FUTURE MAPPING:

Planning Strategies to Achieve Your Vision

Sustainable Planning in “Future Time”

carollo

Engineers...Working Wonders With Water®

Outline of Presentation

1. Planning Forces, Conventional Wisdom, Drivers, and Sustainability
2. “Future Mapping” of Industry Trends
3. Summary of Emerging Technologies and Concepts

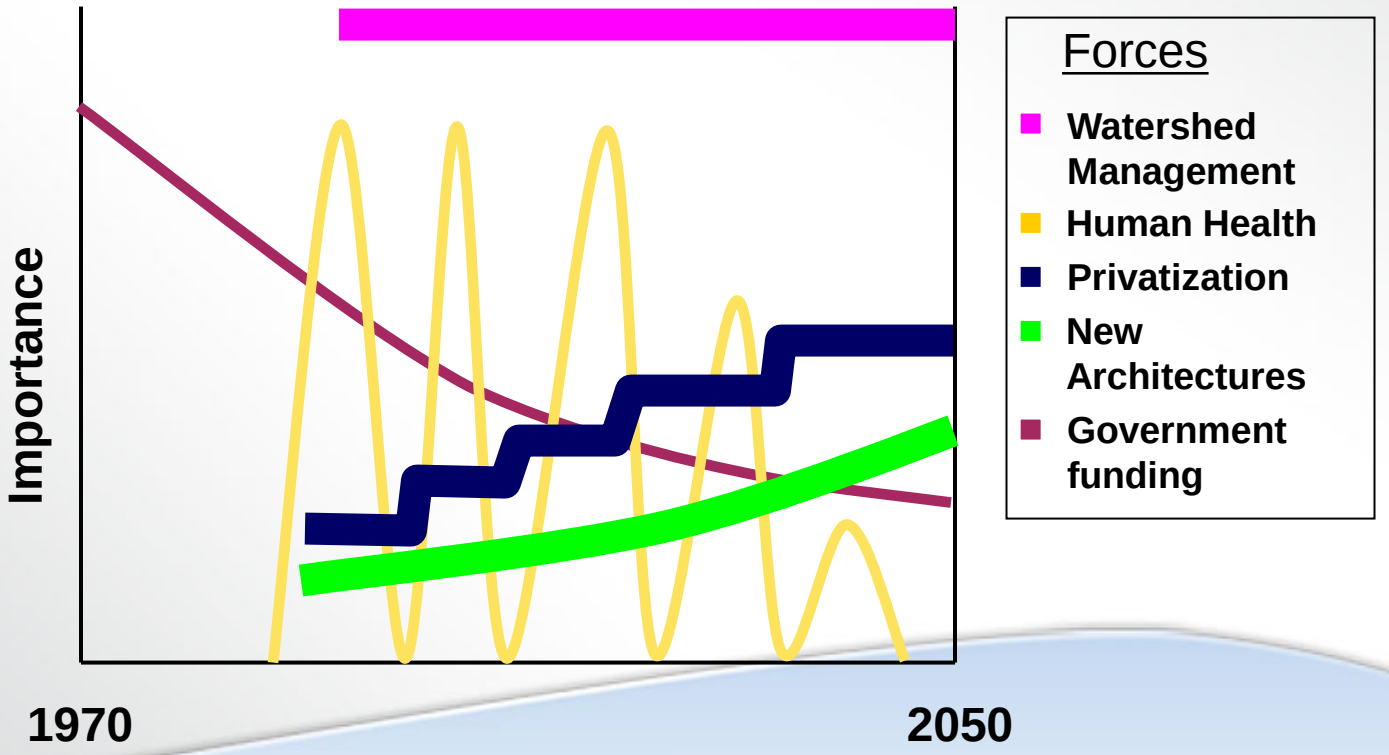
External Planning Forces, Conventional Wisdom, Drivers and Sustainability

Five External Forces to Be Reckoned with…

1. Watershed management
2. Human health issues
3. Privatization
4. Reduced grant funding
5. New “architectures”
   a. Technological changes
   b. Global climate change impacts
   c. New economic and political “realities”.

(Source: WERF perspective)

Conventional Wisdom is that "*Water is Water*" in the Future…



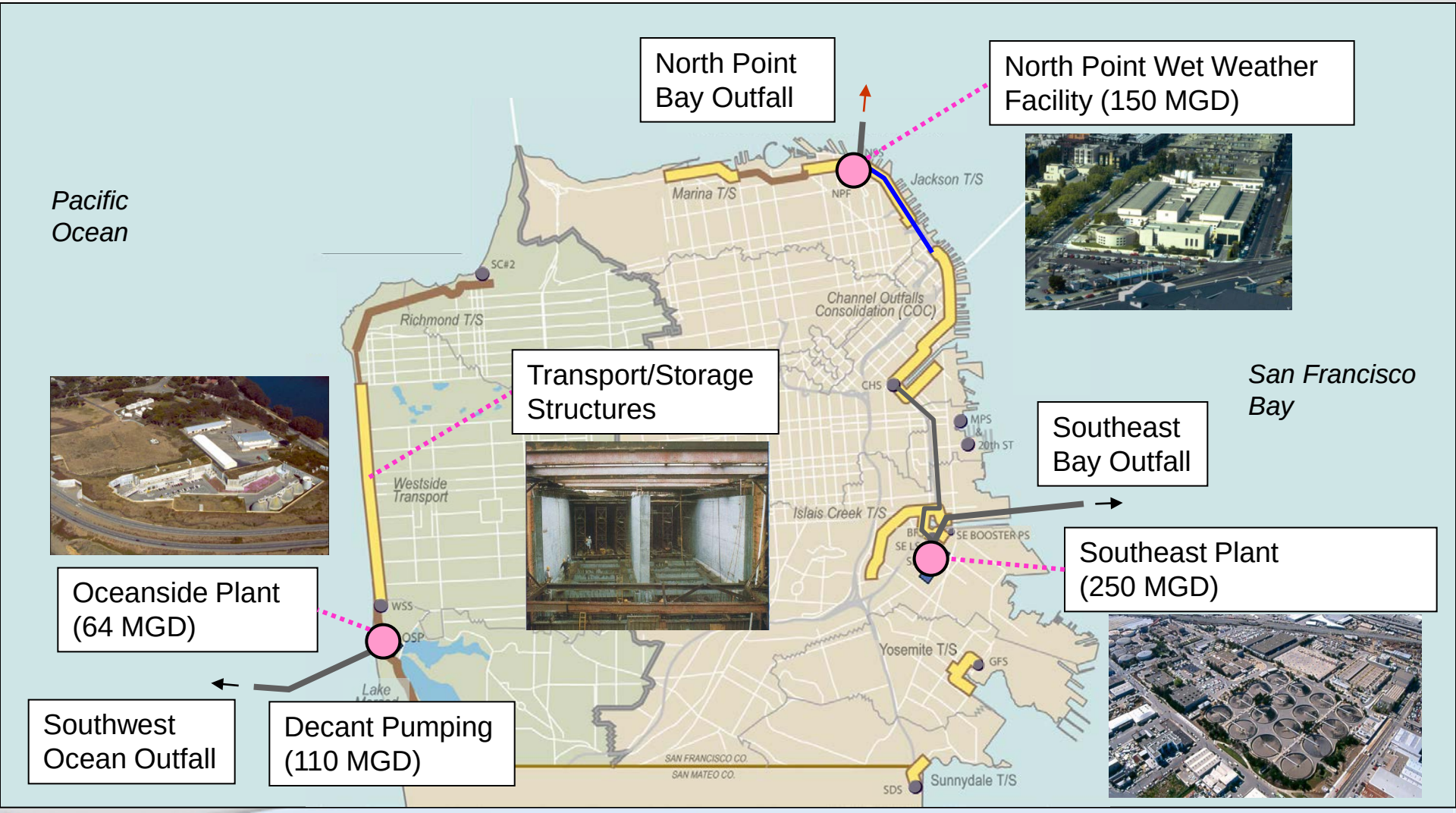
Infrastructure Planning Addresses Four Major Drivers…

1. Repair and Replacement *(to extend life and maximize use of existing facilities).*
2. Regulatory requirements *(to protect public health and the environment).*
3. Growth *(to accommodate new users).*
4. "Best Business Practices" *(to optimize and "do more with less").*

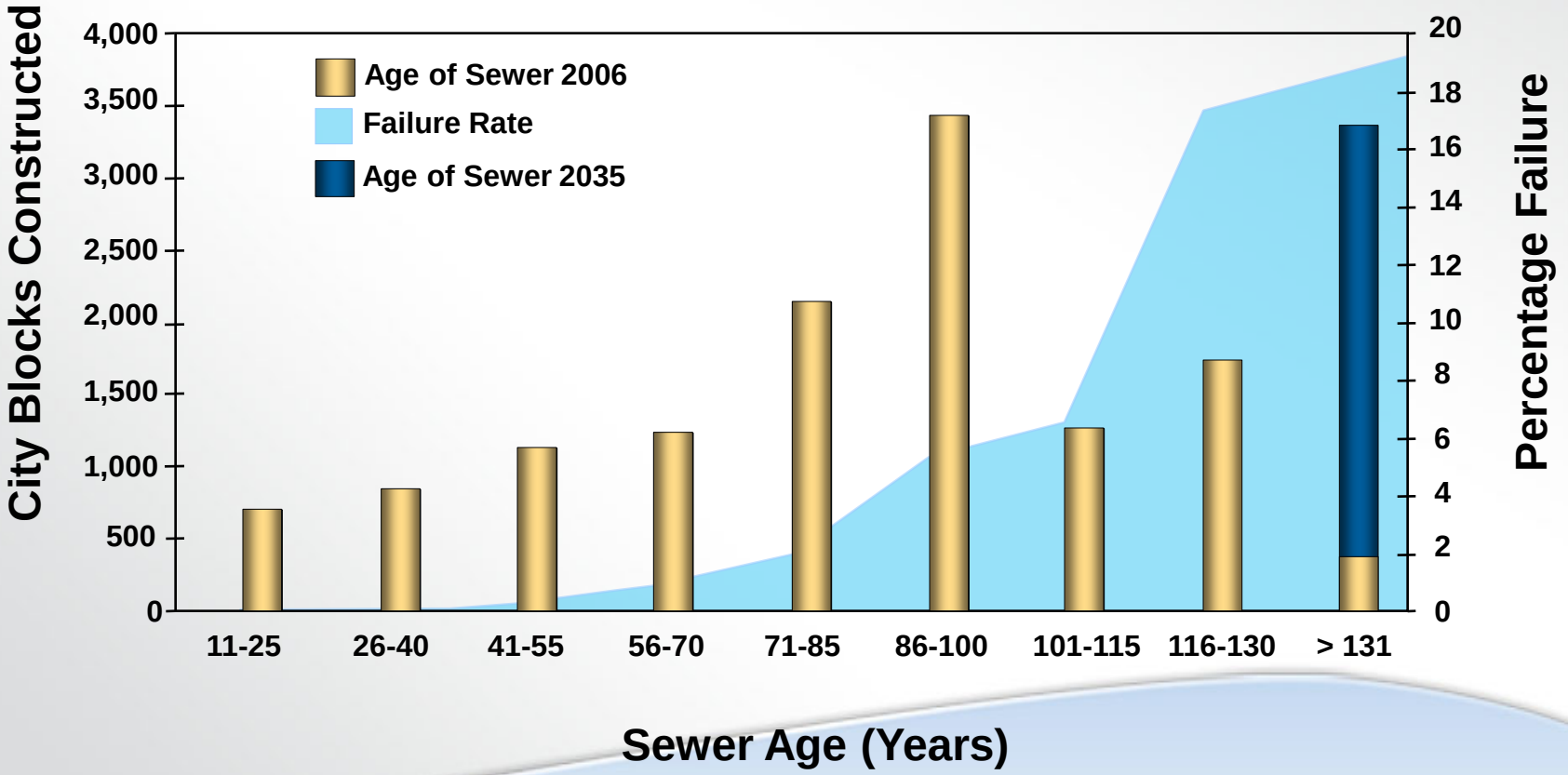
Case Study: San Francisco, CA. - Replacement and Rehabilitation-

1. Combined wastewater and stormwater facilities for 850,000 people.
2. Extensive repair and replacement program for up to 140 year old sewers.
3. Climate change impacts.
4. $7.2 billion over 30-year planning horizon.

