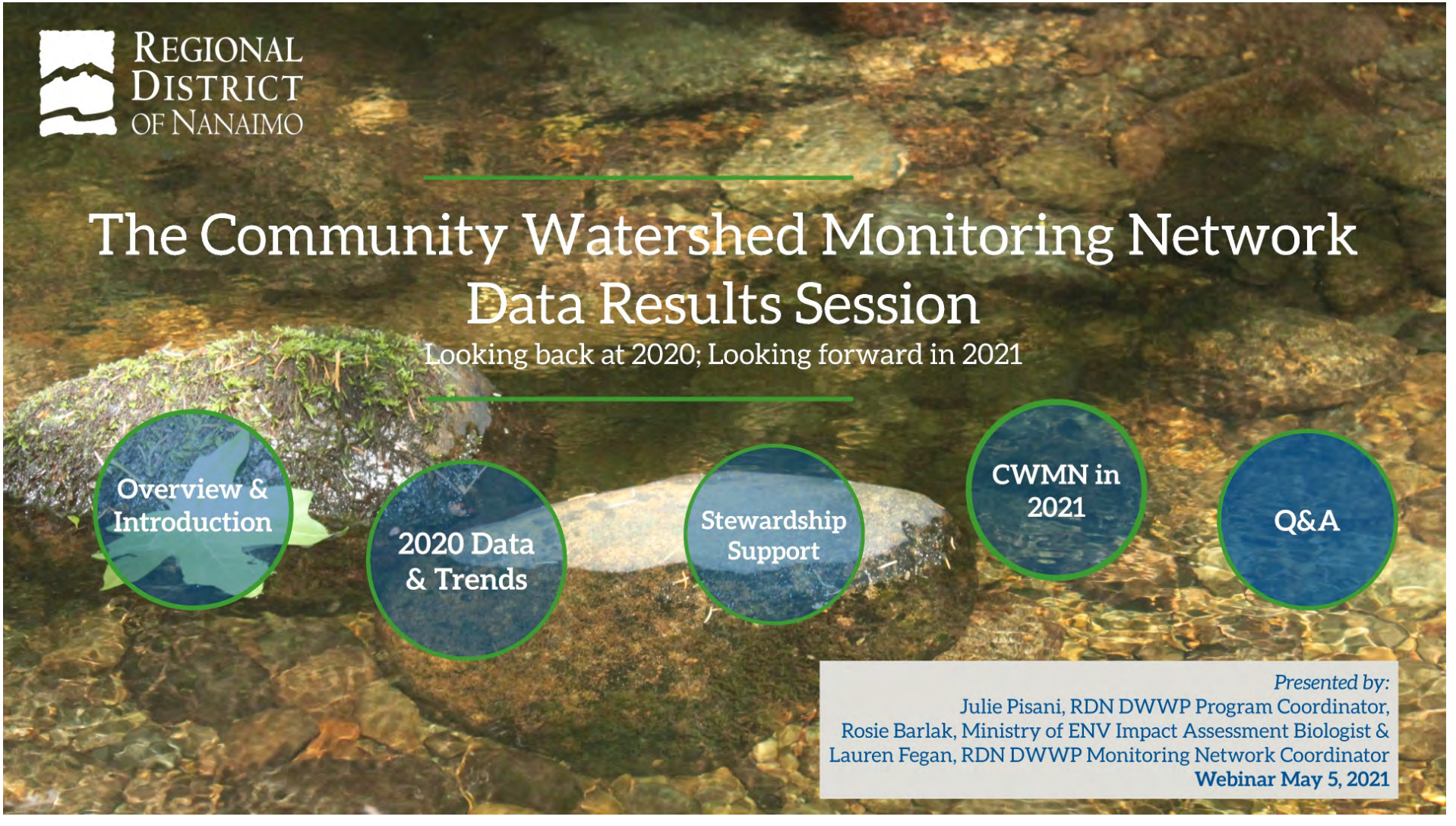

Regional District of Nanaimo
The Community Watershed Monitoring Network
Data Results Session
Looking back at 2020; Looking forward in 2021
Overview & Introduction
2020 Data & Trends
Stewardship Support
CWMN in 2021
Q&A
Presented by:
Julie Pisani, RDN DWWP Program Coordinator,
Rosie Barlak, Ministry of ENV Impact Assessment Biologist &
Lauren Fegan, RDN DWWP Monitoring Network Coordinator
Webinar May 5, 2021

First, some context...

why

RDN's DWWP Program

how

CWMN Background

Partnerships

who

Monitoring Sites

Water Quality Parameters

Guidelines & Objectives

what

where

Drinking Water & Watershed Protection Program

- Parcel tax funded regional program established in 2008, implemented in 2009.
- Delivers science, education, and planning initiatives focused on water sustainability in the RDN.
- DWWP Action Plan 2.0 2020 - 2030 now underway.

Community Watershed Monitoring Network

- Started with shared goal to increase knowledge and understanding of surface water quality in the region.
- Monitoring program began in 2011, designed with provincial protocols and methodologies.
- Partnership between Ministry of Environment & Climate Change Strategy (ENV), RDN DWWP, Streamkeeper volunteers, & private forestry.
- Streams sampled during 2 seasonal periods (summer low flow & fall flush), 5 consecutive weeks each.
- Sites chosen to fill data gaps in provincial monitoring networks, based on local knowledge of Streamkeepers.
- All data entered and stored in publicly accessible, provincially managed database - Environmental Monitoring System (EMS).

Partners

Community Stewardship Groups: attend annual training, perform equipment calibrations & all sampling, provide local knowledge.

Streamkeepers

RDN DWWP: manage equipment, provide technical support & coordination, deliver training, data entry, summarize results.

Surface Water Quality Data: prioritization of efforts, land use planning support, funding applications support, increased awareness.

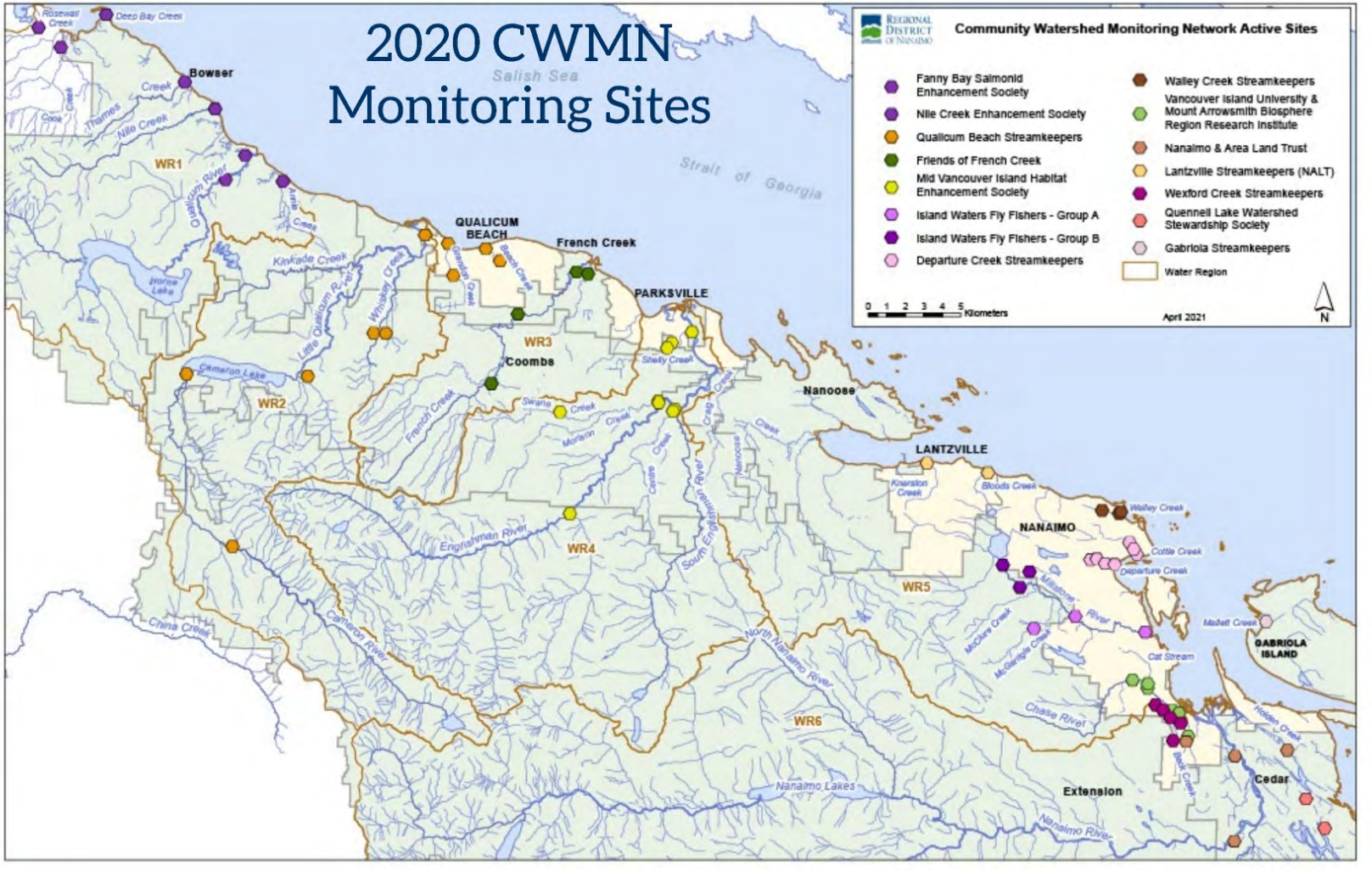
BC ENV: provide technical support, training & sampling protocols, data review, manage database and data portal.

Mosaic Forest Mgmt: provide safety gear, land access to upper watershed sites, sponsor QA/QC lab analysis.

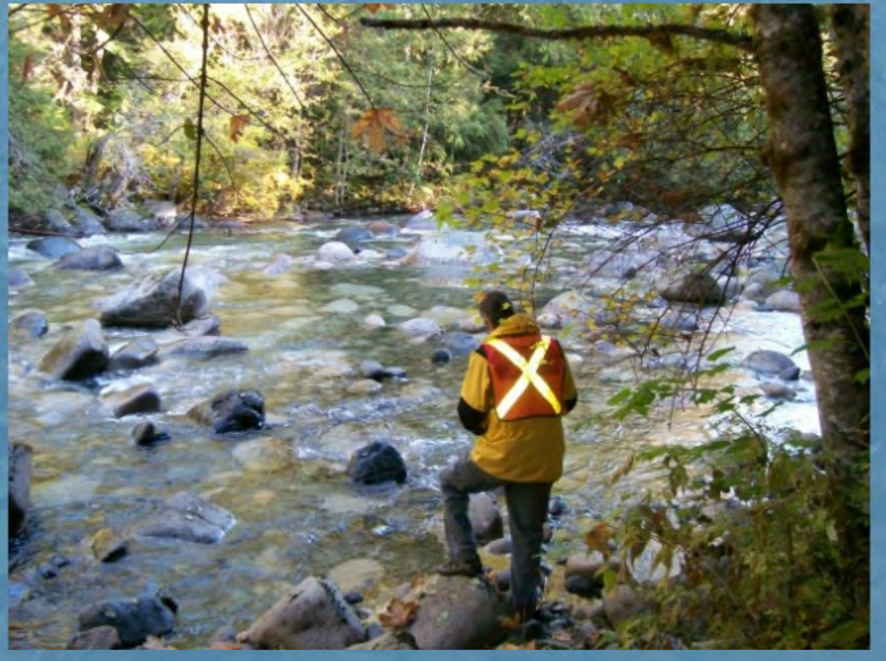
Community Stewardship Groups

- Departure Creek Streamkeepers (DCS)
- Fanny Bay Salmonid Enhancement Society (FBSES)
- Friends of French Creek Conservation Society (FFCCS)
- Gabriola Streamkeepers (GSk)
- Island Waters Fly Fishers (IWFF - 2 groups)
- Lantzville Streamkeepers (LS)
- Nanaimo and Area Land Trust (NALT)
- Nile Creek Enhancement Society (NCES)
- Mid Vancouver Island Habitat Enhancement Society (MVIHES)
- Qualicum Beach Streamkeepers (QBS)
- Quennell Lake Watershed Stewardship Society (QLWSS)
- Walley Creek Streamkeepers (WCS)
- Wexford Creek Streamkeepers (WxCS)
- Vancouver Island University & Mount Arrowsmith Biosphere Region Research Institute (VIU & MABRRI)

Thank you!


2020 CWMN
Monitoring Sites
Salish Sea
Strait of Georgia
Community Watershed Monitoring Network Active Sites
Regional District of Nanaimo
Fanny Bay Salmonid Enhancement Society
Nile Creek Enhancement Society
Qualicum Beach Streamkeepers
Friends of French Creek
Mid Vancouver Island Habitat Enhancement Society
Island Waters Fly Fishers - Group A
Island Waters Fly Fishers - Group B
Departure Creek Streamkeepers
Walley Creek Streamkeepers
Vancouver Island University & Mount Arrowsmith Biosphere Region Research Institute
Nanaimo & Area Land Trust
Lantzville Streamkeepers (NALT)
Wexford Creek Streamkeepers
Quennell Lake Watershed Stewardship Society
Gabriola Streamkeepers
Water Region
0 1 2 3 4 5 Kilometers
April 2021
N
Bowser
QUALICUM BEACH
French Creek
PARKSVILLE
Coombs
Nanoose
LANTZVILLE
NANAIMO
GABRIOLA ISLAND
Cedar
Extension
WR1
WR2
WR3
WR4
WR5
WR6
Deep Bay Creek
Rosewall Creek
Thames Creek
Nile Creek
Qualicum River
Horne Lake
Cameron Lake
Little Qualicum River
Whiskey Creek
Kinkade Creek
French Creek
Englishman River
China Creek
Cameron River
Shelly Creek
Craig Creek
Morison Creek
Centre Creek
South Englishman River
Nanoose Creek
Knarston Creek
Bloods Creek
Walley Creek
Cottle Creek
Departure Creek
Millstone River
Mallett Creek
Cat Stream
McClure Creek
McGarrigle Creek
North Nanaimo River
Chase River
Haslam Creek
Beck Creek
Nanaimo Lakes
Nanaimo River

Water Quality Monitoring Parameters



- Water Temperature
  - Alters physical and chemical properties of water, e.g., DO, CO_2, pH, conductivity, etc.
  - Affects metabolic rates of aquatic organisms.
- Dissolved Oxygen
  - Supports aquatic life.
  - Decreases as temperature increases, also influenced by BOD, water turbulence and amount of flow.
- Specific Conductivity
  - Amount of dissolved minerals, corrected to 25°C.
  - Increases with temperature, turbidity, groundwater, evaporation, saline inputs (e.g., tidal, roads, agri., etc.).
- Turbidity
  - Suspended particles in water column.
  - Correlated to water temperature.
  - Linked to erosion, contaminants, stormwater, etc.
  - Quality assurance-quality control lab analysis.

Objectives & Guidelines

Water Quality Objective (WQO)

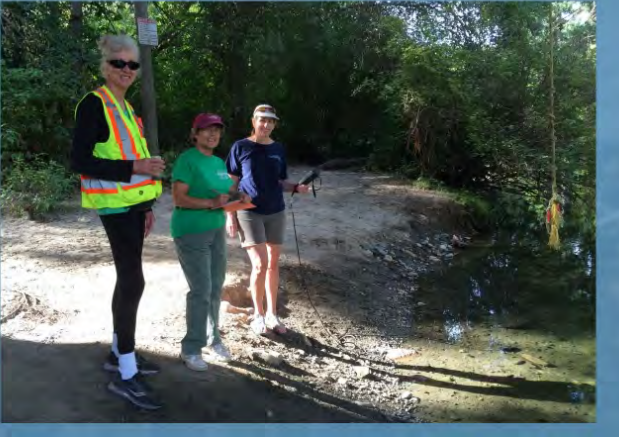
- Developed by the Province for specific water bodies.
- To manage protect specific water uses in that watershed.
- e.g., Englishman River Aesthetic Water Temperature Objective ≤15°C.

Water Quality Guideline (WQG)

- Developed by the Province for B.C.'s aquatic resources and the protection of aquatic life, wildlife, agriculture, drinking water sources, and recreation.
- To assess and manage the health, safety and sustainability of freshwater.
- e.g., Coho Rearing Water Temperature Guideline ≤17°C.

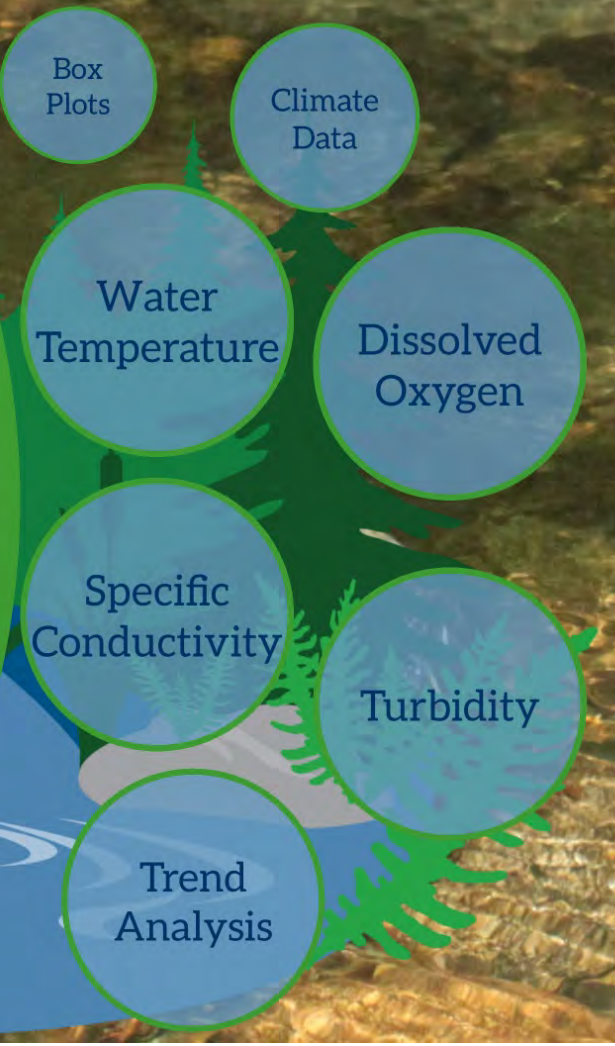
CWMN Data

- Sites with data exceeding WQO's & WQG's flagged for further investigation - physical stream assessments, lab analysis, etc.
- Regular reporting of results publicly available: **www.rdn.bc.ca/cwmn**
  - Annual reports/summaries since 2011.
  - Milestone reports:
    - 3 year trend reports (2013, 2014, 2015).
    - 7 year trend report (2018).
    - CWMN trend & data analysis (2021).

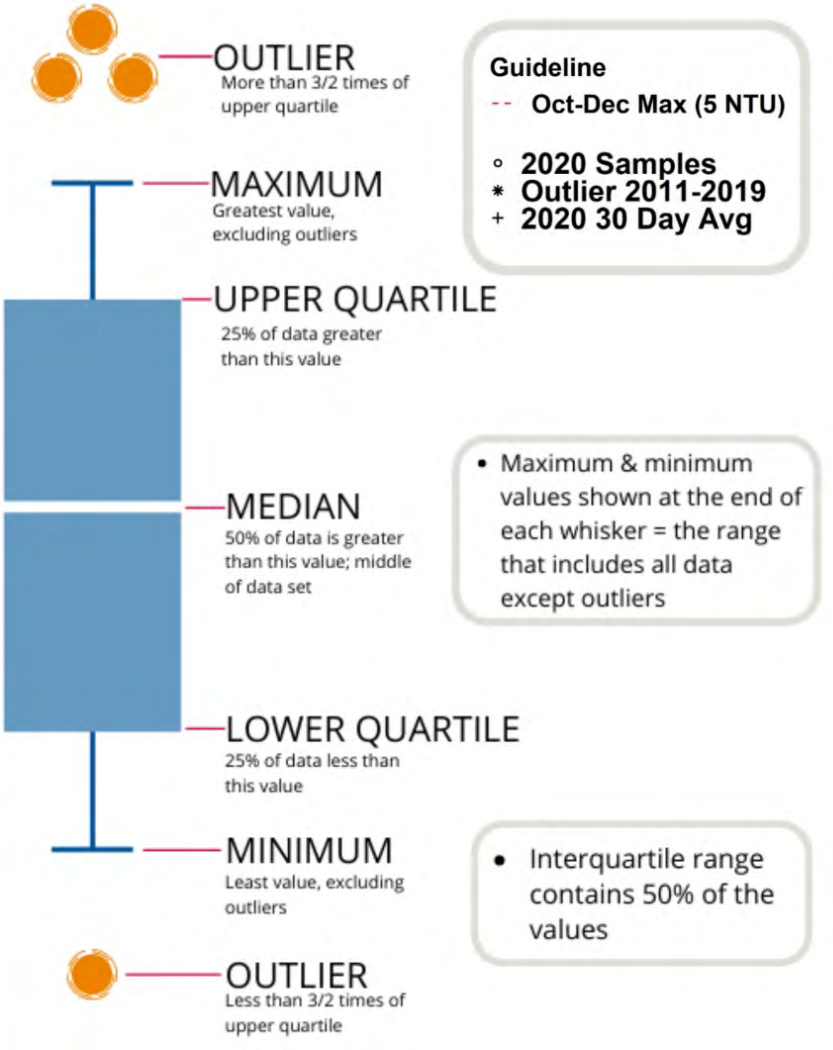


2020 CWMN Data

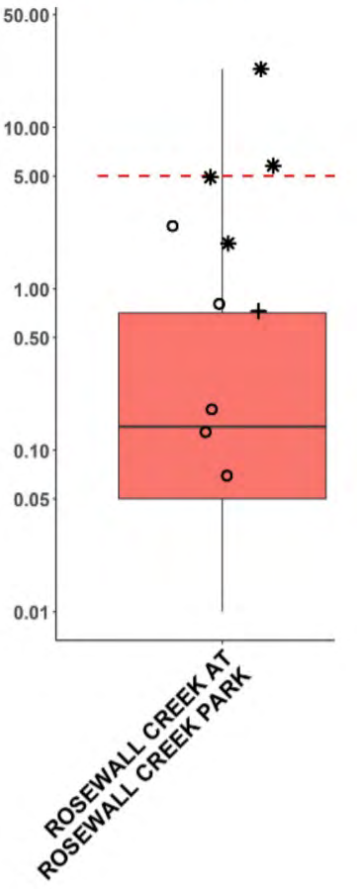
- 67 surface water quality sites sampled on 41 streams in 26 watersheds.
- 4 new sites added in Water Regions 5 & 6.
- Engaged Ecoscape to complete trend analysis on 2011-2020 data. Subset of data shown in this presentation; see 2021 Report for all data.
- 47 sites had 6yrs+ data for trend analysis.
- No lab analysis was completed in 2020 due to COVID-19 precautions and uncertainties.



