BACWA Annual Meeting:
Nutrients Update

January 11, 2019

HDR
Brown AND Caldwell

BACWA
BAY AREA
CLEAN WATER
AGENCIES

Acknowledgements

- Bay Area Clean Water Agencies (BACWA) and all the Member Agencies
- Regional Board
- Support staff at HDR and Brown and Caldwell
- BACWA Contract Management Group (CMG)
- EPA Regional Sidestream Grant (led by EBMUD)
- San Francisco Estuary Institute (SFEI)

Agenda

1. Nutrient Reduction Study Final Report
2. Group Annual Report (2018 and Beyond)
3. Q & A
4. Brochure and Presentation

01

Nutrient Reduction Study Final Report

1. Nutrient Reduction Final Report

Agenda

1. Background
2. Study Limitations
3. Nutrient Reduction Study Findings
4. Key Observations

1. Background

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

April 9, 2014

37 Participating Agencies

7+ Million
Service Population

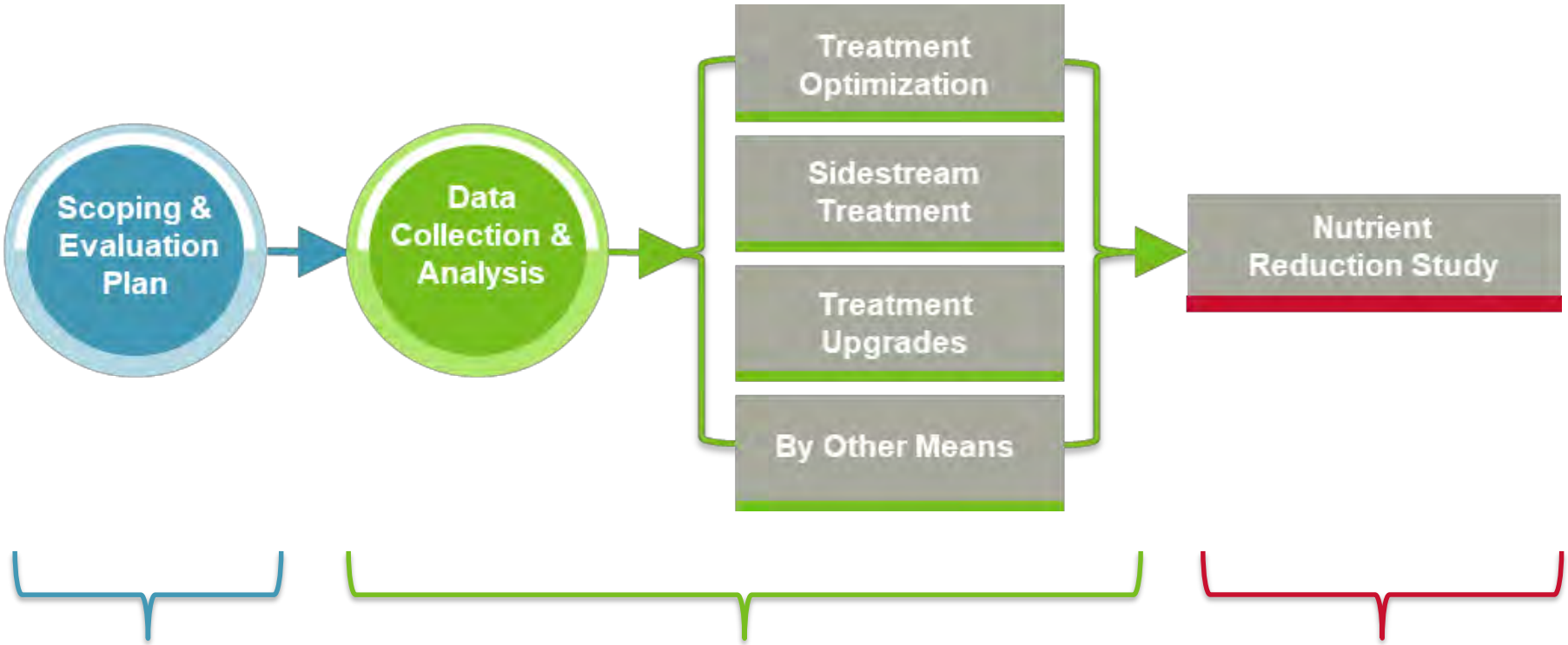
37
WWTPs

Treats ~450
Mil Gals per Day

- Plants range from 1–167 mgd
- Approx. Half of the Plants are <10 mgd
- Each WWTP is unique

Wastewater Treatment Plants Represent about 2/3's of Nutrient Discharge Loads to the Bay

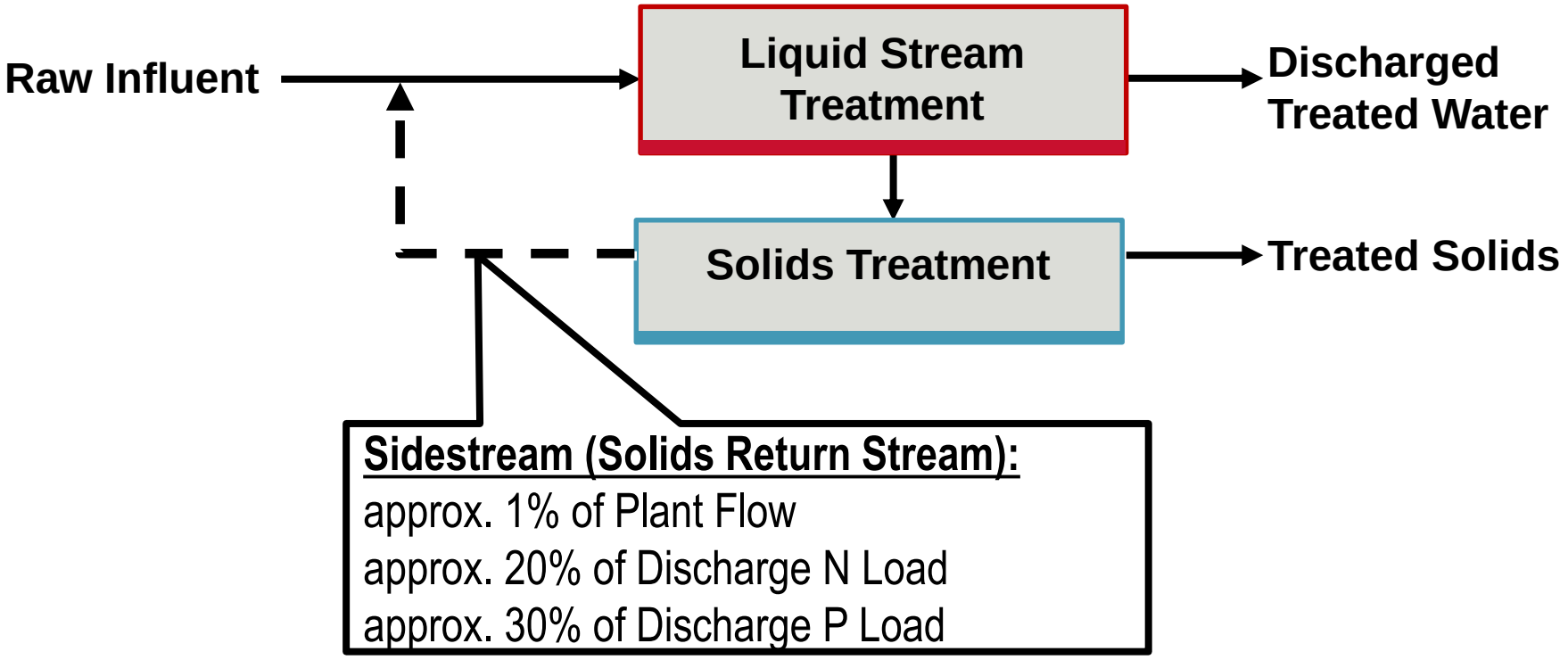
Project Approach Summary



Treatment Levels

Level	Study	Ammonia	TN	TP
Level 1	Optimization / Sidestream	--	--	--
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

What is the Sidestream? The nutrient-rich water extracted during solids treatment



2. Study Limitations

Study Limitations

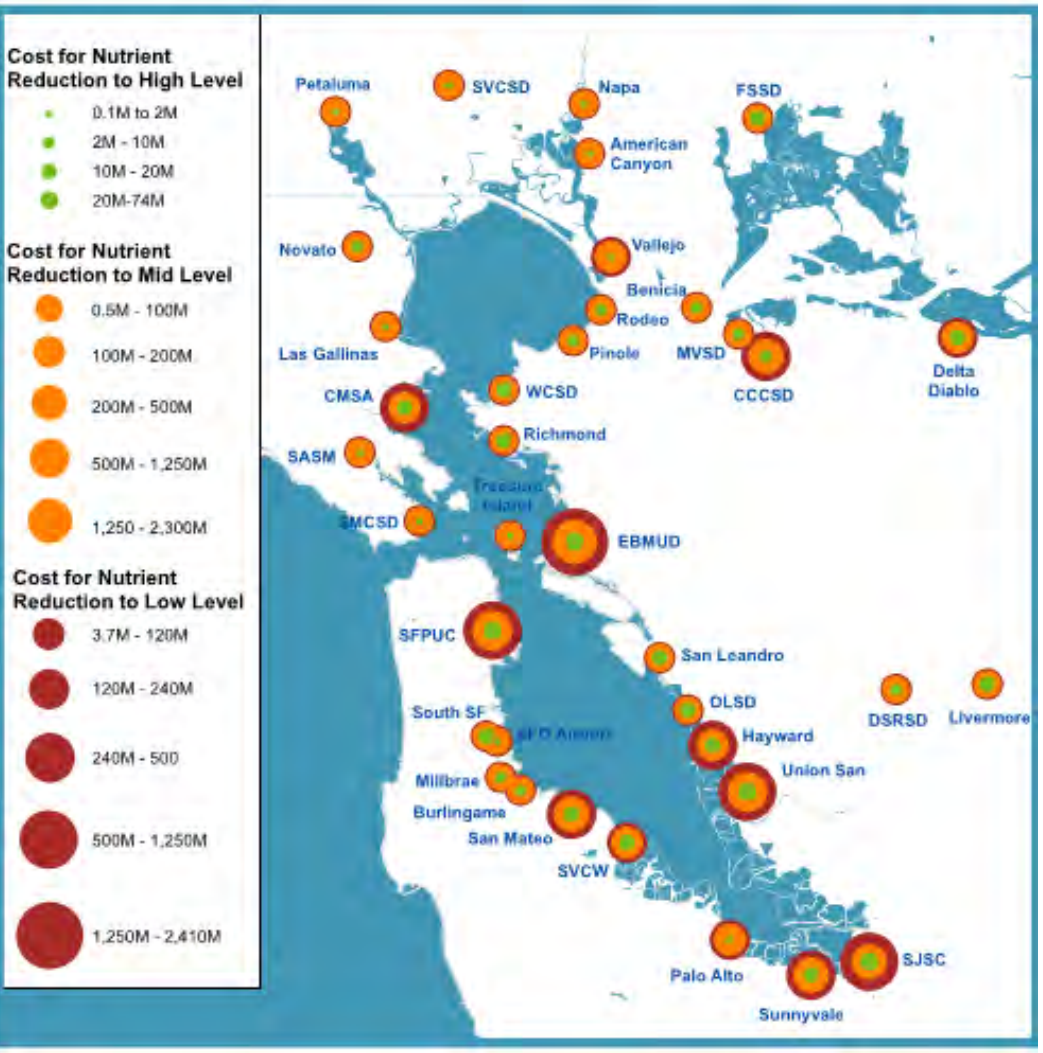
1. Treatment levels are based on treatment performance (not water quality needs of the Bay)
2. Technology selection considered removal of all 3 nutrients (ammonia, TN, and TP)
3. Costs are based on established technologies (not emerging technologies)
4. Planning level effort (not a basis of design report)

3. Nutrient Reduction Study Findings

Nutrient Reduction Study Report (June 2018)

- Main report summarizes study findings for all plants
- 37 individual plant appendices:
  - Existing plant data
  - Optimization
  - Sidestream treatment
  - Plant upgrades
  - Emerging technologies

Study Findings for Total Nitrogen (TN) Load Reduction Across the Bay



Strategy	TN Load Reduction to the Bay	Capital Cost	Total Present Value
Optimization	7%	$119 M	$266 M
Sidestream Treatment	19%	$391 M	$736 M
Upgrade Level 2	57%	$7.0 B	$9.4 B
Upgrade Level 3	82%	$8.5 B	$12.4 B

4. Key Observations

Key Observations

1. Treatment upgrades come with significant cost
2. Nutrient reduction results in:
   - Increase in energy and chemical demands
   - Increase in greenhouse gas emissions
   - Reduction in chemicals of emerging concern discharged to the Bay
   - Reduction in solids produced at treatment plants
3. Each plant is unique and the costs vs. nutrient reduction potential are wide-ranging. The information in this study provides a menu to optimize the tradeoffs between costs and nutrient reduction.