Existing San Francisco Combined System Facilities



San Francisco Aging sewers and failure rates…

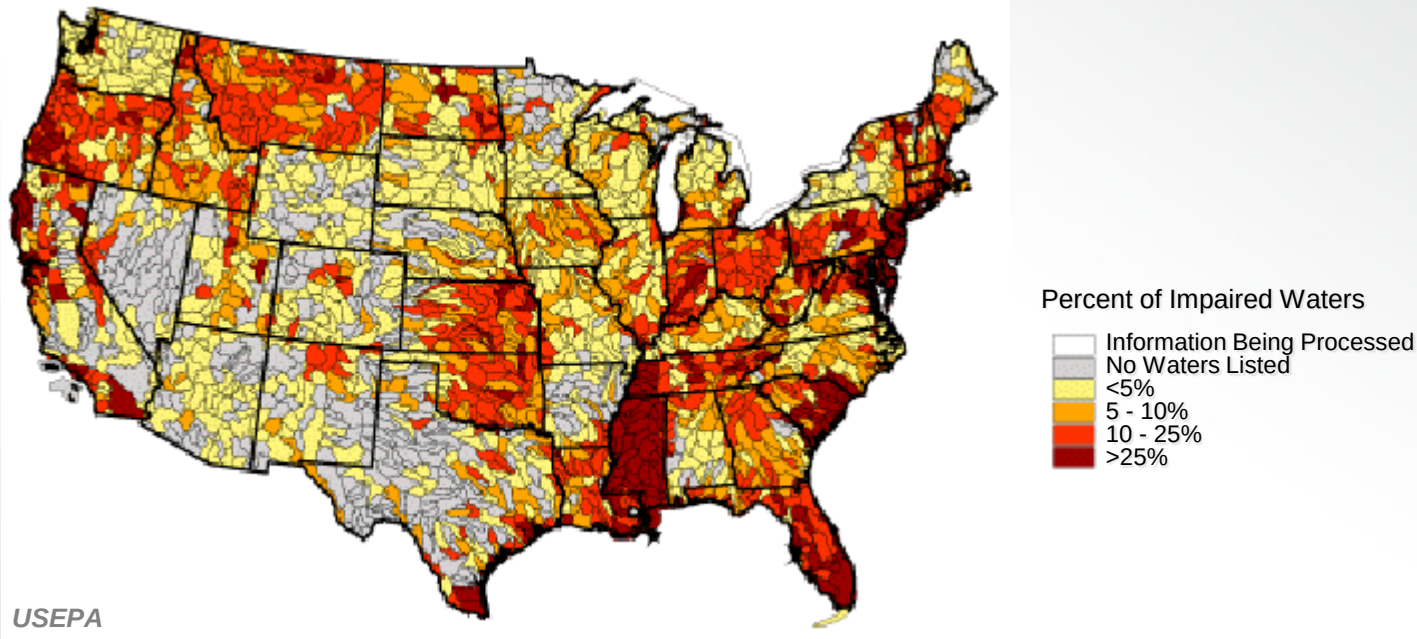


Repair and Replacement Needs = $900 Billion over the Next 10 Years

1. Drinking Water => $15 to $45 billion/year.
2. Clean Water => $33 to $45 billion/year.
3. Annually we spend $10 and $13 billion, respectively, today.

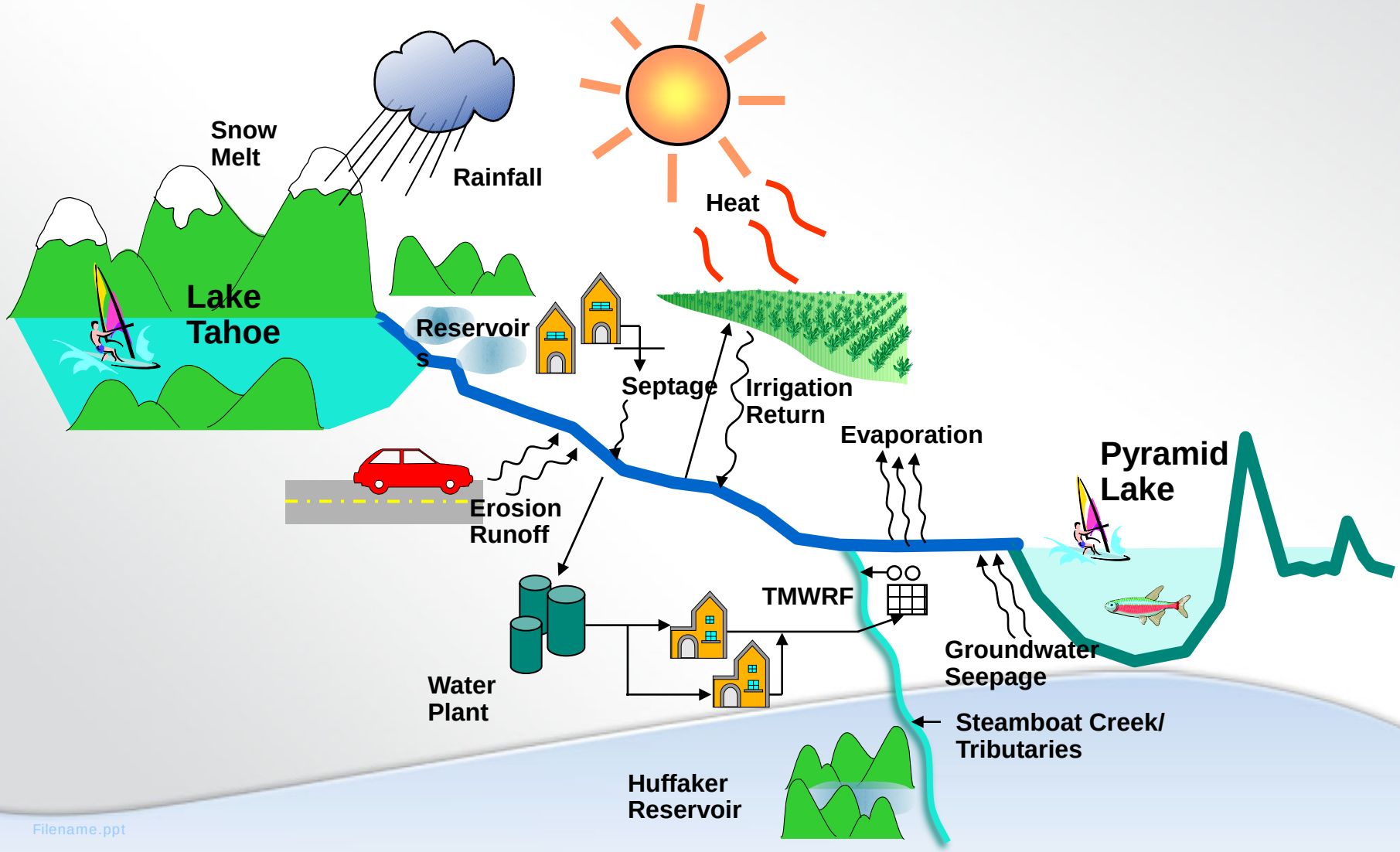
Technical-based Limits have not Achieved WQ Act Goals

(Summary of Section 303(d) Listings)

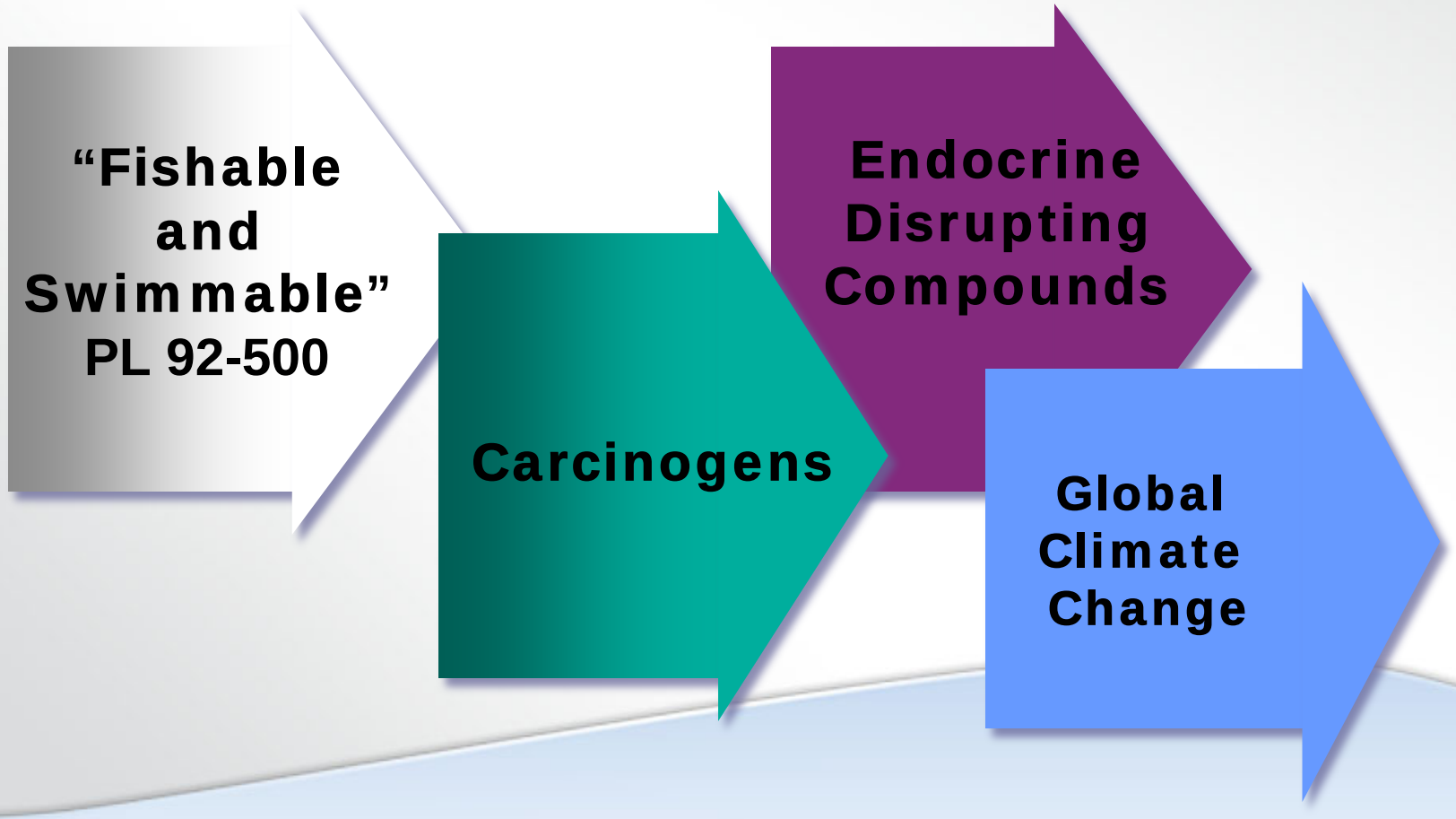


1. 20,000 River Segments, Lakes and Estuaries still "Polluted"
2. 300,000 Miles of Rivers
3. 5 Million Acres of Lakes

Regulations are shifting the focus to Watersheds…



It is Public Concerns that Drive Environmental Regulations



EDCs and Contaminants of Emerging Concern (CEC)…

1. Millions of tons of man-made chemicals have been introduced into the environment since 1950's.
2. Improved levels of detection of trace contaminants.
3. Improved understanding of the human endocrine system.
4. Unexplained changes in aquatic and riparian life…traced to CEC's.
5. Unexplained trends in human health effects.

