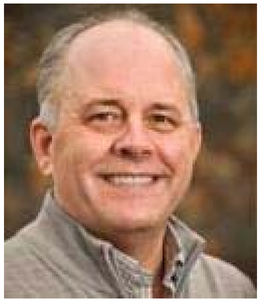
Charting a Path to the Utility of the Future
Web Seminar Series

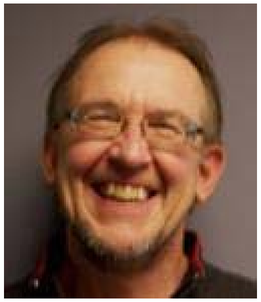
Resource Recovery — From Waste Stream to Goldmine

NACWA
A Clear Commitment to America's Waters

Business of Resource Recovery



Bruce Roll
Clean Water Services, OR

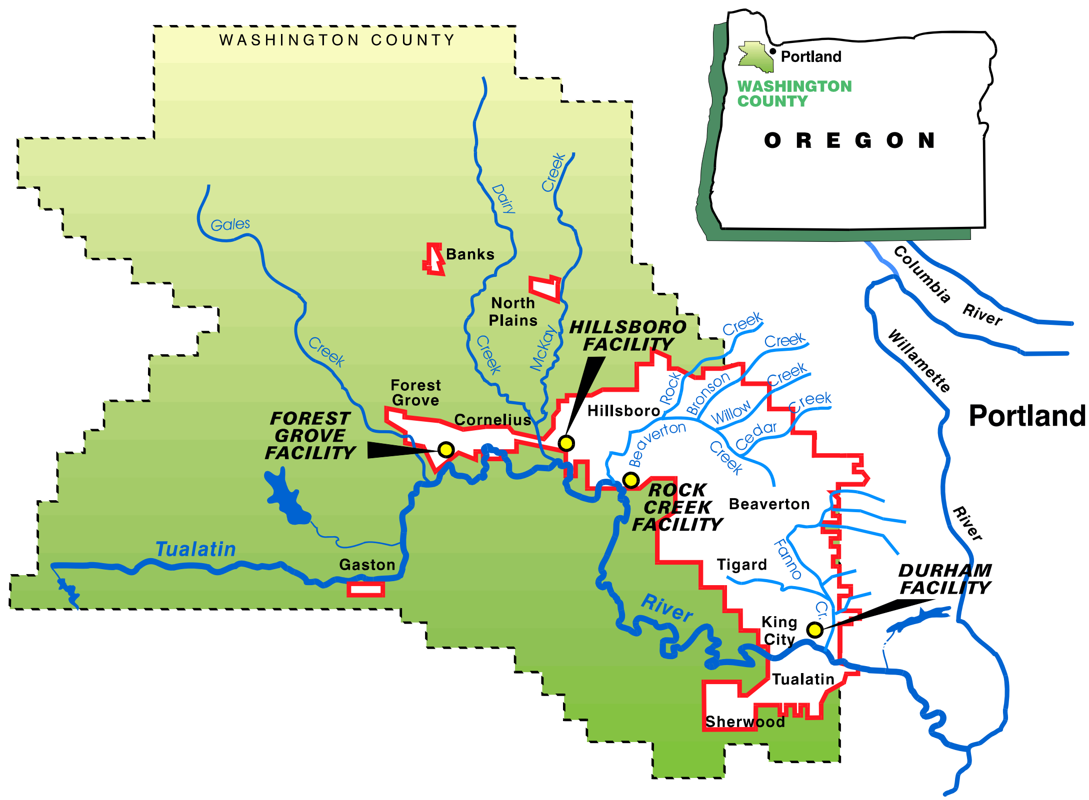


Nate Cullen
Clean Water Services, OR

A Clear Commitment to America's Waters

Clean Water Services

- Special Service District established in 1970
- Serves over 530,000 customers in urban Washington County, Oregon
- 4 wastewater treatment facilities



Durham AWWTF

- 25 mgd tertiary plant discharges to the Tualatin River
- 0.11 mg/l T-PO4 monthly median permit May 1 to October 31
- 0.2 mg/l NH3-N weekly median permit May 1 to November 15

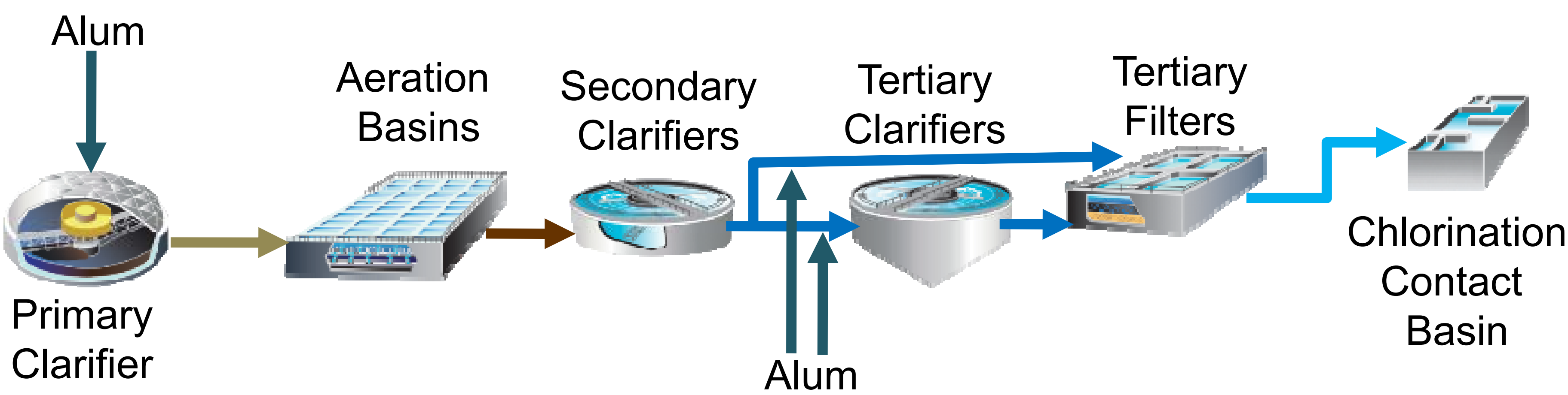
Clean Water Services

Rock Creek AWWTF

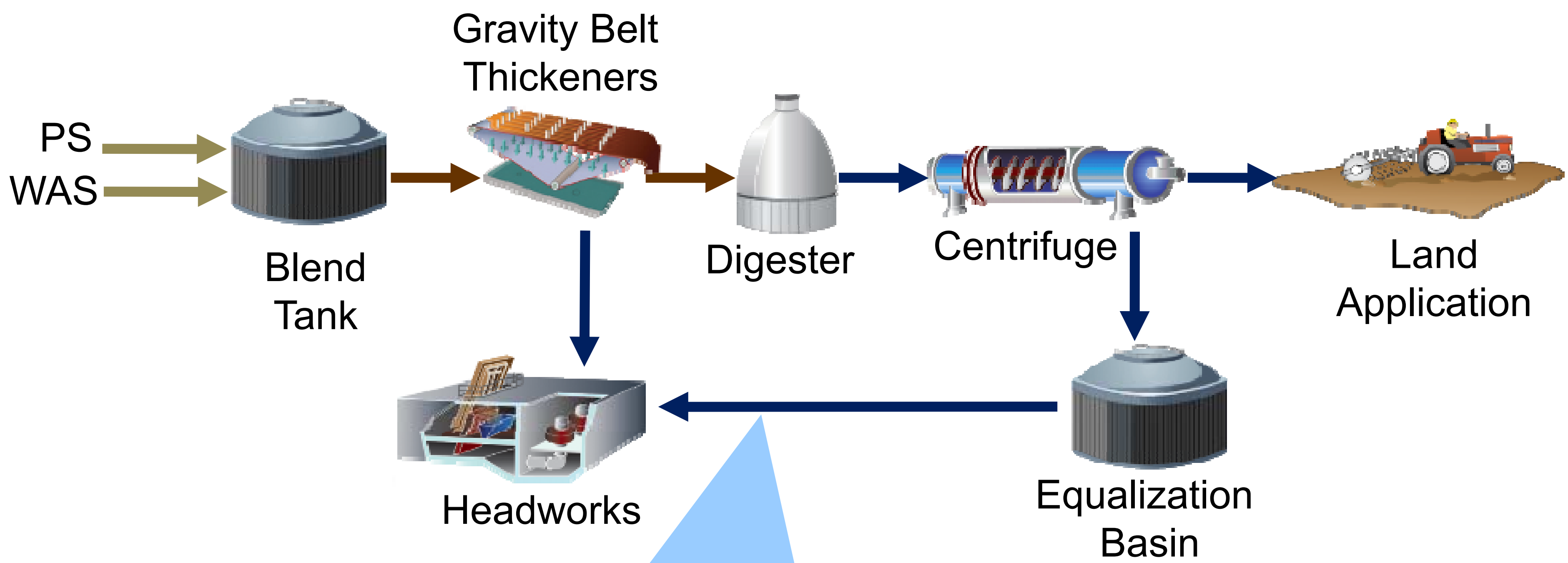
- 35 mgd tertiary plant discharges to the Tualatin River
- 0.10 mg/L T-PO4 monthly median permit May 1 to October 31
- 0.2 mg/L NH3-N weekly median permit May 1 to November 15