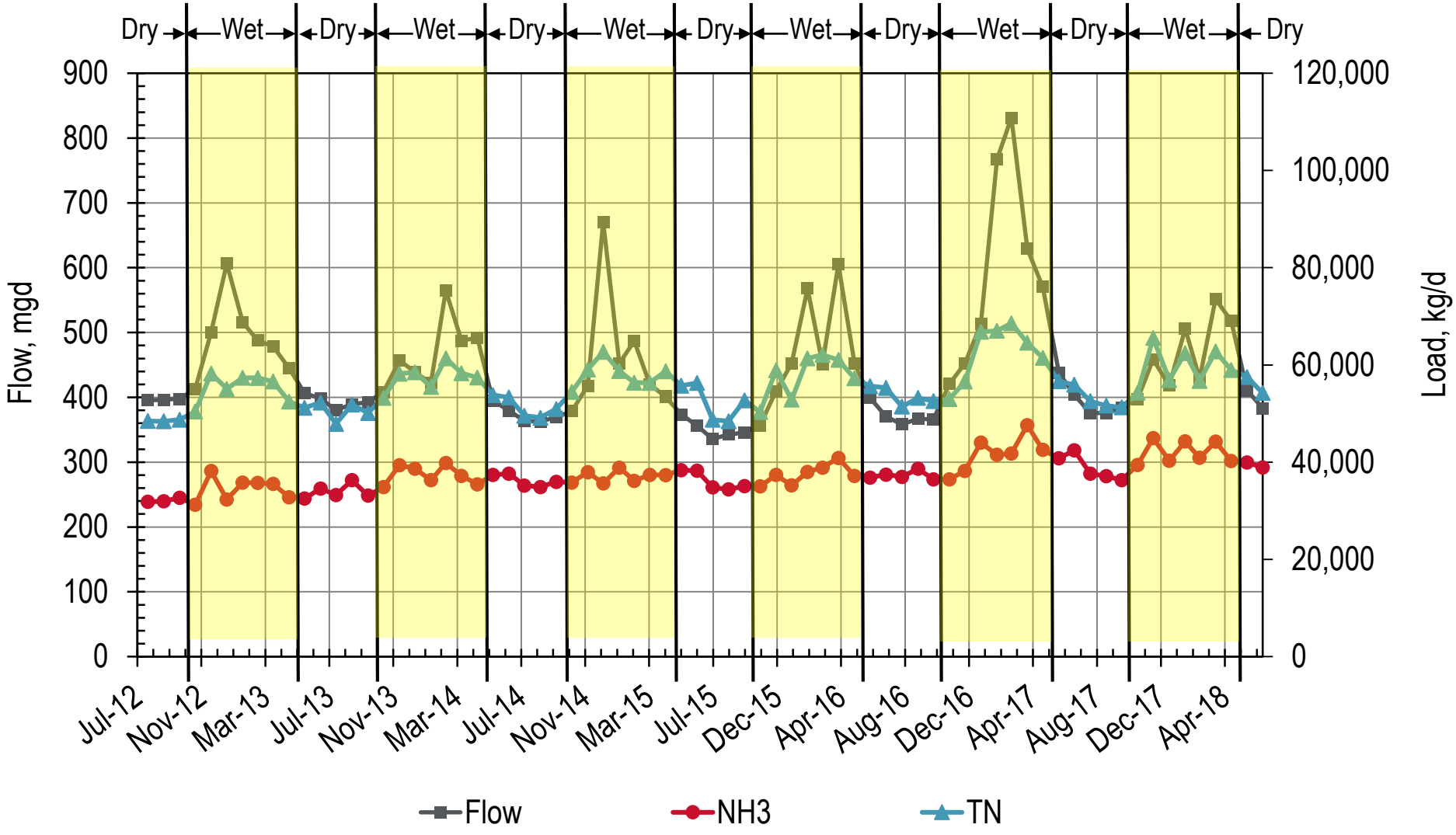
02

Group Annual Report

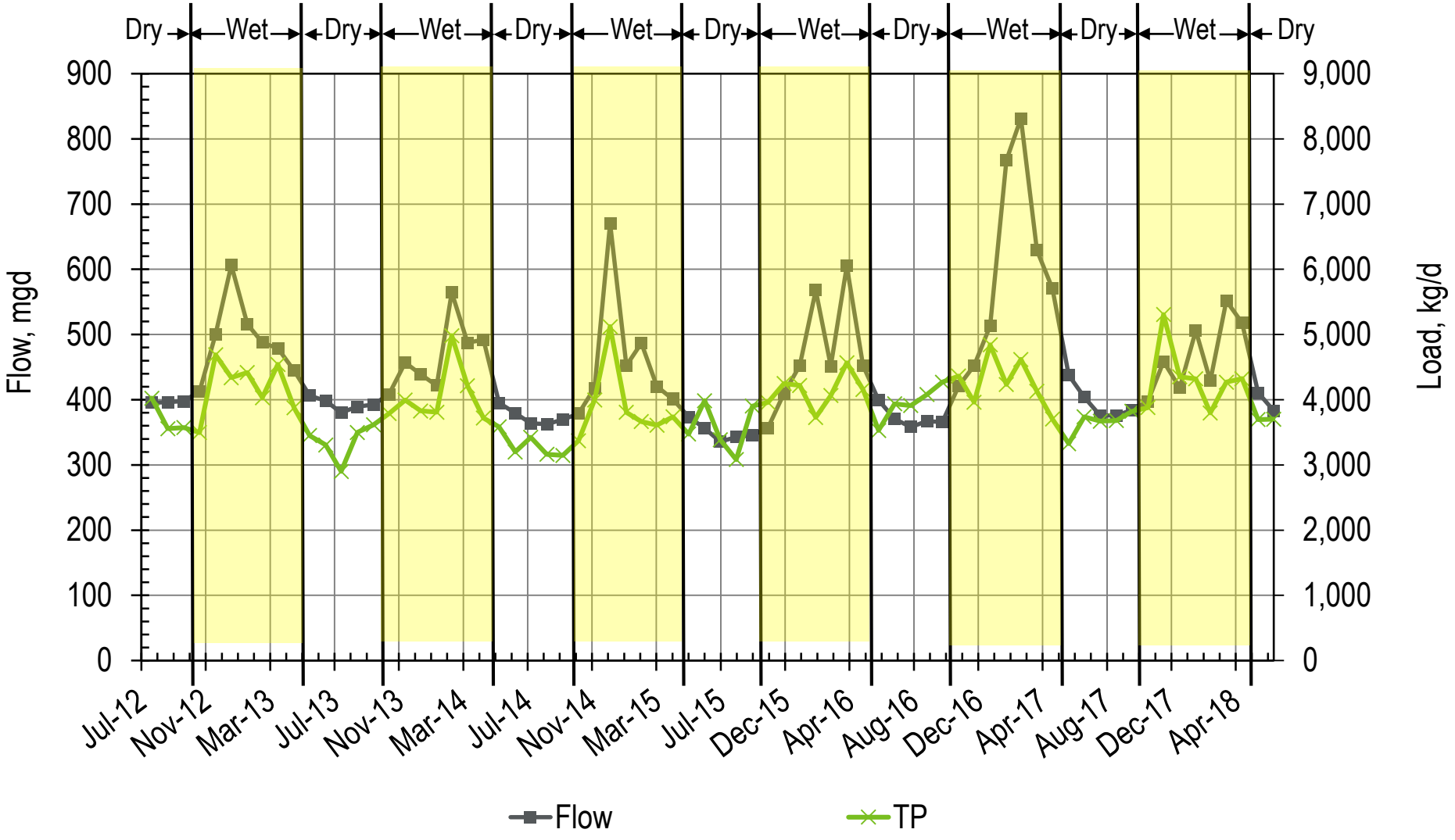
2018 Group Annual Report Summary

- 2016/2017 was the dataset for the exceptionally wet year (high flows/loads)
- 2017/2018 dry weather flows are similar to 2016/2017
- 2017/2018 annual average flows return to pre-2016/2017 levels
- Nutrient Loads (except for NOx/Ortho-P) for both dry and average annual were slightly less than 2016/2017 levels which were the highest since sampling began in 2012