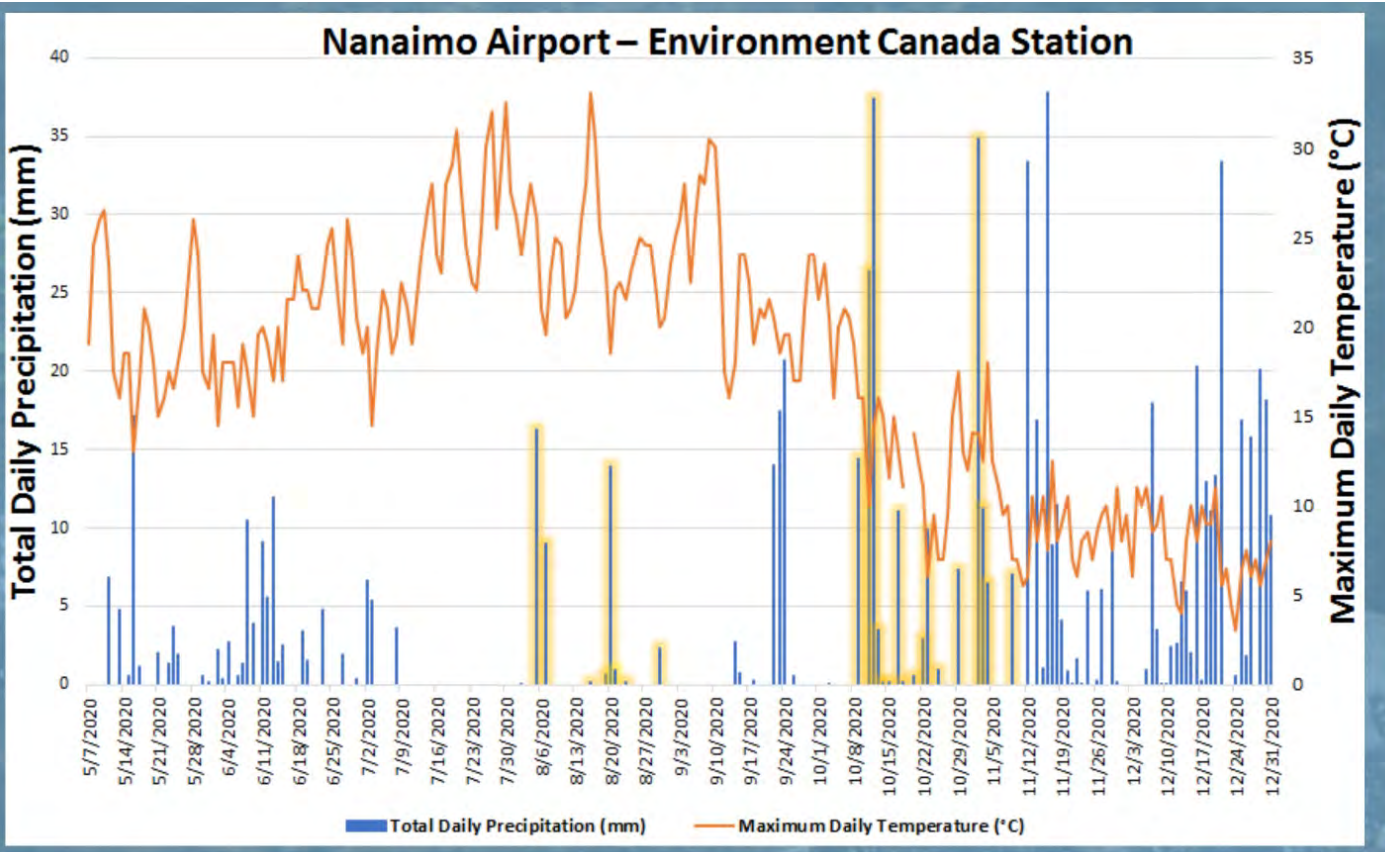
How to Interpret a Box Plot



Turbidity (NTU) Example:



SOUTH END



Summer Sample Period Maximum Daily Averages:
2014 - 24.8°C
2015 - 25.2°C
2016* - 26.0°C
2017 - 26.9°C
2018 - 25.8°C
2019 - 24.8°C
2020 - 24.5°C

*only 16 dates with temperature data.

Fall Sample Period: Rainfall is Associated with Turbidity Spikes.

2014 rainfall:
22.6 mm Summer
(Aug 1 – Sept 10)
282.2 mm Fall
(Oct 1 – Nov 12)

2015 rainfall:
22.1 mm Summer
(Aug 1 – Sept 1)
116.7 mm Fall
(Oct 1 – Nov 11)

2016 rainfall:
23.4 mm Summer
(Aug 1 – Aug 31)
379.2 mm Fall
(Oct 1 – Nov 8)

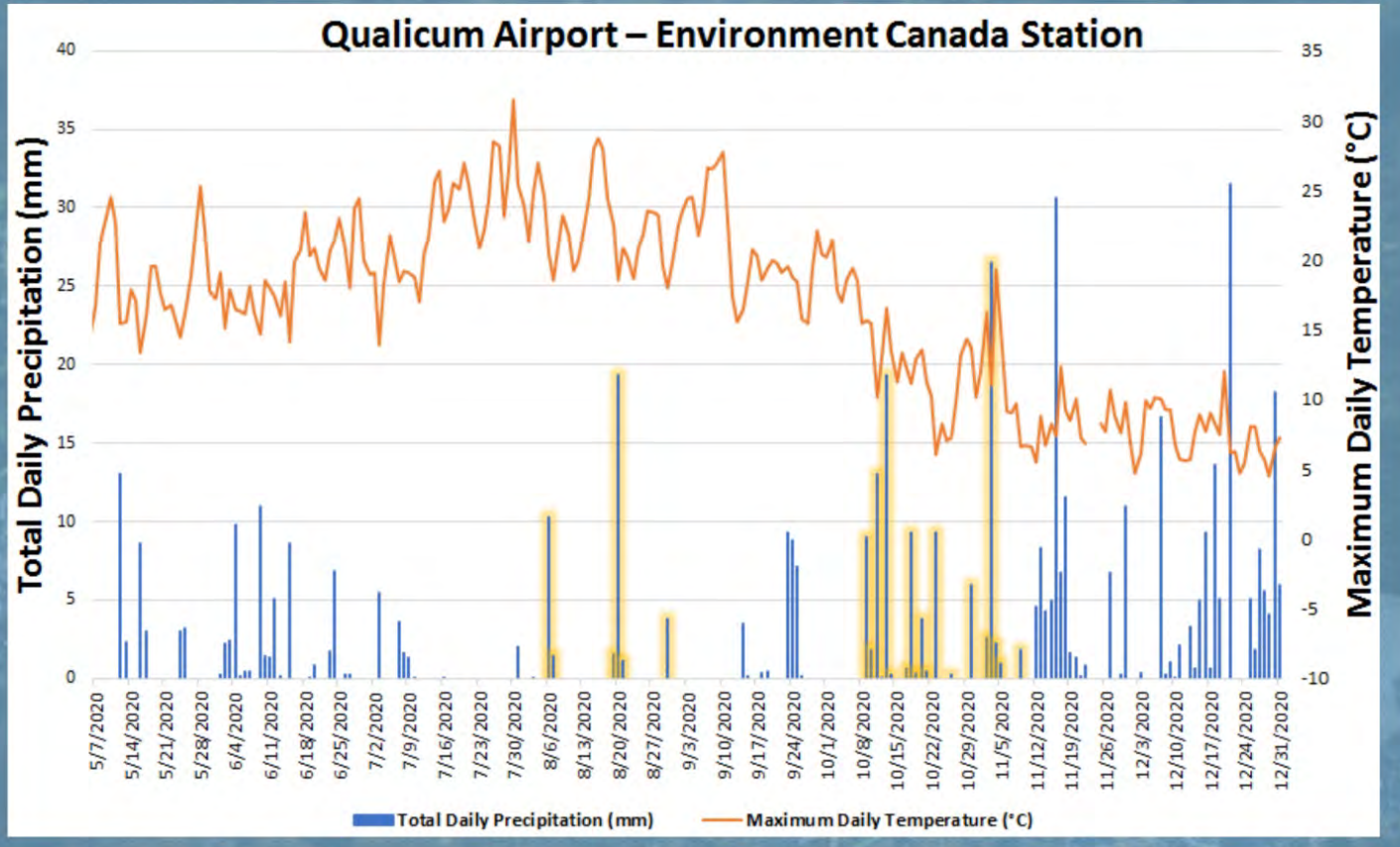
2017 rainfall:
3 mm Summer
(Aug 1 – Aug 31)
336.4 mm Fall
(Oct 1 – Nov 21)

2018 rainfall:
3 mm Summer
(Aug 1 – Aug 31)
109.1 mm Fall
(Oct 1 – Nov 6)

2019 rainfall:
24.6 mm Summer
(Aug 1 – Sept 10)
74.1 mm Fall
(Oct 1 – Nov 5)

2020 rainfall:
43.7 mm Summer
(Aug 1 – Sept 10)
174.9 mm Fall
(Oct 1 – Nov 10)

NORTH END



Summer Sample Period Maximum Daily Averages:
2014 - 23.7°C
2015 - 23.0°C
2016 - 24.2°C
2017 - 25.3°C
2018 - 24.7°C
2019 - 23.2°C
2020 - 22.8°C

Fall Sample Period: Strongest Turbidity Association to Rainfall within 24 hours of sample.

2014 rainfall:
29.4 mm Summer
(Aug 1 – Sept 10)
187.5 mm Fall
(Oct 1 – Nov 12)

2015 rainfall:
24.0 mm Summer
(Aug 1 – Sept 1)
82.3 mm Fall
(Oct 1 – Nov 11)

2016 rainfall:
15.7 mm Summer
(Aug 1 – Aug 31)
252.2 mm Fall
(Oct 1 – Nov 8)

2017 rainfall:
3.5 mm Summer
(Aug 1 – Aug 31)
257.2 mm Fall
(Oct 1 – Nov 21)

2018 rainfall:
0.8 mm Summer
(Aug 1 – Aug 31)
53 mm Fall
(Oct 1 – Nov 6)

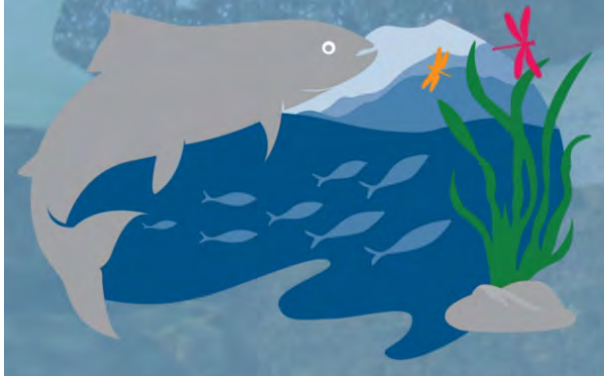
2019 rainfall:
14.3 mm Summer
(Aug 1 – Sept 10)
57.3 mm Fall
(Oct 1 – Nov 5)

2020 rainfall:
37.6 mm Summer
(Aug 1 – Sept 9)
107.9 mm Fall
(Oct 1 – Nov 10)

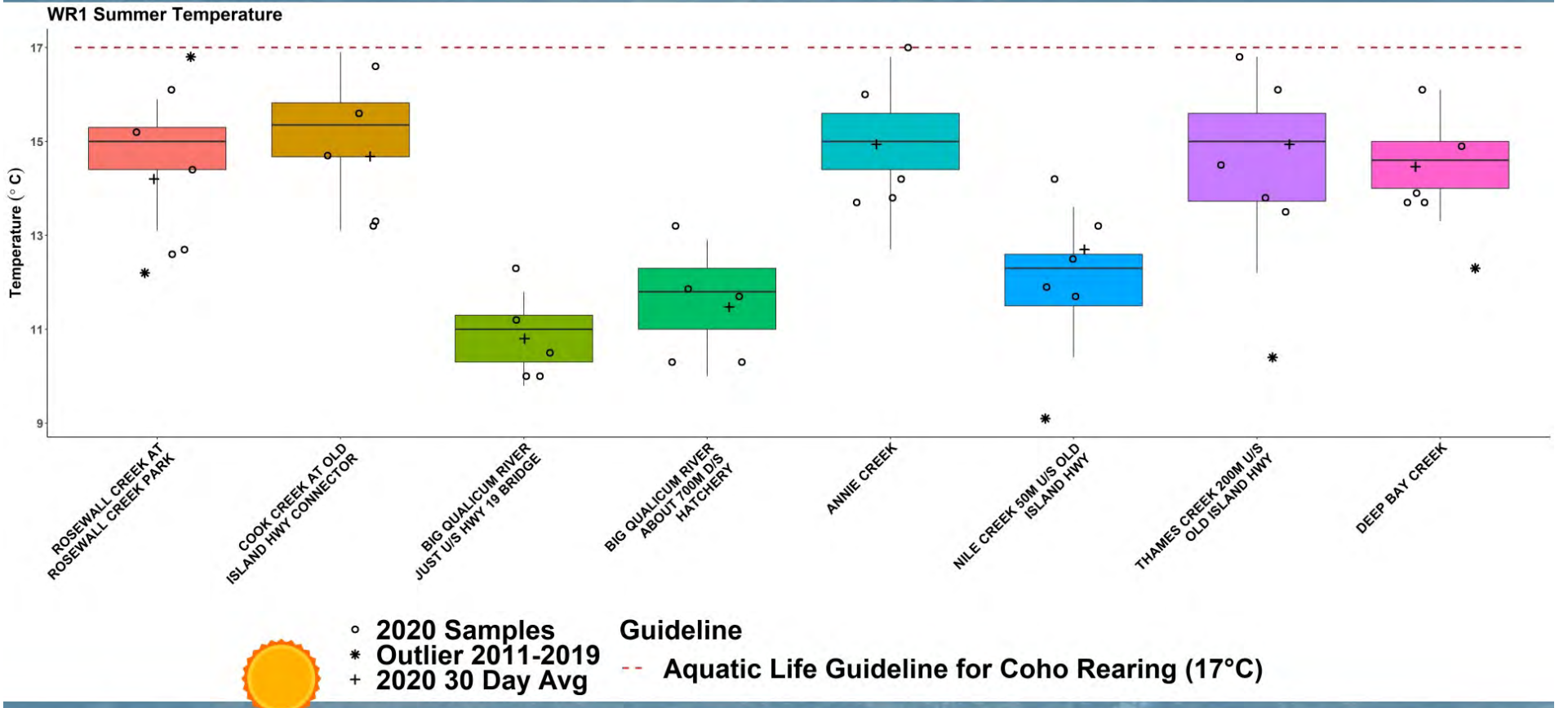
Water Temperature

Exceedances recorded in summer low-flow sample period.

- **Englishman River aesthetic drinking water temperature (temp) objective = weekly average ≤15°C.**
- **Aquatic life temp guideline = weekly average ≤17°C for Coho rearing.**

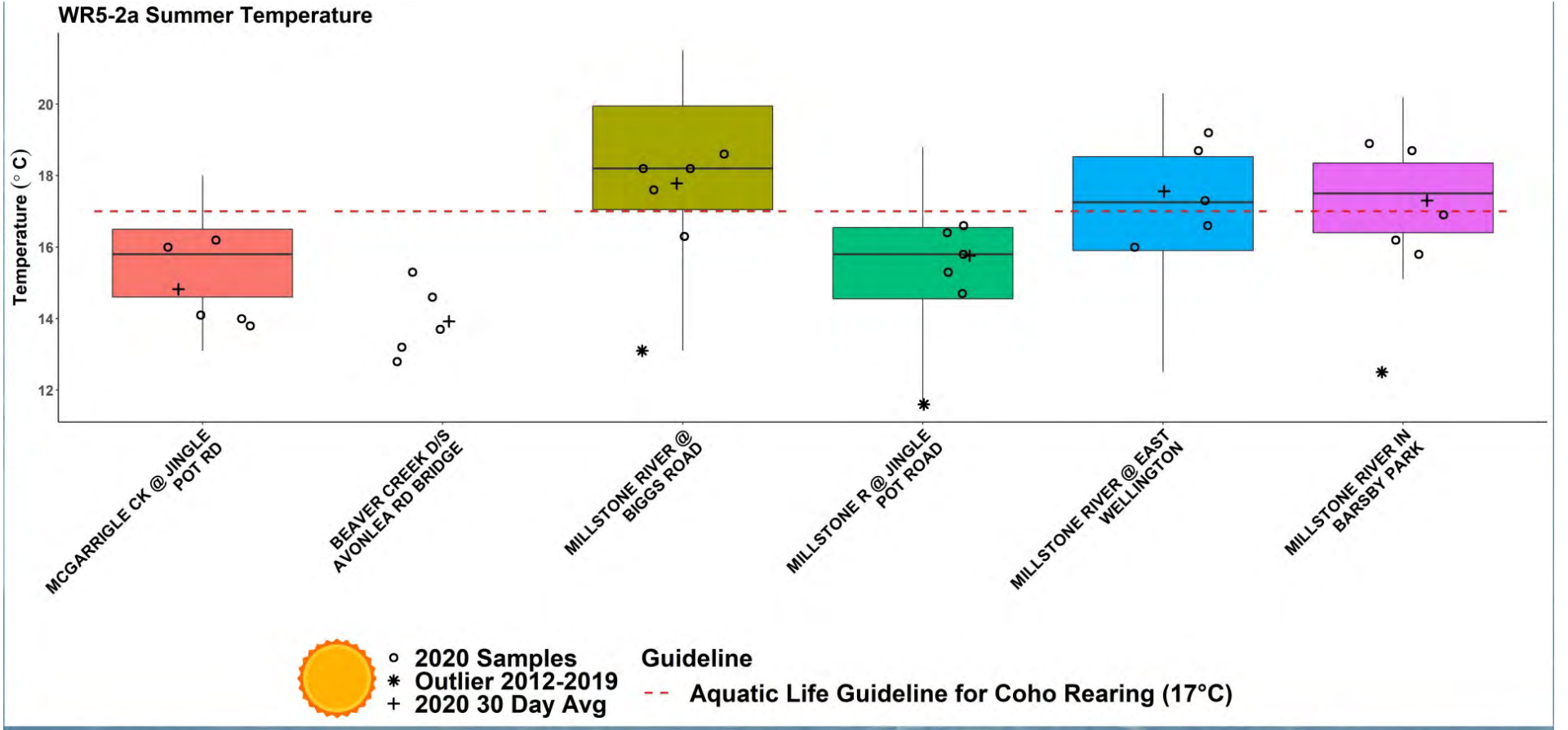


- Affects metabolic rates of aquatic organisms.
- Can alter physical and chemical properties of water (e.g., dissolved oxygen, pH, conductivity).
- **Influenced by air temperature, stream exposure (canopy cover, riparian vegetation), hydraulic connectivity (groundwater - surface water interaction), stream flow and physical attributes.**

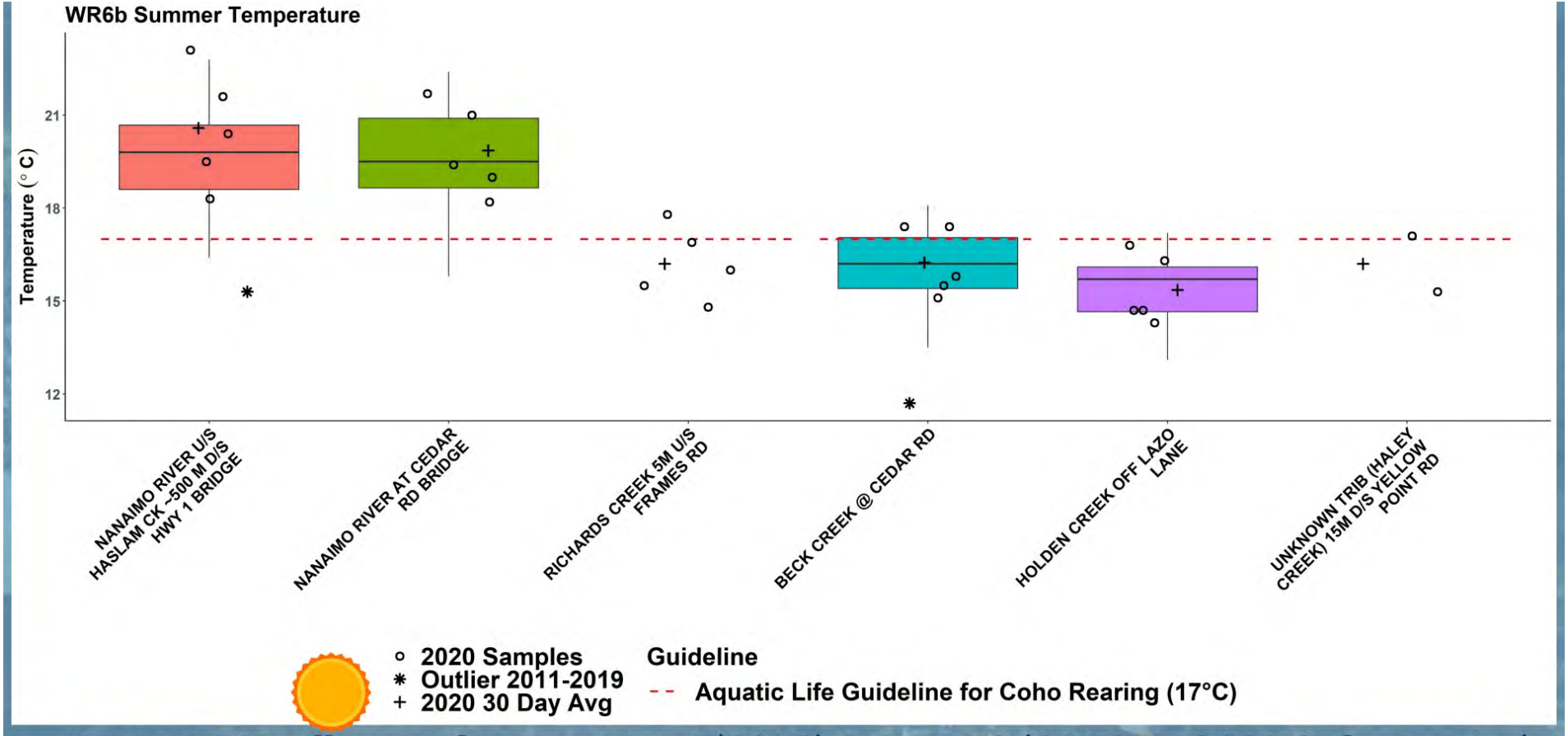


- *Majority of creeks in WR 1 exhibit seasonal summer water temps.*
- *Cooler inputs maintain cooler summer water temps:*

Big Qualicum Horne Lake fed from different depths & Nile Creek groundwater source.



