Chlorine Kinetics Integration

Saving Time and Money for Reclaimed Water Applications

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Brown AND Caldwell

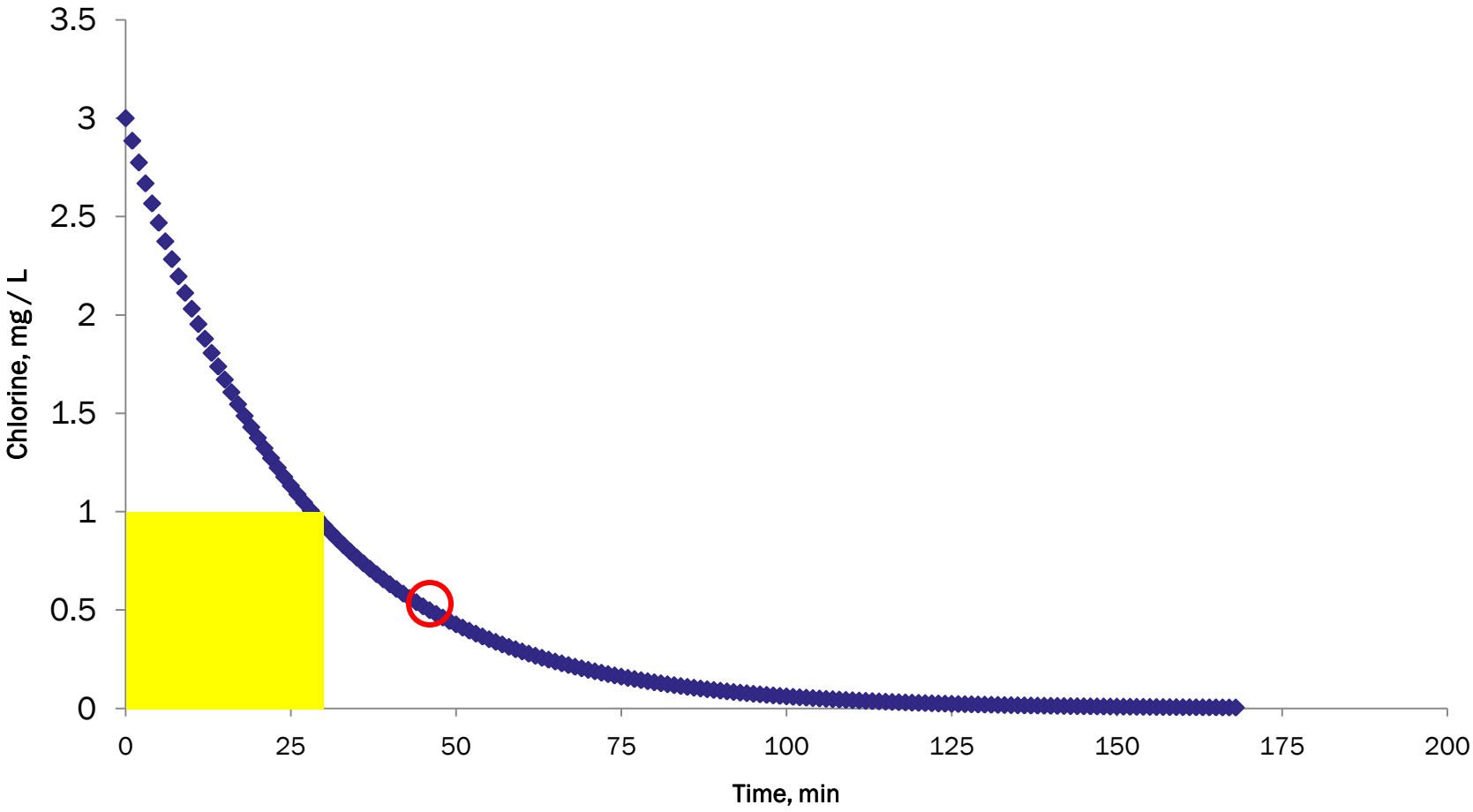
Presentation Outline

- Requirements for Class A reclaimed water
- Background on Lighthouse Point Treatment Plant
- Potential end users
- Reclaimed water systems
- Methods for calculating contact time

