SOUTHERN CALIFORNIA BIGHT NUTRIENT MANAGEMENT

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May 18, 2026

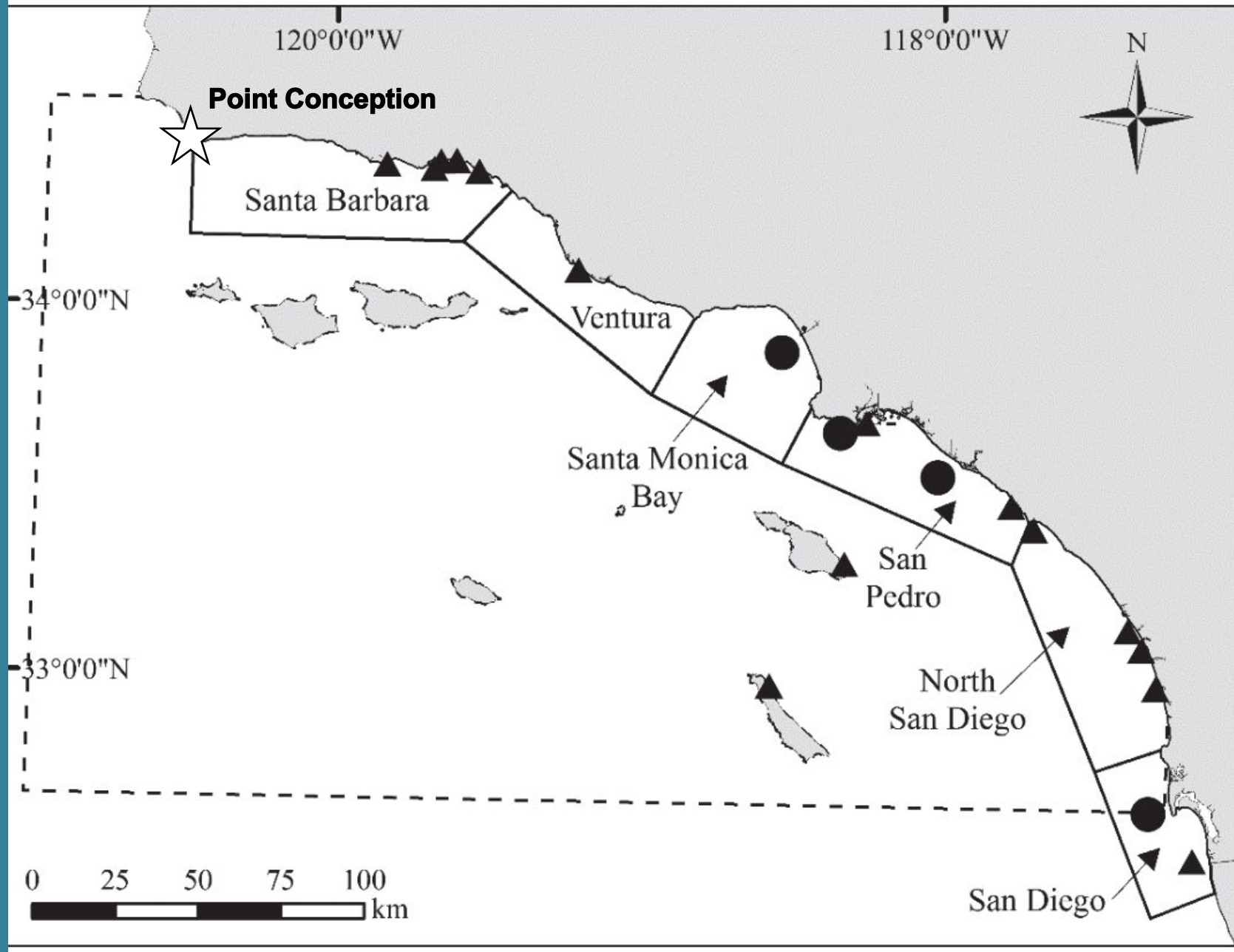
Outline

1. Background
2. Current Flows and Loads
3. Planned Projects
4. Hypothetical Management Scenarios
5. Recycled Water
6. Key Takeaways

Southern California Bight

Long gradual bend or recess in the shoreline that forms a large open bay.

Boundaries of the Bight and of the subregions as defined in Howard et al. (2014).



Source: Howard et al. (2014)

Publicly Owned Treatment Works

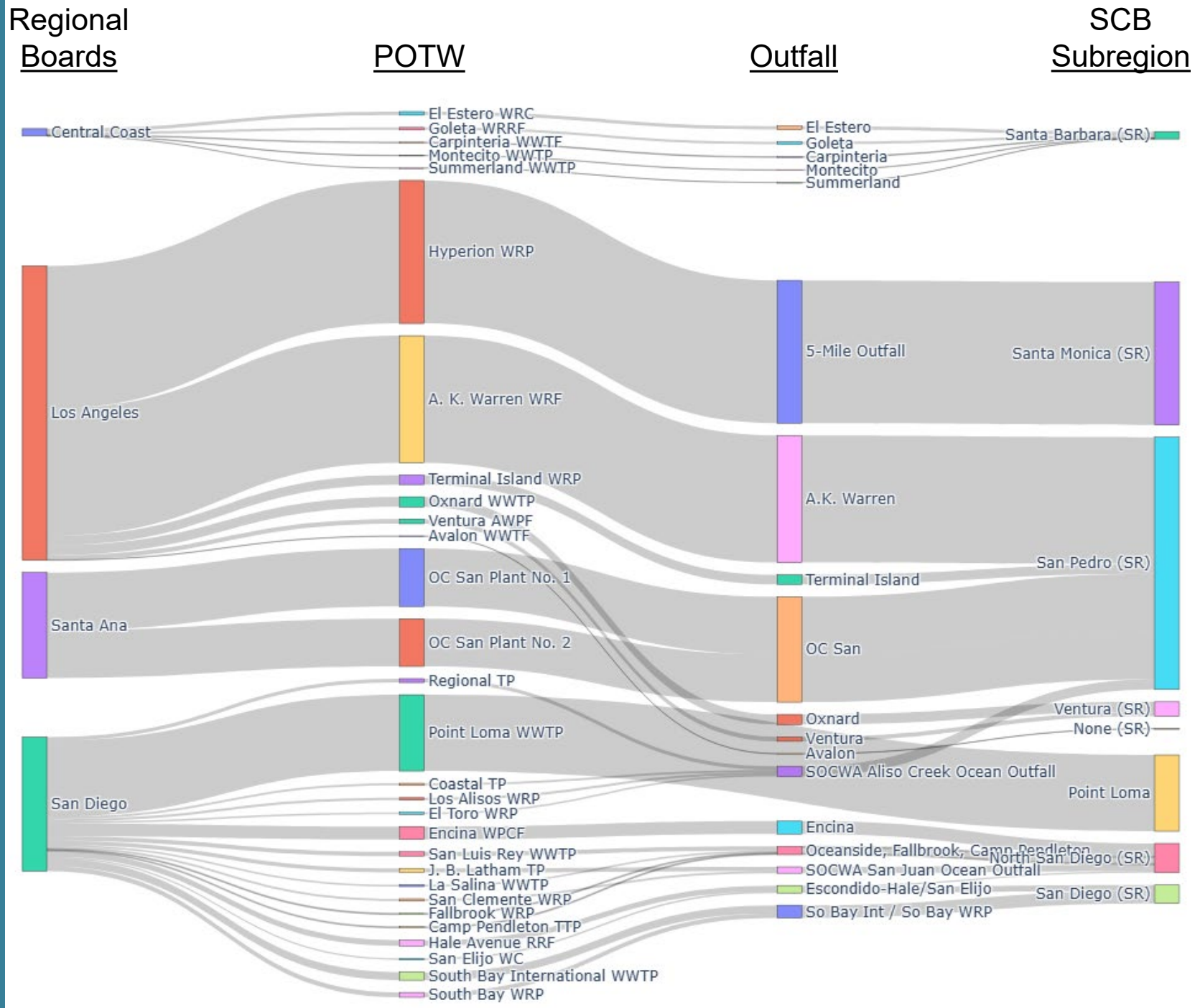
28 Publicly Owned Treatment Works (POTWs) that discharge directly to the Southern California Bight.

Updated to include Ventura AWPF.

Publicly Owned Treatment Works Permitted Capacity

Width of path represents relative permitted flow capacity.

Updated to include Ventura AWPF.