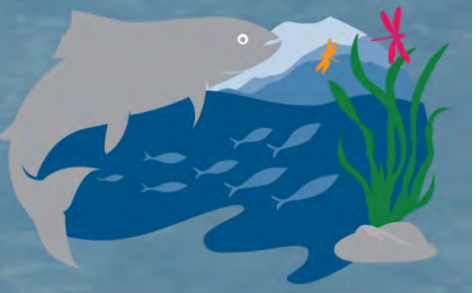
- *Upstream inputs & riparian coverage key factors in summer water temps: temperature exceedances at all Millstone River sites except Jingle Pot.*



- *Across WR, all exceedances Aug. 4 (28°C) & Aug. 18 (25.5°C, >30°C 2-days prior).*
- *Consistently higher temps at Nanaimo River - minimal riparian cover, wide and more shallow portions, & air temps resulting in higher water temps?*

Water Temperature

Exceedances recorded in summer low-flow sample period.



- Aquatic life temp guideline = weekly average ≤17°C.
- Influenced by air temp, upstream inputs, & physical stream characteristics (riparian, stream structure, etc.).
- 76% of summer values ≥17°C occurred on Aug. 4 *(Nan: 28°C & QB: 26.9°)* & Aug. 18 *(Nan: 25.5°C, >30°C 2-days prior & QB: 24.4°C, >28°C 2-days prior)*.
- Watercourses in **bold** below also had potential to exceed in 2019 as well.

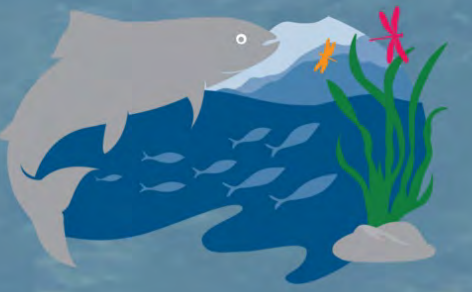
Watercourses with the Potential to Exceed Aquatic Life Temp Guideline

Annie Creek	*Englishman River*	***Nanaimo River***
Beck Creek	*French Creek*	*Richards Creek*
Centre Creek	***Holden Creek***	***Shelly Creek***
Cat Stream	***Little Qualicum River***	***S. Englishman River***
Chase River	*Morrison Creek*	***Walley Creek***
Cottle Creek	***Millstone River***	

Water Temperature

Exceedances recorded in summer low-flow sample period.

- Influenced by air temp, upstream inputs, & physical stream attributes.



- Air temp and rainfall vary year to year.

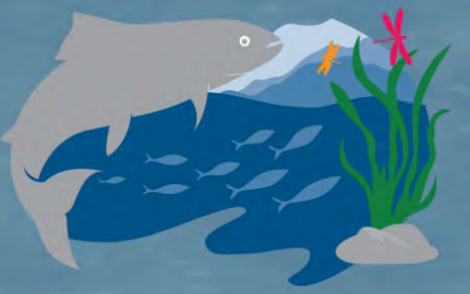
% Summer Values ≥17°C per Year Compared to Summer Air Temp & Precipitation Averages

Year	% ≥17°	Avg °	Total precip.
2014	29.2%	24.3°	26.0 mm
2015	22.7%	24.1°	23.1 mm
2016	21.2%	25.1°	19.6 mm
2017	28.4%	26.1°	3.3 mm
2018	18.7%	25.3°	1.5 mm
2019	15.9%	24.0°	19.3 mm
2020	15.5%	23.7°	40.7 mm

- During 2020 sampling, weather was cooler and experienced more rainfall than in previous years.

Temperature WQG

- *Natural to have variation across / within a watercourse.*
- *Deep pools, groundwater inflow, etc. create cool refuges from temp exceedances for juvenile salmon, supporting survival.*



Generally:

- *Urbanized streams tend to have higher temp averages.*
- *Exceedances of temp WQG more common in lower reaches (i.e., wide and shallow, more developed, accumulation of inputs).*

Understanding temp exceedances:

- *Mapping features to locate water bodies u/s, riparian vegetation, salmon refuges, etc.*
- *Desktop studies & physical stream assessments.*

Addressing temp exceedances:

- *Riparian enhancement & restoration.*
- *Groundwater conservation programs & actions.*
- *Offsetting climate change impacts.*

Dissolved Oxygen

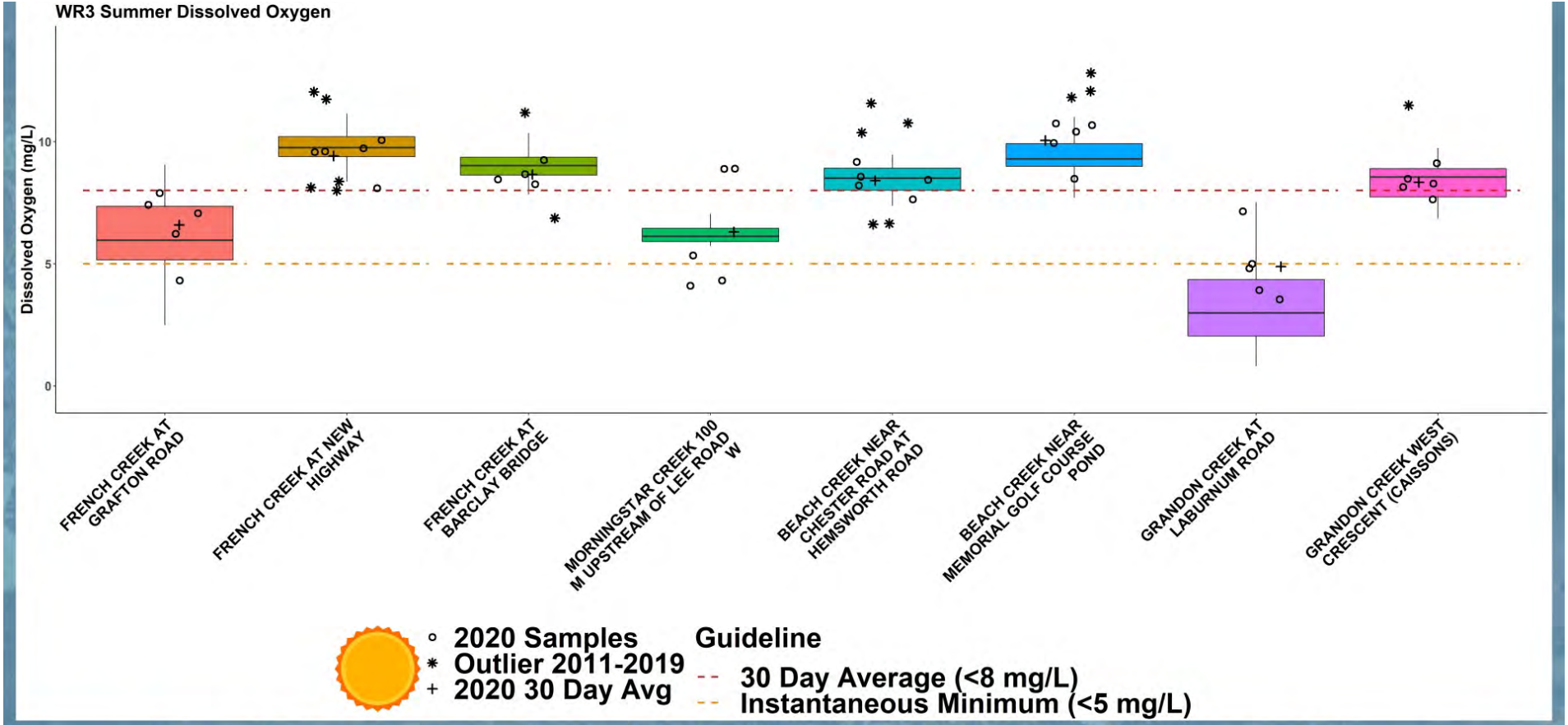
Exceedances most often recorded in summer low-flow sample period.

Occasional exceedances in fall sample period at sites with very low flow.

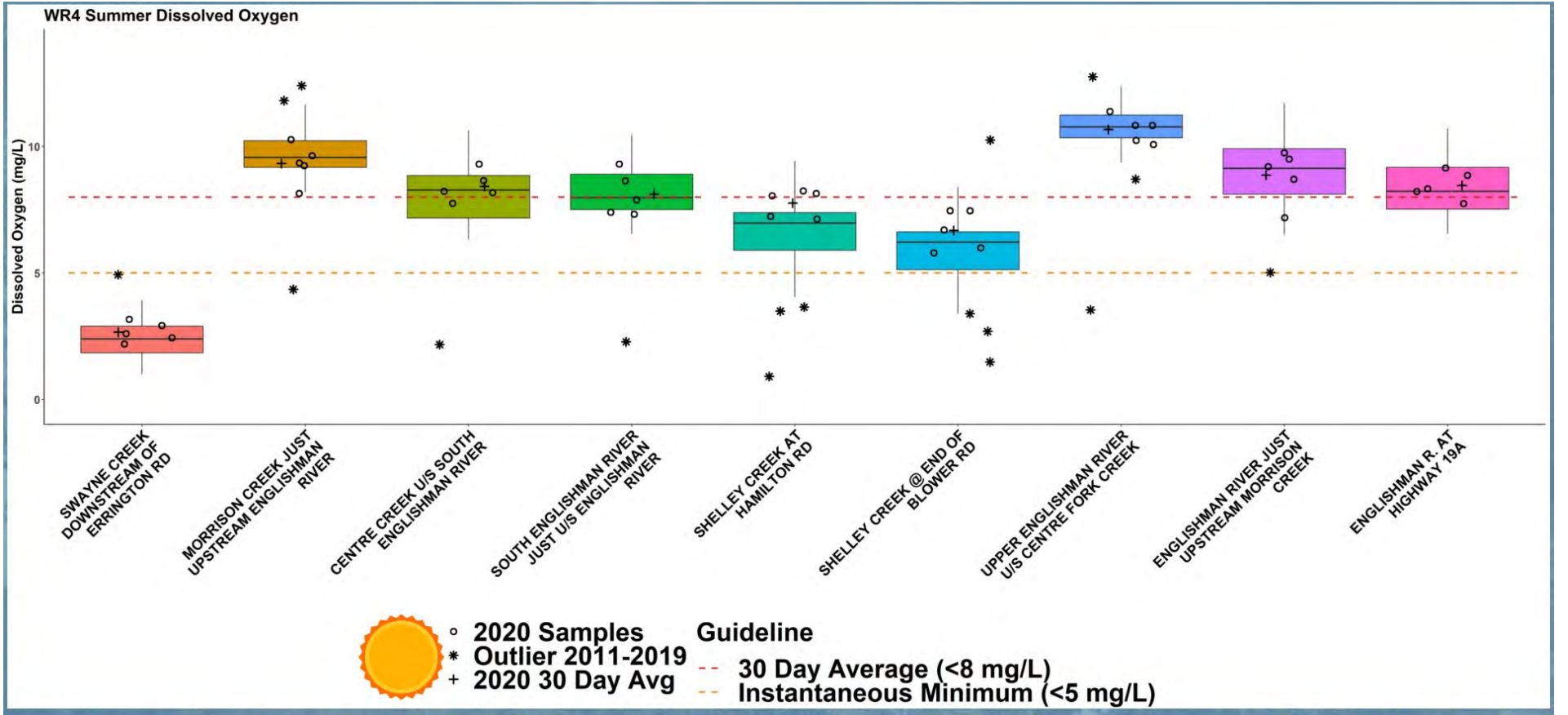
Dissolved Oxygen (DO) Aquatic Life WQG's:

- **5-in-30 day average should be at or above 8 mg/L.**
- **All readings should be above 5 mg/L (instantaneous minimum).**

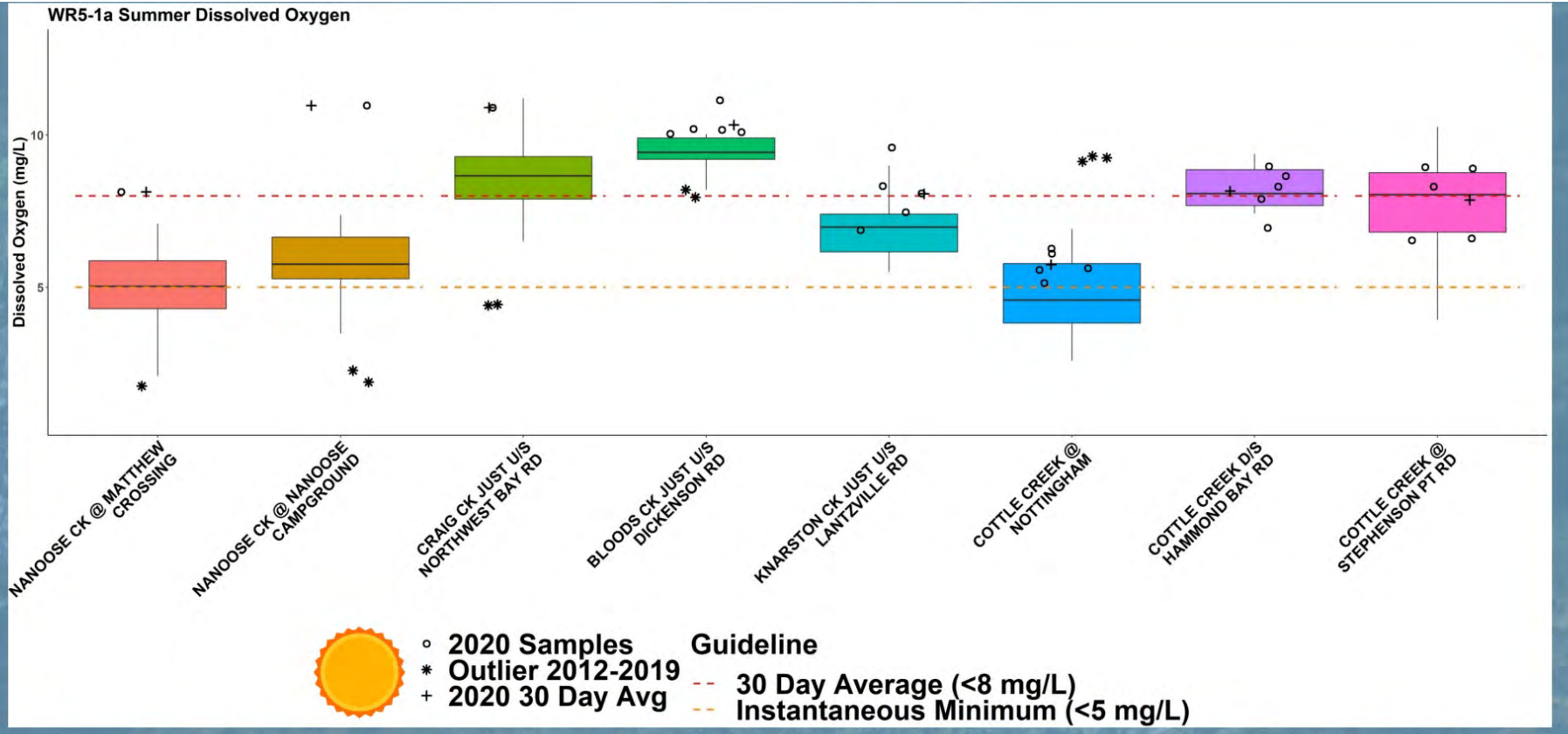
- Supports aquatic life.
- Most pristine coastal streams average >8 mg/L.
- **Influenced by water temp** (O_2 solubility decreases as temp increases); **photosynthesis** (O_2 produced); **BOD** (O_2 consumed); **water turbulence** (increases O_2 absorption); **and amount of flow** (related to temp & turbulence).



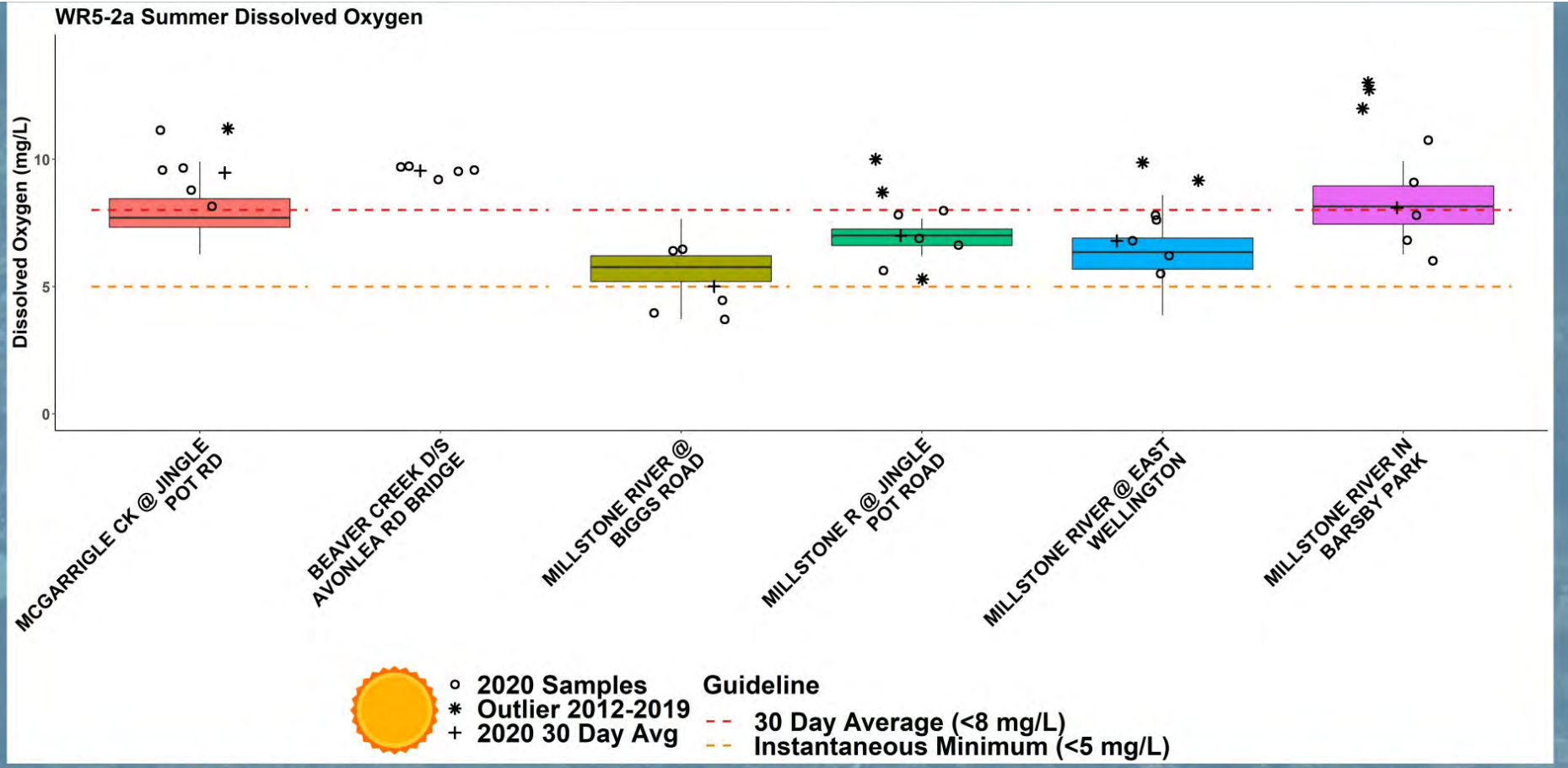
- *Exceedances seen at sites with low flow, limited riparian cover and stream structure, and upstream agricultural / high-nutrient land use.*
- *Occurred on dates with high air and warmer water temps (Aug. 4, 18 and 25).*



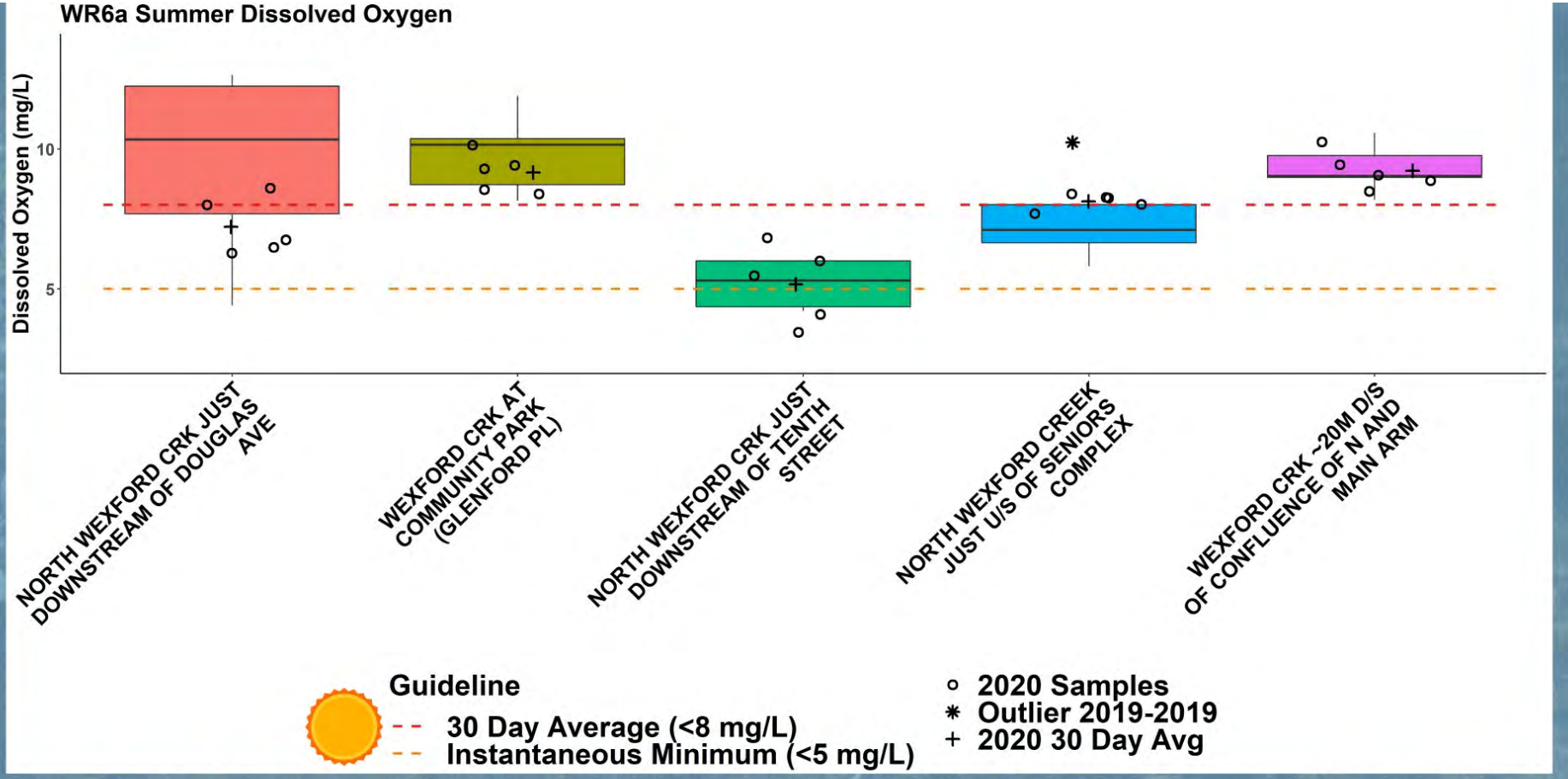
- *Exceedances at Swayne Creek in both summer and fall periods, most likely due to limited stream structure and low flows.*
- *Both Shelly Creek sites continuing to slightly improve - result of restoration efforts.*