Nitrogen Loads Tend to Track with Flow

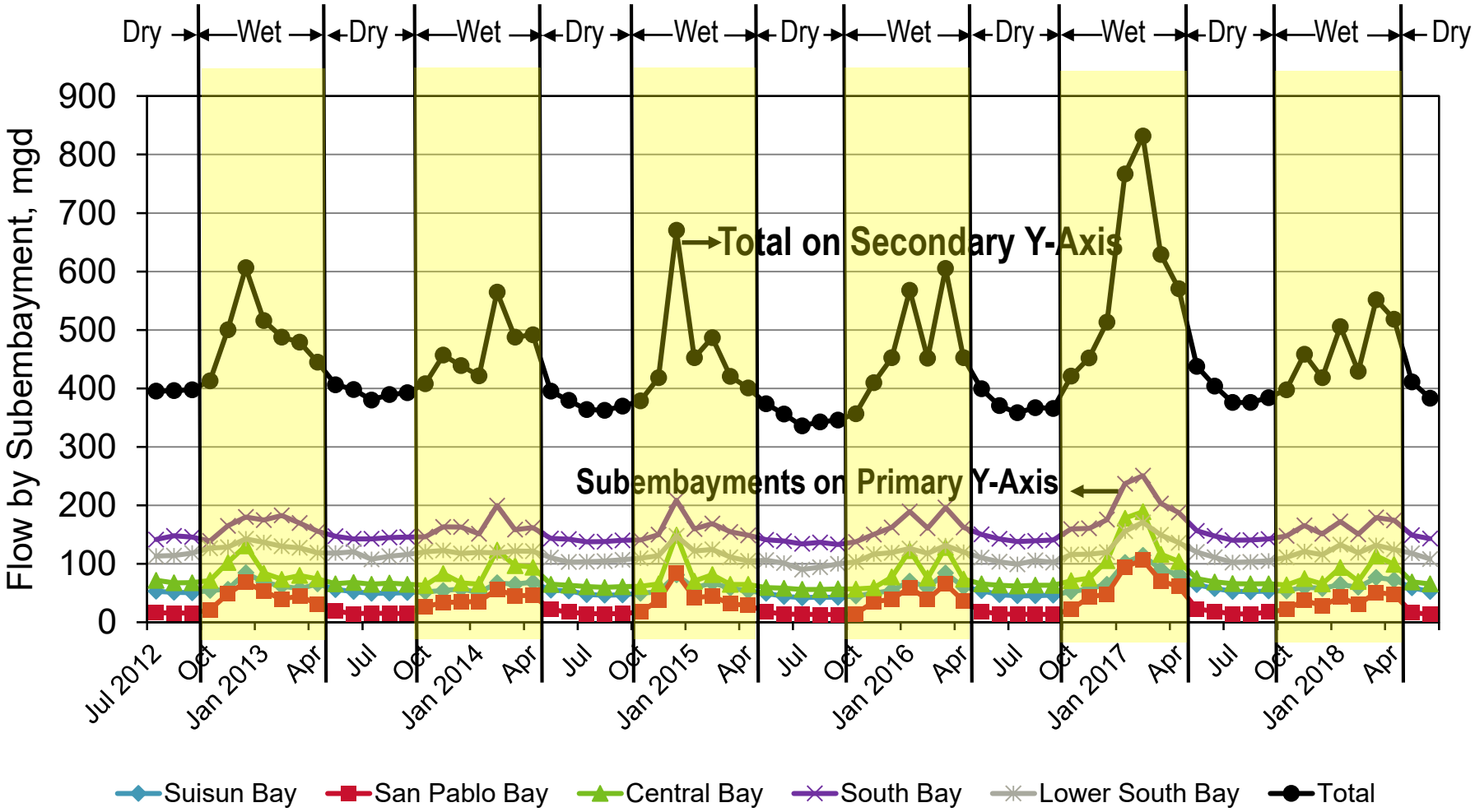


Phosphorus Loads Tend to Track with Flow



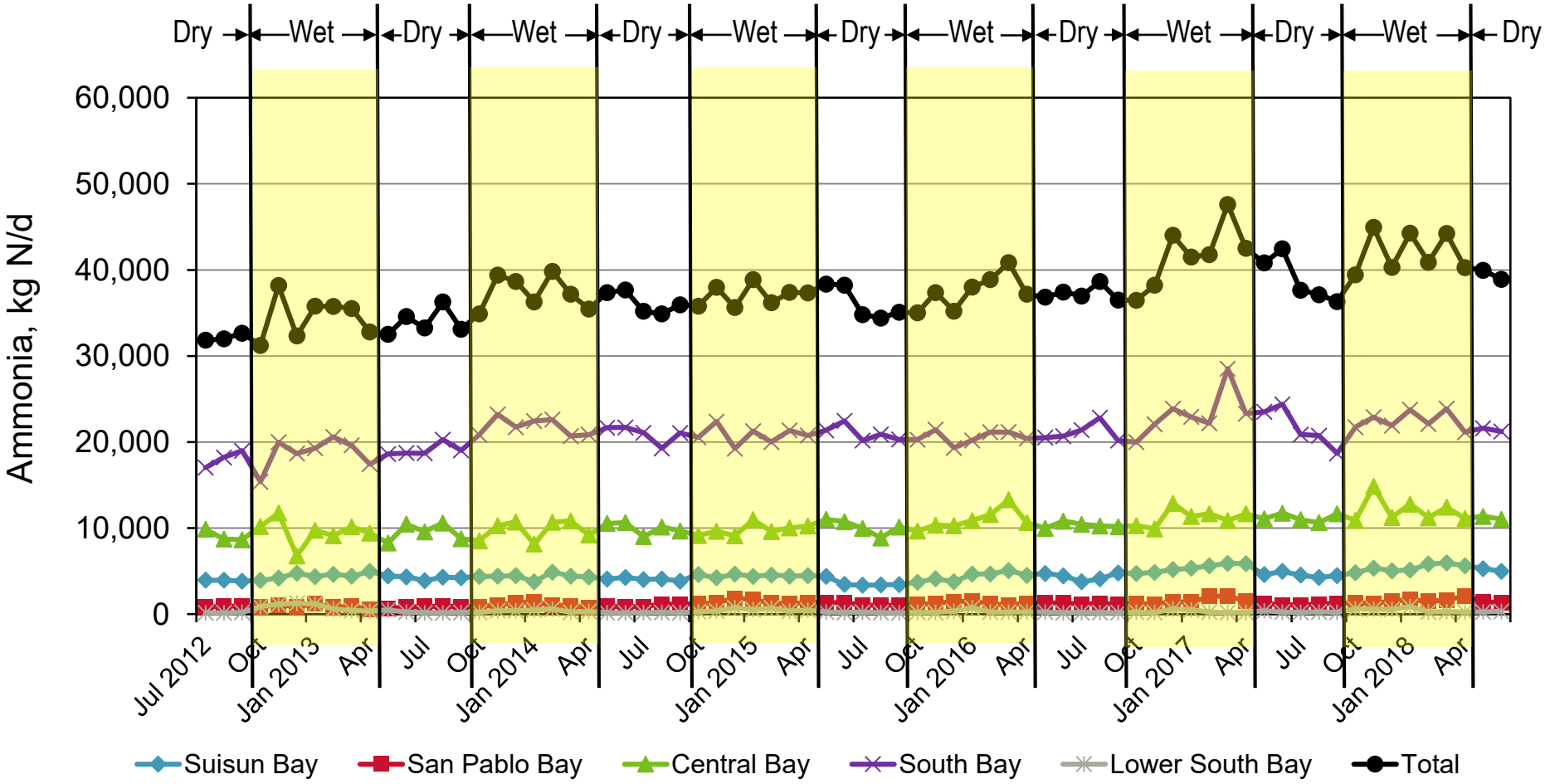
2018 Group Annual Report: Flow

- Total average annual flow for 2017-18 returned to pre-2016/2017 levels
- Decrease attributed to a relatively dry year



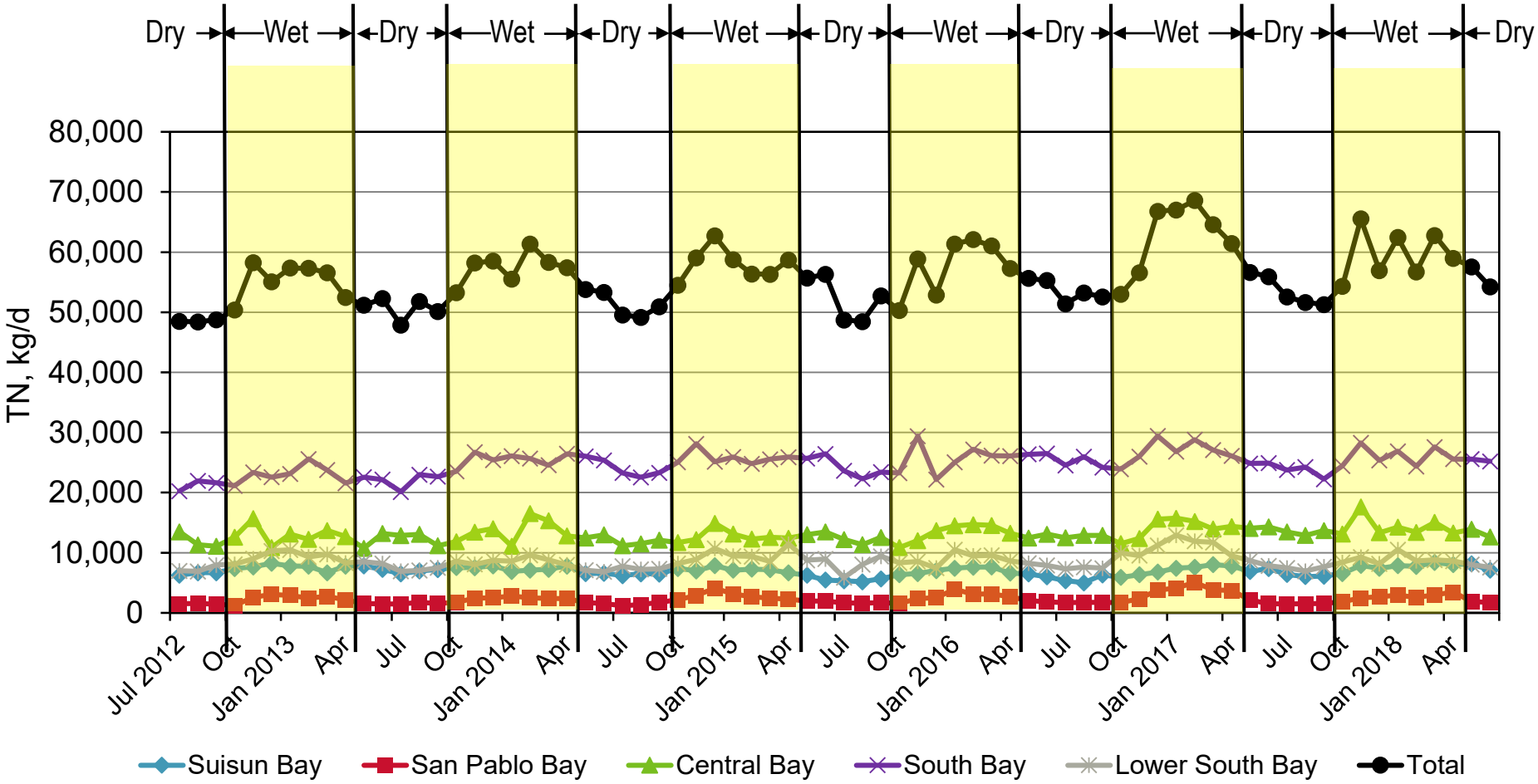
2018 Group Annual Report: Ammonia

- Dry season ammonia load is increasing in all Subembayments except Lower South Bay
- Total average annual ammonia load for 2017-18 was just below the 2016-17 levels (highest since sampling began in 2012)



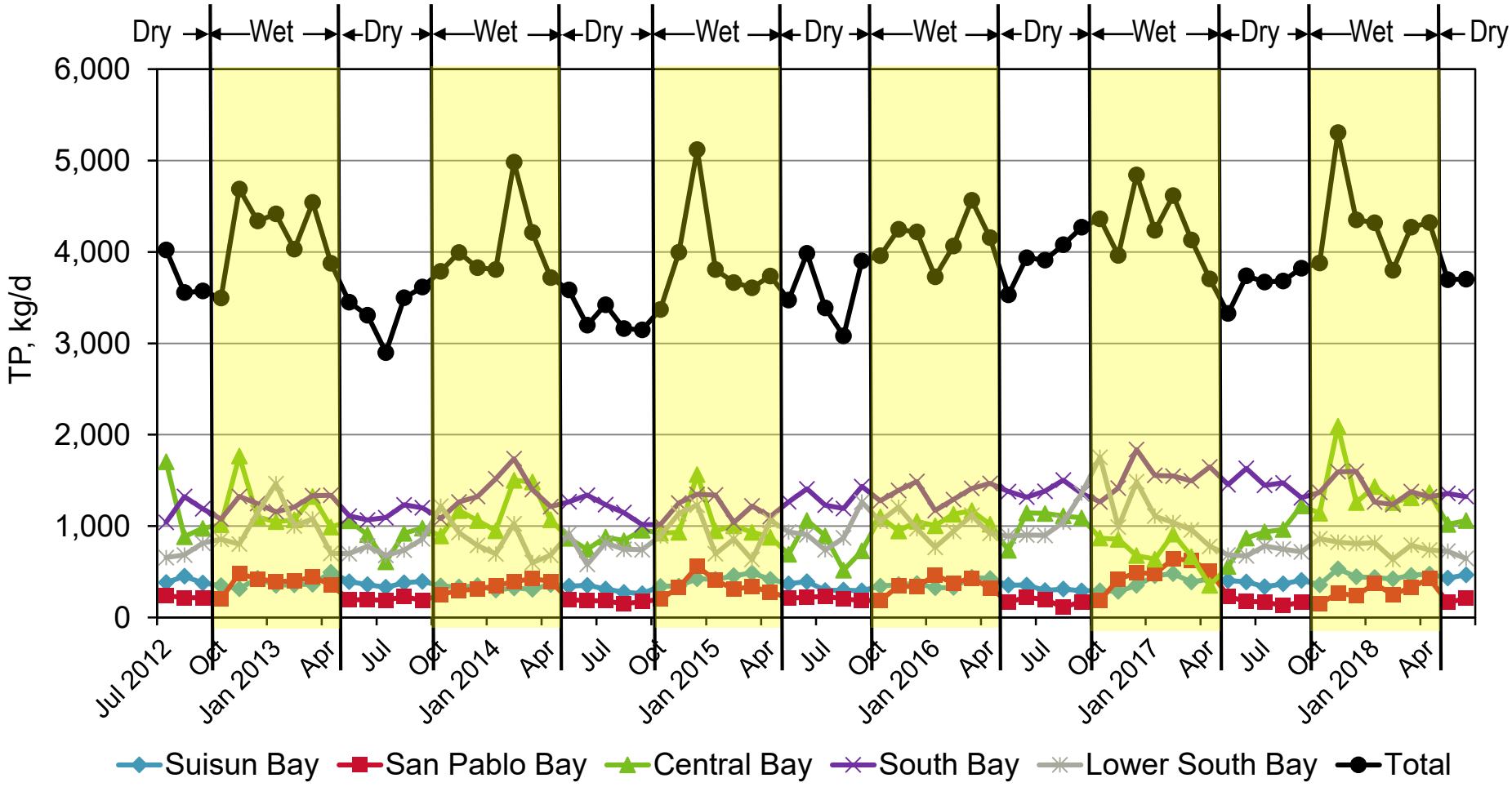
2018 Group Annual Report: Total Nitrogen