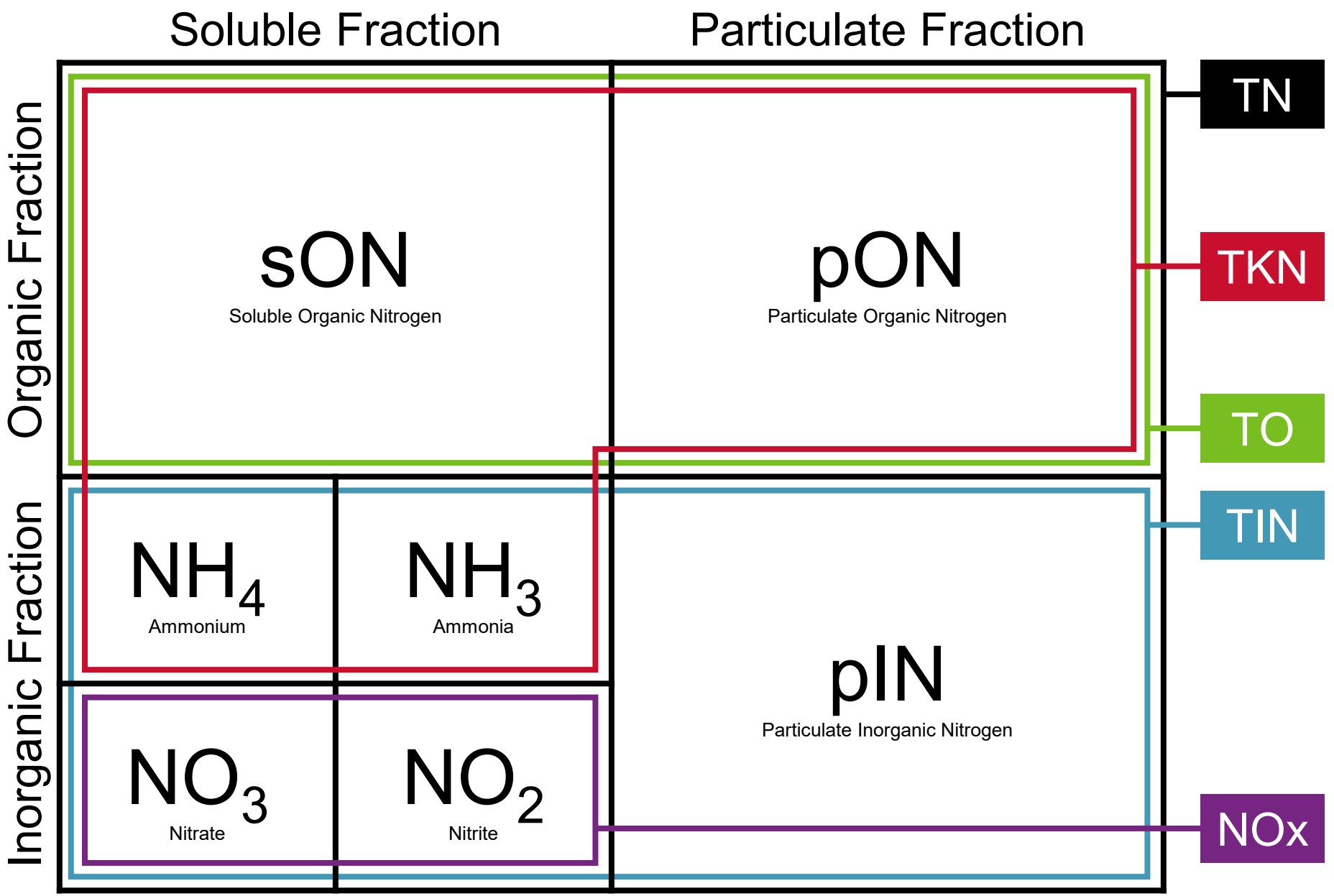


Terminology & Speciation

Nitrogen Species

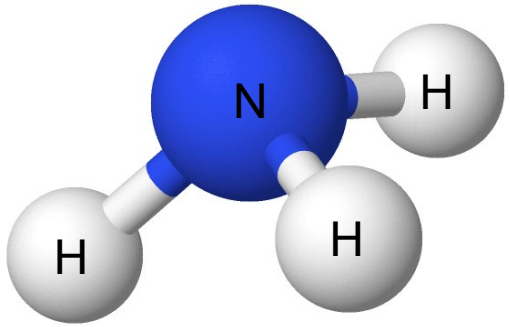
TN	Total Nitrogen
TON	Total Organic Nitrogen
TIN	Total Inorganic Nitrogen
TKN	Total Kjeldahl Nitrogen
NOx	Total Oxidized Nitrogen
NH4	Ammonium
NH3	Ammonia
NO_3	Nitrate
NO_2	Nitrite
sN	Soluble Nitrogen
sON	Soluble Organic Nitrogen
sIN	Soluble Inorganic Nitrogen
pN	Particulate Nitrogen
pON	Particulate Organic Nitrogen
pIN	Particulate Inorganic Nitrogen

TN =	sN + pN = TON + TIN
TON =	sON + pON
TIN =	sIN + pIN
TKN =	TON + NH_4 + NH_3
NOx =	NO_3 + NO_2
sN =	sON + sIN
sIN =	NO_3 + NO_2 + NH_4 + NH_3
pN =	pON + pIN

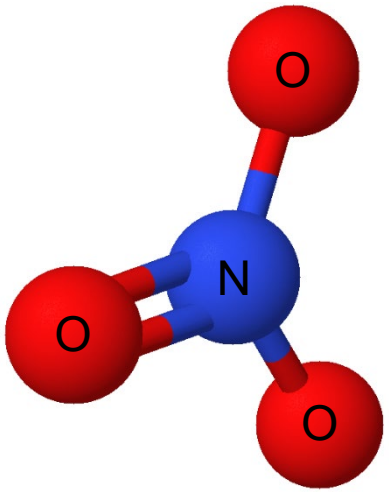


Terminology

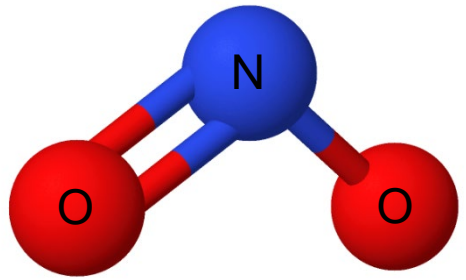
- Most relevant forms of nitrogen in wastewater = ammonia (NH_3), nitrite (NO_2^-), nitrate (NO_3^-), organic nitrogen (Org-N)
- Coastal dischargers are typically regulated as Total Nitrogen (TN) or Total inorganic nitrogen (TIN)
- TIN = Ammonia + Nitrite + Nitrate (we ignore particulate inorganic N)
- TN = TIN + Org-N



Ammonia



Nitrate

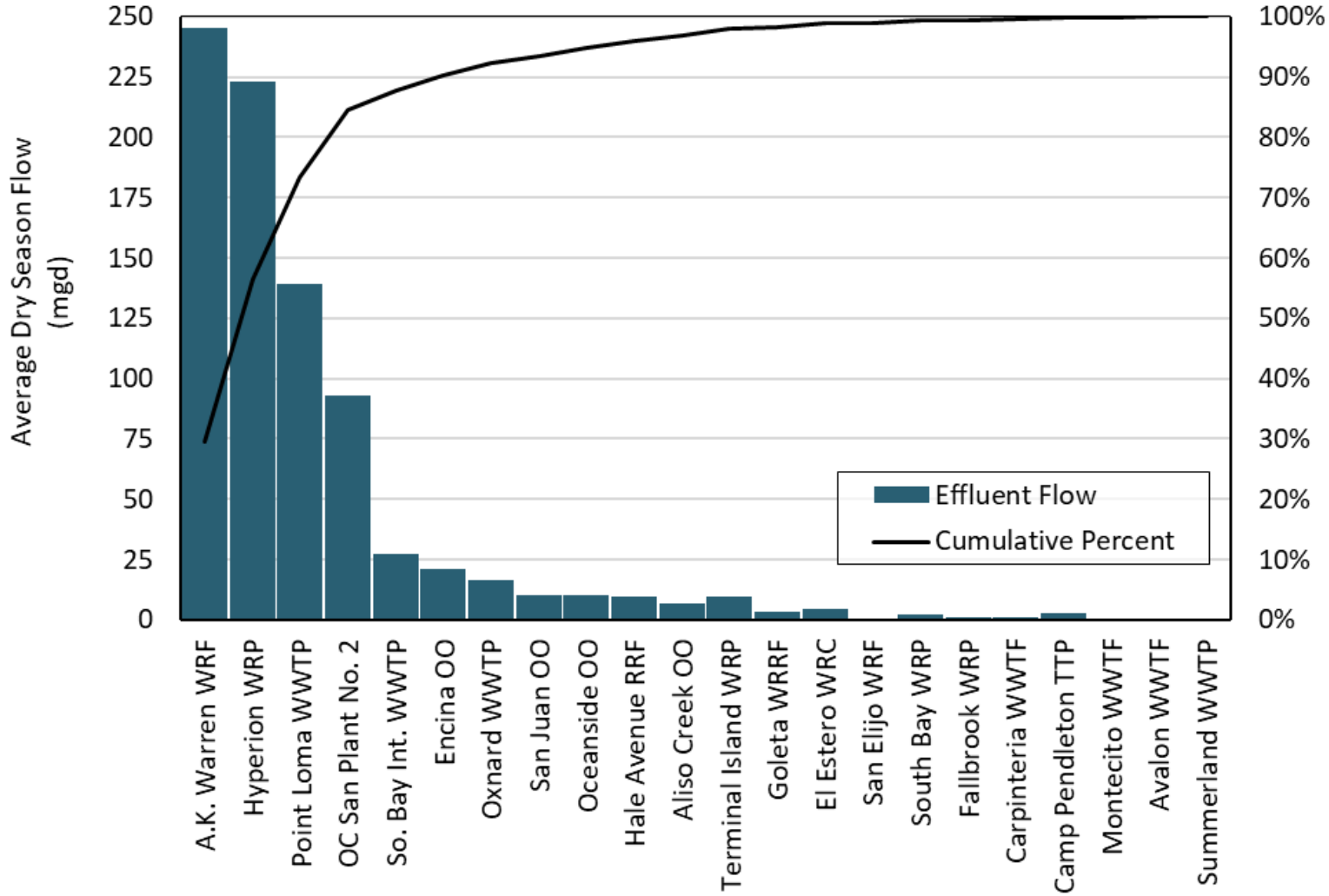


Nitrite

Average Dry Season Effluent Flow

Total estimated dry weather effluent flow: ***830 MGD***

The ***four largest treatment facilities account for approximately 85% of the discharge flow***