- *Nanoose sites sampled on Sept. 1 only, small rain event & lower air temps.*
- *Bloods & Knarston had slightly better DO in 2020 - cooler air temps & more precip?*
- *Cottle at Nottingham, field notes report slightly better flow than previous years.*
- *Other Cottle sites recorded lowest DO the last 2 wks of period - related to flow as well?*



- *McGarrigle had higher than normal DO values - is this site more influenced by climate?*
- *First year of data for Beaver Creek, outflow of Divers Lake and tributary to Millstone.*
  - *All Millstone sites except Barsby (avg 8.09mg/L) were below 30-day avg (8 mg/L).*



- *North Wexford Creek has had lower DO values in 2019 & 2020 - stream characteristics?*
- *Main-stem of Wexford higher DO values - upper site located in Community Park & lower site is below confluence and has more turbulence & mixing of water column.*

Dissolved Oxygen

Sites with Values Below the DO Instantaneous Minimum Guideline (5 mg/L):

French at Grafton
Grandon at Laburnum
Holden d/s Tiesu
Millstone at Biggs
Morningstar Creek
N. Wexford at 10th
Swayne at Errington
Walley at Morningside

Bolded *sites above had values <5mg/L in 2018, 2019 & 2020.*

- *All values ≤5mg/L were during summer period when water temperatures were above 13°C.*
- *Holden d/s Tiesu was only site below this value in fall period - very low flow.*

DO Aquatic Life Guidelines:

- **5-in-30 day avg ≤8 mg/L.**
- **Instantaneous min ≤5 mg/L.**

- *Exceedances most often in summer low-flow period.*
- *Occasionally in fall period at sites with very low flow.*

Dissolved Oxygen

Sites with Values Below the 8 mg/L 30-day Average:

French at Grafton
Grandon at Laburnum
Millstone at Biggs
Morningstar Creek
N. Wexford at Tenth
Swayne at Errington
Walley at Morningside
Chase at Estuary Park
Cottle at Nottingham
Cottle at Stephenson Pt
Holden Creek off Lazo
Holden Ck d/s Tiesu
N. Wexford u/s seniors complex
Millstone at E. Wellington
Millstone at Jingle Pot
Shelly at Blower
Shelly at Hamilton
Walley d/s Hammond
Walley u/s Beach

- *All sites with readings below 5mg/L were also below the 30-day average.*
- *These are in **bold** above.*

- *Two sites went subsurface during summer sampling: Haley Creek (Quennell Lake outflow) & Holden Creek d/s Tiesu Rd.*
- *Haley Creek was subsurface until Nov. 3.*
- *First time in 6 years of sampling Swayne Creek did not go subsurface - outreach & education!*

Dissolved Oxygen

- **Influenced by water temp** (O_2 solubility decreases as temp increases), **photosynthesis** (O_2 produced), **BOD** (O_2 consumed), **water turbulence** (increases O_2 absorption), and **amount of flow** (related to temp & turbulence).

Generally:

- *Occurred consistently at very low flow and low gradient sites.*
- *Increased nutrient inputs often lead to low DO.*
- *Riparian coverage (water temp) also a factor.*

Understanding DO exceedances:

- *Physical stream assessments - stream structure, riparian cover, etc.*
- *Flow & nutrient monitoring.*

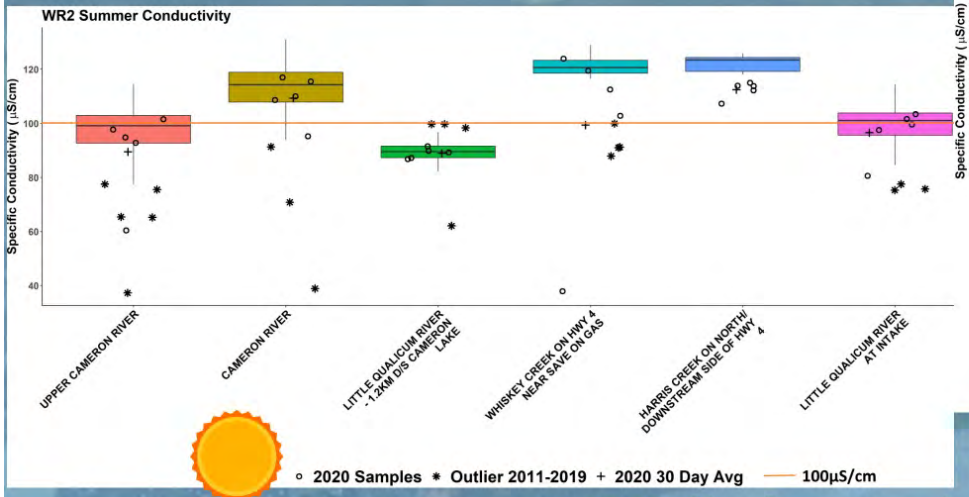
Addressing DO exceedances:

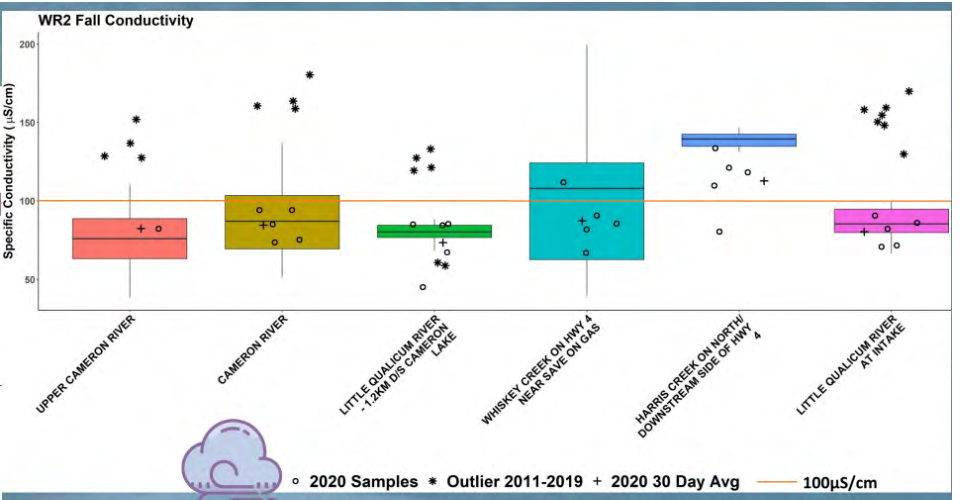
- *Improve temp (restoration & conservation).*
- *Increase stream complexity & structure (i.e., LWD).*
- *Minimize nutrient inputs through outreach & education.*

Specific Conductivity

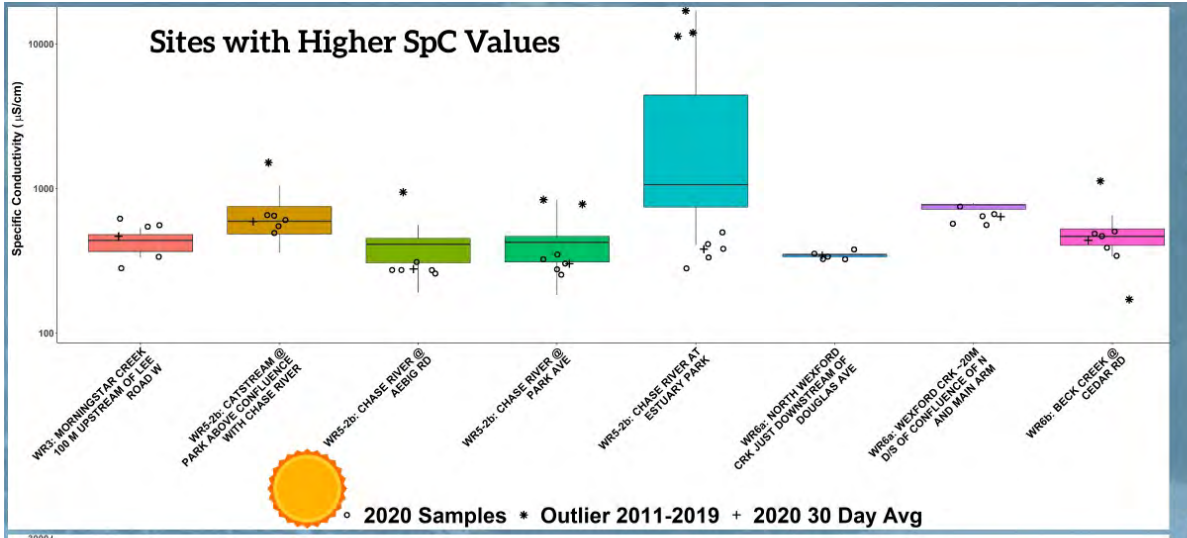
- **Most pristine coastal streams measure <80 uS/cm** *(may be higher if large groundwater influence).*
- **No provincial guideline for this parameter.**

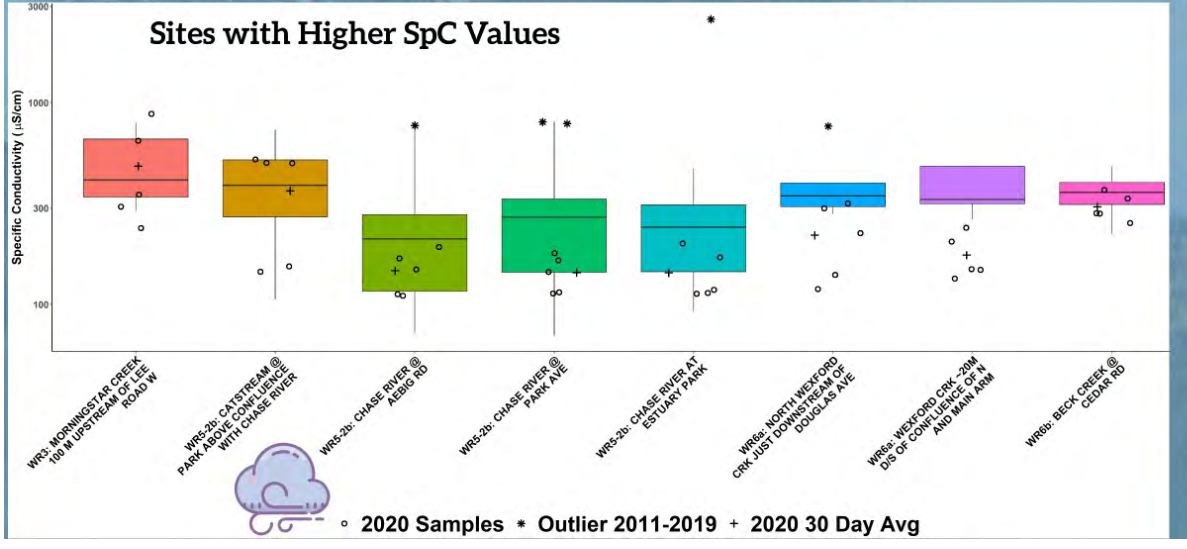
- Measures the concentration, charge, and mobility of dissolved ions in water.
- Specific conductance (SpC) measures conductivity corrected to 25°C, standardizing readings.
- Influenced by water temperature, turbidity, groundwater, evaporation, pollution, and other saline inputs (i.e., sea water, road & agricultural run-off, etc.).
- Adds context when increases/decreases correlate to other parameters measured.





- *WR 2 displays typical seasonal changes.*
- *Summer values elevated in Cameron River - groundwater influence?*
- *Little Qualicum d/s Cameron Lake similar values across seasons.*
- *Whiskey Ck in summer is high and fall is more variable - road run-off?*
- *Harris Creek similar to Whiskey Creek, 2020 averages & value range, respectively: Summer 112.4µS/cm & 7.7µS/cm and Fall 112.7µS/cm & 53.2µS/cm.*
- *Little Qualicum at Intake slightly lower in fall - more volume and less dilution?*
- *Looking at other parameters on these dates can support suppositions.*

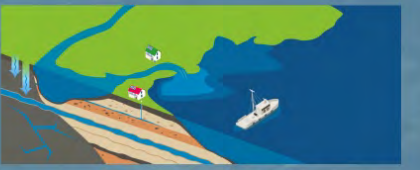




These site readings could indicate naturally higher SpC or be associated with current or legacy anthropogenic influences.

- *Morningstar has groundwater inputs and is d/s agricultural properties & a golf course.*
- *Chase River and Wexford Creek watershed sites have a multitude of human influences.*
- *Chase River at Estuary is tidal.*
- *Beck is downstream agriculture & highways, and has a coal mining history. More investigation is being completed at this site.*

Specific Conductivity (SpC)



SpC Readings ≥130µS/cm:

- *345 instances over Summer & Fall.*
- ***Occurred at 49 different sites.***
- *60% in Summer & 40% in Fall.*
- ***Watercourses in bold below had sites with readings ≥130µS/cm on all 10 sample dates.***

Watercourses with Readings ≥130µS/cm:

- *Annie*
- *Beach*
- ***Beaver***
- ***Beck***
- *Bloods*
- ***Cat***
- *Chase*
- ***Cottle****
- ***Departure***
- *Englishman*
- *French*
- ***Grandon***
- *Haley*
- *Harris*
- *Holden*
- *Knarston*
- *Mallett*
- *McGarrigle*
- *Millstone*
- ***Morningstar***
- *Nanoose*
- *N. Wexford*
- ***Richards***
- *Shelly*
- *S. Englishman*
- *Swayne*
- *Walley*
- ***Wexford***

**At all 3 sites.*

- Some watercourses may have naturally higher SpC levels.
- **Increases may correspond with increases in:**
  - **water temperature,**
  - **turbidity,**
  - **groundwater,**
  - **evaporation,**
  - **pollution, and**
  - **saline inputs (i.e., sea water, road & agricultural run-off).**

Most East coast Vancouver Isl. streams have both groundwater and human influences that impact conductivity.

Specific Conductivity (SpC)

Generally:

- *Summer Specific Conductivity values have less variability than fall values.*

- *Fall values have a larger range, potentially from additional influences associated with rainfall - i.e. more turbidity from erosion and/or stormwater inputs.*

- **Adds context to other parameters when interpreting data.**

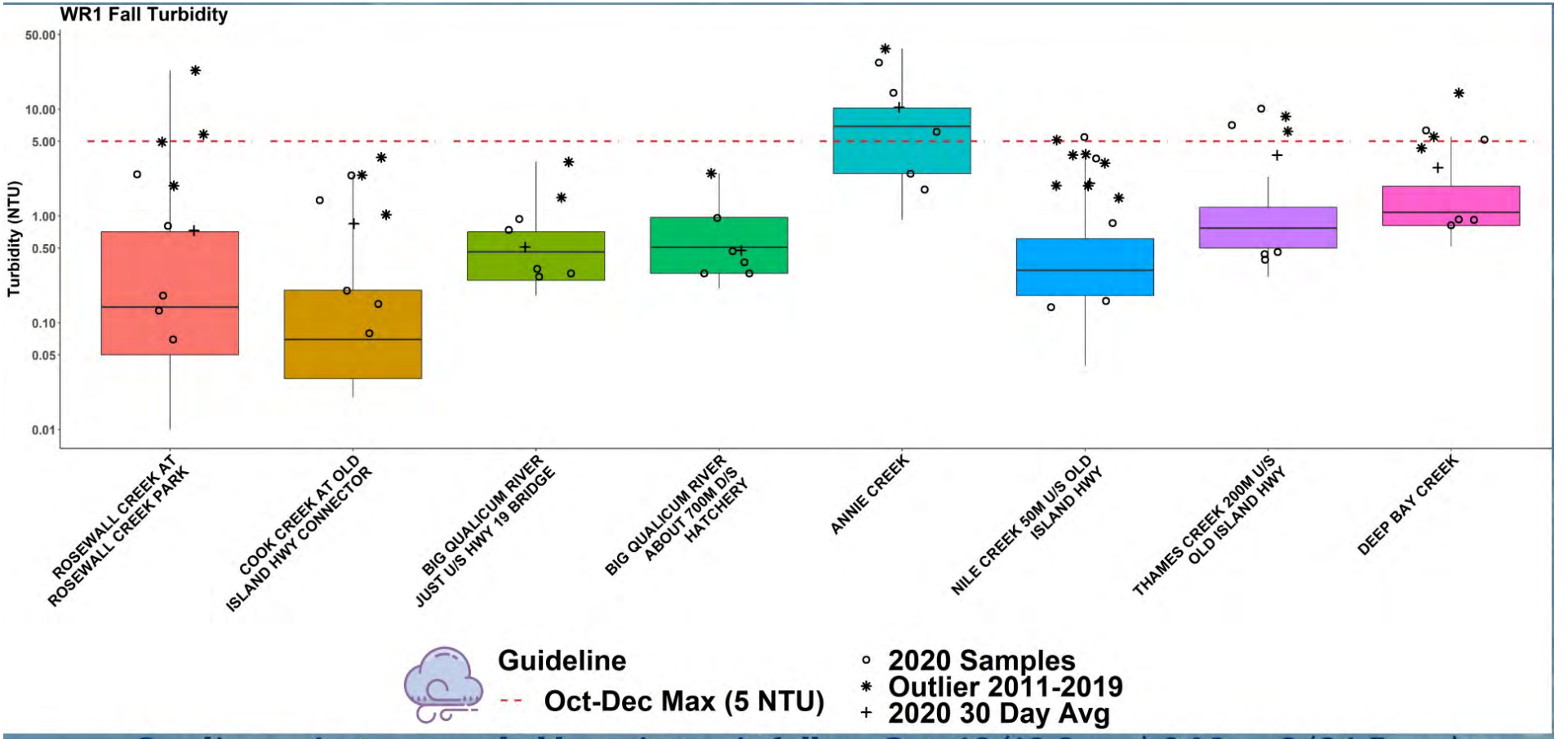
- *i.e., SpC levels >80µS/cm may indicate more groundwater contribution to flow (good) or increased turbidity or anthropogenic inputs entering stream (not good).*

Turbidity

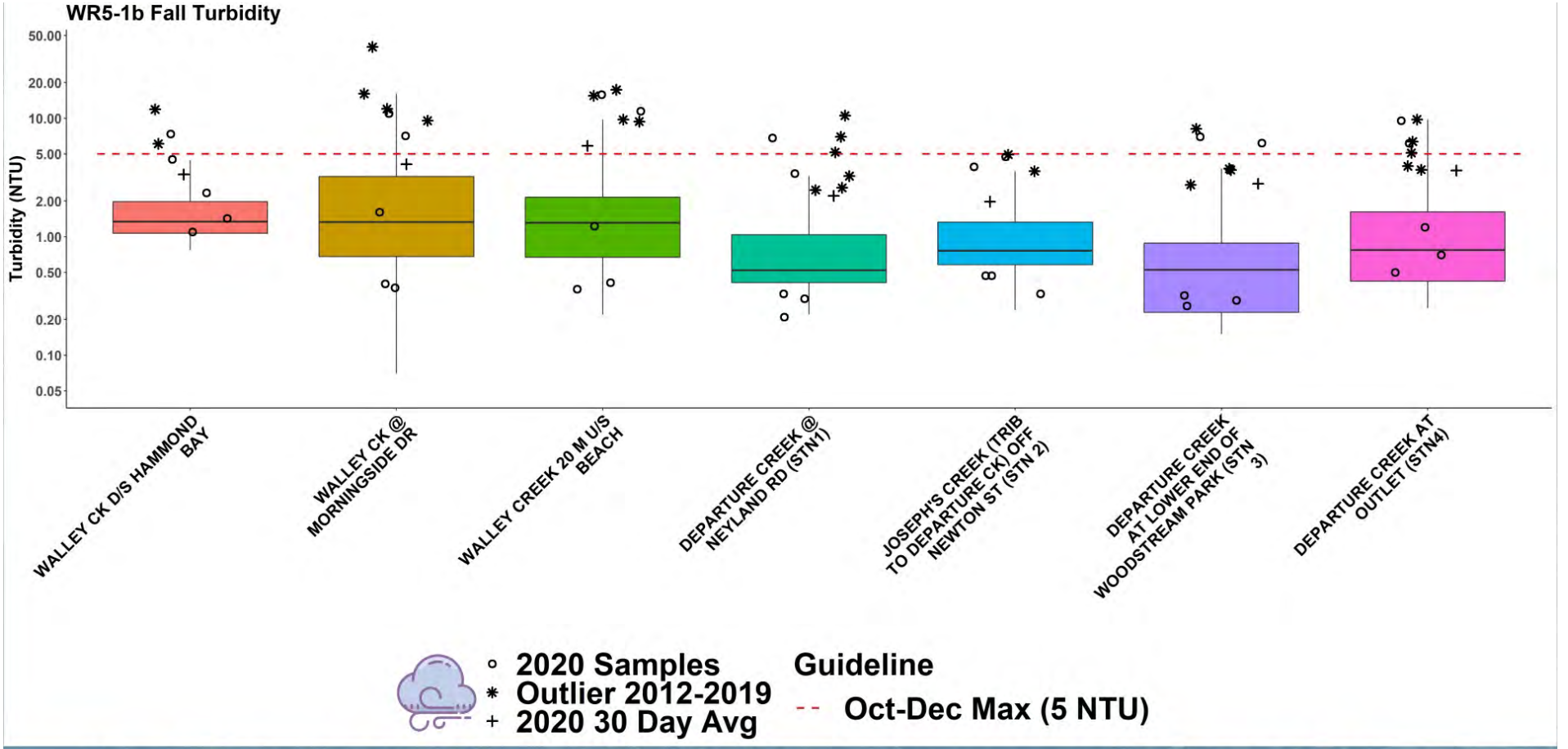
Turbidity (Turb) Aquatic Life Guidelines:

- **January to September (summer period) maximum 2 NTU.**
- **October to December (fall period) maximum 5 NTU.**