- Both dry and annual average TN loads are increasing
- Dry season TN load is increasing in all Subembayments except Suisun Bay (no trend) and Lower South Bay (no trend)



2018 Group Annual Report : Total Phosphorus

- The dry and annual average TP loads are relatively flat (except for occasional excursions)



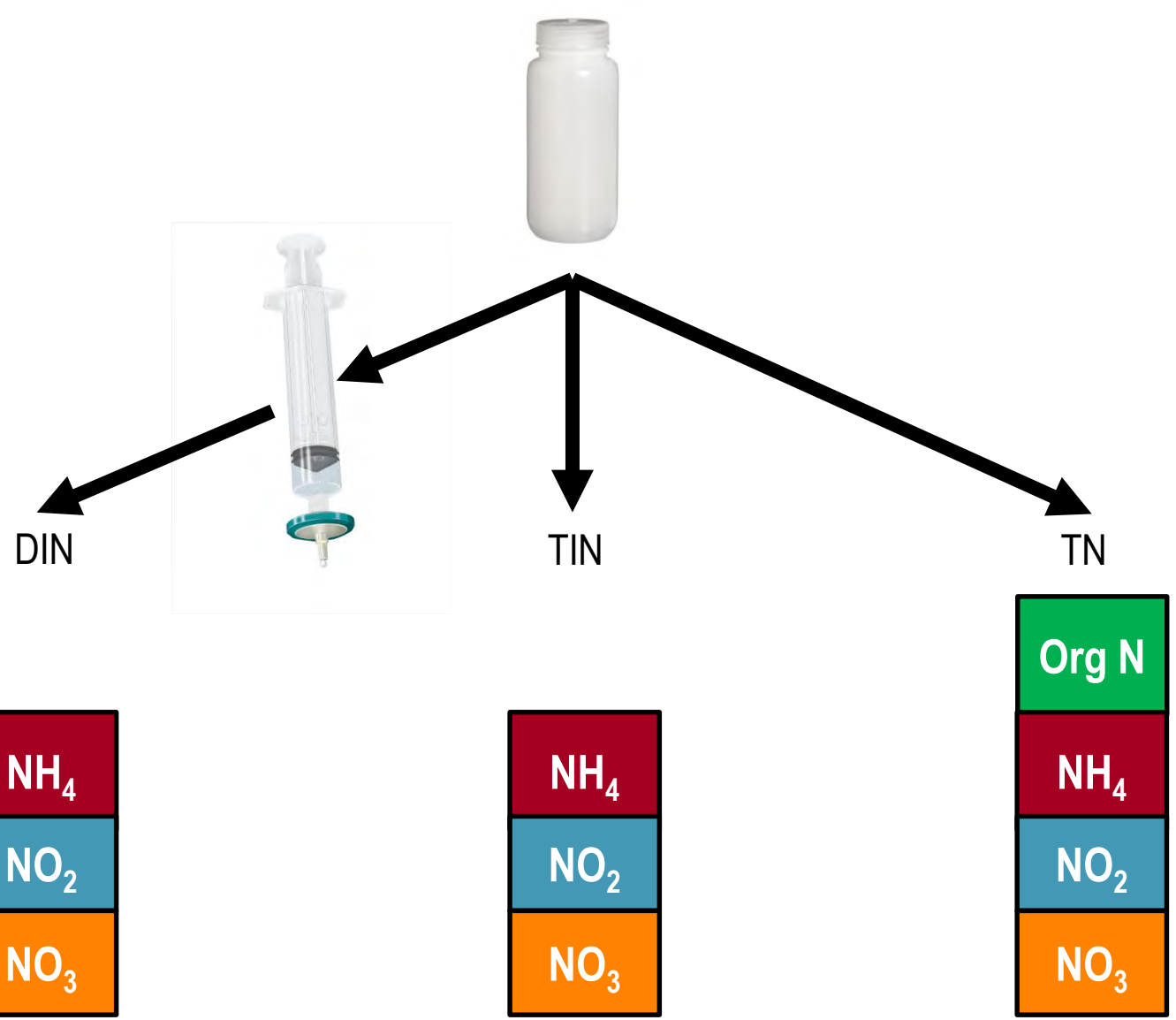
Future Group Annual Reports
(2nd Watershed Permit Admin Draft)

Parameter	2014 Permit	2019 Admin Draft
Influent	None	Ammonia TKN Nitrate+Nitrite Dissolved Inorganic N (DIN) Total P Total N*
Effluent	Ammonia TKN Nitrate+Nitrite Total P Soluble Reactive P Total N Dissolved Inorganic N (DIN)*	Ammonia -- Nitrate+Nitrite Total P -- -- Dissolved Inorganic N (DIN)

* NOT Required but could be calculated for this application:

- DIN = Ammonia + Nitrite + Nitrate
- TN = TKN + Nitrite + Nitrate

What is Dissolved Inorganic Nitrogen (DIN), Total Inorganic Nitrogen (TIN), and Total Nitrogen (TN)?



03 Q&A

04 Brochure and Presentation

BACWA Brochure and Presentation

- Objective: provide material for public outreach
- Content:
  - What is BACWA
  - Nutrients Background
  - Collaborative Nature
  - Watershed Permit Background
  - Nutrient Report Findings
  - Science and Next Steps

Brochure: Cover Page

Brochure: Insert 1st Page (Background on Nutrients)

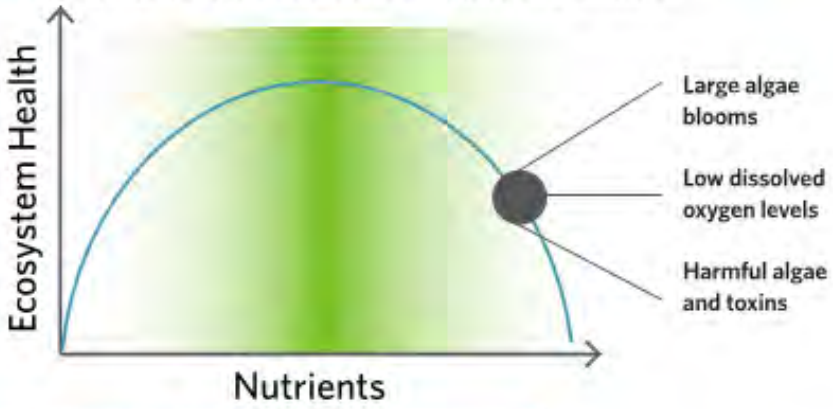
BACKGROUND INFORMATION

San Francisco Bay receives some of the highest nitrogen loads among estuaries worldwide, but has yet to exhibit problems typical of nutrient-enriched estuaries. It is not known whether this level of nitrogen loading, which will continue to rise in proportion to human population increase, is sustainable over the long-term. A broad coalition of scientists, engineers, and policy-makers is in the process of evaluating the factors that cause the Bay's resilience, conditions that may lead to a decline in the Bay's health, and potential impacts on human and ecological health. A wide range of monitoring and special studies are underway to understand the implications on Bay water quality associated with changes in nutrient levels and other factors.

Wastewater treatment plants in the Bay Area represent approximately two thirds of nutrient loads to the Bay because they were not designed to remove nutrients

NUTRIENTS ARE ESSENTIAL FOR LIFE

However, under some conditions, too much of a good thing can lead to:



NUTRIENTS DEFINED

Nutrients, such as nitrogen and phosphorus, are naturally present in estuaries and are essential for a properly functioning biological community. The effects of nutrient level changes on a local ecosystem are gauged by a multitude of factors, and determining the appropriate level is a site-specific exercise. A fundamental goal of the ongoing regional scientific effort is learning the ideal range for the Bay and using that information to guide future policy decisions.

NUTRIENTS OF INTEREST

NITROGEN BASED	PHOSPHORUS BASED
Ammonia	Soluble Phosphorus
Total Nitrogen	Total Phosphorus

Brochure: Insert 2nd Page (Collaborative Spirit and Nutrient Reduction Study Background)

The collaborative approach in the Bay Area for managing nutrients has lauded national attention as evidenced by a National Environmental Achievement Award in 2019 from the National Association of Clean Water Agencies (NACWA). NACWA is the nationally recognized leader in legislative, regulatory, and legal clean water advocacy.

National Environmental Achievement AWARDS

A COLLABORATIVE APPROACH

While the impact of nutrients on Bay health is unclear, a collaborative partnership that includes BACWA, the Regional Water Quality Control Board, San Francisco Estuary Institute (SFEI), Baykeeper, and others exists to better understand this situation. This collaborative effort is essential for developing a transparent and effective strategy for managing nutrients in the Bay.

NUTRIENT REDUCTION STUDY

The Regional Water Board issued a Regional Permit to evaluate nutrient load management strategies at 37 wastewater treatment plants around the Bay.

A Nutrient Reduction Study was written and submitted to the Water Board in June 2018 that compiled all the individual plant reports. The 1,400+ page report includes:

- Individual nutrient reduction analyses for all 37 plants
- Aggregation of the results across all plants, including a summary section that compares the reduction strategies for nutrient reduction at high, medium, and low levels

Brochure: Insert 3rd Page (Study Results)

EFFLUENT CONCENTRATION

Example of Evaluation for Total Nitrogen Load Reduction

CURRENT INFLUENT
- 450 million gallons per day (mgd)
- 46 mg/l Total Nitrogen

-450 mgd

37 Bay Area Wastewater Treatment Plants

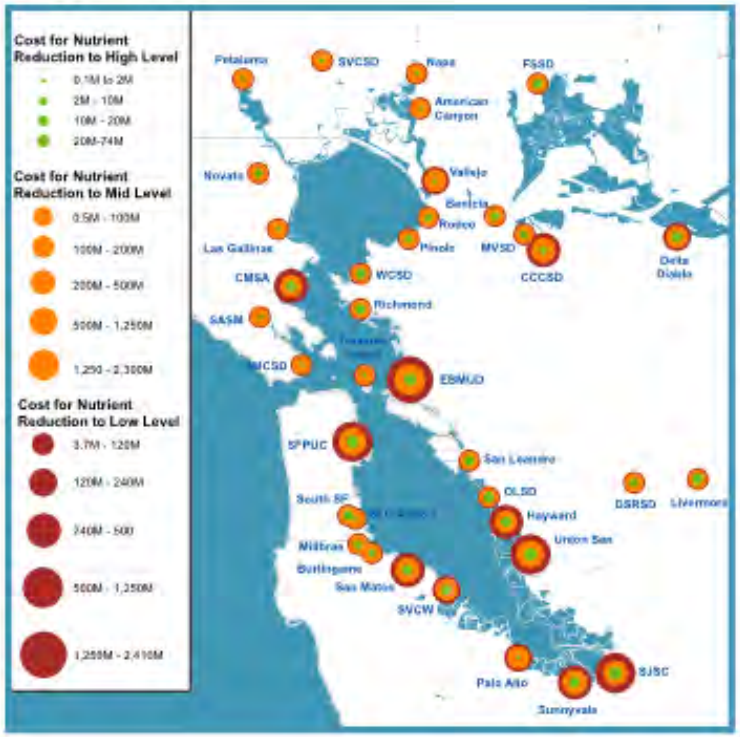
STATUS QUO
32 mg/l Total Nitrogen

NUTRIENT REDUCTION TO HIGH LEVELS
Down to 26 mg/l Total Nitrogen

NUTRIENT REDUCTION TO MEDIUM LEVELS
<15 mg/l Total Nitrogen

NUTRIENT REDUCTION TO LOW LEVELS
<6 mg/l Total Nitrogen

STUDY RESULTS



TARGETED REGION-WIDE SUMMARY

NUTRIENT LOAD REDUCTION	TOTAL NITROGEN LOAD REDUCTION	CAPITAL COST
High Levels	7-19%	$119M - $391M
Medium Levels	57%	$7 Billion
Low Levels	82%	$8.5 Billion