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April 16, 2026 at 6:02 am | *Updated April 16, 2026 at 9:31 am*

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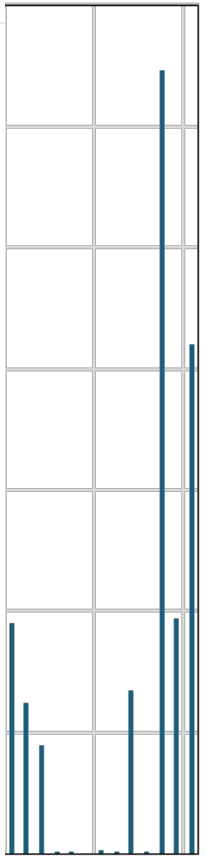


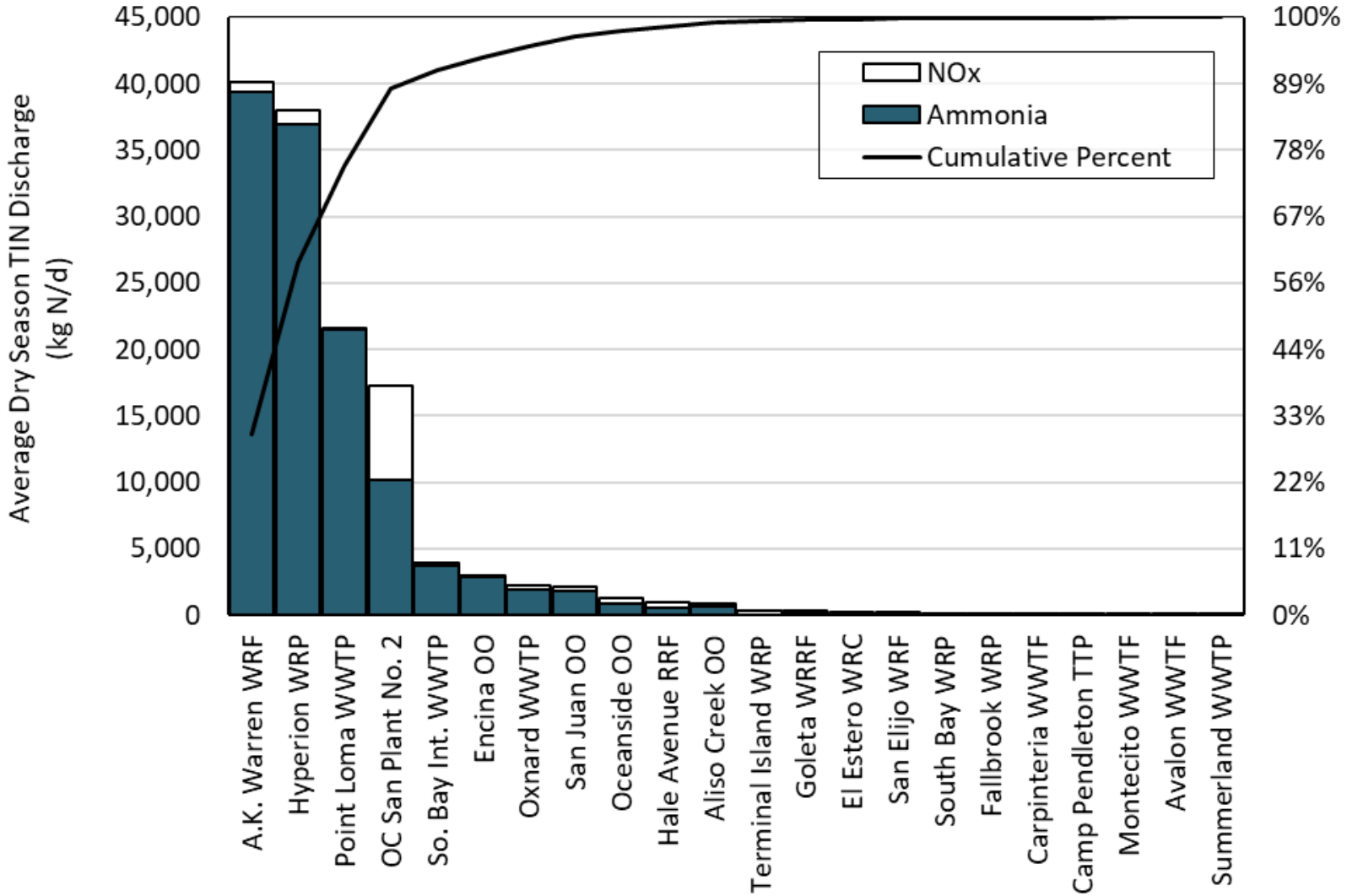
-02-01

Nitrogen Loading

Dry season average: **132,600 kg N/d**

Equivalent to **~42 mg N/L**

The **four largest treatment facilities account for approximately 87% of the discharge TIN** (equivalent **to 5.2%** of the TIN contributed to the Southern California Bight from municipal and natural sources).