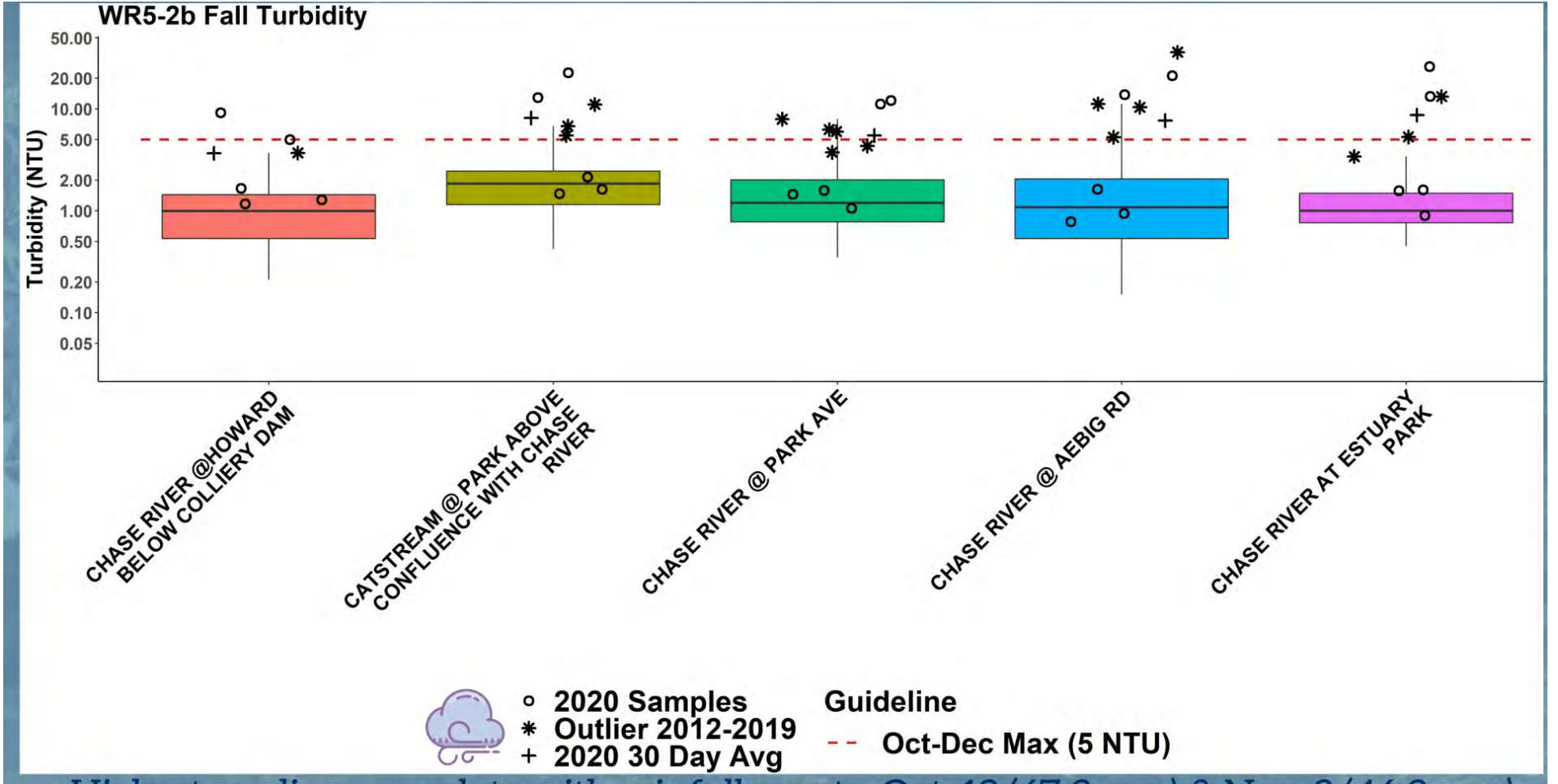
- A measure of water clarity via light reflected by suspended particles.
- **Increased turbidity can increase water temperature as suspended particles will absorb heat more efficiently.**
- Values vary in pristine streams generally <2 NTU.
- **Influenced by inputs from erosion, contaminants, stormwater, etc. Algal growth in summer months may increase turbidity readings.**



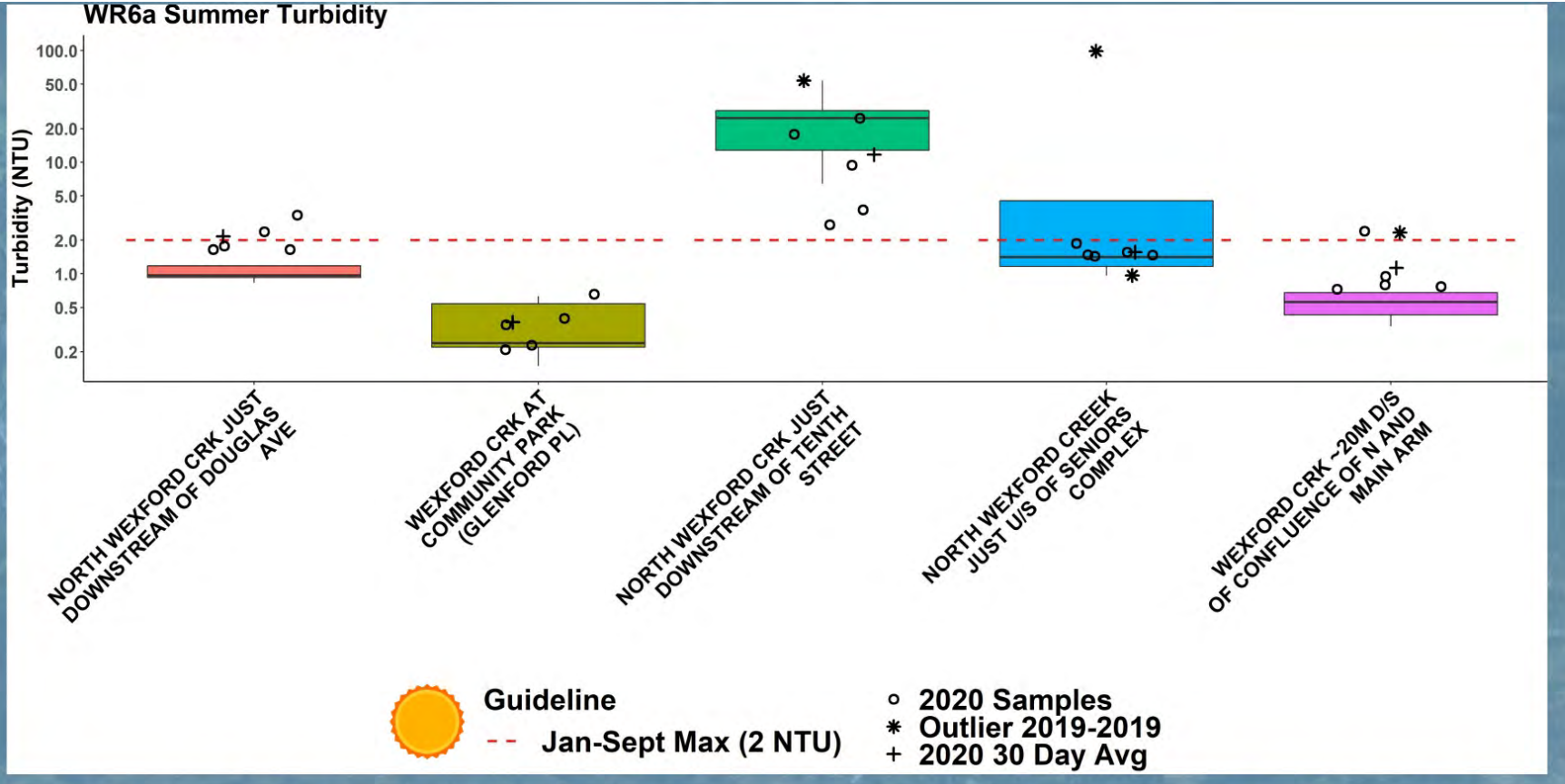
- *Qualicum A stn recorded heaviest rainfall on Oct. 13 (19.3mm) & Nov. 3 (26.5mm).*
- *Highest turb values occurred on these days in all watersheds except Big Qualicum.*
- *All exceedances occurred on above dates except Annie Creek on Nov. 10 (1.8mm on Nov. 9).*



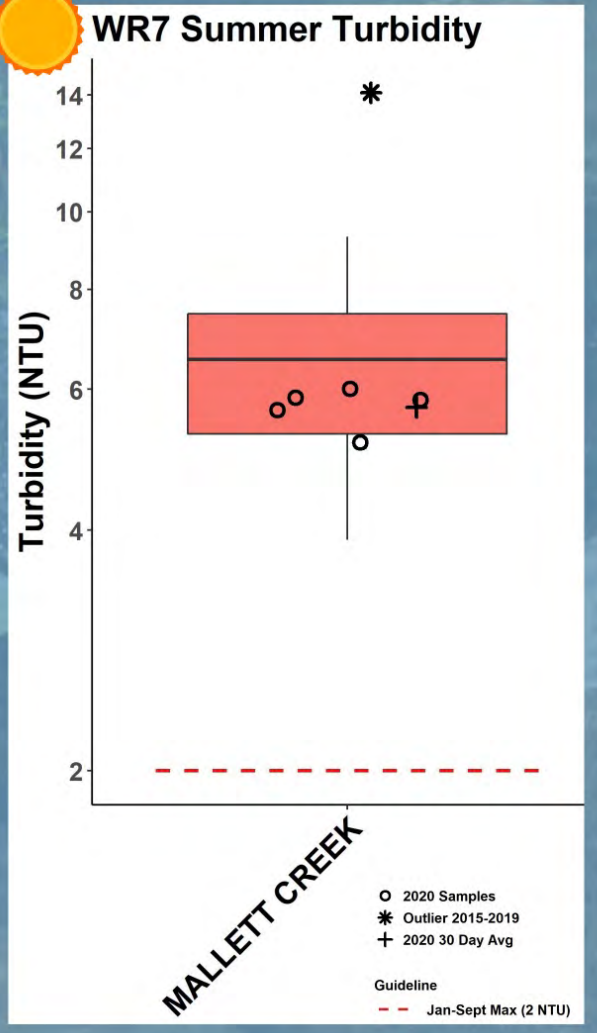
- *Two highest fall turbidity readings at all above sites correlate with rainfall events - within 48 hours of sampling Oct. 13 (67.3 mm) & Nov. 3 (46.2 mm).*

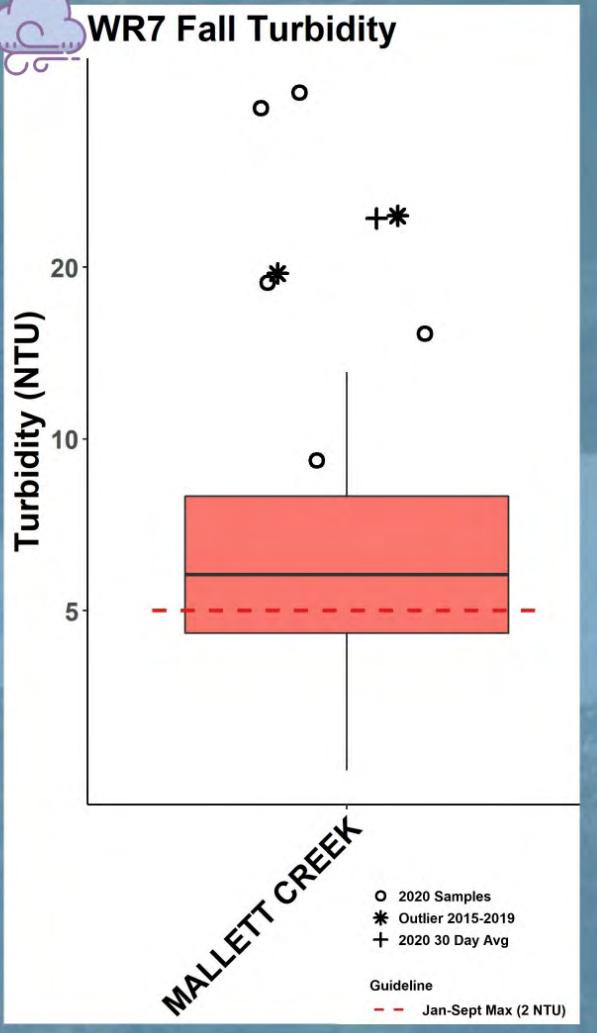


- *Highest readings correlate with rainfall events, Oct. 13 (67.3 mm) & Nov. 3 (46.2 mm).*
- *Oct. 13 - first heavy flush had highest readings.*



- *N. Wexford d/s 10th: high turb, SpC, temp, and low DO throughout summer period - consistent with previous years of readings, highly urbanized watercourse.*
- *Results seen most likely to physical stream characteristics and human inputs.*





- *Summer exceedances within range of previous years.*
- ***Mallett has low flow and lots of fine sediment during summer sample period.***
- *Larger and more recent rainfall coincide with higher turb readings.*
- ***Upstream dam removed in 2020, could account for higher than average fall readings.***

Summer Turbidity

- *Some high values are explained by field observations or weather on a given day.*
- *Urban streams much more difficult to interpret due to various anthropogenic influences.*

Sites with summer turb values ≥2 NTU

Once at:
- Grandom at Laburnum (1)
- Deep Bay Creek
- Chase River at Estuary
- Wexford d/s confluence

Twice at:
- Cat Stream
- Beck at Cedar Rd (1)
- Cottle d/s Hammond
- N. Wexford at Douglas
- Holden d/s Tiesu

Three times at:
- Beach at Golf Course (1)
- Millstone at Biggs
- Millstone at E. Wellington
- Walley d/s Hammond

Five times at:
- Mallett Creek (2)
- Millstone at Jingle Pot (1)
- Swayne Creek (1)
- Harris Creek (1)
- N. Wexford d/s 10th (1)

- *51 summer turb exceedances.*
- *9 (18%) coincide with rain events within the last 72 hours (Sept. 1 sample date).*
- *42 (82%) most likely due to anthropogenic influences or algal growth.*
- *(#) beside indicate exceedances that coincide with rainfall events.*

Fall Turbidity

- *In 2017, 53 of the 63 fall exceedances were experienced after heavy rain events (84%).*
- *In 2018, 18 fall turb exceedances - fall flush was not captured at all sites.*
- *In 2019, 17 of 18 fall exceedances coincide with rain (94%).*
- *In 2020, 84 of 91 fall exceedances occurred on days with rainfall (92%).*
- *Of the 7 that did NOT occur with rain, 6 of these had rainfal the day before.*

- *(#) exceedances that did NOT coincide with a rain event. All occurred on Nov. 10.*

Sites with fall turb values ≥5 NTU

One exceedance:
- Bloods Creek
- Cameron River
- Chase at Howard
- Cottle at Stephenson Pt
- Cottle at Hammond
- Departure at Neyland
- French at Grafton
- French at New Hwy
- Holden d/s Tiesu
- Little Qualicum River at intake
- Nile u/s hwy
- Shelly at Blower
- Shelly at Hamilton
- S. Englishman River
- Walley d/s Hammond
- Whiskey at Hwy 4

Two exceedances:
- Beach Creek at Hemsworth
- Beach Creek at Golf Course
- Beaver Creek
- Beck Creek
- Cat Stream
- Chase at Aebig
- Chase at Park
- Chase at Estuary
- Cottle at Nottingham

Two exceedances (cont.):
- Deep Bay Creek
- Departure at Woodstream
- Departure at Outlet
- Grandon at Laburnum
- Grandon u/s W. Crescent
- Knarston Creek
- MaGarrigle at Jingle Pot
- Millstone at Jingle Pot
- Millstone at Barsby Park
- Morrison Creek
- N. Wexford d/s Douglas
- N. Wexford d/s 10th
- Walley at Morningside
- Walley u/s Beach
- Wexford d/s confluence

Three exceedances:
- Annie Creek (1)
- Englishman u/s Morrison (1)
- Harris Creek (1)
- Morningstar Creek (1)
- Swayne Creek (1)
- Haley Creek

Five exceedances:
- Mallett Creek (1)

Turbidity

Addressing summer turb:

- To decrease algal growth, limit nutrients entering the watercourse & promote cooler temp with shading riparian vegetation.
- Community awareness of stream and streambank protection when recreating in summer months.

Potential causes of turb:

- Summer algal growth.
- Stream bank erosion.
- Storm drain inputs.
- Other anthropogenic influences.

Taking action:

- Streamside outreach & education - how to protect the watercourse in your backyard.
- Physical stream assessments to determine best locations for restoration & stabilization projects.
- Implementation of green infrastructure.

Addressing fall turb:

- Riparian restoration & streambank stabilization to prevent erosion.
- Stormwater management to slow & infiltration before inputs enter streams.

Data Trend Analysis

All data 2011 - 2020 included.

Analyses completed:

1. Comparison to water quality guidelines and objectives for ***frequency of sample periods with exceedances*** *(DO, temp, & turbidity only).*

2. Forty-seven sites with 6yrs+ data for ***significant trends over time.***

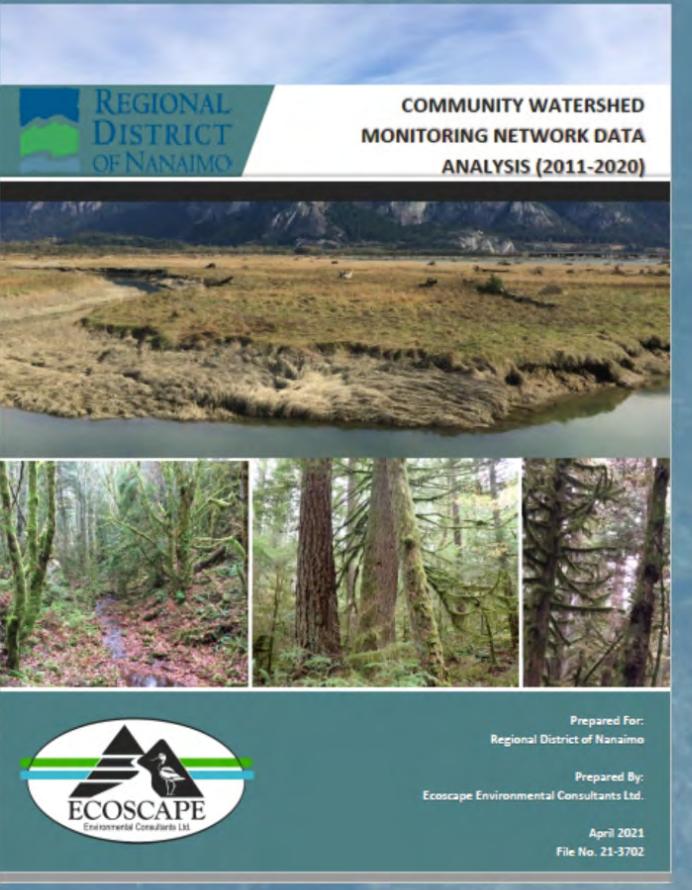
Three focus areas of the report:

1. Water regions: 3, 5, & 6.

2. Sites with 10 yrs of data.

3. Sites that were not previously analyzed in 2018 Trend Report.

Report completed by Ecoscape will be available online: www.rdn.bc.ca/cwmn



1. Exceedance Frequency

Comparison to water quality guidelines & objectives for frequency of exceedances in sample periods (summer low-flow / fall flush) at each site over the entire data set from **2011-2020**.

Categories are based on the **number of sample periods with exceedances.**

Completed for DO (instantaneous min. of ≤5 mg/L); **temperature** (≥17°C); & **turbidity** (summer ≥2 NTU or fall ≥5 NTU) **for each sampling period.**

Exceedance Categories*:
No Exceedance Recorded.
Low = 1 to 2 exceedances.
Moderate = 3 to 4 exceedances.
High = 5 or more exceedances.

*Thresholds are relevant for CWMN data assessed and are not necessarily applicable to other data sets.

Note that these categories are reflective of **the number** of sample periods with exceedances, **not the number or values** of the exceedances.

Visualizing Exceedance Frequency

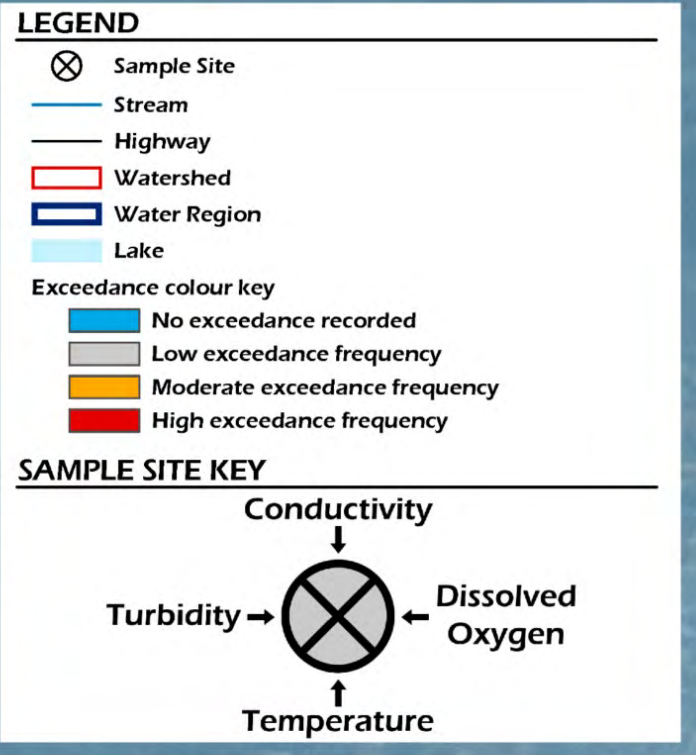
Results for all 87 sites, both active and inactive, were mapped per water region / sub-water region for DO, temp, & turbidity.

On the maps, SpC is coded as "*No exceedance recorded*" as there is no guideline for comparison.

