



*Locating human sewage
sources in a small urban
stream using
temperature/conductivity
dataloggers*

A cooperative study by

*Seattle Public Utilities
and*

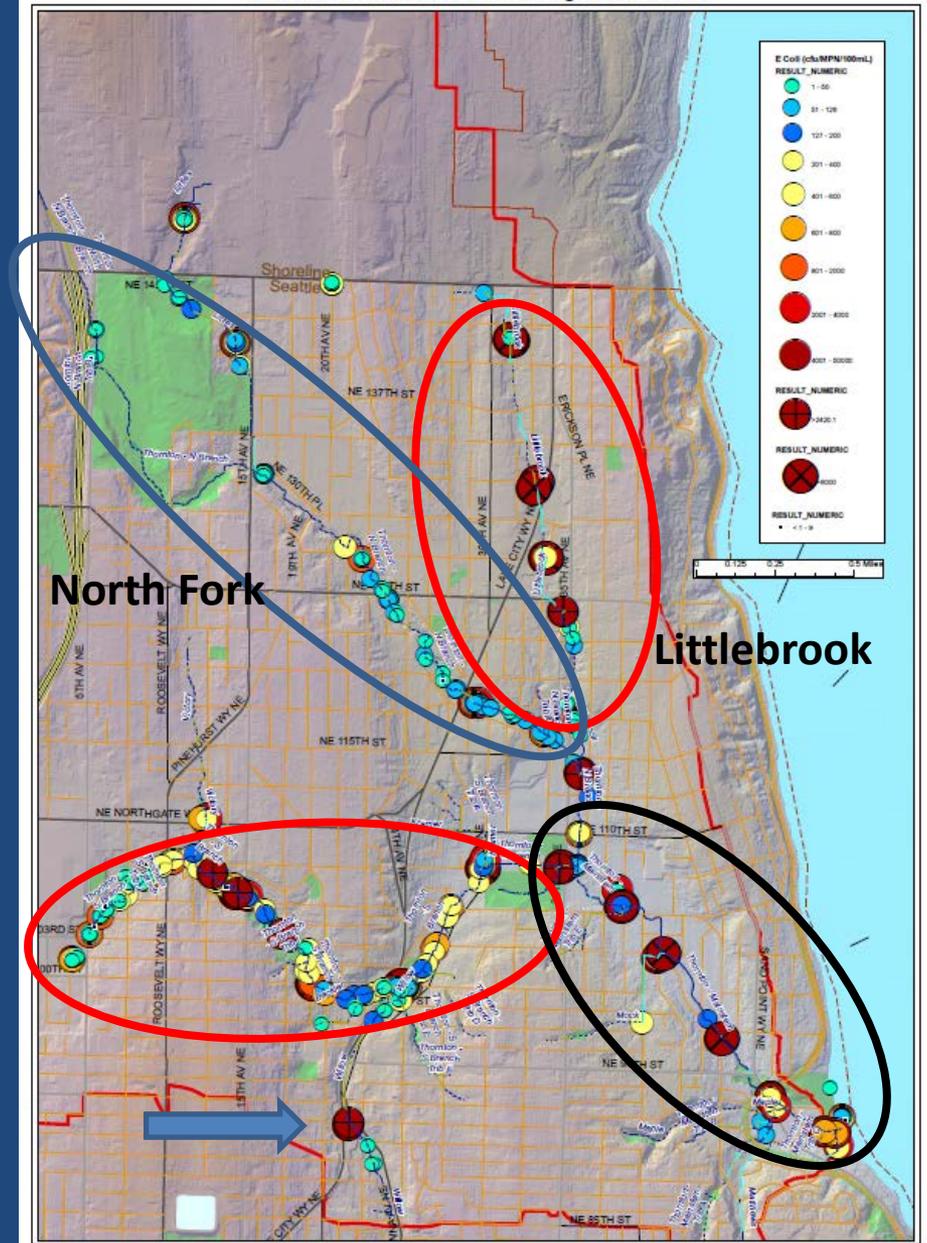
*King County Department of Natural
Resources and Parks*

Jonathan Frodge
Limnologist
Seattle Public Utilities

E.Coli is a better indicator of human source bacteria than fecal coliform and is used in the Thornton Creek Bacteria Investigation (TCBI)

fecal coliform is the regulated indicator in Washington (*WAC173-201A*)