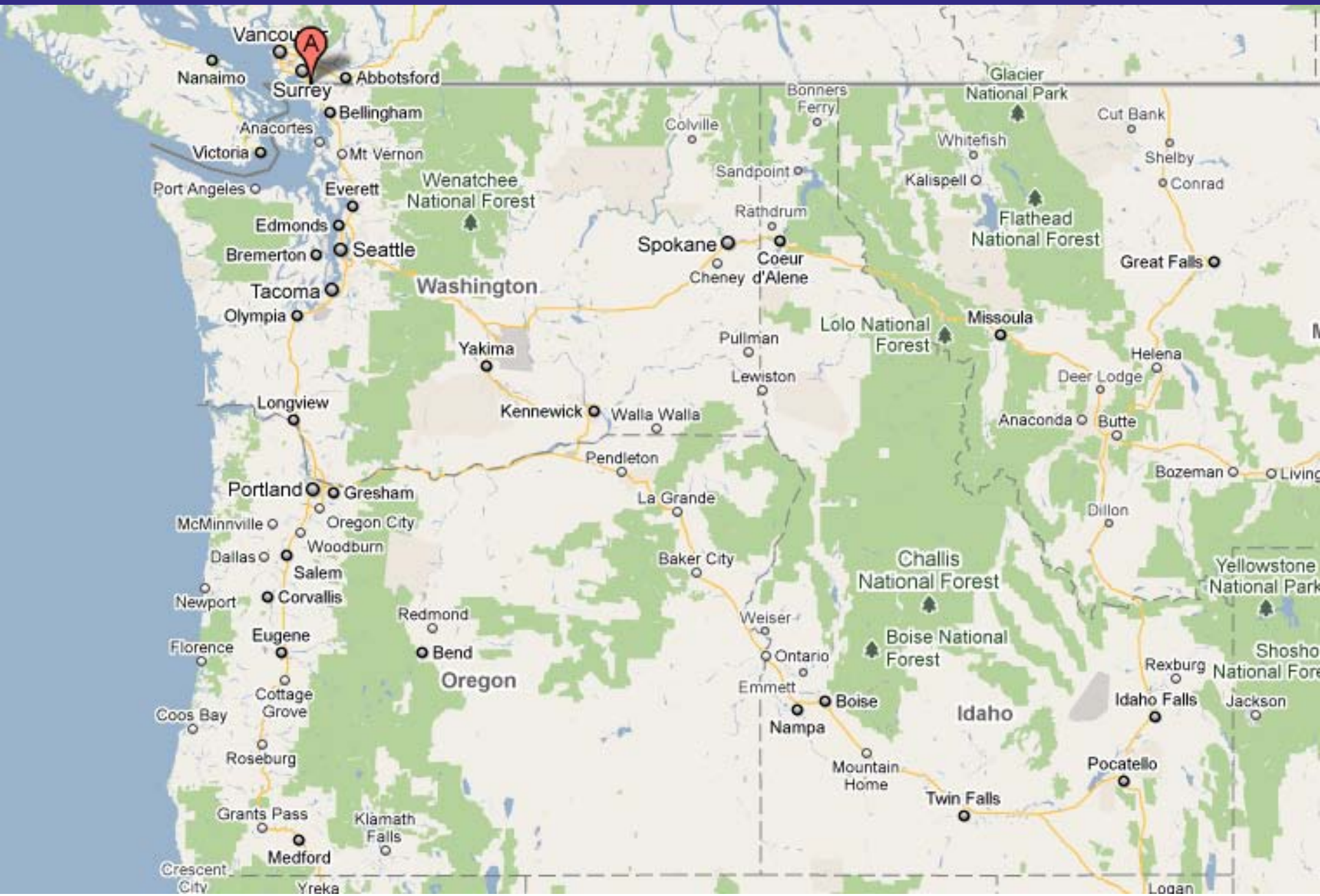
Reclaimed Water in Washington State

- Set by Department of Health and DOE
- Filtration
  - Average turbidity below 2 NTU
  - Maximum turbidity of 5 NTU
- Chlorination
  - Minimum 30 minutes CT based on 1 mg/L
  - Residual of 0.5 mg/L at end user