20 maps were created to visualize the number of sample periods with an exceedance:

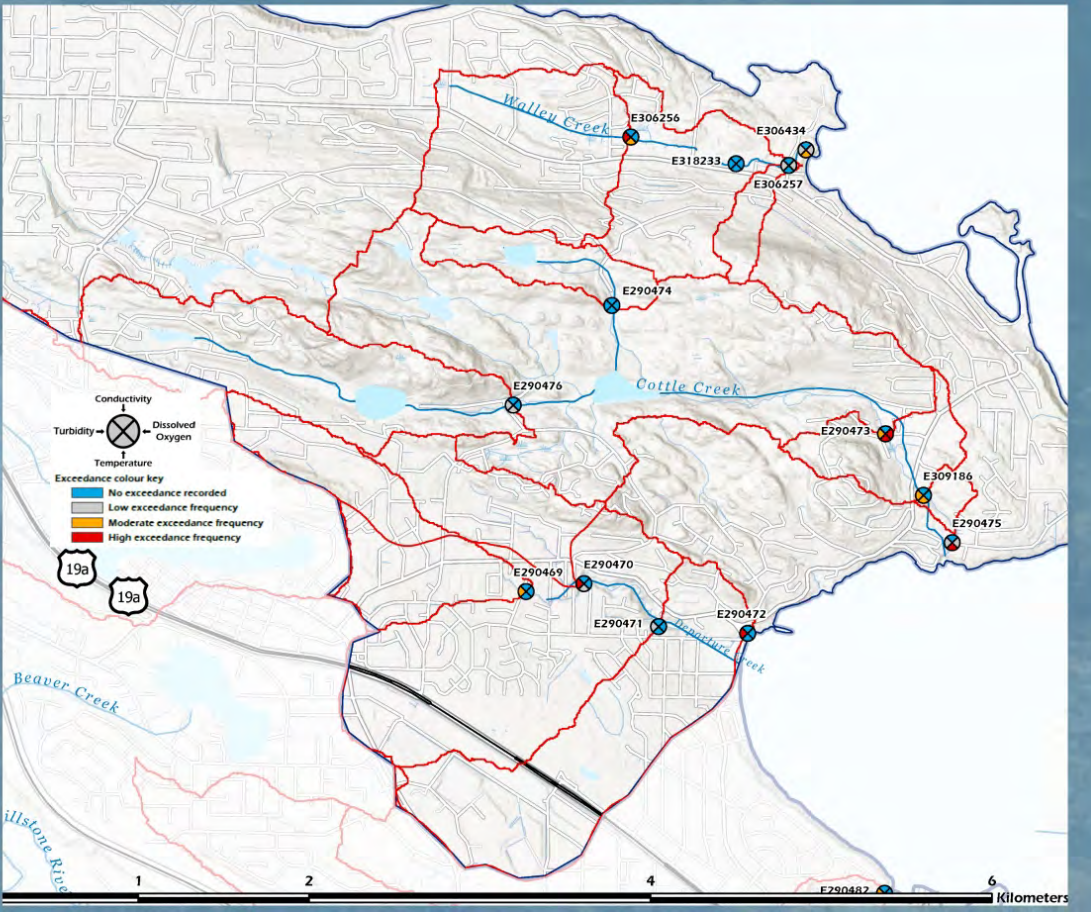
- A summer and fall map for each of the below regions.

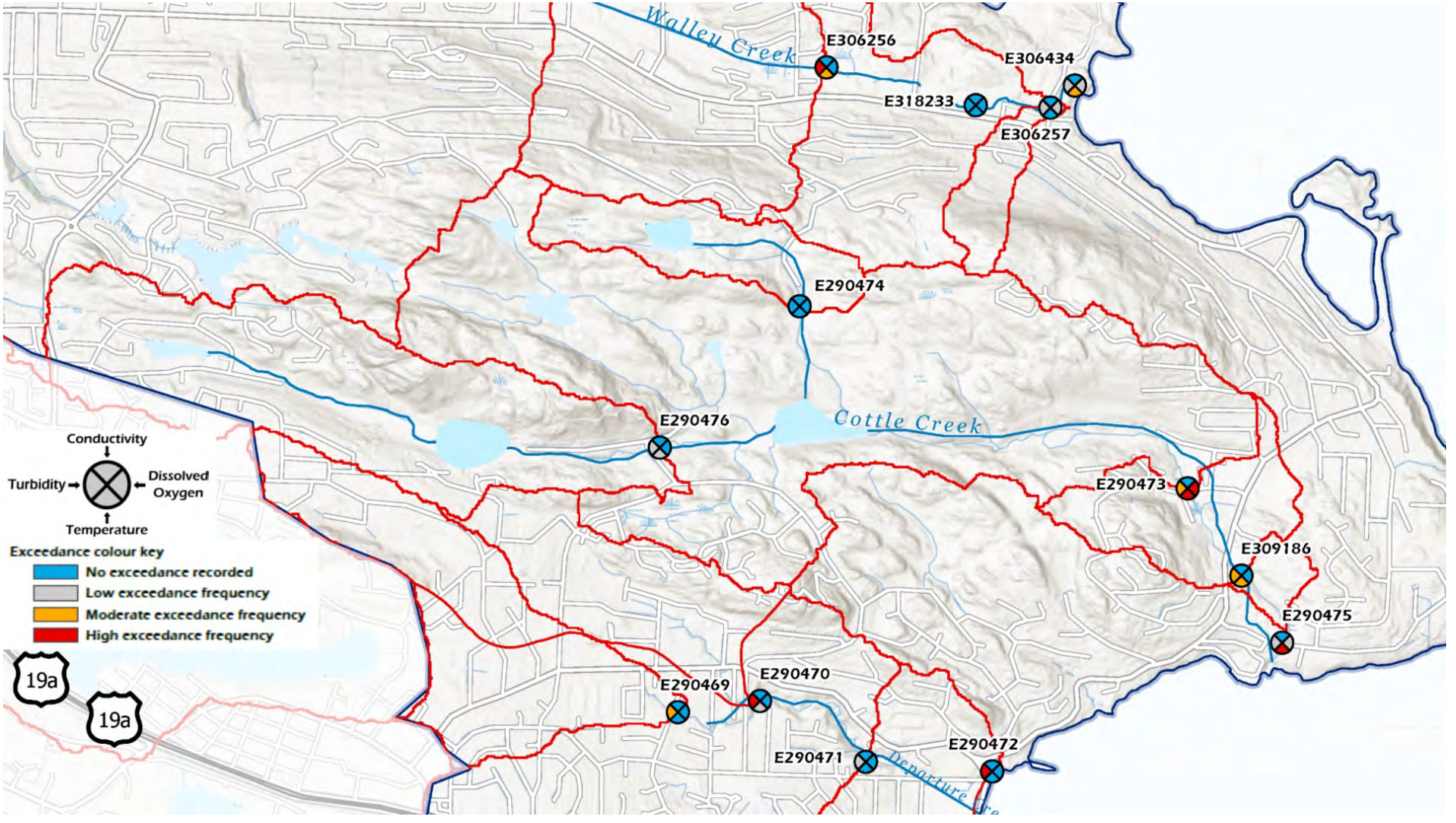
- WR 1, WR 2, WR 3, WR 4a, WR 4b, WR 5-1a, WR5-1b, WR 5-2, WR 6 , & WR 7.



WR 5-1b Summer Exceedance Frequency

- Highly urbanized waterways are exposed to many non-point source inputs.
- This is reflected by the frequency of summer sample period exceedances for each of the three parameters in Walley, Cottle, and Departure Creeks.
- Potential influences:
  - Summer low flows - stream is less diluted and more concentrated.
  - Stormdrain inputs - washing cars, driveways, etc.

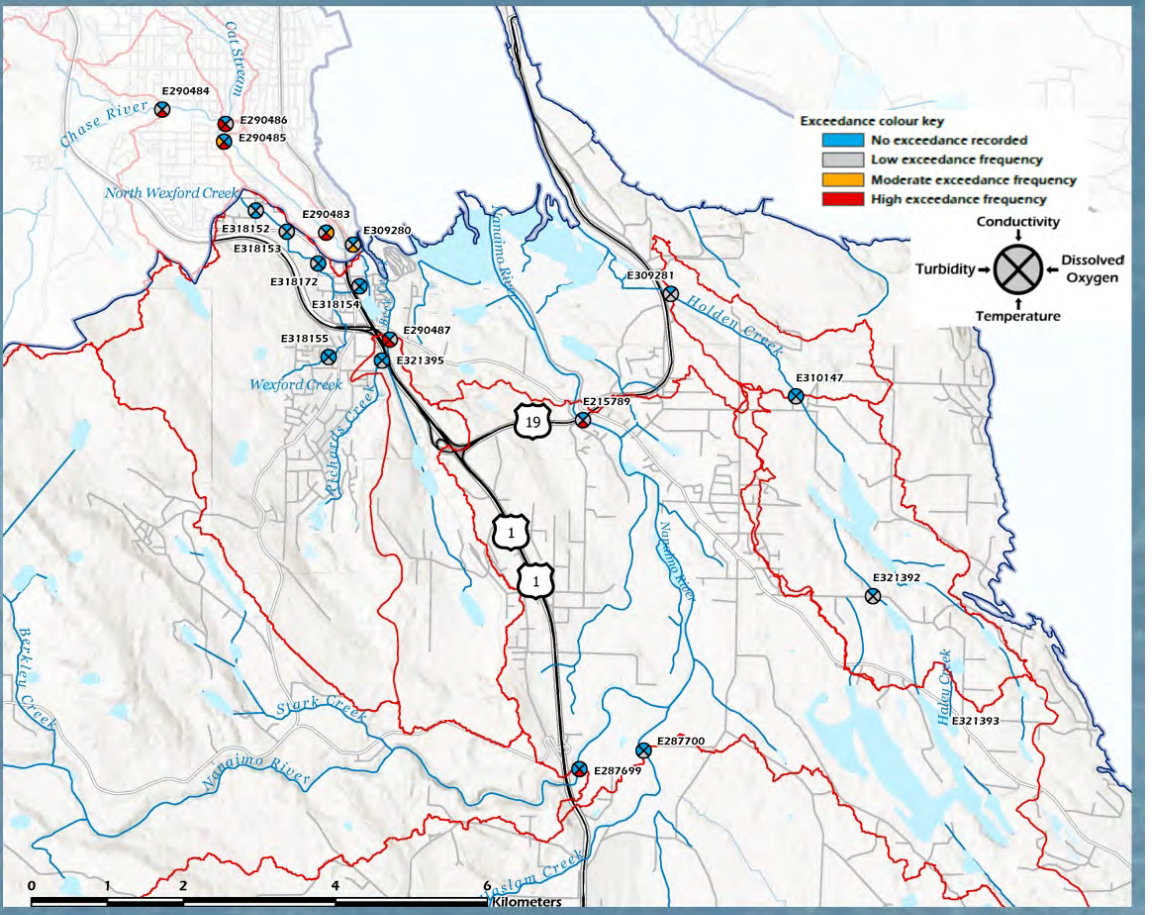


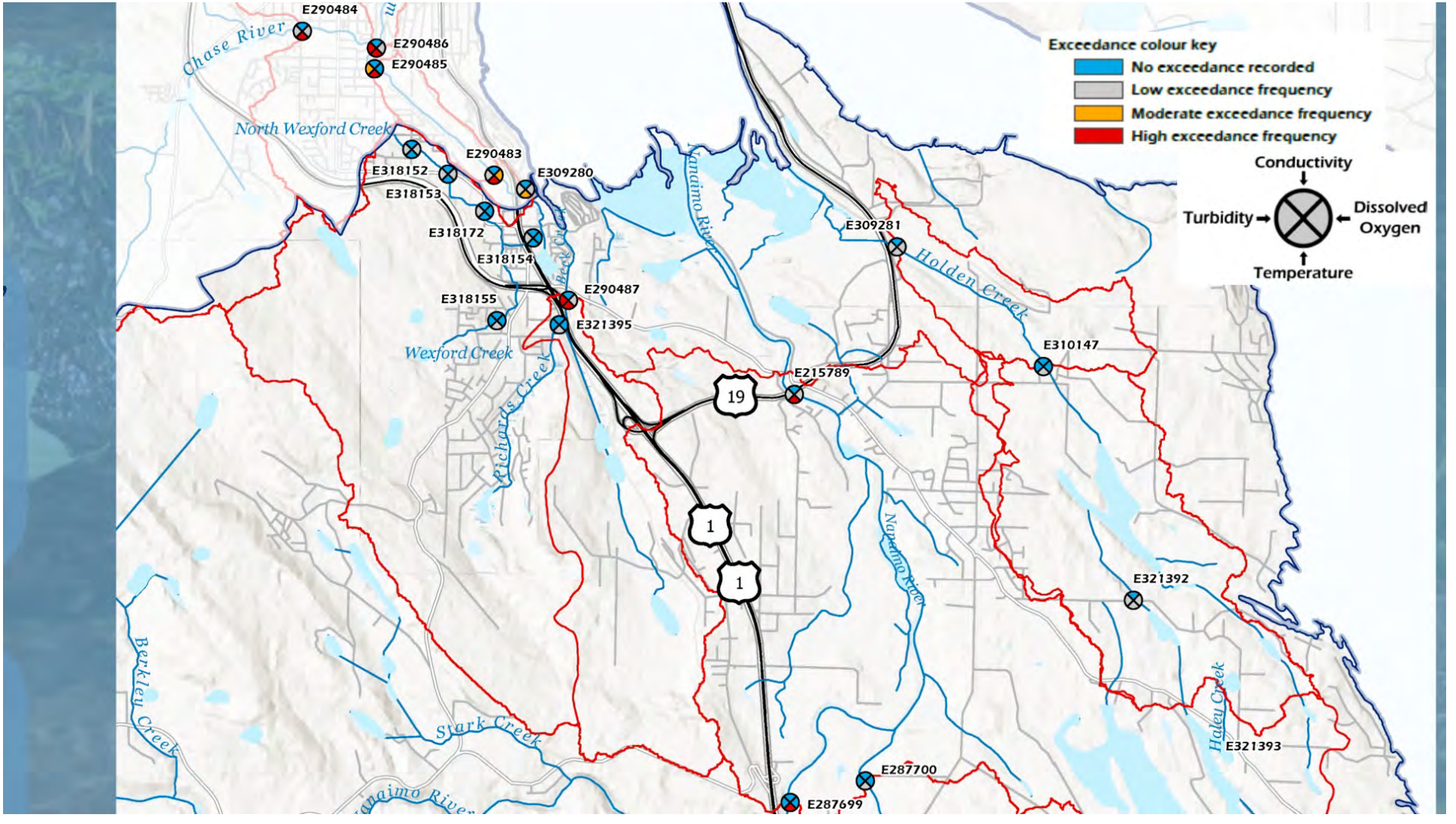

Walley Creek
E306256
E306434
E318233
E306257
E290474
E290476
Cottle Creek
E290473
E309186
E290475
E290469
E290470
E290471
E290472
Departure Cre
Conductivity
Turbidity
Dissolved Oxygen
Temperature
Exceedance colour key
No exceedance recorded
Low exceedance frequency
Moderate exceedance frequency
High exceedance frequency
19a
19a

WR 6 Summer Exceedance Frequency

- Wexford (North and main arm), Beck, Richards, Holden, Haslam and Haley Creeks all show anthropogenic influences, i.e., climate change, legacy, current impacts, etc.

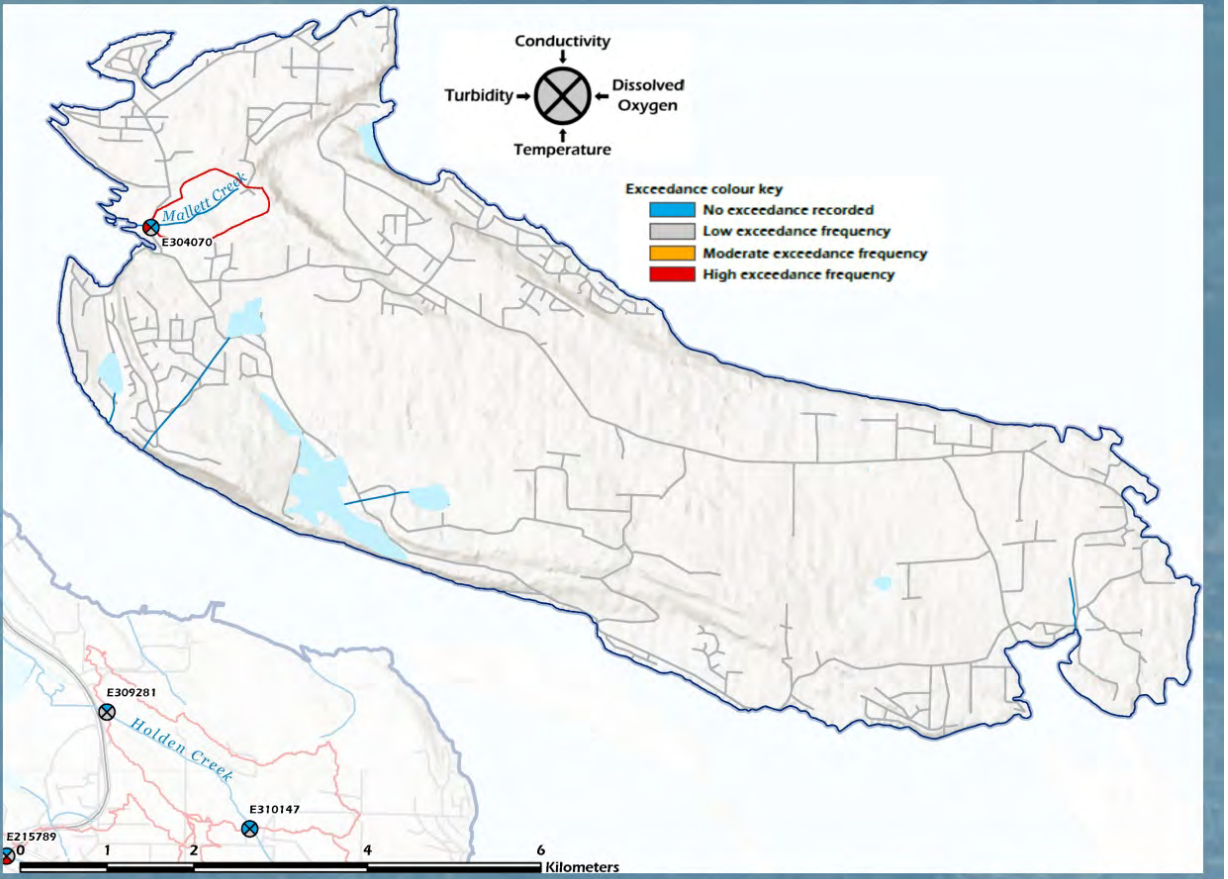
- Summer exceedances highlight the need for riparian cover, bank stabilization, and awareness in the community that what we do on our property and the land impacts the health of our streams.

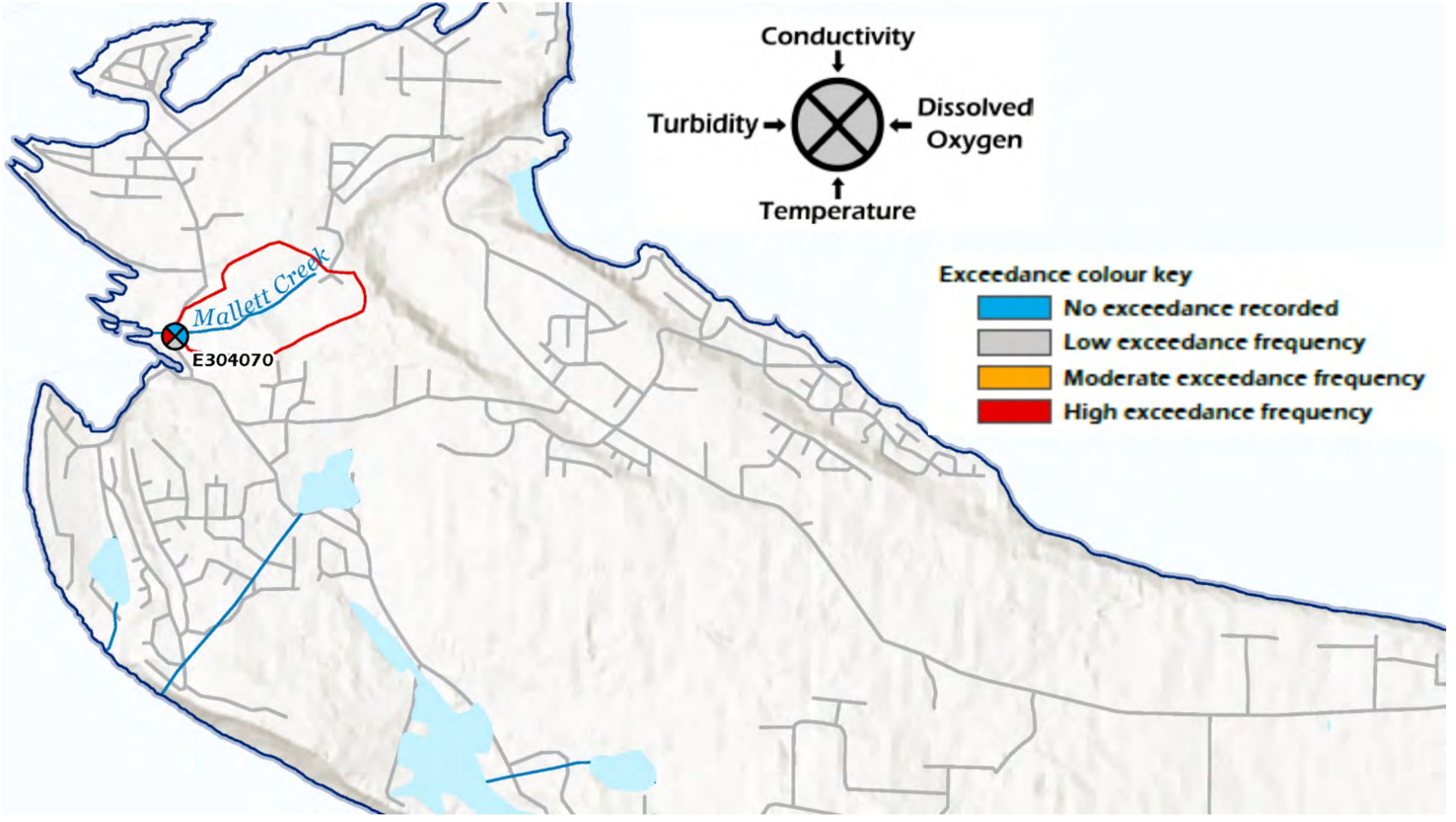



Exceedance colour key
No exceedance recorded
Low exceedance frequency
Moderate exceedance frequency
High exceedance frequency
Conductivity
Turbidity
Dissolved Oxygen
Temperature
E290484
E290486
E290485
E290483
E318152
E309280
E318153
E318172
E318154
E290487
E318155
E321395
E309281
E310147
E215789
E321392
E321393
E287700
E287699
Chase River
North Wexford Creek
Wexford Creek
Richards Creek
Nanaimo River
Holden Creek
Berkley Creek
Stark Creek
Haley Creek
19
1
1

WR 7 Summer Exceedance Frequency

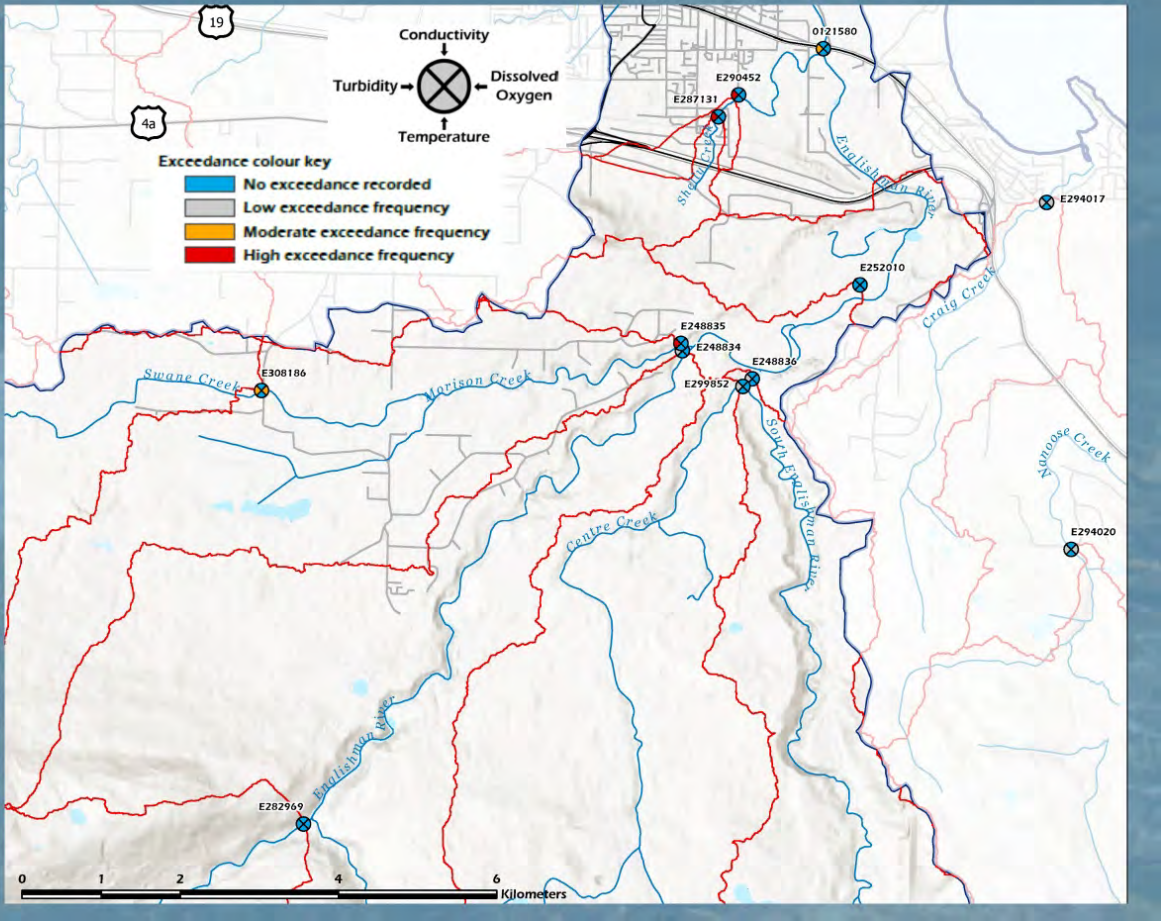
- Mallett Creek has and continues to experience a high frequency of summer sample periods with turbidity exceedances - attributed to fine sediment. Erosion also a factor?
- There was one summer sample period (2017) with temp exceedances - due to low flow?
- DO is not indicated as having exceedances using the 5mg/L threshold. However, in 2015 & 2016 DO values were below the 30-day average of 8mg/L.