For access to information presented, please visit www.BACWA.org

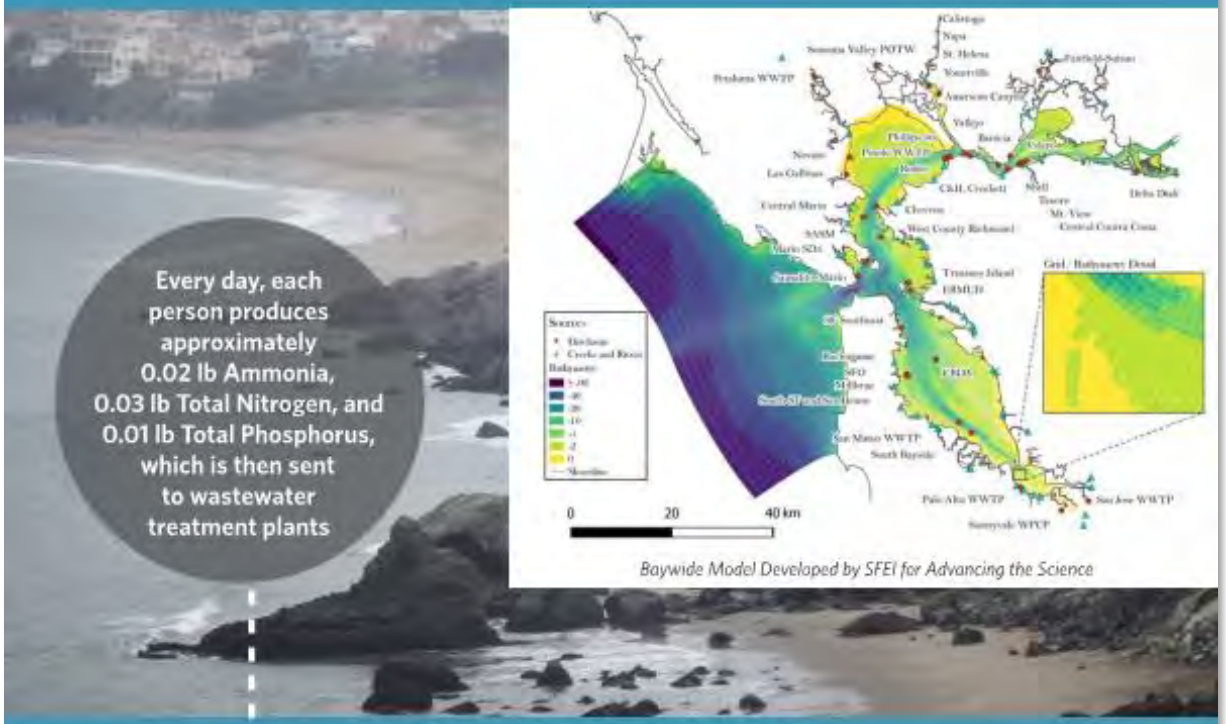
Brochure: Back Pages (Science and Next Steps)

SCIENCE

The San Francisco Estuary Institute is working to advance the scientific understanding of how nutrients function in the Bay and what combination of factors could contribute to its decline. This understanding is critical to developing nutrient management policies that will protect the Bay. A cornerstone of the Institute's research is development of a Bay model, as illustrated below.

NEXT STEPS

The collaborative effort to further both the science and the evaluation of management actions will continue.



Brochure: Back Pages (What is BACWA)

WHAT IS THE BAY AREA CLEAN WATER AGENCIES (BACWA)?

BACWA is a joint powers agency formed under the California Government Code by the five largest wastewater treatment agencies in the San Francisco Bay Area. Our members include the many municipalities and special districts that provide sanitary sewer services to more than seven million people. BACWA is dedicated to working with our members, state and federal regulatory agencies, and non-governmental organizations to improve and enhance the San Francisco Bay environment. We provide technical expertise, financial support, and a public utility perspective to ensure that regulations affecting our members are well-informed, thoughtful, and effective.

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Nutrients Update

January 11, 2019

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AGENCIES

Hip Pocket

Nutrient Management in the Bay: BACWA Brochure Presentation

December 14, 2018

HDR
Brown AND Caldwell

BACWA
BAY AREA
CLEAN WATER
AGENCIES

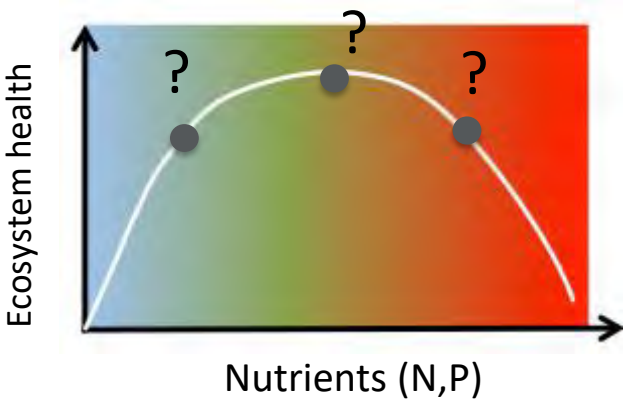
What is the Bay Area Clean Water Agencies (BACWA)?

- BACWA is a joint powers agency, formed under the California Government Code by the five largest wastewater treatment agencies in the San Francisco Bay Area.
- Members: include the many municipalities and special districts that provide sanitary sewer services to >6.5 million people.
- Mission: dedicated to working with our members, state and federal regulatory agencies, and non-governmental organizations to improve and enhance the San Francisco Bay environment. We provide technical expertise, financial support, and a public utility perspective to ensure that regulations affecting our members are well-informed, thoughtful and effective.

Suggestions: Ask BACWA if they have “an about BACWA” slide that they prefer to use. If not, consider a picture of the Bay in the background

Issue: is the Bay Area at Risk for Impairment from Nutrients?

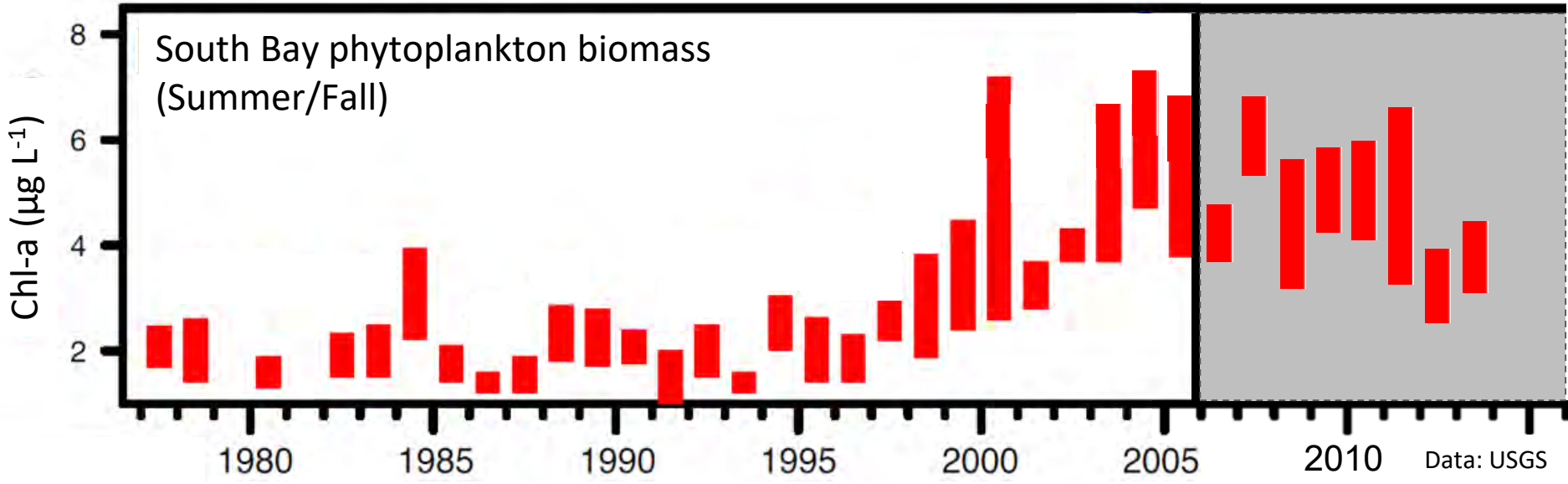
Nutrients are Essential for Life (too much of a good thing?)



Elevated Nutrient Levels:

- Large algae blooms
- Low DO
- Harmful algae, toxins

Elevated Chl-a Levels Initiated the Bay Area Nutrient Mgmt Efforts



Cloern et al. 2007

Data: USGS
SFEI 2015

Concerns over Potential Impairment Prompted Scientific/Engineering Investigations

Watershed Permit

CALIFORNIA
Water Boards

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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

The Watershed Permit Required Wastewater Treatment Plants to Develop Strategies and Cost for Low-, Medium-, and High-Level Nutrient Load Reduction

Wastewater Treatment Plants Represent ~67% of the Nutrient Loads to the Bay

7+ Million
Service Population

37
WWTPs

Treats ~450
Mil Gals per Day

- Plants range from 1–167 Mil Gals per Day
- Approx. Half of the Plants Treat <10 Mil Gals per Day
- Each Treatment Plant is Unique

Wastewater Treatment Plants Represent about 2/3's of Nutrient Discharge Loads to the Bay

Collaboration: Key for a Managing Nutrients in a Transparent and Cost Effective Means

- BACWA (Wastewater Utilities)
- Water Board (Regulatory)
- San Francisco Estuarine Institute (SFEI; Science)
- Non-Governmental Organizations (NGOs)
- Others

Regional Permit Features at Wastewater Plants

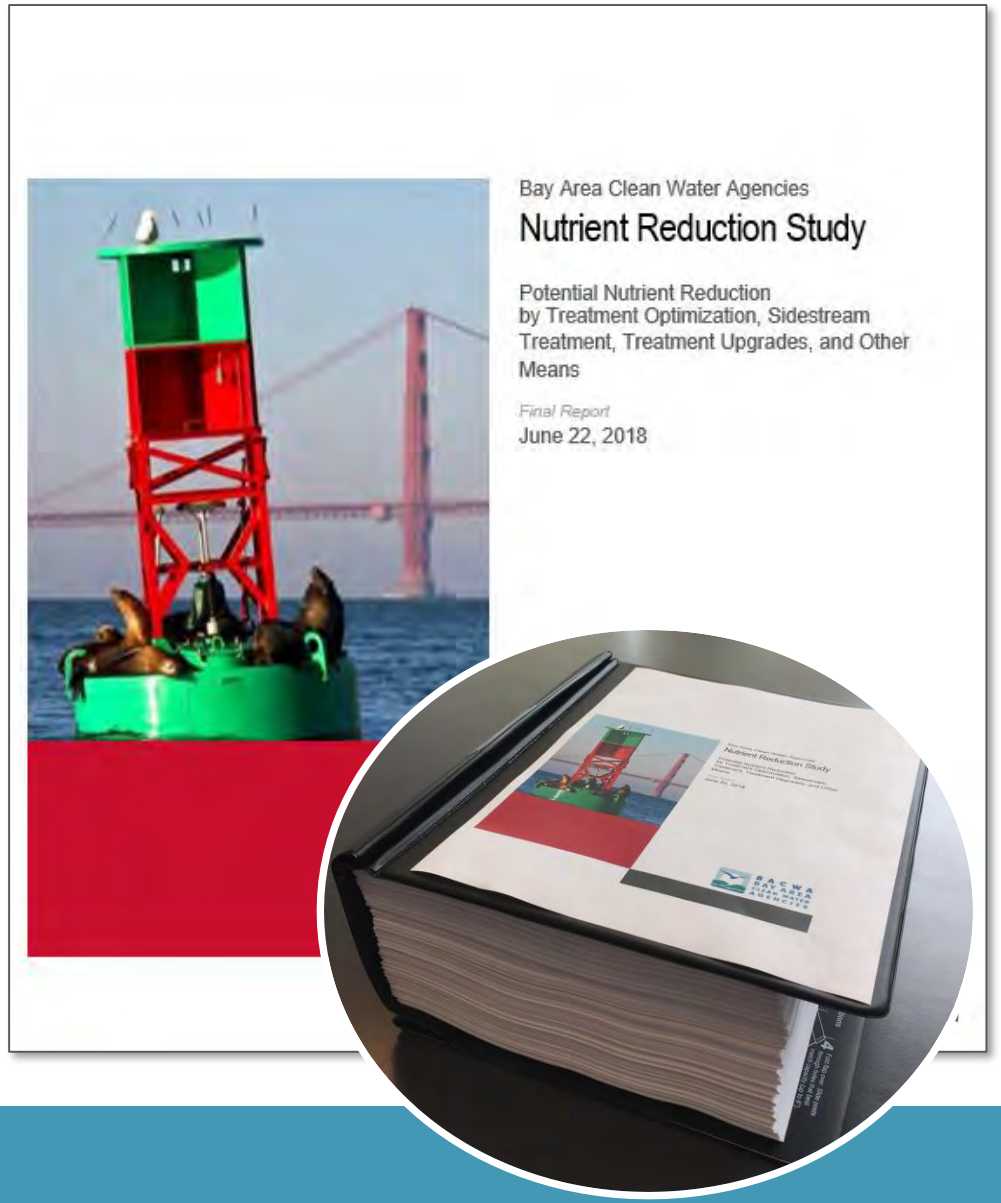
- Evaluation of nutrient load management strategies

