City of Newberg

Total Maximum Daily Load (TMDL) 2018-2022 Implementation Plan

March13, 2023

City of Newberg TMDL Implementation Plan

Annual Report Covering 2022 Activities

Submitted: March 13, 2023

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ACRONYMS

ACWA - Association of Clean Water Agencies

ASCE - American Society of Civil Engineers

AWWA - American Water Works Association

BMP - Best Management Practice

CESCL - Certified Sediment and Erosion Control Lead

CRRC - Citizen's Rate Review Committee

City - City municipal staff of Newberg, Oregon

DEQ - Oregon Department of Environmental Quality

ESC - Erosion and Sediment Control

EWRI - Environmental and Water Resources Institute

FOG - Fats, Oil, and Grease

GIS – Geographic Information System

GFU - George Fox University

GYWC - Greater Yamhill Watershed Council

IDDE - Illicit Discharge Detection and Elimination

MS4 – Municipal Separate Stormwater Sewer System

NORP - Northwest Oregon Restoration Partnership

NPDES – National Pollutant Discharge Elimination System

O&M- Operations and Maintenance

PW - Public Works

TMDL - Total Maximum Daily Load

YCSW - Yamhill County Solid Waste

Executive Summary

The City of Newberg entered its fifth 5-year of the 2018-2022 Total Maximum Daily Load (TMDL) cycle in January 2022, which covers TMDL activities completed in calendar year 2022. Progress was made towards our planned goals, but some activities were not accomplished or delayed due to safety concerns for staff members and/or availability of resources. The 2018-2022 TMDL Matrix can be seen in Appendix A. The matrix consists of Best Management Practice Measures (BMPs), the following seven focus areas:

- Public Education
- Public Involvement
- Illicit Discharge Detection and Elimination (IDDE)
- Construction Site Stormwater Runoff Control
- Post-Construction Runoff Control
- Pollution Prevention in Municipal Operations
- Temperature

The first six focus areas are aligned with typical MS4 NPDES requirements, and the seventh focus area addresses stream temperature. Each area of focus has associated best management practices (BMP), strategies, and measurable goals. This 2022 annual report documents progress made toward achieving measurable goals.

The TMDL Matrix in Appendix A shows all the best management practices, strategies, and their related measurable goals. Each measurable goal has an associated 2022 status. The following status options and their definitions are listed below:

- "**Completed**" is used as a status update when a particular measurable goal has been completed and there are no ongoing activities associated with the measurable goal.
- "**Ongoing**" is used as a status update when a particular measurable goal has been completed each year via continuing ongoing activities.
- "**Incomplete, But Started**" is used as a status update when progress has been made on a measurable goal, but it has not yet moved into a "completed" or "ongoing" status.
- "**Not Started**" is used as a status update when no work for a measurable goal has been started
- "**Delayed**" is used as a status update when a measurable goal hasn't been completed, and some but very minimal progress has been made on the goal. This may in some instances be related to available staffing or other resources.

2022 TMDL Matrix Summary

The City has a total of 54 measurable goals identified in the TMDL Matrix. At the end of 2022 the status for those goals is as follows: Complete (6), Ongoing (42), Incomplete, But Started (5), Not Started (1), and Delayed (0).

Measure No. 1 – Public Education

The Public Education measure has two best management practices which include Stormwater Education and Watershed Education. These BMPs are comprised of five (5) strategies and seven (7) measurable goals which are listed below:

Best Management Practice	Strategy	Measureable Goal	Performance Measure
Measure No. 1 – Public Education			
PE-1 Stormwater Education	Website Education	Supply stormwater information on the City's website.	Provide general stormwater information and website links to the annual TMDL Implementation Plan.
	Citizen Group Education	Present stormwater information to interested citizen groups at local venues.	Track number of presentations, presentation messages, and number of participants (if available).
	Water Quality Report	Provide stormwater education in the City's annual Water Quality Report.	Provide website links to the annual Water Quality Report, and track stormwater messages included in the report.
PE-2 Watershed Education	Public Signage	Develop public infrastructure signage program.	Develop public infrastructure signage program to determine sign locations and messaging.
		Provide signage at stream crossings or LIDA infrastructure facilities.	Track number of signs installed and associated messages.
		Mark 50 unmarked catch basins a year with "No Dumping, Drains to Stream" type language.	Track number of catch basins marked per year. Prepare a GIS map showing coverage of locations that are permanently marked or marked with after-market plastic labels.
	Student Education	Provide watershed education to students.	Track number of presentations, presentation messages, and number of participants (if available).

