The Unexpected Consequences of Water Conservation on Water Reuse Facilities

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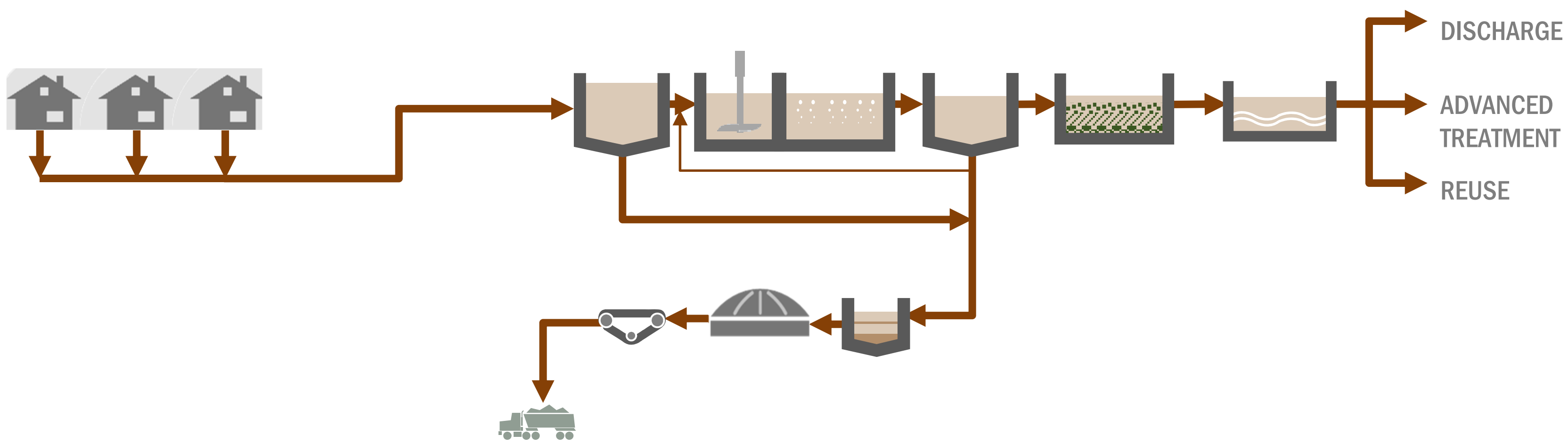
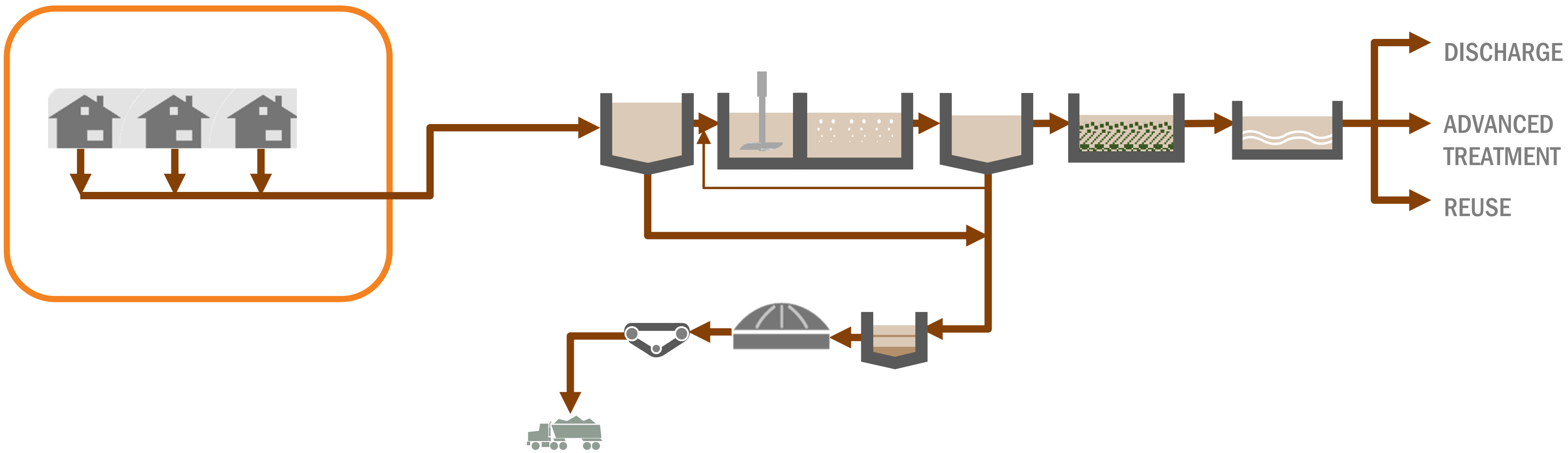
Water Conservation and Water Reuse

- Decreased Flows and Flow Projections
- Treatment Process Loading Capacity
- Alkalinity Limitations
- Effluent Quality
- Recycled Water Flows

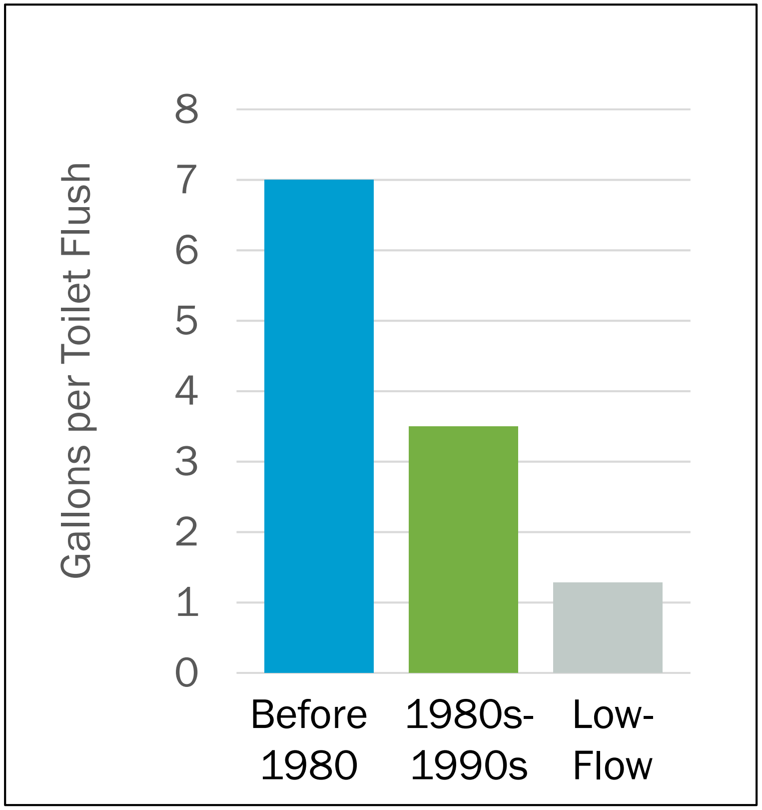


Decreased Flows and Flow Projections

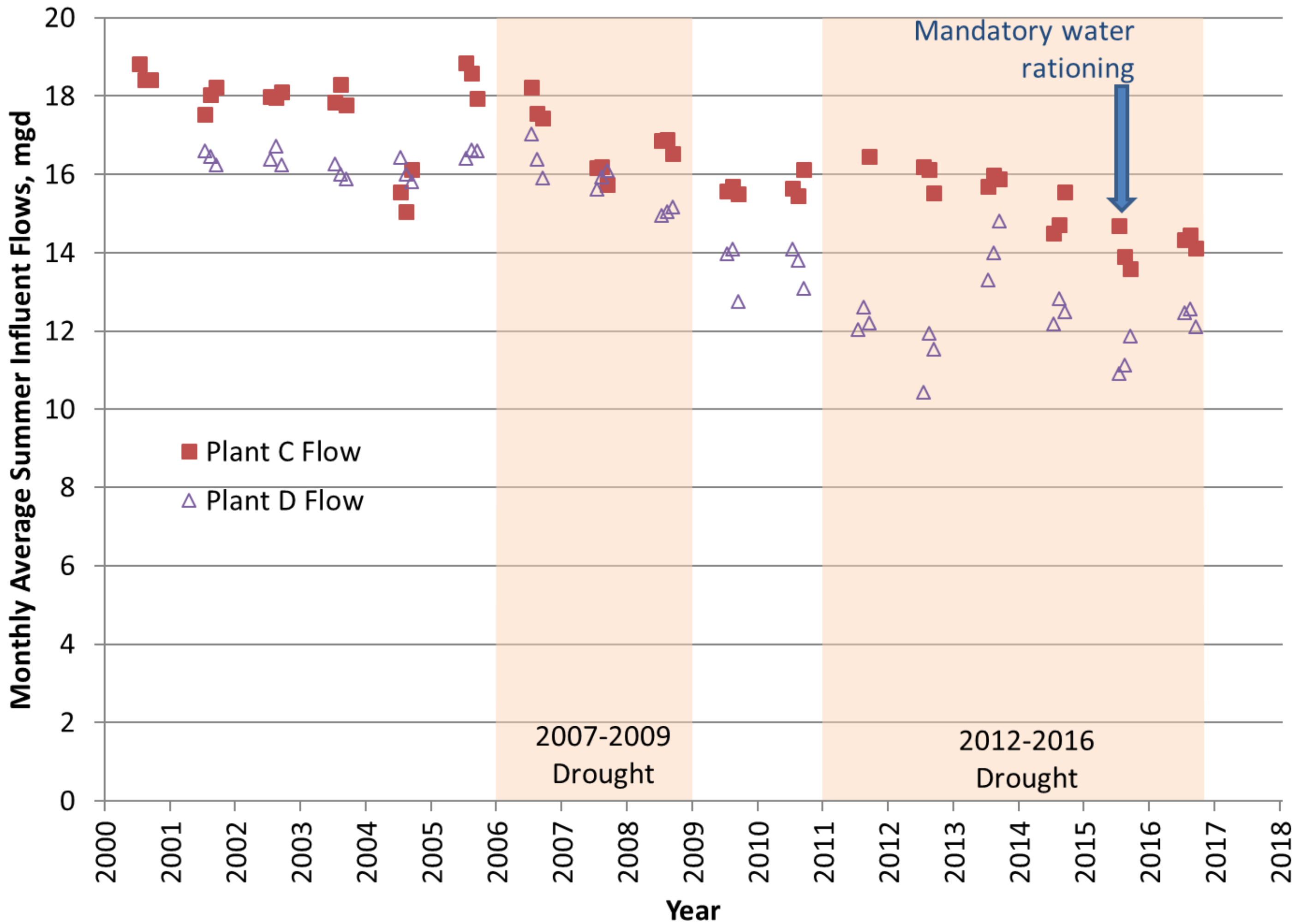


Drought Led to Water Conservation

- Water conservation measures include
  - Drought tolerant landscaping
  - Outdoor water restrictions
  - Low-flow toilets
  - Low-flow shower heads
  - Faucet aerators
  - Water conserving appliances
  - Greywater recycling
  - Not flushing as often
  - Shorter showers



Water Conservation Results in Lower Wastewater Flows



Summer flow is July through September

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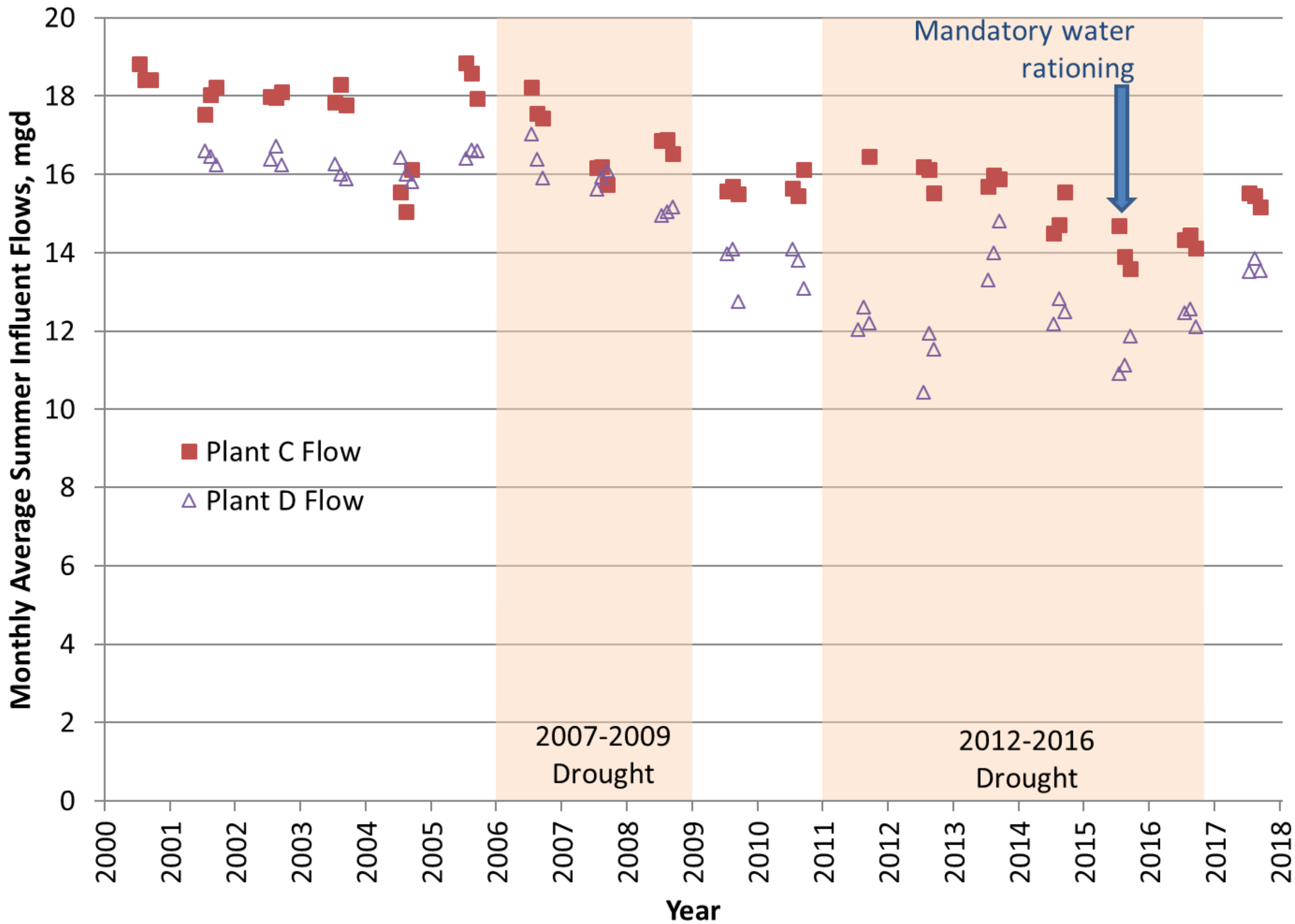