Clean Water Services

Stringent Effluent Phosphorus Limits are Met Through EBPR + Alum



Solids Operation Recycles P to Head of Plant



Approx. 500 lbs/day of P

Clean Water Services

Solids Processing Problems

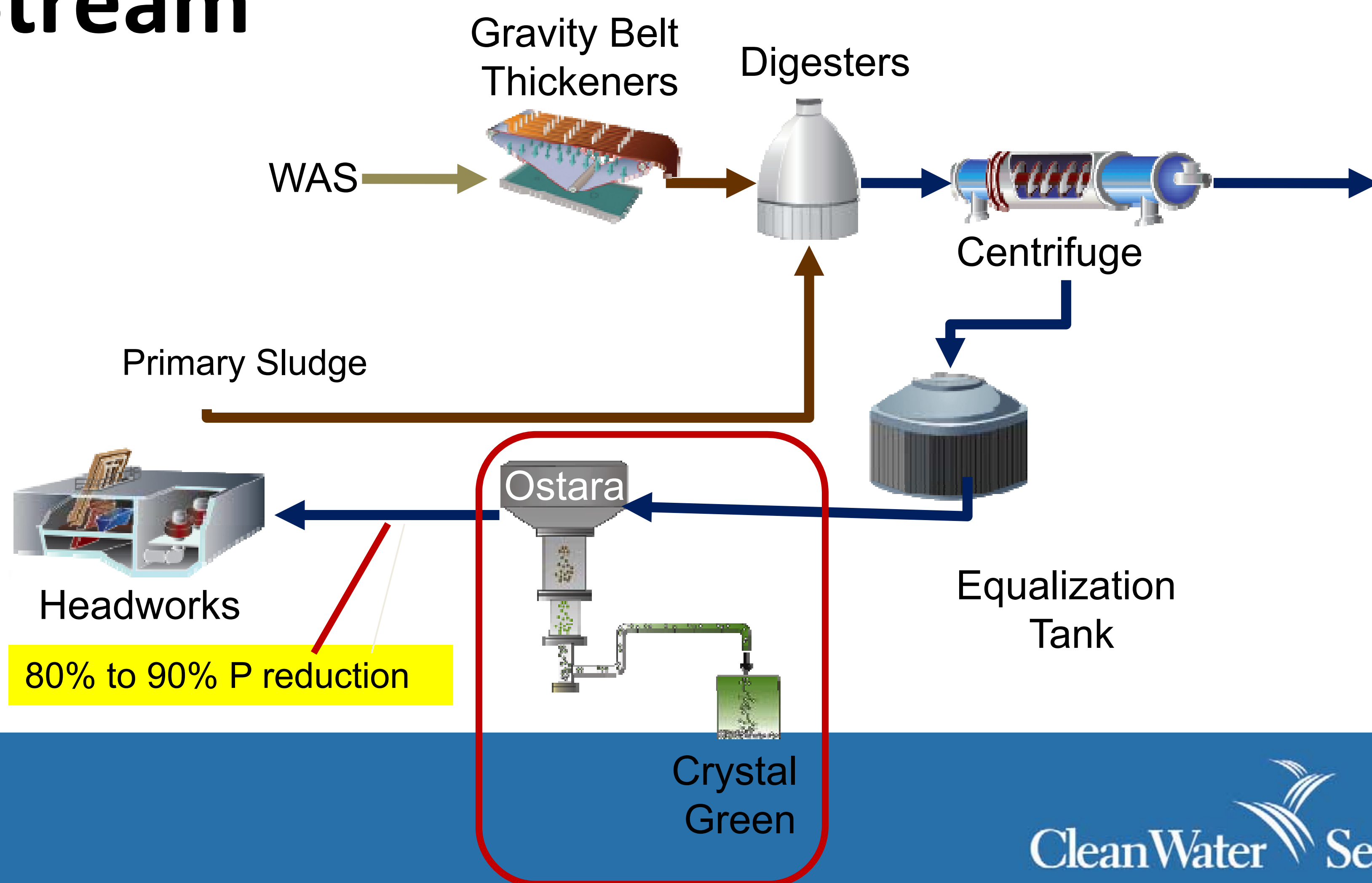
- Anaerobic digestion
  - PO_4 & Mg released from PAOs
  - NH_3 is released from biomass
- Creates struvite
- $NH_3 + PO_4 + Mg + 6\ H_2O \rightarrow NH_4PO_4Mg * 6\ H_2O \downarrow$
- 1:1:1 mole ratio NH_3:PO_4:Mg

Clean Water Services

Drivers to Recover Phosphorus

- Improve BPR performance
- Reduce struvite formation in the solids processing system
- Generate a valuable, renewable fertilizer

Controlled Struvite Precipitation Reduces Nutrients From Recycle Stream



Clean Water Services

Durham SRF Facility

Two Pearl 500 units
One Pearl 2000 unit
Operational May 2009
Total Capacity – 3,000 kg/day

Rock Creek SRF Facility

Two Pearl 2000 units
Operational May 2012
Total Capacity – 4,000 kg/day

Clean Water Services

Benefits of Removing Phosphorus Recycle

- Reduction of recycle phosphorus load (80%-90%)
- Increased process (EBPR) stability
- Reduction in alum needed (25%- 35%)
- Reduction in lime needed
- Reduction in biosolids dry tonnes (15%-20%)
- Struvite revenue

Clean Water Services

Phosphorus Recovery

- Crystal Green fertilizer
- 5-28-0 +10% Mg
- Premium, slow release 6 to 9 months
- Container plants & golf courses and custom blends

Clean Water Services

Bottom Line Benefit

Projected Payback

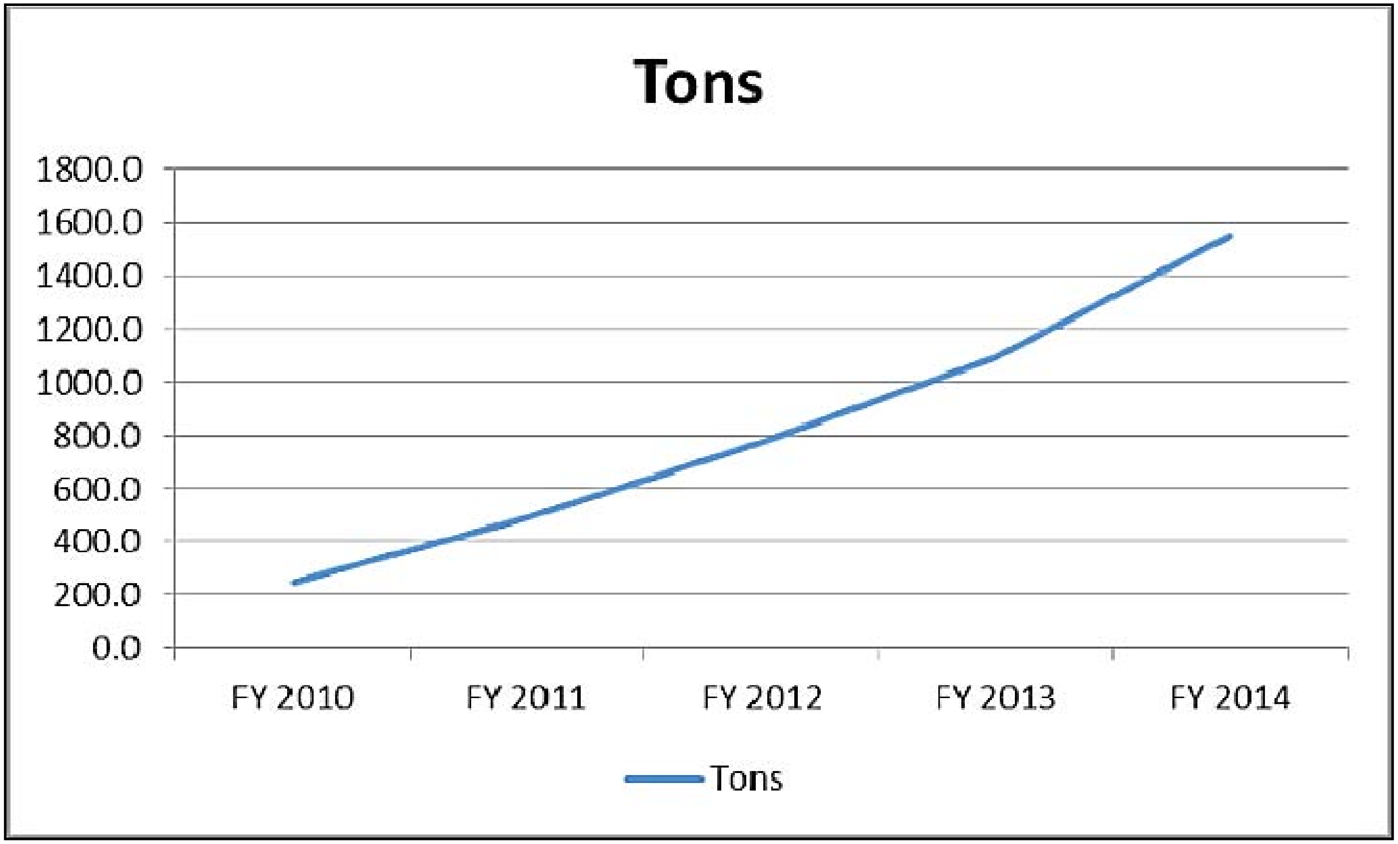
$$\text{Payback} = \frac{\text{Capital Cost}}{\text{Revenue + Operational Savings}}$$

- Operational savings from:
  - Reduced phosphorus removing chemicals
  - Reduced biosolids disposal

Project Payback Projections

	Durham	Rock Creek
Capital Cost	$2,500,000	$4,400,000
Revenue + Operating Savings	$300,000/yr to $400,000/yr	$600,00/yr to $700,000/yr
Simple Payback	~ 7 years	~ 7 years

Crystal Green Production



Clean Water Services

Environmental Benefit

PEAK PHOSPHOROUS

- Phosphorous is a primary nutrient required for plant growth, an essential element of all life forms, and a material without substitute.

- Global demand for it is increasing dramatically

- Supplies are declining in both quality and accessibility

Community Benefit

The Business of Clean Water Grow

All-purpose Plant Food

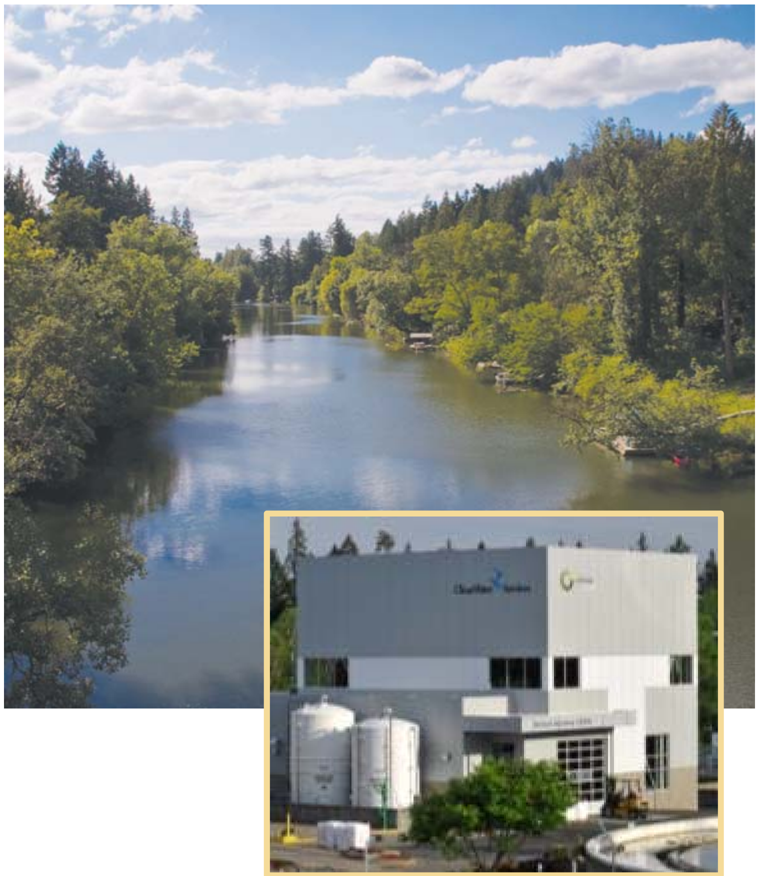
Clean Water Services

What is Clean Water Grow?

- A balanced retail fertilizer-product that includes nutrients recovered from CWS's resource recovery facilities.
- Locally sourced, blended, and sold.

Clean Water Services

Why did Clean Water Services develop this product?

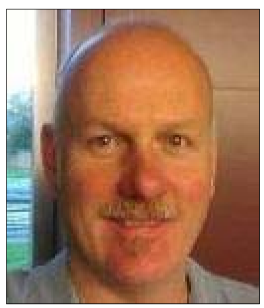


- Make sustainably-recovered material available to CWS ratepayers
- Further watershed health education goals
- Explore new revenue opportunities
- Confirm commitment to protecting the Tualatin River Watershed

Why Sell Recovered Nutrients?