E.Coli does not need an S4F

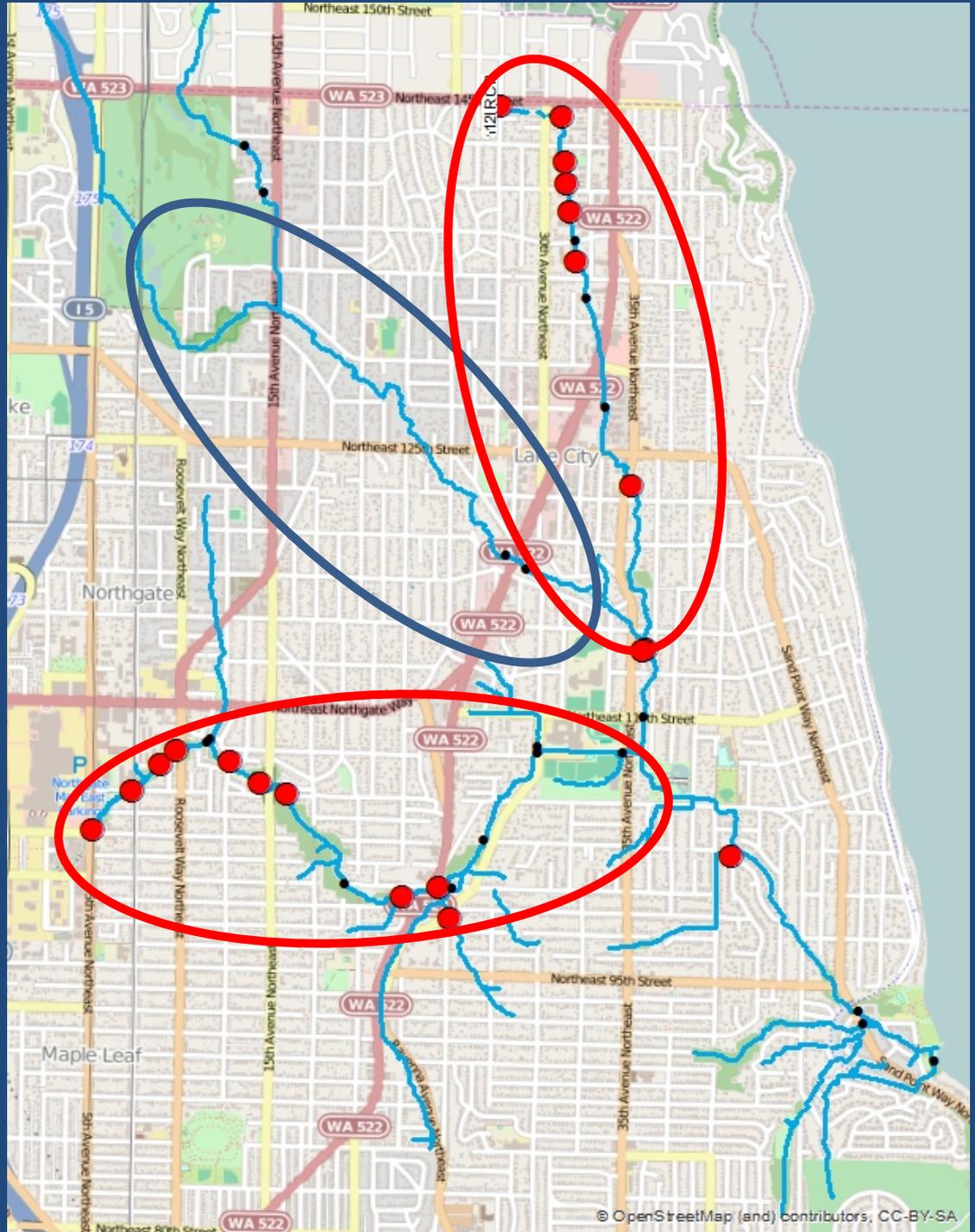


South Fork

Willow Creek cross connection

Locations where temperature/conductivity data loggers have been deployed

currently we have only ten dataloggers, so we need to shift resources

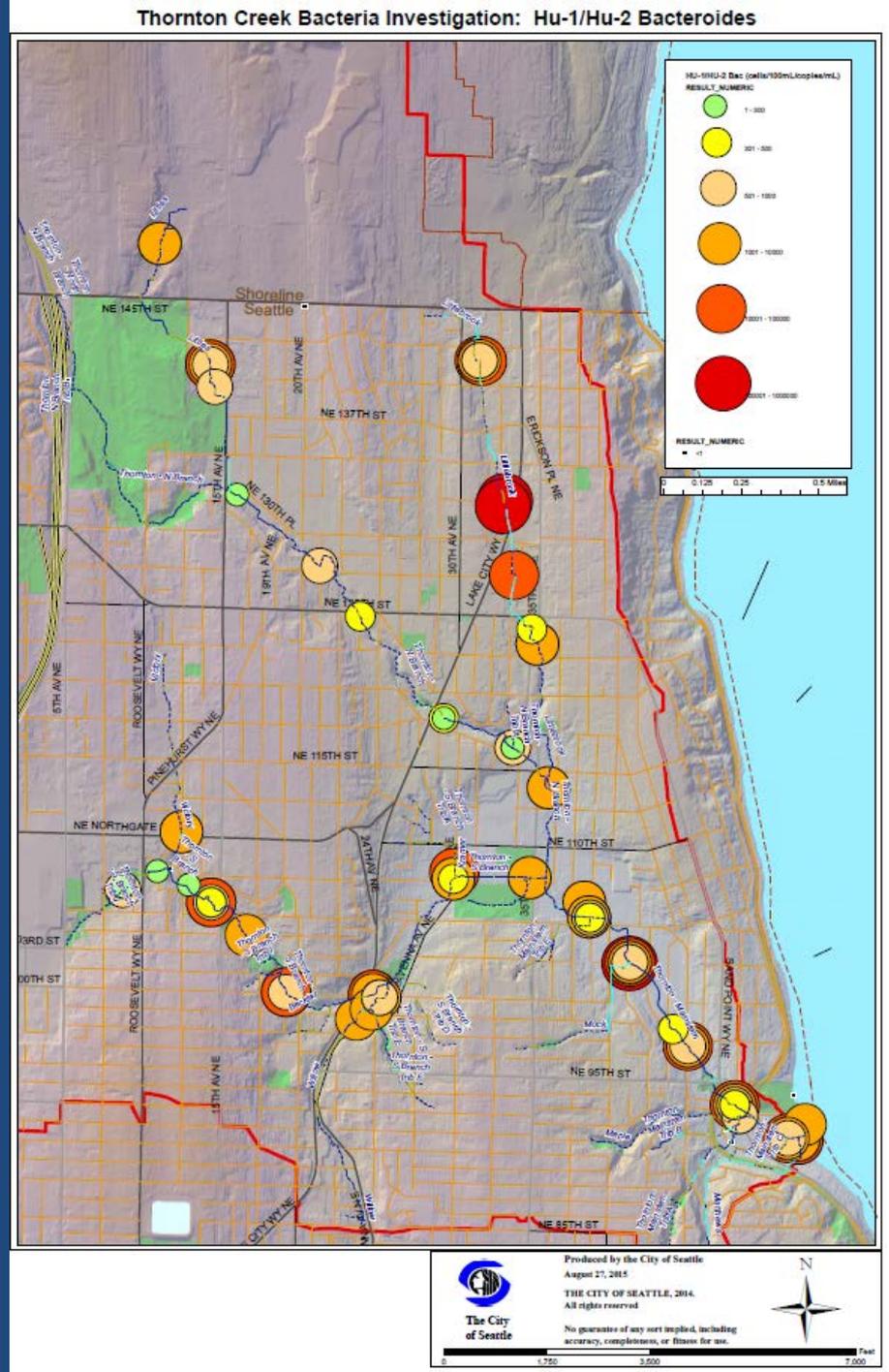


Hu-1 and Hu-2 Bac uses analytical techniques cooperatively developed by *King County Environmental Laboratory* and *EPA*

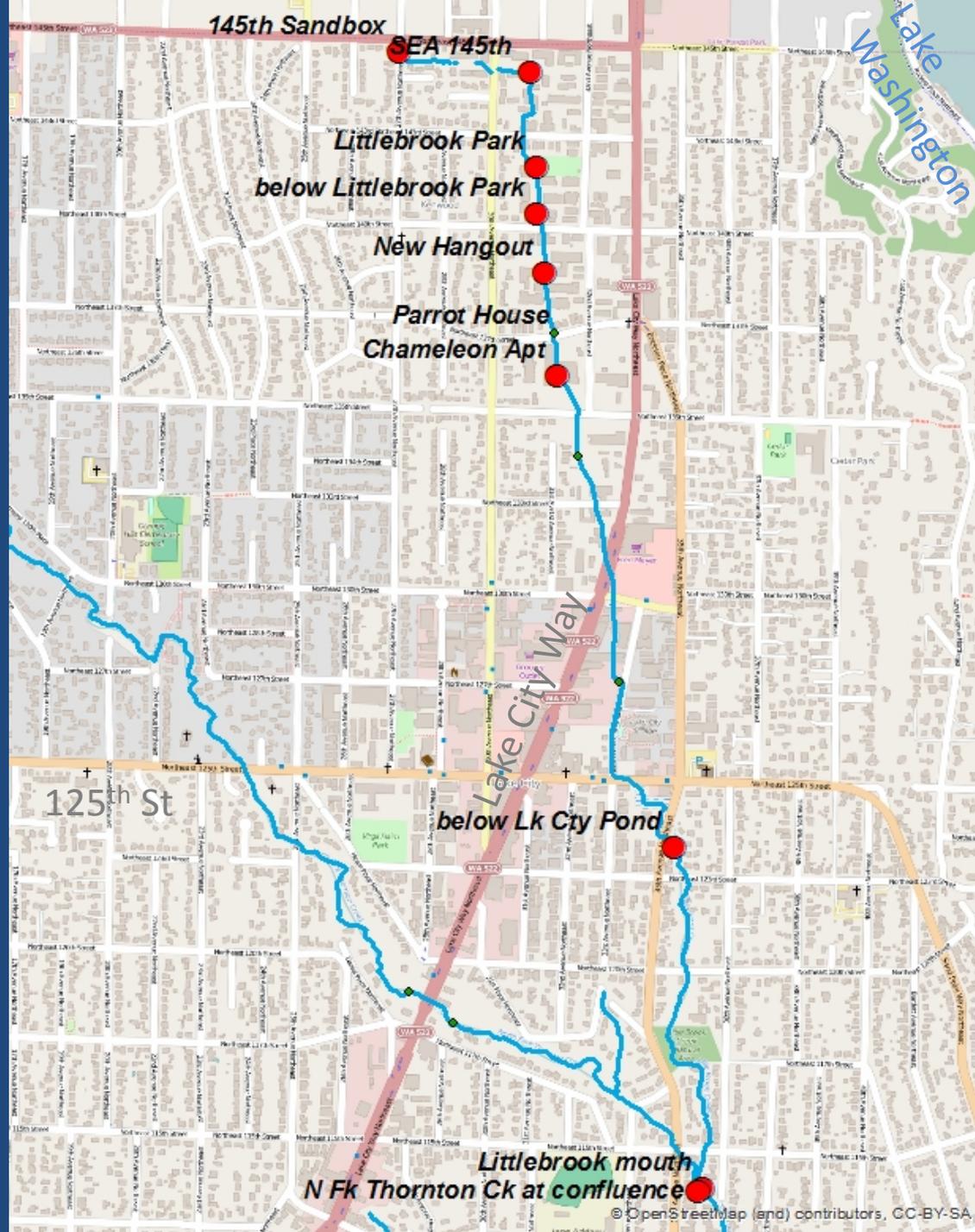
this microbiological analysis quantifies human-specific *Bacteroides thetaiotamicron*

high counts of this bacteria is used to confirm human source bacteria (fecal material), still unsure of quantification