Required Dosing To Meet 30 mg min/L



Lighthouse Point Treatment Plant


A
Vancouver
Nanaimo
Surrey
Abbotsford
Bellingham
Anacortes
Victoria
Mt Vernon
Port Angeles
Everett
Edmonds
Bremerton
Seattle
Tacoma
Olympia
Wenatchee National Forest
Washington
Yakima
Longview
Kennewick
Walla Walla
Portland
Gresham
McMinnville
Oregon City
Woodburn
Dallas
Salem
Newport
Corvallis
Florence
Eugene
Cottage Grove
Coos Bay
Roseburg
Grants Pass
Medford
Klamath Falls
Crescent City
Yreka
Redmond
Bend
Oregon
Colville
Bonners Ferry
Sandpoint
Rathdrum
Spokane
Cheney
Coeur d'Alene
Pullman
Lewiston
Pendleton
La Grande
Baker City
Weiser
Ontario
Emmett
Boise
Nampa
Mountain Home
Twin Falls
Glacier National Park
Whitefish
Kalispell
Flathead National Forest
Cut Bank
Shelby
Conrad
Great Falls
Lolo National Forest
Missoula
Helena
Deer Lodge
Anaconda
Butte
Bozeman
Dillon
Challis National Forest
Boise National Forest
Idaho
Yellowstone National Park
Rexburg
Idaho Falls
Jackson
Pocatello
Logan

Plant Highlights

- Replacement for existing treatment plant
- Influent Flows
  - Peak Hour– 3.1 mgd
  - Average Annual – 0.9 mgd
- MBR treatment plant
- Hypochlorite disinfection
  - Effluent chlorination requirements
  - Maximum discharge of 0.1 mg / L

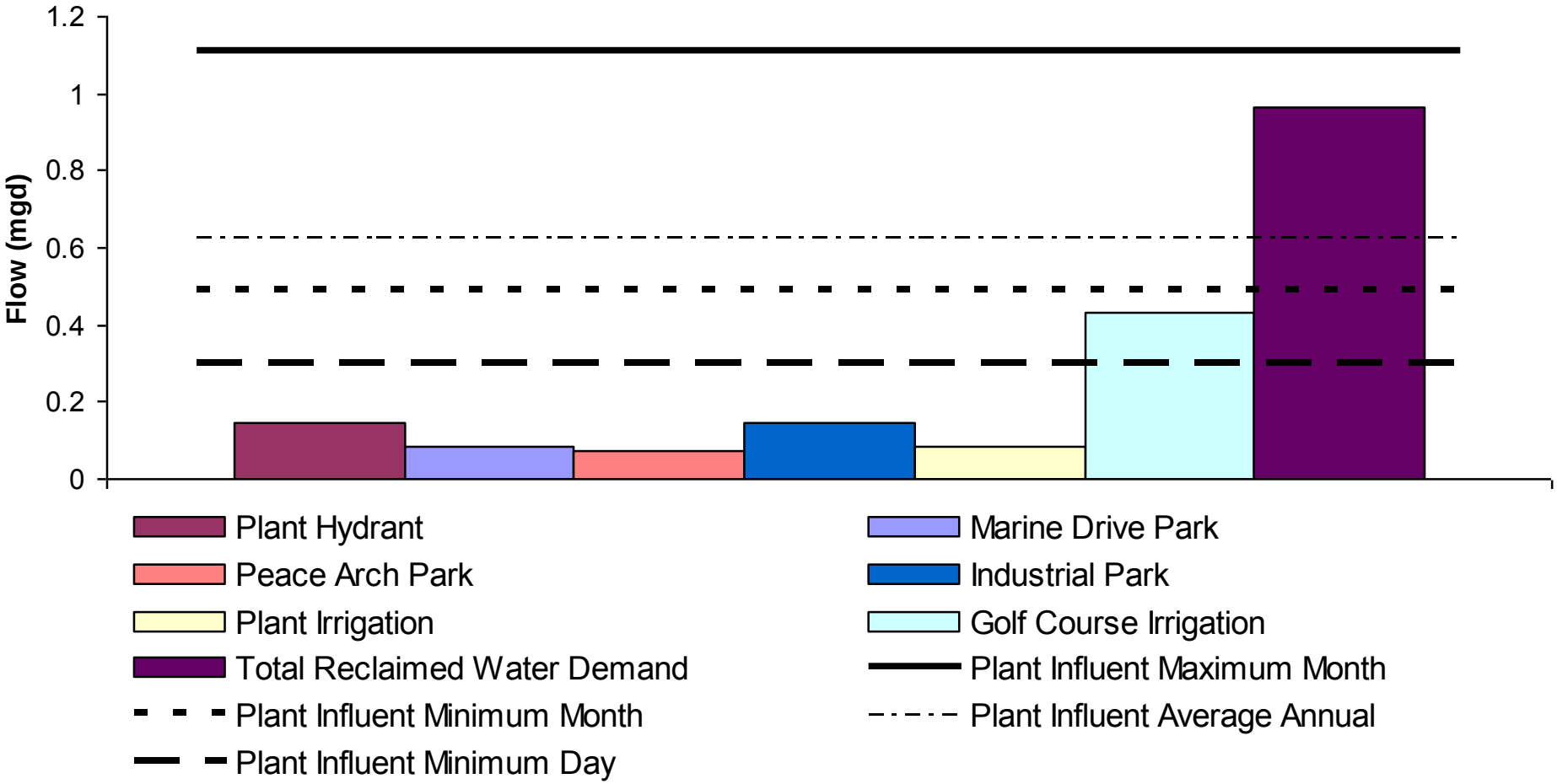
- Completely enclosed
- Located in a park
- Public can view part of treatment process