- Provides a new revenue opportunity
- Educates rate-payers
- Reduces local nutrient loading from run-off
- Slows the depletion of a vital global resource

Journey to Energy Independence



Alan Johnston

City of
Gresham, OR

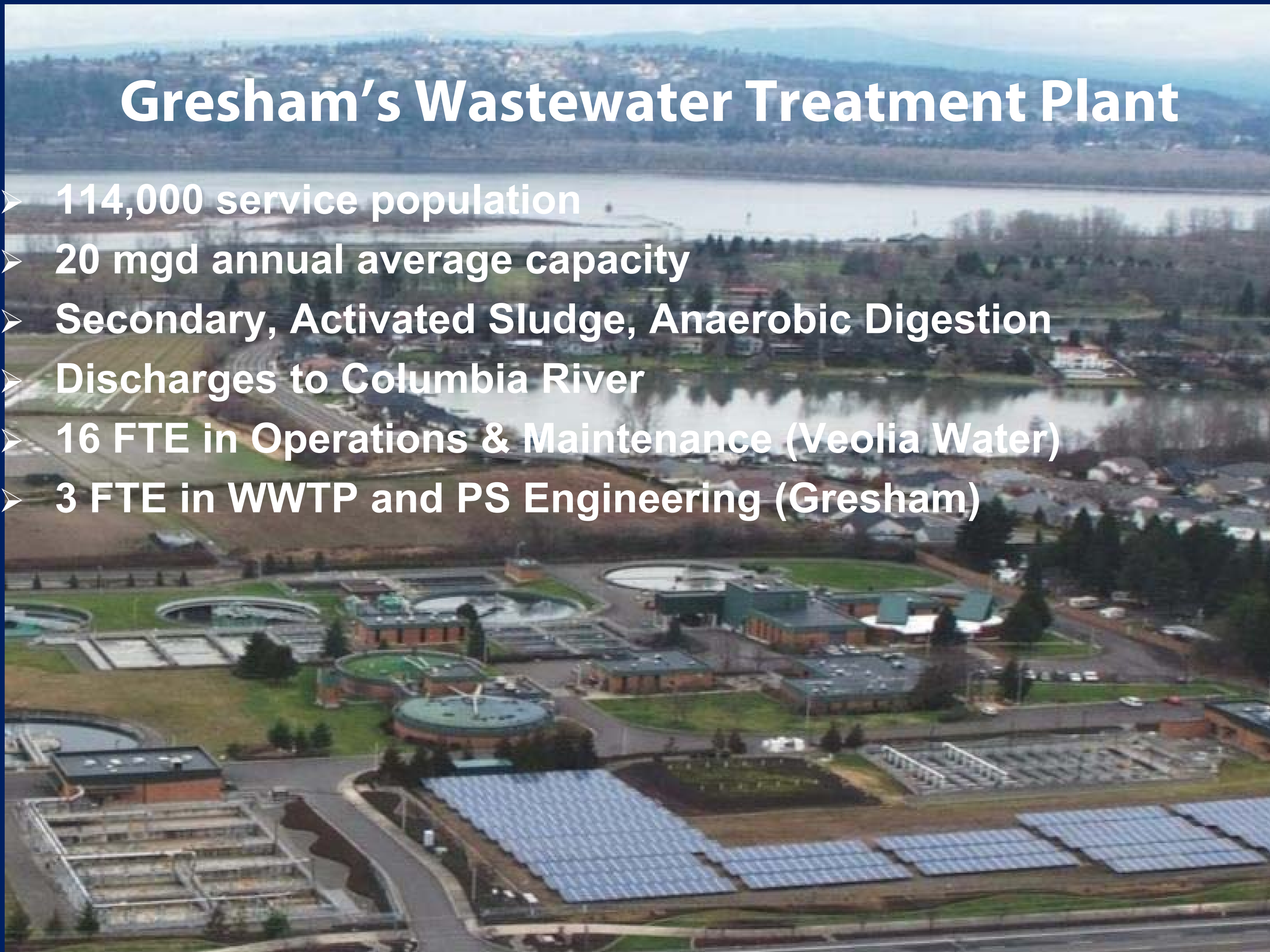
NACWA
A Clear Commitment to America's Waters

Update on the Gresham WWTP Energy Net-Zero Journey

Alan Johnston, Senior Engineer, Wastewater Services Division

Gresham's Wastewater Treatment Plant

- 114,000 service population
- 20 mgd annual average capacity
- Secondary, Activated Sludge, Anaerobic Digestion
- Discharges to Columbia River
- 16 FTE in Operations & Maintenance (Veolia Water)
- 3 FTE in WWTP and PS Engineering (Gresham)



Energy Net-Zero Milestones

- 2005 400 kw Cogenerator Installed with Biogas Treatment
- 2008 ACWA / Energy Trust Energy Independence Study
- 2009 City of Gresham Sustainability Policy Adopted
- 2009 FOG Feasibility Study
- 2010 Formal Monthly Energy Management Team Kickoff
- 2010 420 kw Peak Ground Mount Solar Installed
- 2011 Energy Projects included in WWTP Master Plan
- 2012 FOG Receiving Station Phase 1
- 2013 Large Energy Conservation Project
- 2014 FOG Receiving Station Phase 2A expansion
- 2015 Cogeneration Phase 2B Expansion (under construction)
- 2015 Lofty Goal: Energy Net-Zero by 2015/16?

400 kw CAT Cogenerator (Installed 2005)

Cogeneration by the Numbers

- 93% Runtime since 2005 (off about 48 hours per month)
- Produces power and heats buildings with jacket water heat
- 72,000+ Operating Hours
- 26,000,000+ kwh of power production
- 2.6 cents per kwh operation/maintenance expenses
- 50% of WWTP Power needs
- $250,000 in annual avoided electrical costs.
- 3.5 year payback

Kennedy/Jenks Consultants

Engineers & Scientists

oregon association of CLEAN WATER agencies

EnergyTrust of Oregon, Inc.™

Energy Independence Project

A Project for

Oregon Association of Clean Water Agencies

and

The Energy Trust of Oregon

Prepared by

Kennedy/Jenks Consultants

June 2008

General Recommendations

- Do Energy Efficiency First!
  - Most cost-effective option
  - An energy audit can help identify cost-effective EEMs
  - Install indentified EEMs and seek funding $
- Resource Options
  - IC Engines are the most cost-effective and highest scoring resource option
  - Investigate a FOG and Green Waste program to enhance digester biogas supply

Gresham's Sustainability Policy

Adopted by Gresham City Council in 2009.

"The City of Gresham will strive to design and deliver services that:

- Support a stable, diverse and equitable economy.
- Promote community health and well-being, outdoor recreation, cultural awareness, and encourage learning.
- Protect and improve the quality of the air, water, land and other natural resources by reducing human impacts and increasing public awareness of the valuable services the environment provides."

Gresham's Sustainability Policy
Key Goals

- 1) 80% Reduction in City Greenhouse Gas Emissions by 2050
- 2) 100% Renewable Energy by 2030
- 3) Zero Waste in City Operations by 2020
- 4) Ongoing Protection of Natural Resources (including water quality and availability, and habitat)
- 5) Toxin Reduction and Eventual Elimination

This discussion involves Goals 1 and 2 at the WWTP.

Final Report

Feasibility Study of Digester Grease/Food Waste Injection System

Wastewater Treatment Plant Process Improvements Pre-Design

Contract No. 3009

Prepared for

City of Gresham, Oregon

December 2009

Prepared by
CH2MHILL
2020 SW 4th Ave, Suite 300
Portland, OR 97201

FOG Feasibility Study Highlights

- $40,000 Grant from State Economic Development Dept.
- Adding FOG Receiving Facilities is Economically Viable
- There is a market for this service in our area
- An additional 400 kw Cogenerator is economically viable
- FOG Tipping Fee of at least 3 cents per gallon required
- Need 7,000 to 11,000 gpd of FOG
- Estimated cost of $3.7 million
- Leverage $1.5 million in potential grants
- Simple payback of 7 years

Energy Management Plan

- First written EMP and EM team developed in 2010
- Selected Energy Team Members (Management, Ops, engineering, maintenance)
- Meet Monthly for 1 hour and talk only energy
- Update and review energy production and consumption numbers every month
- Select and evaluate projects
- Stay on track!
- Assign projects to team members
- Keep Running agenda in EMP
- Update plan monthly (keep it alive!)

City of Gresham WWTP
Energy Management Plan
Updated thru June, 2014

Brief Description of Utility and Scope (Fenceline):

Gresham WWTP physical fence line and all WWTP facilities fed by main PGE utility netmeter.

Goals:

- *Become Electricity Net-Zero within 5 years or by FY 2015/16.*
- *Continue to increase renewable energy production as a % of energy used on site.*
- *Energy production and energy efficiency decisions need to have clear capital cost, O&M cost and pay back analysis completed to justify project.*
- *Continuously Track, submeter and monitor energy production (solar and cogeneration) and consumption throughout the WWTP. Evaluate alternatives to Energy Xpert.*
- *Continuously monitor utility power quality using the i-grid system.*
- *Maximize grant funding for energy related projects.*
- *Design/Construct additional 400 kw cogeneration system with Cogen Phase 2 CIP 318500 by 2015/16. Complete Design FY 2013/2014. Complete Construction FY 2014/2015.*
- *Maximize Biogas production and FOG tipping fee Revenues.*
- *Complete and distribute to staff FOG and Cogeneration Data Dashboards Monthly.*
- *Complete and distribute to staff Energy Fact Sheet annually.*
- *Review Goals and Targets monthly during Energy Management Team meetings.*

Targets (Status Shown in Target Dashboard):

- 12 month running average consumption of no more than 450,000 kwh/month or 5.4 MkWh/year.
- Cogen runtime output at 380 kw (95% of 400 kw) or more monthly average.
- Cogen runtime at 90% or more based on a 12 month average

420 kw Solar Update

- Installation completed in Dec. 2009
- 420 kW peak capacity
- 1+ acre ground-mounted system
- Power Purchase Agreement with SunEdison in July 2009
- PGE net metering agreement
- No capital cost to City
- kwh charge 2/3 PGE rate
- Fixed annual escalation of 3%