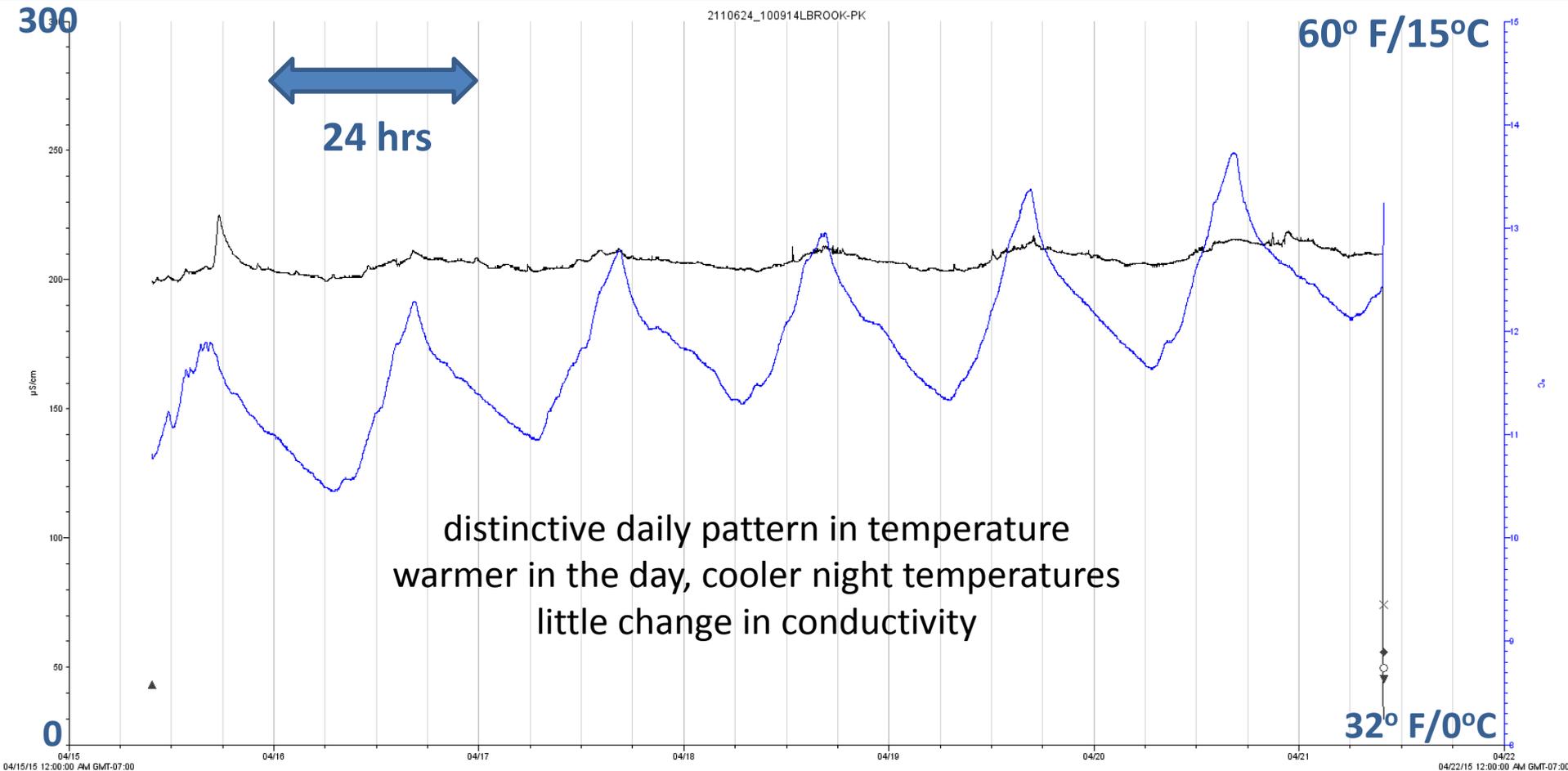
increased public health risk



initial datalogger
deployment locations in
Littlebrook Creek



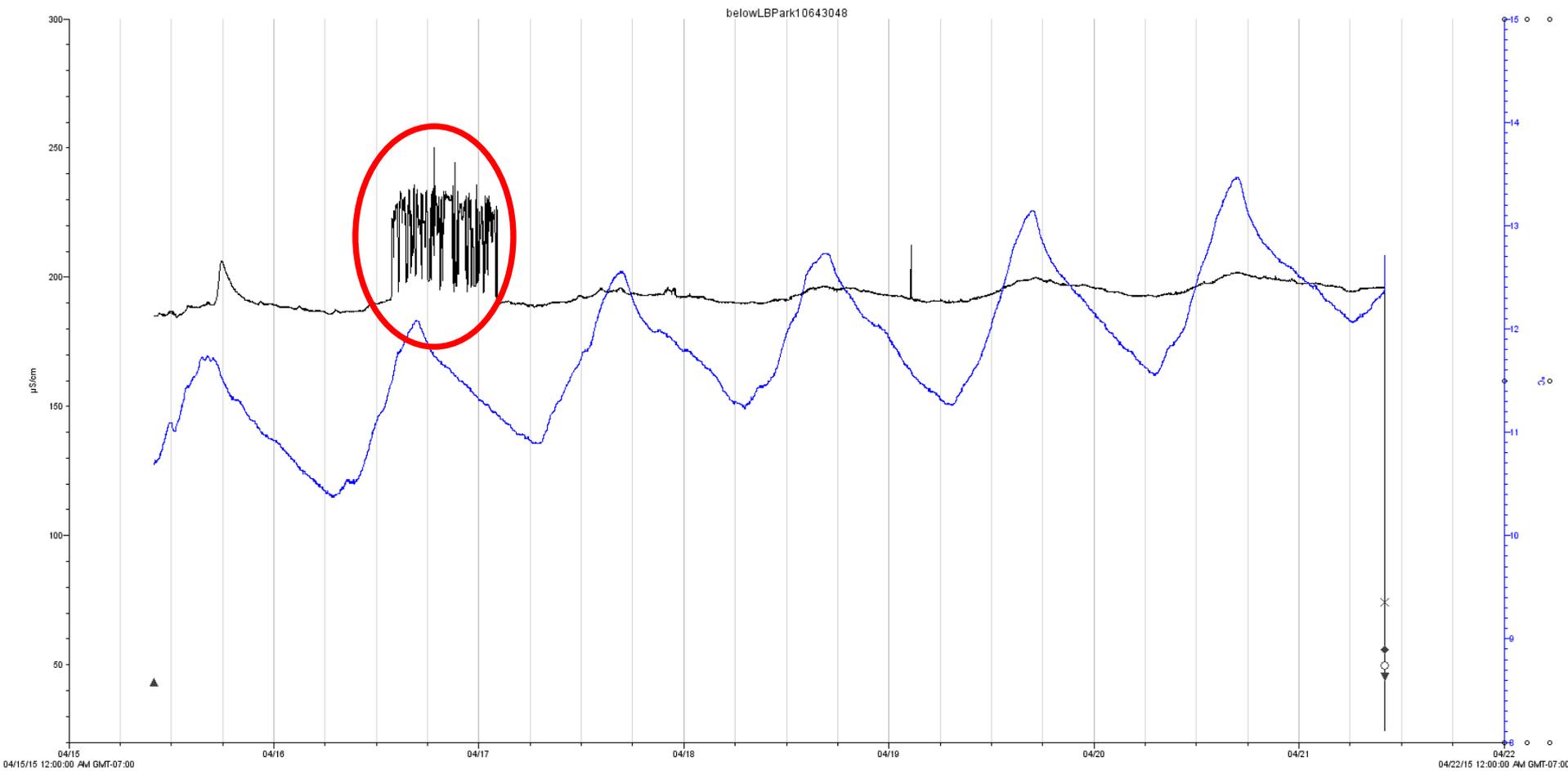
Littlebrook Park (output from HOBO Pro software)



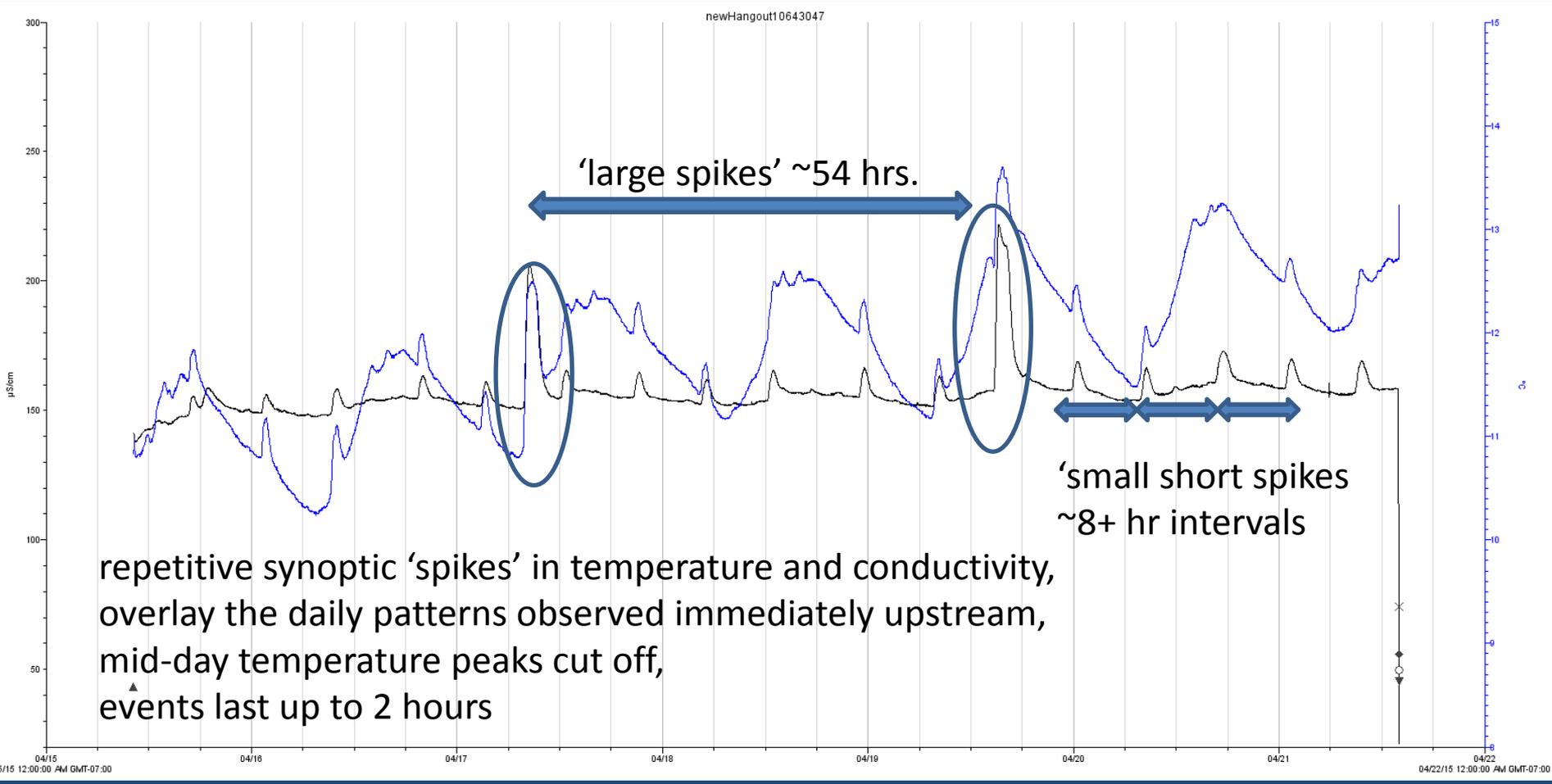
sewage is warmer (in winter) and has higher dissolved ions, and therefore conductivity, than creek water