Anecdotal Public Health Impacts of EDCs

1. 40% decrease in sperm counts in last 50 years - *(Skakkebaek, et.al. 1992).*
2. Reduced fecundity rates to 1:5 today, vs 1:8 15 years ago – *(NSFG, 1995)*.
3. 50% increase in testicular cancer rates in last 25 years - *(U.S. Cancer Institute, 2005).*
4. 30% increase in breast cancer rates in last 15 years – *(Ries, et.al., 1994)*.

Summary of Trends in Wastewater Regulations

- Increasing pace of development of regulations (driven by public interests)
- Local => watershed => global impacts.
- Technology-based => water-quality based standards.
- Standards for concentration only => both concentration and mass limits (TMDLs)

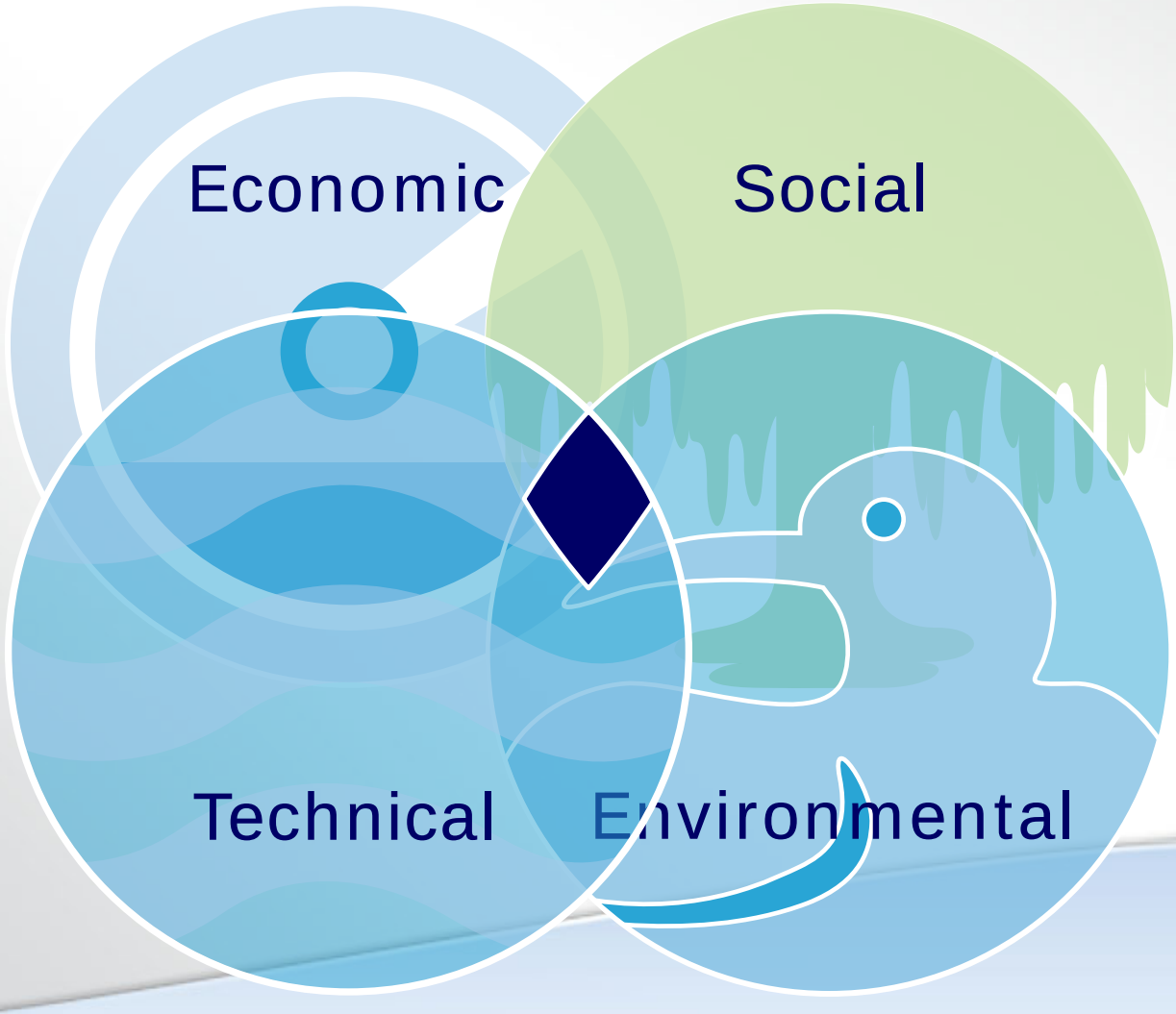
Summary of Regulatory Trends (cont.)

- Increasing restrictive stormwater requirements
- Increasing concerns over wet weather overflows (SSOs/CSOs)
- Increasing concerns over ammonia, nitrogen, nutrients (e.g. redefinition of “secondary treatment”)
- Increasing restrictions on disposal/reuse of biosolids

Summary of Regulatory Trends (cont.)

- Focus on Contaminants of Emerging Concern (CECs/EDCs), toxics, and trace organics
- Reduction or elimination of dilution allowance due to “indirect reuse”
- Disinfection of Ocean Discharges

Sustainability is the Overarching Theme Today…



“Laws” of Sustainability

1. Nothing Disappears.
2. Everything Spreads.
3. Biological and economic value lies in the concentration and structure of matter (we consume quality, not matter).
4. Sun-driven process (photosynthesis) is the only net producer of structured matter on the planet.