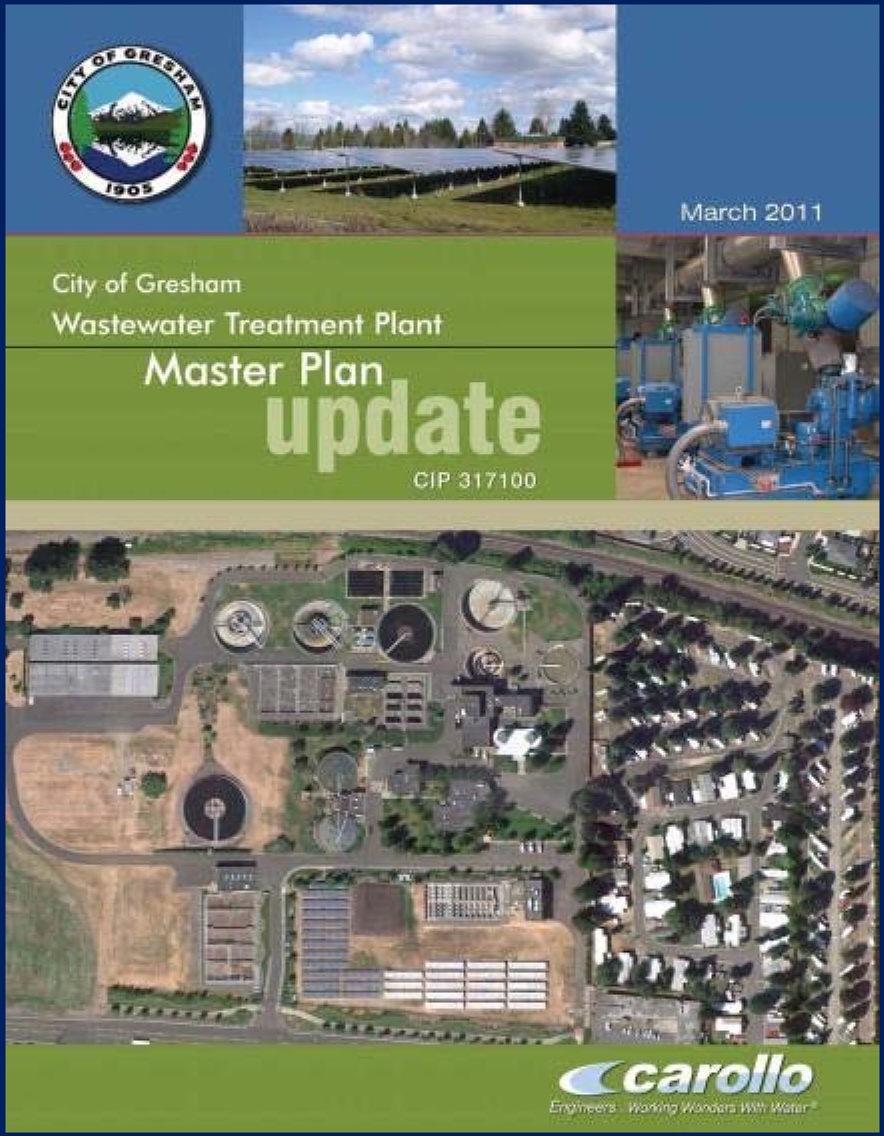
Solar Layout

City of Gresham WWTP

Solar By The Numbers

- 420 kw Peak DC Capacity
- Payback in years = 0
- Capital Cost to City = $0
- O&M Costs to City = $0
- COG purchases energy produced for 20 years
- Average Annual Power Production 450,000 kwh
- Produces 8% of WWTP consumption each year

2011 Master Plan included study of Energy Net-Zero Projects



City of Gresham WWTP

FOG Receiving Station, Phase 1, 2012

- 10,000 gallon FOG Receiving Tank
- FOG Grinder, FOG Unload/Tank Mixing Pump and FOG Feed Pump
- FOG Heat Exchanger with Cogen Heat Loop

FOG Receiving Station, Phase 1, 2012

- **Advertised a FOG Hauler RFP**
- **3 FOG Haulers Contracted**
- **7,500 gpd Received since 2012**
- **8 cents per gallon tipping fee**
- **$205,000 revenues in 2013**

2 Energy Efficiency Projects, 2013

- Energy Efficiency Study financed by ETO

- Replace gas mixing system (3 - 40 hp compressors)
- Install Linear Motion Mixers (LMM) for both digesters
- Each LMM consumes 5 hp
- Essentially trading 80 hp 24 hrs/day for 10 hp 24 hrs/day

- Replace 2 Hoffman mutistage blowers (100 hp each)
- Install 2 Neuros Turbo blowers (100 hp each)
- Install fine bubble diffusers in Aeration basins


100 hp Neuros Blowers

Linear Motion Mixer
Installed on Primary and Secondary Digesters

City of Gresham WWTP

Linear Motion Mixer (Inside Digester)

Energy Efficiency By the Numbers

Project Cost	$1,000,000
Energy Trust Incentive	$272,115
BETC	$220,000
Capital Cost	$507,885

Energy Savings

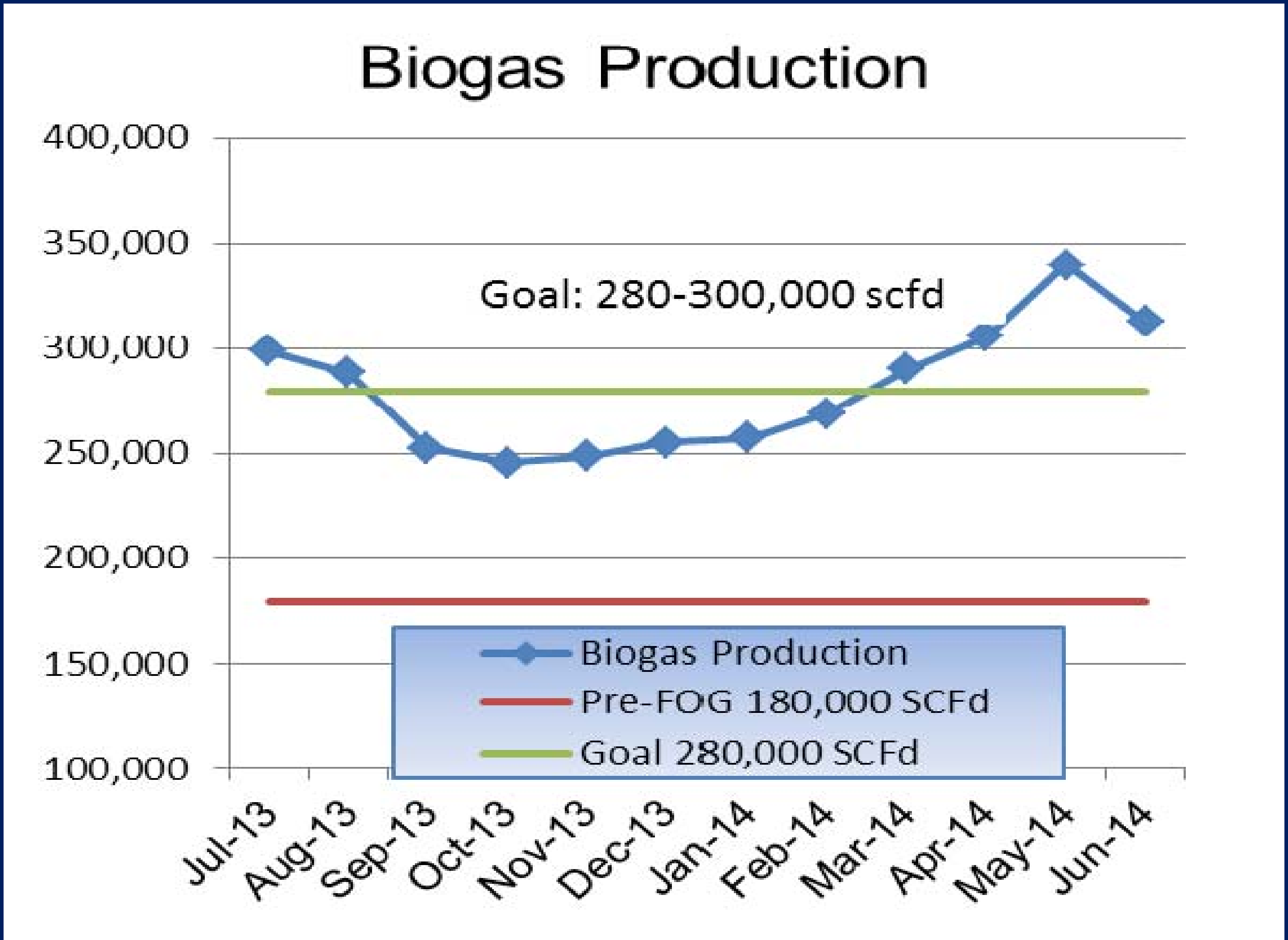
Linear Motion Mixing	412,375
Neuros Blowers/Diffusers	437,983
	850,358 kwh per year
	$58,270 per year

Approximate payback 8 years

FOG Receiving Station, Phase 2A, 2014

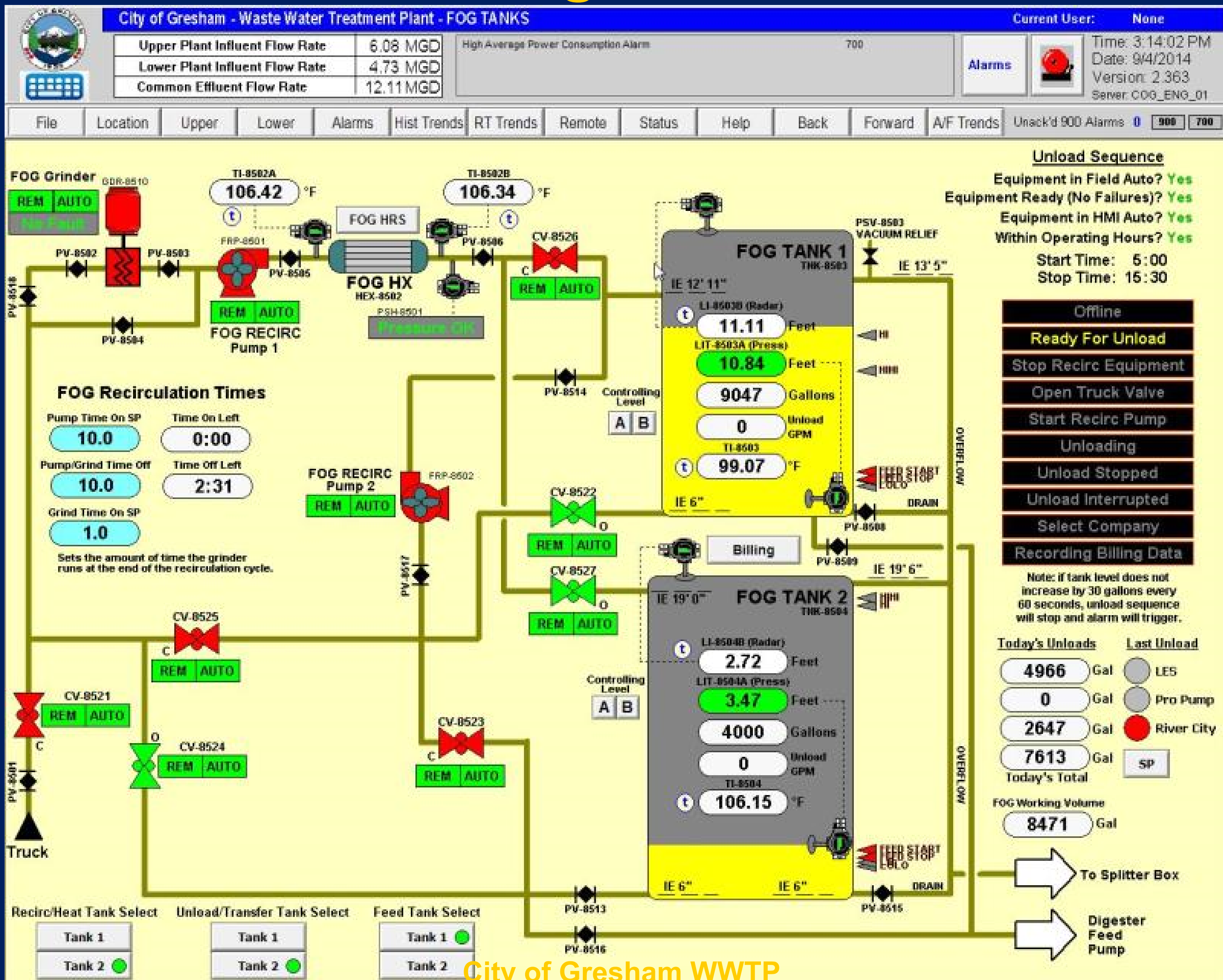
- **Added 20,000 gallon receiving tank**
- **30,000 gallon total capacity as of April, 2014**