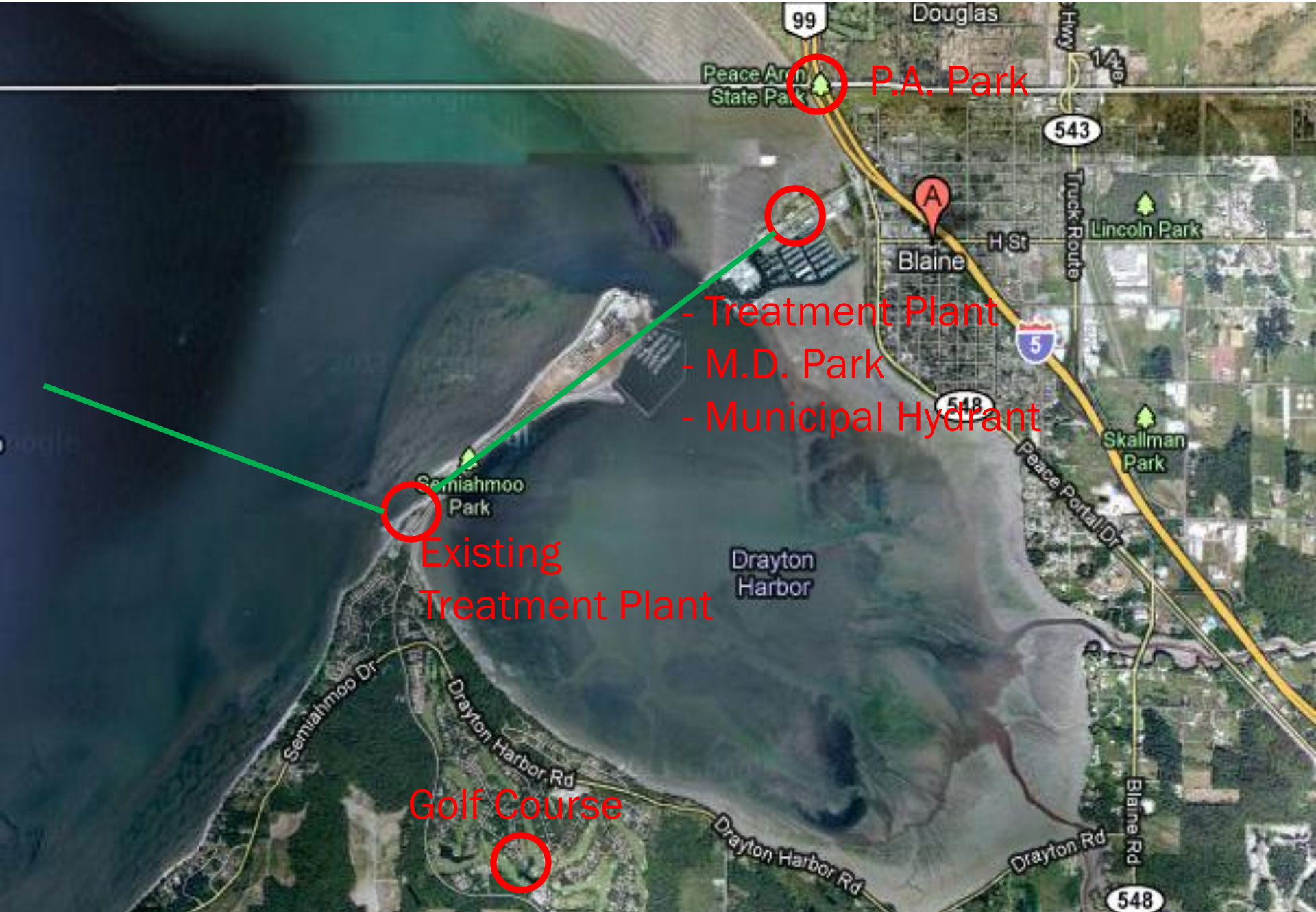
Potential Uses of Reclaimed Water

Potential End Users

- Treatment Plant – 200 gpm
- Marine Drive Park – 60 gpm
- Peace Arch Park – 50 gpm
- Industrial Park – 100 gpm
- Municipal Vehicles – 100 gpm
- Semiahmoo – 300 gpm