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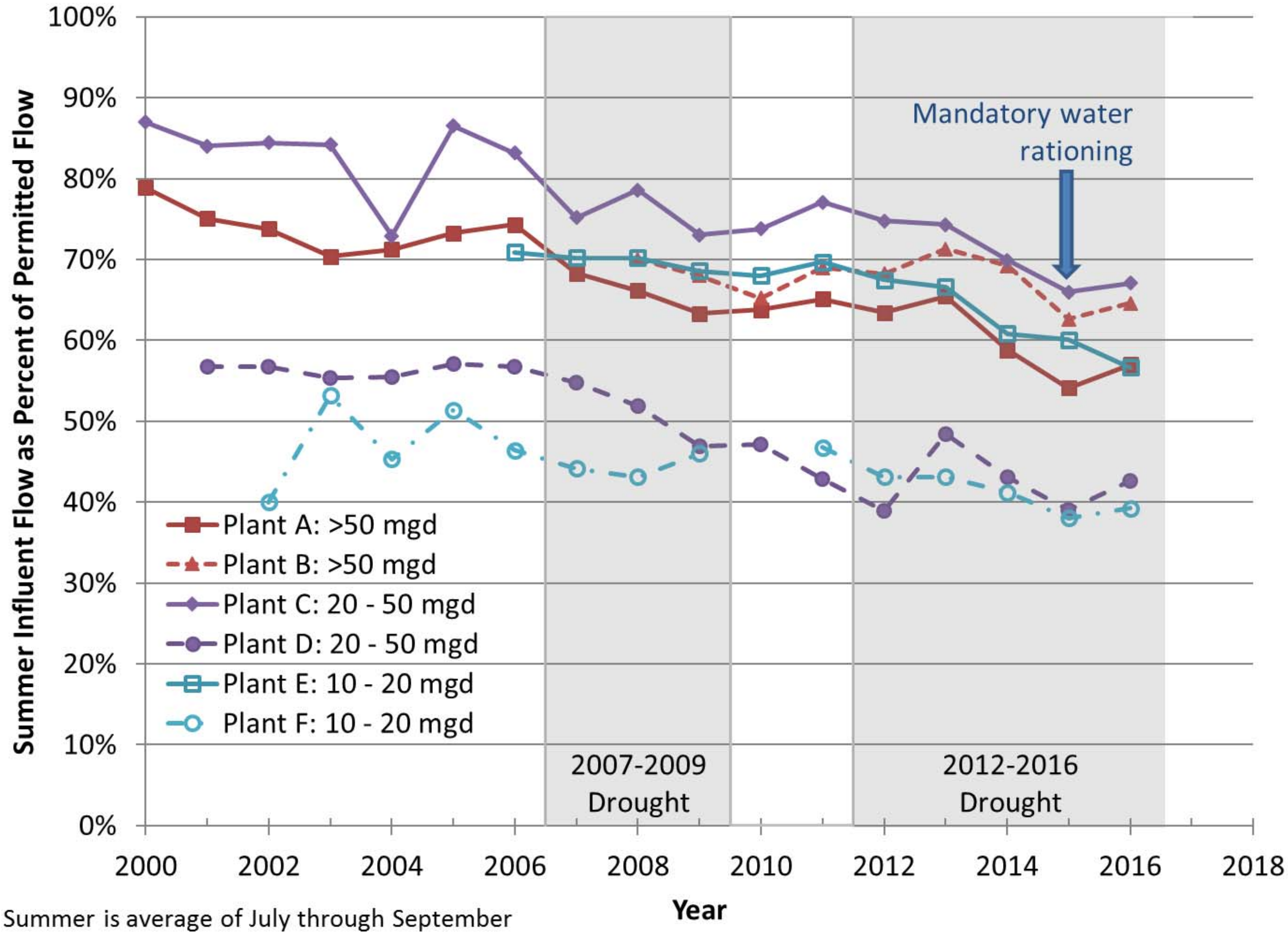

Summer is average of July through September

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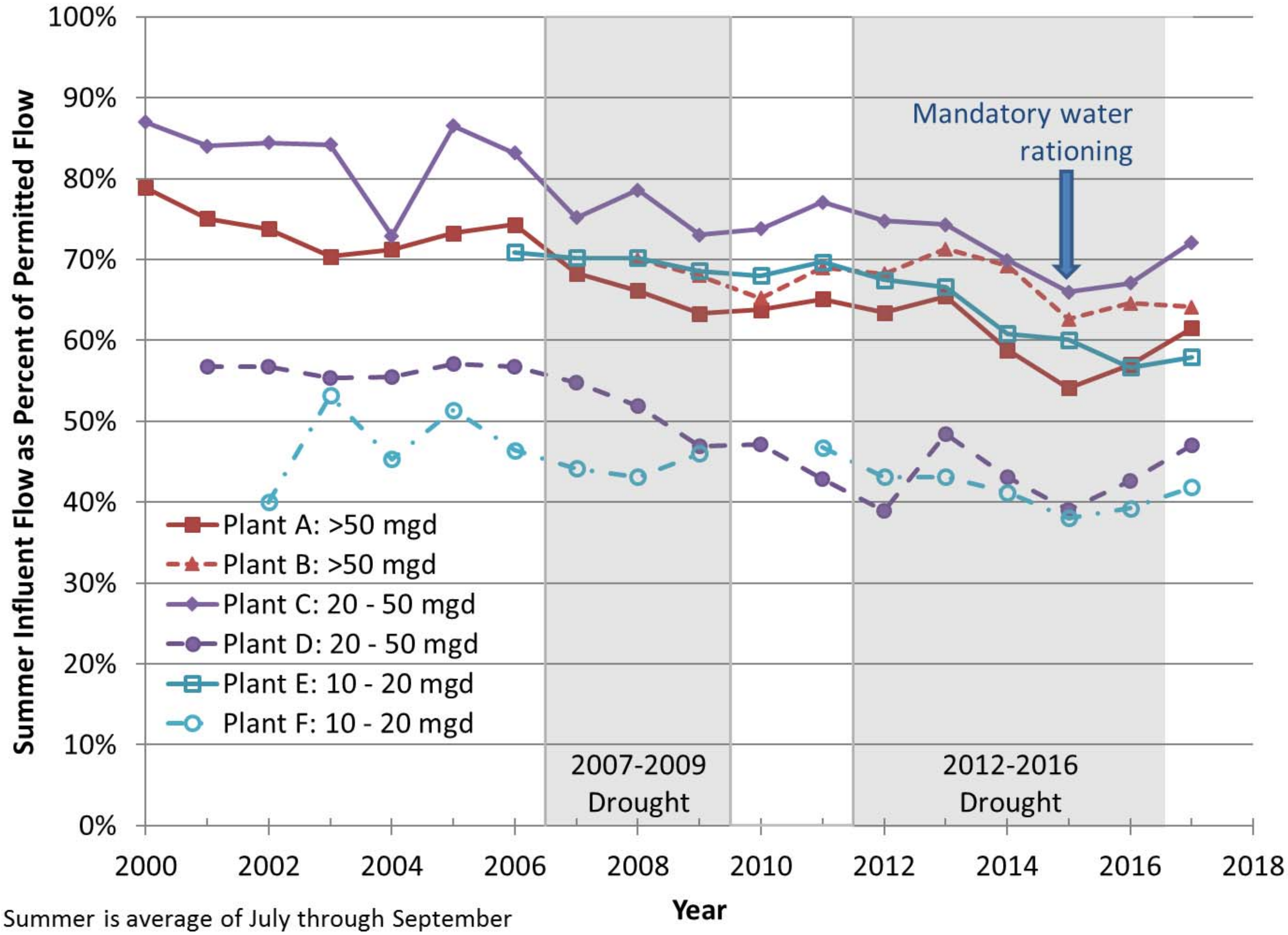

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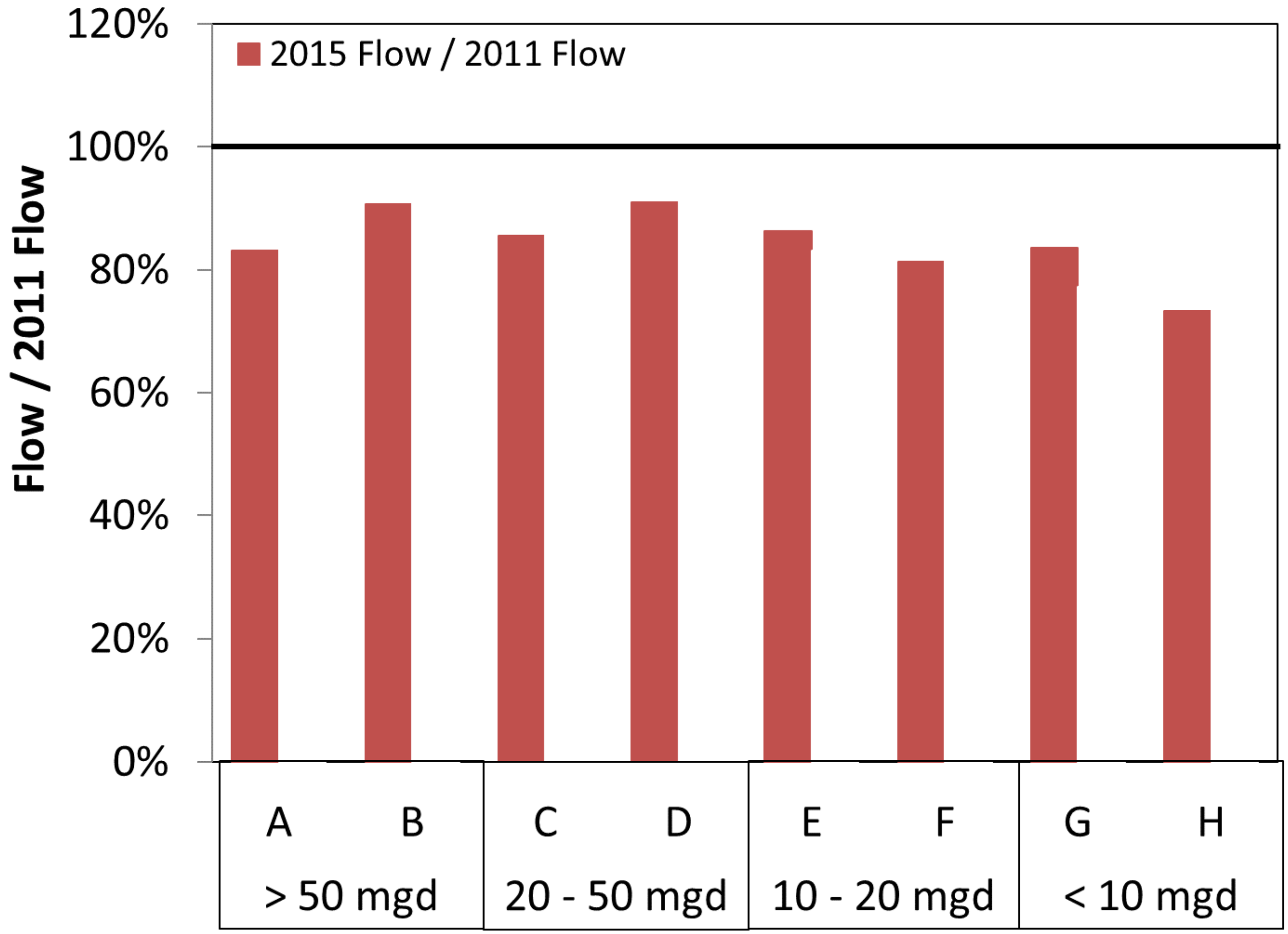
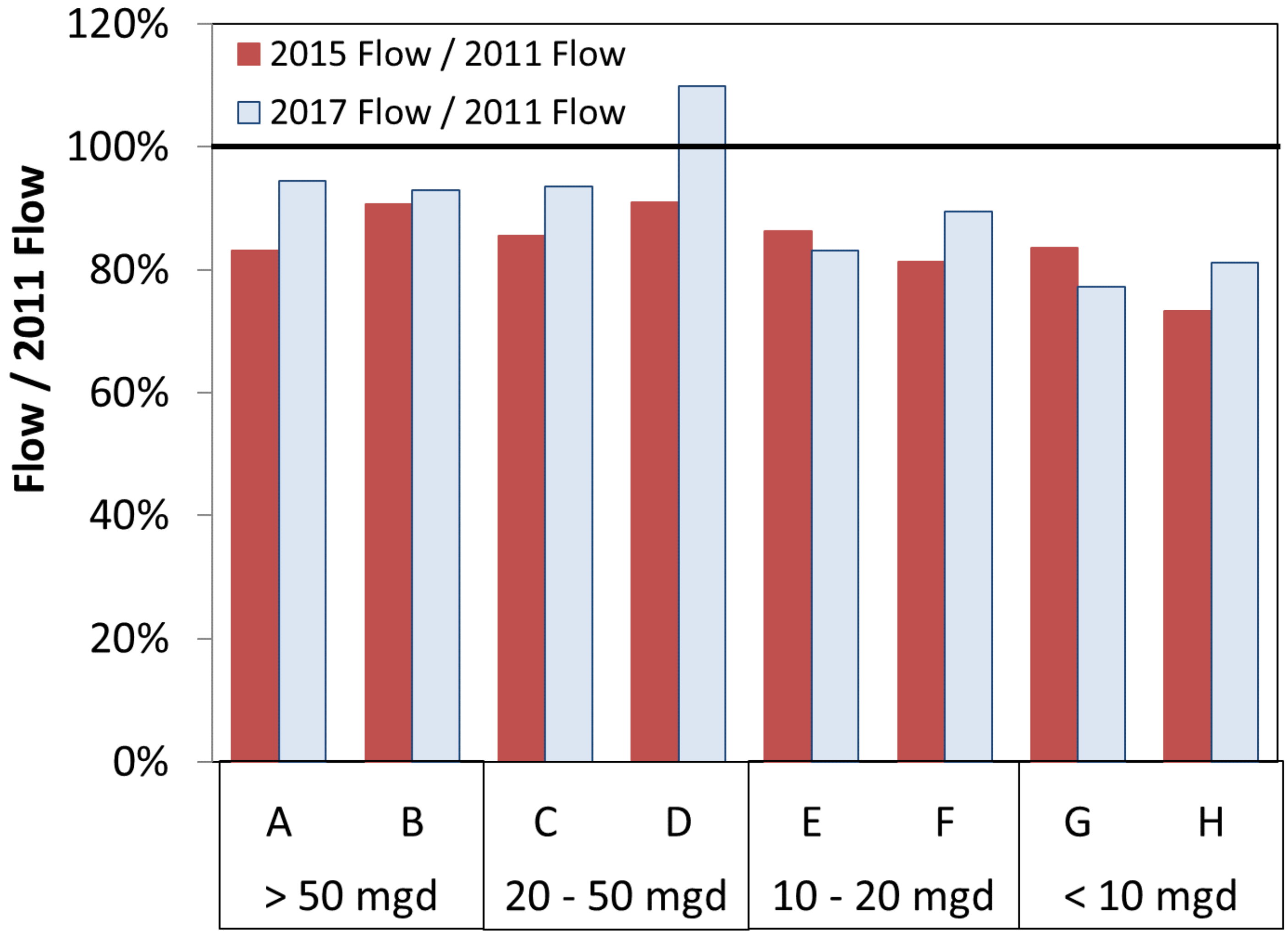


Letters indicate different plants. Flow range is permitted flow.
Ratios based on summer flow (average of July through September).

