

# Optimizing Poplar Water and Nutrient Use for Water Quality Benefits

Managing Poplar and Willow for Environmental Benefits and the Renewable Fuels Industry - Portland, OR – April 12, 2016



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# Outline

- Drivers for recycled water and biosolids reuse
- Typical loading rates and system sizing for poplars
- Ideas to maximize tree system performance

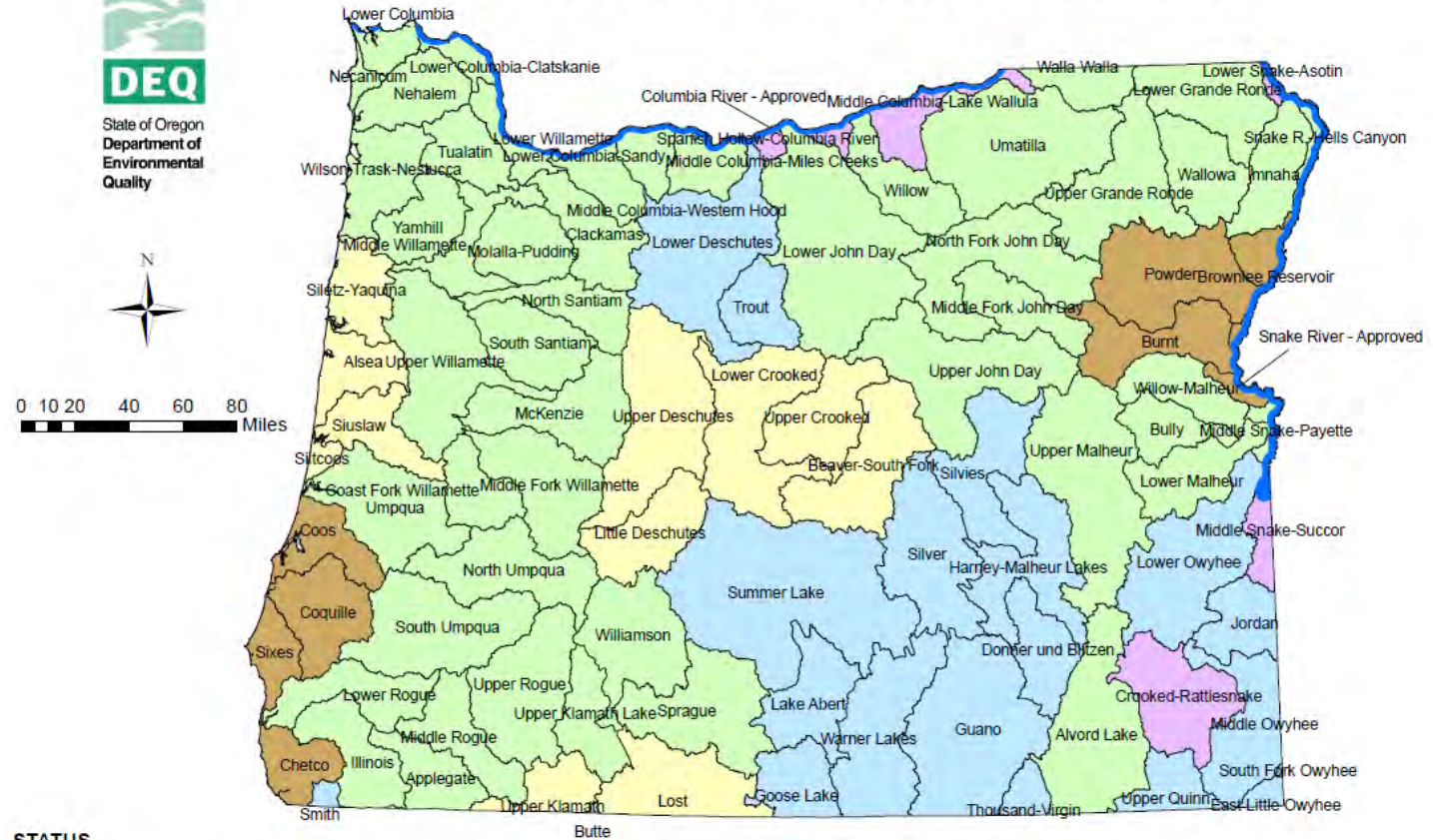
# TMDLs (Total Maximum Daily Load) Coming to a Watershed Near You