Ventura WRF and AWPF in Context

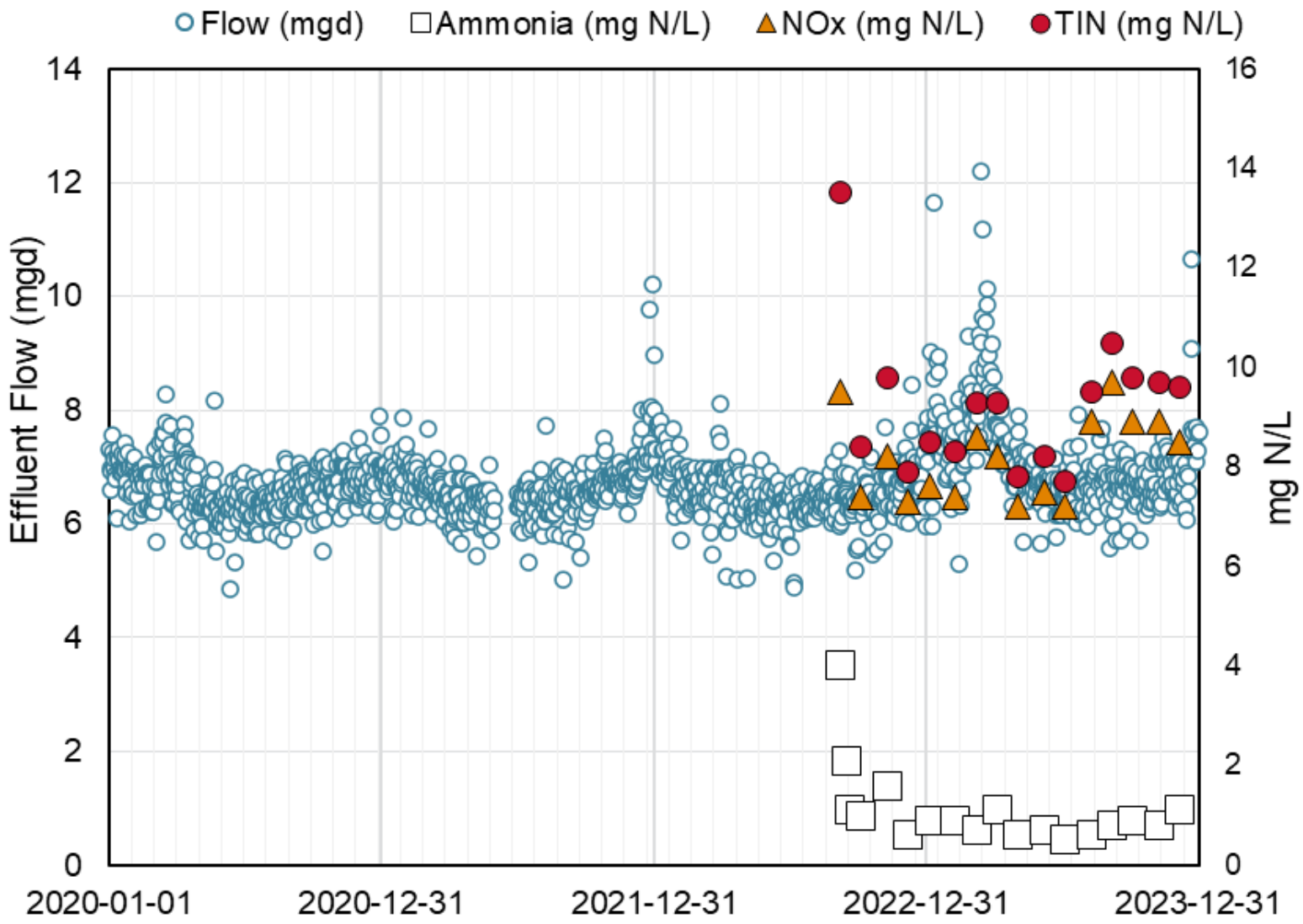
Ventura WRF Average Dry Season

Flow : **6.4 MGD**
TIN: **9.6 mg/L (249 kg/d)**

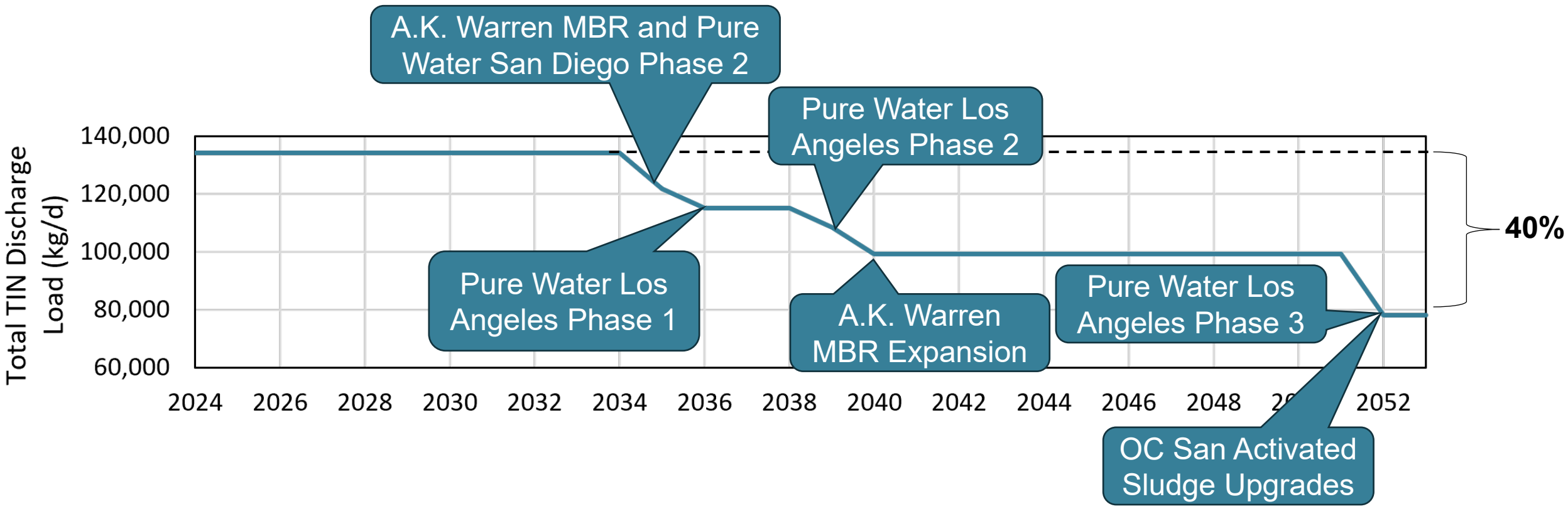
0.2% of Bight dischargers TIN load

Ventura AWPF TIN (estimate):
4.42 mg N/L @ 6 MGD = 95 kg N/d

Based on build-out condition

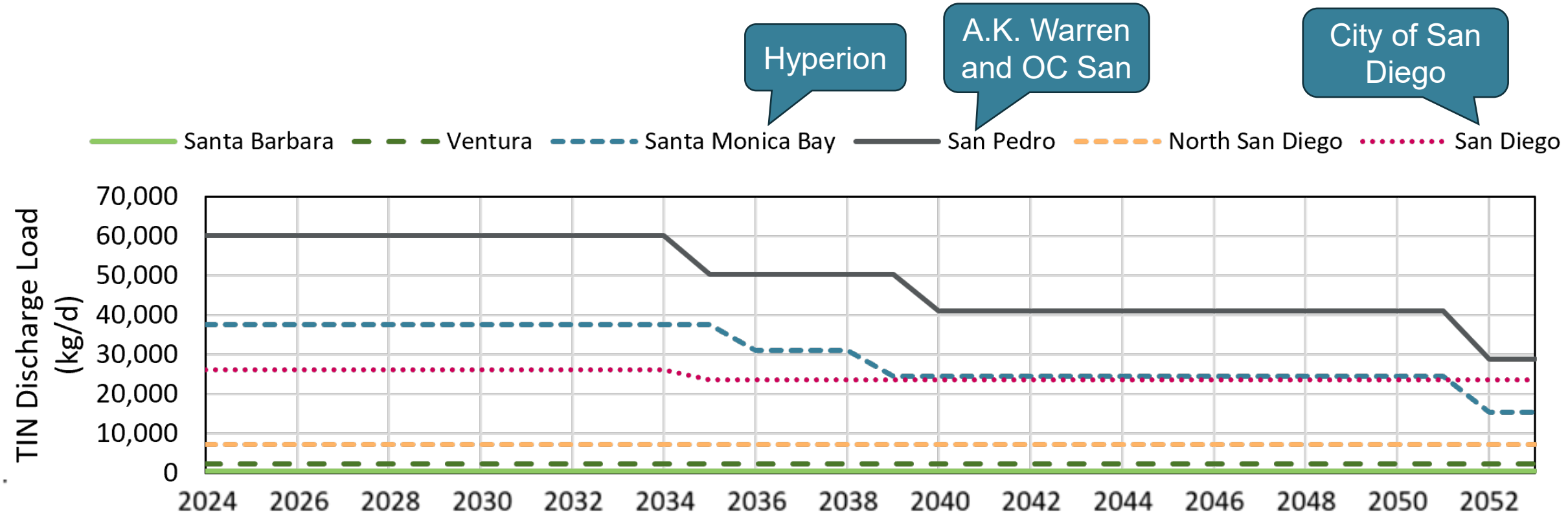


Planned Reductions



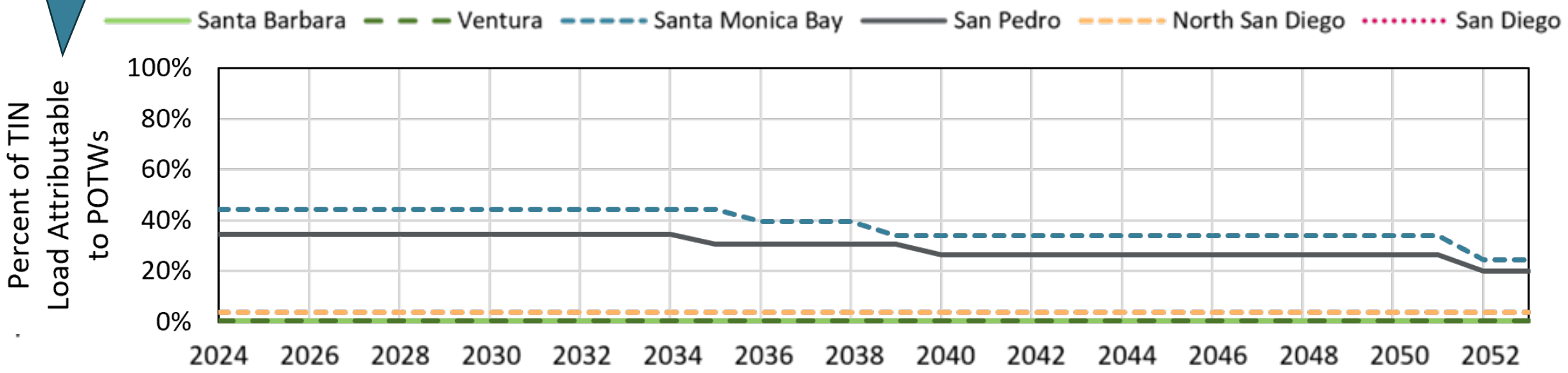
Conventional Nutrient Removal at the other treatment facilities could cost up to **$3.2 billion** and could reduce the municipal TIN load by an additional **7%** (from approximately **80,000 kg N/d to 70,000 kg N/d**).