Water Conservation Results in Lower Wastewater Flows



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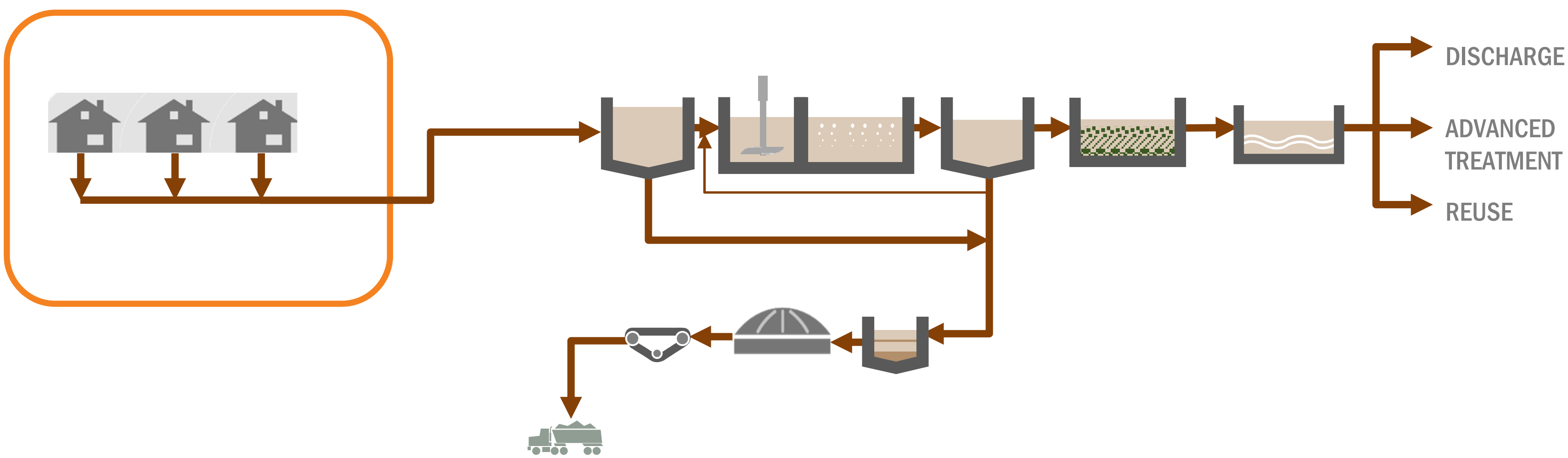
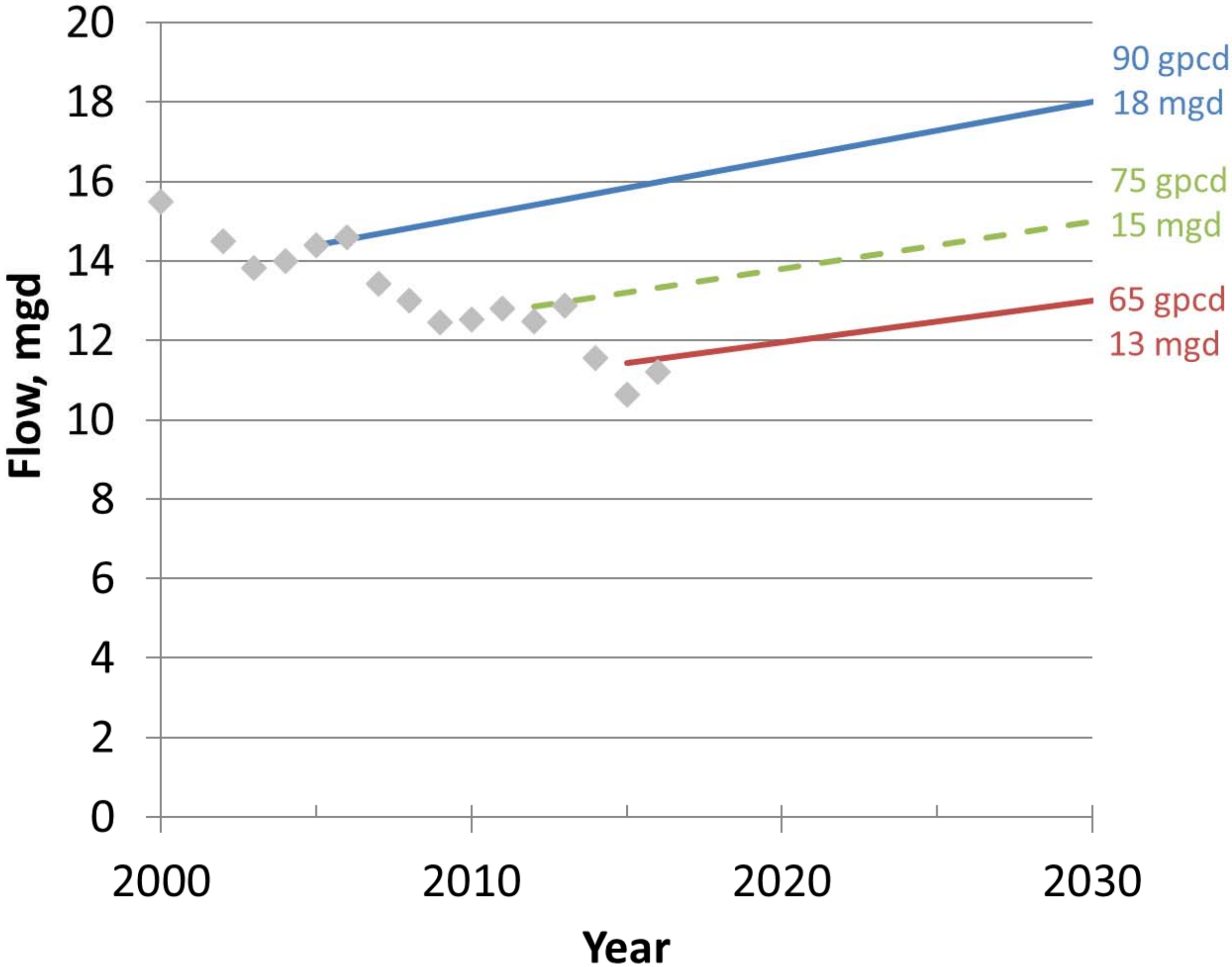
Ratios based on summer flow (average of July through September).

Flow Projections and Decreased Flows

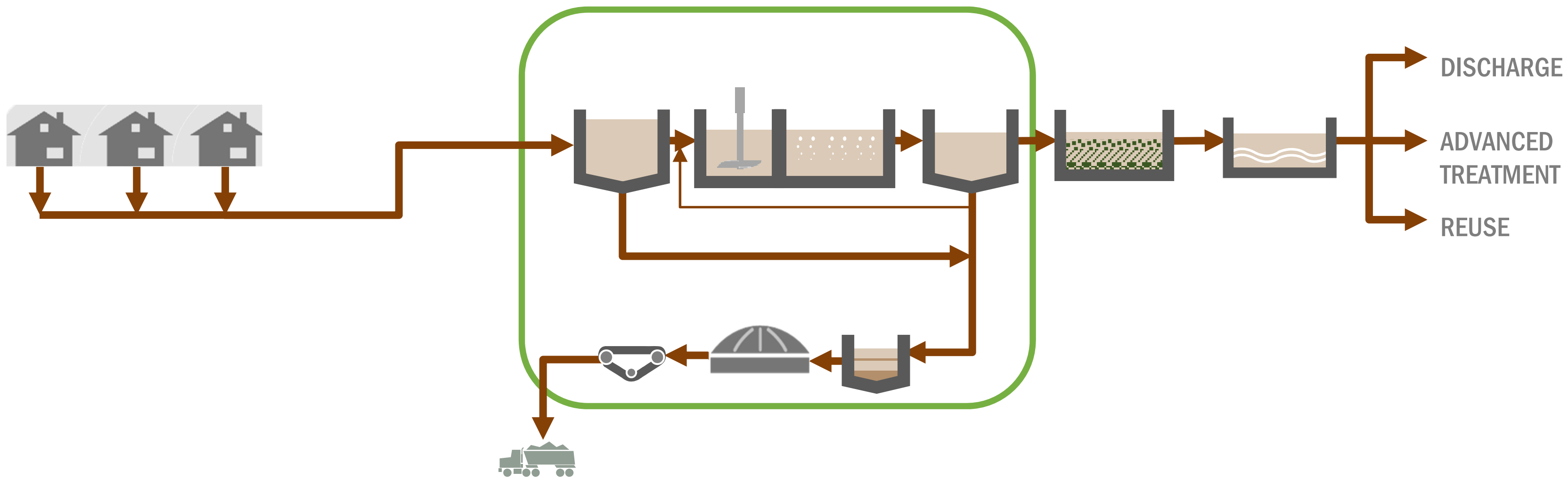
- Often developed with collection system planning
- Biggest concern is conveying peak flows