- Dissolved Oxygen
- Bacteria
- Sediment
- Pesticides
- Algae
- pH
- Nitrogen
- Ammonia
- Phosphorus
- Metals
- Temperature



0 10 20 40 60 80  
Miles

## TMDL Development Status for 303(d) Listed Waters



### STATUS

- EPA Approved\*
- TMDL Report In-Progress (Data analysis & report writing phase)
- TMDL Initiated (Initial scoping & data collection phase)
- TMDL Not Started (Minimal or no activity)
- No TMDL Necessary (No 303(d) listings)

\*See TMDL supporting documentation for parameters addressed at <http://www.deq.state.or.us/wq/tmdls/tmdls.htm>. Additional 303(d) listings may exist for parameters not addressed in approved TMDLs.

# Example TMDL Limit that Drove Woodburn to Investigate Recycled Water Use

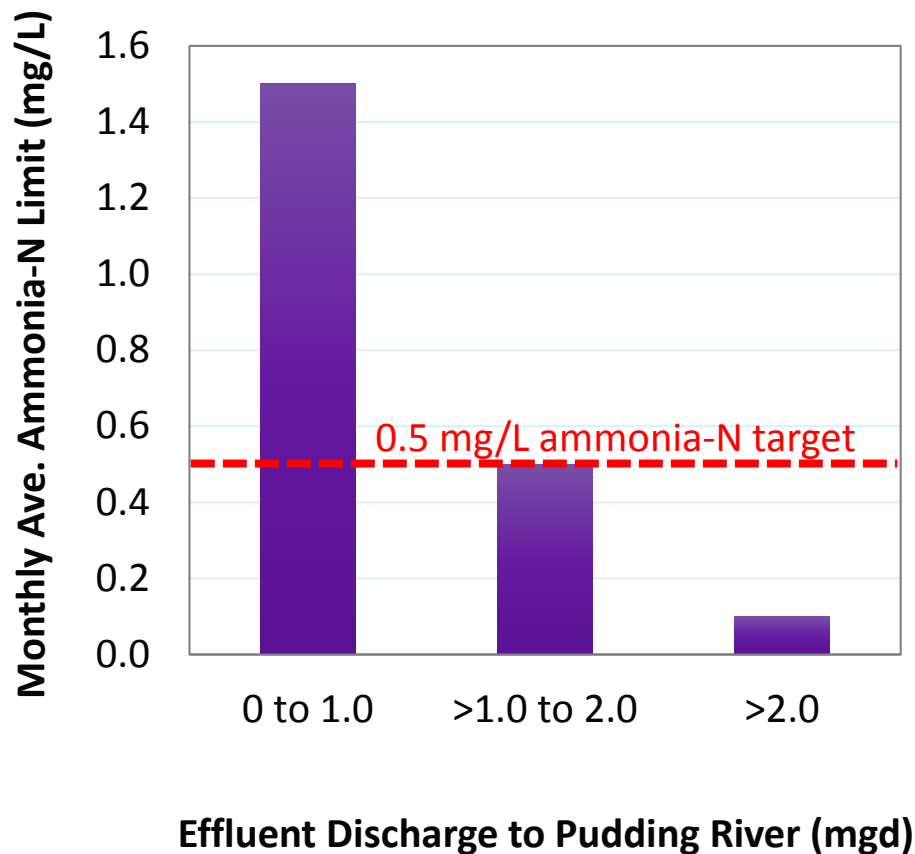
- Problem

- 1993 TMDL set strict new ammonia limits
- Ammonia treatment to  $< 0.1$  mg/L has marginal reliability - required for discharge of full flow

- Solution

- Ammonia treatment to  $< 0.5$  mg/L has high reliability
- Manage flows in excess of 2 mgd in July and August ( $< 1$  mgd) for irrigation to poplar trees