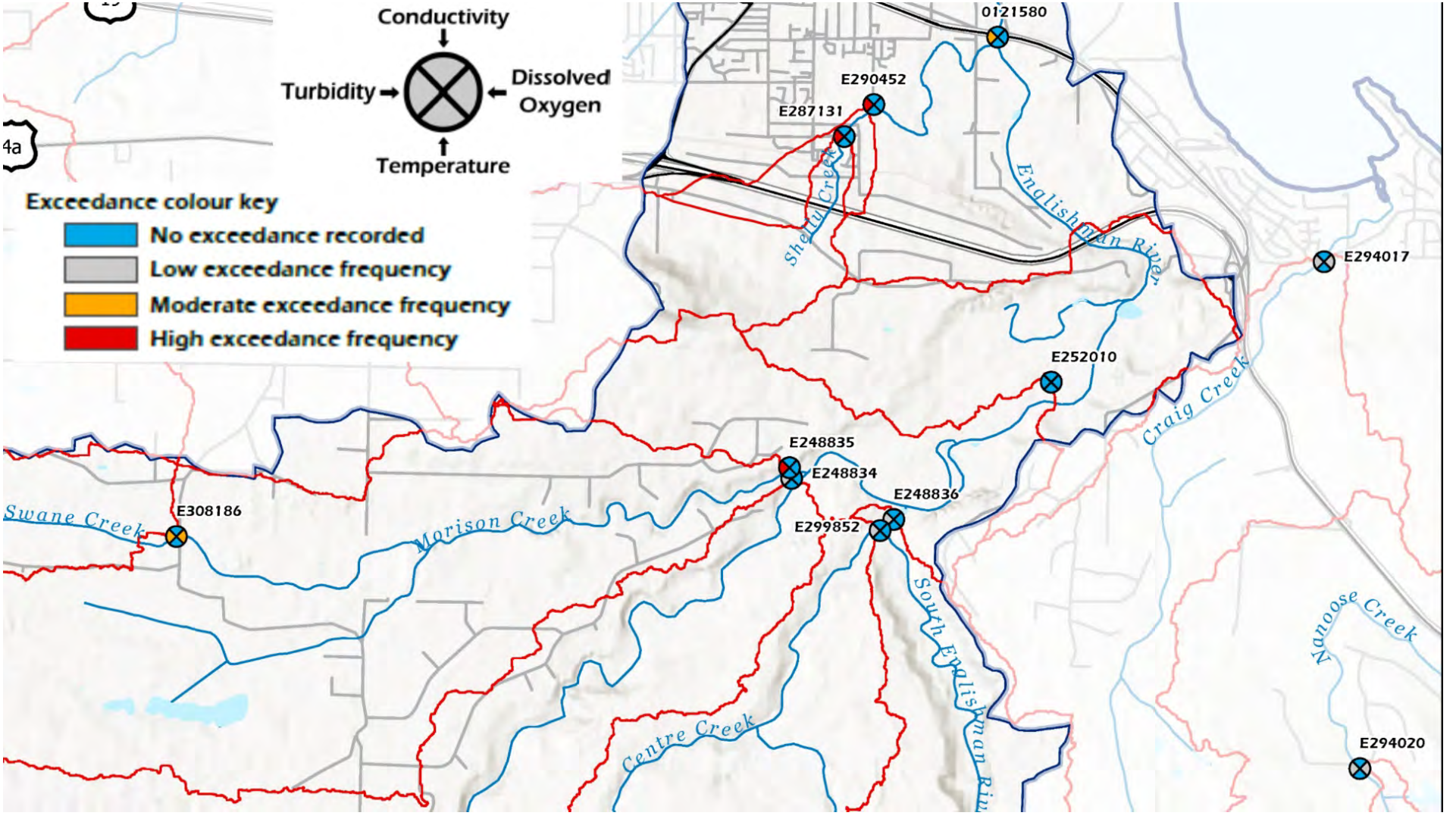



Conductivity
Turbidity
Dissolved Oxygen
Temperature
Mallett Creek
E304070
Exceedance colour key
No exceedance recorded
Low exceedance frequency
Moderate exceedance frequency
High exceedance frequency

WR 4a Fall Exceedance Frequency

- Englishman River watershed experiences high turbidity levels at a number of sites during the fall flush period - particularly in smaller tributaries that run through urban residential and agriculture properties.
- DO values ≤5mg/L (instantaneous minimum) occurred at moderate frequency for the fall sample periods for Swayne Creek due to low flows.
- Riparian plantings, bank stabilization, green infrastructure, & targeted outreach / education could benefit sites with frequent seasonal exceedances.




Conductivity
Turbidity
Dissolved Oxygen
Temperature
Exceedance colour key
No exceedance recorded
Low exceedance frequency
Moderate exceedance frequency
High exceedance frequency
0121580
E290452
E287131
Shelly Creek
Englishman River
E294017
E252010
Craig Creek
E248835
E248834
E248836
E299852
E308186
Swane Creek
Morison Creek
South Englishman River
Nanoose Creek
Centre Creek
E294020

2. Changes Over Time

Sites with **6 years+ data** had a Mann-Kendall test completed for all four parameters (temp, DO, turb, & SpC*) to assess statistically significant trends over time.

Trend Categories:

Improving = Indicates improving water quality.

Stable = Water quality not changing over time.

Degrading = Indicates declining water quality.

Parameter Relation:

Temp: decreasing = improving.

DO: **increasing** = improving.

Turb: decreasing = improving.

*SpC: decreasing = improving.

This analysis speaks to **changes in water quality** over the years of sampling at a given site and is **not reflective of guideline exceedances.**

SpC has many influences, **increasing values are not always an indication of degrading water quality.*

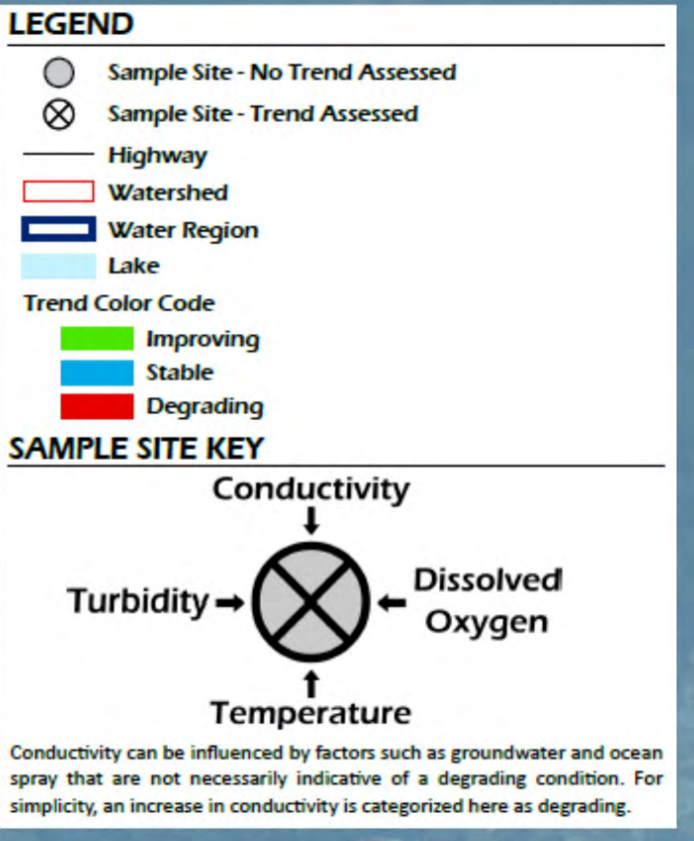
Degrading trends highlight sites that may benefit from stewardship support.

Visualizing Trend Results

Trend results from sites with data sets six years+ were mapped per water region / sub-water region for each parameter.

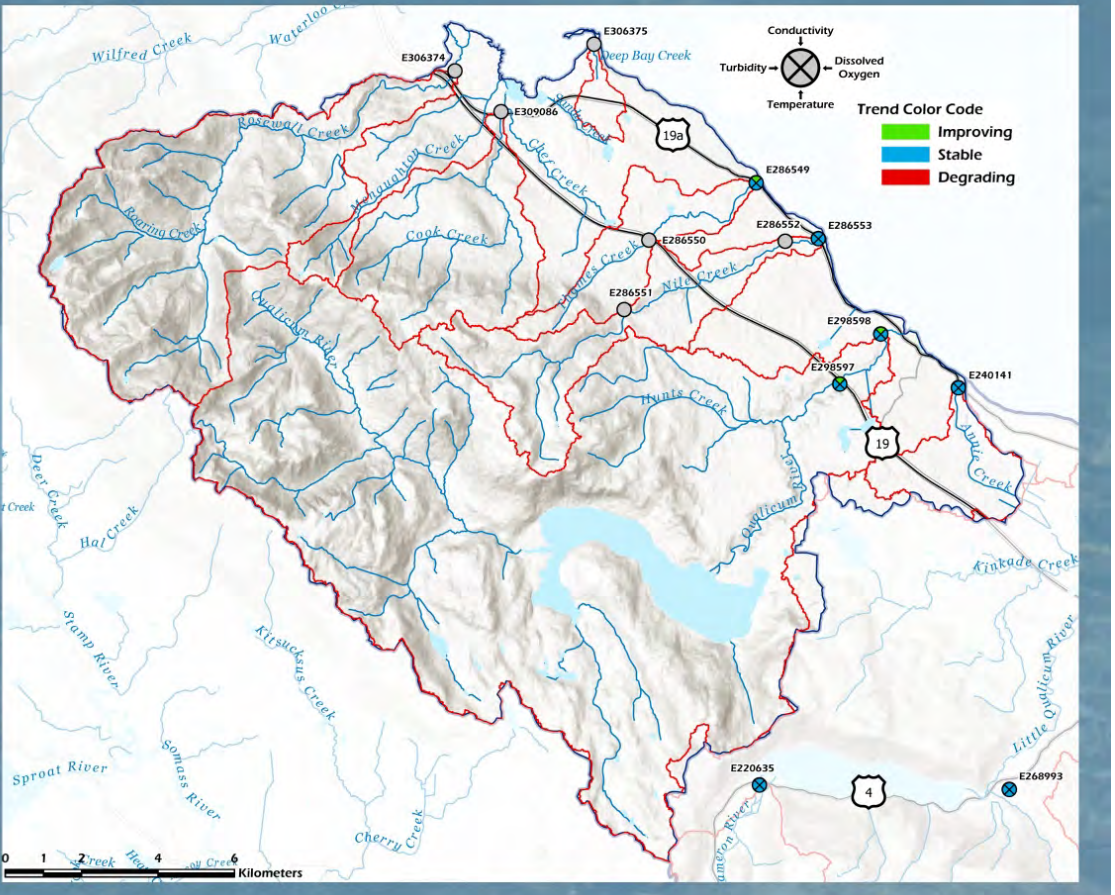
Sites with fewer than six years of available data for trend analysis were labeled as "no trend assessed."

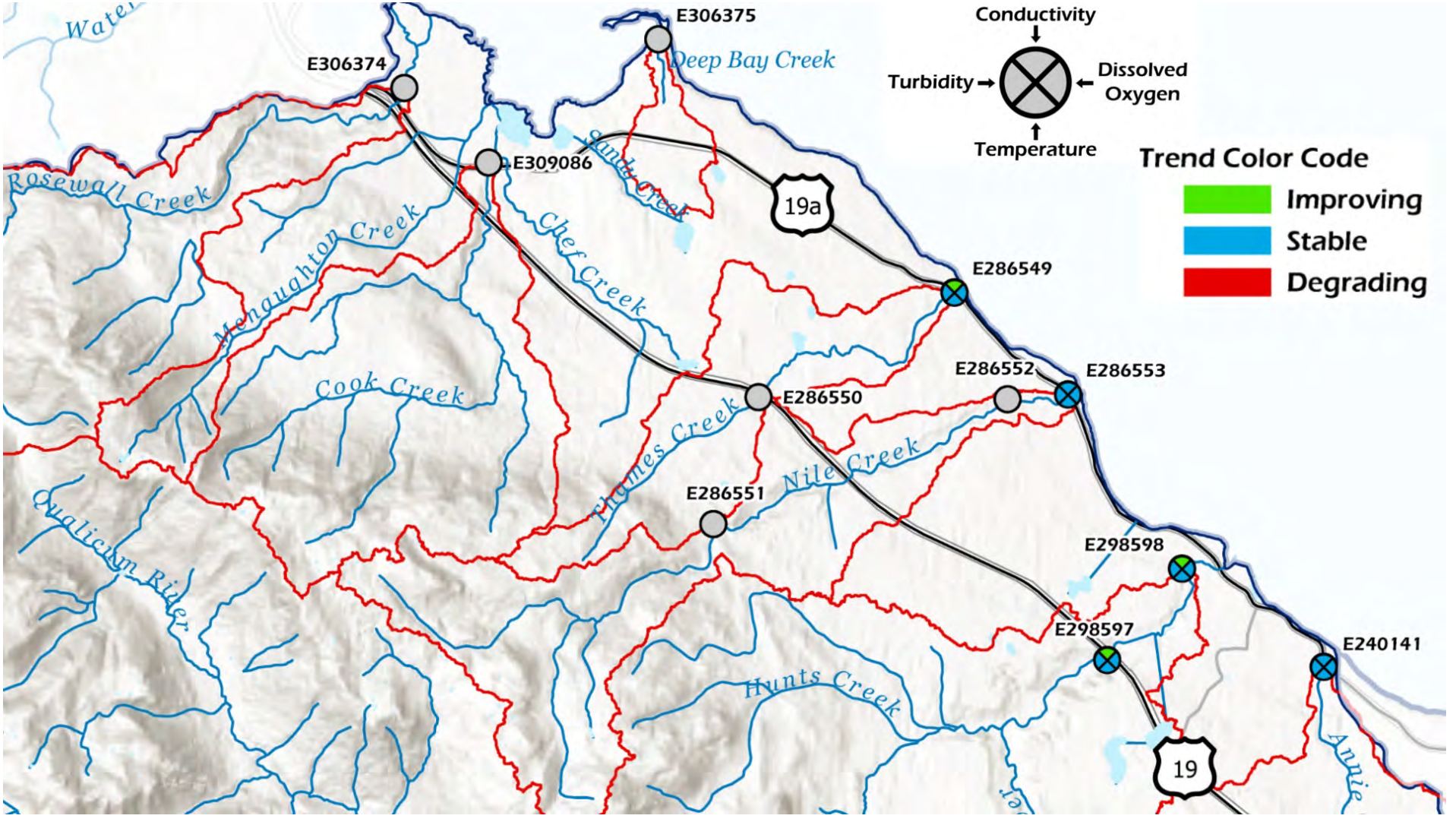
Ten maps were created to visualize Mann-Kendall trends:
WR 1, WR 2, WR 3, WR 4a, WR 4b, WR 5-1a, WR5-1b, WR 5-2, WR 6 , WR 7.



WR 1 Changes Over Time

- WR 1's Nile & Thames Creeks "background" conditions for the region.
- When compared to other WR's:
  - *low residential density,*
  - *large forested areas upstream,*
  - *good riparian buffers,*
  - *groundwater contribution to summer flows.*
- Looking at results:
  Annie Creek shows stable trends, the exceedances of temp, DO, & turb experienced at this site since 2014 have consistently been occurring with no change over the past 7 yrs.

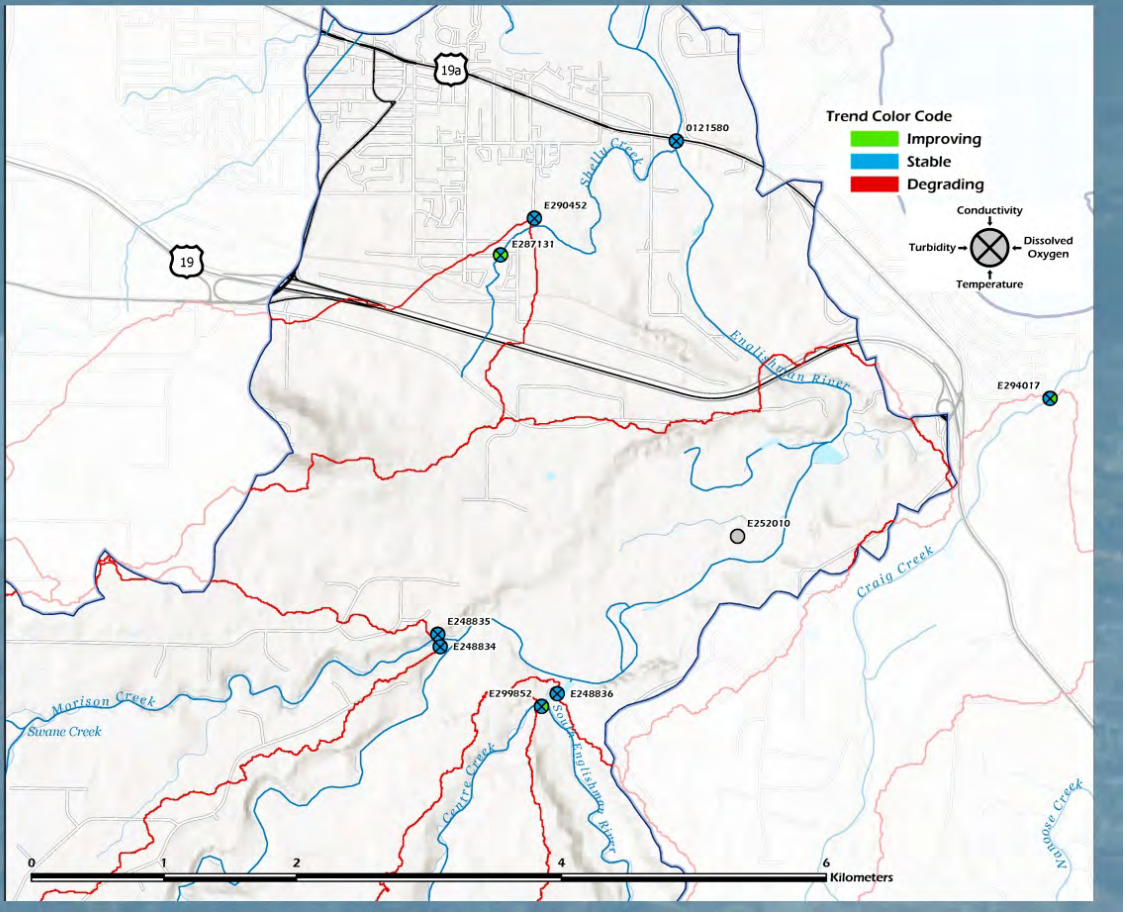


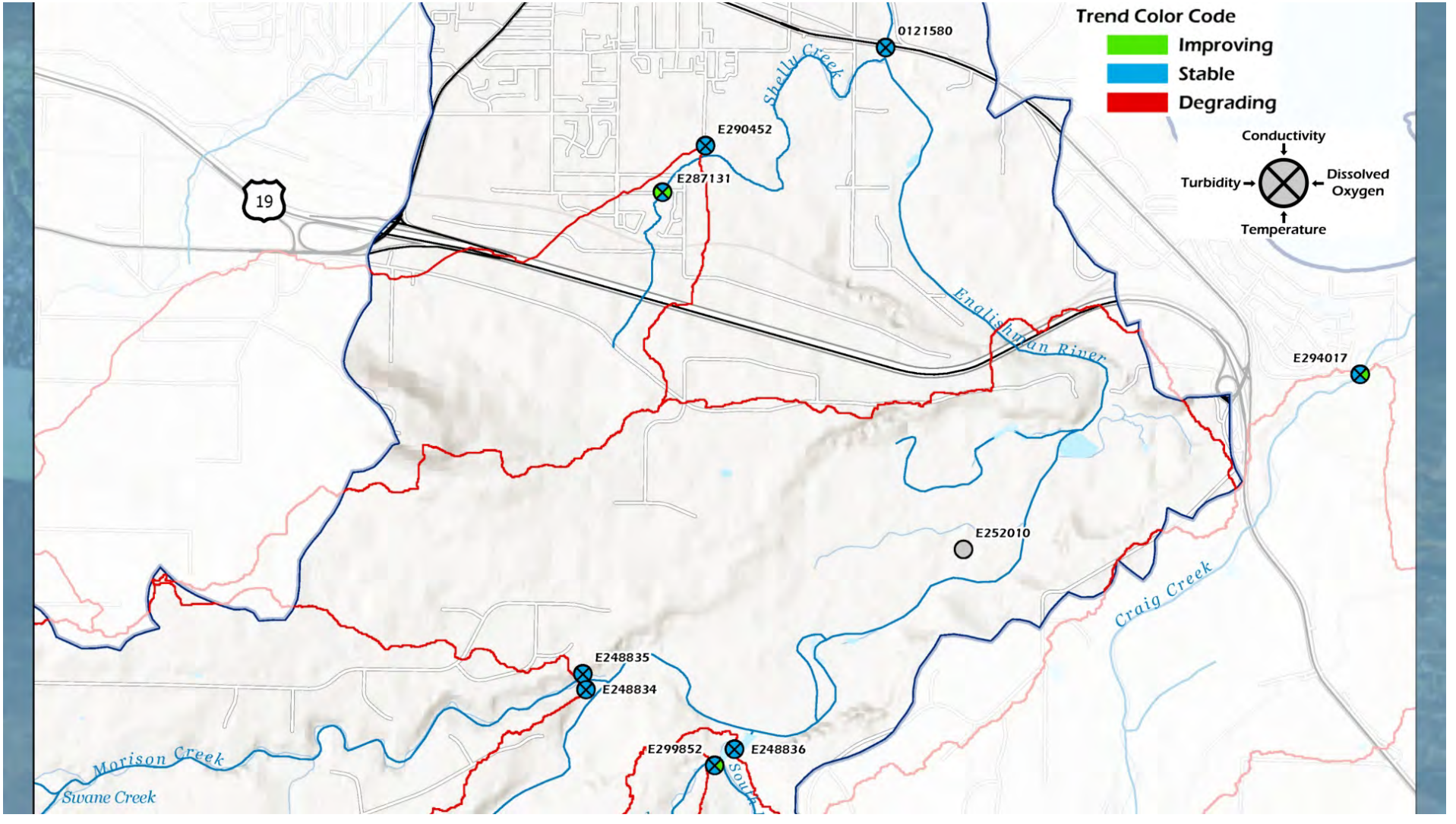

Conductivity
Turbidity
Dissolved Oxygen
Temperature
Trend Color Code
Improving
Stable
Degrading
E306375
E306374
E309086
Deep Bay Creek
Sandy Creek
Rosewall Creek
Chef Creek
Menaughton Creek
Cook Creek
Thames Creek
Nile Creek
Qualicum River
Hunts Creek
Annie
19a
19
E286549
E286552
E286553
E286550
E286551
E298598
E298597
E240141

WR 4b Changes Over Time

- Centre Creek has improving trend for DO. Is this due to restoration activities - i.e., LWD and improved stream structure?