Subregional Analysis



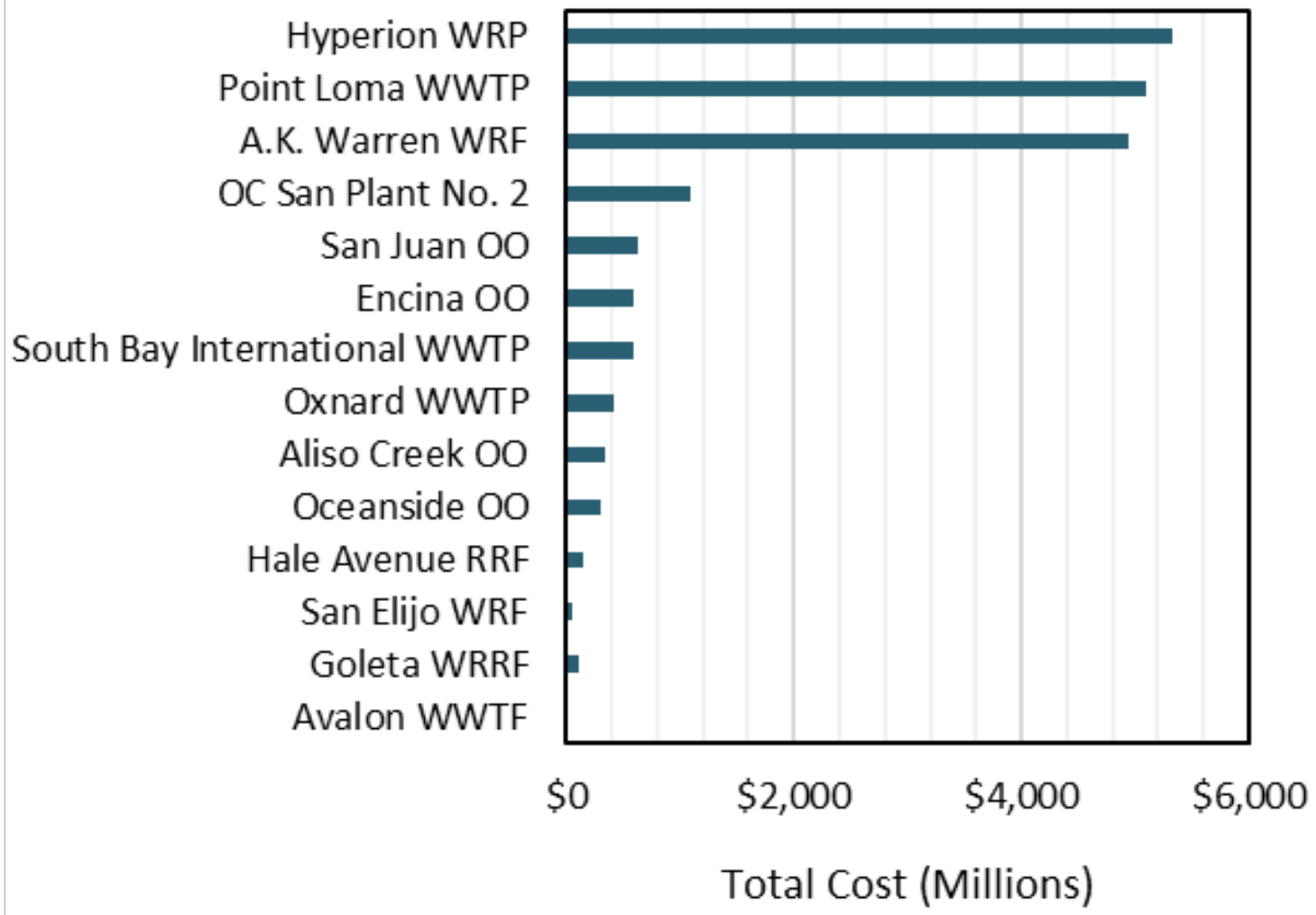
Subregional Analysis

Natural and Anthropogenic



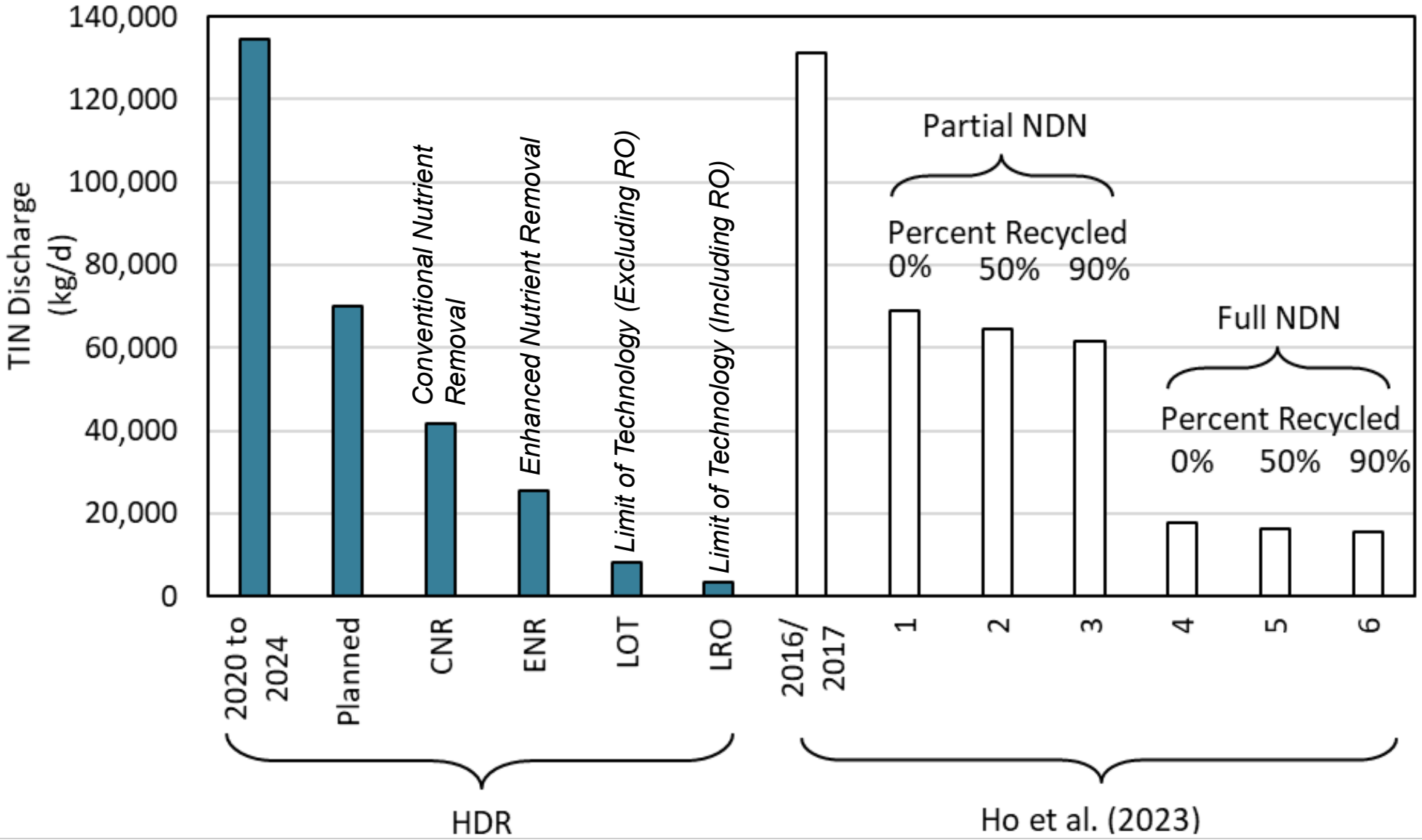
The planned reductions could reduce the total Bight-wide TIN load (municipal and natural sources) by 2.5%. The hypothetical upgrades to conventional nutrient removal for the remaining facilities could provide an additional 0.5% reduction in total TIN load.

Preliminary Costs
(Planned and Conceptual)

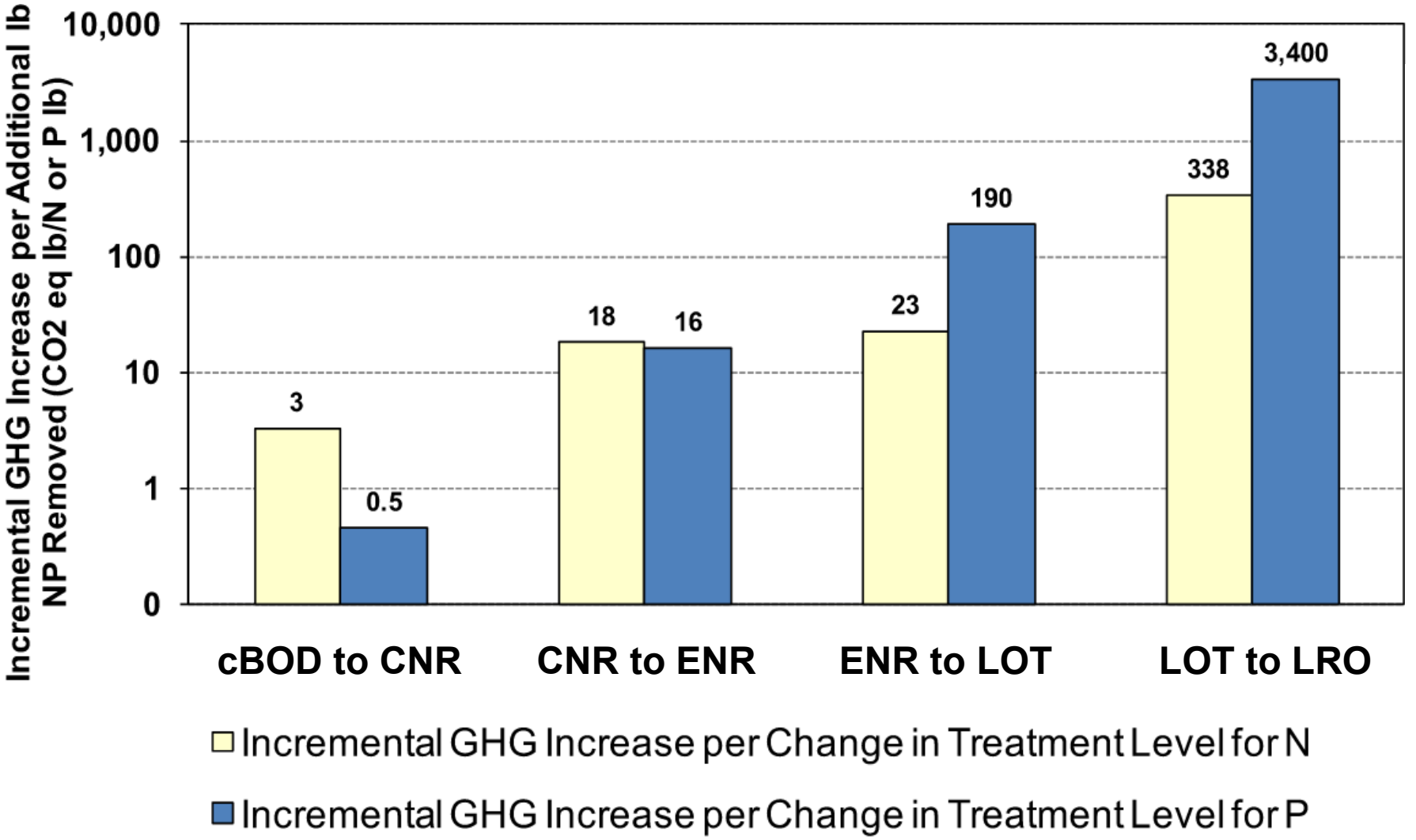


$16.5B capital costs for the big four, up to $3.2B lifecycle cost for the rest.