assume inputs of sewage will result in synoptic changes in temperature and conductivity

below Littlebrook Park



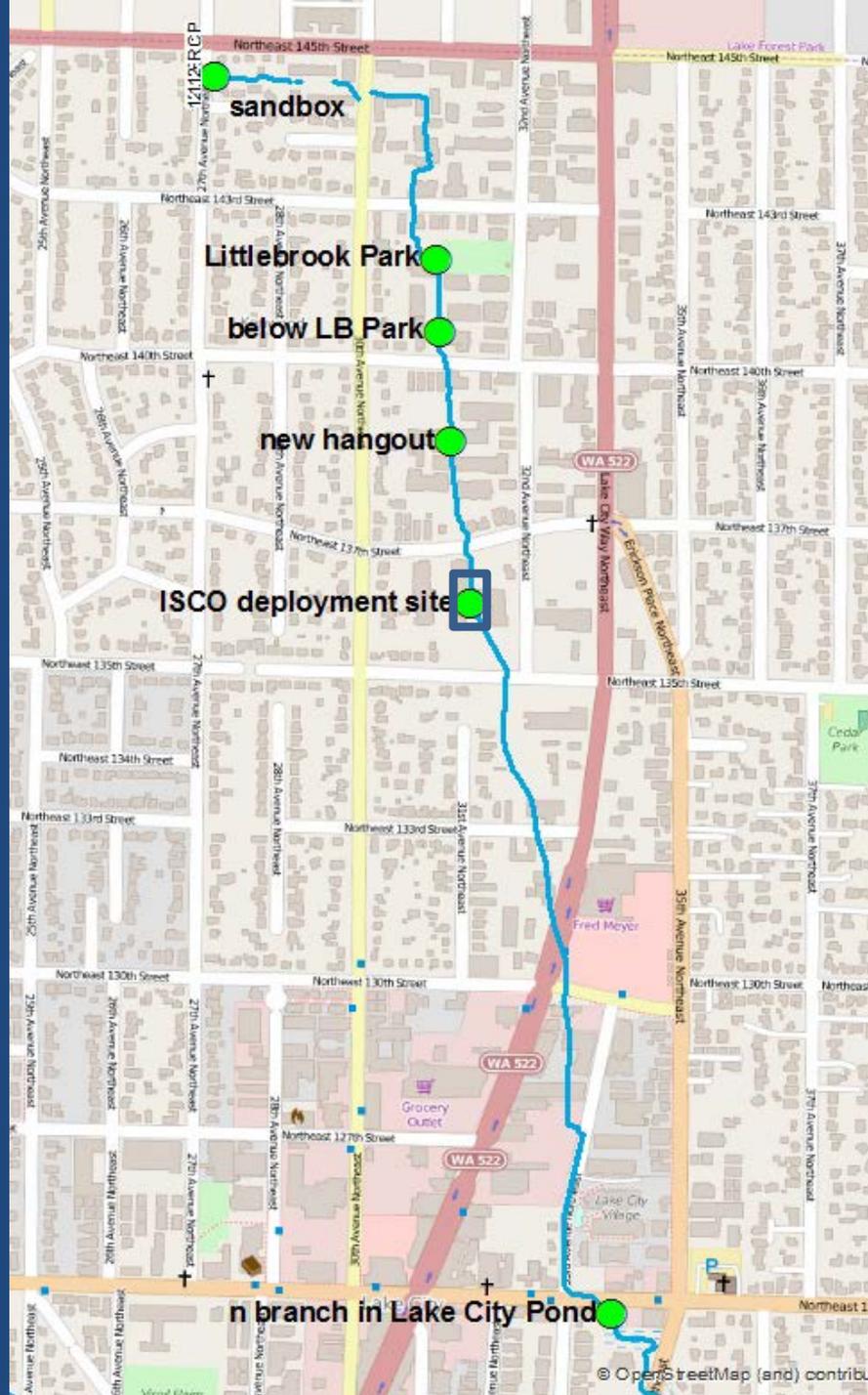
12 hour event- increased conductivity no apparent effect on temperature - cause?



repetitive synoptic 'spikes' in temperature and conductivity, overlay the daily patterns observed immediately upstream, mid-day temperature peaks cut off, events last up to 2 hours

these 'spikes' or simultaneous repetitive temperature/conductivity anomalies are the signal assumed to identify unknown discharges into the creek

The ISCO sampler collects a composite sample (partial samples every 15 minutes) every hour for 24 hours between 11AM April 29 and noon April 30, 2015



these other sites were sampled during the early part of the ISCO deployment (11AM– 4PM) as reference sites



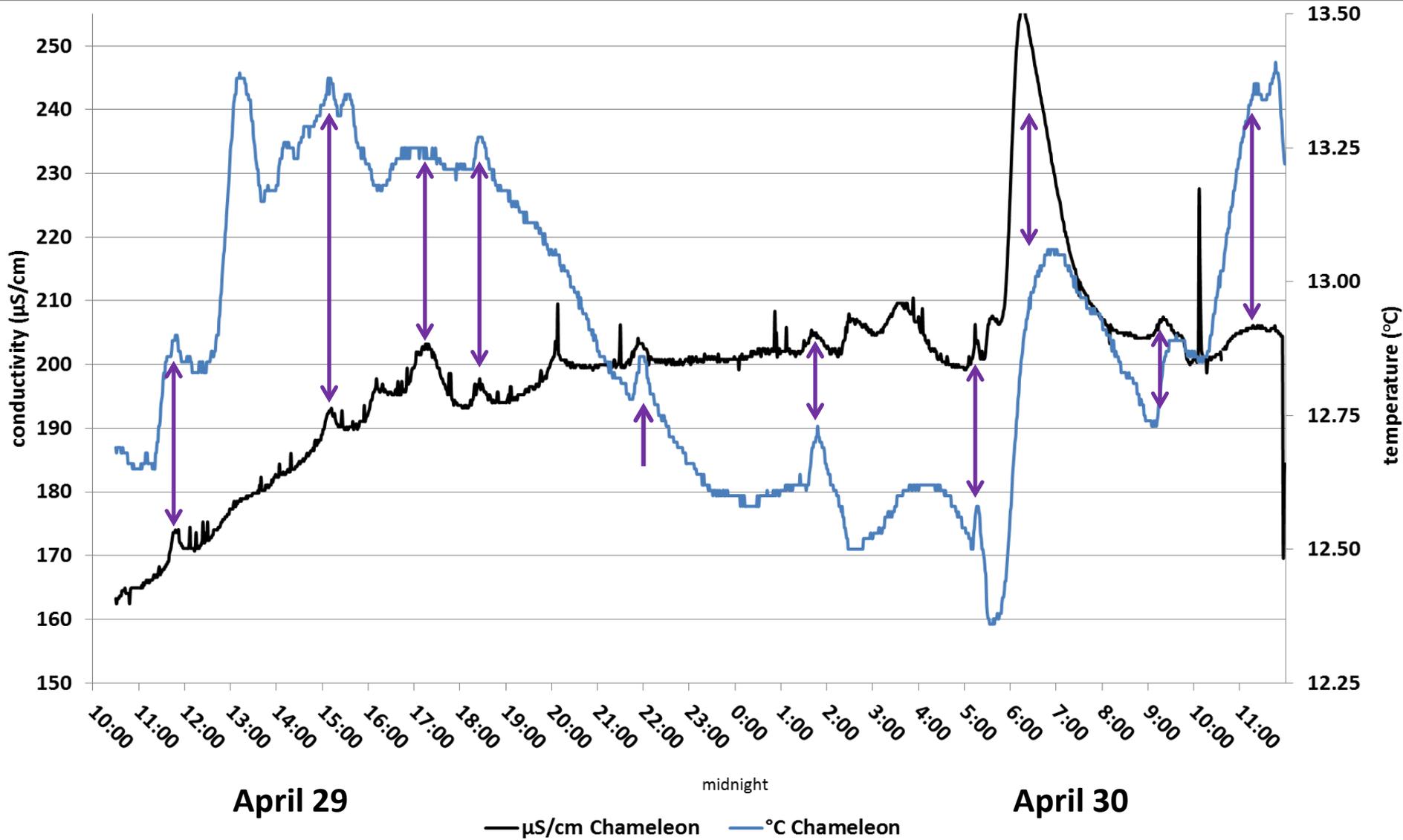
24 1 hour
composite
samples
analyzed for
E. coli and
Bacteroides