Population Growth Throughout History

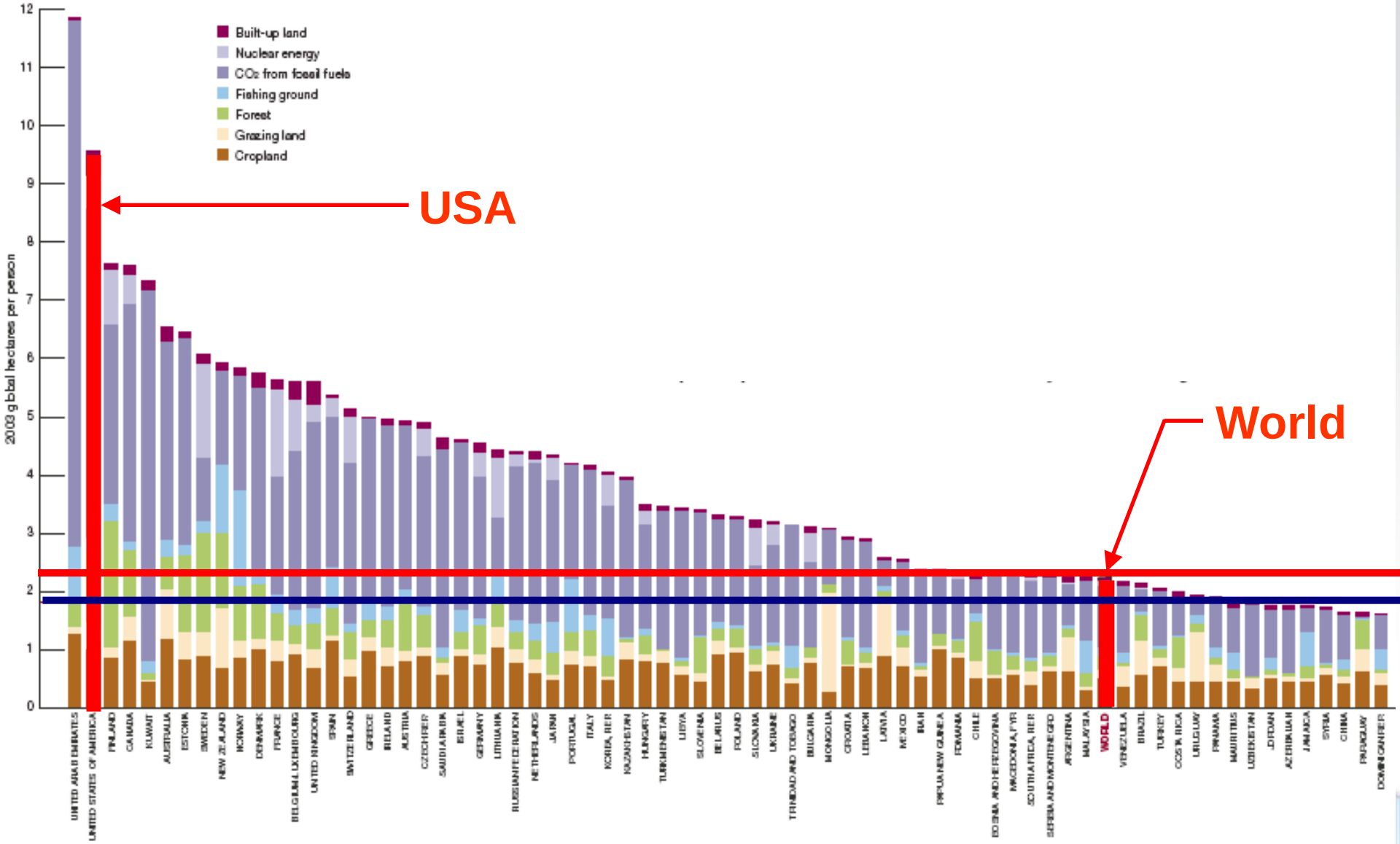
Source: United Nations

Global C02 Emissions

Fossil Fuel Burning, Cement Manufacture & Gas Flaring 1751-2002

Source: Environmental Protection Agency

Ecological Footprint per Capita, by Country



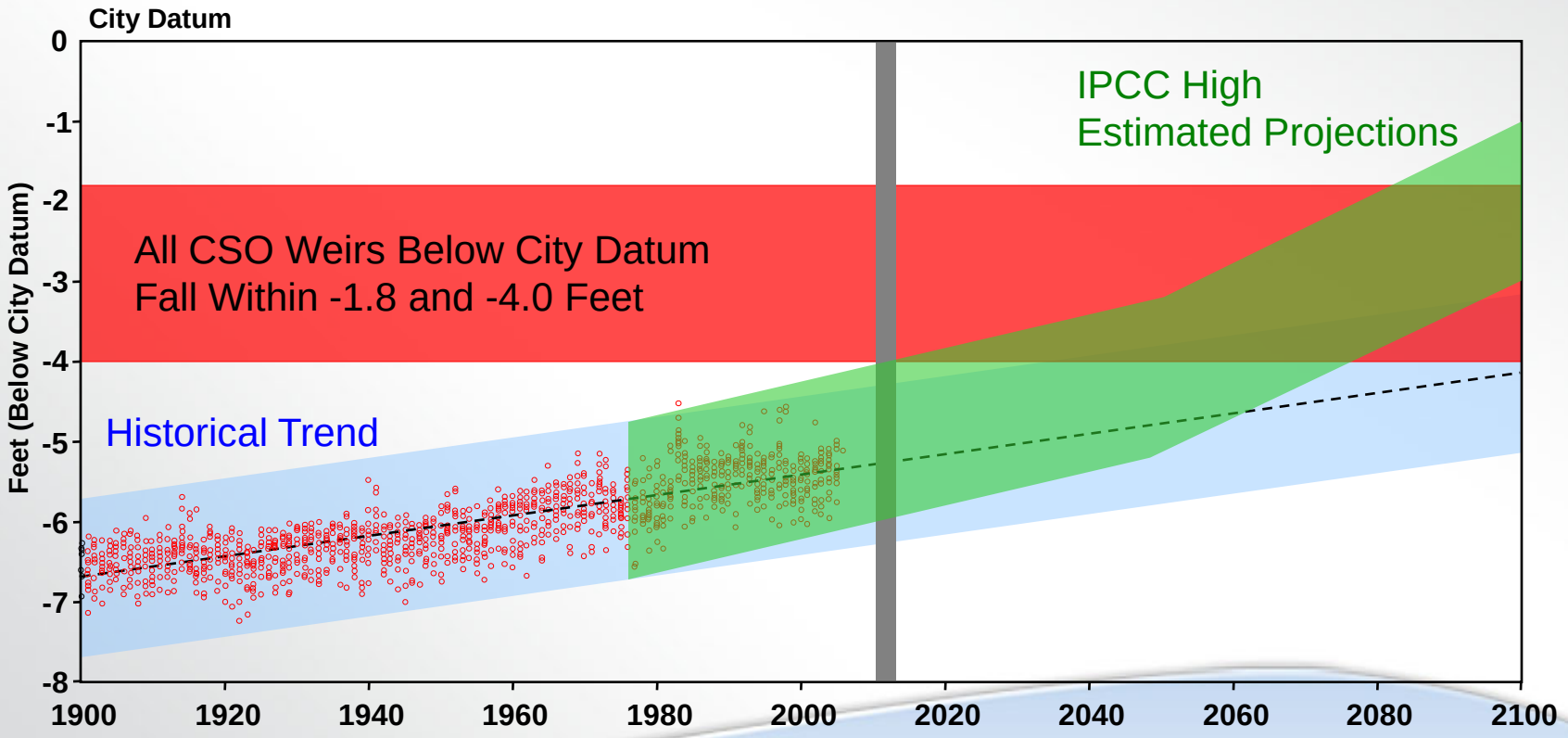
Source: The Living Planet Report - 2006

Impact of Global Climate Change on Our Industry

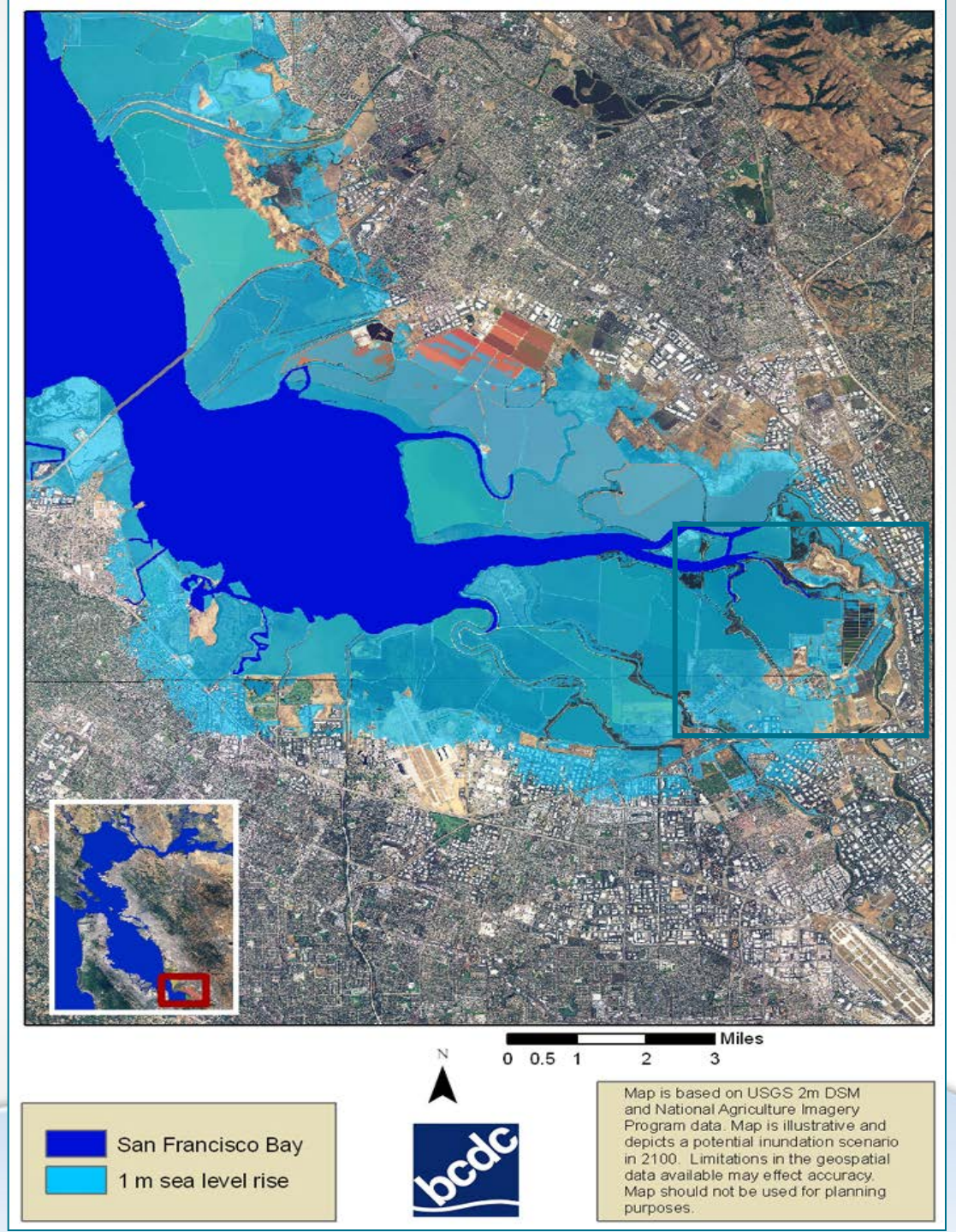
Climate Change Challenge No.1 - Projected Sea Level Rise

-Sea Level in San Francisco-

Historical and Projected Monthly Mean Higher-High Water (MHHW) relative to the San Francisco City Datum