Reclaimed Water Demands

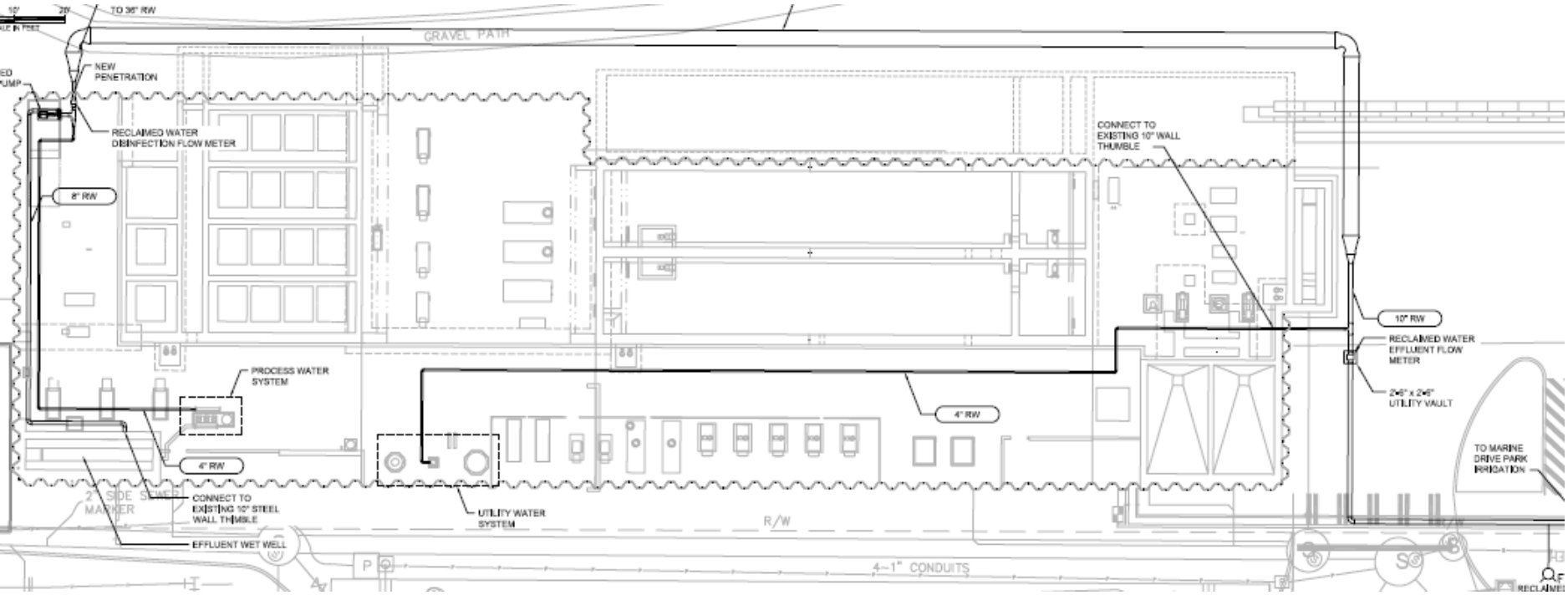



99
Douglas
Peace Arch State Park
P.A. Park
543
Blaine
H St
Truck Route
Lincoln Park
- Treatment Plant
- M.D. Park
- Municipal Hydrant
5
548
Skallman Park
Peace Portal Dr
Semiahmoo Park
Existing Treatment Plant
Drayton Harbor
Semiahmoo Dr
Drayton Harbor Rd
Golf Course
Drayton Harbor Rd
Drayton Rd
Blaine Rd
548