**City of Woodburn Ammonia Limits for Jul/Aug when Pudding River Flow  $< 30$  cfs**





# Recycled Water Options for Treatment and End Use

H  
I  
G  
H

Cost of Treatment and Requirements  
for Recycled Water Quality

Level of Restrictions and  
Controls on Allowed End Uses

H  
I  
G  
H

**Class A**  
(Tertiary  
Filtration  
Required)

**Class B**  
(Advanced  
Secondary w/  
Enhanced  
Disinfection)

**Class C**  
(Advanced  
Secondary w/  
Disinfection)

**Class D**  
(Secondary  
Treatment w/  
Disinfection)



**Parks and  
landscapes with  
unrestricted access  
to public**



**Golf courses,  
cemeteries, medians,  
industrial or business  
campuses with ability  
to restrict access**



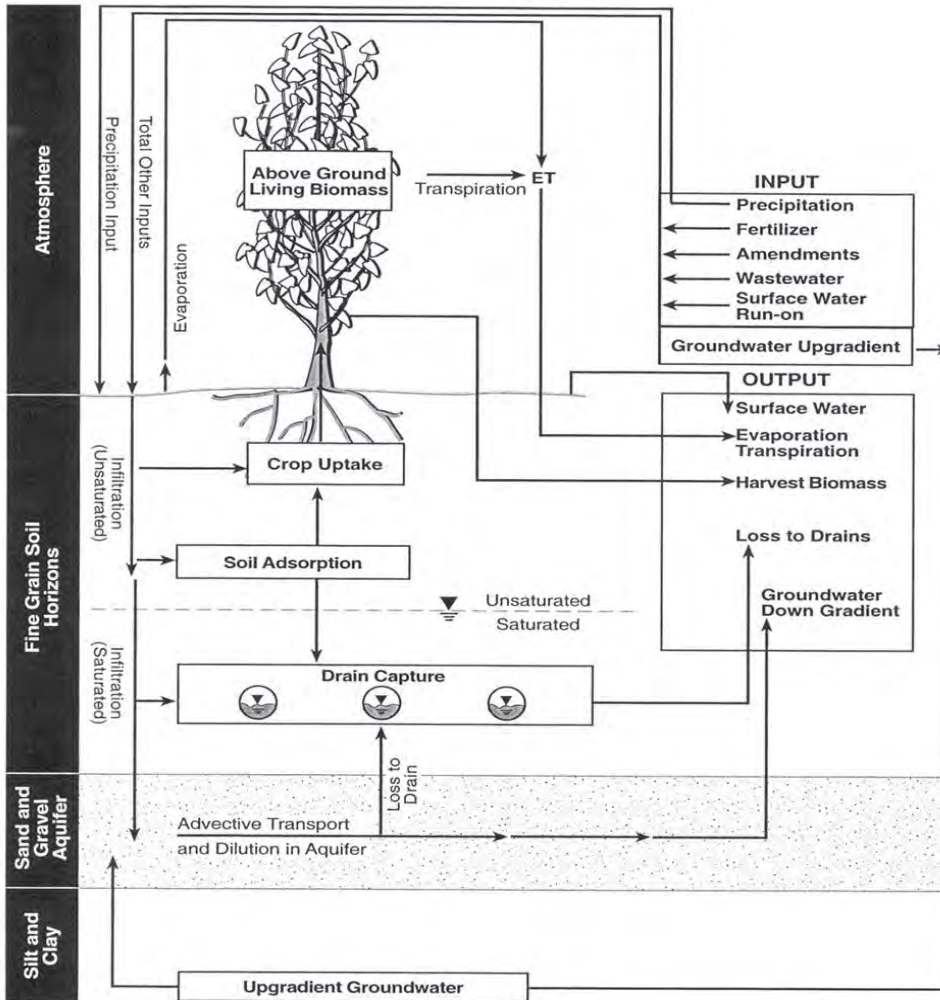
**Non-food crops  
including pasture,  
sod, Christmas trees,  
fodder, fiber, seed,  
commercial timber**


# Benefits of Poplar Tree Systems for Recycled Water and Biosolids Use

- Class D water compatible use
- Low maintenance and infrequent harvest
- Potential to utilize both recycled water and biosolids
- High water and nutrient utilization compared to many other crops
- Tall dense structure can provide a visual screen for site aesthetics and habitat value



# Need to Address Tree Systems Holistically for Sustainable Management



- Location Factors
  - Site soil and drainage conditions
  - Climate conditions
- Water/Nutrient Source Factors
  - Effluent/Biosolids quality
  - Application quantity and timing
  - Application methods
- Tree Management
  - Planting density
  - Harvest management