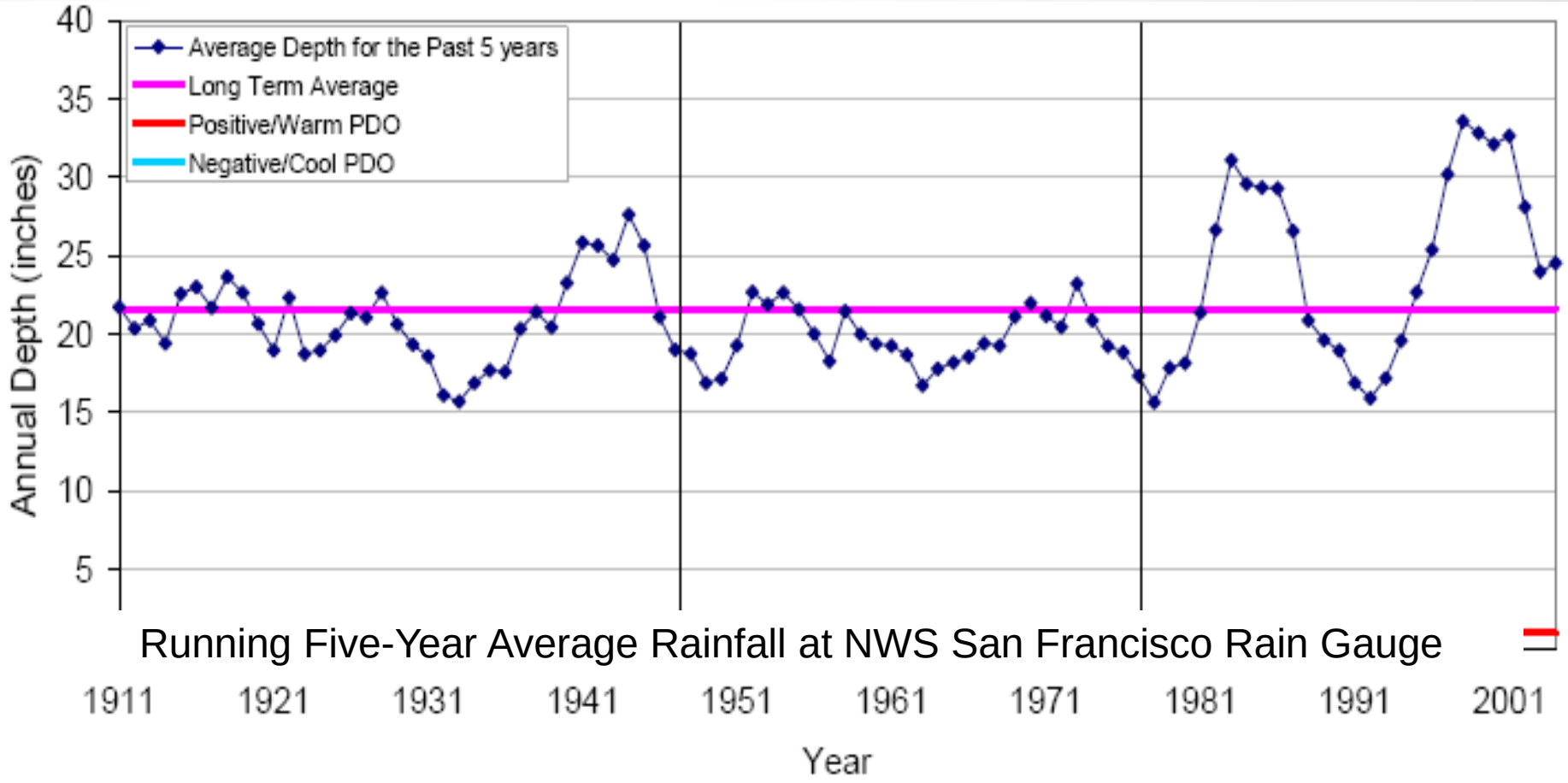


South San Francisco Bay Scenario for Sea Level Rise

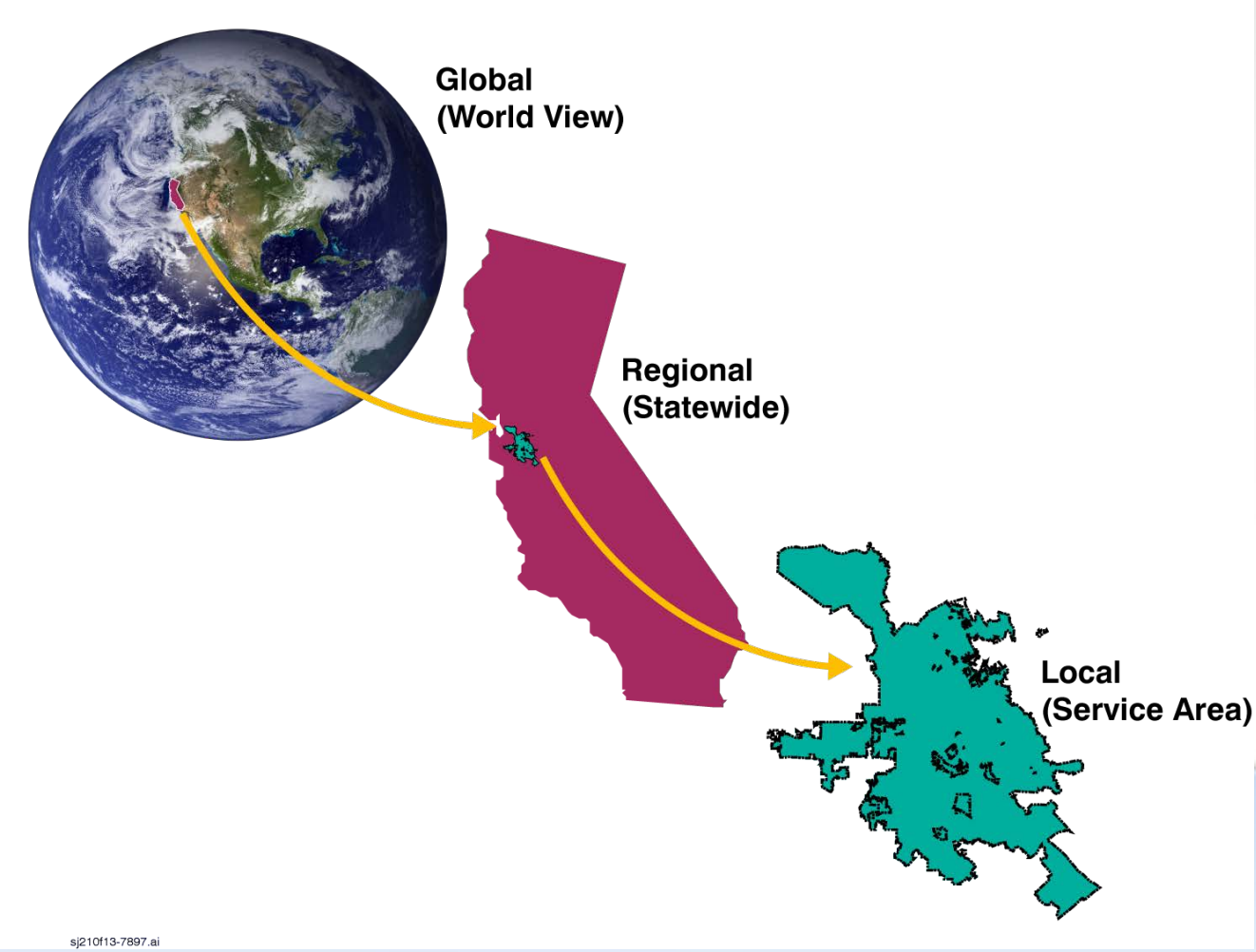


Climate Change Challenge No. 2 - More Intense Rainfall Events

-Precipitation in San Francisco-



“Boundary conditions” for sustainability must be set with three perspectives in mind…



And these perspectives must define the criteria and metrics

Goals	Boundary	Objectives	Evaluation Criteria	Metrics
Environmental				
Maximize benefits to the environment.	Global	↓Impacts to the global environment	↓ Carbon dioxide equivalent emissions per year	Tons CO_2e
	Regional	↑Resource recovery, reuse, and efficiency	↑ Biosolids reused per year	DTPY
			↑ Renewable energy use	%
			↑ Average annual recycled water use	mgd
			↓ Energy purchased per year	kWh
	Local	↑Local conservation, preservation, and restoration of open spaces and on-site natural habitat	↑ Food waste recovered and used per year	TPY
			↓ Per capita energy use	%
			↑ Area of land/habitat restored or preserved	Acres

Future Mapping

Planning Strategies
to Achieve Your Vision

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Engineers...Working Wonders With Water®

A Global Perspective…

Innovation Closer to Home

Clean Water Services, Durham Advanced WWTF, Tigard, OR

King County, Brightwater Facility, Woodinville, WA

Gloverville-Johnstown Joint WTF, Johnstown, NY

Reno/Sparks Truckee Meadows WRF, Sparks, NV

New York City DEP, Wards Island WPCP, New York, NY

East Bay Municipal Utility District WWTP, Oakland, CA

Hampton Roads Sanitation District Nansemond Seawater Treatment Plant, Virginia Beach, VA

Orange County Sanitation District Plant No. 1, Fountain Valley, CA

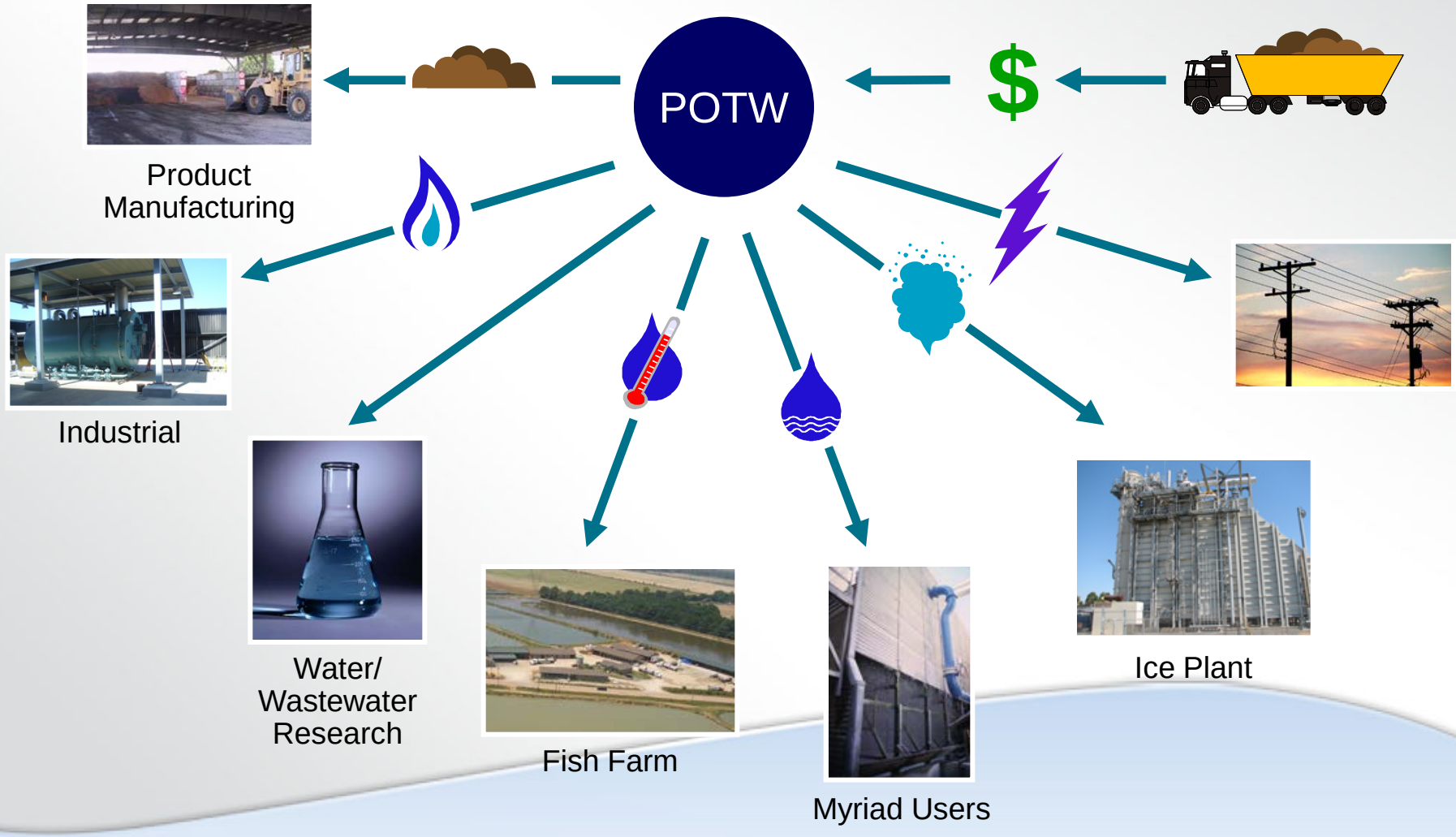
El Paso Water Utilities, Fred Hervey WRP, El Paso, TX

Gwinnett County, F. Wayne Hill Water Resources Center, Buford, GA

Assessing Opportunities

1. Decreasing cost of membranes
2. Harvesting un-oxidized carbon and nutrients
3. Development of short-cut nitrification
4. Thermal process emissions removal/ reduction
5. Digestion pretreatment technology improving
6. Treatment trains developing for reuse - Ozone/BAF

Basically, the overall trend is POTWs as resource recovery centers



Nutrient Removal
Protect receiving water quality and increase reuse demands.

Energy Management
More effective energy management and alternative energy strategies.

Sustainability
Protect and serve current and future generations.

Treatment for Non-Traditional Constituents
Accelerate the application of advanced treatment and removal technologies.

Community Engagement
Increase emphasis on “transparent” and good neighbor policy.

Implementing Your Vision

What If We Started Over?

Image © 2007 TerraMetrics

Image NASA

Google

1. Minimizing costs of existing facilities
2. Managing uncertainty of future energy costs
3. Keeping rates affordable
4. Reverse man's impact on global climate change
5. Improve community benefits

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Unlock Hidden Capacity and Minimize Life-Cycle Costs

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Be Energy Self-Sufficient in 5 Years

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Be Economically Self-Sufficient in 20 Years

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Be Carbon Neutral in 20 Years and be “Greener”

