FIX IT, CLEAN IT AND MAKE IT LAST

I just love the title of this book that my mother bought me several years ago. Why throw something out if it can be fixed, cleaned and maintained? We have become such a throw away society, that the usual fall back position is to throw something out and replace it with something new. Sometimes that is truly necessary when the fix will cost more than a new item, but I don't believe that this is the case when considering what to do with the Ashland Canal.

I have been pondering the fate of the canal since the last study session on July 15, and to be completely honest, the most pondering that I do deals with what the possible source of the E. coli in the water is. I began to wonder whether or not the cleaning that the city and county crews do might play any part in light of the fact that in our neighborhood the leaves and large debris is just removed to the canal bank and could possibly re-enter the water. Remember that E. coli can survive in soil, sand, plants and algae, so my educated guess is that this debris is a potential "natural reservoir" of the organism.

I did some more digging and found this from the study from 2007 that was done on the Bear Creek Watershed when the Total Daily Minimum Loads (TMDL) were being re-evaluated for E. coli. Here is a quote from that study that talks about *E. coli* in sediment:

Bacterial Re-suspension

"Fecal indicator bacteria can adhere to suspended particles in water which then settle causing an accumulation of bacteria in the bottom sediment (Davies et al., 1995). Numerous studies have found fecal indicator bacteria at greater concentrations in the sediment than in the overlying water in rivers, estuaries and beaches (Stephenson and Rychert, 1982, Struck 1988, Obiri-Danso and Jones, 1999, Byappanahalli, et al. 2003, Whitman and Nevers, 2003). Concentrations in the sediment can range from 10 to 100 times greater than in the overlying water. Re-suspension of bottom sediment has been shown to increase fecal indicator bacteria concentrations in the water column. (Sherer et.al., 1988, and Le Fever and Lewis, 2003)." and *"Two recent field studies have indicated the possibility that fecal indicator bacteria can form a stable, dividing population in sediment in a temperate environment (Whitman R.L and M.B. Nevers, 2003 and Byappanahalli, et al. 2003). Whitman and Nevers (2003) concluded that "more research into the environmental requirements and potential for in situ growth is necessary before E. coli multiplication in temperate environments can be confirmed, but this study provides initial data supporting that hypothesis."*

Bear Creek Watershed TMDL - ODEQ

FIX IT, CLEAN IT AND MAKE IT LAST

When I read that, I began to wonder about the cleaning procedures that the city and county work crews do. I communicated with Steve Walker and Kevin Caldwell to get a better understanding of what the work crews did and didn't want to make any assumptions from what I've observed. The crews clean the canal twice a year. Once in late November/early December and then again in late March or early April prior to irrigation season. The crews did their spring cleaning on March 25th, 26th, 28th and 29th, 2019. Robinson Concrete came in on April 9, 2019 to begin their preparation of the canal for the repair work that they did. This preparation included power washing the canal, and *by explicit instruction of the public works department, they vacuumed up the debris and sediment and took it away.* A comment made by the contractor was that power washing was the correct way to clean a ditch.

The work crews have not done cleaning of this magnitude in the 19 years that Steve Walker has been worked for the city. Here's a quote from his response to me when I asked what the procedure for cleaning was, "Power washing has not been something we've done since I've been here typically its rakes, shovels, wheel barrows and leaf blowers. The leaves and debris are for the most part carried out to locations where we can take them away but there are still a few areas that are not as heavily populated that if all there is are leaves from the trees surrounding the ditch they are raked off the side of the canal." The latter, as I've already stated, is what happens in my neighborhood

With this information at hand, I did a little internet search regarding proper procedures for cleaning irrigation ditches, because I didn't want to assume anything here either, and stumbled upon a study from the University of Arizona. Here are some of the findings from that study: *"Canal maintenance, involving mechanical removal of sediments and algal growth from canal basins, is necessary for sustaining the viability of the irrigation water delivery system in the Imperial Valley of California. Maintenance activities, however, disturb canal sediments laden with bacteria and can negatively impact water quality downstream."* The recommendations were: *"Further, irrigation district guidelines may consider: 1) disposing of the"first flush"of canal water following maintenance into nearby open areas, rather than sending poor-quality water into the irrigation canal system; 2) collect sediments and algae deposited on canal banks and transport to a secondary location to prevent precipitation runoff and re-introduction of bacteria-laden sediments to canals".*

FIX IT, CLEAN IT AND MAKE IT LAST

What if the canal were power washed each spring and the debris and sediment was completely removed instead of left on the canal bank? I hypothesis that the E. coli counts would be kept at a lower level.

I also wanted to let you know about some more recent results from the swim reservoir and the wading area. Samples were taken on July 24, 2019. E. coli levels at the wading area were 10.0 MPN E. coli/100 ml and at the swim reservoir they were 21.0 MPN E. coli/100ml. Doesn't look like to me like the TID is affecting the wading area much.

I, along with other members of our city, believe that the E. coli issue is a "Red Herring", and for goodness sakes, why is Public Works pushing the data from the 2011 Ashland Creek Study (data collected in 2010) when there is more recent E. coli testing on the TID (2018). Using old data doesn't make sense to me.

As one more additional thought, is there any plan to addressed all of the little canals (aka gutters and downspouts) in Ashland and their contribution of pollutants? From what the EPA says, *"Every time it rains, water runs off impermeable surfaces, such as roofs or driveways, collecting pollutants such as particles of dirt, fertilizer, chemicals, oil, garbage, and bacteria along the way. The pollutant-laden water enters storm drains untreated and flows directly to nearby streams and ponds. The US EPA estimates that pollutants carried by rainwater runoff account for 70% of all water pollution."* I ask because of how our storm drains are marked "Drains to Streams". I think I'll put in a rain garden.

Julie Bonney-Shanor
B.A. Microbiology CSU Chico
B.A. Chemistry CSU Chico
MT (ASCP)
CLS (NCA)
CLT (State of California)
Retired Medical Laboratory Manager

To Pipe or not to Pipe the Ashland Canal?

Informational Meeting Facts and Discussion

***August 10, 12-1:00pm**
E.coli

Presented by : Julie Bonney-Shanor
B.A. Chemistry, B.A. Microbiology
MT (ASCP)
CLS (NCA)
CLT (State of California)
Retired Medical Laboratory Manager

Organized by the Citizens' Alternative
City Councilors and City Staff are being personally invited.
G0 TO: ashlandtrails.com/keep-the-canal/

E. coli (Escherichia coli)

Hypothesis:
E. coli counts will be lowered in Ashland's TID canal if the city's two miles are properly cleaned and maintained.

Background:
Power washing and vacuuming up the debris and sediment was part of the preparatory work that Robinson Concrete (the company that did repair work on 400 feet of canal in April 2019) did prior to applying Fiber Reinforced Concrete by shotcrete application to repair this section of canal. The vacuuming was by explicit instruction of the City.