water collection tube, located in same sampling block with temperature

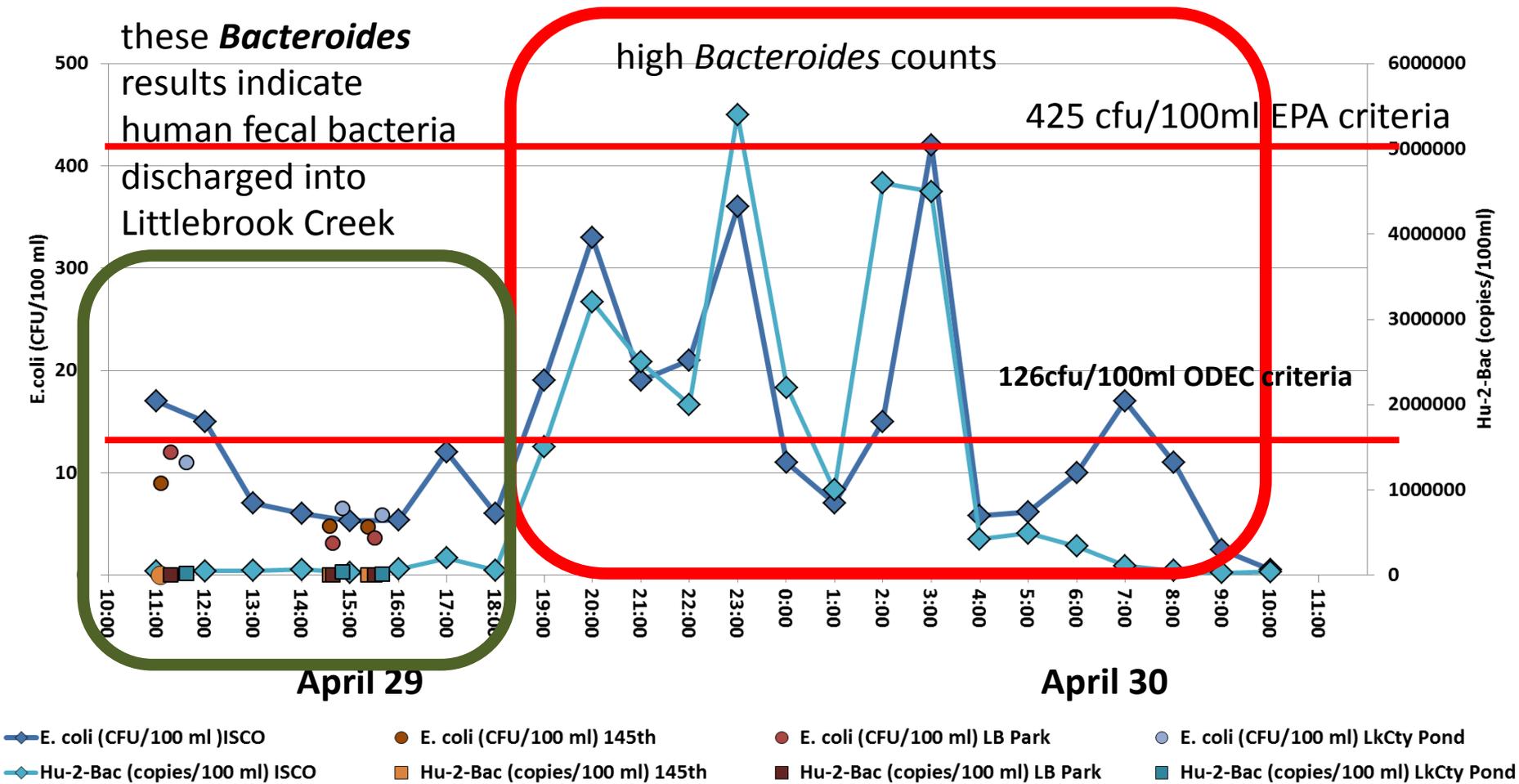


Chameleon Apts. 24 hours



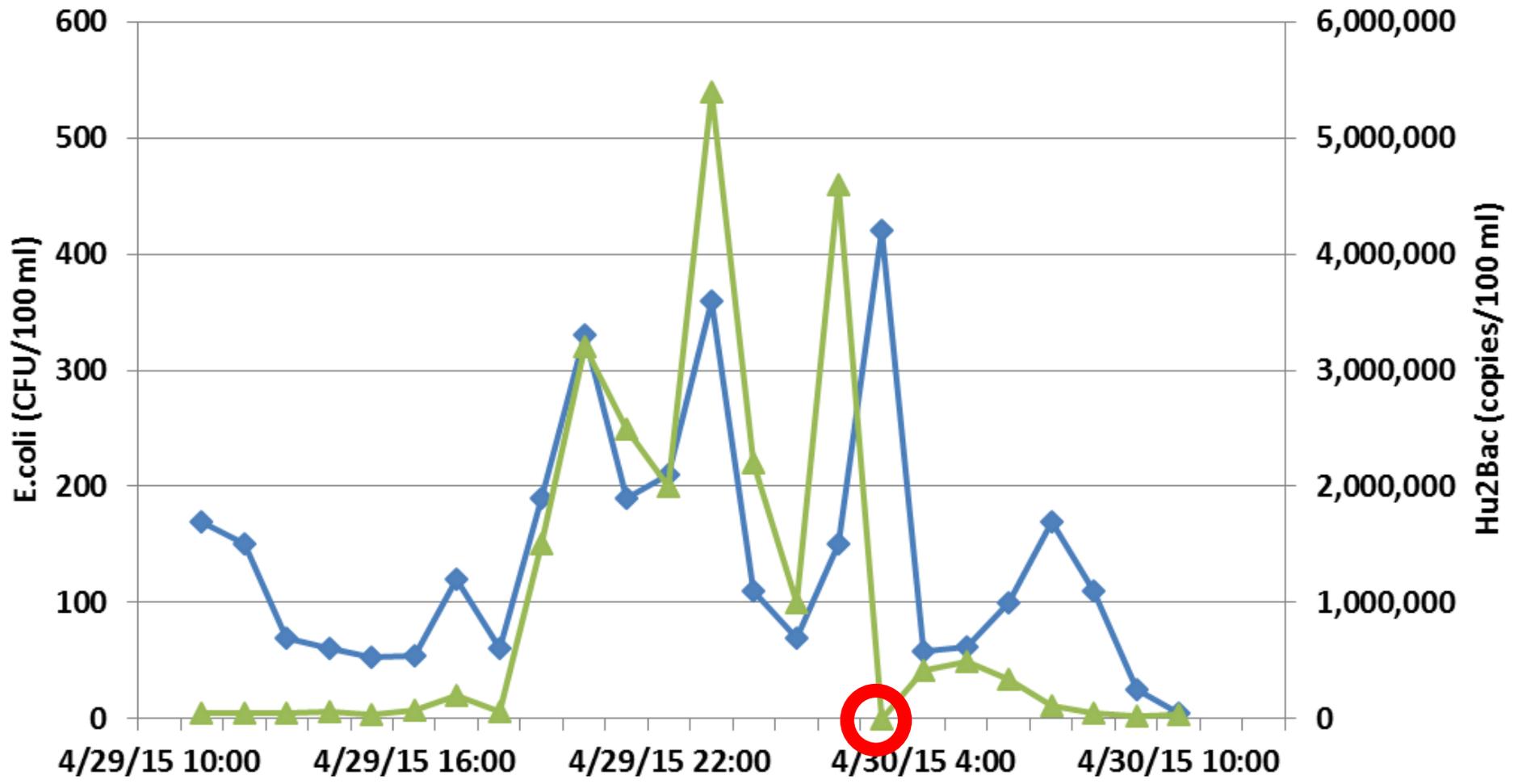
temperature – conductivity data for the same period as the ISCO deployment and bacteria sampling