Nutrient Load Reduction Level	Total Nitrogen Load Reduction
Low	7-19%
Medium	>57%
High	>82%

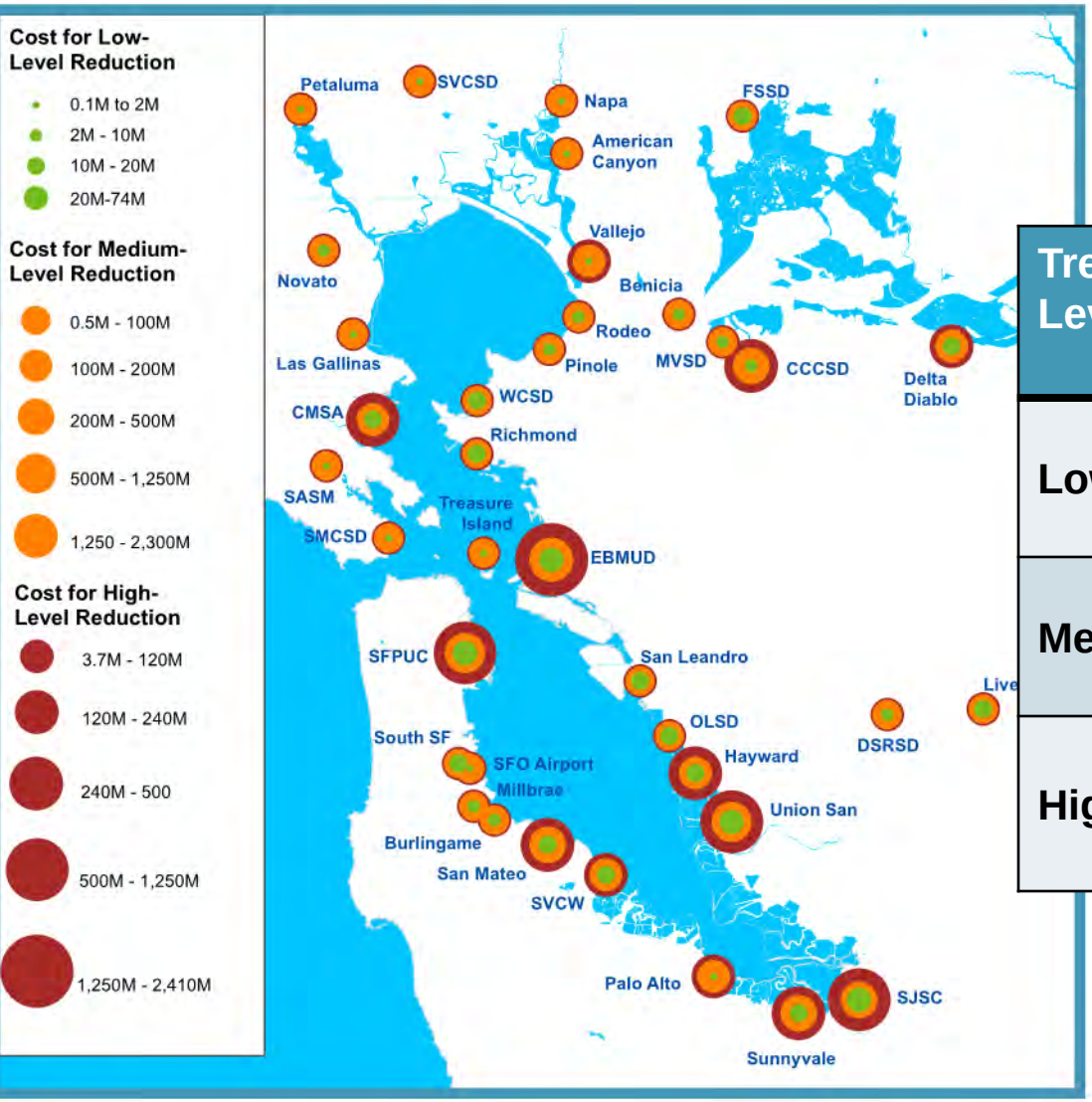
- Annual Nutrient Trending Report: Loads by Wastewater Plants to the Bay

Findings:
Nutrient Reduction Study Report (June 2018)

- Main report summarizes study findings for all plants
- 37 individual plant appendices:
  - Existing plant data
  - Treatment Levels (Low-, Medium-, and High-Level)



Study Findings for Total Nitrogen (TN) Load Reduction Across the Bay

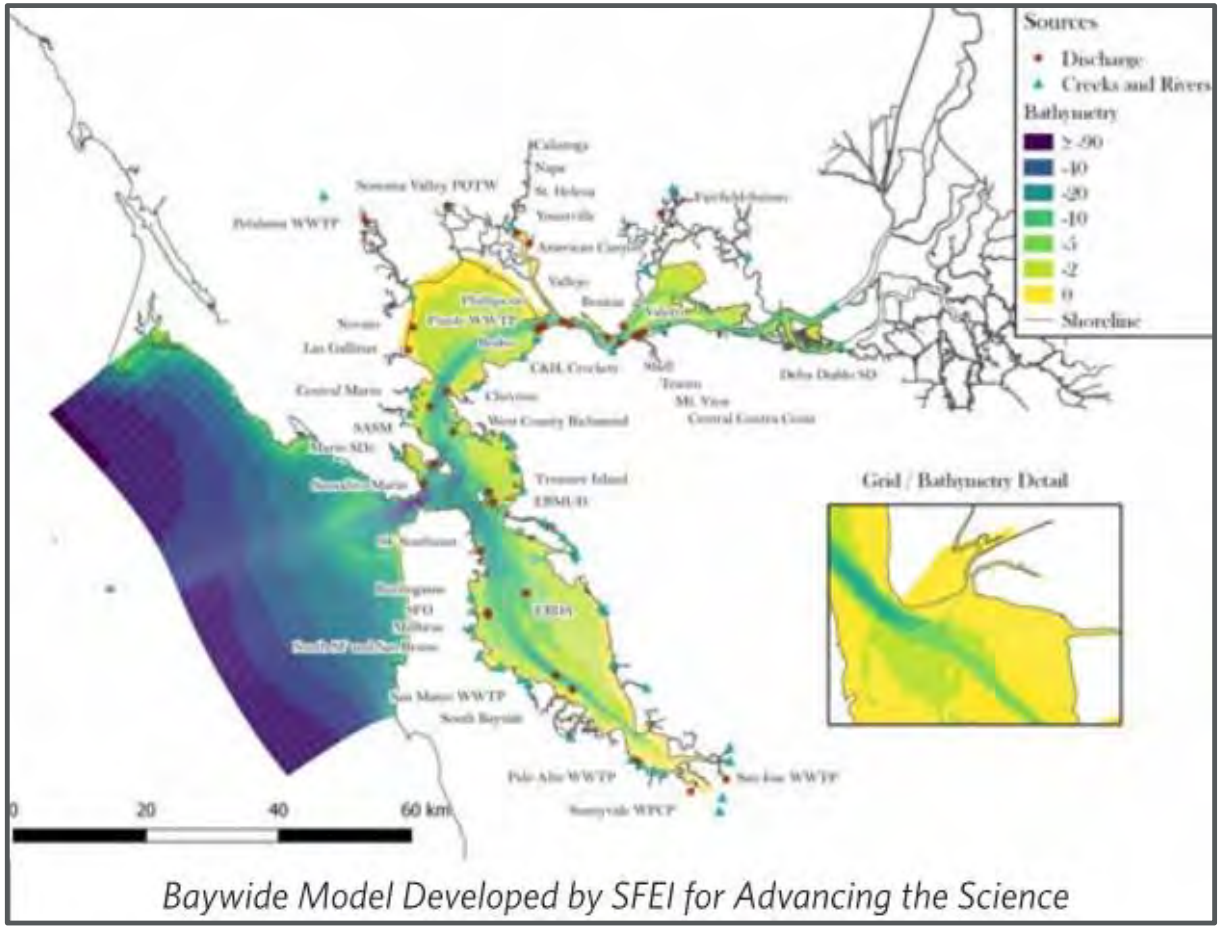


Summary

Treatment Level	Total N Load Reduction to the Bay	Capital Cost ($Millions)
Low-Level	7-19%	$119M - $391M
Medium-Level	57%	$7B
High-Level	82%	$8.5B

Next Steps: Advance the Science

- On-going science to inform policy by 2024
- Treatment plants to continue evaluating and implementation of nutrient management solutions
- Continue stakeholder involvement



Hip Pocket

How Do Loadings to the Bay Compare to Other Watersheds

Hide?: too complicate to convey

Chl-a (µg L^{-1}) during average bloom

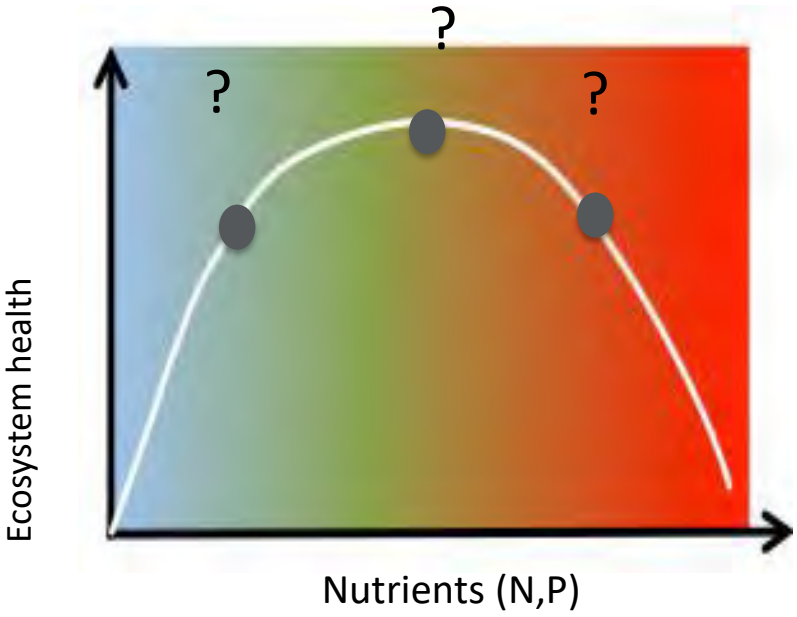
Unit Nitrogen Load (g $N/m^2/yr$)

Chesapeake
Delaware
Florida Bay
Pensacola
SOU
CEN
SPB
SUI

National Estuarine Experts Workgroup (2010)
SFEI (2013)

Issue: is the Bay Area at Risk for Impairment from Nutrients?

Striking a Balance: Nutrients are Essential for Life (too much of a good thing?)