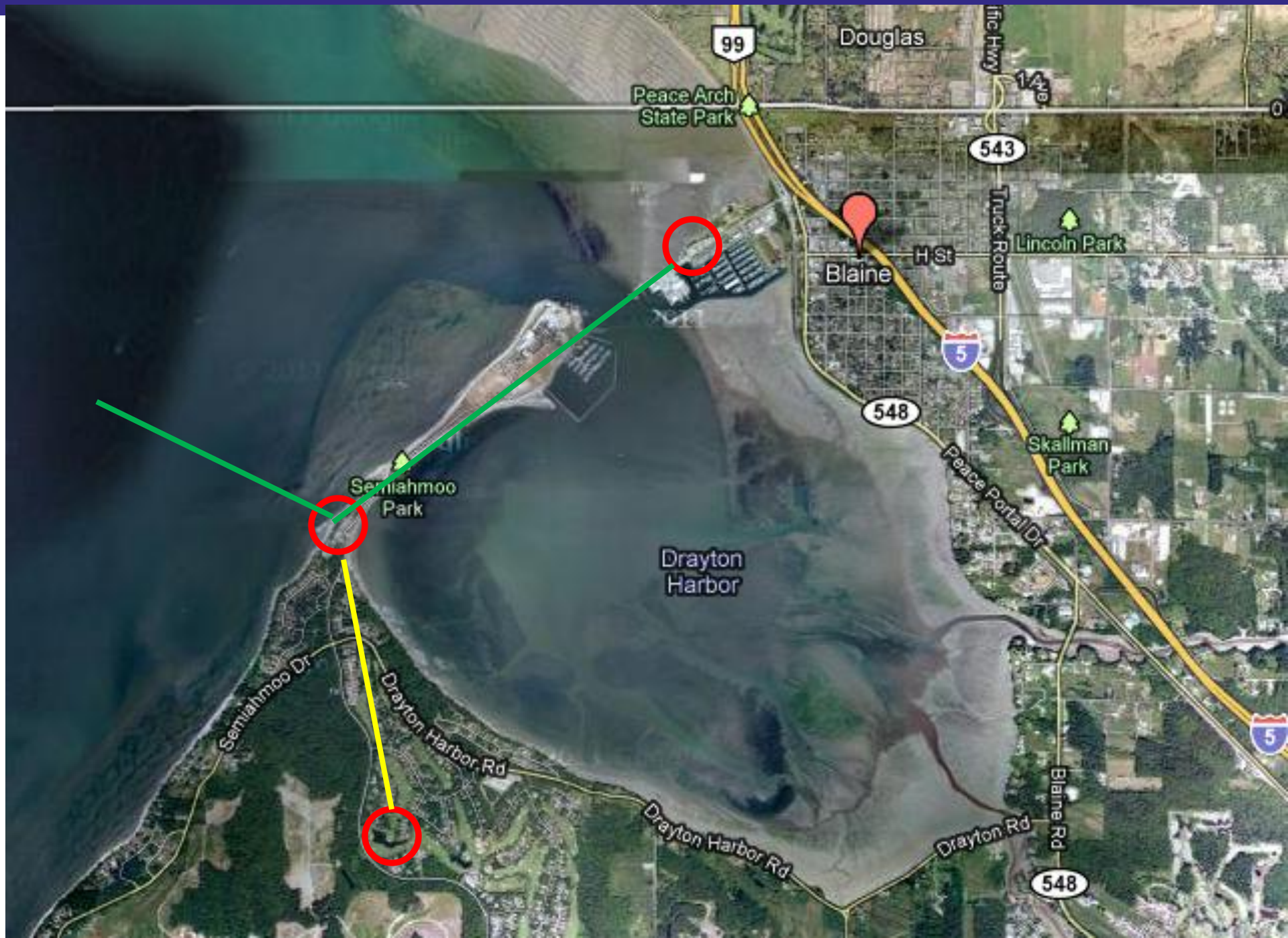
Local Demands

Method for Achieving Contact Time

- Total demand of roughly 500gpm
- Sized for peak instantaneous demand
- 280 feet of36-inch diameter pipe
- Additional chlorination required
  - 1 mg / L from effluent wetwell
  - Additional 1 mg / L for reclaimed water
  - Total maximum dose of 2 mg/L


TO 36" RW
GRAVEL PATH
NEW PENETRATION
RECLAIMED WATER DISINFECTION FLOW METER
8" RW
CONNECT TO EXISTING 10" WALL THUMBLE
10" RW
RECLAIMED WATER EFFLUENT FLOW METER
2'-6" x 2'-6" UTILITY VAULT
PROCESS WATER SYSTEM
4" RW
4" RW
TO MARINE DRIVE PARK IRRIGATION
CONNECT TO EXISTING 10" STEEL WALL THIMBLE
UTILITY WATER SYSTEM
R/W
EFFLUENT WET WELL
4-1" CONDUITS