2022 TMDL Activities Completed

Activities completed in 2022 for each measurable goal for Public Education are described below.

PE-1 Stormwater Education

The Stormwater Education best management practice consists of three strategies: Website Education, Citizen Group Education, and the Water Quality Report.

Website Education (Ongoing)

The City has 20 web pages related to stormwater covering information on erosion and sedimentation control, riparian vegetation, water quality, illicit discharge, public works

standards, and the Total Maximum Daily Load (TMDL) program. Some clean-up of the City's TMDL related webpages was done in 2021. You can find the City's TMDL related webpages here: Willamette TMDL Implementation Plan | Newberg Oregon . Also, The Green Scene in Newberg | Newberg Oregon

The City posted on social media via the City of Newberg and Public Works Department Facebook pages 16 times about stormwater activities including the catch basin cleaning, illicit discharge, compost, waste management hazardous materials collections, the drug takeback program, native plant sales, the rate review committee, and volunteer events.

The annual TMDL report is uploaded each year to the City's website after receiving and incorporating comments from DEQ.

Citizen Group Education (Ongoing)

There were two Wastewater plant tours for community and education groups, and two Wastewater plant tours for folks in the industry. The total number of participants on all the tours was approximately 44.

A public messaging video called "That Doesn't Go There" was released in Jun 2021, about items that should never be put down in the drain sink and the City supply helps dispose of chemicals safely. You can find the video on the City's YouTube channel here: That Doesn't Go There - City of Newberg - YouTube

A public messaging video the City released about the City's watershed and stormwater to help educate residents about their role in protecting the watershed. You can find the video on the City's YouTube channel here Where does your storm water go? - City of Newberg - YouTube

All the master plans are posted and available to the public. The Stormwater Master Plan last updated in 2021 after the Riverfront Master Plan was adopted in 2019. The plan was updated to reflect existing conditions, future conditions, and to identify stormwater projects. A Citizens Advisory Committee was established to provide feedback to the consultant and City staff. The Stormwater Master Plan was developed to provide a clear understanding of the existing stormwater system and to provide a capital improvement project (CIP) program to address shortcomings in the system. The main objects of the plan are:

- Update the City's stormwater system's hydrologic and hydraulic models to evaluate system capacity.
- Develop an integrated stormwater system capital improvement program to address storm system capacity needs and water quality.
- Evaluate stream channel conditions looking towards erosion and the impact future developments might have.
- Continue following water quality regulations.
- Review the City's stormwater management program and make recommendations on activities and staffing where applicable.
- Identify implementation priorities and impacts on the program's budget.

- Develop a Master Plan document that is useful and easy to read, reference, and update.

The Stormwater Master Plan is updated every 5 year - Next Update due in 2026. The Stormwater Master Plan can be found on the City's website here: Stormwater Master Plan - Updated 2021 | Newberg
Oregon

In June 2022, the City held the annual Public Works Day event in the park across from the Chehalem Cultural Center. The Engineering Department provided education posters about Newberg Watersheds, storm system GIS map, and a stormwater public outreach and education to raise awareness about the costly impacts of polluted stormwater runoff under "Soak the Rain" with green infrastructure as part of the event. The event activities were very interactive and gave the public the opportunity to see and ask questions on how stormwater systems work. See Figure 1 for images from the event City of Newberg Watersheds and Streams Public Education Activity.

Figure 1: Public Works Day Water City of Newberg Watersheds and Streams Public Education Activity

Water Quality Report (Ongoing)

The Environmental Protection Agency (EPA) and the State of Oregon require the City of Newberg to distribute a Water Quality Report each year to all residences/customers. The majority of information in the report is required by the EPA and the report is mailed to residents/customers by June 30th each year. The 2022 Water Quality Report was mailed out in June 2022 and can be found on the City's website here: https://www.newbergoregon.gov/operations/page/water-quality-report

The report included the following TMDL related messages:

- Watershed Volunteer opportunities (PE-1 Citizen Group Education)
- Watershed Education (PE-1 Citizen Group Education)
- City's Watershed Grant (PI-2 Public Participation in Stormwater Management)
- Illicit Discharge (Measure No. 3 – Illicit Discharge Detection and Elimination)
- Citizen Rate Review Committee (PI-1 Stormwater Utility Fee)

PE-2 Watershed Education

The Watershed Education best management practice consists of two strategies: Public Signage and Student Education.

Public Signage

The Public Signage strategy consists of three measurable goals.