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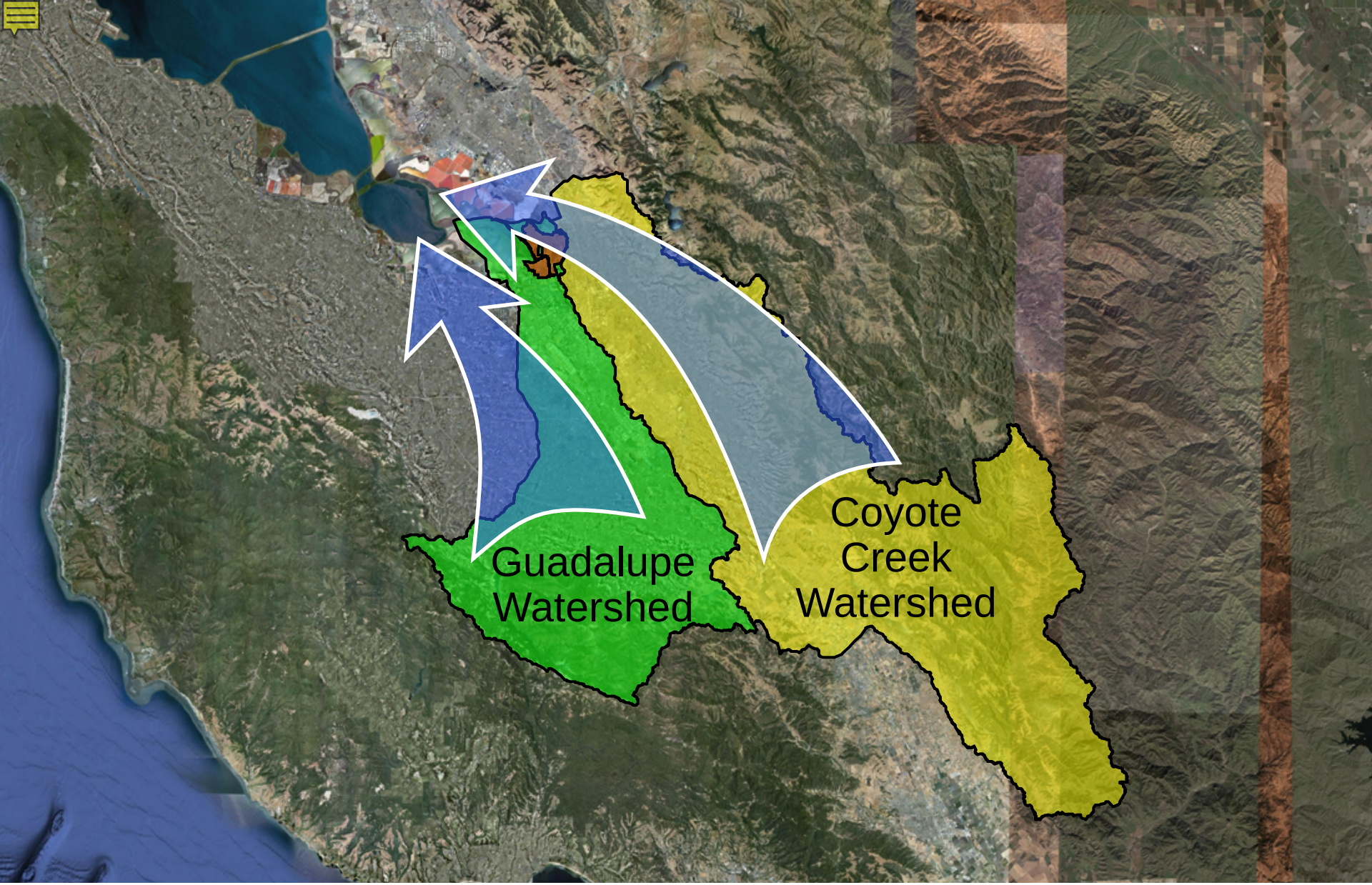
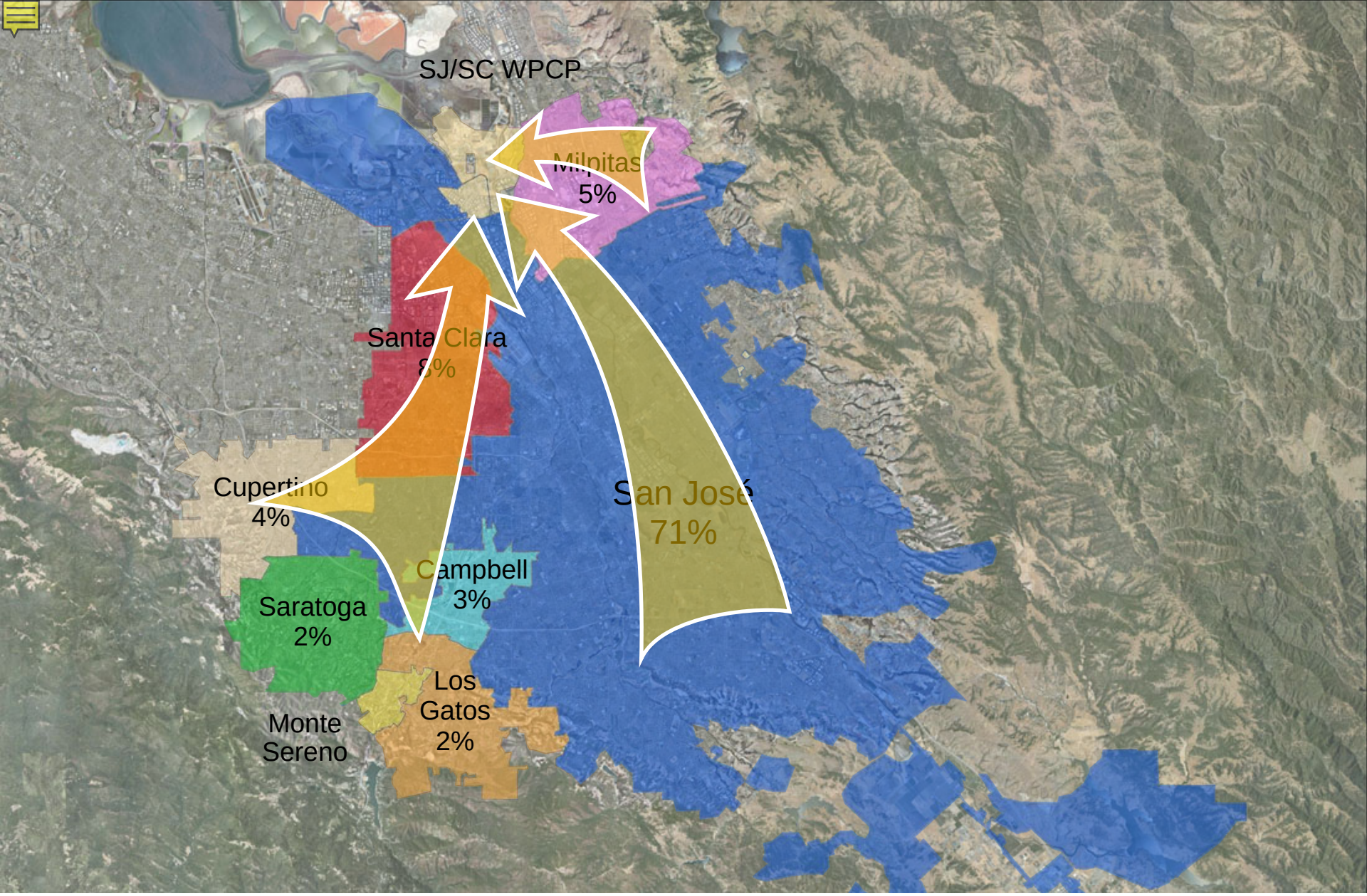


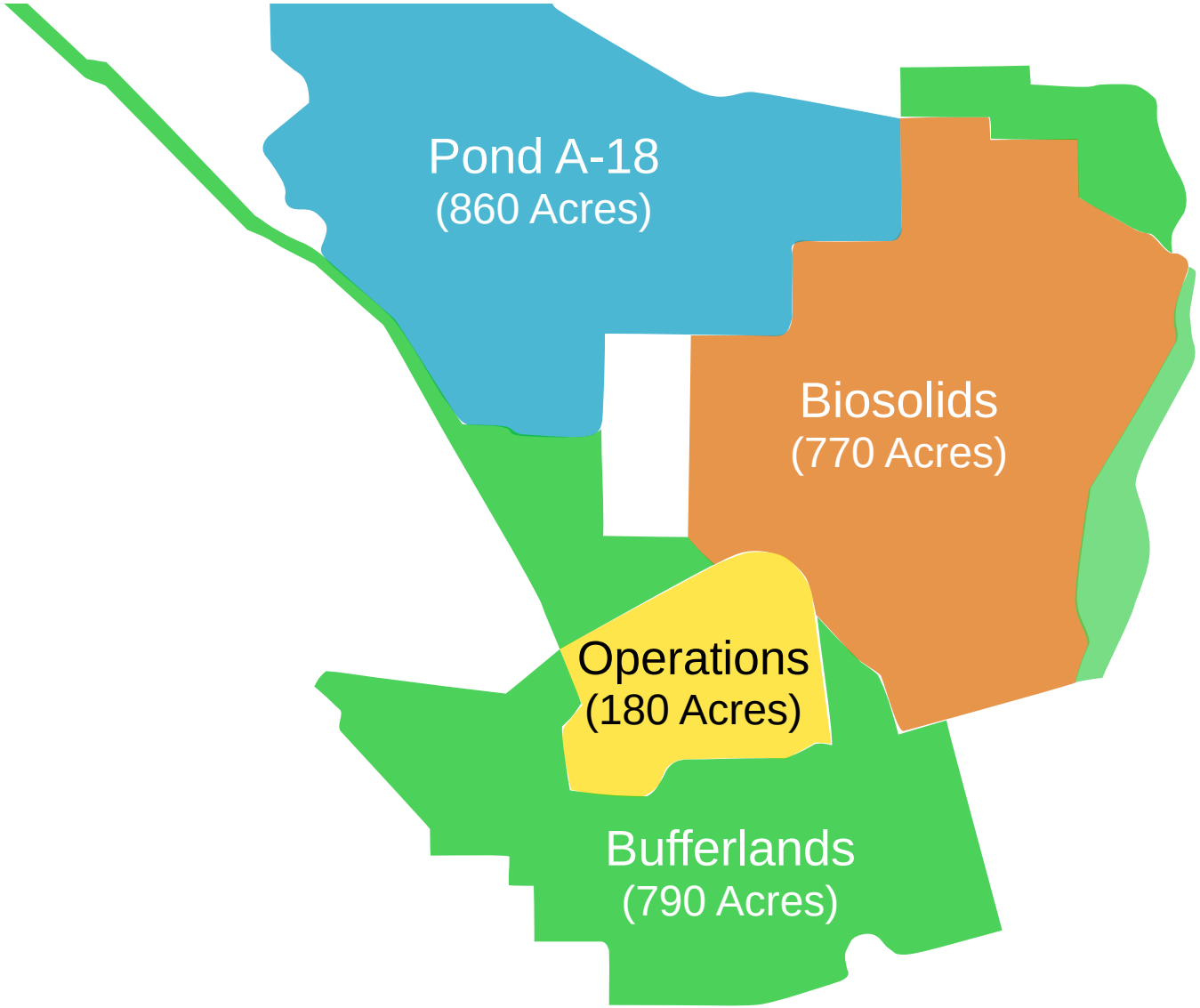
The Plant is located at the confluence of two watersheds



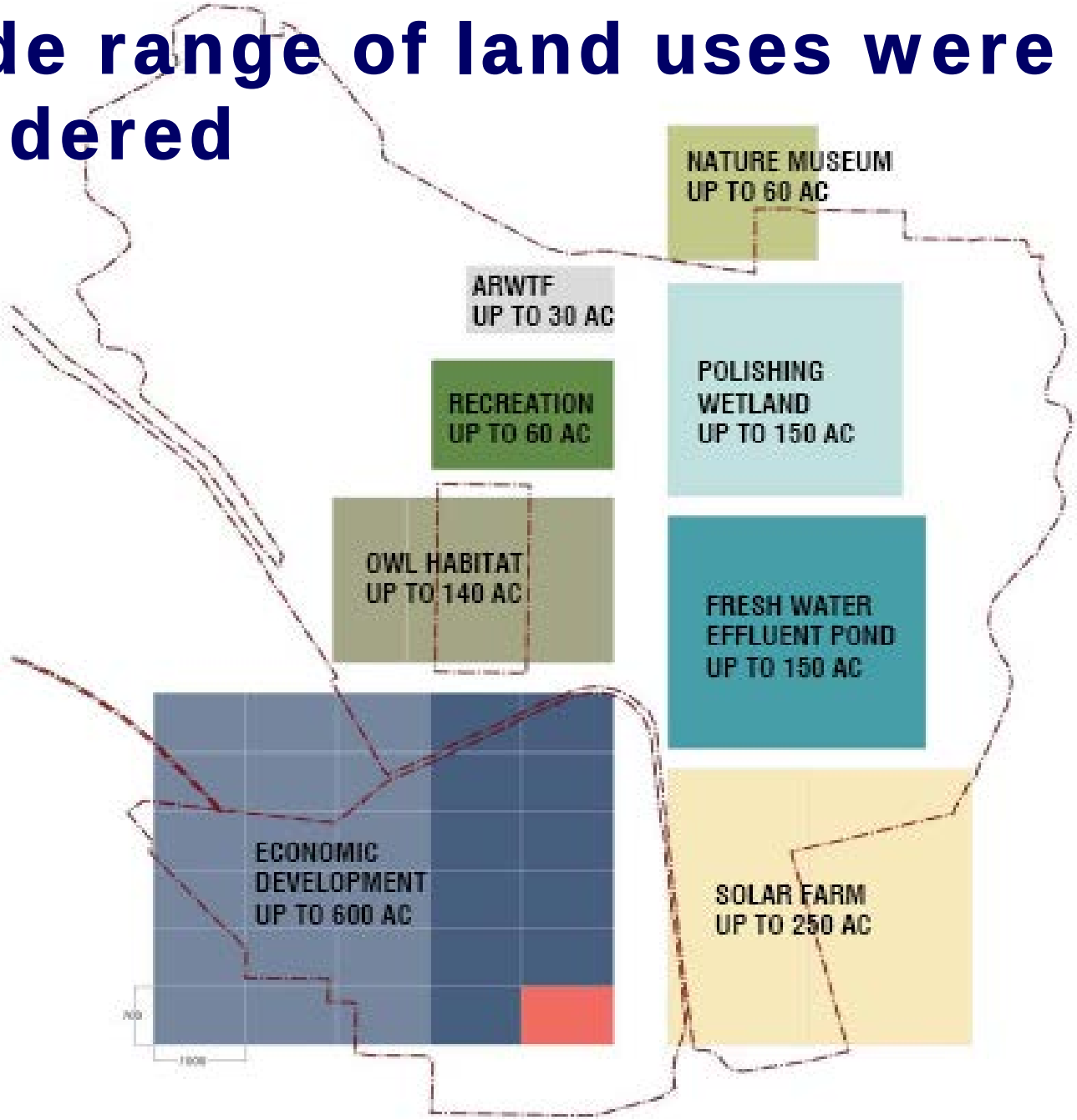
The Plant serves 8 Cities in Silicon Valley