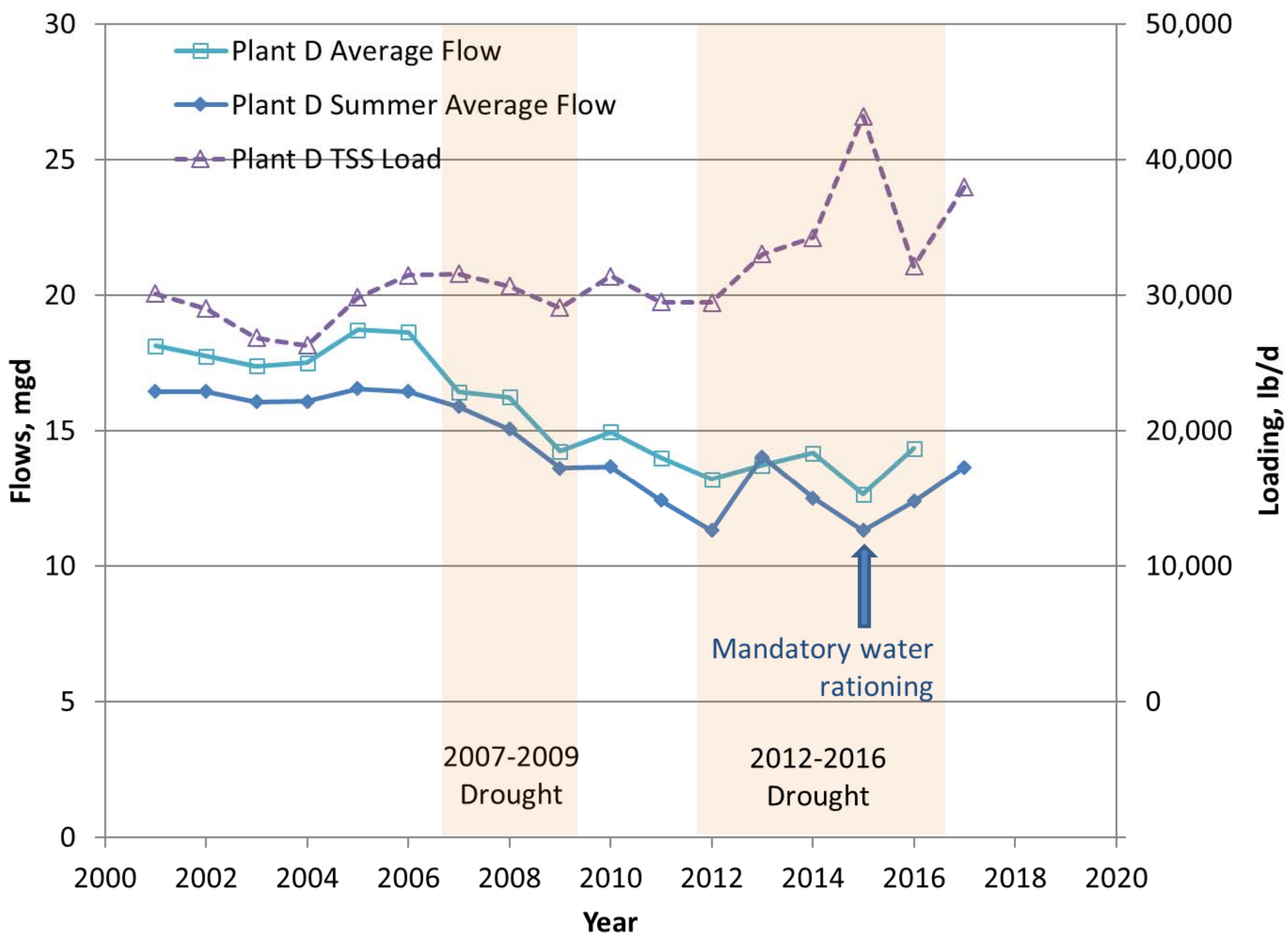
Flow Projections Conservatively High



Treatment Process Loading Capacity



Loadings Have Increased at Some Plants



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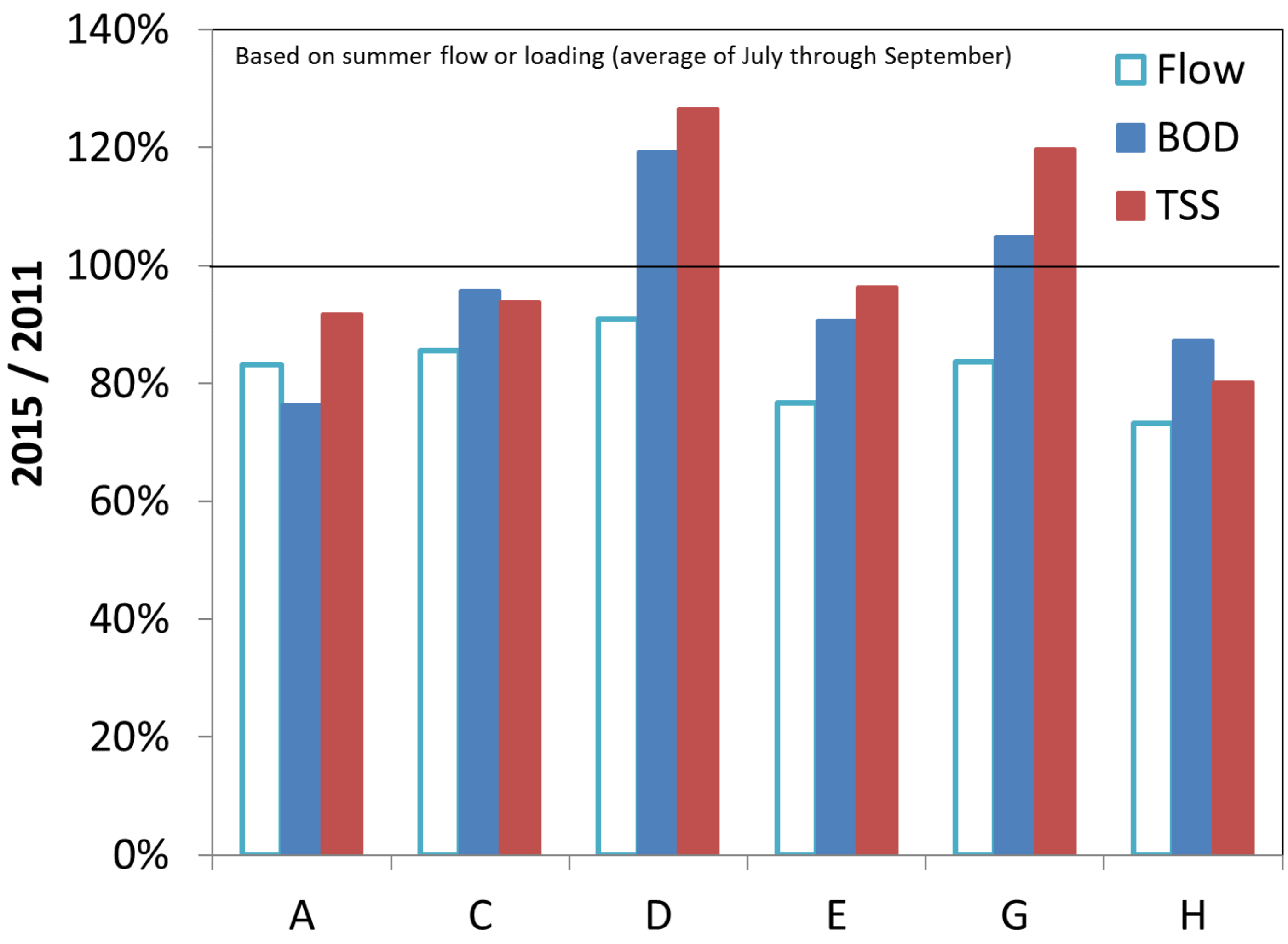
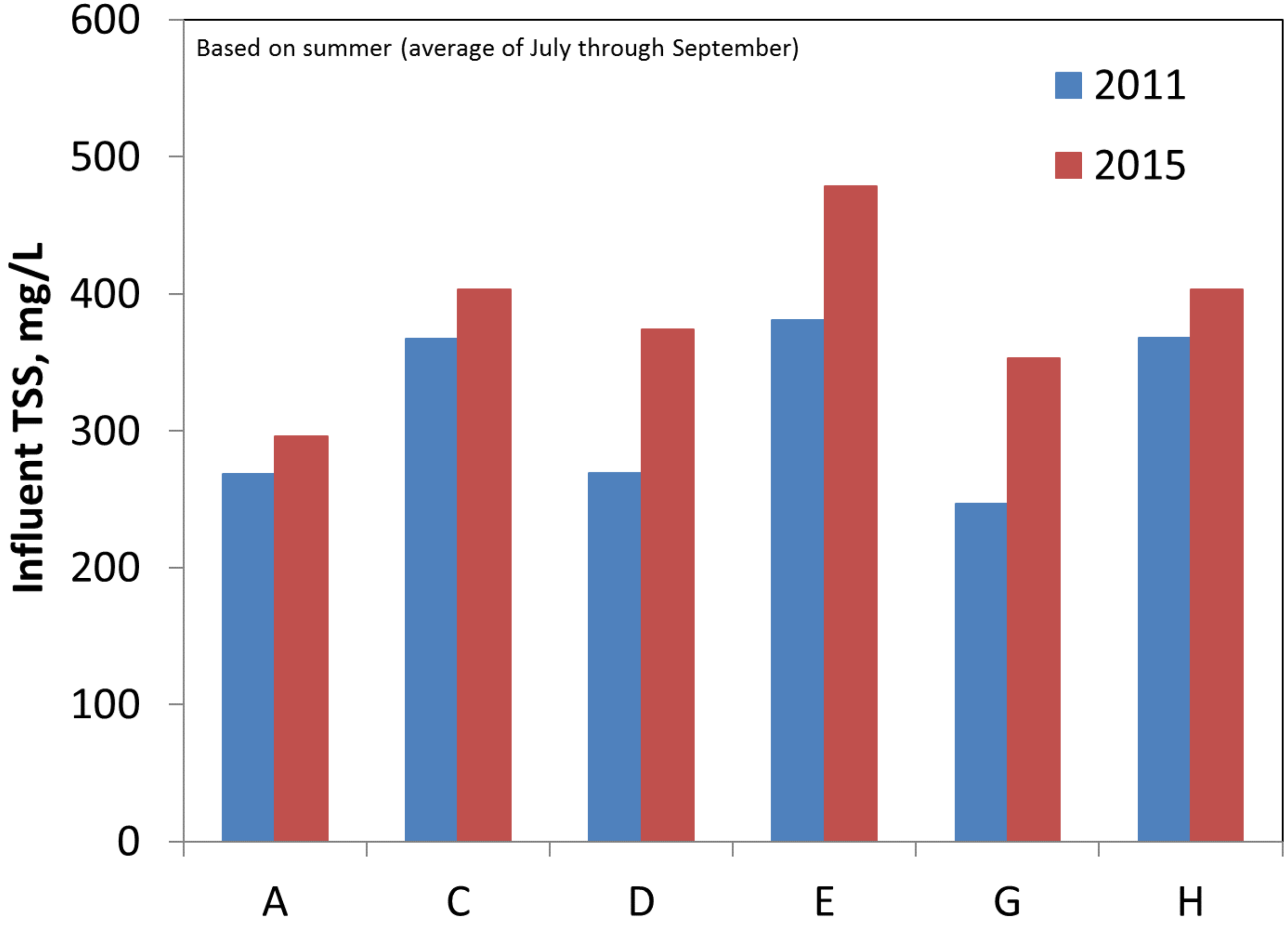
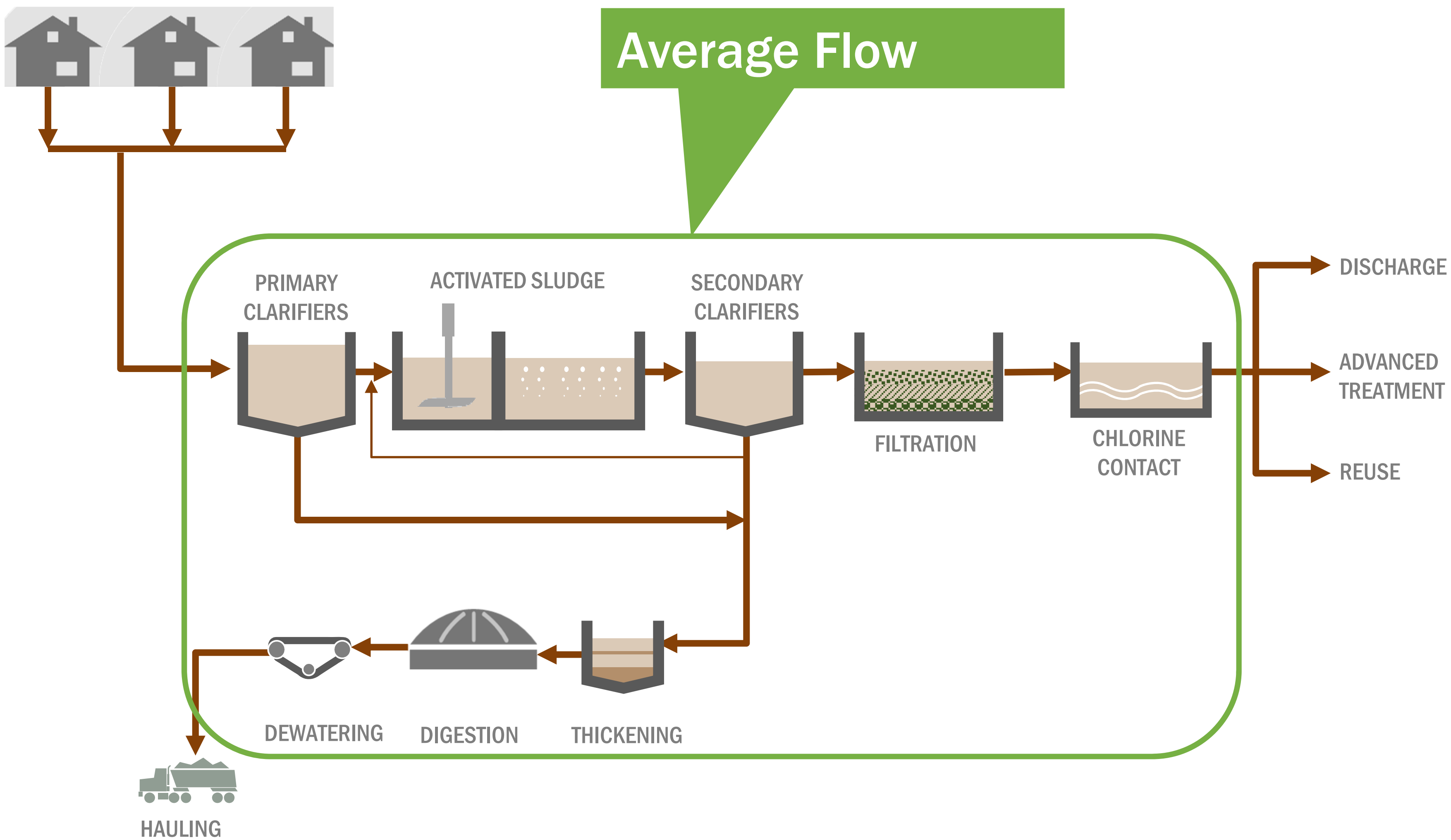


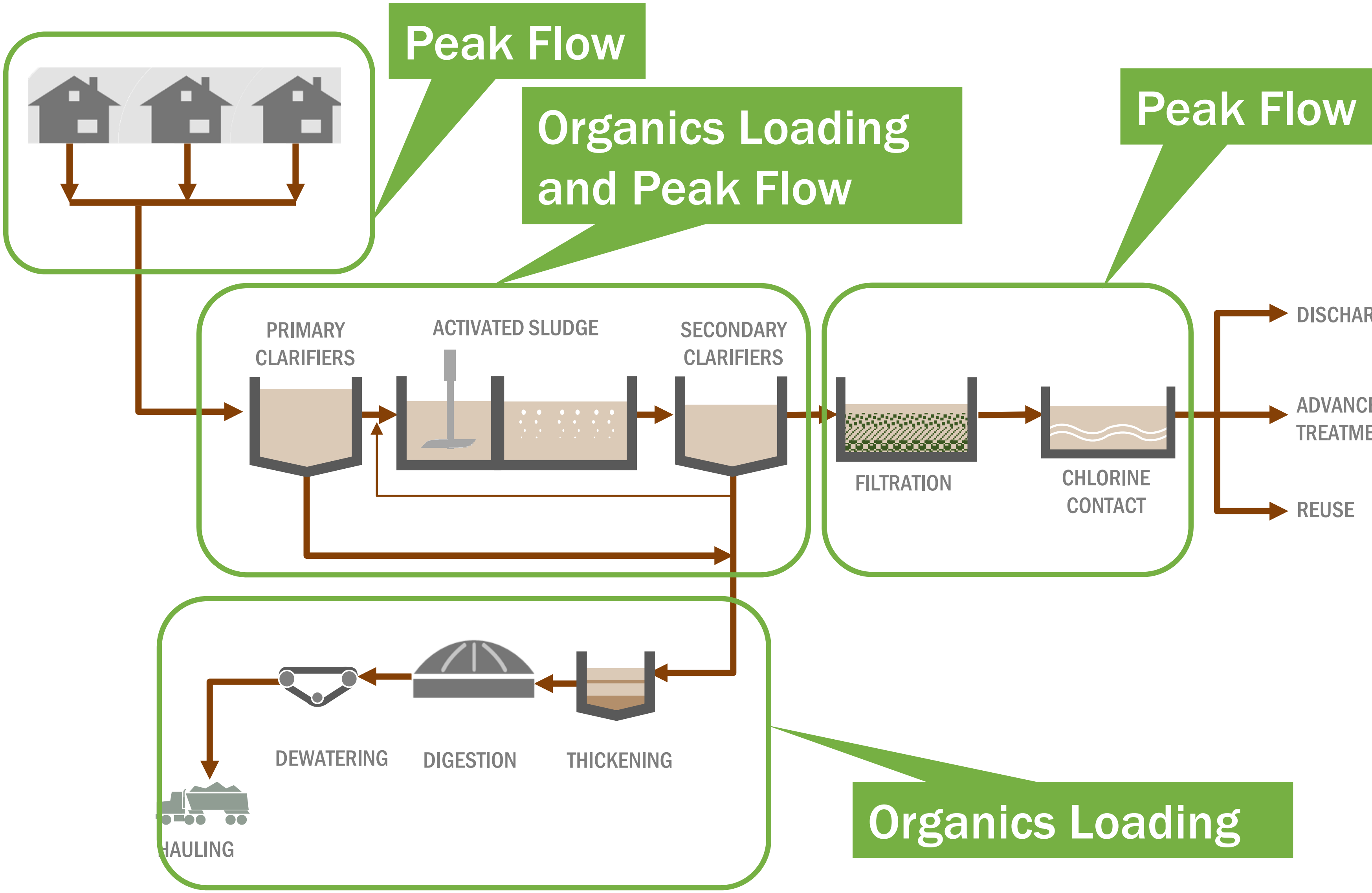
Influent Concentrations Have Increased



Average Flow is Typically Used to Rate Capacity



What Really Limits Plant Capacity?