Develop a Public Infrastructure Signage Program (Incomplete, but started)

Development of a Public Infrastructure Signage Program for the City's watershed/stormwater system was started in 2020 and significant progress was made in developing preliminary sign layouts, determining sign messaging, and sizing. Unfortunately, due to staffing constraints, the work was not finished in 2021, and an Adaptive Management date of December 2023 is being set to complete the work.

Make progress providing signage at stream crossings or LIDA infrastructure facilities consistent with signage program. (Not Started)

Tracking number of signs installed and associated messages, due to staffing constraints, the work was not started in 2022, and an Adaptive Management date of December 2023 is being set to complete the work.

Marking 50 Unmarked Catch Basins a Year with "No Dumping, Drains to Stream" Language (Ongoing)

No fish markers installed in 2022. The City installed 71 bi-lingual "No Dumping, Drains to Creek" catch basin markers throughout 2020 and finished marking catch basins in The Greens neighborhood near the Chehalem Glenn Golf Course on the eastern edge of the City. Catch basins downtown were marked near the Farmers Market located at S College Street and E Second Street and catch basins in the neighborhood near Glady's Park were marked shows a screen capture from Cartegraph OMS showing the location of the "No Dumping, Drains to Creek" markers installed in 2020, seen in purple. Being able to track where catch basins have

been marked around the City will help us to better target high risk areas and work to get full coverage across Newberg.

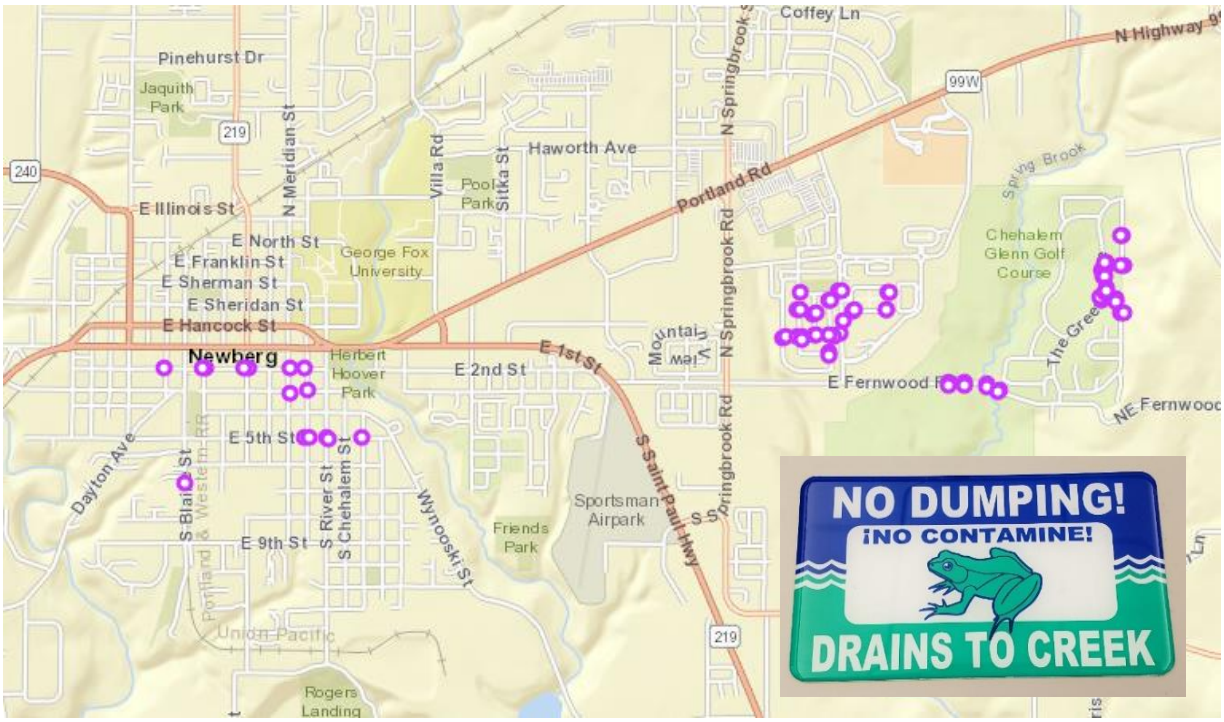


Figure 2: "No Dumping, Drains to Creek" markers installed in 2020.