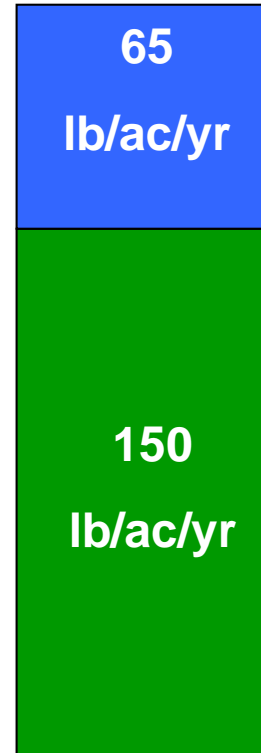
# Example Poplar Tree Plantation Sized for Hydraulic Limits and Optimized for Biosolids Reuse



## 215 lb/ac/yr N Limit

(average across tree age classes)

Annual lbs of Nitrogen per acre



Effluent

28 in/yr

@ 10 mg/L N

Biosolids

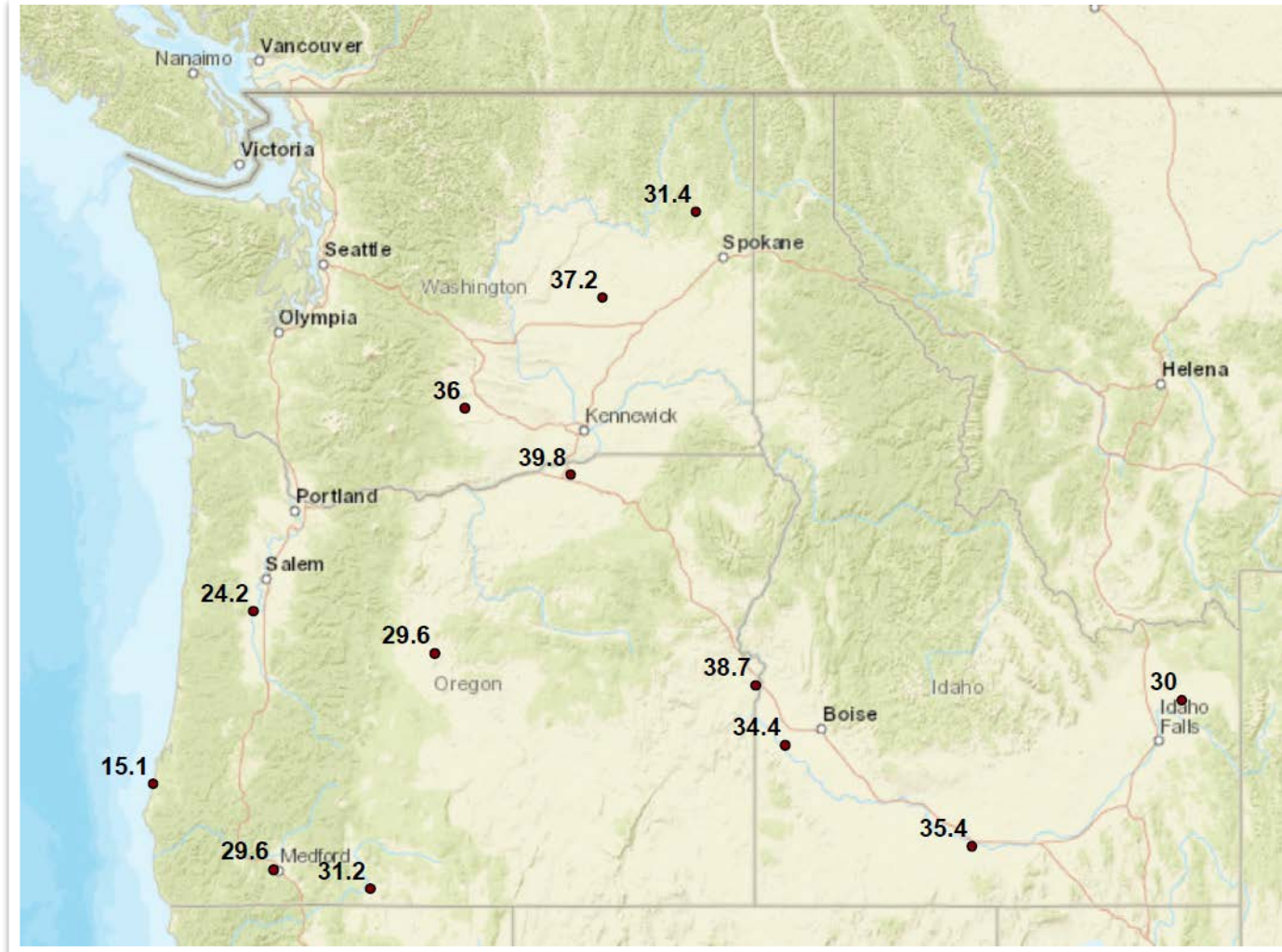
2.9 dT/ac/yr

@ 52 lbs PAN/dT

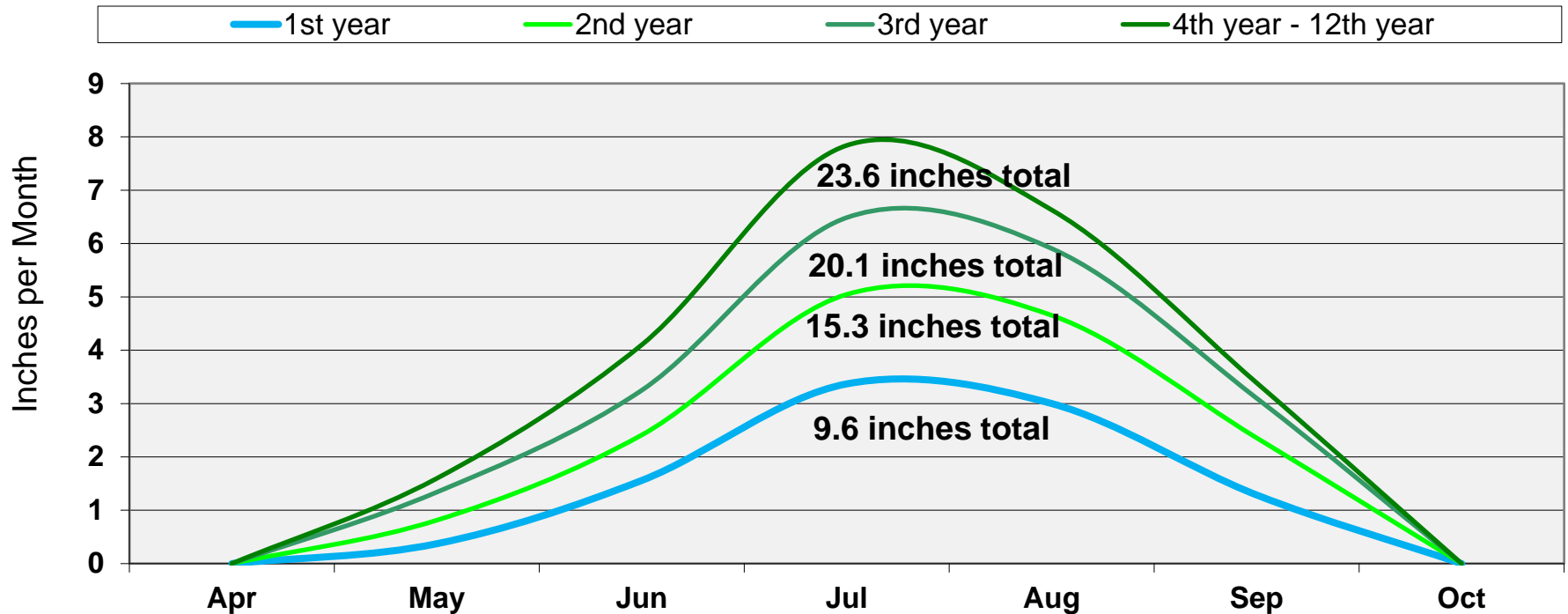


# Poplar Irrigation Water Requirements Across the PNW

Annual Net Irrigation Water Requirements (inches)  
4 to 12 yr old Drip Irrigated Poplar Trees  
2000-2015