Semiahmoo Golf Course


99
Douglas
Peace Arch
State Park
543
Blaine
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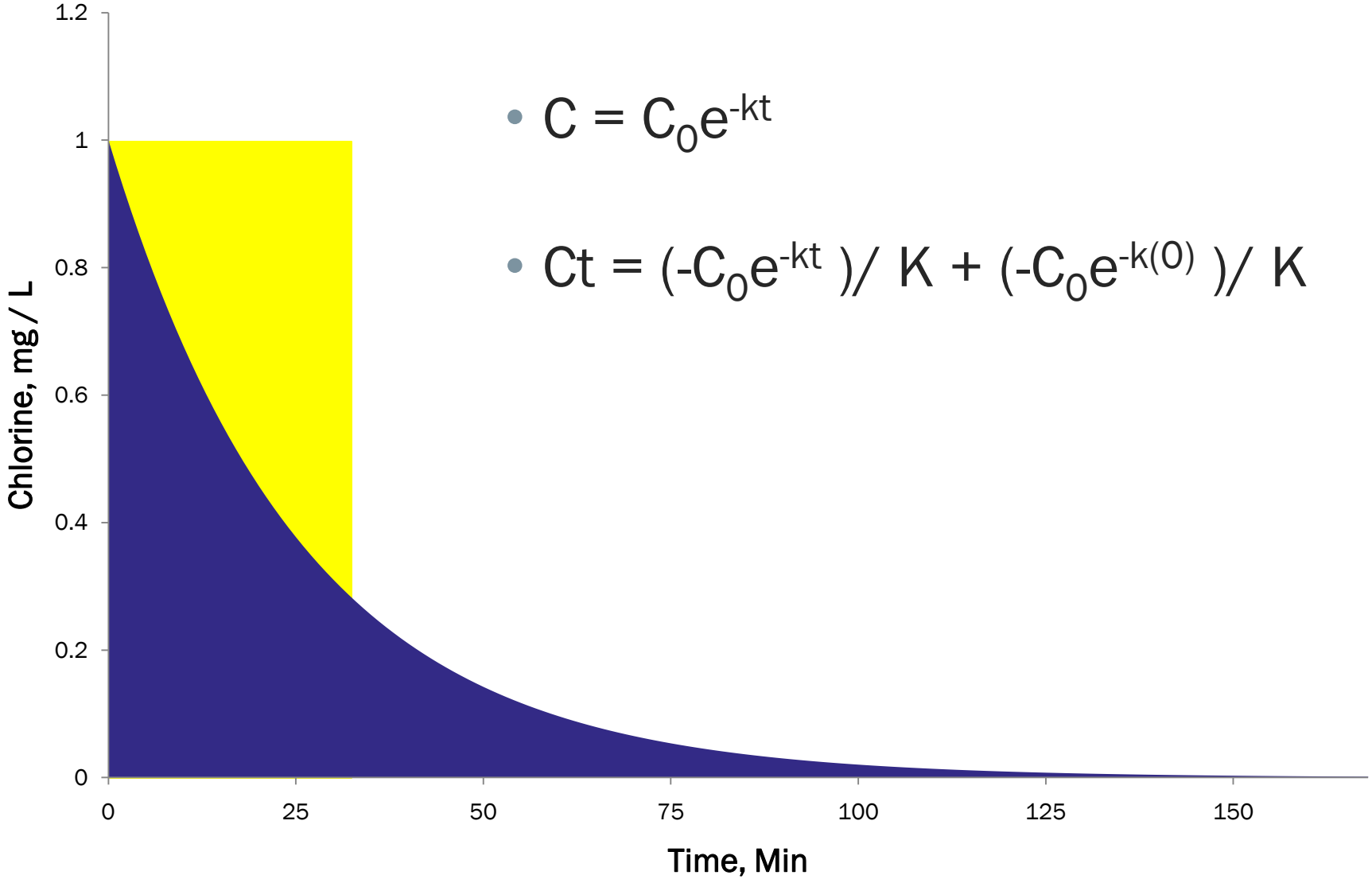
Truck Route
Lincoln Park
5
548
Skallman
Park
Peace Portal Dr
Semiahmoo
Park
Drayton
Harbor
Semiahmoo Dr
Drayton Harbor Rd
Drayton Harbor Rd
Drayton Rd
Blaine Rd
548
5

Chlorination Restrains

- Effluent limits of 0.1 mg/L
- Secondary dosing would be required
  - Meet Ct of 30 mg min / L
  - Discharge residual of 0.5 mg/L
- Larger pump station would be required
  - Tablet feeder
  - Storage
  - Eye wash / shower

What happens to the chlorine residual?

