
Annual Reporting

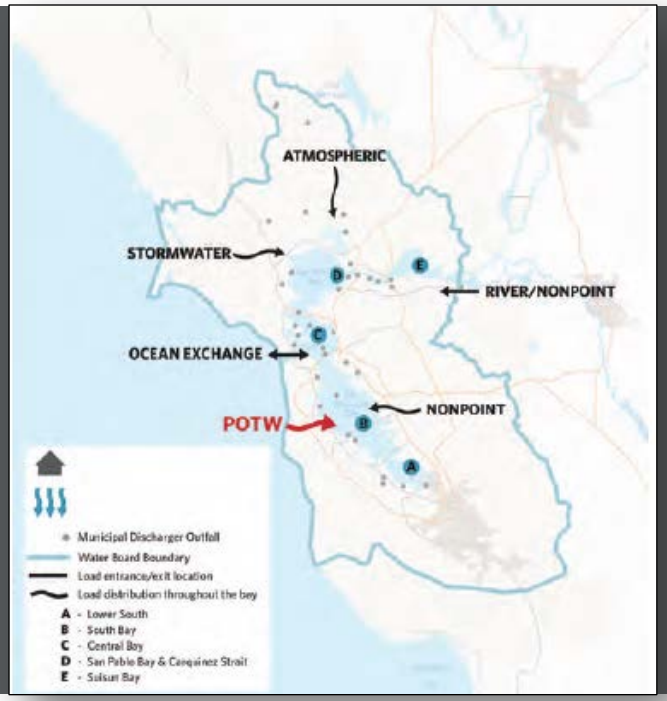
- Ongoing effort documents nutrient loading to SF Bay
- Determine changes and trends and causes for change
- Annually collect data for plants (CIWQS program)
- Verify data
- Compile trends and report
- Due Sep 1 each year



Nutrient Reduction Report

Study Results will Provide the Basis for Nutrient Reduction Strategies for the Bay





Scoping Plan → Evaluation Plan → Data Collection & Analysis

- Plant Optimization
- Sidestream Treatment
- By Other Means
- Facility Upgrades

→ Synthesis → Nutrient Reduction Plan

HDR Brown AND Caldwell

Potential Nutrient Reduction by Treatment Optimization and Treatment Upgrades

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30 January 2015

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Worksheet B – General Info/Sidestream Treatment Questions

- General Plant Info
- Prior Reports (Nutrient Removal, CIP, By Other Means)
- Flows (Current and Permitted Capacity)
- Constituent Limits
- Energy Demand
- Chemical Demand
- Info on Recycled Water
- Unit Process Questions

Worksheet B – General Info/Sidestream Treatment Questions

	A	B	C	D	E
1					
2		**Questions to Understand Plant:**	**Value**	**Units/Comments**	
3		**PLANT BACKGROUND:**	INFO FROM POTW		Comments from POTW (optional)
4		Plant Footprint, acres or square feet =		Ball park; provide units	
5		Submit a Plant Process Flow Diagram and mark off areas planned for future projects =		As a separate file (marked up scan is OK)	
6					
7		**SERVICE AREA DESCRIPTION:**			
8		Number of Service Connections =			
9		Area covered by the Discharger =			
10					
11		**Prior Reports:**			
12		Provide any planning reports on nutrient removal (**send separately**)		Example, master plan	
13		Provide information on Capital Improvement Projects planned for nutrient removal (**send separately**)		Example, aeration basin expansion for nitrification	
14		Provide any reports completed related to By Other Means (**send separately**)		Example, nutrient trading, water recycling, wetlands treatment, biosolids export, source control, and non-point source	
15		Provide any reports completed related to Sea Level Rise and Climate Change (**send separately**)			
16					
17		**FLOW LIMITS:**			
18		Permitted Flow (ADWF), mgd =			
19		Permitted Flow (Peak Flows), mgd =		If listed on NPDES Discharge Permit	
20		Rated Capacity (ADWF), mgd =		If known	
21		Current ADWF Flows, mgd =			
22					
23		**BOD LIMITS:**			
24		Permitted BOD Discharge Limit (AVERAGE MONTH) =		Example, 10 mg/l	

Worksheet B – Data Request Matrix

Data is Prioritized

Data Priority Numbering system	
1 = Required/Essential	
2 = Would like to have numbers	
Grey = Not needed	

Component	Description	Method Comment	Primary Effluent	Primary Solids
Flow	Flow	Flowmeter info		1
BOD5 OR cBOD	5-day BOD OR carbonaceous BOD		1	
sBOD	Soluble BOD5	Sample filtered through 0.45 um filter. Analyze BOD5 of filtrate.	2	
COD	Chemical Oxygen Demand		2	
sCOD	Soluble COD	Sample filtered through 0.45 um filter. Analyze COD of filtrate.	2	
TSS	Total suspended solids		1	1
VSS	Volatile suspended solids		2	2
NH4	Ammonia		1	
TKN	Total Kjeldahl Nitrogen		1	

Worksheet B – Sample Data

	A	B	C	D	E	F	G	H	I
1									
2	**SamplePoint**	Primary Clarifiers		Primary Effluent	Primary Effluent	Primary Effluent	Primary Effluent	Primary Effluent	Primary Effluent
3	**SampleName**	Number of Units in Service		BOD	soluble BOD	COD	soluble COD	TSS	VSS
5	**Sampling Type**	No		Composite (Flow-Paced)	Composite (Flow-Paced)	Composite (Flow-Paced)	Composite (Flow-Paced)	Composite (Flow-Paced)	Composite (Flow-Paced)
6	**Date**	Unitless		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
7	(OPTIONAL) Comment per Constituent								
8	EXAMPLE, 6/30/2014	4.00		150.00	120.00	200.00	160.00	100.00	80.00
9									
10	7/1/2011								
11	7/2/2011								
12	7/3/2011								
13	7/4/2011								