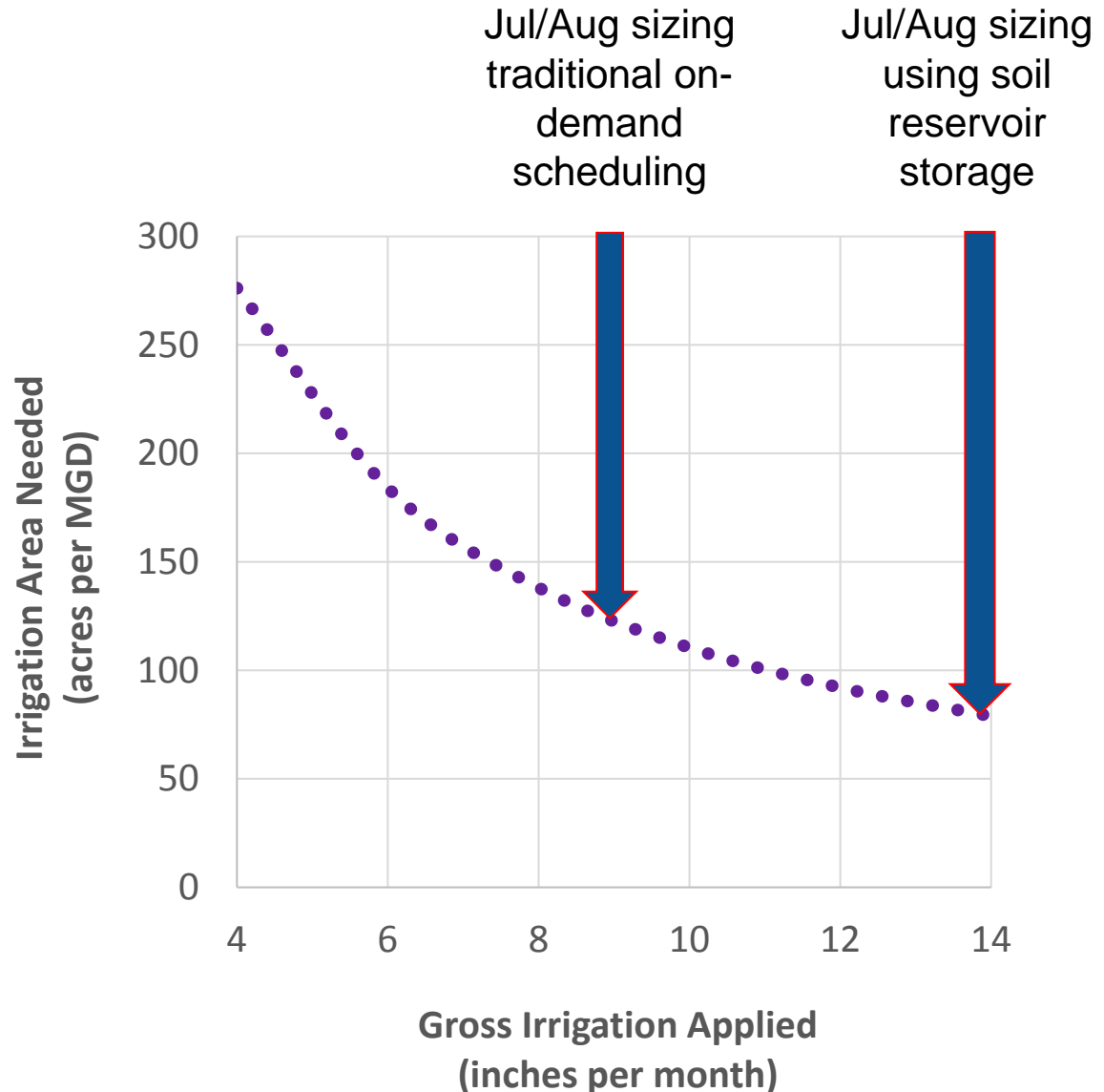
# Poplar Tree Stand Monthly Net Irrigation Water Requirements (Corvallis, OR)