Student Education (Ongoing)

The City of Newberg has been working with a student led organization called Chehalem Valley Watershed Project (CVWP), which is comprised of students from Newberg High School.[1] The focus of this organization is to encourage high school students to learn about the environment through hands-on research, restoration work, and outreach events. No formal student education presentations occurred with the CVWP/Newberg High School in 2022.

The CVWP also supported the City of Newberg via collaborative social media posts about the City's educational surveys sent out in July 2020 as part of best management practice PI-4.

The City of Newberg does have a capital improvement project N Elliott Road occurring near the Newberg High School in 2021/2022. The coordination with the CVWP/Newberg High School is expected to continue.

2022 Adaptive Management

The City of Newberg is modifying the completion date for the measureable goal listed under best management practice PE-2 Develop a Public Infrastructure Signage Program from December 2021 to December 2023. As noted, significant progress was made on this goal, however due to staffing constraints it was not finished in December of 2020.

[1] Chehalem Valley Watershed Project https://sites.google.com/view/cvwp/home

Looking Ahead - 2023 Activities

Under Measure No. 1, there is one measurable goal with a completion date in 2023 due to the proposed Adaptive Management schedule for the Public Infrastructure Signage Program.

The remaining five measureable goals have a status of “ongoing” which means progress made toward the goal each year via recurring activities.

Measure No. 2 – Public Involvement

The Public Involvement measure has four best management practices which include reviewing the Stormwater Utility Fee, Public Participation in Stormwater Management, Public Participation in Reporting Stormwater Issues, and Public Participation in Educational Focus. These four best management practices are comprised of four (4) strategies and five (5) measurable goals which are listed below, and a status summary can be found in Appendix A:

Best Management Practice	Strategy	Measurable Goal	Performance Measure
Measure No. 2 – Public Involvement			
PI-1 Stormwater Utility Fee	Participate in Citizen Rate Review Committee (CRRC) Meetings	Present stormwater funding needs to CRRC.	Document meeting attendance, adopted rates, and effective dates of rate changes.
PI-2 Public Participation in Stormwater Management	Provide Grant Funding for Water Quality Improvement or Watershed Awareness Projects	Provide a minimum of $2,000 in a grant program to fund non-profit projects that fulfill goals of the TMDL plan.	Track number of funded projects, amount disbursed per project, stream affected, and either the number of stream miles affected or the number of participants.
PI-3 Public Participation in Reporting Stormwater Issues	Public Participation in Stormwater, Illicit Discharge, and Erosion Control Issues	Provide methods for citizens to report concerns during and after business hours. Notify public of available reporting methods.	Document methods and frequency of public notifications.
		Respond to public concerns.	Document number of stormwater, erosion control, and illicit discharge complaints reported by citizens and note resolutions.
PI-4 Public Participation in Determining Stormwater Educational Focus	Determine Focus of Stormwater Educational Messages to the Public	Conduct a public survey to revise and refine educational messages related to stormwater and the TMDL Implementation Plan.	Provide copy or link to survey and report results of the survey.

2022 TMDL Activities Completed

Activities completed in 2022 for each measurable goal for Public involvement are described below.

PI-1 Stormwater Utility Fee

Present stormwater funding needs to CRRC. (Ongoing)

The Citizen's Rate Review Committee (CRRC) started in 1992 and consists of volunteers from the public who meet every two years to review utility rates proposed by staff. After a discussion with the committee, the rates are presented by staff to the City Council for approval.

A meeting was held with CRRC on October 13, 2021, to discuss rate increases specifically for stormwater. New stormwater rates were effective January 1, 2023, and can be seen below in Table 1.

Table 1: Stormwater Utility Fee effective January 1, 2022

Municipal Services Statement Fees – Stormwater Service Charges	
Service Charge ($/month)	$14.54*
Storm System Development Fee* **	
Single Family – Equivalent Dwelling Unit (EDU)	$438.28 flat fee**
Other than Single Family	(Impervious Area/2877) x $438.28

*Rate effective January 1, 2022.

**Rate effective April 1, 2022.

***Revenues are used to maintain the City's Stormwater System. This fee is collected for each new development that connects to or otherwise uses the City's stormwater system and is determined by the square feet of impervious area. Impervious surface is the hard surface area which either prevents or retards entry of water into the soil mantel and/or causes water to run off the surface in greater quantities or at an increased rate of flow from that present under natural conditions. Impervious surface areas include, but are not limited to, rooftops, concrete or asphalt paving, walkways, patios, driveways, parking lots or storage areas and trafficked gravel or other surfaces which impede the natural infiltration or runoff of surface water. An equivalent dwelling unit (EDU) is equal to 2,877 square feet of impervious area.