And discharges to ecologically sensitive South San Francisco Bay

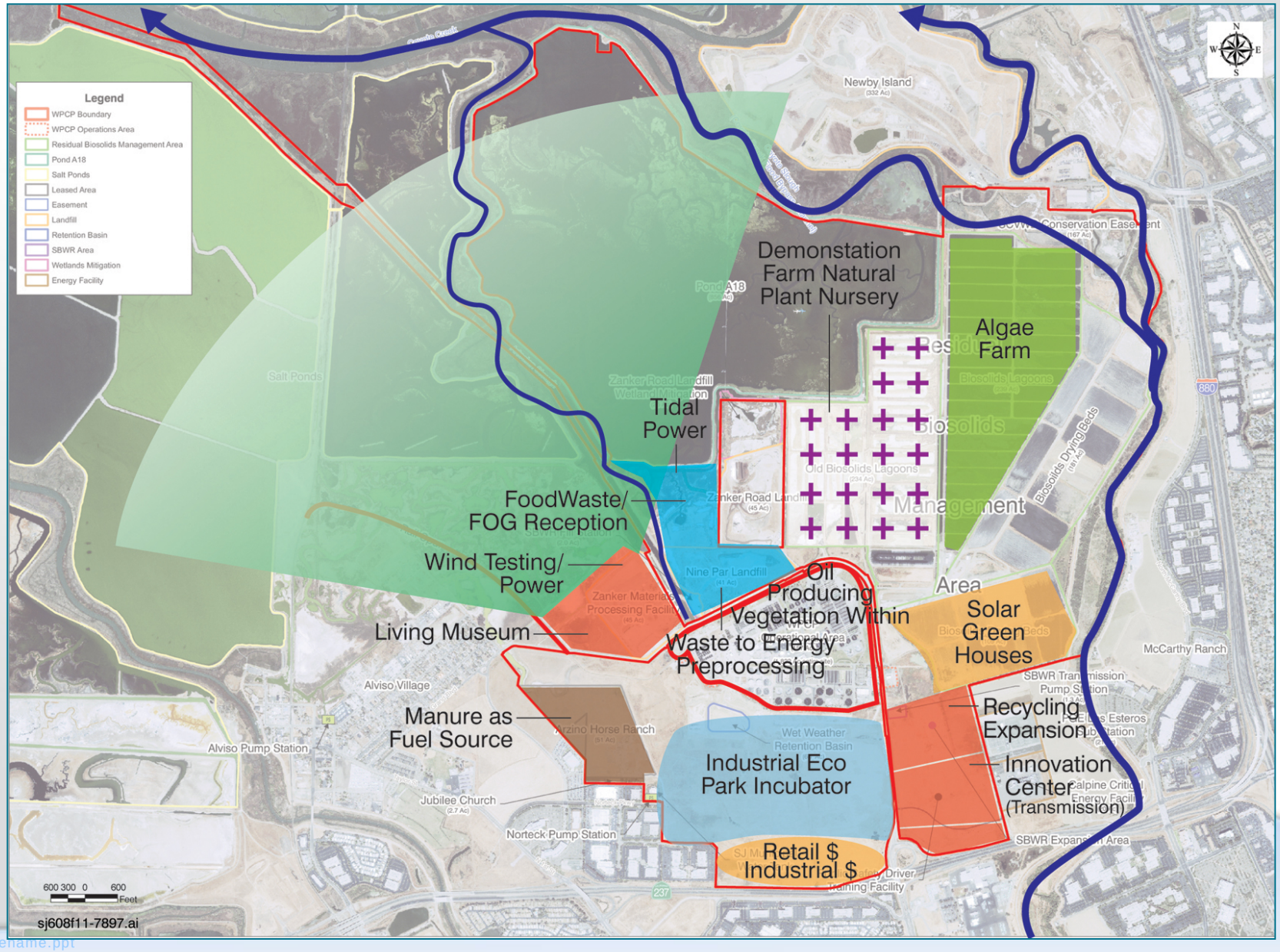
There are 4 major land uses, covering 2,680 acres, or ~4.5 square miles



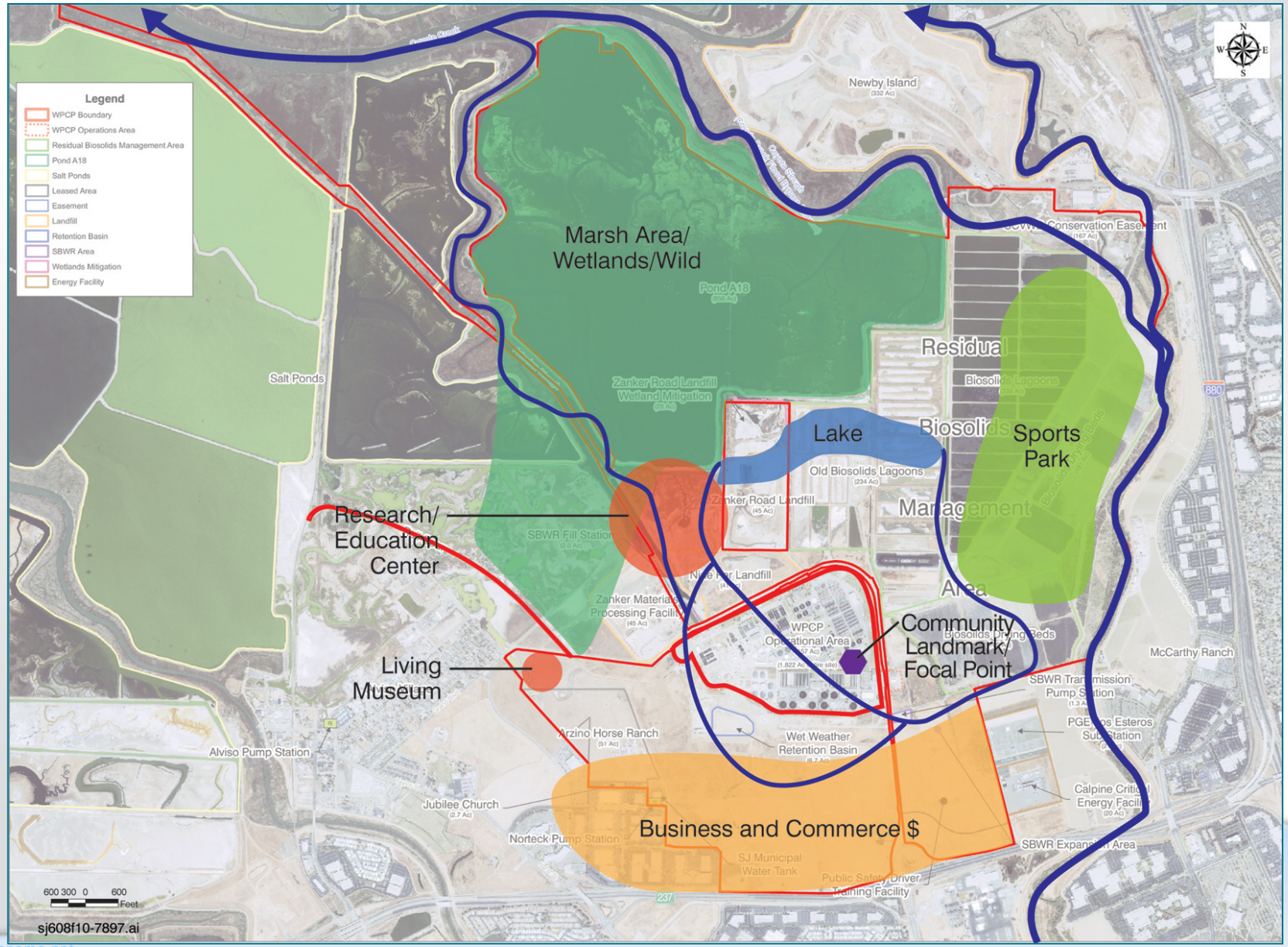
A wide range of land uses were considered