Comparison to Hypothetical Scenarios



Greenhouse Gas Emissions



cBOD = Carbonaceous Biochemical Oxygen Demand (i.e., Secondary Treatment)

CNR = Conventional Nutrient Removal

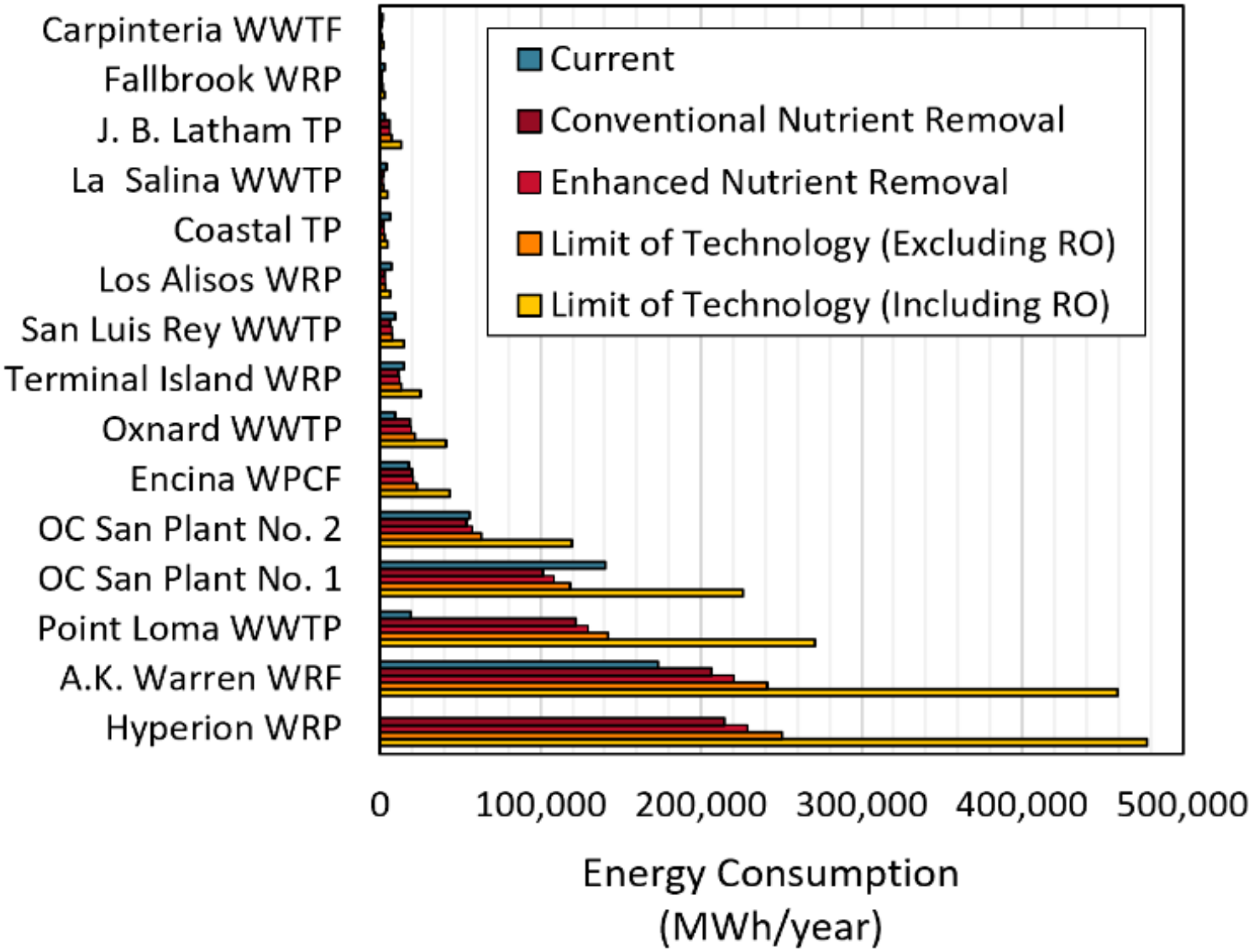
ENR = Enhanced Nutrient Removal

LOT = Limit of Technology (Excluding RO)

LRO = Limit of Technology (Including RO)

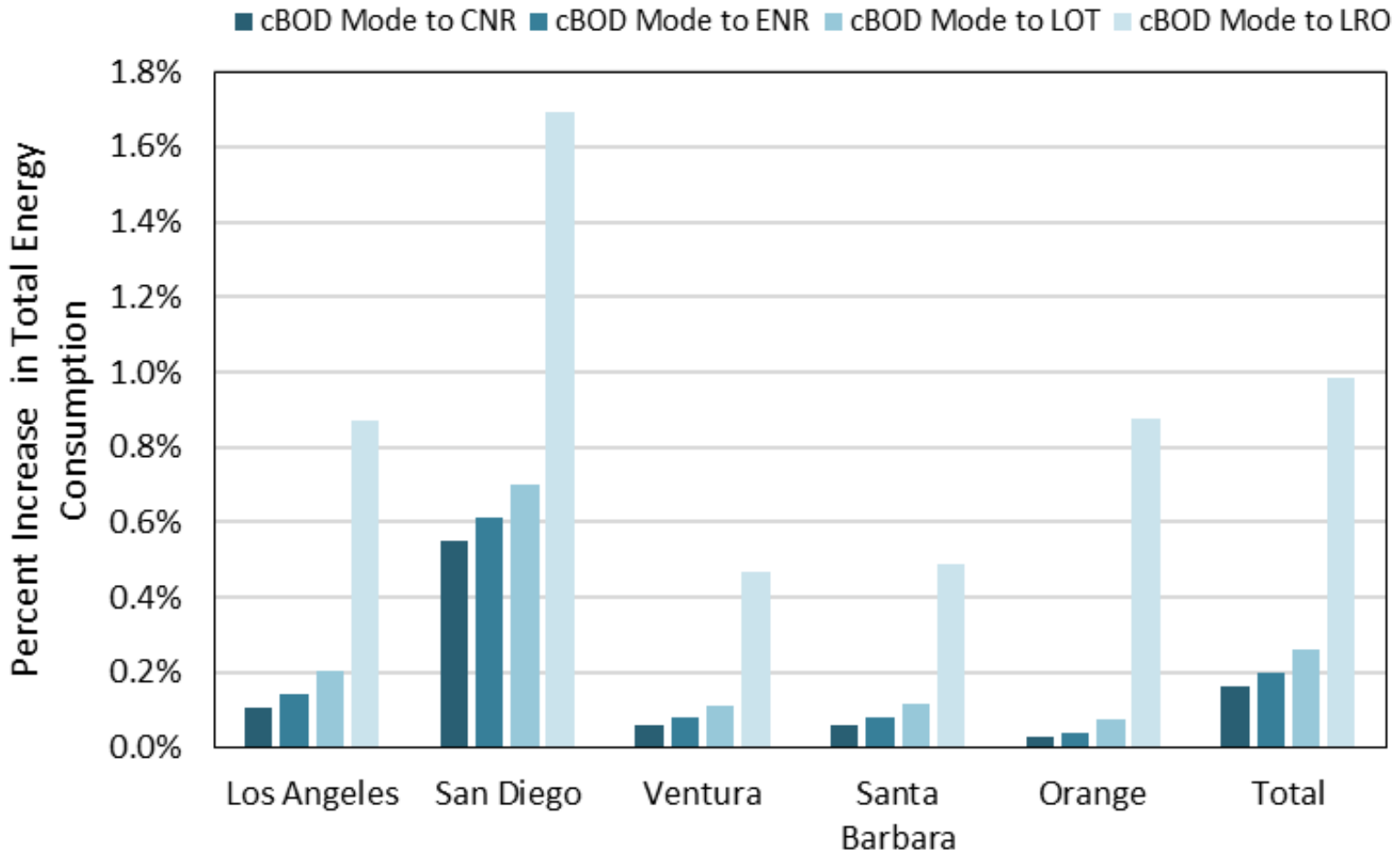
Falk, M. Reardon, D. Neethling, J.B. (2011). Striking the Balance Between Nutrient Removal in Wastewater Treatment and Sustainability. Water Environment Research Foundation. Final Report.