FOG Receiving Station, Phase 2A, 2014



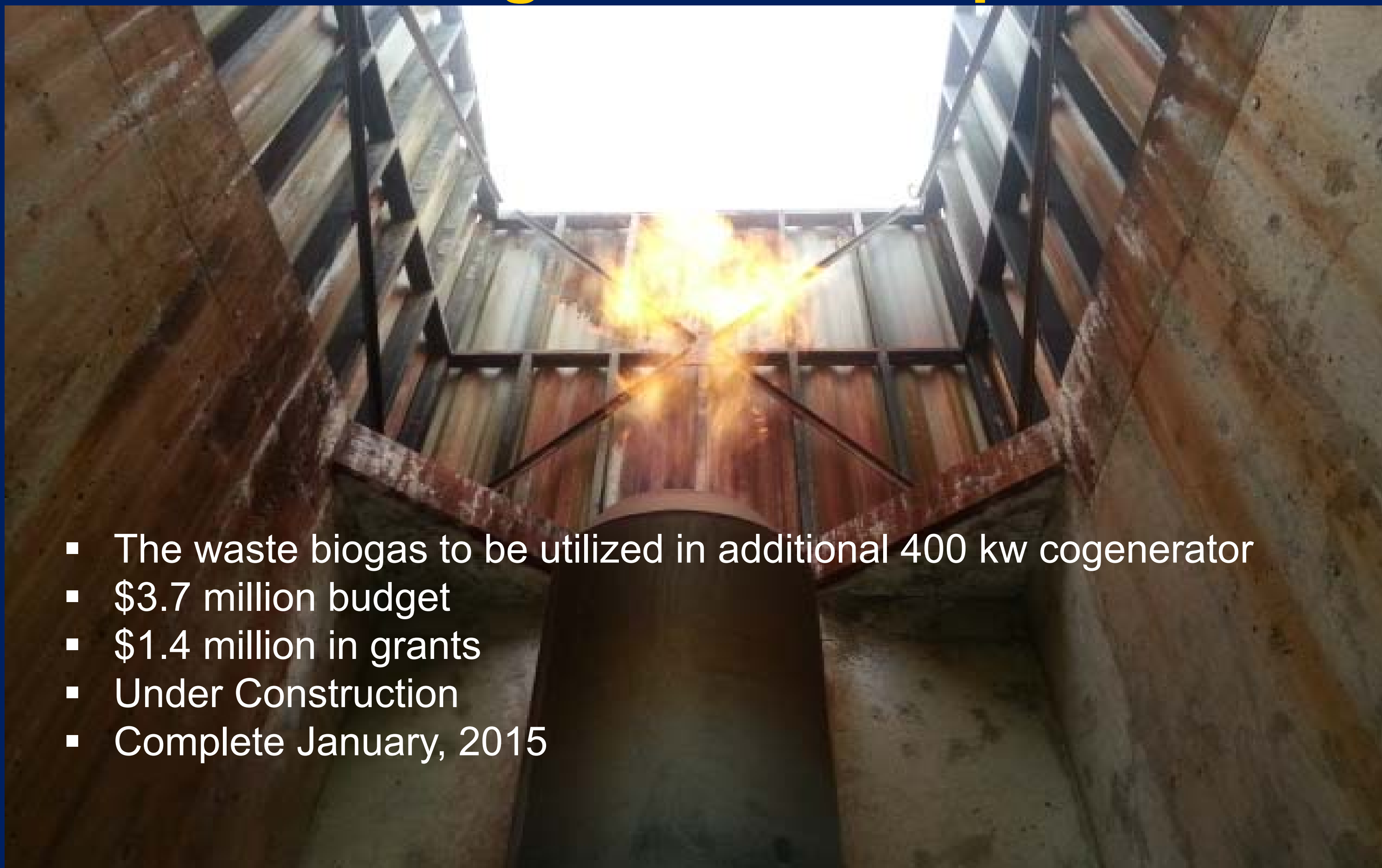
- **180,000 to 300,000 SCFD Biogas Production**

FOG Receiving Station Control



City of Gresham WWTP

FOG Phase 2B:
400 kw Cogeneration Expansion

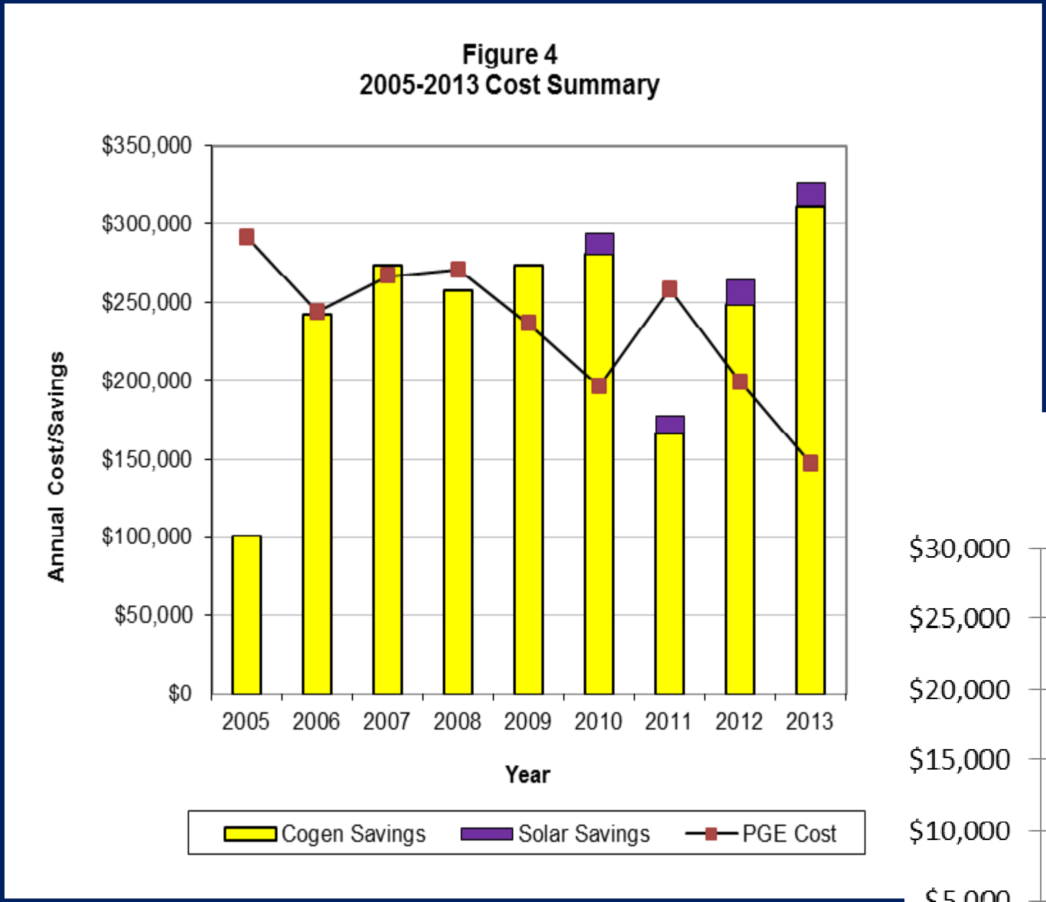


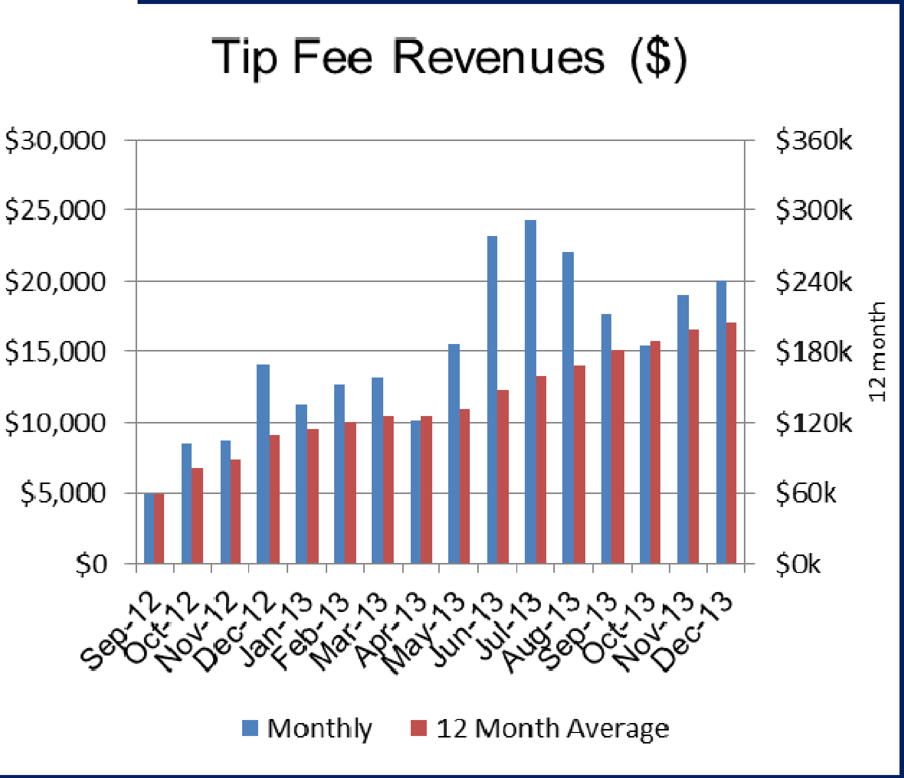
- The waste biogas to be utilized in additional 400 kw cogenerator
- $3.7 million budget
- $1.4 million in grants
- Under Construction
- Complete January, 2015

Leverage Grants! Apply, Apply, Receive?

Project Name	CIP No.	OECDD	Energy Trust	BETC	City of Gresham	Total
2005 400 kw Cogen	313800		$82,000	$288,000	$760,000	$1,130,000
2009 420 kw DC Solar Array	N/A		$500,000	$551,303	$0	$1,051,303
2011 Process Improvements	315300	$40,000	$273,021	$220,048	$2,304,212	$2,837,281
2012 FOG Phase 1 FOG Receiving Station	318200		$40,000	$183,838	$673,331	$897,169
2013 FOG Phase 2A and 2B FOG and Cogen Expansion	318500		$330,000	$1,011,749	$1,308,942	$2,650,691
2012 Micro-Hydro	317800		$40,000		$73,448	$113,448
2012 Small Wind	318700		$9,360		$9,360	$18,720
2013 Upper aeration basin mixers	317400		$14,104		$14,104	$28,208
Total		$40,000	$1,288,485	$2,254,938	$5,143,397	$8,726,820
			Grant Total:	**$3,583,423**	**41.1%**	