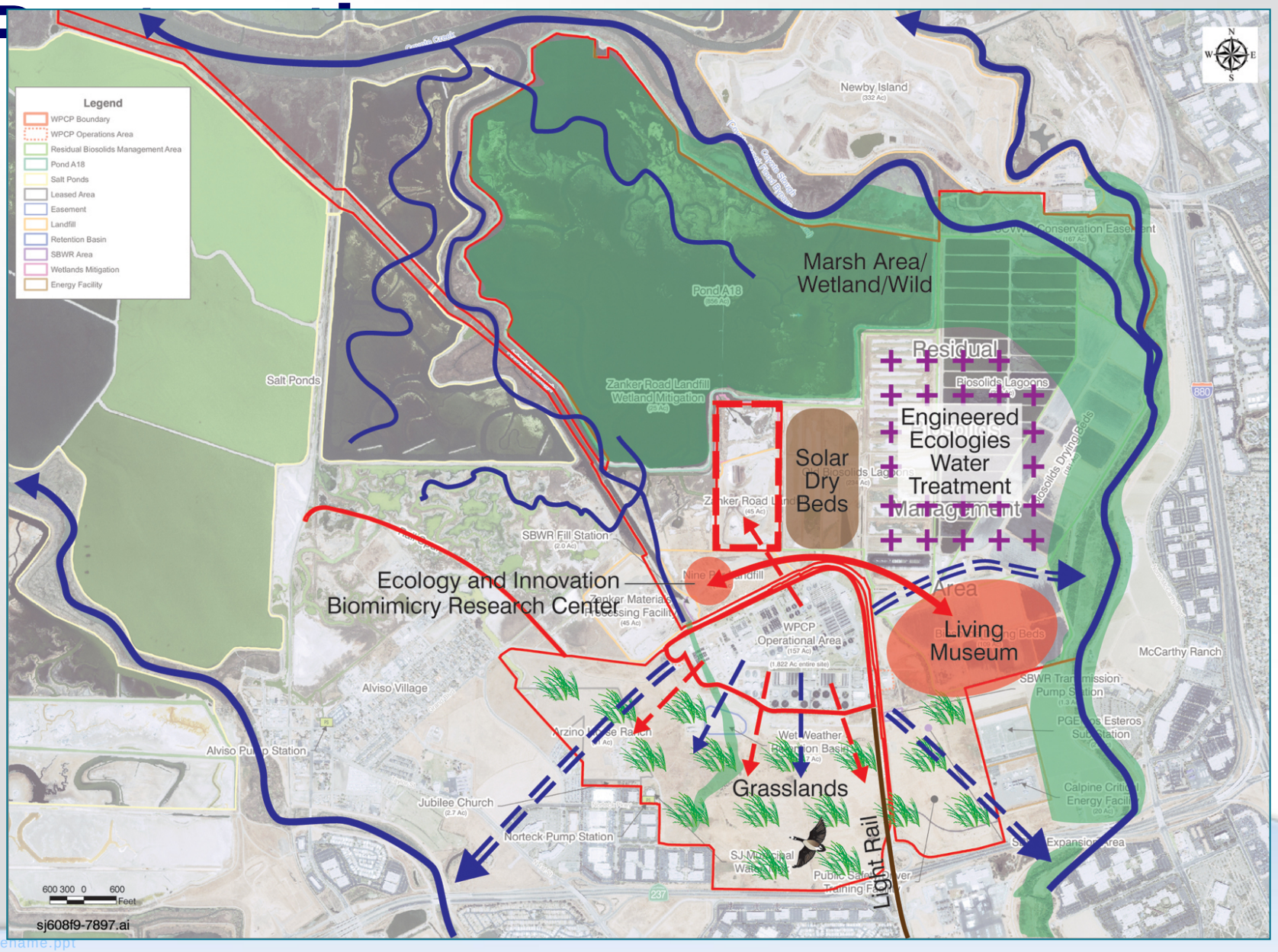
Maximize Economic Benefits

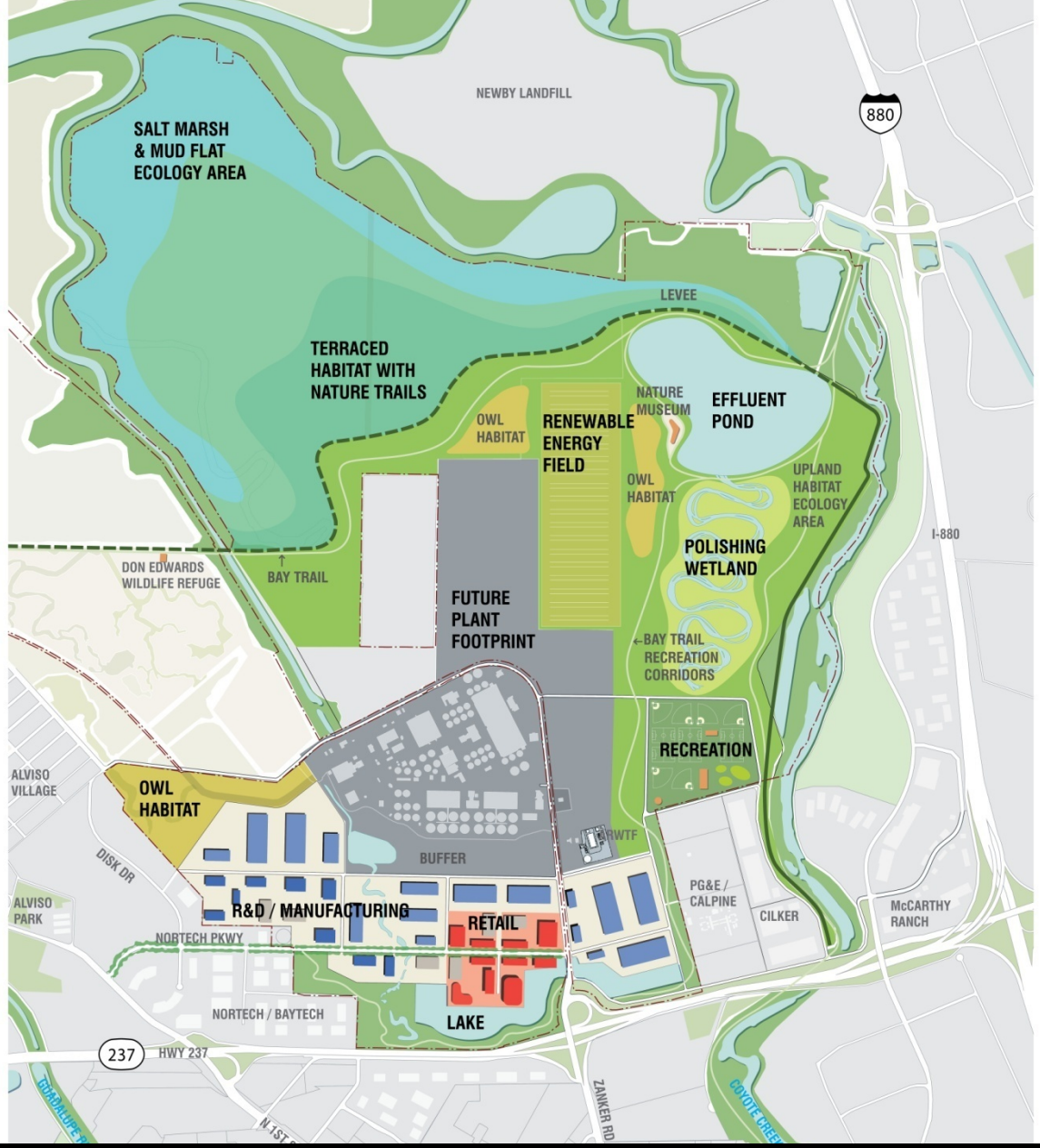


Maximize Community Benefits



Maximize Ecological Benefits





LAND AREA (ACRES)	
Manufacturing	215
Industrial Park (R&D)	50
Commercial Retail	35
Institute / Campus	-
Total	**300**

BUILT AREA (GFA)	
Manufacturing	3,278,000
Industrial Park (R&D)	2,613,600
Commercial Retail	396,000
Institute / Campus	-
Total	**6,287,600**

FAR ASSUMPTIONS	
Manufacturing	0.35
Industrial Park (R&D)	1.20
Commercial Retail	0.26
Institute / Campus	-

JOBS	
Manufacturing	3,278
Industrial Park (R&D)	9,504
Commercial Retail	495
Institute / Campus	-
Total	**13,277**

“BACK TO THE BAY” SCENARIO

SUMMARY OF ECONOMIC DEVELOPMENT BENEFITS BY PHASE

Item	At Build Out (2040+)
Developed Acres	300 ac
Light Industrial/Cleantech	4.5 million sq ft
Office Research & Development	2.5 million sq ft
Retail	238,000 sq ft
Institute	2.3 million sq ft
Jobs (Total Permanent and Construction)	17,800
Ground Lease Proceeds	$10.5 million/yr
County Property Tax Revenue	$1.3 million/yr
School District Tax Revenue	$3.8 million/yr
Net City Tax and Service Impact	$1.1 million/yr

Summary of Future Trends of Water Industry Solutions and Technologies

Planning and Engineering Trends Driven by Regulations

1. Sustainable (TBL) decision processes.
2. Greater stakeholder involvement.
3. Increasing political profile and media attention.
4. Treatment for ammonia, and nutrients.
5. Treatment of EDC's and other contaminants of concern (CECs).
6. Energy optimization and self-sufficiency (inc. FOG & food waste recovery, improved digester gas production).
7. Water reuse, including indirect potable reuse (IPR).
8. Green house gases (GHG) and HAP's emission management.

Developing Upstream "Urban Watershed Management" Solutions (demand management)

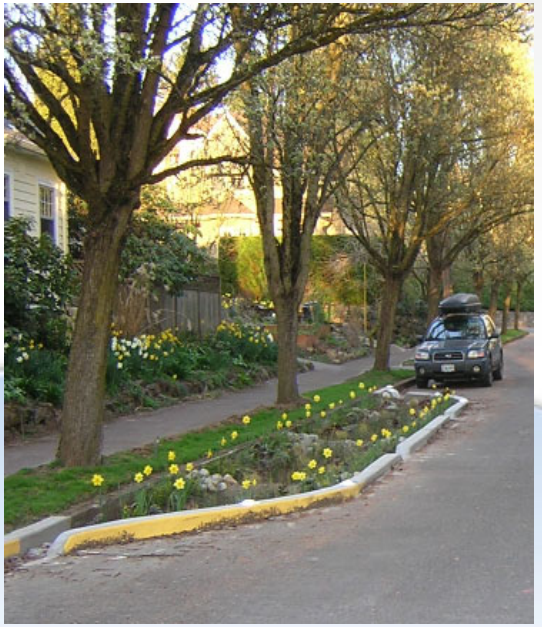
1. Water conservation.
2. Low Impact Development (LID): green roofs, street trees, bioswales, stream daylighting, and others including rainwater harvesting.
3. Stormwater management (e.g. "dry weather" flow diversions to POTWs).
4. Load reductions (e.g. food waste separation, etc.)
5. Satellite or "scalping" plants for upstream reuse.
6. Decentralized treatment facilities.
7. Upstream urine collection and treatment.
8. Nutrient recovery (Ostara).
9. "Off the grid" green (LEED) buildings.

Bioretention
a.k.a Rain Gardens

Parking Lot
Bioretention

Stormwater
Planters

Lowered
Planter Strip



Curb Extension

Developing Wastewater Liquid Treatment Technologies and Solutions

1. Compact footprint technologies.
2. Membranes (MBR, MF, NF).
3. BNR processes.
4. Advanced Oxidation Processes for EDC treatment.
5. UV, Ozonation for disinfection.
6. Energy optimization (e.g. increased gas production, cogen).
7. “Symbiotic” commercial development with POTWs (e.g. San Jose, SRWTP).
8. “Environmental justice” and architectural and good neighbor practices.

The Public wants Aesthetic and "Good Neighbor" Improvements

1. Visual aesthetics improvement
2. Odor improvements
3. Noise abatement
4. Addresses "environmental justice" issue

Developing Reuse and Biosolids Technologies and Solutions

1. Wastewater reuse, including indirect potable reuse (IPR).
2. Groundwater augmentation, land disposal.
3. Improved digester operations (e.g. 2-phase, etc.).
4. Egg-shaped digesters and improved performance.
5. Fluidized bed incineration and thermal processes.
6. Biosolids “greenhouse” drying.
7. Low-temperature driers

Munich, Germany (Egg-shaped Digester with Architectural Treatment)

Greenhouse biosolids drying (Laval, France)

Summary: Five Lessons for Sustainable Planning

1. Lead with listening and a stakeholder Visioning process.
2. Invest in a Decision Support System (DSS).
    1. Put the focus on “systems integration”, and on “the long now”
    2. Metrics framed by TBL+ => and using global, regional and local costs/benefits.
3. Conduct “baseline” condition assessment,
4. Optimization Study to maximize use of existing facilities.
5. Conduct “future mapping” to identify trends and to assess emerging technologies & concepts.

Stay True to Your Vision by …

1. Retaining conventional wisdom…
   a. Visioning
   b. DSS
2. Addressing the foreseeable future…
   a. Condition assessment
   b. Optimization
3. Anticipating the unforeseeable future…
   a. Future mapping

END OF PRESENTATION