Elevated Nutrient Levels:

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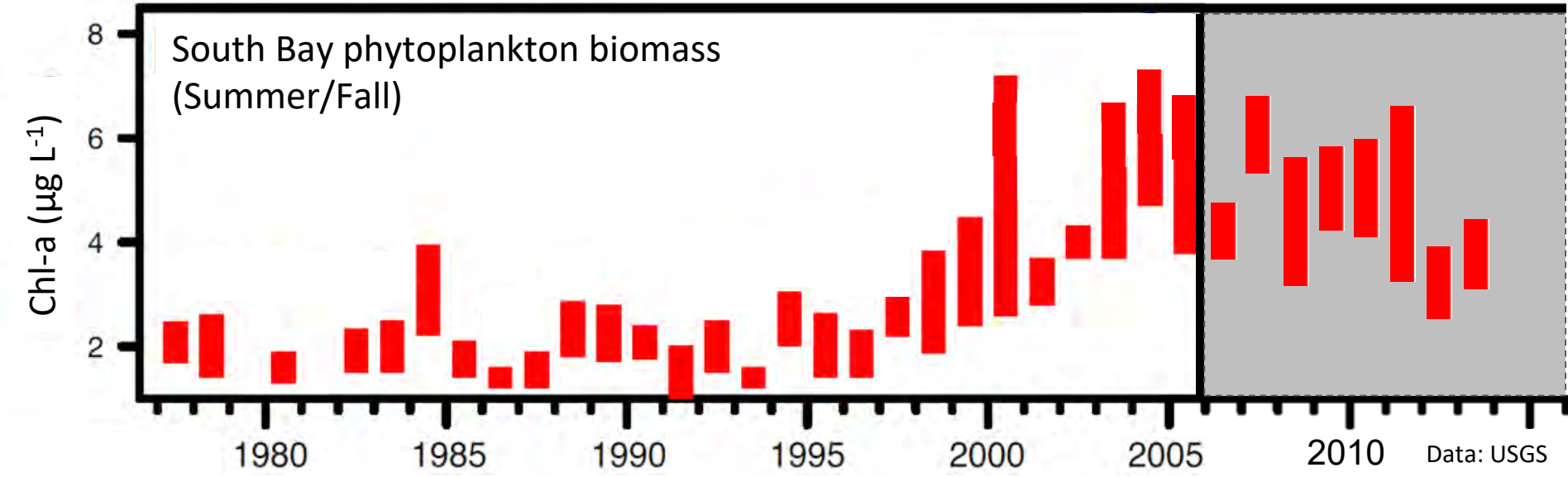


Cloern et al. 2007

Data: USGS
SFEI 2015

The Bay Area has Historically Been Resilient to Nutrients

San Francisco Bay Does Not use Most of its Nutrients

1. High turbidity
2. Strong tidal mixing
3. Filter-feeding clams

Historically: Resistant to classic eutrophication symptoms

Recently: Evidence of changing response to nutrients

e.g., Cloern et al., 2007, 2010

2018 Group Annual Report Summary (Rounded Values)

Dry Season Average

Parameter	Units	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018
Total Flow	mgd	399	387	365	359	387	386
Total Ammonia							38,000
Total TN							53,500
Total TP							3,700

Line Chart OR Bar Chart

Flow Separate

Annual A

Parameter							2017/2018
Total Flow	mgd	453	434	421	425	510	434
Total Ammonia	kg N/d	33,800	36,600	36,900	36,800	40,700	40,400
Total TN	kg N/d	53,100	55,000	55,800	55,400	58,900	57,100
Total TP	kg P/d	4,000	3,800	3,700	3,900	4,100	4,100

The 2017/2018 flows and loads are all similar to 2016/2017 (except average annual flow). The average annual flows returned to pre-2016/2017 levels. The dry season flows did not return to the extreme drought period levels from 2014/2015 through 2015/2016.

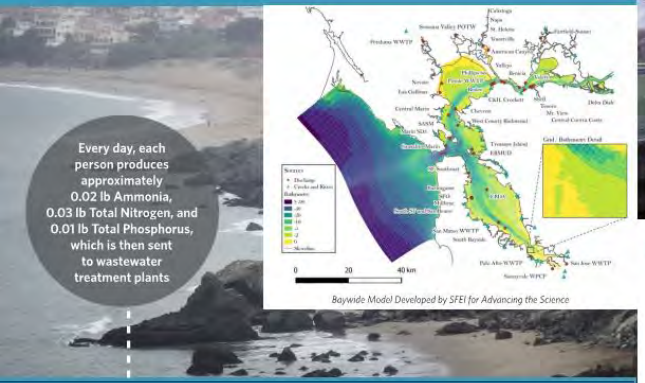
Brochure: Cover Page

SCIENCE

The San Francisco Estuary Institute is working to advance the scientific understanding of how nutrients function in the Bay and what combination of factors could contribute to its decline. This understanding is critical to developing nutrient management policies that will protect the Bay. A cornerstone of the Institute's research is development of a Bay model, as illustrated below.

NEXT STEPS

The collaborative effort to further both the science and the evaluation of management actions will continue.



Baywide Model Developed by SFEI for Advancing the Science

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NUTRIENT MANAGEMENT
in the San Francisco Bay

BACWA BAY AREA CLEAN WATER AGENCIES

January 2019

SCIENCE

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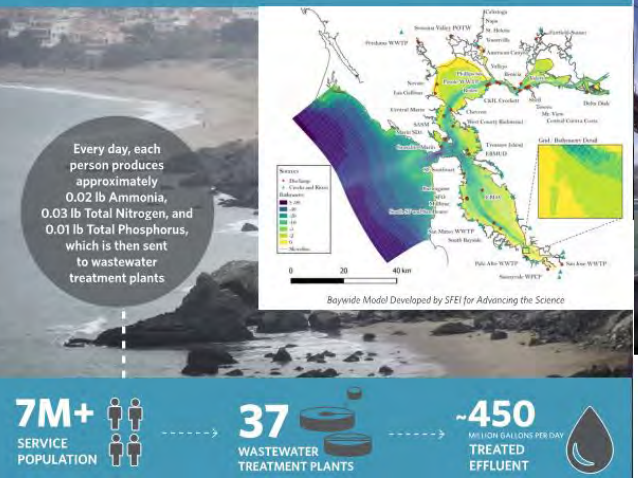

Baywide Model Developed by SFEI for Advancing the Science

7M+ SERVICE POPULATION

37 WASTEWATER TREATMENT PLANTS

~450 MILLION GALLONS PER DAY TREATED EFFLUENT

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NUTRIENT MANAGEMENT
in the San Francisco Bay

BACWA BAY AREA CLEAN WATER AGENCIES

January 2019

Brochure: Insert 1st Page

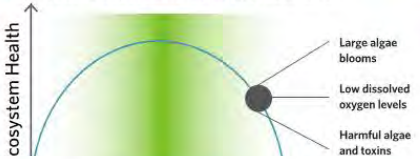
BACKGROUND INFORMATION

San Francisco Bay receives some of the highest nitrogen loads among estuaries worldwide, but has yet to exhibit problems typical of nutrient-enriched estuaries. It is not known whether this level of nitrogen loading, which will continue to rise in proportion to human population increase, is sustainable over the long-term. A broad coalition of scientists, engineers, and policy-makers is in the process of evaluating the factors that cause the Bay's resilience, conditions that may lead to a decline in the Bay's health, and potential impacts on human and ecological health. A wide range of monitoring and special studies are underway to understand the implications on Bay water quality associated with changes in nutrient levels and other factors.

Wastewater treatment plants in the Bay Area represent approximately two thirds of nutrient loads to the Bay because they were not designed to remove nutrients

NUTRIENTS ARE ESSENTIAL FOR LIFE

However, under some conditions, too much of a good thing can lead to:



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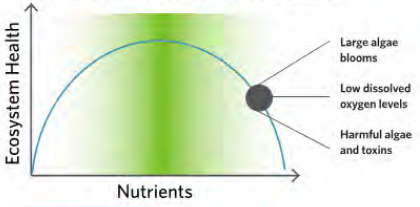


NUTRIENTS DEFINED

Nutrients, such as nitrogen and phosphorus, are naturally present in estuaries and are essential for a properly functioning biological community. The effects of nutrient level changes on a local ecosystem are gauged by a multitude of factors, and determining the appropriate level is a site-specific exercise. A fundamental goal of the ongoing regional scientific effort is learning the ideal range for the Bay and using that information to guide future policy decisions.

NUTRIENTS OF INTEREST

NITROGEN BASED	PHOSPHORUS BASED
Ammonia	Soluble Phosphorus
Total Nitrogen	Total Phosphorus

The collaborative approach in the Bay Area for managing nutrients has lauded national attention as evidenced by a National Environmental Achievement Award in 2019 from the National Association of Clean Water Agencies (NACWA). NACWA is the nationally recognized leader in legislative, regulatory, and legal clean water advocacy.

National Environmental Achievement AWARDS

A COLLABORATIVE APPROACH

While the impact of nutrients on Bay health is unclear, a collaborative partnership that includes BACWA, the Regional Water Quality Control Board, San Francisco Estuary Institute (SFEI), Baykeeper, and others exists to better understand this situation. This collaborative effort is essential for developing a transparent and effective strategy for managing nutrients in the Bay.

NUTRIENT REDUCTION STUDY

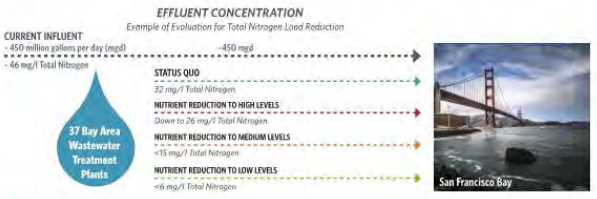
The Regional Water Board issued a Regional Permit to evaluate nutrient load management strategies at 37 wastewater treatment plants around the Bay.

A Nutrient Reduction Study was written and submitted to the Water Board in June 2018 that compiled all the individual plant reports. The 1,400+ page report includes:

- Individual nutrient reduction analyses for all 37 plants
- Aggregation of the results across all plants, including a summary section that compares the reduction strategies for nutrient reduction at high, medium, and low levels

EFFLUENT CONCENTRATION

Example of Evaluation for Total Nitrogen Load Reduction



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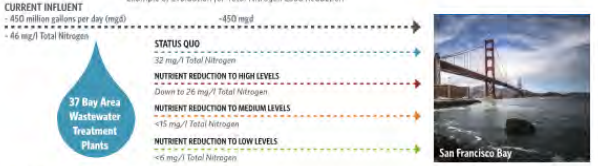
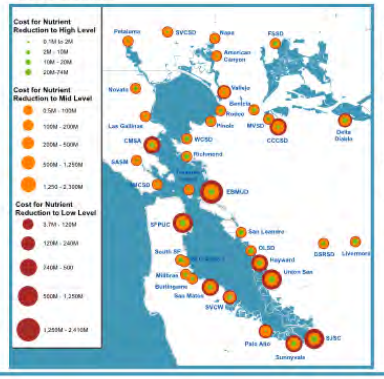