The City and County Work Release crews that come through prior to the beginning of the irrigation season only use shovels, rakes, wheelbarrows and leaf blowers to clean the ditch removing the large debris from the canal. They do not wash it, thereby leaving fine particulate material in the bottom of the canal. The City also does not clean the inside of the currently piped sections, so there is undoubtedly some sediment that has accumulated on the bottom of these as well. City crews cleaned the canal this past spring on March 25th, 26th, 28th and 29th, 2019. Studies have shown that E. coli has natural reservoirs in soil, sand, algae and plants seemingly in the absence of fecal material. Because of this natural reservoir, there is a potential for the debris left on the canal bank and the sediment that is left at the bottom of the canal and piped sections to contaminate the water.

It is of concern to the City that we keep storm water run-off out of the canal, but as noted in the Ashland Creek Bacterial Study, it hardly rains in Ashland during the summer. The TID is not the only source of storm run-off. Storm drains also add additional E. coli to Ashland Creek. There are 19 storm drains that empty into Ashland creek above the wading area in Lithia Park according to city data. Rogue Valley Council of Governments is currently monitoring the storm drains that empty into Bear Creek to better understand storm drain influence on water quality.

According to the preliminary engineering report by Adkins Engineering, if the piping project were completed, there is a plan to place a "traveling bar screen" at the new inlet. This screen will filter out leaves, sticks and algae, but will not take care of the fine sediment that will continue to come down the canal. Placing a screen fine enough to keep sediment out would completely block the flow of water. As the sediment accumulates in bottom of the pipe, this will become a reservoir for *E. coli* causing levels to increase again.

Facts about *E. coli*
General
1. Found in the gastrointestinal tract of warm blooded animals, birds, and uncommonly in fish frogs and reptiles.
2. Can persist and even thrive in soil, sand, algae and plants (natural environments) **in the absence of fecal material.**
3. Grows best at 37 C° (98.6 F°), but can survive a wide range of temperatures including cold Michigan winters.
4. Water quality testing for *E. coli* only tests for "generic" *E. coli*
5. The TID and Ashland Creek are both conveyances for all kinds of *E. coli*
6. The majority of *E. coli* 0157infections, a known pathogen, come from consuming contaminated food

From Bear Creek Watershed TMDL-ODEQ Study (July 2007)
- "Fecal indicator bacteria can adhere to suspended particles in water which then settle causing an accumulation of bacteria in the bottom sediment. **Concentrations in the sediment can range from 10 to 100 times greater than in the overlying water**. Re-suspension of bottom sediment has been shown to increase fecal indicator bacteria concentrations in the water column." (pg. 6) There is sediment in the bottom of the canal and in the piped sections the Ashland section of TID which could harbor *E. coli*.

From Ashland Creek Bacterial Study (2011)
- *E. coli* levels prior to entering currently piped sections show increased counts upon exiting; therefore, if the canal is piped, *E. coli* addition will not be eliminated. **2010 data: 143.6 prior to entering the piped section at Herbert Street and 163.7 at the TID outfall** This area is also a "No Public Access" area on the Ashland Canal trail easements so domestic animal wastes are at a minimum and may not be a large contributing factor.

From a University of Arizona Study (2015):
- "Canal maintenance, involving mechanical removal of sediments and algal growth from canal basins, is necessary for sustaining the viability of the irrigation water delivery system in the Imperial Valley of California", and "Irrigation district guidelines may consider 1) disposing of the 'first flush' of canal water following maintenance into nearby open areas, rather than sending poor-quality water into the irrigation canal system; **2) collect sediments and algae deposited on the canal banks and transport to a secondary location to prevent precipitation runoff and re-introduction of bacteria-laden sediments to canals**".

From the City Study Session 8-5-2019:

- The city acknowledges that water from the TID is very turbid and will need to be run through a very fine screen in order to remove sediment at the water treatment plant.

DEQ water standards

For Freshwater Contact Recreation ORS 340-041-009 (1)(a)(A)(B):

- 90-day geometric mean of 126 *E. coli*/100ml using a minimum of 5 samples
- No single sample may exceed 406 *E. coli*/100ml
- Intention is to maintain a risk of G.I. illness at fewer than 8 cases per 1,000 swimmers at freshwater beaches based on exposure to point-source*, untreated human wastewater discharge or spill.

*Point Sources include: Waste Water Treatment Facilities, Landfills, Onsite Sewage Systems, Stormwater Discharges and Confined Animal Feeding Operations.

For Animal Waste ORS 340-041-0009 (4):

- Animal Waste: Runoff contaminated with domesticated animal wastes must be minimized and treated to the maximum extent practicable before it is allowed to enter waters of the State.

From Parks and Rec

- Bacterial counts on samples taken June 26, 2019 showed elevated levels of *E. coli* at the swim reservoir and acceptable levels at the wading area. The TID does not influence *E. coli* levels at the swim reservoir.

Problems with 2011 (data collected during 2010) Ashland Creek Bacterial Study:

1. Sample size from site to site is inconsistent.
2. Direct sampling of TID outfall, but not of Nutley Storm Drain. This is an issue because we don't know the level of E. coli contained within any storm water runoff and storm water is known to have higher *E. coli* levels. There is an increase in E. coli levels downstream of the Nutley storm drain, but we don't know what the storm run off might be contributing because we don't know the actual level of *E. coli* in that water.
3. No correlation done between wading area closure and *E. coli* numbers at TID outfall, so we don't know how the *E. coli* levels are influencing any closures at the wading area, if at all.
4. *E. coli* results used by City of Ashland included samples taken during rain events. ***"The data are somewhat biased because "we purposefully collected samples whenever it rained in order to study potential effects of rain on E. coli levels. It rarely rains in Ashland during the summer…It was noted that E. coli levels were higher during summer rain storms".***
5. *E. coli* counts continue to increase downstream of the TID outfall even though the TID has been shut off (October) indicating there is another source of bacteria input., most likely storm drains (see table below).

Geometric Mean E. coli MPN/100ml during "no rain" days at Ashland Creek Sampling Locations

Sampling Dates	Site 5 (Above TID Outfall)	TID Outfall (This sample is not from the creek)	Site 3 (Below TID Outfall)	Site 2 (Above Nutley Storm Drain)	Site 1 (Below Nutley Storm Drain)
6/10 – 10/13	17.9	148.6	45.3	51.2	57.1
10/14 – 10/30	17.8	Off	17.8	35.3	34.9

6. There is more current data on *E. coli* counts (2018) which show a decrease of *E. coli* at the TID outfall, however sample size was smaller and it is unknown if the collections dates included any rain events. 2010 data: 163 MPN *E. coli*/100ml (outside DEQ limits); 2018 data: 78 MPN *E. coli*/100ml (the 2018 value is within DEQ limits)
7. The source for *E. coli* was not determined and it was recommended that further study be done, but a thorough study has yet to be done.