Example of Plant Capacity Change

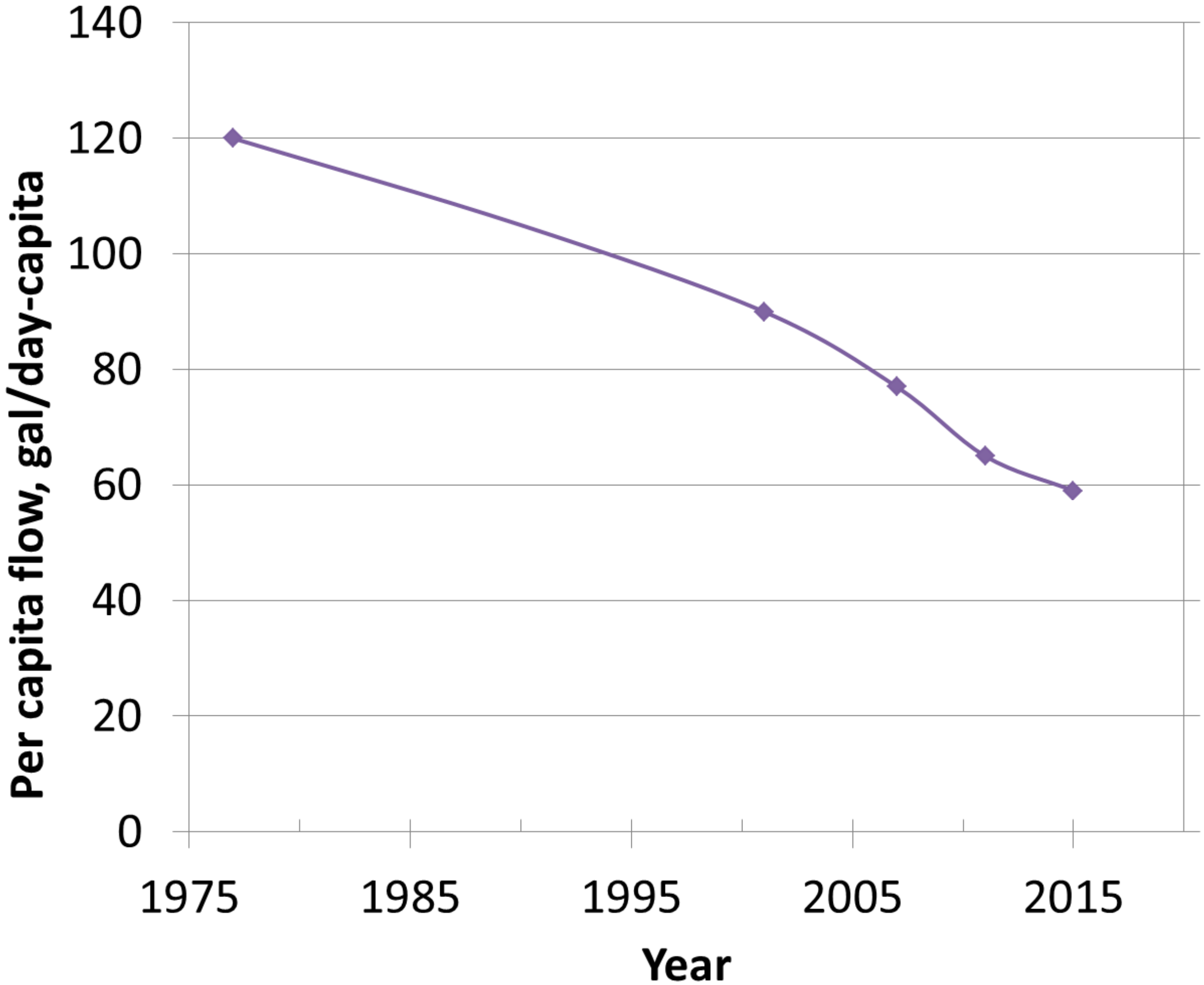
Plant designed in the 1970s:

12 mgd at 120 gal/capita-day

20,000 lb BOD/day at 0.2 lb BOD/capita-day

Population: 100,000

Per Capita Flows Have Decreased



Loading Capacity Exceeded at Design Flow

Treating design flow in 2015:

12 mgd at ~~120~~ 60 gal/capita-day

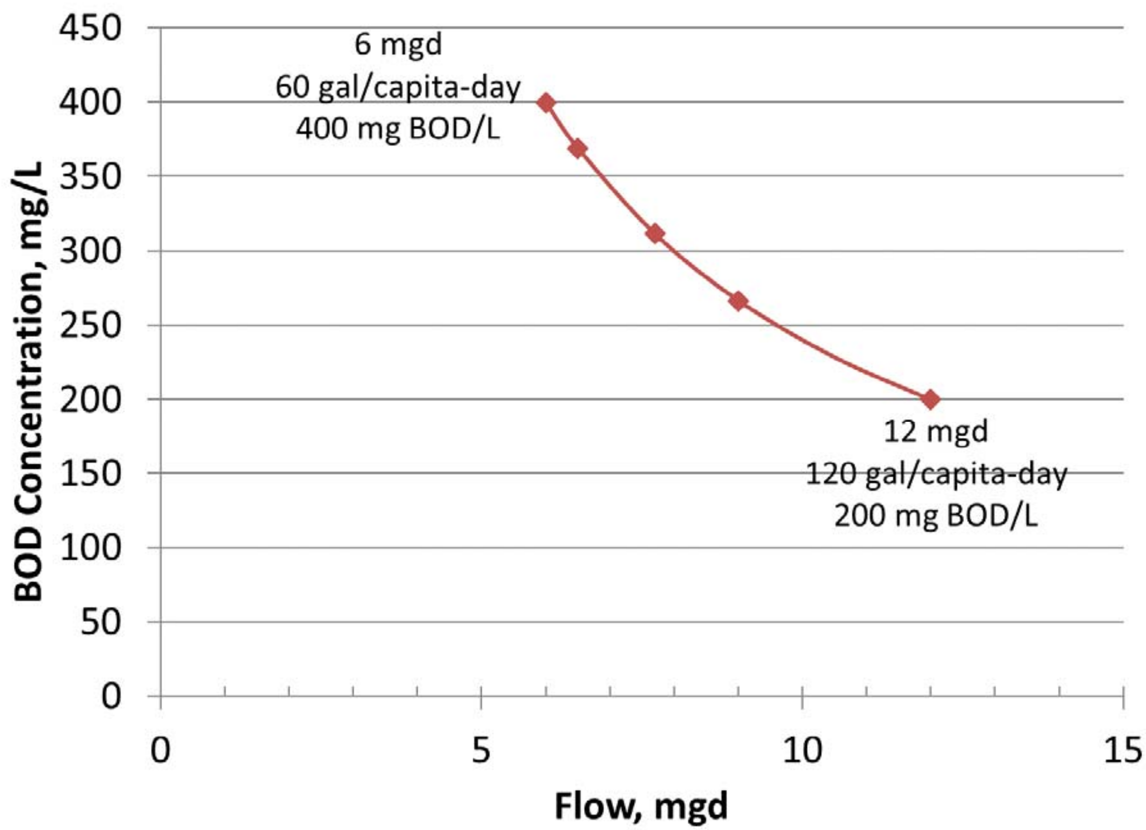
~~20,000~~ 40,000 lb BOD/day at 0.2 lb BOD/capita-day

Population: ~~100,000~~ 200,000

Flow Capacity Reduced at Design Loading

Treating design loading and population in 2015:

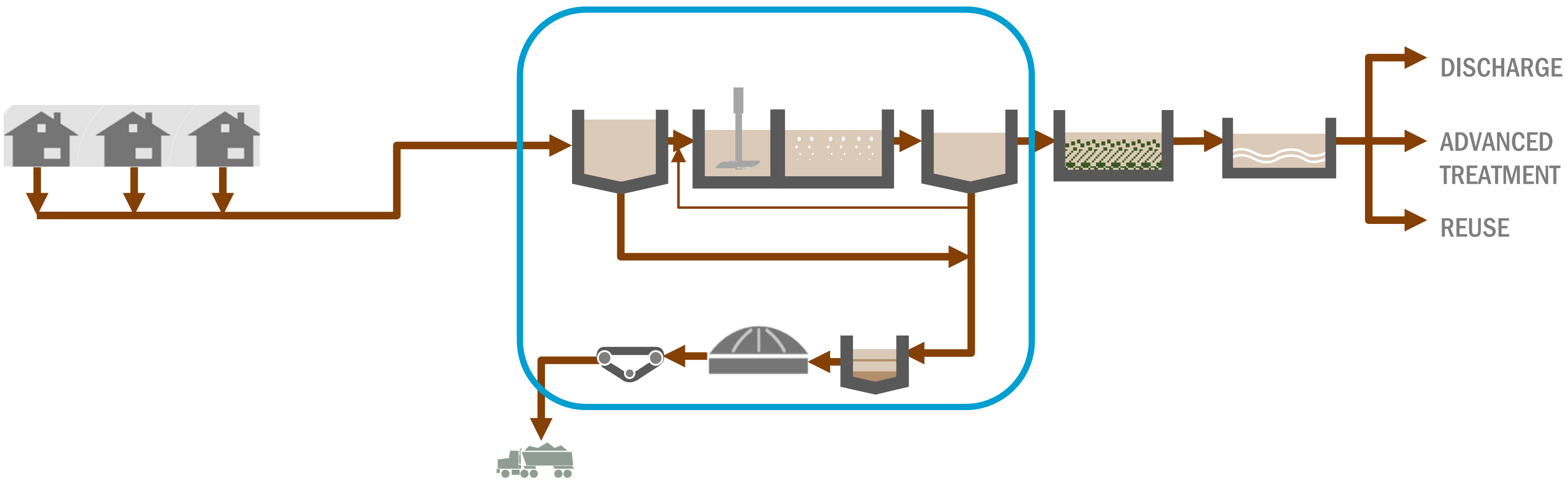
~~12 mgd~~ 6 mgd at ~~120~~ 60 gal/capita-day



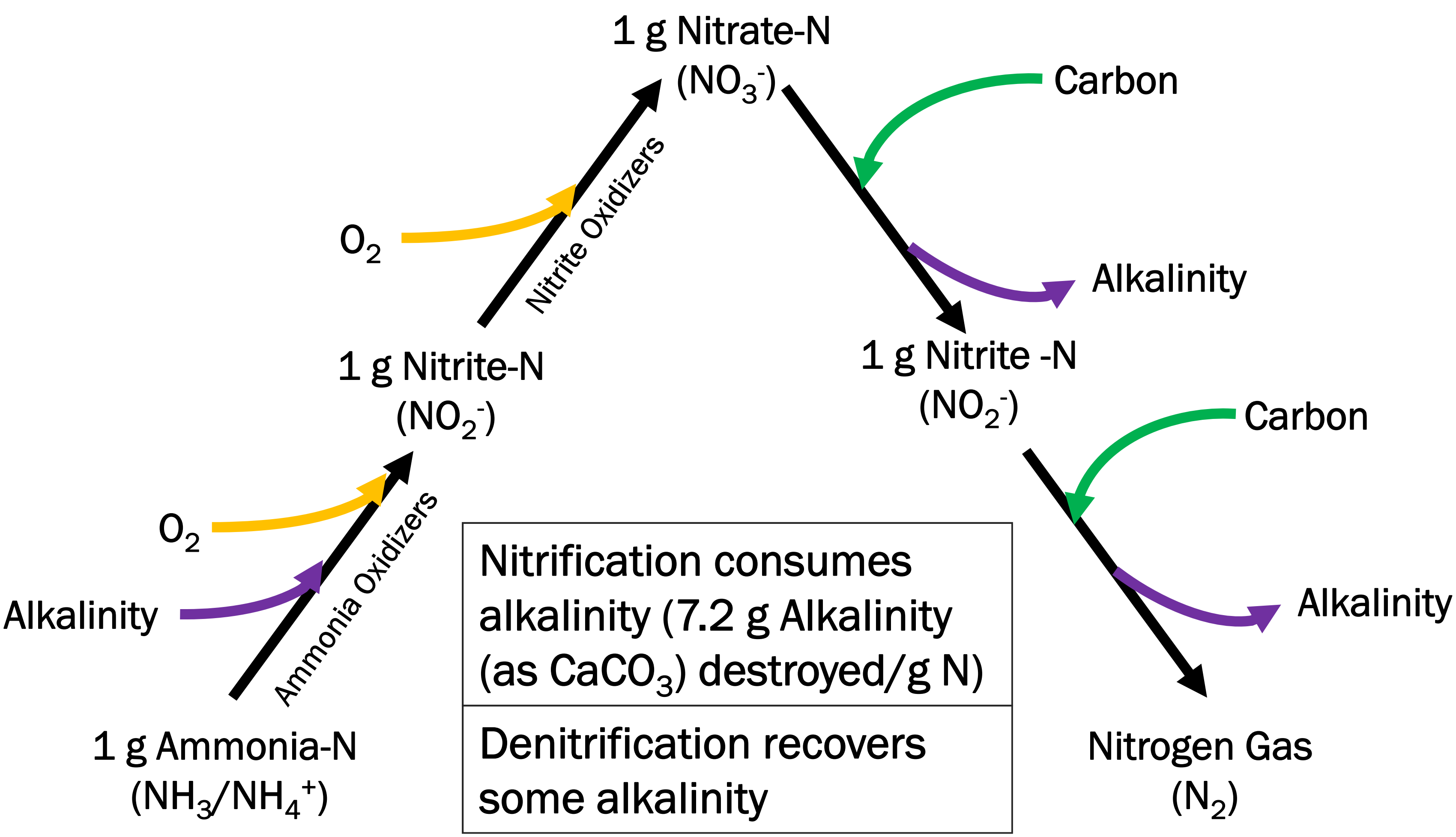
Flow and Capacity

- Loading is key to capacity
- Equivalent flow capacity now is probably less than it used to be
- Less flow does NOT mean spare capacity