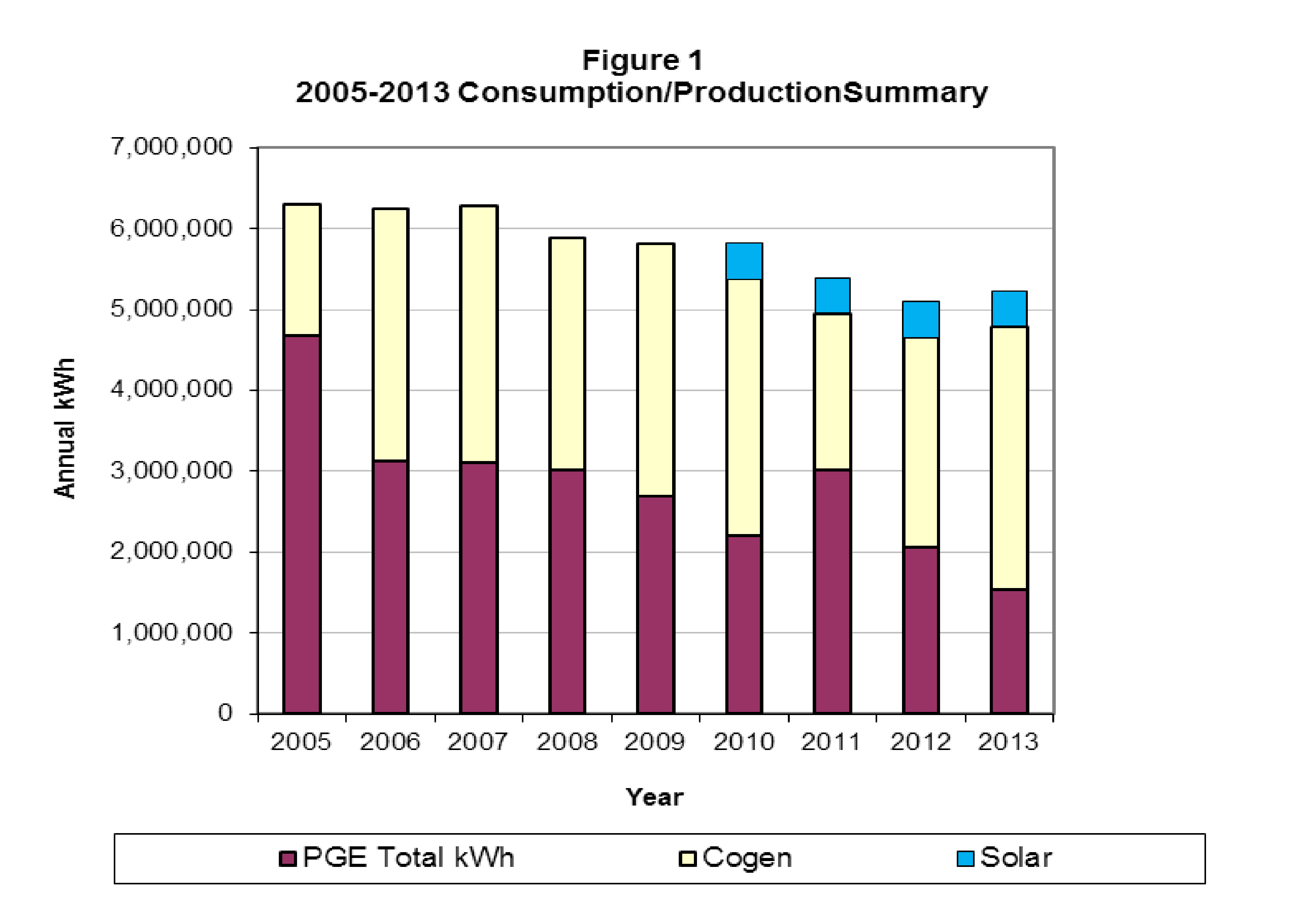
2013 Avoided PGE Costs and FOG Revenues





2013 Avoided PGE Costs	$325,000
2013 FOG Revenues	$205,000
Annual Savings	$530,000

Energy Accomplishments Since 2005



Alan Johnston, Senior Engineer, Wastewater Services Division

A Tale of Two Texas Towns:
Direct Potable Reuse in Wichita Falls & Brownwood

Brad Castleberry
Lloyd Gosselink Rochelle & Townsend, P.C., TX

Lloyd Gosselink
ATTORNEYS AT LAW

“The good news is that soon we will all be drinking treated wastewater.
The bad news is there won’t be enough to go around.”

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Topics of Discussion

- Background Regarding Water Reuse
- Direct Reuse v. Indirect Reuse
- Permitting Reuse Projects
- “Potable” Reuse?
- Challenges Moving Forward

State Water Plan

- Population expected to double between 2000 & 2060
- Demand for water expected to increase 27%
- Texas will need 8.8 M ac-ft. of water by 2060 if no new supplies developed
- Regional Water plans establish “Water Management Strategies”
  - New Supplies
  - Water Conservation Measures
  - Water Reuse


BOAT RAMP
CLOSED

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What Is Water Reuse?

- Using wastewater or reclaimed water for a beneficial purpose
- Two Types of Water Reuse:
  - Direct Reuse
  - Indirect Reuse
- Blending Projects

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Advantages of Water Reuse

- Reduces the demands on potable water sources
  - e.g., lawn maintenance and golf course irrigation
- Lowers the volume of wastewater discharged, resulting in a beneficial impact on aquatic environment
- Capital costs are low to medium for most systems
- Nutrient-rich wastewaters can increase agricultural production in water-poor areas

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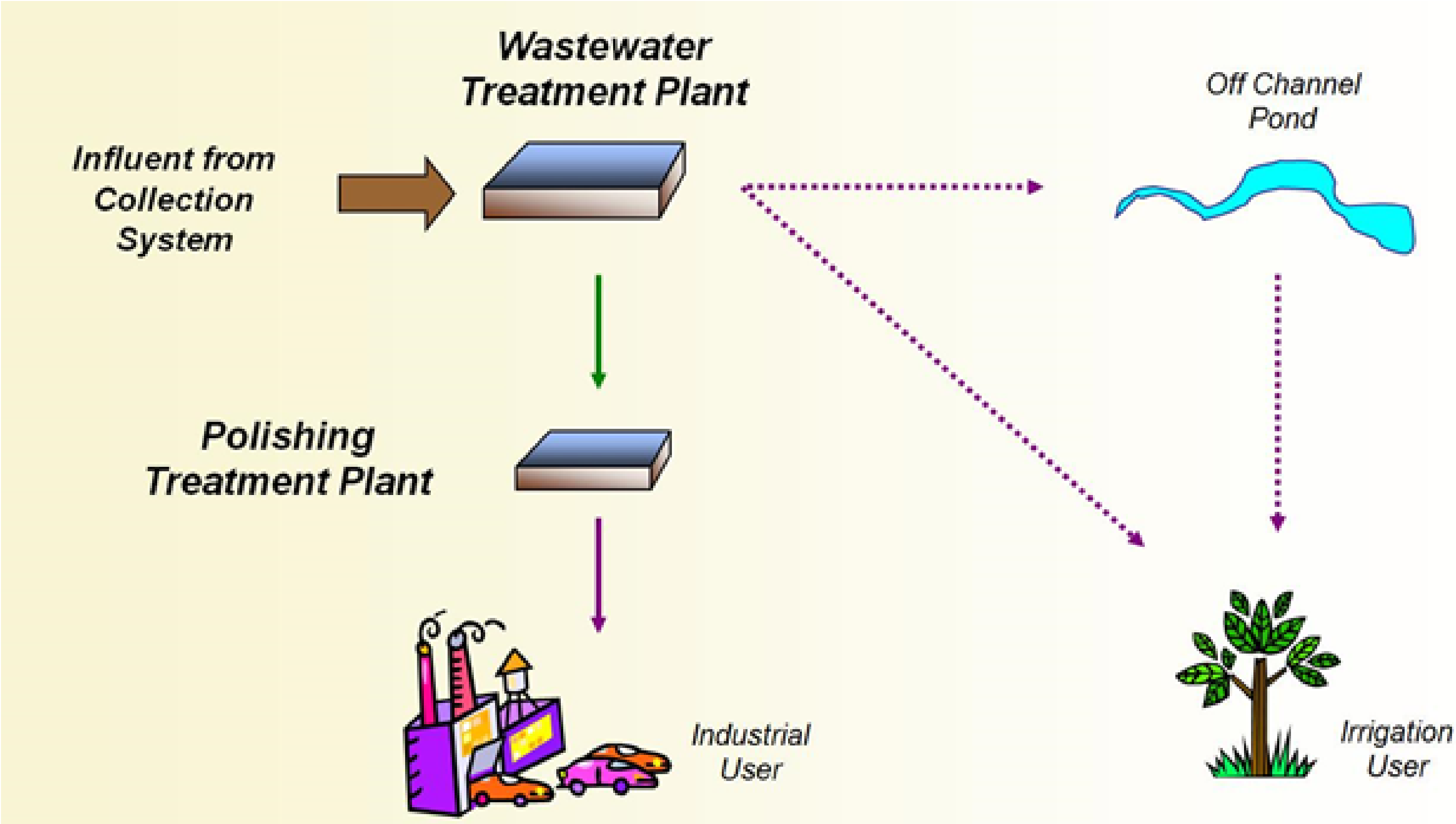
What Is Direct Reuse?

- Use of treated effluent ("Reclaimed Water") for non-potable needs
- Effluent is treated at a WWTP, but never reaches a state watercourse
- (i.e. flange-to-flange)
- "Purple Pipe" Projects
- Primarily used for agriculture or landscape irrigation or for industrial supplies

Direct Reuse Scenarios



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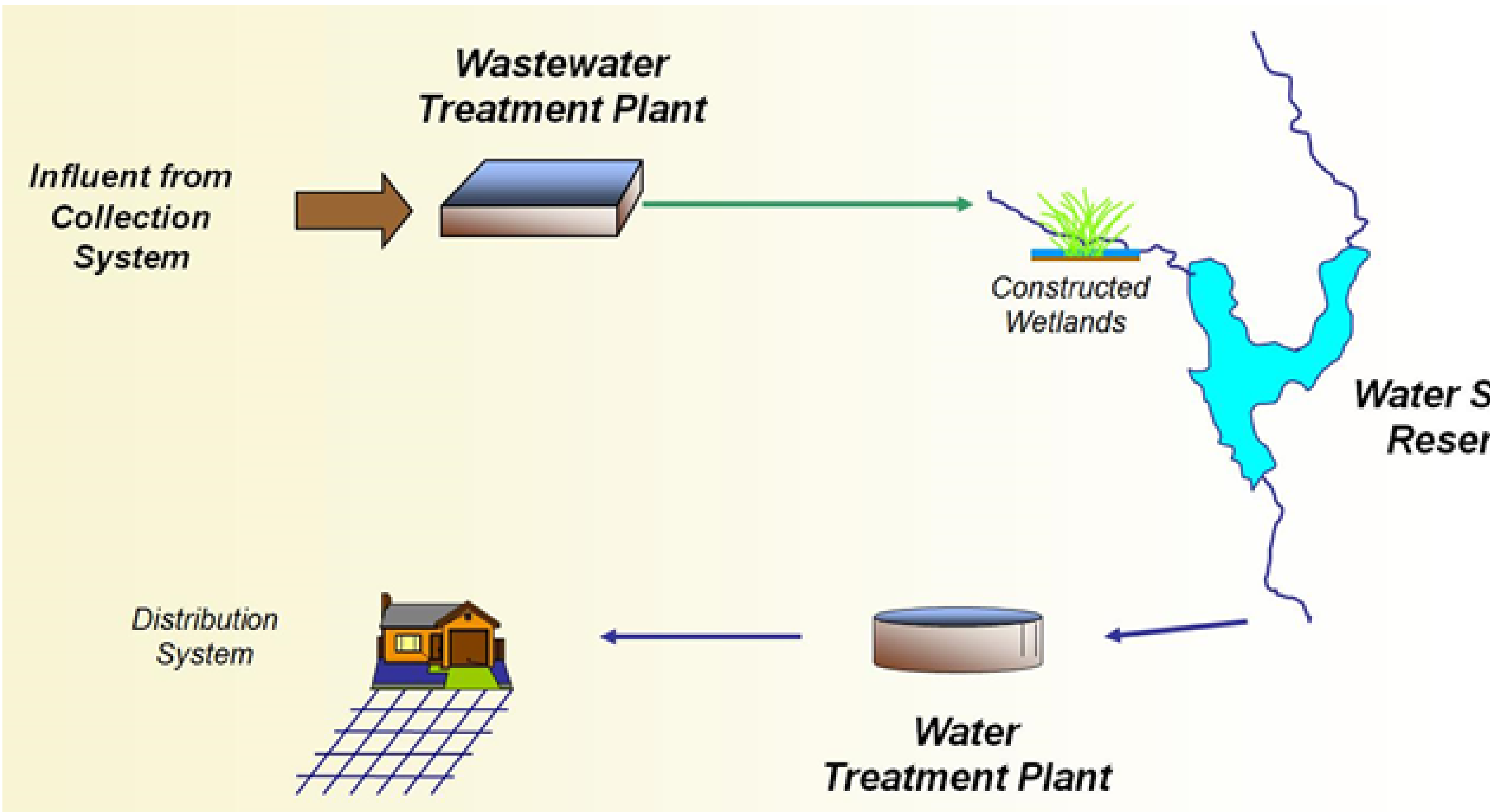
What Is Indirect Reuse?