hourly composite *E. coli* and *Bacteroides* bacteria results



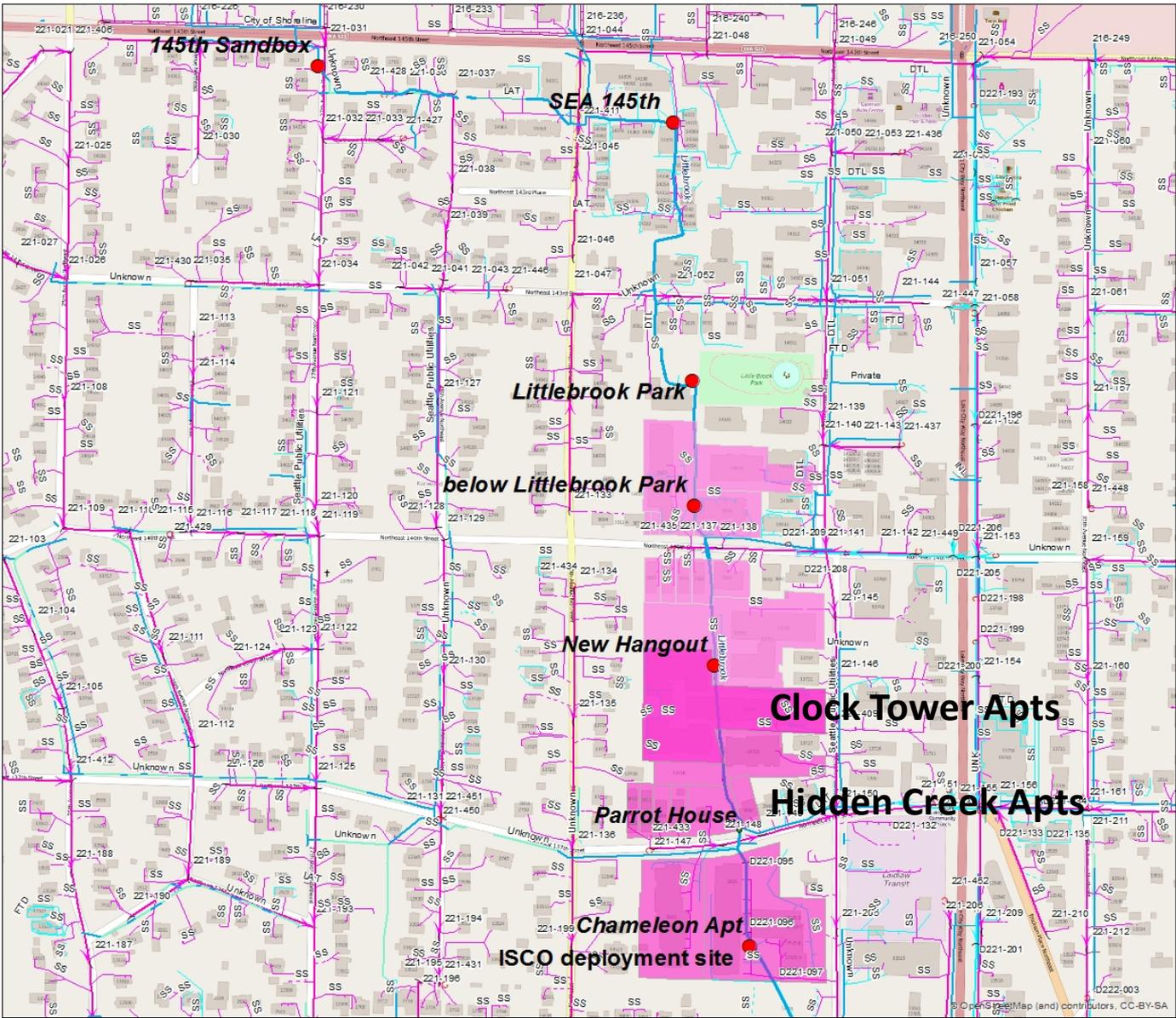
If assume a grab sample ~1minute plug flow in the creek then this ~ 0.07% of the daily flow

ODEQ and EPA recommended *E.coli* criteria (425 cfu/100ml)



- E. coli (CFU/100 ml) ISCO
- E. coli (CFU/100 ml) 145th
- E. coli (CFU/100 ml) LB Park
- E. coli (CFU/100 ml) LkCty Pond
- Hu-2-Bac (copies/100 ml) ISCO
- Hu-2-Bac (copies/100 ml) 145th
- Hu-2-Bac (copies/100 ml) LB Park
- Hu-2-Bac (copies/100 ml) LkCty Pond

HU-2 bac was re-run after centrifuging which removed bubbles that resulted in spurious data



Legend
 thermistor deployment site

-  thermistor deployment site
-  suspect_parcels
-  ThorntonCreek
-  Culvert
-  Ditch
-  SPU Drainage Main
-  SPU Sanitary Main
-  SPU Combined Main
-  King County Drainage Main
-  King County Sewer Main
-  Private Drainage Main
-  Private Sanitary Main
-  Private Combined Main



**Stormwater catch basin at
Clock Tower Apts.**



Stormwater catch basin at Clock Tower Apts





**Clock Tower Apts.
stormwater
detention vault**

**dye-test confirms
direct discharge
from toilets to
stormwater
detention vault**



Department of Ecology - Environmental Report Tracking System

ERTS # 658594

Initial Report				External Reference #			
Caller Information				Where did it happen			
First Name	Last Name	Berth	Anchorage	Location Name			
ALEX	WOLPOW-GINDI	CLOCKTOWER APARTMENTS		Street Address	13725 32ND AVE NE		
Business Name SEATTLE PUBLIC UTILITIES				Other Address			
Street Address 700 5TH AVE SUITE 4900				City/Place	SEATTLE	State	WA
Other Address				Zip			
City	SEATTLE	State	WA	Zip	98124		
E-mail	alex.wolpow-gindi@seattle.gov		Confidential_FL	<input type="checkbox"/>	County - Region	KING	NWRO FS ID
Phone	Ext	Type	Waterway	LITTLEBROOK CREEK	Type	STORM DRAIN	
(206) 255-2044		Business	Latitude	Longitude			
				Topo Quad 1:24:00	SEATTLE		
What happened				Direction/Landmark (mile post, cross roads, township/range)			
Spills Program Oil Spill? N							
Incident Date	8/3/2015	Received Date	8/3/2015 13:34				
Medium	STORM DRAIN PIPE						
Material	SEWAGE/SLUDGE						
	Quantity	Unit					
Source	DOMESTIC						
Cause	OTHER						
Activity	ROUTINE/NORMAL OPERATIONS						
Impact	WATER POLLUTION						
Vessel Name							
Hull Number							
Additional Contact Information				Primary Potentially Responsible Party Information			
Name	Phone	Ext	Type	First Name	Last Name		
				SARAH	ALLWORTH		
				Business Name	CLOCKTOWER APARTMENTS, REGIONAL MANAGER		
				Street Address			
				Other Address			
				City	State	WA	Zip
				Phone	Ext	Type	
				E-mail			
More Information							
REPORT RECEIVED VIA ONLINE SUBMITTAL FORM:							
SPU IDDE observed raw sewage in a private stormwater detention system at the Clocktower Apartments (13725 32nd Ave NE). Illicit connection was confirmed via dye-test. This detention system discharges directly to Littlebrook Creek. SPU will work with Clocktower Apartments to have repair made.							
ONLINE SUBMITTAL FORM AVAILABLE AT: X:\NWRO ERTS\ERTS Incident Additional Info\2015\658594							
Entry Person SACAYANAN, TAMARA				Entry Date 8/5/2015			

ERTS # 658143

Initial Report

External Reference #

Caller Information

Name **ROBERT WHITE**
 Business Name **SEATTLE PUBLIC UTILITIES**
 Street Address **714 CHARLES ST**
 Other Address
 City **SEATTLE** State **WA** Zip **98124**
 E-mail **robertj.white@seattle.gov** Confidential_FL
 Phone **(208) 552-5878** Ext Type **Business**

Where did it happen

Location Name
 Street Address **3032 NE 140TH ST**
 Other Address
 City/Place **SEATTLE** State **WA** Zip **98125**
 County - Region **KING** NWRO FS ID
 WIRA #
 Waterway Type
 Latitude Longitude
 Topo Quad **1:24:00 SEATTLE**
 Direction/Landmark (mile post, cross roads, township/range)

What happened

Spills Program Oil Spill? **N**

Incident Date **7/14/2015** Received Date **7/14/2015 13:13**
 Medium **BUILDING/STRUCTURE**
 Material **SEWAGE/SLUDGE**
 Quantity Unit
 Source **PIPELINE**
 Cause **EQUIPMENT FAILURE**

Primary Potentially Responsible Party Information

Name
 Business Name
 Street Address **3032 NE 140TH ST**
 Other Address
 City **SEATTLE** State **WA** Zip **98125**
 Phone Ext Type
 E-mail

Activity **ROUTINE/NORMAL OPERATIONS**
 Impact **HUMAN**
 Vessel Name
 Hull Number

Additional Contact Information

Name Phone Ext Type

More Information

REPORT RECEIVED VIA ONLINE SUBMITTAL FORM:

MAXIMO#- 5884958 PRIV LAT CLEAN OUT PLUGGED. SEWAGE OVERFLOW ON PRIV PROP. NO SPU ASSETS AFFECTED. SEWAGE CONTAINED TO PRIVATE STRUCTURES ON PROPERTY

PRIV APARTMENT BLDG CLEAN OUT- MULTI UNIT COMPLEX. BLDG PROPERTY MNGR ON SITE ADDRESSING CLEAN UP AND REPAIR.