Calculating The True Ct



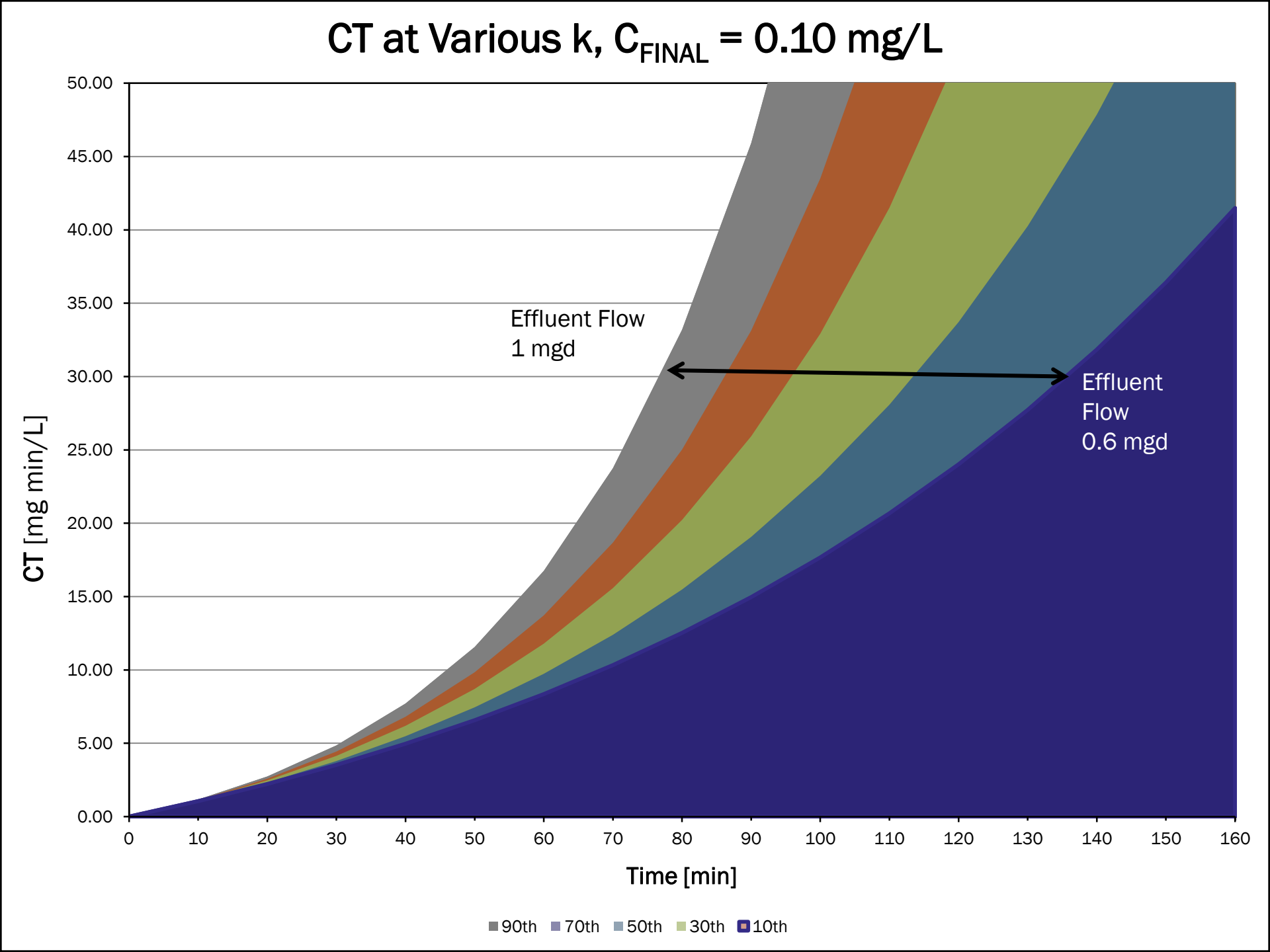
- $C = C_0 e^{-kt}$
- $Ct = (-C_0 e^{-kt})/ K + (-C_0 e^{-k(0)})/ K$

Reclaimed Water Permit Submitted

- Approval provided for eastern side demands
- DOE accepted the integration method
- DOE waives the residual requirement at discharge
- Wanted confirmation of K value before final approval for Semiahmoo

Results So Far

- High variation in K values
  - Range from 0.01 to 0.03 min^{-1}
- Chlorination may not be required depending on the flow
  - Depends on K value
- Chlorination is not required during summer months


CT at Various k, C_{FINAL} = 0.10 mg/L
CT [mg min/L]
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Time [min]
Effluent Flow
1 mgd
Effluent
Flow
0.6 mgd
90th
70th
50th
30th
10th

Questions