General Flaws of *E. coli* Monitoring:

1. Testing does not include identification of pathogenic organisms such as *Giardia*, *Cryptosporidium* or *Salmonella*.
2. High *E. coli* counts may not indicate the presence of pathogenic organisms mentioned above.
3. *E. coli* counts within parameters may not indicate the presence of pathogenic organisms mentioned above.
4. *E. coli* counts can vary depending upon the time of day and morning samples have typically higher counts than afternoon samples

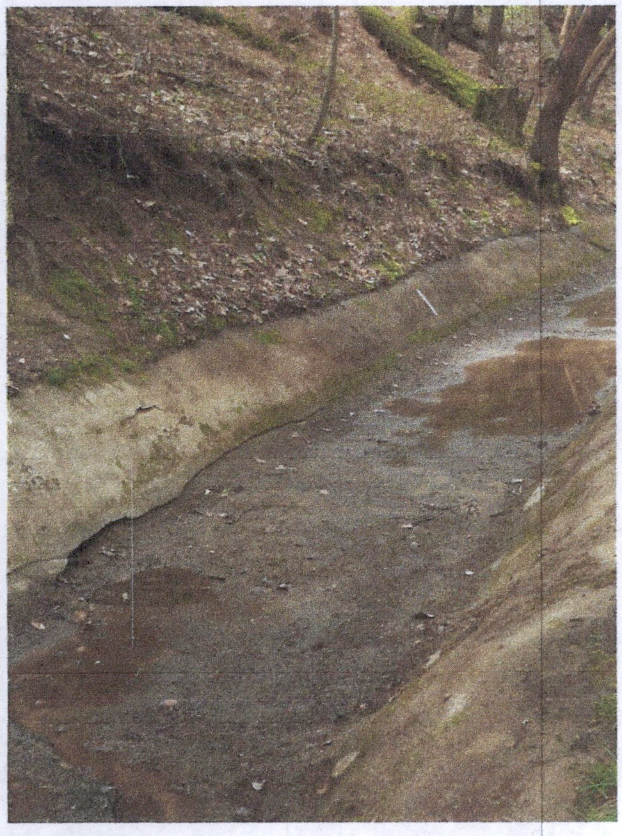
5. *E. coli* counts can vary depending upon the depth of the water. Shallow water typically has higher counts than deeper water
6. Variation can also occur from day to day
7. *E. coli* counts are likely to increase following a rain event
8. *E. coli* counts can vary along a shoreline often just inches apart
9. Test results do not indicate "real time" counts because incubation time for the testing is 24 hours

Conclusion:

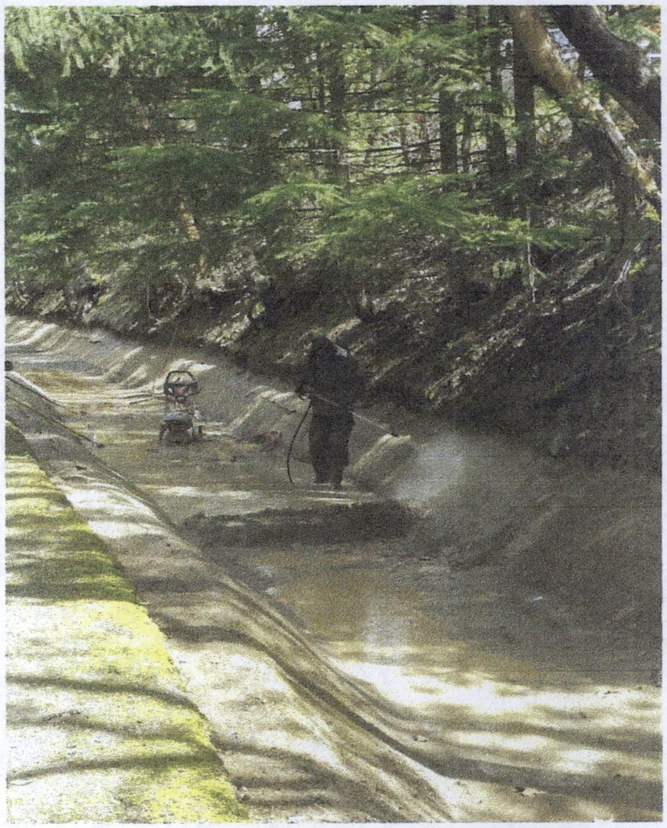
E. coli is of concern to everyone. As indicated in the Ashland Creek Bacterial Study (2011), the source of the *E. coli* is unknown. "Due to the numerous potential inputs, determining specific sources of high bacteria levels is complicated. Extensive study of the creek is required, including influences of weather and seasons, to determine accurate estimates of means and variability of water quality parameter readings. It is imperative to understand how recreational use, irrigation, and wild and domestic animals influence water quality before solutions to reduce bacteria problems can be addressed." and from Recommendations: "While this study indicates that the TID is a **conveyance** for bacteria, the source of the bacteria remains unknown. Further study is warranted ..." Given the information that has been shared, *E. coli* levels are not a valid reason to pipe the canal. The relevance of *E. coli* to the decision to pipe the canal is questionable and secondary to the logistical difficulties of construction, community pushback and known and unknown costs of the piping project.

To mitigate the contribution of *E. coli* to Ashland Creek, the City of Ashland should instead take a look at their current cleaning and maintenance of the canal and make necessary changes to include removal of **all debris and sediment** that accumulates in the canal to a secondary site. They should also work to come up with a plan to reduce the contribution of storm water runoff from the nineteen storm drains that currently drain into Ashland Creek as well as all of the storm drains within the city that "Drains To Streams".