Alkalinity Limitations



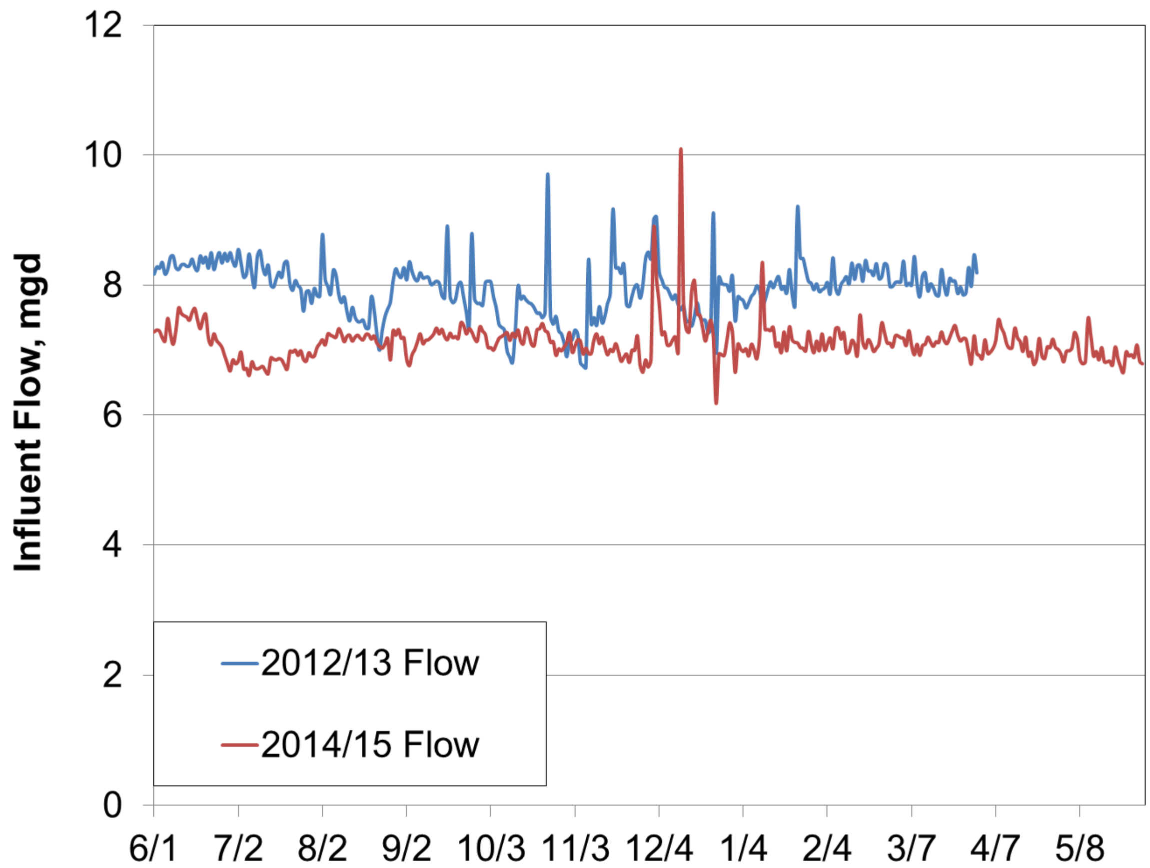
Alkalinity is needed for nitrification



Nitrification consumes alkalinity (7.2 g Alkalinity (as $CaCO_3$) destroyed/g N)
Denitrification recovers some alkalinity

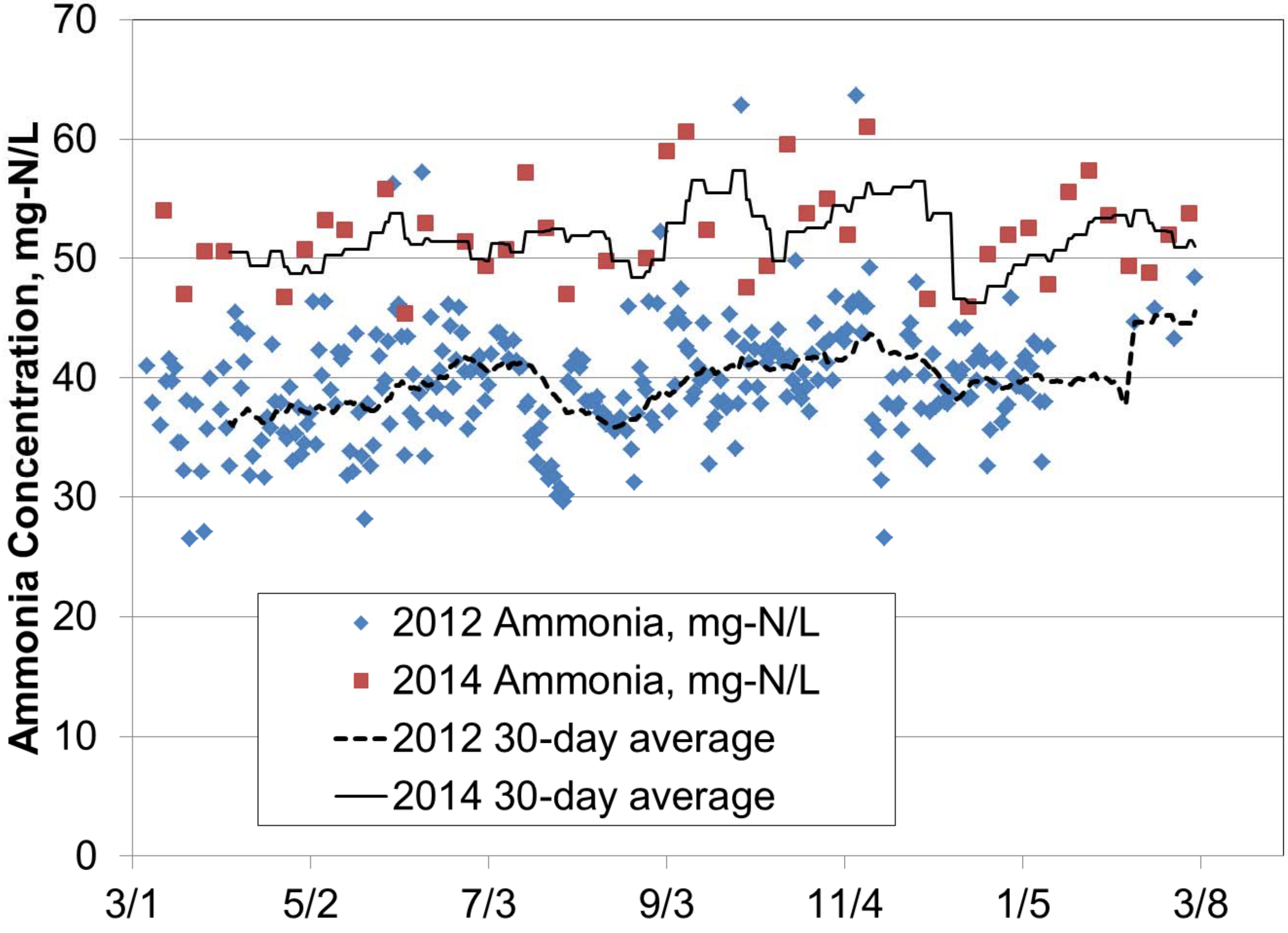
Case Study – El Estero Plant in Santa Barbara

- Process includes primary clarifiers and activated sludge
- Flow decreased 12%
- Converting to nitrification

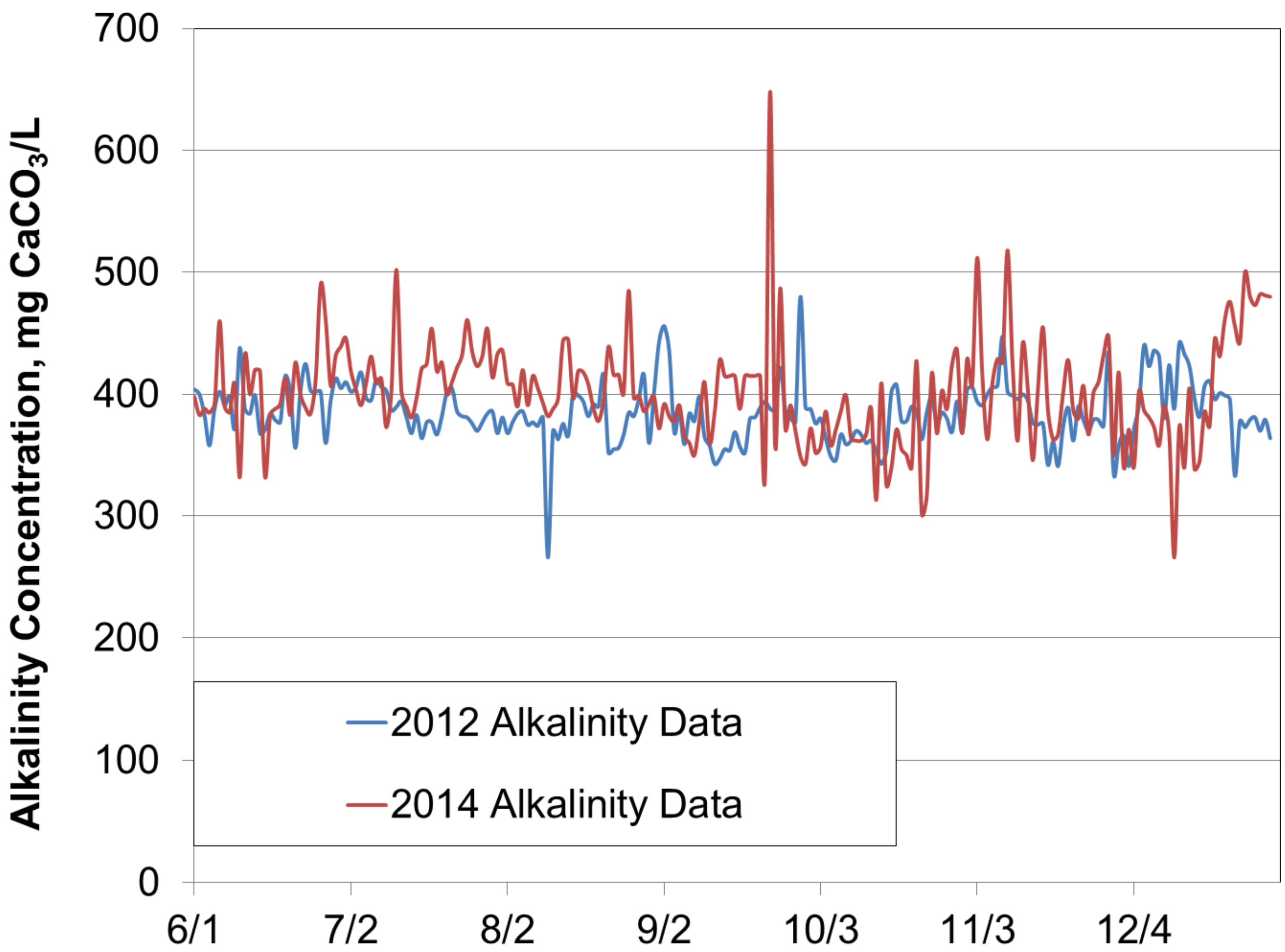


Reference: Sawyer et al, "Planning for Future Droughts – Lessons Learned at Water Resource Recovery Facilities, WEFTEC 2016,

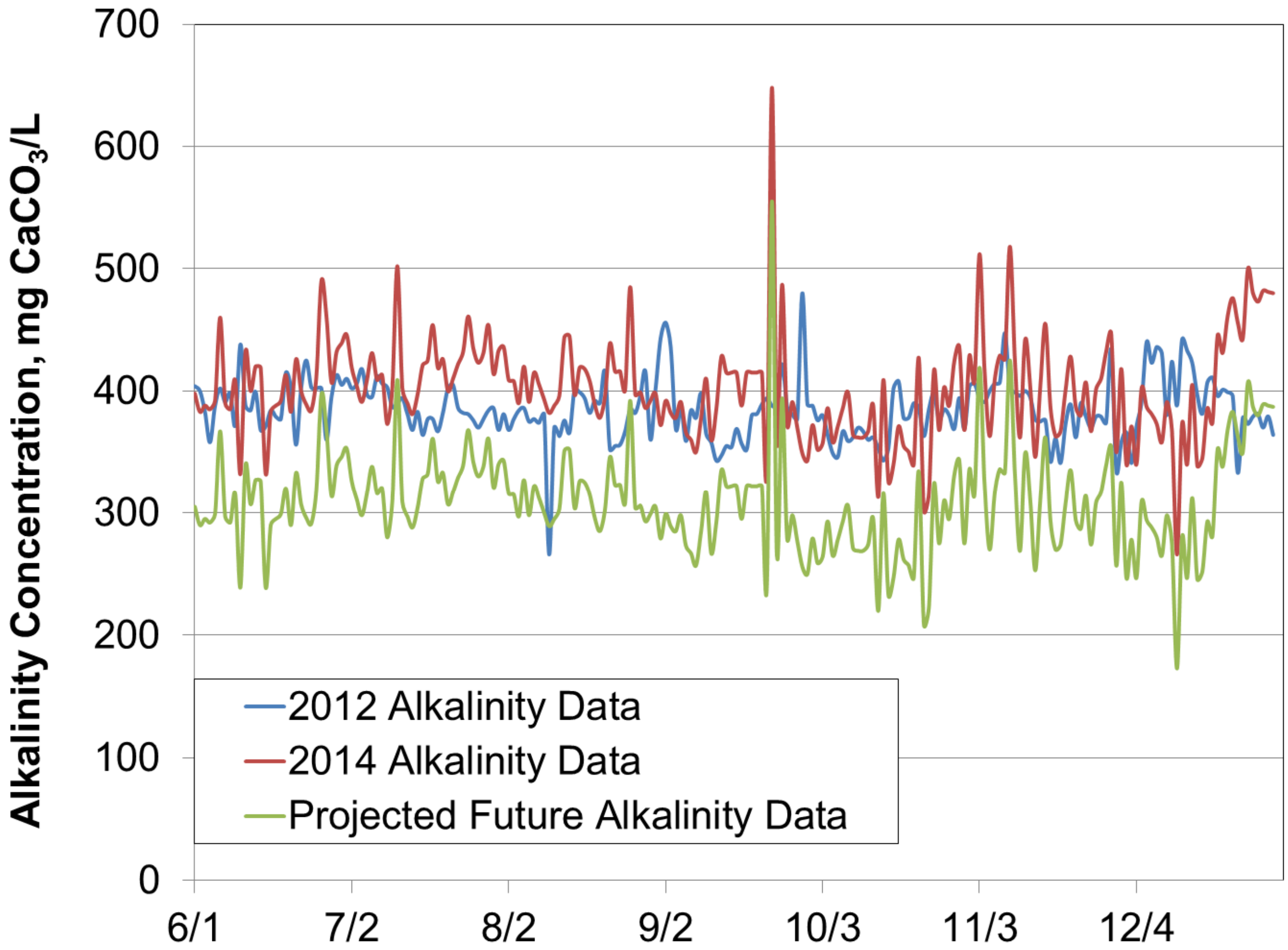
El Estero Influent Ammonia Increased 35%