STUDY RESULTS

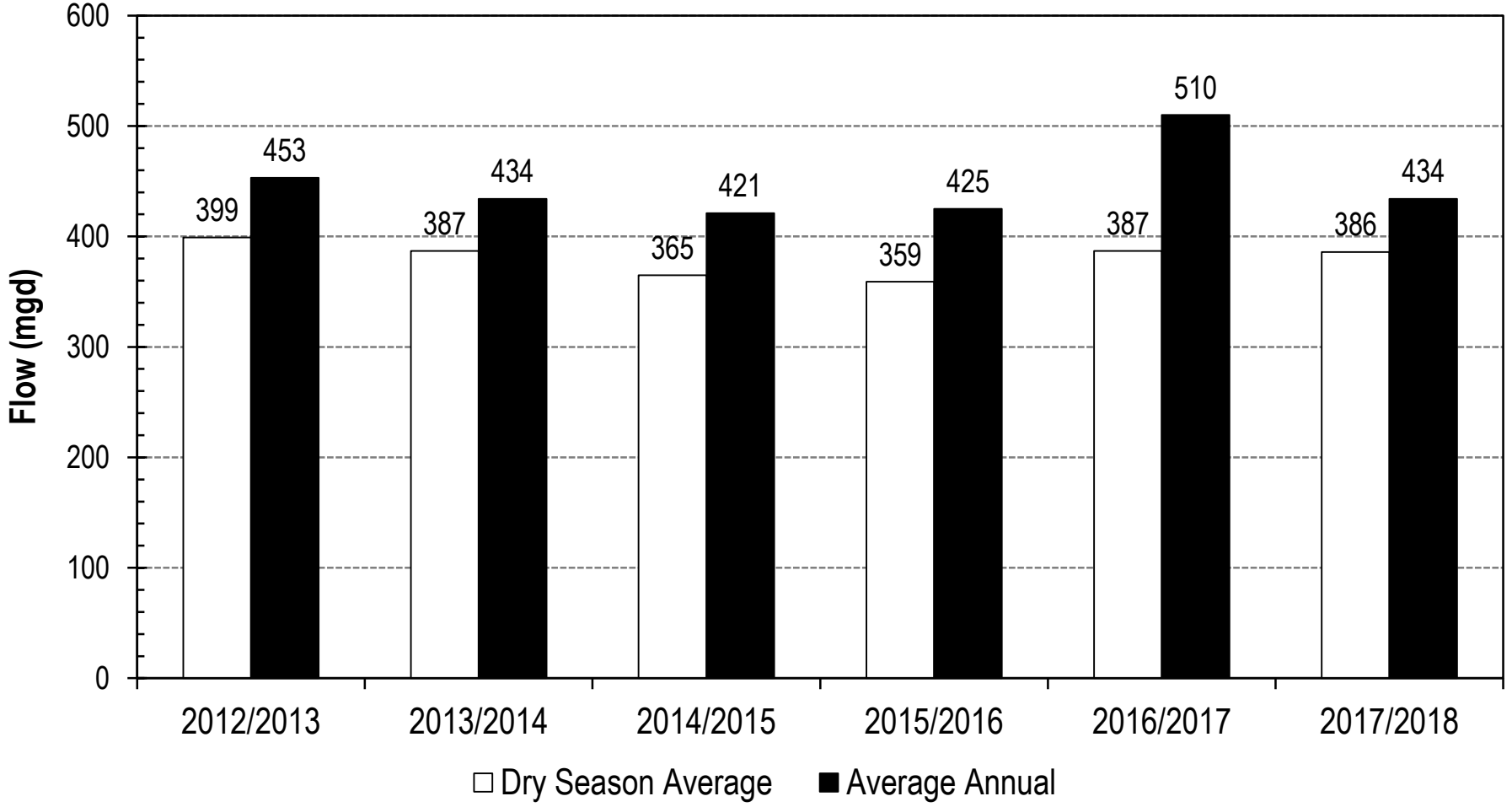


TARGETED REGION-WIDE SUMMARY

NUTRIENT LOAD REDUCTION	TOTAL NITROGEN LOAD REDUCTION	CAPITAL COST
High Levels	7-19%	$119M - $391M
Medium Levels	57%	$7 Billion
Low Levels	82%	$8.5 Billion

For access to information presented, please visit www.BACWA.org

2018 Group Annual Report Summary (Rounded Values)



The 2017/2018 flows and loads are all similar to 2016/2017 (except average annual flow). The average annual flows returned to pre-2016/2017 levels. The dry season flows did not return to the extreme drought period levels from 2014/2015 through 2015/2016.

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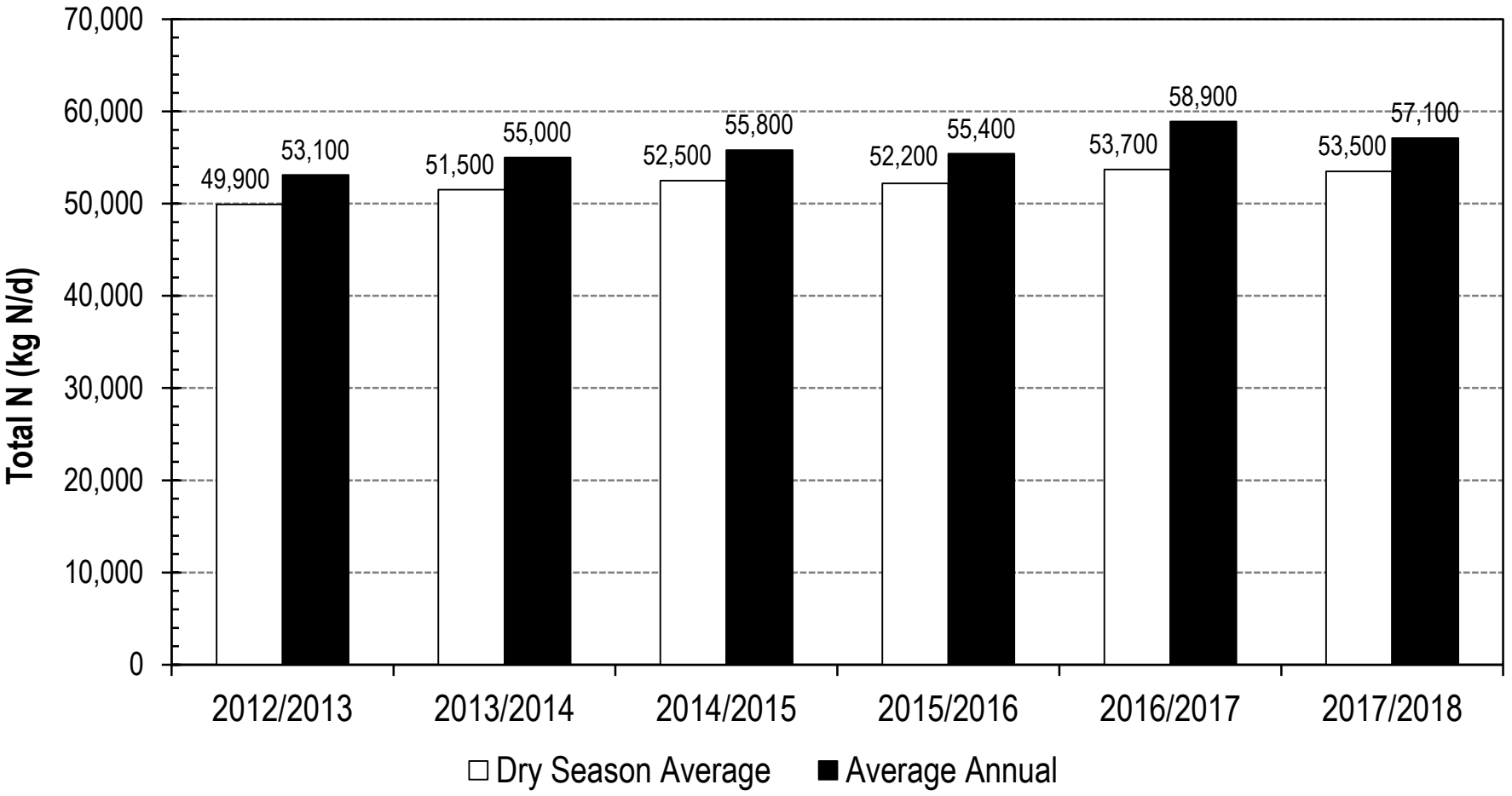

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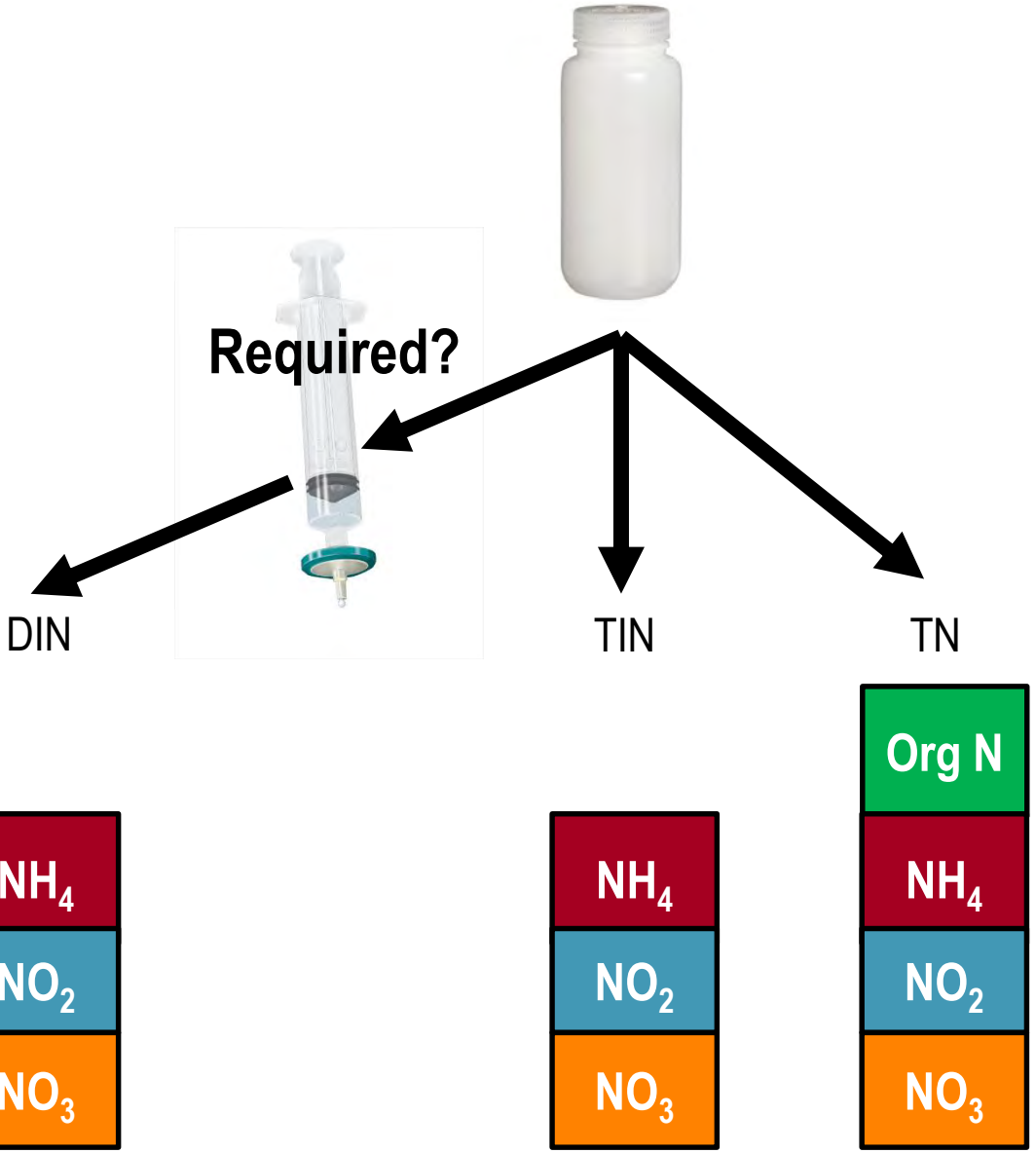
What is Dissolved Inorganic Nitrogen (DIN), Total Inorganic Nitrogen (TIN), and Total Nitrogen (TN)?

Is the filtration step necessary for DIN?

For BACWA members, the answer is NO in the 2nd Watershed Permit: the reported DIN values by SFEI were the sum of reported non-filtered values for Ammonia, Nitrite, and Nitrate

It is recommended that clarifying language be included in the 2nd Watershed Permit



Study Findings for Total Nitrogen (TN) Load Reduction Across the Bay

Strategy	TN Load Reduction to the Bay	Capital Cost	Total Present Value
Optimization	7%	$119 M	$266 M
Sidestream Treatment	19%	$391 M	$736 M
Upgrade Level 2	57%	$7.0 B	$9.4 B
Upgrade Level 3	82%	$8.5 B	$12.4 B

2018 Group Annual Report Summary (Rounded Values)

Dry Season Average

Parameter	Units	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018
Total Flow	mgd	399	387	365	359	387	386
Total Ammonia	kg N/d	32,700	35,500	36,600	35,700	39,100	38,000
Total TN	kg N/d	49,900	51,500	52,500	52,200	53,700	53,500
Total TP	kg P/d	3,600	3,400	3,400	3,700	3,900	3,700

Annual Average

Parameter	Units	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018
Total Flow	mgd	453	434	421	425	510	434
Total Ammonia	kg N/d	33,800	36,600	36,900	36,800	40,700	40,400
Total TN	kg N/d	53,100	55,000	55,800	55,400	58,900	57,100
Total TP	kg P/d	4,000	3,800	3,700	3,900	4,100	4,100

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