- Effluent is discharged into a state watercourse and diverted downstream for use
- Developed water-based return flows vs. surface water-based return flows
- Historical return flows vs. future return flows
- No water quality permits required, but water rights are necessary (regulated by TCEQ)

Indirect Reuse Scenarios



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Indirect Potable Reuse Defined

- An IPR project involves the augmentation of a drinking water source (surface or groundwater) with WWTP effluent that has been subject to constructed physical and/or chemical treatment in addition to blending with a natural water source. ***The treated WWTP effluent must be adequately mixed, diluted, and receive natural biological and/or filtration treatment (environmental buffer/barrier)*** to reduce harmful, and/or potentially harmful, pathogens and/or chemicals ***prior to conventional drinking water treatment.***

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Environmental Buffers

- "A referenced environmental buffer ***will need to be evaluated*** to determine if it is actually providing a natural biological and/or filtration treatment barrier for reduction of pathogens and/or chemicals and the log removal achieved."

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"Indirect Potable" Reuse Projects?

- The Colorado River – City of Bastrop
- Lake Livingston – City of Houston
- Lake Ray Hubbard – City of Dallas
- Aquifer Discharge – City of El Paso
- Lake Travis – City of Marble Falls
- What is not indirect potable reuse?
  - Where there is no downstream diversion
  - Discharges into the Gulf of Mexico

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What is "Direct Potable" Reuse?

A DPR project is when a WWTP ***effluent receives further constructed physical and/or chemical treatment for the removal of harmful, and/or potentially harmful, pathogens and/or chemicals prior to being distributed for human consumption.*** The treated WWTP ***effluent may be mixed with a raw surface or groundwater source at some point during the constructed physical and chemical treatment processes, but this process only achieves dilution*** and does not provide a measurable or verifiable reduction in harmful, and/or potentially harmful, pathogens and/or chemicals by natural biological and/or filtration treatment processes prior to being distributed for human consumption.

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Examples of Treatment

- Hollow fiber Membranes
- Microfiltration
- Ultrafiltration
- Reverse Osmosis
- Ultraviolet Disinfection

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What are the legal requirements for DPR?

- SDWA source water assessment
- 30 TAC Chapter 290.41 requires approval for new water sources for public water systems
- 30 TAC Chapter 290.39(l) requires an exception be granted for technology not authorized by rule
- 30 TAC Chapter 290.42(g) addresses "innovative and alternative" treatment technology

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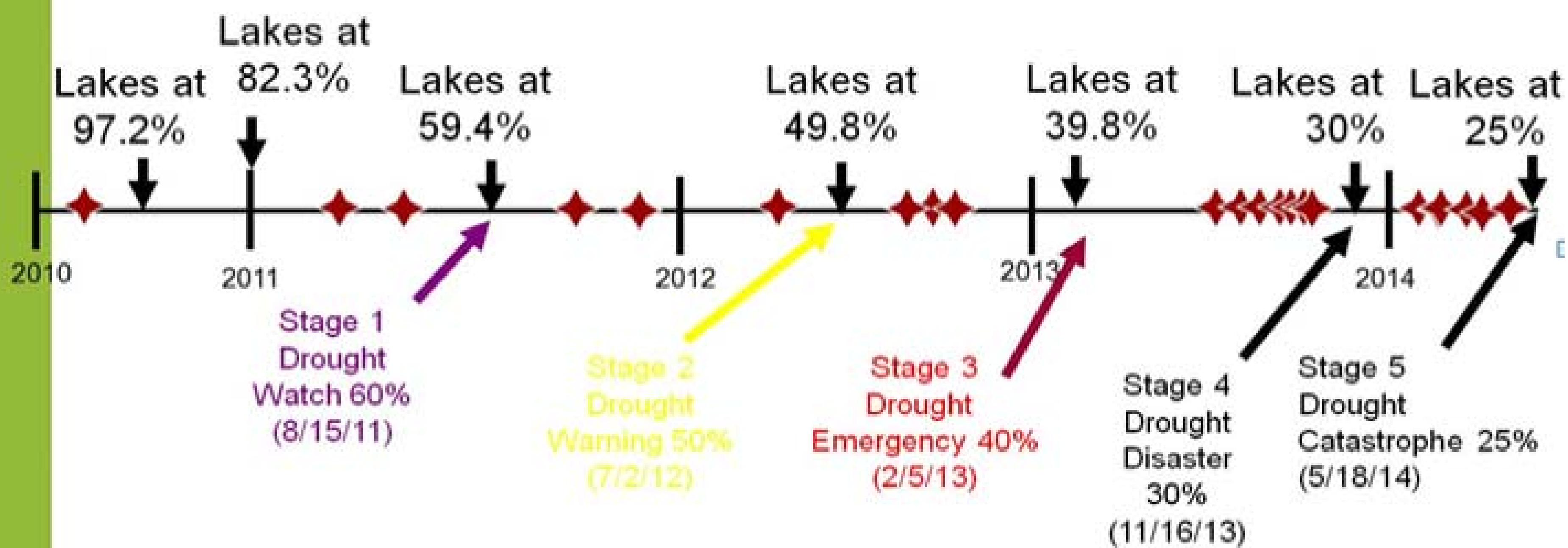
Potential Challenges

- Uncertainty in treatment technology that may be needed to implement DPR
  - Cost of technology is issue
  - Timing of review and approval is issue
- New thoughts on IPR may raise questions about existing treatment works
  - What is an environmental buffer?
  - Does this mean an added review for water rights permitting on indirect reuse projects?

Wichita Falls

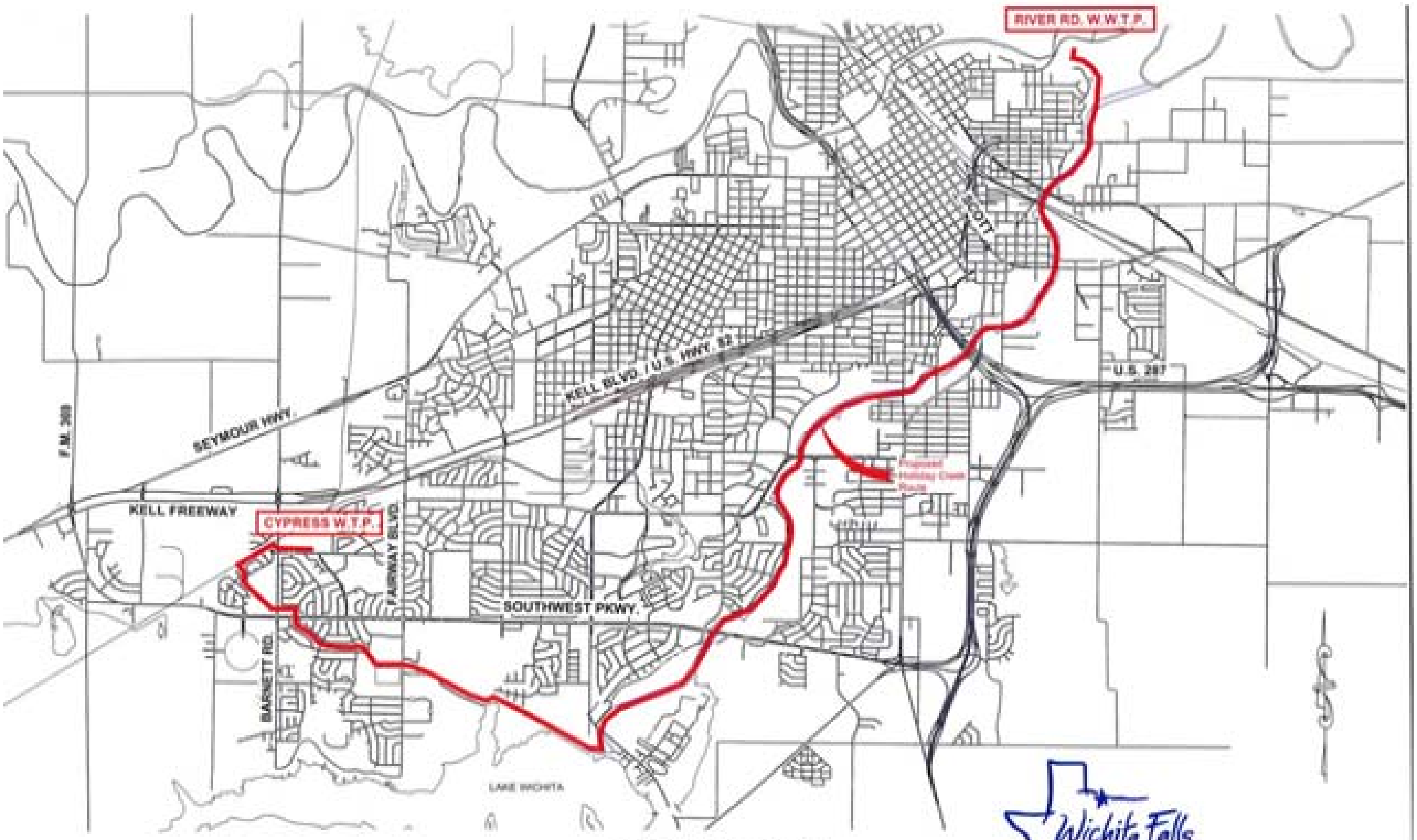
Drought Triggers



✦ Denotes a Water Resources Committee Meeting

- City has been much more aggressive with restrictions during this drought.
- Conservation efforts saved over 2.5 Billion gallons in 2012 - 13