E. coli counts will be lowered in Ashland's TID canal if the city's two miles are properly cleaned and maintained.

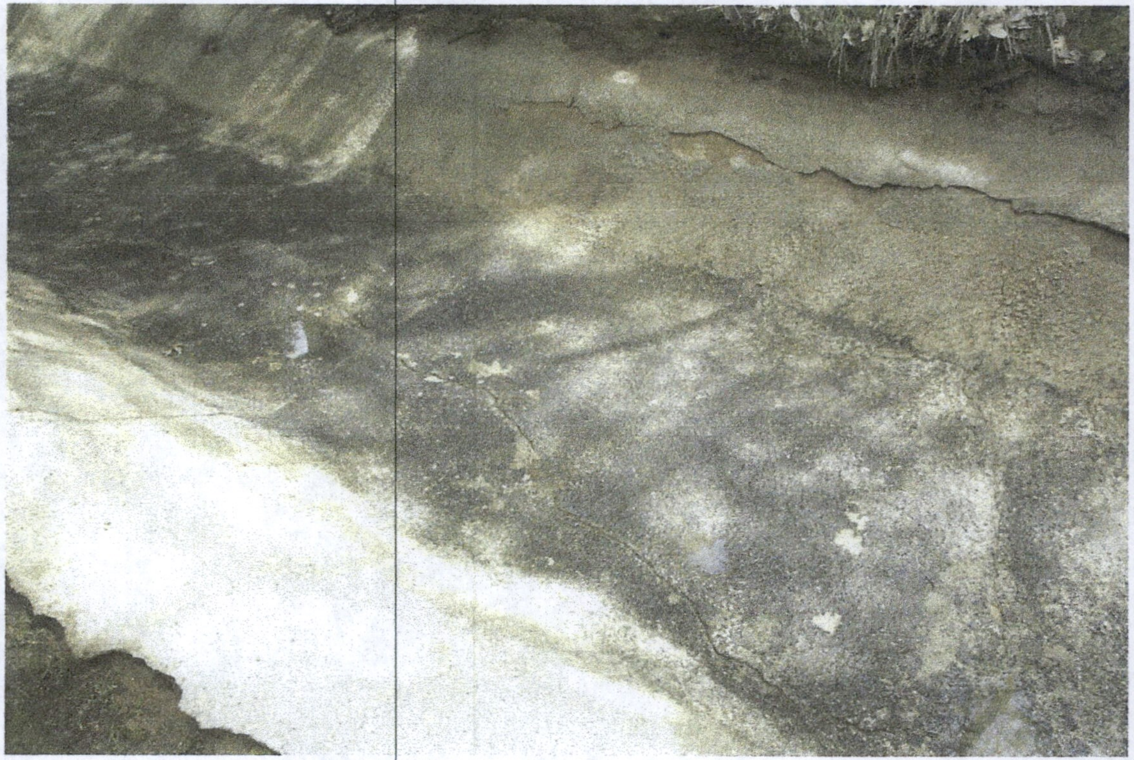


4-7-2019 Canal **after** City Crews have done their spring cleaning

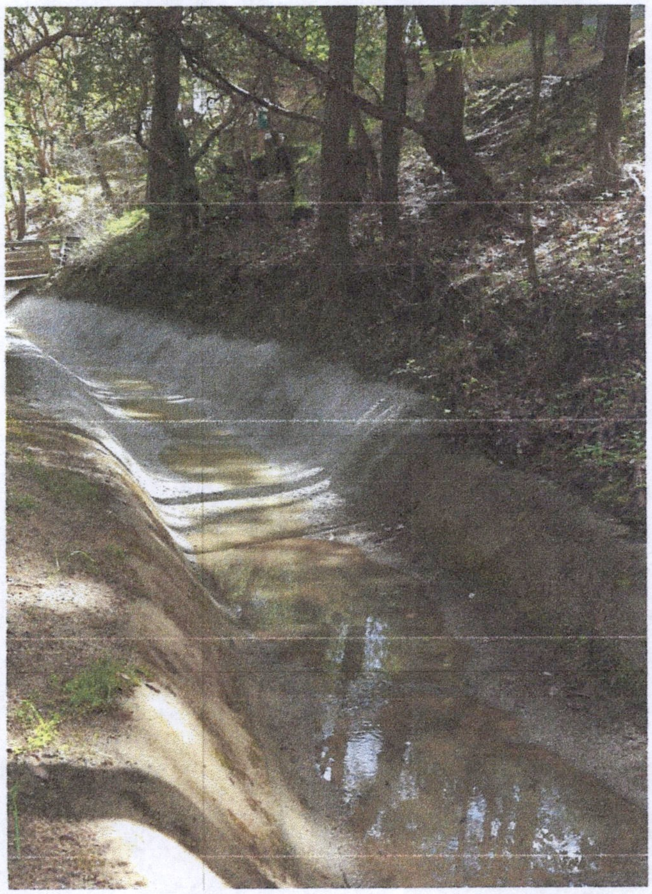


4-10-2019 Cleaning done by Robinson Concrete prior to Fiber Reinforced Concrete application

4-7-2019 Close-Up of canal after city and county crews have done the spring cleaning

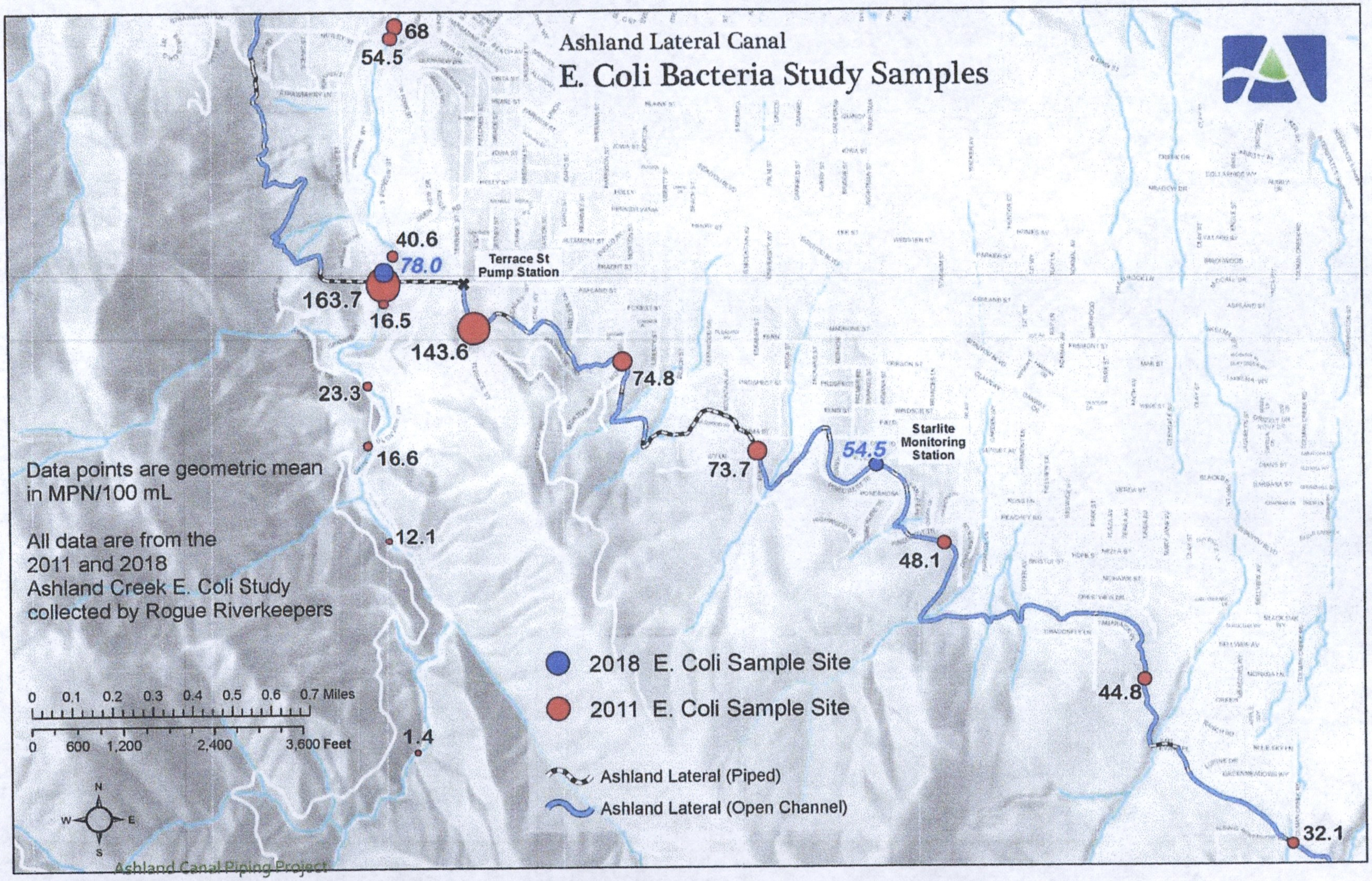


4-10-2019 Close-Up of canal following power washing and prior to shotcrete application of Fiber Reinforced Concrete