ONLINE SUBMITTAL FORM AVAILABLE AT:
 X:\NWRO ERTS\ERTS Incident Additional Info\2015\658143

Entry Person **SACAYANAN, TAMARA**

Entry Date **7/14/2015**



Hidden Stream Apts.

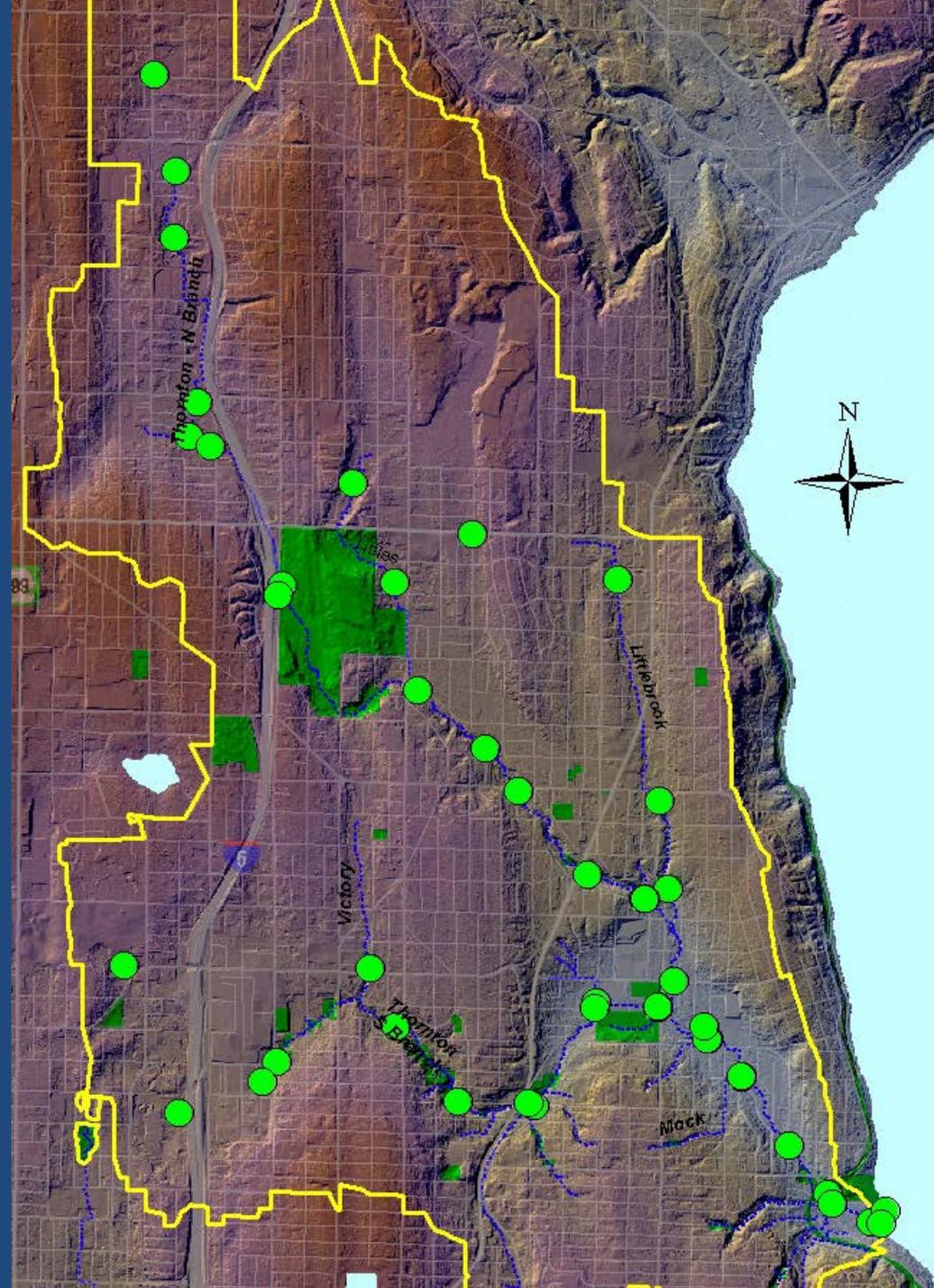
Currently there are two grant proposals submitted to expand and test this methodology:

SPU only

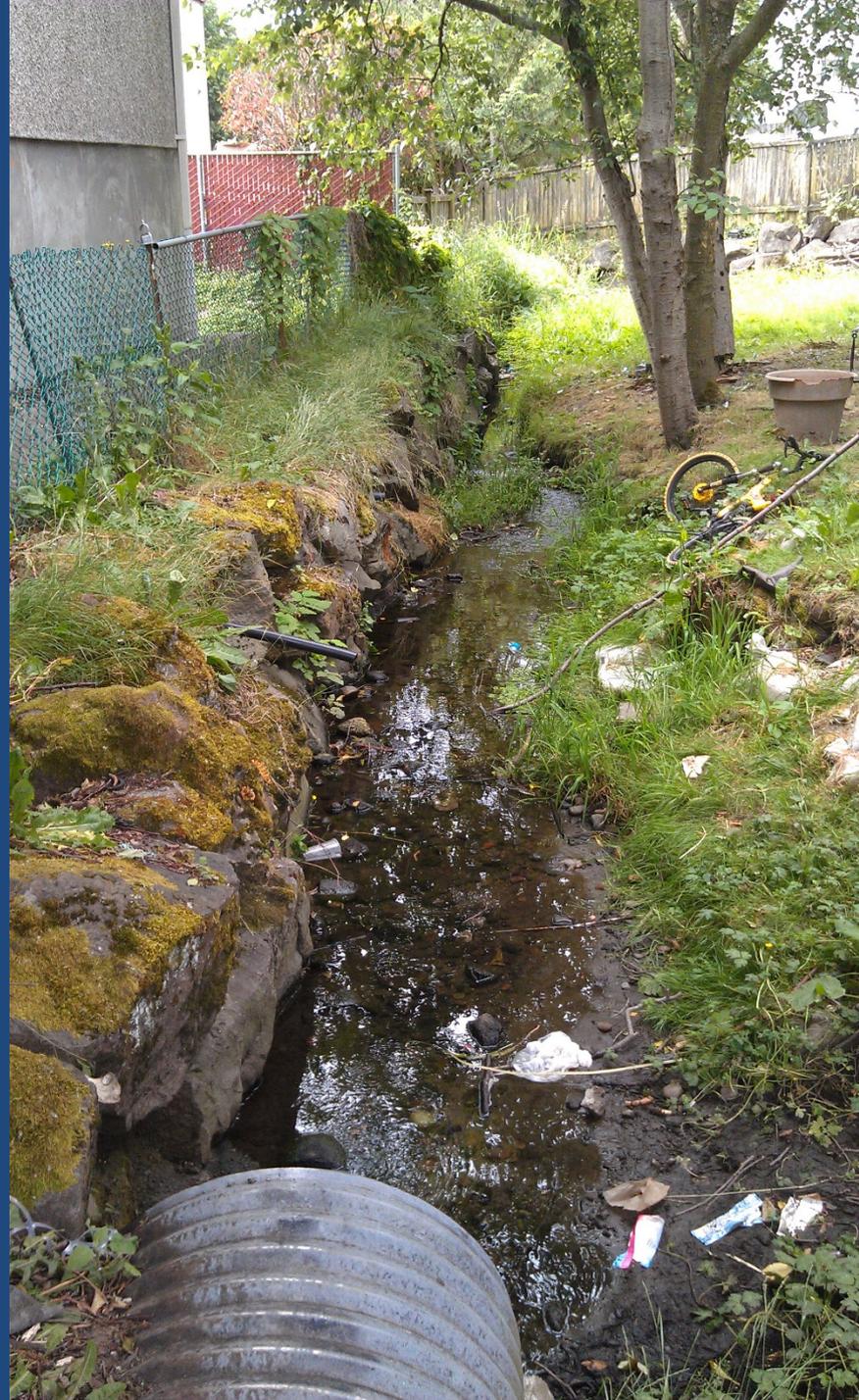
Thornton Creek basin

Coordinated SPU/King County study

**Thornton Creek
Juanita Creek
White Center
Boise Creek**



Questions?