Emergency Reuse Project



LOCATION MAP

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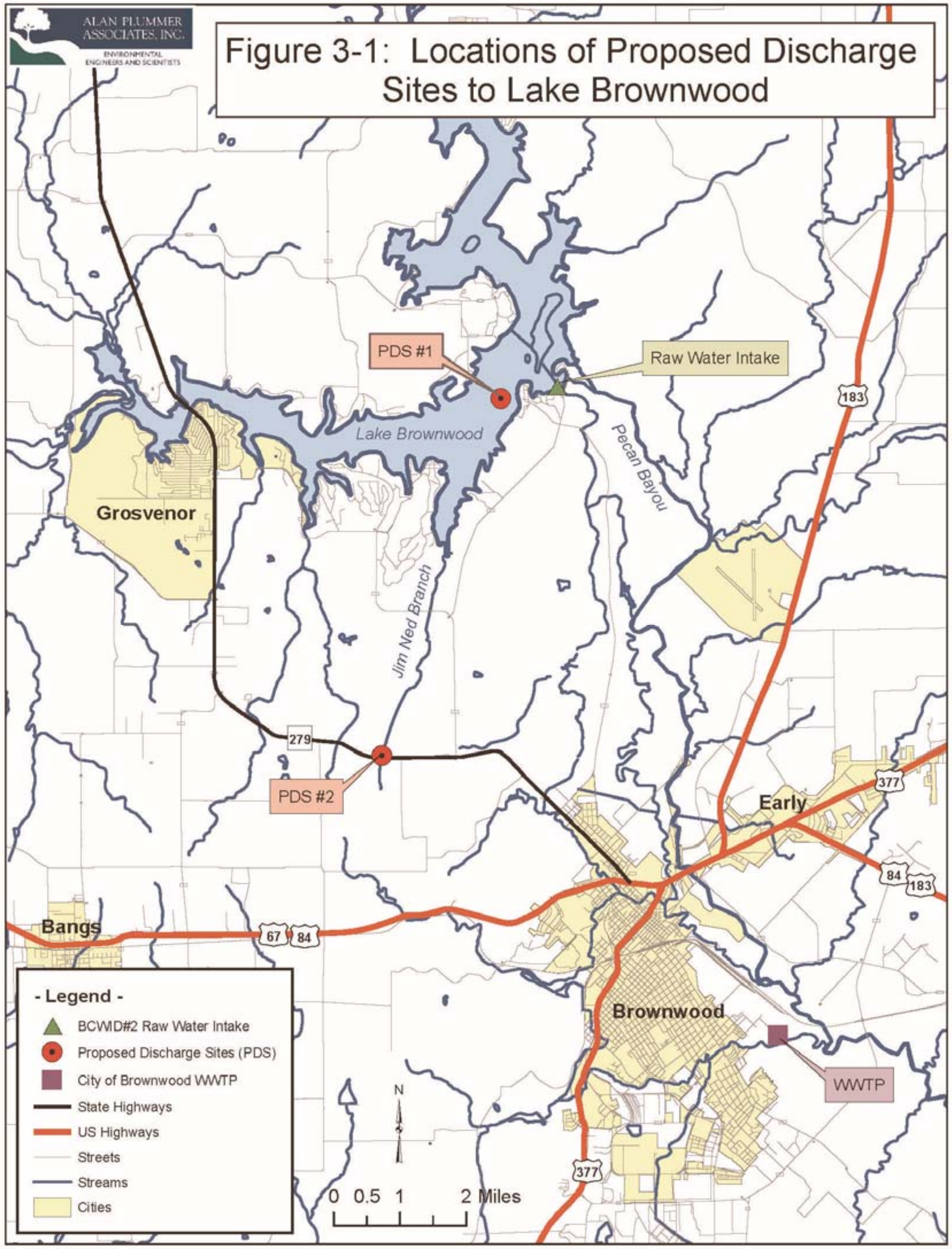
Lessons Learned

- Full-scale verification process inherent with uncertainties
- Public relations campaign
  - Public education is important
  - Carefully consider media engagement
- Planning for alternatives



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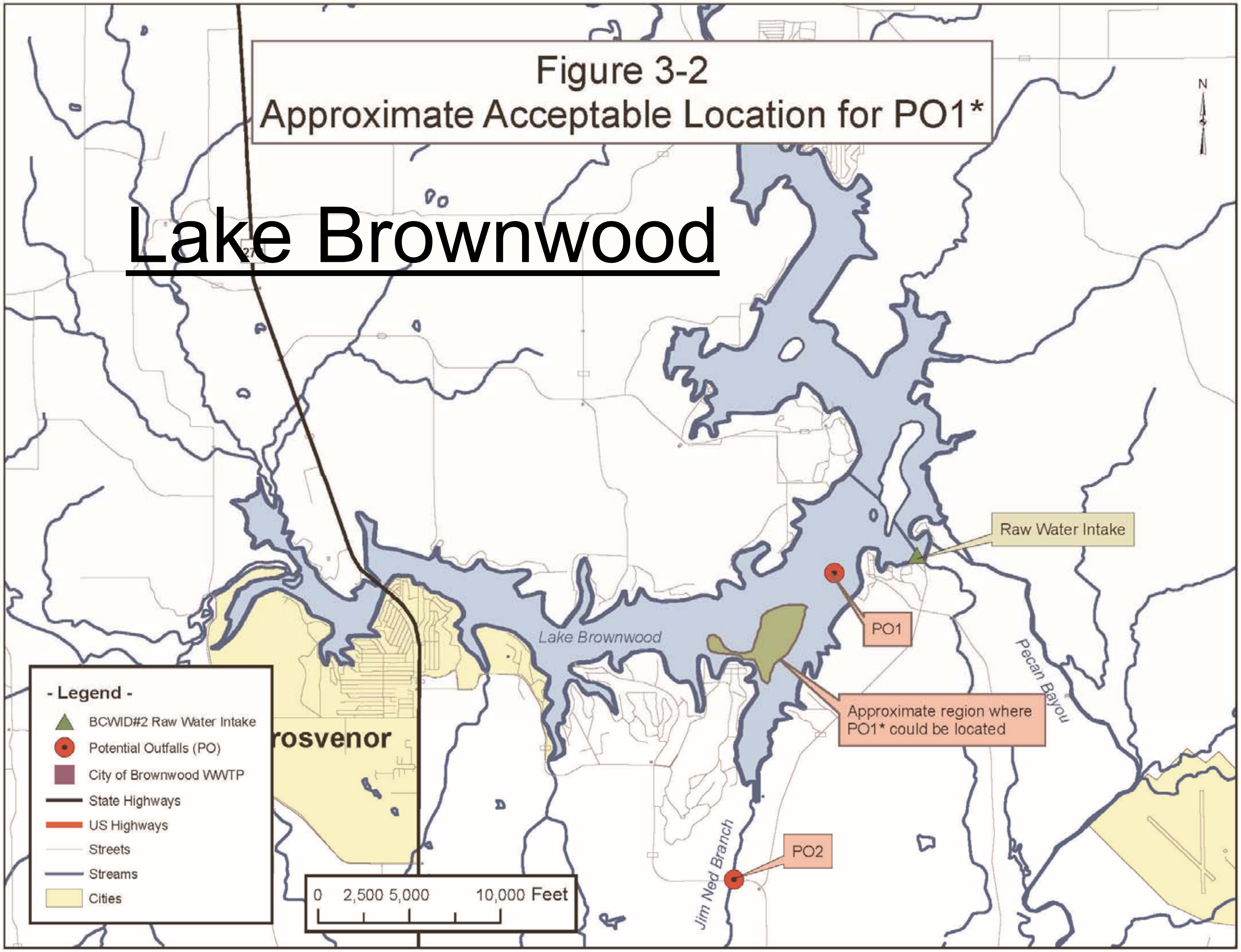
Lake Brownwood



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Lessons Learning…

- Watch process of other cities
- Public perception is important
  - Indirect reuse options need to be fully considered
  - Wholesale customer opinions
- Customer contracts and equity

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Summary

- IPR/DPR are here to stay
- Each project will be unique
- Consider options to clarify regulations
- Good PR and media strategies
- Need to have unified front

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Thank you!

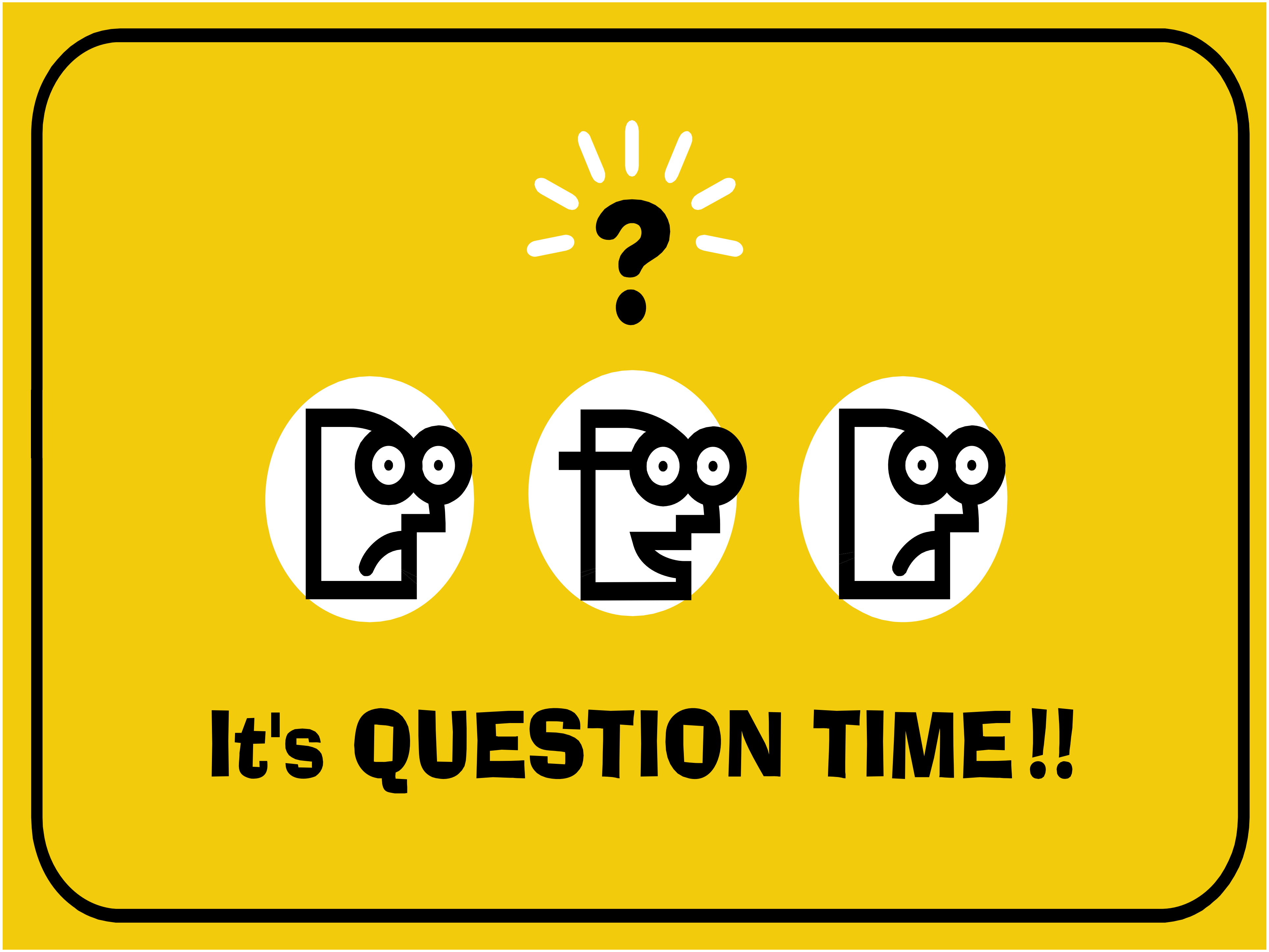
Brad B. Castleberry

bcastleberry@lglawfirm.com

Unconventional Partners in Resource Recovery

Ryan Bennett
National Milk Producers Federation, VA

NACWA
A Clear Commitment to America's Waters


It's QUESTION TIME!!

Join Us Next Week & Again in Two Weeks!

September 16, 2014

2:00 – 3:30 ET

Sustainable Infrastructure —
Resiliency, Gray, Green & the Regulatory Regime

September 23, 2014

2:00 – 3:30 ET

Innovative Financing & Rates —
Finding New Revenue & Stretching Each Dollar