4-16-2019 Photo of clean, repaired section of canal and old section
Note: The canal was raised on the side in order to compensate for the addtion of concrete to the bottom

City of Ashland Storm Drain Cover: "Drains to Streams"


Ashland Lateral Canal
E. Coli Bacteria Study Samples
68
54.5
40.6
78.0
Terrace St Pump Station
163.7
16.5
143.6
74.8
23.3
16.6
73.7
54.5
Starlite Monitoring Station
48.1
12.1
44.8
1.4
32.1
Data points are geometric mean in MPN/100 mL
All data are from the 2011 and 2018 Ashland Creek E. Coli Study collected by Rogue Riverkeepers
2018 E. Coli Sample Site
2011 E. Coli Sample Site
Ashland Lateral (Piped)
Ashland Lateral (Open Channel)
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 Miles
0 600 1,200 2,400 3,600 Feet
N
W
E
S

Ashland Canal
Trail Easements
MAPPING IS SCHEMATIC ONLY AND BEARS NO WARRANTY OF ACCURACY. ALL FEATURES, STRUCTURES, FACILITIES, EASEMENT LOCATIONS, OR ROADWAY LOCATIONS SHOULD BE INDEPENDENTLY FIELD VERIFIED FOR EXISTENCE AND/OR LOCATION.
Legend
No Public Trail Easement
Yes, Public Trail Easement
VIEWPOINTE TERRACE SUBDIV
JOHNSON
WESTIGARD
PERRIN
DIENEL
SNEIDER
KEEVIL
PARK ESTATES, PHASE 1
ASHLAND PARKS
QUAILHAVEN SUBDIVISION
ESTATES OF MIND SUBDIV
R.O.W.
Beach Creek
Roca Creek
Ashland Canal
ASHLAND ST
PRACHT ST
FOREST ST
CASCADE ST
WATERLINE RD
TERRACE ST
ASHLAND LOOP RD
GLENWOOD DR
WILDWOOD WY
EMMA ST
PLEASANT WY
FERN ST
ROCA ST
MADRONE ST
OREGON ST
PROSPECT ST
ELMS ST
WINDSOR ST
FELDER ST
WOODLAND DR
WEISSENBACK WY
PINECREST TR
PONDEROSA DR
HIGHWOOD DR
WEBSTER ST

Special Project Results

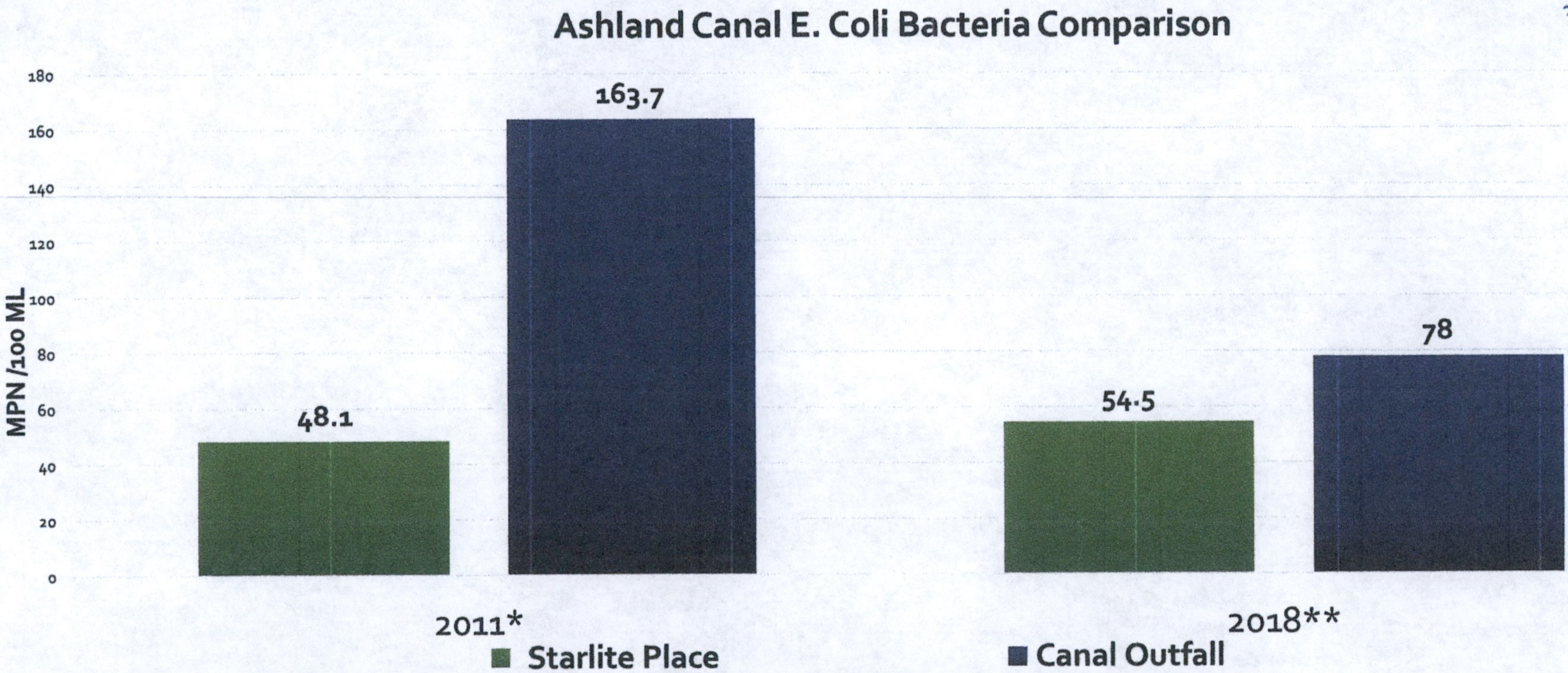
Rogue Valley Council of Governments
Natural Resources Department