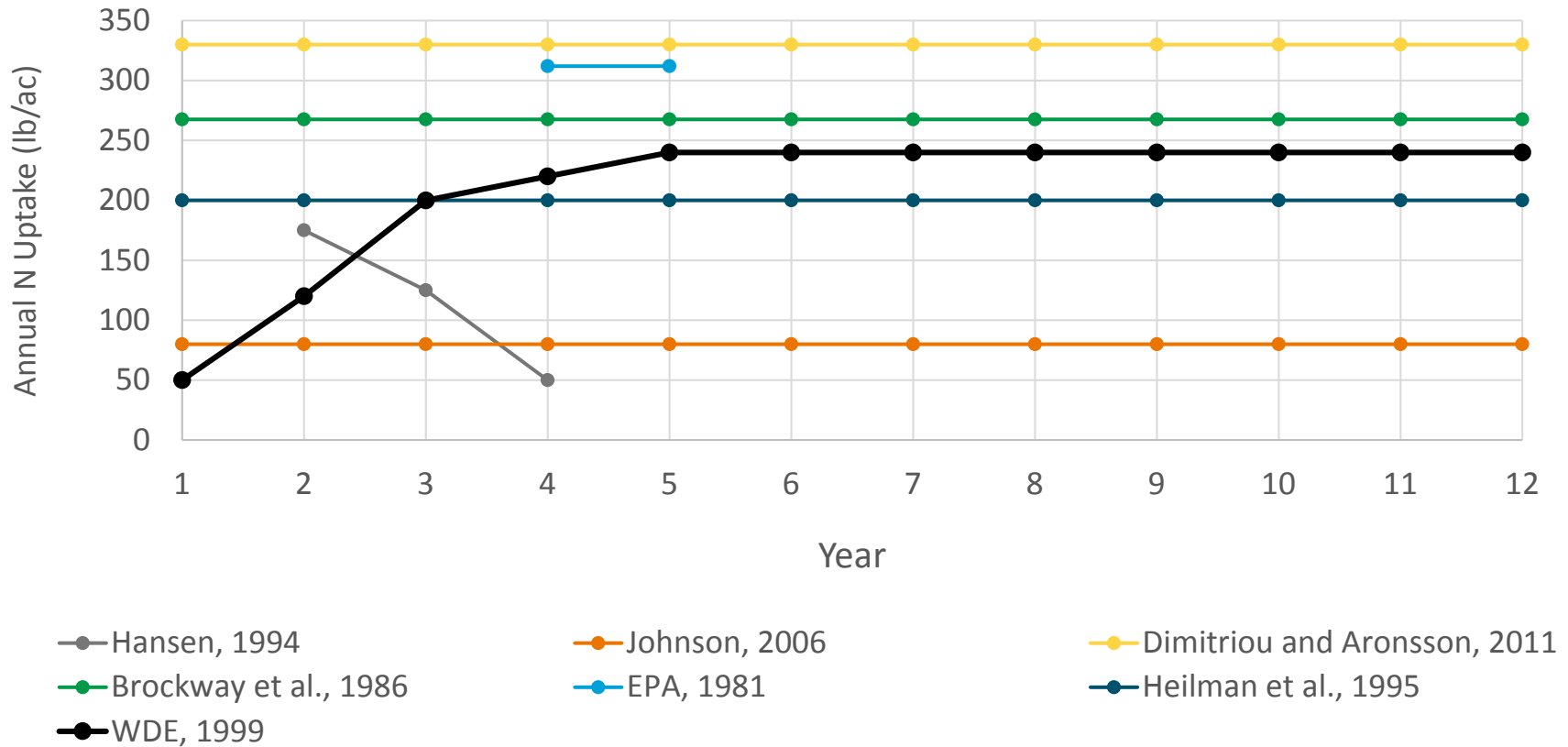
- Develop a sustainable harvest plan that considers reductions in water and nutrient use during tree development
- Plan accordingly...

# Poplar Tree Plantation Sizing in the Willamette Valley

- For most municipal wastewater, plantations will be hydraulically limited vs. nutrient load limited
- Soil water reservoir can be used in some cases to reduce system size



# Poplar Nitrogen Requirements



- Develop a sustainable harvest plan that considers reductions in water and nutrient use during tree development
- Plan accordingly...



# Important Agronomic Factors in Poplar Tree System Management

- Primary Goal

- Maximize tree growth for high rates of biomass accumulation (N uptake) and leaf area development (water uptake)

- Agronomic Strategies

- Select proven varieties and space plantings according to the target rotation age and markets
- Good soil preparation and early weed and pest control and water management for establishment
- Thoughtful irrigation water and nutrient management



# Important Irrigation System Factors for Poplar Tree Systems

- Primary Goal
  - Full integration with WWTP allowing easy irrigation operations to meet agronomic demands and discharge goals
- Equipment Components
  - Application System
  - Filtration
  - Regulation Storage
  - SCADA



# General Concepts for Optimizing Tree System Performance

- Provide conservatism in design with room to maneuver
  - Helps to respond to the unexpected (water quality changes, weather, blowdown, etc)
- Perform monitoring to track nutrient dynamics over time
  - Soil Nitrate-N at a minimum
- Plan for low N utilization in years 1-3 of new plantations
  - Cover crops can help increase uptake in years 1-2
  - Stagger block harvests to equalize average stand age
- Maximize biomass production rates to maximize N utilization
  - Linked to site soil and management factors and stand density
  - Highest N utilization rates in stands at peak productivity with full canopy closure



Thank You

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