Alkalinity Concentration Only Increased 6%



Changes in Potable Water Source May Exacerbate the Problem

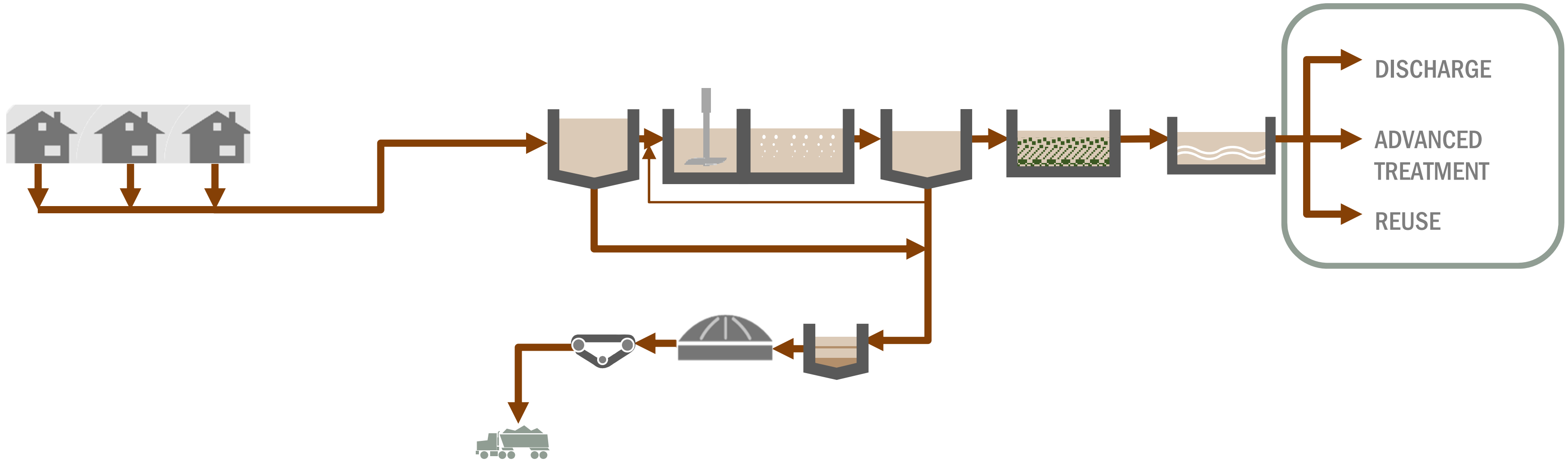


Alkalinity Supplementation Needed

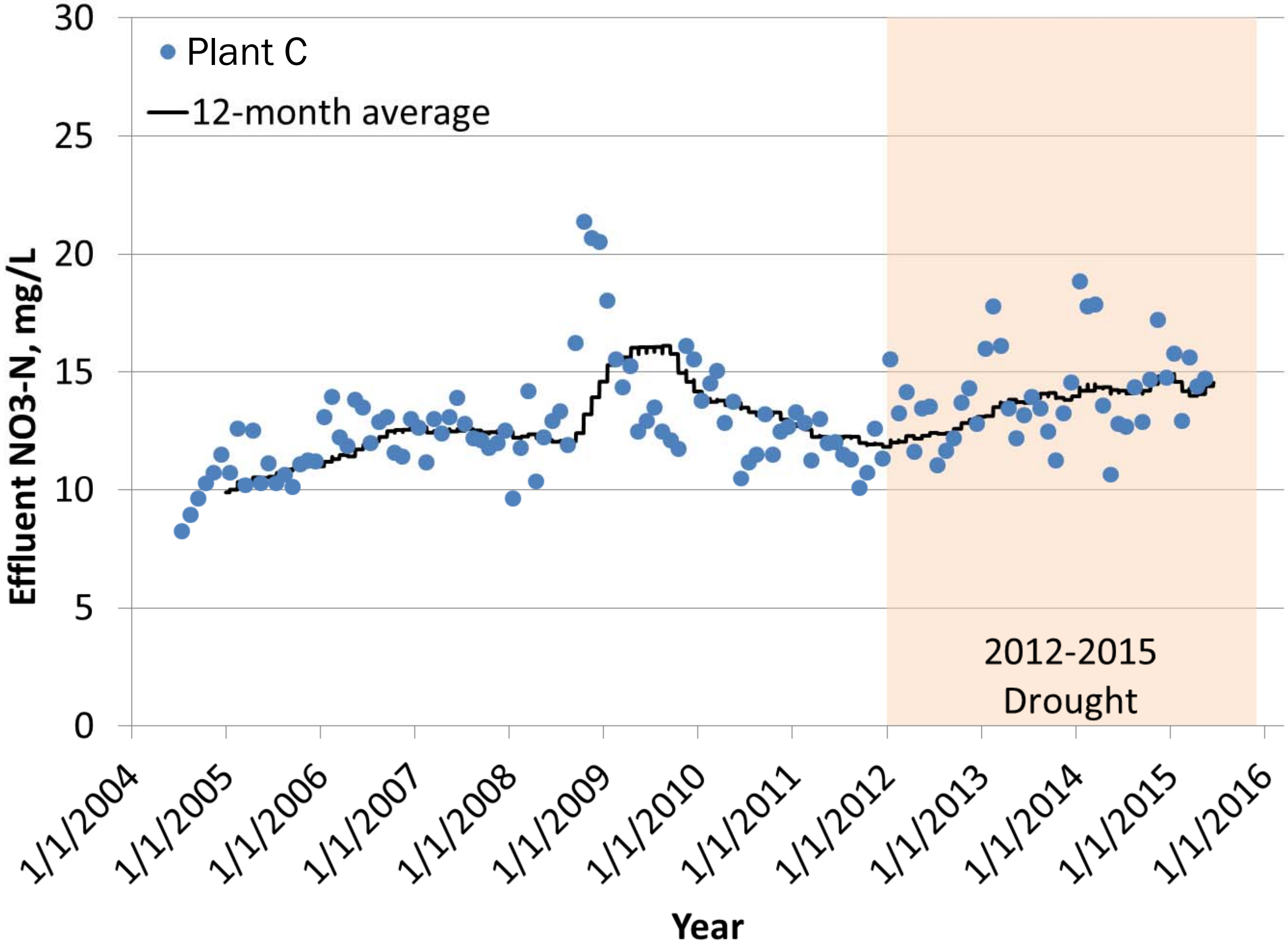
	2012	2014	Projected with desalination
Average alkalinity, mg $CaCO_3$/L	385	402	309
Average Ammonia, mg N/L	39	52	52

- Before drought, alkalinity was sufficient
- Based on 2014 data, alkalinity supplementation was needed
- Source water changes can exacerbate the problem
- Monitor alkalinity and add chemical if needed