Estimated Energy Requirements

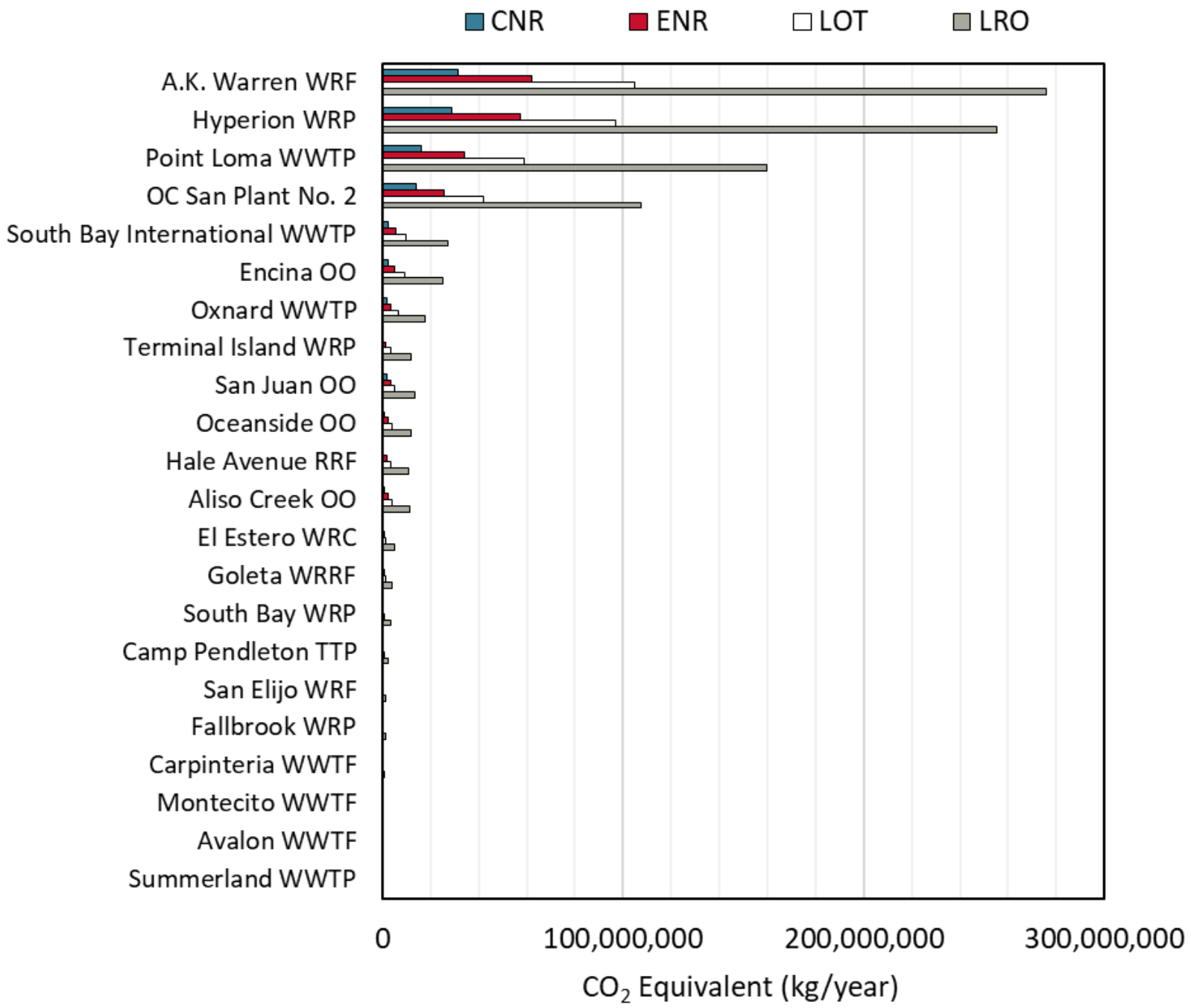


Energy Impacts

County-level energy requirements.



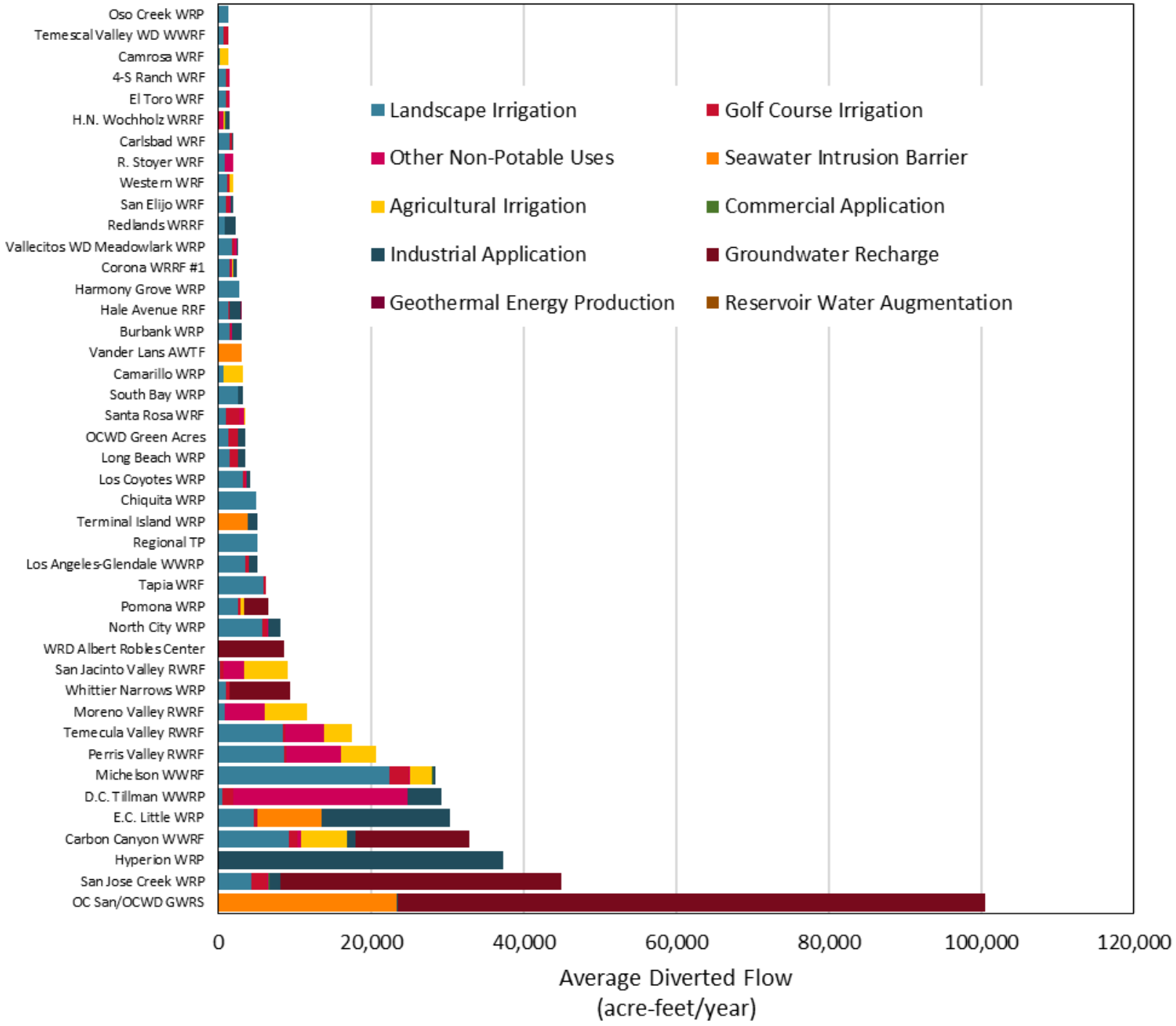
Greenhouse Gas Emissions



Regional Recycled Water for 81 POTWs

*Average (2019 to 2023) estimated recycled water flow: **475,000 acre-feet / year (424 MGD)**.*

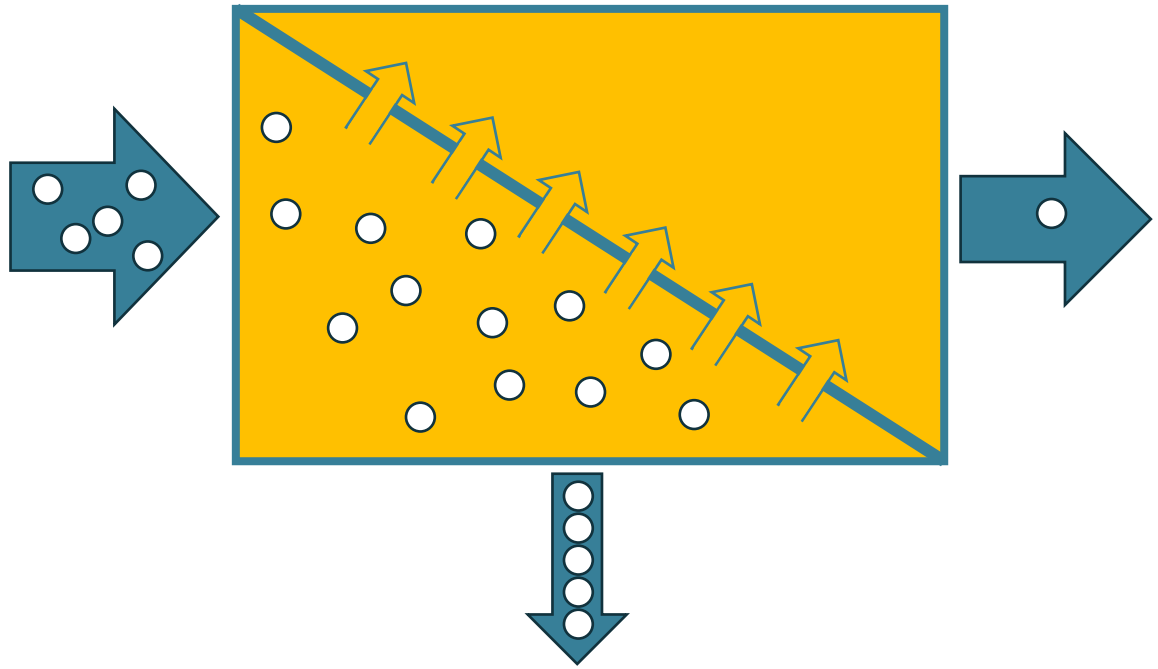
Note this includes inland POTWs and satellite facilities. Only facilities recycling greater than 1 MGD are shown.