Site Designation:	Site:	Date:	Time:	E.coli Bottle #:	E.coli MPN:	Comments:
Site 4 - TID Outfall	Siphon	06/14/18	9:10	A4	613.1	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	06/14/18	9:45	27p	137.6	Bucket sample.
Site 4 - TID Outfall	Siphon	06/21/18	10:35	B2	191.8	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	06/21/18	10:10	B20	127.4	Bucket sample.
Site 4 - TID Outfall	Siphon	06/28/18	9:18	B20	41.9	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	06/28/18	9:40	B44	48.7	Bucket sample.
Site 4 - TID Outfall	Siphon	07/05/18	11:25	518	62.0	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	07/05/18	11:05	B7	45.7	Bucket sample.
Site 4 - TID Outfall	Siphon	07/12/18	9:38	B2	77.1	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	07/12/18	9:56	B18	38.4	Bucket sample.
Site 4 - TID Outfall	Siphon	07/19/18	10:55	0.0	74.9	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	07/19/18	10:20	B4	83.9	Bucket sample.
Site 4 - TID Outfall	Siphon	07/26/18	9:30	B28	325.5	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	07/26/18	9:47	B17	146.7	Bucket sample.
Site 4 - TID Outfall	Siphon	08/02/18	10:50	B37	117.8	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	08/02/18	9:50	B34	30.9	Bucket sample.
Site 4 - TID Outfall	Siphon	08/09/18	9:40	37p	65.7	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	08/09/18	9:55	B2	39.3	Bucket sample.
Site 4 - TID Outfall	Siphon	08/16/18	10:05	B35	62.4	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	08/16/18	9:40	B47	44.8	Bucket sample.
Site 4 - TID Outfall	Siphon	08/23/18	9:25	100p	61.3	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	08/23/18	10:45	B44	53.8	Bucket sample.
Site 4 - TID Outfall	Siphon	08/30/18	9:45	B12	16.1	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	08/30/18	10:40	B2	24.0	Bucket sample.
Site 4 - TID Outfall	Siphon	09/06/18	10:55	B24	38.4	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	09/06/18	10:35	518	19.5	Bucket sample.
Site 4 - TID Outfall	Siphon	09/13/18	9:34	B4	54.6	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	09/13/18	10:34	A11	34.1	Bucket sample.

Site 4 - TID Outfall	Siphon	09/19/18	10:41	420B	41.9	Bucket sample.
TID Site D - Pinecrest Terrace	Starlite	09/19/18	10:17	B44	127.4	Bucket sample.

Collector: Amie Siedlecki, RVCOG

E. COLI BACTERIA STUDIES



All figures are geometric mean. All units are MPN/100 ML
***2011 data from Rogue Riverkeeper Ashland Creek Bacteria Study (62 samples taken)**
****2018 data from City of Ashland and RVCOG (30 Samples taken)**

Canal Maintenance Effects on Irrigation Water Quality

CANAL MAINTENANCE EFFECTS ON IRRIGATION WATER QUALITY

By

Victoria Obergh

A Thesis Submitted to the Faculty of the

Author
Obergh, Victoria Lee

Issue Date
2015

Keywords
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E. coli
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Salmonella
Soil, Water & Environmental Science
canal maintenance

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McLain, Jean E.

Metadata

Publisher
The University of Arizona.

Abstract
Canal maintenance, involving mechanical removal of sediments and algal growth from canal basins, is necessary for sustaining the viability of the irrigation water delivery system in the Imperial Valley of California. Maintenance activities, however, disturb canal sediments laden with bacteria and can negatively impact water quality downstream. Our work quantified fecal indicator bacteria (Escherichia coli) and pathogens (Salmonella) in canal water prior to, during, and post-maintenance events. The goal of this study was to construct a post-maintenance time matrix that will allow growers downstream to estimate when canal water once again meets water quality guidelines. In addition, we assessed the water quality impacts of lining canals with concrete, which is a costly endeavor in the short term, but may be beneficial in the long term as lined canals do not require routine dredging to maintain canal integrity. During eight maintenance events from March 2013 through August 2014, 22% of 396 water samples collected exceeded the irrigation water quality guidelines (<126 MPN E. coli 100 mL-1) during canal maintenance. During summer months (July and August 2013-2014), E. coli concentrations in water samples commonly reached maximum values (>2419.6 MPN E. coli 100 mL-1), and these samples were more readily collected from unlined canal sampling sites. During winter and spring months, 80.8% of E. coli exceedances for unlined canals met guideline standards in less than 22 hours, while 19.2% of exceedances took longer (up to 48 hours) to return to acceptable levels; in lined sites, 63.6% and 36.4% met guidelines in less than 22 hours and 48 hours, respectively. Summer months showed a different trend: in unlined canal sites, 56.3% of E. coli exceedances met standards within 22 hours and 43.7% within 48 hours; in lined sites, 100% of water samples met standards in less than 22 hours. Unlined sites averaged higher temperatures overall compared to lined sites, and canal water in July (2013) was extremely warm (averaging 32.8° C) and reached human body temperature (37° C) at several unlined sites, a temperature at which enteric bacteria are known to thrive. Culturable Salmonella were detected in water samples collected in summer, with 22.2% of Salmonella-positive samples within 1° C of human body temperature. E. coli concentrations were significantly correlated with temperature and pH in unlined canals only. Unlined canals showed 15.2% of water samples were Salmonella-positive during summer maintenance whereas 1.7% of lined canals were positive. Salmonella significantly correlated with pH in lined canals. Fecal indicators (E. coli) did not predict pathogen (Salmonella) presence. Molecular methods (qPCR) suggested far higher levels of Salmonella when compared to cultural methods, with molecular markers for Salmonella exceeding culturing by more than 600%. The results of this work suggest that growers should exercise caution when irrigating after canal maintenance events, and to be completely certain of acceptable irrigation water quality, should wait for 48 hours following the onset of maintenance (typically 24 hours following the re-introduction of water to the channels) prior to irrigating crops. Further, irrigation district guidelines may consider: 1) disposing of the"first flush"of canal water following maintenance into nearby open areas, rather than sending poor-quality water into the irrigation canal system; 2) collect sediments and algae deposited on canal banks and transport to a secondary location to prevent precipitation runoff and re-introduction of bacteria-laden sediments to canals,

and 3) consider the long-term costs and benefits of canal lining.

Type
text
Electronic Thesis

Degree Name
M.S.

Degree Level
masters

Degree Program
Graduate College
Soil, Water & Environmental Science

Degree Grantor
University of Arizona

Collections
Master's Theses

NEILSON RESEARCH CORPORATION

Neilson Research Corporation
245 S Grape St
Medford, OR 97501
TEL: (541) 770-5678 FAX: (541) 770-2901
Website: www.nrclabs.com

Analytical Report

WO#: **19061081**
Date Reported: **7/1/2019**

CLIENT: Ashland Parks & Rec.
Lab ID: 19061081-01
Client Sample ID: AC at Playground
Project: Ashland Creek
Sample Address:

Collection Date: 6/26/2019 9:15:00 AM
Received Date: 6/26/2019 10:17:00 AM
Matrix: AQUEOUS

Sample Location: AC at Playground

Analyses	Method	NELAP Status	Result	Qual	DF	RL	Units	MCL	Date Analyzed/Analyst	
BACTERIA BY QUANTI-TRAY										
Total Coliform Bacteria	A9223B	A	>2420		1	1.00	MPN/100mL		06/26/19 16:30	DJK
E. Coli Bacteria	A9223B	A	40.0		1	1.00	MPN/100mL		06/26/19 16:30	DJK

QUALIFIERS

CI	Sample container temperature is out of limit as specified at testcode	H	Holding times for preparation or analysis exceeded
MI	Recovery outside control limits due to Matrix Interference	ND	Not Detected at the Reporting Limit
PL	Permit Limit		

Original

NELAP

NELAP A Accredited. ORELAP 100016, OR-028

NEILSON RESEARCH CORPORATION

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Analytical Report

WO#: **19061081**
Date Reported: **7/1/2019**

CLIENT: Ashland Parks & Rec.
Lab ID: 19061081-02
Client Sample ID: AC at Reservoir
Project: Ashland Creek
Sample Address:

Collection Date: 6/26/2019 9:00:00 AM
Received Date: 6/26/2019 10:17:00 AM
Matrix: AQUEOUS

Sample Location: AC at Reservoir

Analyses	Method	NELAP Status	Result	Qual	DF	RL	Units	MCL	Date Analyzed/Analyst	
BACTERIA BY QUANTI-TRAY										
Total Coliform Bacteria	A9223B	A	>2420		1	1.00	MPN/100mL		06/26/19 16:30	DJK
E. Coli Bacteria	A9223B	A	411		1	1.00	MPN/100mL		06/26/19 16:30	DJK

QUALIFIERS

C1 Sample container temperature is out of limit as specified at testcode
MI Recovery outside comtrol limits due to Matrix Interference
PL Permit Limit
H Holding times for preparation or analysis exceeded
ND Not Detected at the Reporting Limit

Original

NELAP

NELAP A Accredited. ORELAP 100016, OR-028

The current recreational contact standard is a 30-day log mean of 126 *E. coli* organisms per 100 ml, based on a minimum of five samples, with no single sample exceeding 406 *E. coli* organisms per 100 ml. A water body is considered water quality limited if more than 10% of the samples exceed 406 organisms per 100 ml or the 30-day log mean is greater than 126 organisms per 100 ml(Table 4). The standard is based on 1986 USEPA recommendations that correlate a geometric mean concentration of 126 organisms per 100 ml of *E. coli* per 100 milliliters (mL) of water with a gastrointestinal illness rate of about 8 individuals per 1,000 swimmers.

In both the *E. coli* and the fecal coliform standard that preceded it, there is an average concentration target and an extreme concentration target. TMDL targets are based on achieving the average concentration targets. Average concentrations represent chronic risk. It is a more stable indicator of fecal contamination which can be addressed through available analytical methods. The management practices that control fecal bacteria to achieve the average concentration target will also control most loading associated with the peak concentrations. If during future monitoring it is shown that peak concentrations are consistently exceeding the extreme concentration target, additional monitoring will be required to ensure compliance with the average target for nonpoint source discharges. In addition Bear Creek DMAs will be asked to modify their management plans to address these peak loads.

Table 4. Water quality standards for bacteria in the Rogue Basin

Beneficial Use	Standard and Description
Freshwaters and Estuarine Waters Other than Shellfish Growing Waters (Water Contact Recreation)	(A) A 30-day log mean of 126 *E. coli* organisms per 100 milliliters, based on a minimum of five samples; (B) No single sample may exceed 406 *E. coli* organisms per 100 milliliters.
Freshwaters and Estuarine Waters (Water Contact Recreation) prior to 1996:	(A) A 30-day log mean of 200 fecal coliform organisms per 100 milliliters, based on a minimum of five samples; (B) No more than 10% of samples greater than 400 fecal coliform organisms per 100 milliliters.

Bacterial Die-off
Fecal coliforms, of which *E. coli* is a subset, are found in the intestines of warm blooded animals. This environment provides warm constant temperatures and nutrients which are conducive to bacterial growth. Once excreted from an animal host, however, these organisms encounter limited nutrient availability, osmotic stress, large variations in temperature and pH, and predation (Winfield and Groisman, 2003). However, bottom sediment can serve as a reservoir for fecal indicator bacteria, complicating the link between sources and bacteria concentrations in the water column.

Once excreted from their host, fecal bacteria typically have a limited ability to survive in the water column (EPA 2001). Death rates can be influenced by temperature, salinity, predation and sunlight. However, it is usually considered sufficient to approximate the die-off rate with an exponential decay which is dependent on concentration and temperature. Low survival rates of *E. coli* in waterbodies have been well documented with an approximate half life of 1 day (Winfield and Groisman 2003). Anecdotal evidence suggests that coliform exposed to polluted waters may survive for long periods of time and reproduce. The fate of *E. coli* in sediment, though, is not clear and has been the topic of many studies.

Bacterial Re-suspension
Fecal indicator bacteria can adhere to suspended particles in water which then settle causing an accumulation of bacteria in the bottom sediment (Davies et al., 1995). Numerous studies have found fecal indicator bacteria at greater concentrations in the sediment than in the overlying water in rivers, estuaries and beaches (Stephenson and Rychert, 1982, Struck 1988, Obiri-Danso and Jones, 1999, Byappanahalli, et al. 2003, Whitman and Nevers, 2003). Concentrations in the sediment can range from 10 to 100 times greater than in the overlying water. Re-suspension of bottom sediment has been shown to increase fecal indicator bacteria concentrations in the water column. (Sherer et.al., 1988, and Le Fever and Lewis, 2003).

The higher concentrations of fecal indicator bacteria in sediment are attributed to much slower die-off rates when compared to overlying water (Gerba and MeLeod, 1976, LaLiberte and Grimes, 1982, Burton et. al., 1986, Sherer et. al., 1992, Davies et. al. 1995,). Davies et al. (1995) found that the usual exponential decay model is not appropriate for fecal coliforms in sediment. Particle size distribution, nutrients and predation were hypothesized to influence survival rates; however, no quantitative correlation of survival rates with environmental factors was presented.

Two recent field studies have indicated the possibility that fecal indicator bacteria can form a stable, dividing population in sediment in a temperate environment (Whitman R.L and M.B. Nevers, 2003 and Byappanahalli, et al. 2003). Whitman and Nevers (2003) concluded that "more research into the environmental requirements and potential for in situ growth is necessary before *E. coli* multiplication in temperate environments can be confirmed, but this study provides initial data supporting that hypothesis."

Pollutant Identification

The pollutant of concern is fecal-related microorganisms. Fecal coliform and *E. coli* bacteria (a subset of fecal coliform bacteria) have been measured in water bodies within the Bear Creek watershed. These bacteria are produced in the guts of warm-blooded vertebrate animals, and indicate that human pathogens may be present.

Department of Environmental Quality

Chapter 340

Division 41
WATER QUALITY STANDARDS: BENEFICIAL USES, POLICIES, AND CRITERIA FOR OREGON

340-041-0009
Bacteria

(1) Numeric Criteria: Organisms commonly associated with fecal sources may not exceed the criteria in subsections (a)-(c) of this section:

(a) Freshwater contact recreation:

(A) A 90-day geometric mean of 126 E. coli organisms per 100 mL;

(B) No single sample may exceed 406 E. coli organisms per 100 mL.

(b) Coastal water contact recreation, as designated in OAR 340-041-0101, 340-041-220, 340-041-230, 340-041-300 and 340-041-0320:

(A) A 90-day geometric mean of 35 enterococcus organisms per 100 mL;

(B) Not more than ten percent of the samples may exceed 130 organisms per 100 mL.

(c) Shellfish harvesting, as designated in 340-041-0101, 340-041-220, 340-041-230, 340-041-300 and 340-041-0320:

(A) A fecal coliform median concentration of 14 organisms per 100 mL;

(B) Not more than ten percent of the samples may exceed 43 organisms per 100 mL.