- Shelly Creek at Hamilton showed improving turbidity and DO. Restoration work has been completed to improve structure & maintain riparian.




Trend Color Code
Improving
Stable
Degrading
Conductivity
Turbidity
Dissolved Oxygen
Temperature
0121580
Shelly Creek
E290452
E287131
19
Englishman River
E294017
E252010
Craig Creek
E248835
E248834
E299852
E248836
Morison Creek
Swane Creek

Three Focus Water Regions

Water regions: 3, 5, & 6
Three priority water regions selected for focus in the report based on related concurrent projects:

- ***French Creek (WR3)***
  - *Watershed Performance Targets for Rainwater Management*
- ***South Wellington to Nanoose (WR5)***
  - *City of Nanaimo Stream Stewardship*
- ***Nanaimo River (WR6)***
  - *DFO Chinook Recovery Watershed Assessment and Planning*

Water Regions 3, 5, & 6 - Key Findings

WR3 - French Creek

- *WQ trends: Grandon at Laburnum (increasing DO), French at Barclay (decreasing DO), & Beach at Hemsworth (increasing temp).*
- *In 2020, three sites below summer 5mg/L DO guideline: French at Grafton, Morningstar, & Grandon at Laburnum.*
- *Upstream riparian restoration most likely reason for improved water quality at French at Grafton (turb & temp) and Grandon at Laburnum (temp).*

WR5 - Nanoose to South Wellington

- *WQ trends: increasing SpC at Cottle at Nottingham, Cottle at Stephenson Pt, & Millstone at Biggs.*
- *In 2020, seven sites were below the summer 8mg/L DO guideline most likely due to stream structure, limited flows, and/or high water temps.*
- *Physical stream assessments and photo monitoring could assist in determining if BOD is a factor in low DO.*

WR6 - Nanaimo River

- *WQ trends: no significant trends (several sites did not have 6 yrs of data required for analysis).*
- *In 2020, four sites were below the summer 8mg/L DO guideline: Haley, Holden at Lazo, N. Wexford d/s Douglas, & N. Wexford d/s 10th.*
- *N. Wexford d/s 10th is main site of concern, more info is needed to understand summer turbidity spikes & low DO.*

Water Regions 3, 5, & 6 - Recommendations

- ***WR3 - French Creek:***
  - Additional sampling for nutrients.
  - Riparian restoration to ameliorate turbidity associated with rainfall.
  - Provide resources for farming best practices - i.e., Environmental Farm Plans program, riparian fencing, seeding, planting programs, etc.

- ***WR5 - Nanoose to South Wellington:***
  - Continue to monitor sites with increasing SpC to determine causes.
  - Draw off previous or complete updated desktop and field studies to better understand and ID activities impacting Brannen Lake water quality findings.

- ***WR6 - Nanaimo River:***
  - Continue to monitor N. Wexford d/s 10th & investigate potential sources of summer turbidity spikes.
  - Investigate restoration opportunities u/s of both Nanaimo River sites to decrease summer temp at these sites.

Sites with 10 Years of Data

At the end of the 2020 monitoring season ***18 sites had 10 years of data****, allowing a look at decade long trends in our region. Of these,* ***4 exhibited significant trends****...*

WR	Site Name	Analyte	Trend	Condition	Values w/in Guidelines
2	Little Qualicum at Intake	Turb	↑	Degrading	Yes
3	French at Barclay Bridge	DO	↓	Degrading	Yes
3	Grandon at Laburnum	DO	↑	Improving	No
3	Beach at Hemsworth	Temp	↑	Degrading	Yes

This indicates that although there may be degrading trends, these sites do not necessarily translate into Sites of Concern. Rather, the trend analysis tracks changes over time and can be used as a tool in concert with the exceedance analysis to identify problematic sites.

Sites Not Previously Analyzed

To undergo Mann-Kendall trend analysis, 6 yrs+ data is needed. Since the previous trend report, 9 additional sites meet this threshold that can now have trends analyzed.

WR	Site Name	# Years Sampled	Analyte	Trend	Condition
1	Annie Creek	6	N/A	-	No significant trend
1	Big Qualicum u/s Hwy 19a	6	SpC	↓	Improving
1	Big Qualicum River d/s hatchery	6	SpC	↓	Improving
1	Thames Creek u/s Old Isl. Hwy	7	SpC	↓	Improving
4	Centre Creek u/s South Englishman confluence	7	DO	↑	Improving
4	Shelly Creek at end of Blower Rd	6.5	DO	↑	Improving
4	Shelly Creek at Hamilton Rd	7	DO	↑	Improving
4	Shelly Creek at Hamilton Rd	7	Turb	↓	Improving
4	Swayne Creek d/s of Errington Rd	7	N/A	-	No significant trend
7	Mallett Creek u/s Taylor Bay Rd	6	DO	↑	Improving

Region-Wide Report Recommendations

Stewardship Support / Watercourse Restoration:

- Support physical stream assessments & stream mapping to document erosion, potential contamination sources, & priority sites for enhancement.

- Identify sites with compromised riparian habitat and prioritize restoration. Important in areas with modified adjacent land uses - agricultural, forestry, urban, etc.

Additional Monitoring:

- Sample for Phosphorus, Nitrates, & Nitrogen during summer low flow period at sites with surrounding agriculture and depleted DO to identify critical areas for restoration & outreach.

- Establish or participate in along-term benthic invertebrate monitoring program to further evaluate changes in watercourses over time. Prioritize creeks with multiple land-uses and sites close to proposed development.

- Sample sites with >230 µS/cm for Chloride as values greater than this can alter fish communities.

Region-Wide Report Recommendations

Future Analysis:

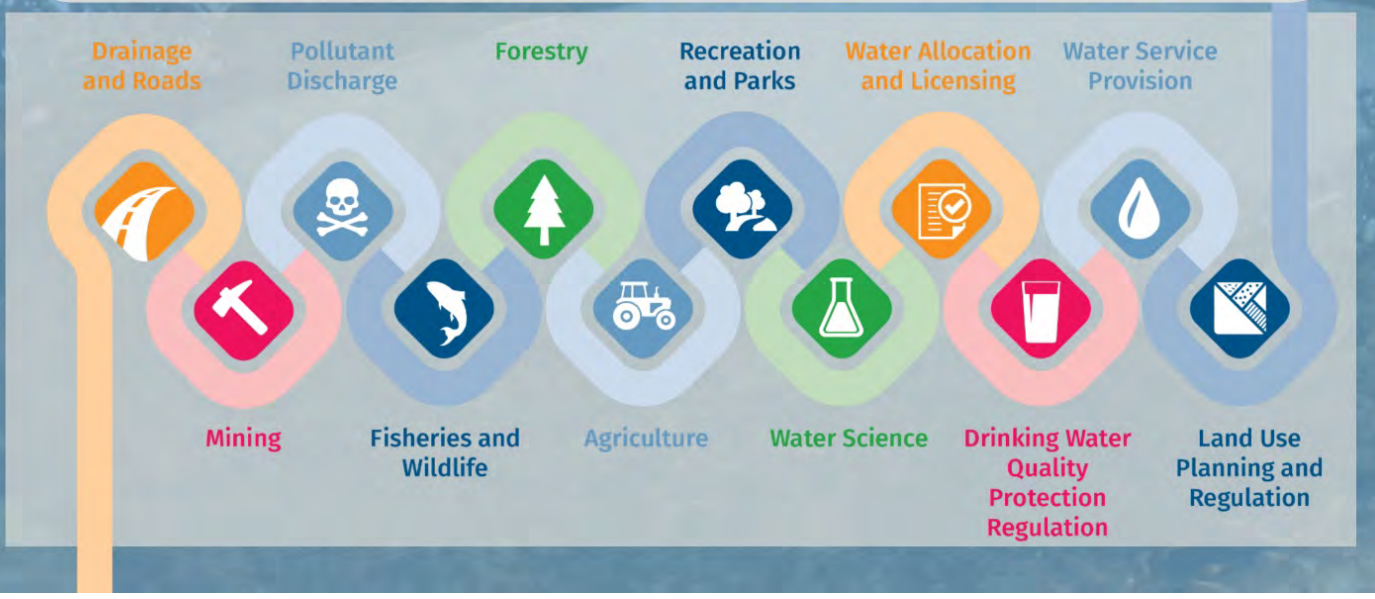
- *Compare turbidity readings to hourly precipitation data to evaluate at a more granular level.*
- *Review soil survey data (ENV) and surficial geology (GSC) against water quality results to better understand context for natural variation in SpC.*
- *Review & compare CABIN data to CWMN results to more in-depth picture & analysis.*
- *Repeat Mann-Kendall trend analysis as data set grows.*
- *Spatially analyze where rain gardens & green infrastructure would provide the greatest benefit.*

Policy / Planning:

- *Plan targeted outreach / collaborative campaign to educate public about stormwater / drains.*
- *Policy advocacy for agricultural lands to ensure effective buffers around watercourses .*
- *Development applications where the Riparian Areas Protection Regulation (RAPR) is applied can present opportunities for requiring riparian restoration and for improving stream mapping.*

Related DWWP initiatives...

- Regional Strategy for Rainwater Management
- Demonstration sites & interpretive signage
- Ecological Accounting Project (Millstone River)
- Wetland monitoring
- School freshwater stewardship curriculum connections



Stewardship Support

With **multiple years of data** we can **identify sites** that have consistent water quality concerns, and **support community actions** to address those concerns.

This includes **prioritizing sites for restoration and enhancement works** undertaken by stewards, and **providing funding partnerships and tools** for these efforts.

Supporting additional monitoring to help direct restoration efforts, i.e., physical stream assessments using Urban Salmon Habitat Program methodology.

Stewardship Seed Funding

- **RDN's DWWP program supports efforts of stewardship groups to take community-level action to monitor, restore and enhance local waterways.**
- Funding priority: non-profit organizations that have previously partnered with the DWWP program.
- Since 2016, 19 projects have been supported across the region.
- In 2021, eligible projects can apply for up to $5000 per project.
- One project has been allocated funding in 2021 and one application is in the works.

Photo credit: David Cotton (QBSS 2020).

To Apply For Funding:

rdn.bc.ca/stewardship-seed-funding

Tool Lending Library

- **DWWP program has a tool kit to help with your streamside projects!**
- Borrow items for your restoration and enhancement projects.
- Dibbler, loppers, shears, rakes, trowels, shovels (tree and spade), extractigator jr., hose, etc.
- **Is there a tool or equipment you would like to see in the library? Send requests & ideas to watermonitoring@rdn.bc.ca**

To Borrow Equipment:

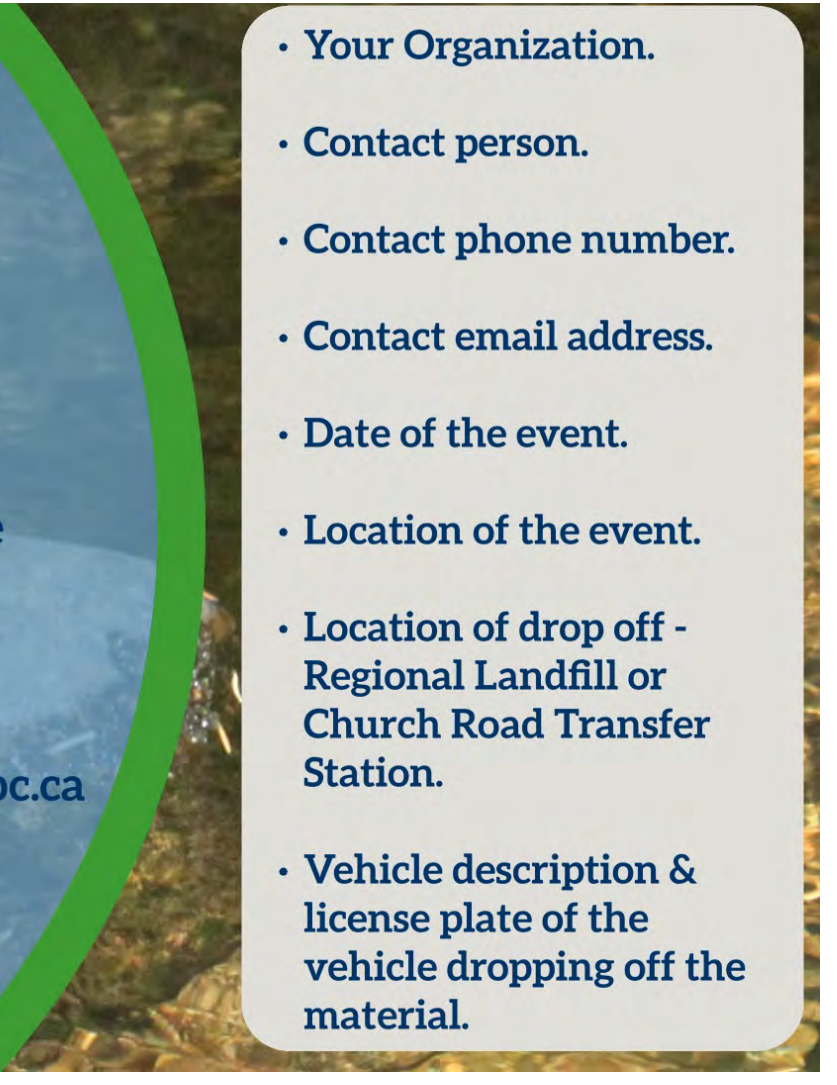
rdn.bc.ca/tool-lending-library

Photo credits: NALT & Alder Environmental.

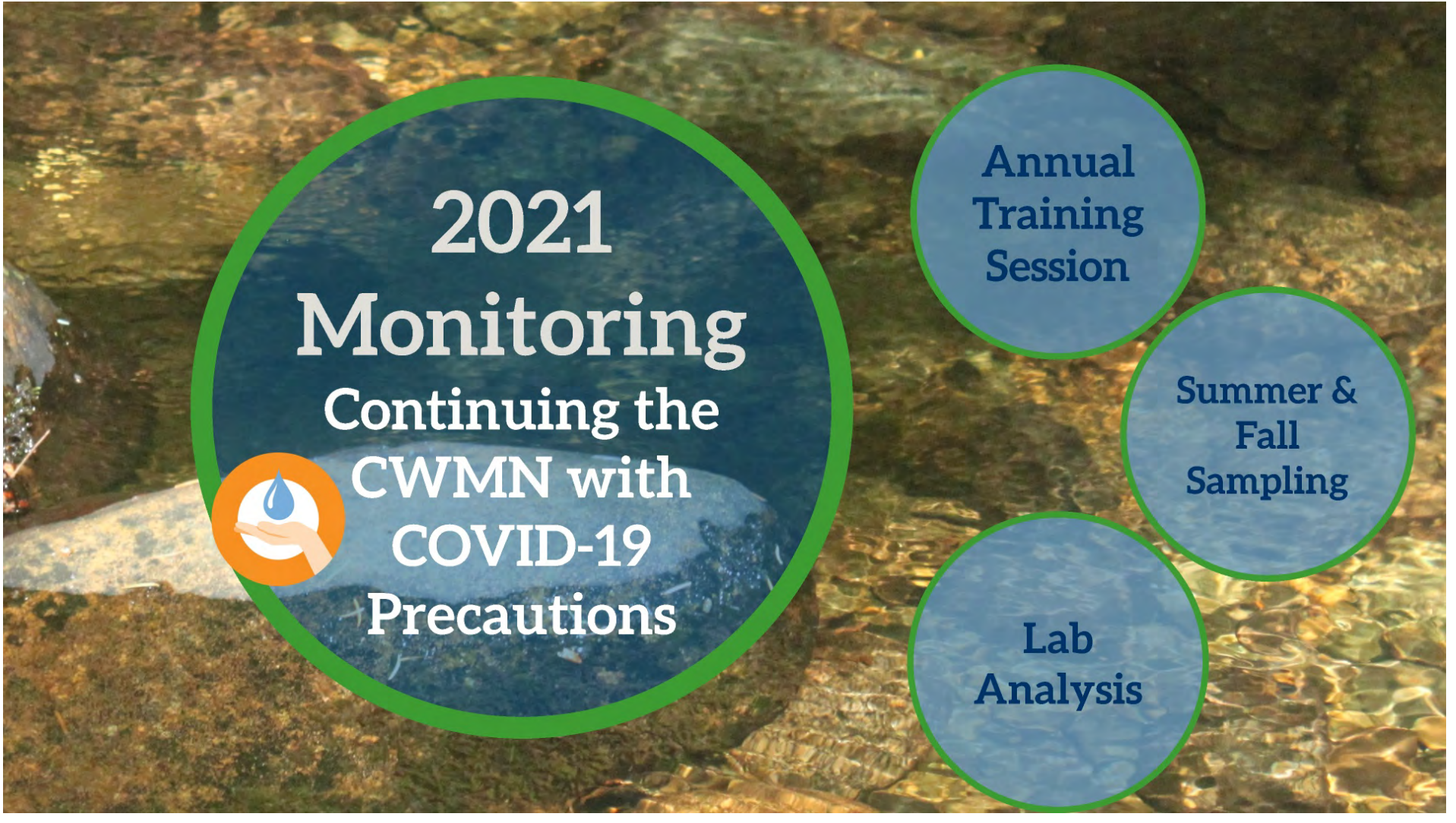
Waiving Tipping Fees

- **The RDN wants to support your community clean up by providing free disposal at the Regional Landfill or Church Road Transfer Station.**
- To have your tipping fees waived - apply to the RDN **at least five business days before** your community clean up.
- **Phone: 250-390-6560 or Email: zerowaste@rdn.bc.ca**

More Info. at:
rdn.bc.ca/community-clean-up



- **Your Organization.**
- **Contact person.**
- **Contact phone number.**
- **Contact email address.**
- **Date of the event.**
- **Location of the event.**
- **Location of drop off - Regional Landfill or Church Road Transfer Station.**
- **Vehicle description & license plate of the vehicle dropping off the material.**


2021
Monitoring
Continuing the CWMN with COVID-19 Precautions
Annual Training Session
Summer & Fall Sampling
Lab Analysis

Annual Training

July Training

- Dates being scheduled for July 19 - 28.
- **Mandatory for participants completing 2021 sampling & using CWMN equipment.**

Small Group Sessions

- Maximum of 8 participants & 2 RDN staff (tentative).
- **Outdoor, stream-side locations: Nile Creek, French Creek, & Millstone River.**
- Face masks required.
- All equipment sanitized.

Focused

- Video content will be sent for mandatory viewing & sign-off before in-person training.
- **In-person training session will focus on:**
  1) Equipment Calibration
  2) Sampling Procedure

CWMN Sampling - August to November

- Will continue to collect water quality samples, with added precautions:
  - 2 volunteers min./max.
  - Division of tasks to minimize cross-handling of equipment.
  - If not in same "bubble", separate vehicles encouraged.

Will adhere to any updated guidance from BC Health Officer, subject to change at any time.

We value our dedicated volunteers; safety and comfort is paramount!

2021 Lab Analysis

Quality Assurance-Quality Control (QA/QC)

- Supported by Mosaic Forest Management.
- 10% of sites.
- Parameter: turbidity.
- Lab analysis compared to grab sample.
- Completed by CWMN volunteers.

Phosphorus

- Continuation of 2018 recommendations for sites.
- Nutrients as a proxy for agricultural run-off.
- Targeted outreach & education.
- Completed collaboratively: RDN & ENV.


REGIONAL DISTRICT OF NANAIMO
THANK YOU FOR YOUR PARTICIPATION!
Question & Answer Period
Two ways to ask questions:
1. Type in the meeting chat box, or
2. Hit the 'raise hand' icon and we will call on you & turn your microphone on so you may ask a question verbally.
Julie Pisani (RDN)
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