Nutrient Management Challenges with Reverse Osmosis

Advanced Treatment
(Includes Reverse Osmosis)

Treated Wastewater
(Conventional Nutrient
Removal (~15 mg N/L))



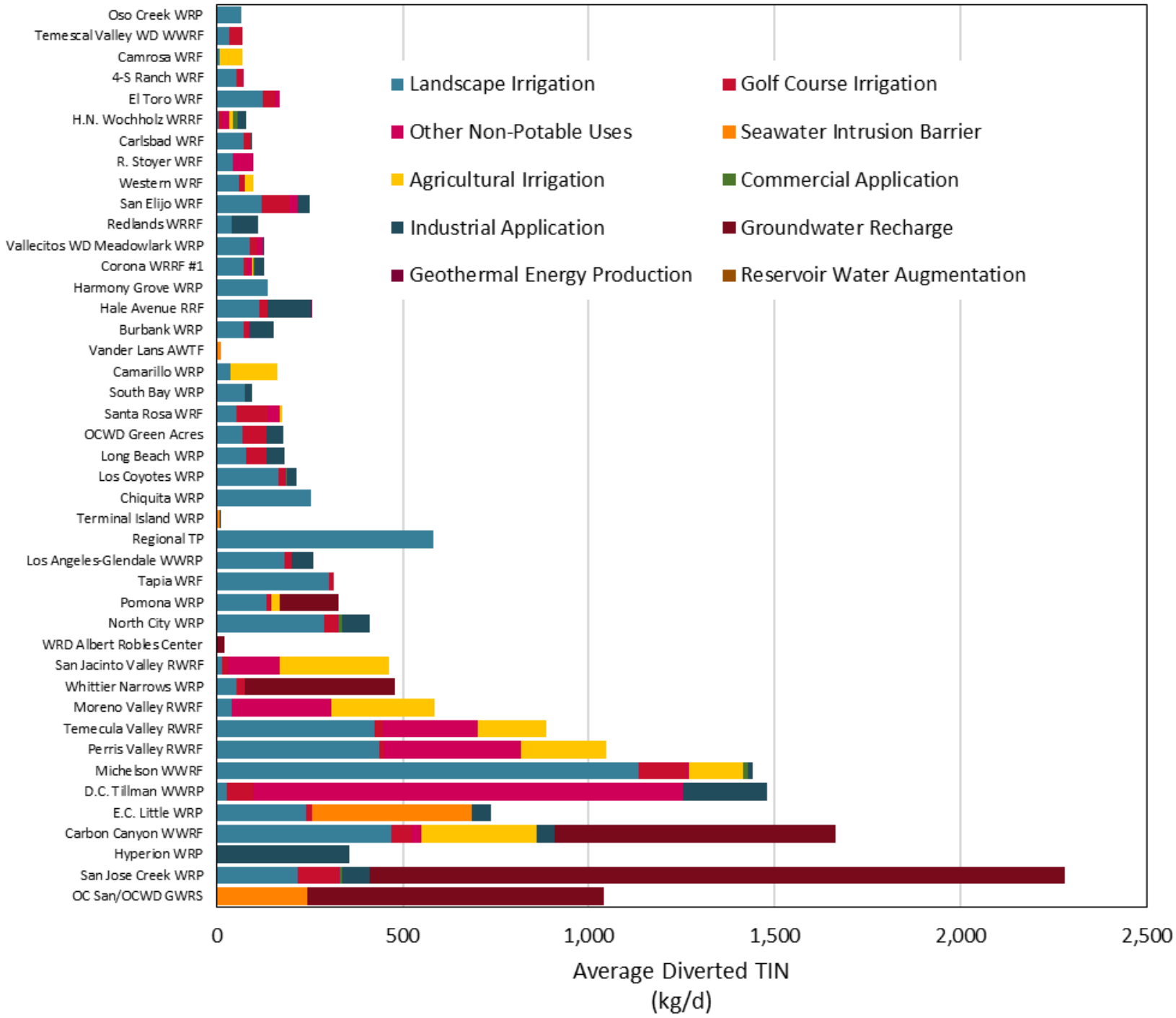
Treated Water
~85% of the Feed Flow
~5% of the Feed Nitrogen Species

Reverse Osmosis Concentrate
~15% of Feed Flow
~95% of the Feed Nitrogen Species

Diverted TIN Loads

TIN diversion is not proportional to flow due to the discharge of reverse osmosis concentrate.

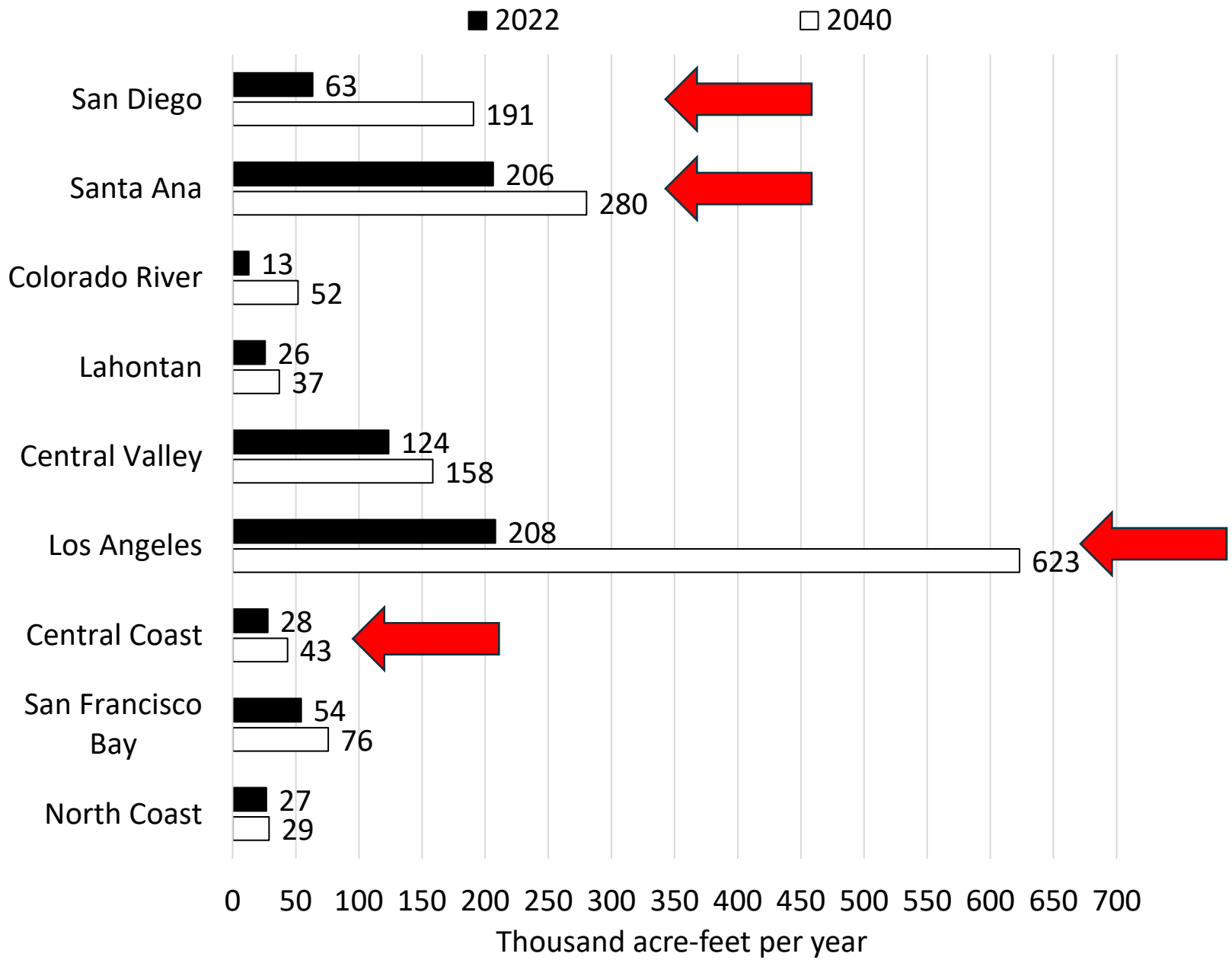
If all TIN in reverse osmosis concentrate was diverted from receiving waters, approximately 46,000 kg/d could be diverted, the majority of which would directly affect the Southern California Bight.



Planned Recycled Water Projects

For San Diego, Santa Ana, Central Coast, and Los Angeles:

Total increase of 632,000 acre-feet per year, more than doubling total recycled water volumes from 2022 (125% increase from 506,000 acre-feet per year in 2022)



Key Takeaways

- The four largest dischargers discharge ~85% of the effluent flow and ~88% of the effluent TIN.
- TIN from municipal effluent is small compared to Bight-wide natural upwelling, however municipal loads are significant in several subregional contexts (Santa Monica Bay and San Pedro subregions).
- Planned projects could reduce the TIN discharged to the Southern California Bight by 40% by 2052 (mainly in the Santa Monica Bay and San Pedro subregions).
- The nexus between water recycling and nutrient management will become even more important. Potable reuse alone is not necessarily a solution for nutrients.
- Local energy supply capacity may be overburdened.
- Regional costs for nutrient removal upgrades could reach $20B or more, depending on the required treatment levels.
- Proactive engagement with modelers and regulators will help ensure the most appropriate regulatory outcome.