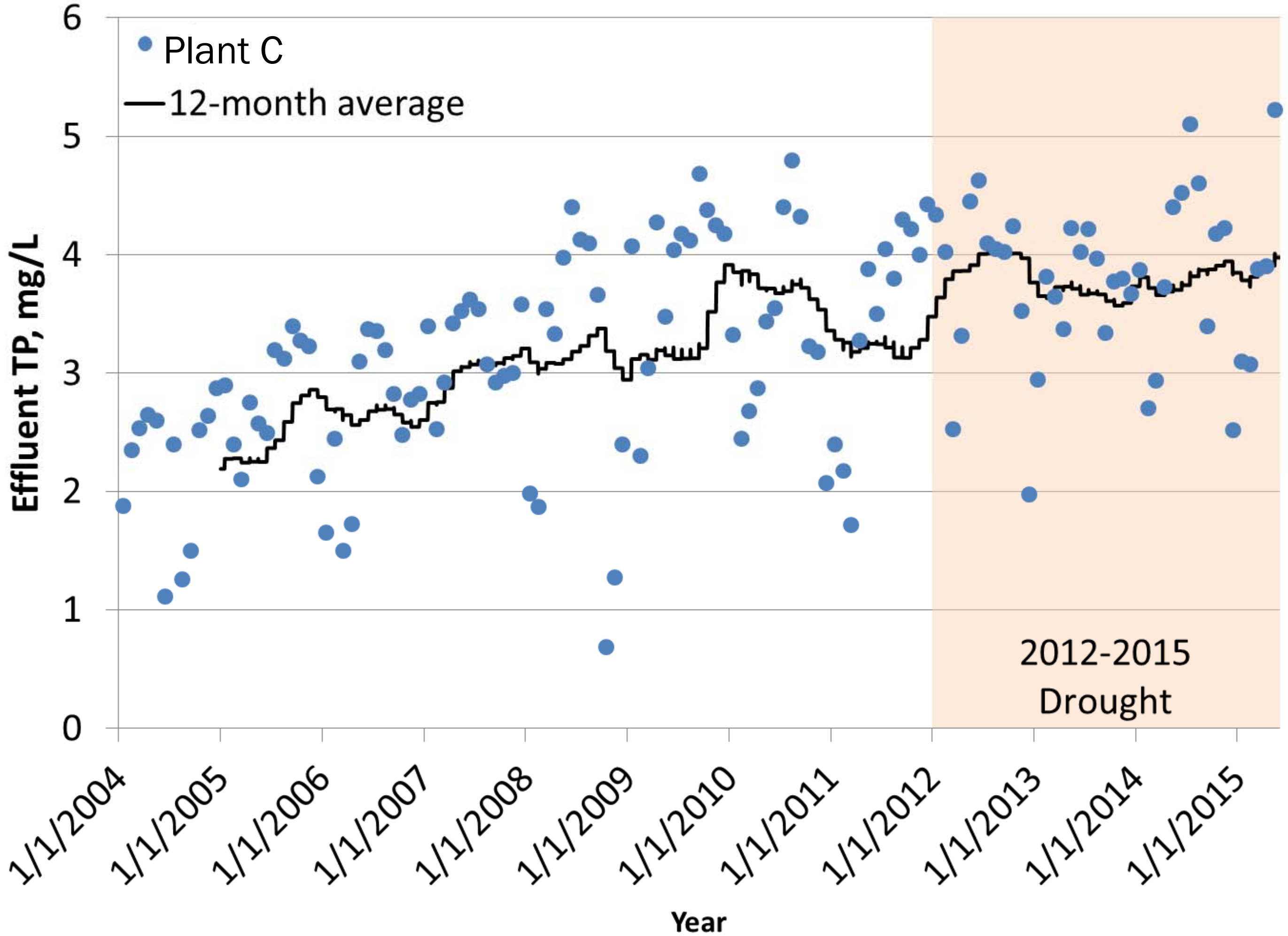
Effluent Quality



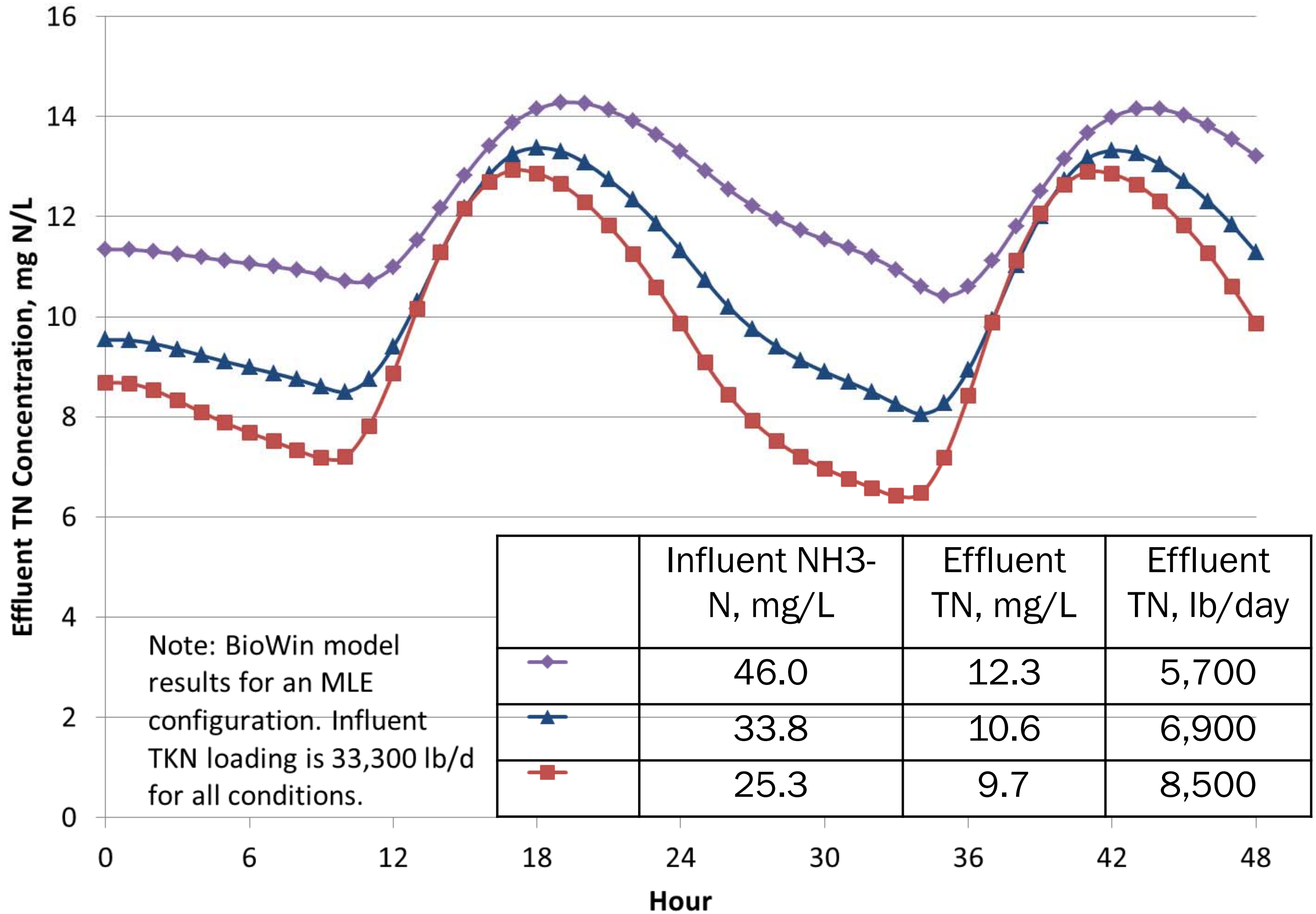
Plant C Effluent Nitrate has Increased



Plant C Effluent Phosphorus has Increased



Process Models Predict Nutrient Concentration Increases

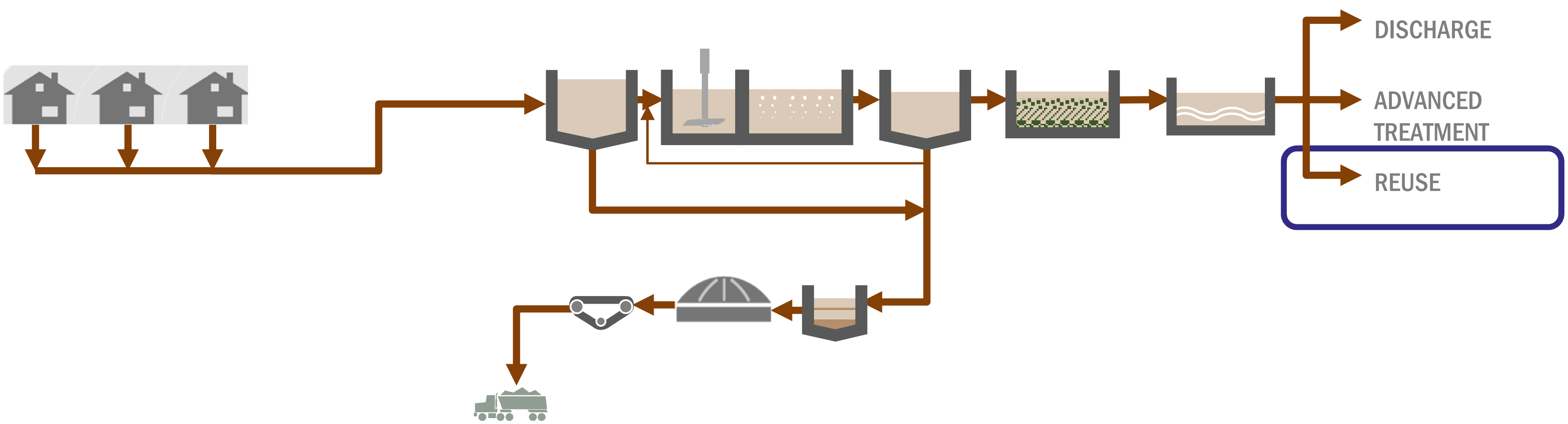


	Influent NH3-N, mg/L	Effluent TN, mg/L	Effluent TN, lb/day
◆	46.0	12.3	5,700
▲	33.8	10.6	6,900
■	25.3	9.7	8,500

Planning for Effluent Concentration Increases

- Additional chemicals or improved processes may be needed
- Consider loading-based limits instead of concentration-based limits in permit negotiation
  - Attractive if strict discharge limit, but expect reduced discharge flow due to recycling.

Recycled Water

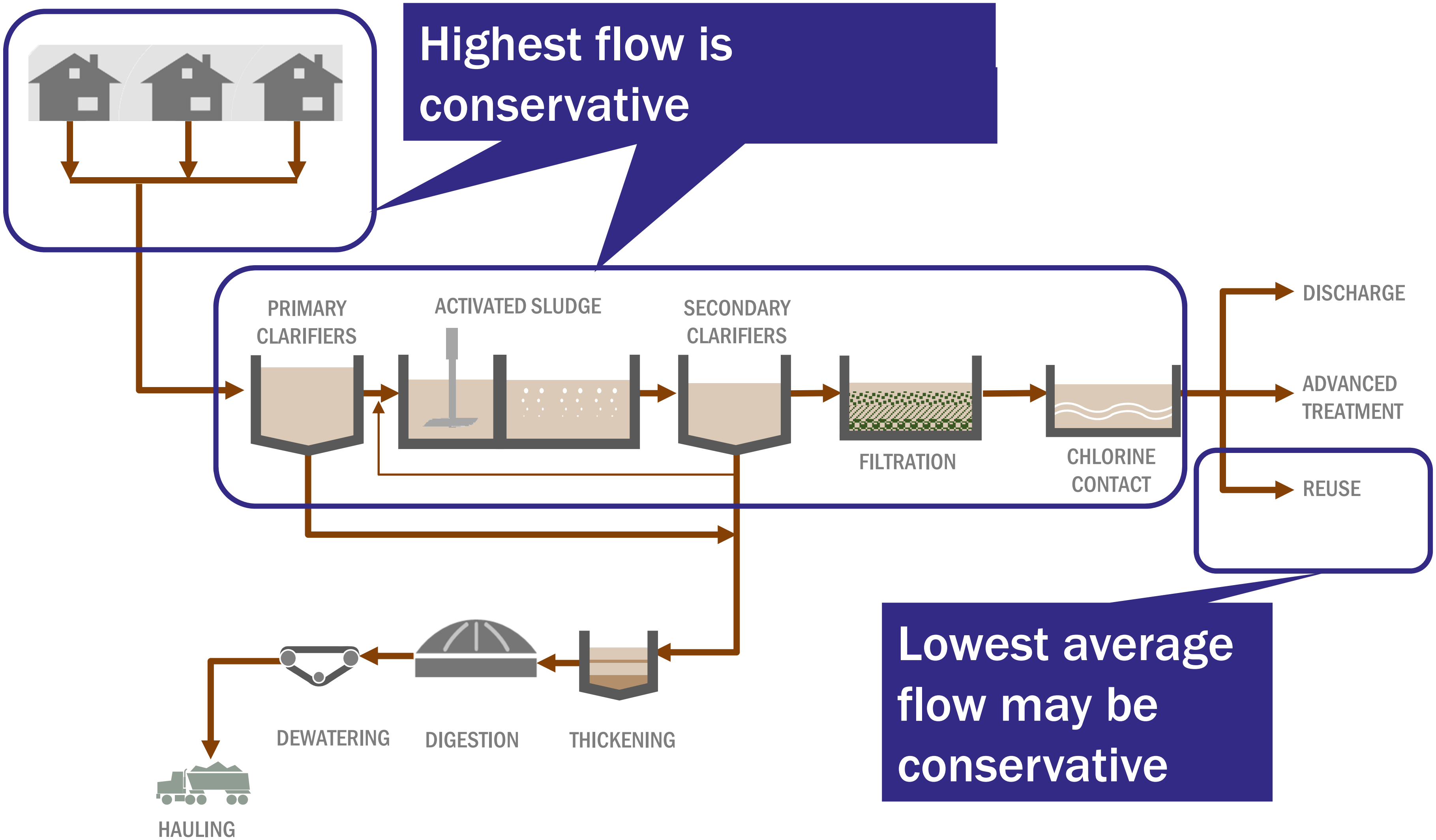


Less Water Available Due to Conservation

- Excess capacity (stranded assets)
- Insufficient water to meet demands
- Revenue impacts

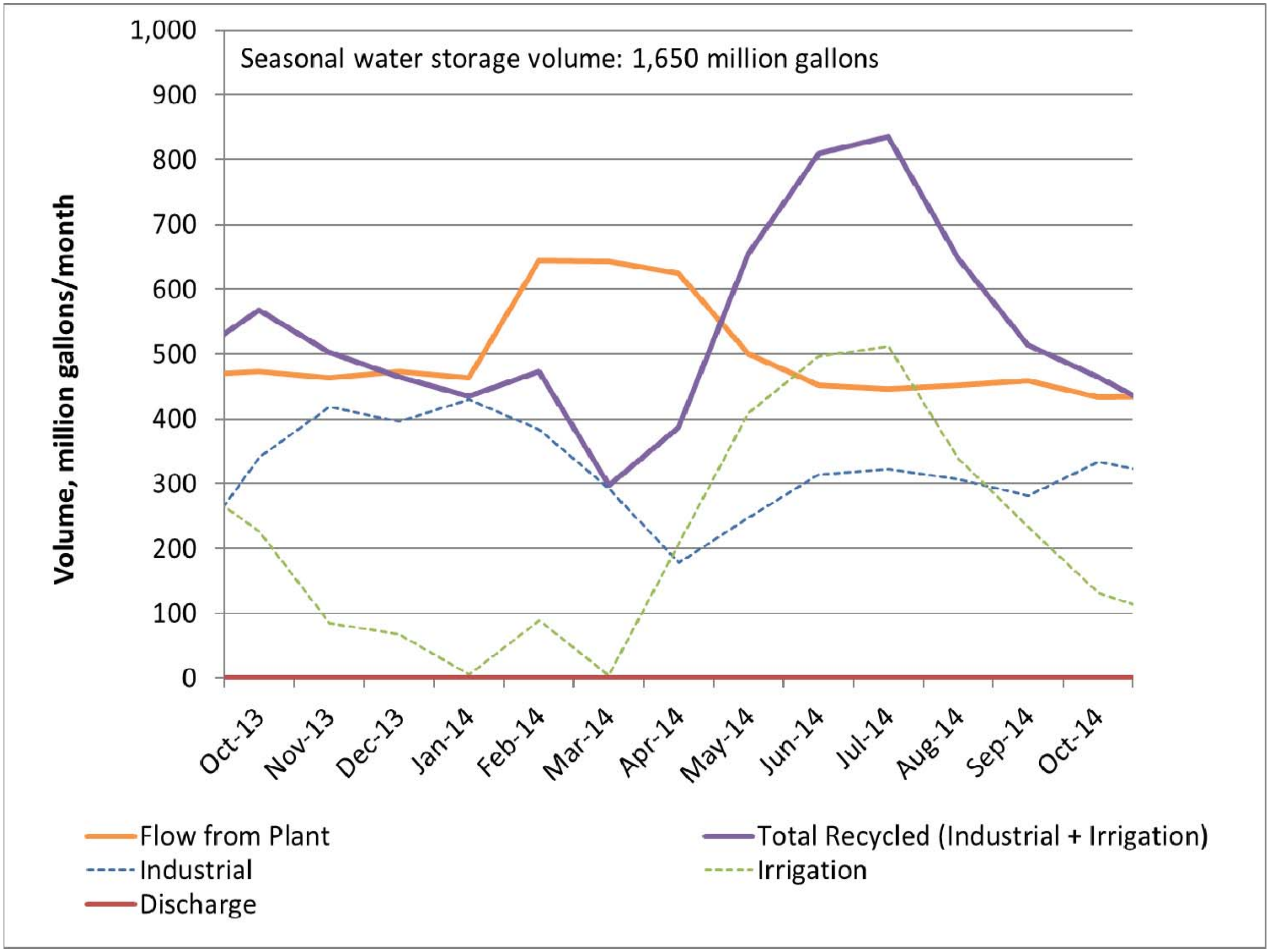
Planning Conservatism

Highest flow is conservative



Lowest average flow may be conservative

Complete Reuse is Challenging



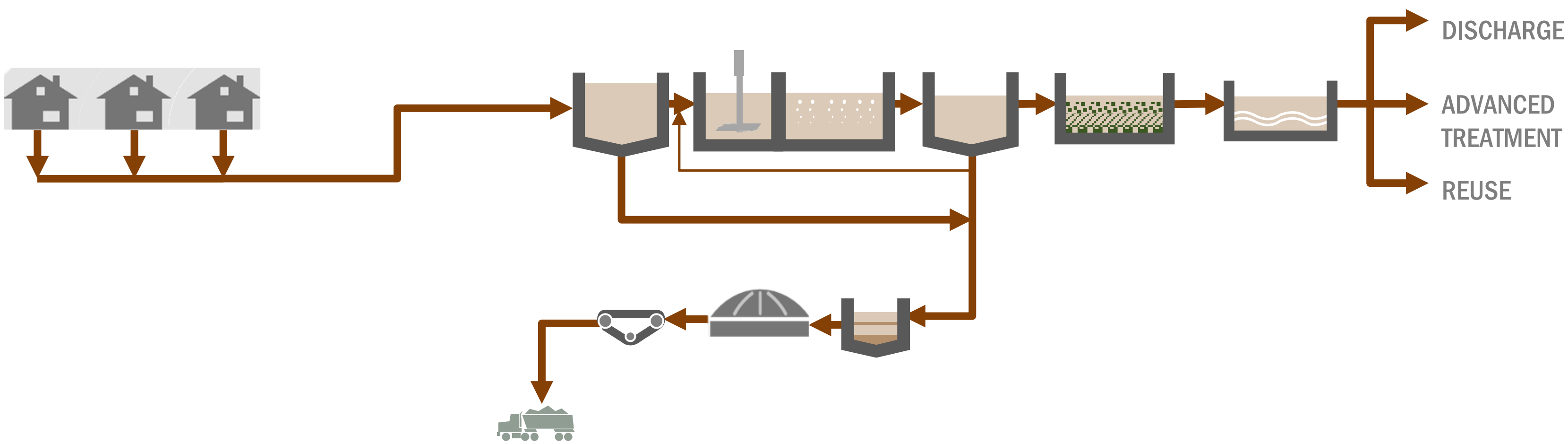
Recycled Water – Challenges

- Less water available for recycling
- Peak reuse demand is often in a different season and year than peak influent flow
- IPR and DPR demands are year-round, but brine disposal is required

Planning for Water Conservation

Planning for Future Water Conservation

- Expect less flow that is more concentrated
- Understand the conservatism of flow projections
- Less flow may not mean spare treatment capacity
- Anticipate possible alkalinity limitations
- Expect increased effluent concentrations
- Plan for variations in recycled water supply and demand



Thank You

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