The temperature- conductivity data logger study design:

sanitary sewage has higher conductivity and temperature than ambient stream flow in the Pacific Northwest;

if sewage enters the surface waters, temperature and conductivity will increase;

automated monitoring of temperature and conductivity at a one minute interval, 24 hrs/day may detect ephemeral pulses of sewage entering the surface waters;

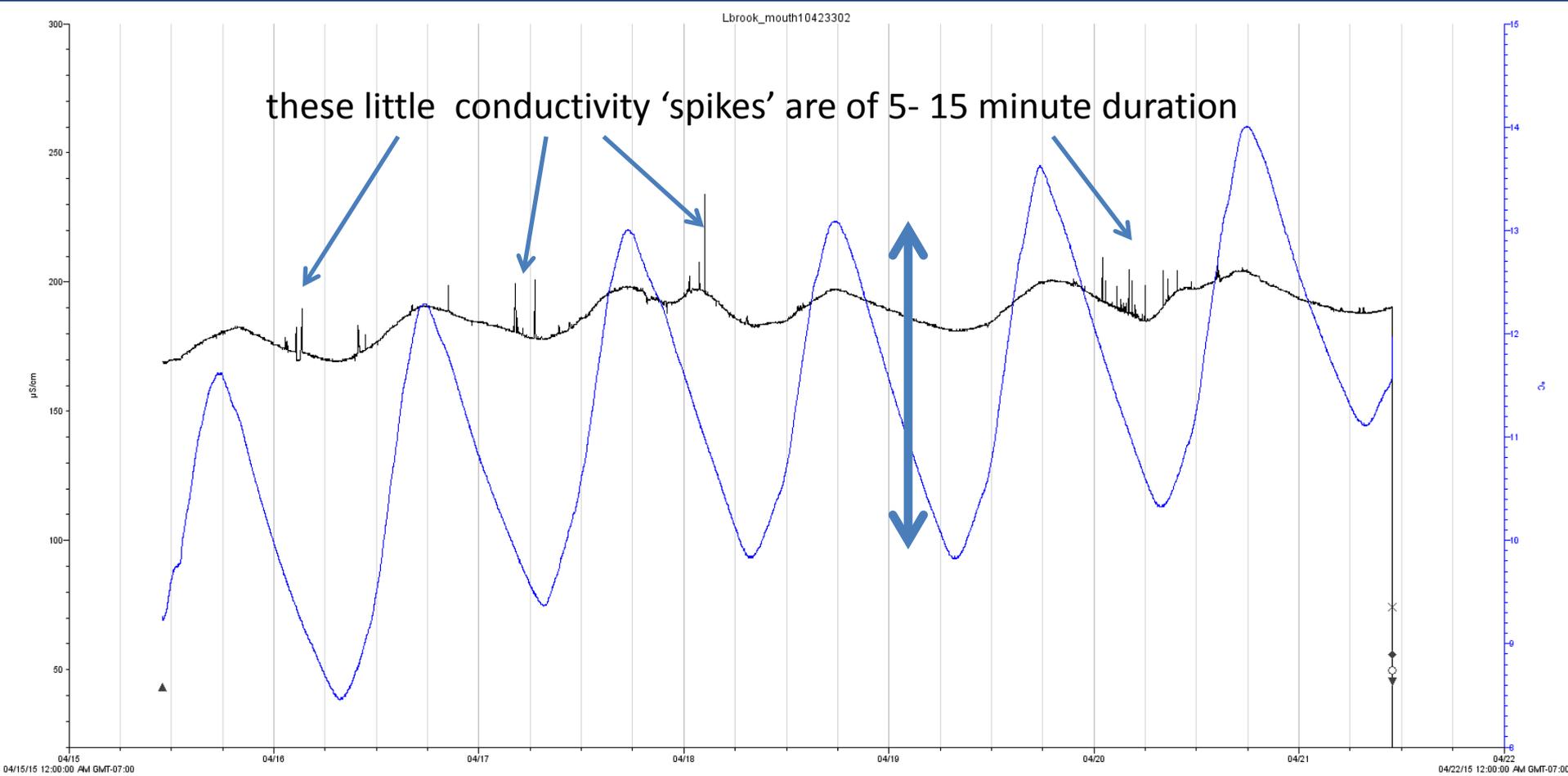
deployment of multiple dataloggers allows for comparison of short stream reaches (re-deployment within suspect can further reduce the suspect bacteria source search area)

using temperature and conductivity instead of direct monitoring of bacteria to track sewage inputs:

- avoids the potential confounding bacteria sources of RV dumping and homeless encampments

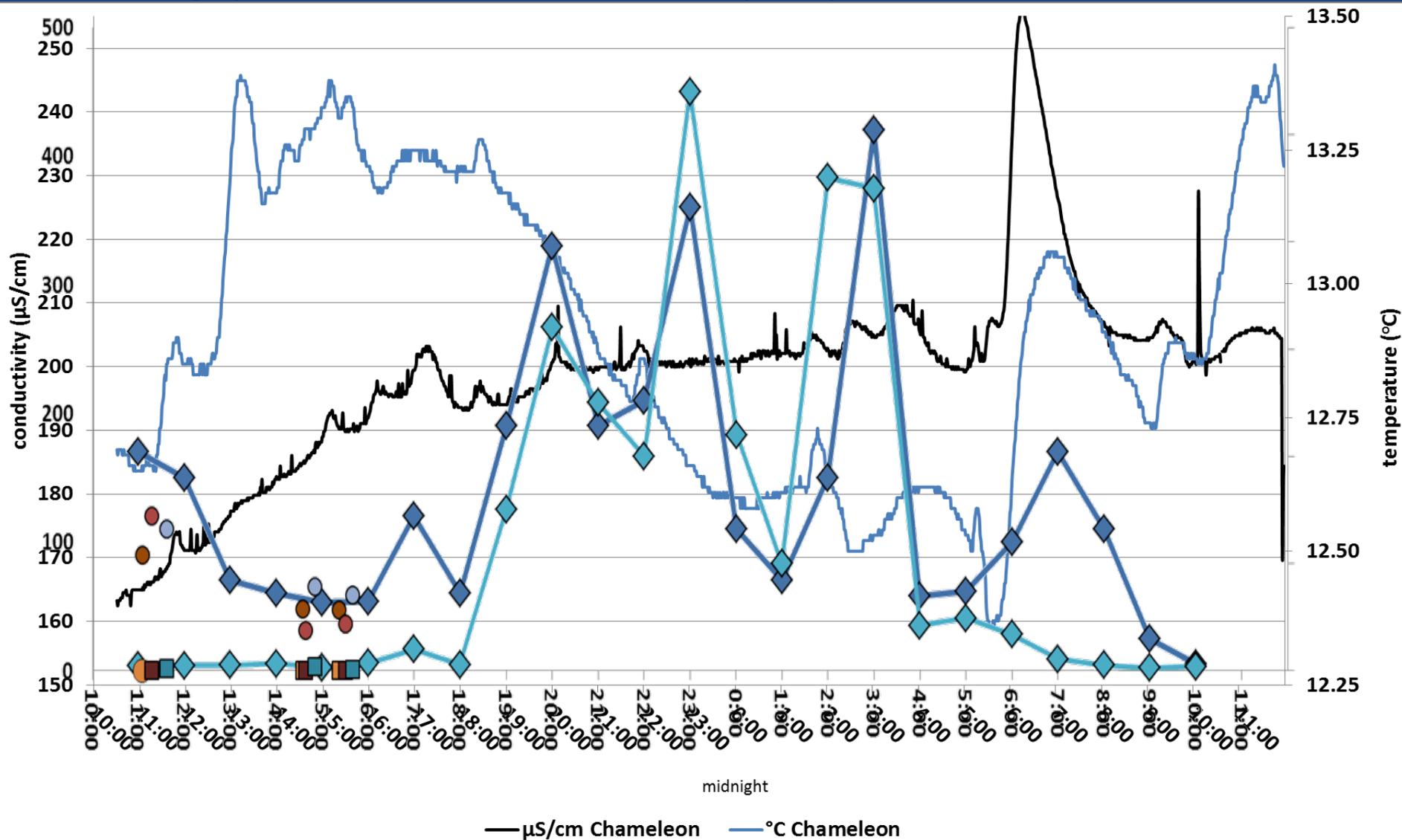
- more frequent, more immediate and less expensive than direct bacteria monitoring

if temperature or conductivity anomalies are detected, automated composite sampling for bacteria (*E.coli* and *Bacteroides*) will be used to determine if the changes in temperature and conductivity are a result of sewage entering the stream segment.



much larger daily swing in temperature in this fully exposed section of Littlebrook Creek

matching up 1 minute interval data with hourly composite data



While it is difficult to have a fully 1:1 match up between the data from the temperature – conductivity loggers and the ISCO composite bacteria data, this technique appears to be a viable inexpensive technique for identifying suspect stream segments in smaller streams