(2) A minimum of five samples in a 90-day period is required for calculating the criteria in sections (1)(a)(A) and (1)(b)(A) and (B) of this rule.

(3) Raw Sewage Prohibition: No sewage may be discharged into or in any other manner be allowed to enter the waters of the State, unless such sewage has been treated in a manner the Department approved or otherwise allowed by these rules.

(4) Animal Waste: Runoff contaminated with domesticated animal wastes must be minimized and treated to the maximum extent practicable before it is allowed to enter waters of the State.

(5) Bacterial pollution or other conditions deleterious to waters used for domestic purposes, livestock watering, irrigation, bathing, or shellfish propagation, or otherwise injurious to public health may not be allowed.

(6) Implementation in NDPES Permits: Upon NPDES permit renewal or issuance, or upon request for a permit modification by the permittee at an earlier date, bacteria in effluent discharges associated with fecal sources may not exceed the following amounts:

(a) In waters designated for coastal water contact recreation:

(A) A monthly geometric mean of 35 enterococcus organisms per 100 mL, and

(B) Not more than ten percent of samples in a month may exceed 130 enterococcus organisms per 100 mL.

(b) In waters designated for freshwater contact recreation:

(A) A monthly geometric mean of 126 E. coli organisms per 100 mL; and

(B) No single sample may exceed 406 E. coli organisms per 100 mL. However,

(C) No violation will be found for an exceedance if the permittee takes at least five consecutive re-samples at four-hour intervals beginning as soon as practicable (preferably within 28 hours) after the original sample was taken and the geometric mean of the five re-samples is less than or equal to 126 organisms per 100 mL of E. coli. However, if the Department finds that re-sampling within the timeframe outlined in this section would pose an undue hardship on a treatment facility, a more convenient schedule may be negotiated in the permit, provided that the permittee demonstrates that the sampling delay will result in no increase in the risk to water contact recreation in waters affected by the discharge;

(c) For sewage treatment plants that are authorized to use recycled water under OAR 340, division 55, and that also use a storage pond as a means to dechlorinate their effluent prior to discharge to public waters, effluent limitations for bacteria may, upon a permittee's request, be based upon appropriate total coliform limits as OAR 340-055-0012-requires:

(A) Class C limitations: No two consecutive samples may exceed 240 total coliform per 100 mL.

(B) Class A and Class B limitations: No single sample may exceed 23 total coliform per 100 mL.

(C) No violation will be found for an exceedance under this paragraph if the permittee takes at least five consecutive re-samples at four hour intervals beginning as soon as practicable (preferably within 28 hours) after the original sample(s) were taken; and in the case of Class C recycled water, the log mean of the five re-samples is less than or equal to 23 total coliform per 100 mL, or, in the case of Class A and Class B recycled water, if the log mean of the five re-samples is less than or equal to 2.2 total coliform per 100 mL.

(7) Sewer Overflows in winter: Domestic waste collection and treatment facilities are prohibited from discharging raw sewage to waters of the State during the period of November 1 through May 21, except during a storm event greater than the one-in-five-year, 24-hour duration storm. However, the following exceptions apply:

(a) The Commission may on a case-by-case basis approve a bacteria control management plan to be prepared by the permittee, for a basin or specified geographic area which describes hydrologic conditions under which the numeric bacteria criteria would be waived. These plans will identify the specific hydrologic conditions and the public notification and education processes that will be followed to inform the public about an event and the plan, describe the water quality assessment conducted to determine bacteria sources and loads associated with the specified hydrologic conditions, and describe the bacteria control program that is being implemented in the basin or specified geographic area for the identified sources.

(b) Facilities with separate sanitary and storm sewers existing on January 10, 1996, and that currently experience sanitary sewer overflows due to inflow and infiltration problems, must submit an acceptable plan to the Department at the first permit renewal, which describes actions the facility will take to assure compliance with the discharge prohibition by January 1, 2010. Where discharges occur to a receiving stream with sensitive beneficial uses, the Department may negotiate a more aggressive schedule for discharge elimination.

(c) On a case-by-case basis, the Department may define the beginning of winter as October 15, if the permittee so requests and demonstrates to the Department's satisfaction that the risk to beneficial uses, including water contact recreation, will not be increased due to the date change.

(8) Sewer Overflows in summer: Domestic waste collection and treatment facilities are prohibited from discharging raw sewage to waters of the State during the period of May 22 through October 31, except during a storm event greater than the one-in-ten-year, 24-hour duration storm. The following exceptions apply:

(a) For facilities with combined sanitary and storm sewers, the Commission may on a case-by-case basis approve a bacteria control management plan such as that described in subsection (6)(a) of this rule.

(b) On a case-by-case basis, the Department may define the beginning of summer as June 1 if the permittee so requests and demonstrates to the Department's satisfaction that the risk to beneficial uses, including water contact recreation, will not be increased due to the date change.

(c) For discharge sources whose permit identifies the beginning of summer as any date from May 22 through May 31: If the permittee demonstrates to the Department's satisfaction that an exceedance occurred between May 21 and June 1 because of a sewer overflow, and that no increase in risk to beneficial uses, including water contact recreation, occurred because of the exceedance, no violation may be triggered, if the storm associated with the overflow was greater than the one-in-five-year, 24-hour duration storm.

(9) Storm Sewers Systems Subject to Municipal NPDES Stormwater Permits: Best management practices must be implemented for permitted storm sewers to control bacteria to the maximum extent practicable. In addition, a collection-system evaluation must be performed prior to permit issuance or renewal so that illicit and cross connections are identified. Such connections must be removed upon identification. A collection system evaluation is not required

where the Department determines that illicit and cross connections are unlikely to exist.

(10) Storm Sewers Systems Not Subject to Municipal NPDES Stormwater Permits: A collection system evaluation must be performed of non-permitted storm sewers by January 1, 2005, unless the Department determines that an evaluation is not necessary because illicit and cross connections are unlikely to exist. Illicit and cross-connections must be removed upon identification.

(11) In water bodies the Department identifies as water-quality limited for bacteria, and in accordance with priorities the Department establishes, the Department may require those sources that the Department determines to be contributing to the problem to develop and implement a bacteria management plan. The Department may determine that a plan is not necessary for a particular stream segment or segments within a water-quality limited basin based on the contribution of the segment(s) to the problem. The bacteria management plans will identify the technologies, best management practices and measures and approaches to be implemented by point and nonpoint sources to limit bacterial contamination. For point sources, their National Pollutant Discharge Elimination System permit is their bacteria management plan. For nonpoint sources, designated management agencies will develop the bacteria management plan that will identify the appropriate best management practices or measures and approaches.

Statutory/Other Authority: ORS 468.020, 468B.030, 468B.035 & 468B.048
Statutes/Other Implemented: ORS 468B.030, 468B.035 & 468B.048
History:
DEQ 9-2016, f. & cert. ef. 8-18-16
DEQ 16-2013, f. & cert. ef. 12-23-13
DEQ 10-2011, f. & cert. ef. 7-13-11
DEQ 6-2008, f. & cert. ef. 5-5-08
DEQ 17-2003, f. & cert. ef. 12-9-03

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