PI-2 Public Participation in Stormwater Management

The Public Participation in Stormwater management provide Grant Funding for water Quality Improvement or Watershed Awareness Projects practice consists of one measurable goal.

Provide a minimum of $2,000 in a grant program to fund non-profit projects that fulfill goals of the TMDL plan. (Ongoing)

Programs are available in the City to help residents and businesses be more sustainable, the programs and projects we're working on to reduce our footprint and make small changes that can have a big impact. More information can be found on the City's website here: Summer of Sustainability | Newberg Oregon

The Sustainability Programs for Community Members and businesses are:

- Watershed Grants.
- Water Efficiency Kits.
- Residential Sidewalk Grant and Loan Program
- Business Sidewalk Loan Program

Private property owners can apply for grants to add erosion control, add native plants within 50ft of a stream, or create a rain garden or swale.

The City is in the process of revising the grant forms and selection criteria and will be making an effort in 2023 to do more public outreach about the Watershed Grant Program. We did not have public participation in the grant program in 2022.

In 2022 the City granted 50 Water Efficiency Kit Boxes for community members. The funds/resources serve customers who receive water from the City system. More information can be found on the City's website here: Water Efficiency Kits | Newberg Oregon

PI-3 Public Participation in Reporting Stormwater Issues

The Public Participation in Reporting Stormwater Issues best management practice consists of two measurable goals.

Provide Methods for Citizens to Report Stormwater Concerns (Ongoing)

In 2022, the City used its website to provide a phone number for the public to call about stormwater issues/concerns which are then logged in Cartegraph OMS, the City's asset management program, by the Maintenance Division. The City rolled out a mobile app service in 2022 called SeeClickFix which provides residents with another way to report TMDL related issues around town. SeeClickFix is integrated with Cartegraph OMS for better data management.

https://www.newbergoregon.gov/maintenance/page/report-issue-newberg-seeclickfix

Respond to Public Concerns (Ongoing)

The City categorizes public concerns into four main categories which include illicit discharge, erosion control, flooding, and illegal dumping. Totals for each type of concern received in 2022 can be found in Table 2 and are inclusive of concerns received by both the maintenance division and code enforcement. More information concerning incident resolution for illicit discharge concerns can be found in Appendix B. Once a concern is logged by a resident, city staff work to keep that resident informed about the issue resolution.

Table 2: Stormwater Concerns Received from the Public

Types of Concerns	Number of Concerns Received					Total
	2018	2019	2020	2021	2022	
Illicit Discharge	1	8	7	5	1	22
Erosion Control	1	0	0	0	0	1
Flooding	7	1	6	10	8	32
Illegal Dumping	0	2	4	1	3	10

PI-4 Public Participation in Determining Stormwater Educational Focus (Completed)

This best management practice completed in July 2020. The City posted two separate surveys with the first called “Test Your Knowledge” and the second called “How do You Interact with Newberg’s Watersheds and Waterways?” These surveys were used to help focus our educational messaging and in future will provide direction for the watershed/stormwater signage program. The first survey received 21 responses and helped the City identify education gaps that citizens have about our watershed. As an example, roughly 30% of respondents thought water going into storm drains is treated at the Wastewater Treatment Plant before being discharged into our creeks. The second survey received 18 responses and has helped the City understand where and how often people interact with our waterways and what they perceive as the condition of those facilities.

2022 Adaptive Management

The City of Newberg is not proposing to modify any measurable goals through adaptive management.

Looking Ahead – 2023 Activities

Under Measure No. 2, there are no measurable goals with completion dates in 2022. One goal has been completed, and the remaining four of the five measurable goals have a status of “ongoing” which means progress is made toward the goal each year via recurring activities.

Measure No. 3 – Illicit Discharge Detection and Elimination (IDDE)

The Illicit Discharge Detection and Elimination measure has four best management practices which include Training Staff to Implement IDDE, Implementation of the IDDE Plan, Hazardous Waste Collection, and the Drug Take-Back Program. These BMPs are comprised of six (6) strategies and nine (9) measurable goals which are listed below. A status summary of the performance measures can be found in Appendix A:

Best Management Practice	Strategy	Measurable Goal	Performance Measure
Measure No. 3 – Illicit Discharge Detection and Elimination (IDDE)			
ID-1 Train Staff to Implement IDDE Plan	Train Staff in Illicit Discharge Investigation and Spill Response	Train new staff members in illicit discharge investigation and spill response. Provide training in some aspect of illicit discharge investigation and spill response every five years for all applicable staff.	Track type of training (webcast, class, certification, on-the-job, etc.), number of employees trained, and the training subject (maintenance, response, investigation, sampling, etc.).
ID-2 Implement IDDE Plan	Conduct Illicit Discharge Inspections	Field screen outfalls.	Inventory type, size, and location of public and private outfalls. Map existing and new development outfall locations in GIS.
		Investigate outfalls for illicit discharges.	Document location, number and types of samples taken date, cause, and resolution.
	Respond to Illegal Dumps	Clean up illegal dumps.	Track number of illegal dumps, citations issued, and resolution.
	Respond to Illicit Discharges/Spills	Fire Department spill response.	Track date and cause of spills that occur. Document whether the spill reached the stormwater system or a stream and if water sampling was conducted. Document response resolution.
		Public Works illicit discharge/spill response.	Track date and cause of illicit discharges/spills that occur, identified illicit discharges from private wastewater laterals or from failing public infrastructure. Document whether the pollutant reached the stormwater system or a stream and if water sampling was conducted. Document response resolution.
		Provide spill response cards and spill response kits on municipal trucks and sweepers.	Track number of municipal trucks and sweepers with spill response cards and spill kits. Document the number of spill kits used annually in response to spills.
ID-3 Hazardous Waste Collection	Provide Opportunity for Residents to Dispose of Hazardous Waste	Offer free hazardous waste collection service twice per year to City residents.	Track volume of waste received during collection events.
ID-4 Drug	Provide	Offer free unused	Track the volume of unused medication

Take-Back Collection	Opportunity for Residents to Dispose of Unused Medication	medication collection service to City residents.	collected annually.

2022TMDL Activities Completed

Activities completed in 2022 for each measurable goal described below.

ID-1 Train Staff in Illicit Discharge Investigation and Spill Response (Ongoing)

Public Works Maintenance staff members are reminded of the appropriate response to spills and illicit discharges throughout the year as part of regular staff meetings. As noted in Table 2 and Appendix B, illicit discharges were reported and responded to in 2022.

ID-2 Implement IDDE Plan

The Implementation of the IDDE Plan consists of three strategies and six measurable goals.

Conduct Illicit Discharge Inspections

The strategy for conducting illicit discharge inspections consists of two measurable goals.

Fieldscreen Outfalls (Completed)

The City screens outfalls during stormwater system maintenance and stream assessments. As maintenance performs work throughout the system, requests are made to the GIS department to update asset mapping.

Investigate Outfalls for Illicit Discharges (Ongoing)

There were no events in 2022 that warranted samples being taken at an outfall location as a result of a known or suspected illicit discharge.

As part of the City's Stormwater Credit Program, one participant performs their own sampling and testing at discharge locations. The applicant keeps these records, and they coordinate directly with DEQ to meet the requirements of their 1200-Z permit.

Respond to Illegal Dumps (Ongoing)

The City of Newberg had no reported illegal dumping occur in 2022.

Respond to Illicit Discharges/Spills

The strategy for responding to illicit discharges/spills consists of three measurable goals.

Fire Department Spill Response (Ongoing)

The Fire Department, Tualatin Valley Fire & Rescue (TVF&R) responded to five (5) "spill" incidents in 2022 related to a motor vehicle crash. The spill was contained, and oils/petroleum were prevented from entering storm drains.

Public Works Illicit Discharge/Spill Response (Ongoing)

Public Works Maintenance Division provided clean up response to two illicit discharges/spills within the City in 2022 which is as noted in Appendix B.

Provide spill Response Cards/Kits on Municipal Trucks and Sweepers (Ongoing)

The City of Newberg has PIG® Truck Spill Kits available on eighteen (18) public works vehicles. Maintenance staff are made aware of these spill kits and the associated instruction manual.

ID-3 Hazardous Waste Collection (Ongoing)

Yamhill County Solid Waste (YCSW) continues to sponsor hazardous waste collection events for Newberg 2022 June 4th, @ Waste Management Transfer Station, 2904 Wynooski St, Newberg Both events are open to all Yamhill County residents, and it is an opportunity for residents to safely dispose of hazardous items for free. Higher collection numbers were recorded at the event. Additionally, it should be noted that medication will no longer be collected at these events until July 2023, all pharmacies in Oregon will be required to have their own take back programs. Annual totals from the hazardous waste collection events can be seen in Table 3.

newberg_hhw_flyer_2022.pdf (newbergoregon.gov)

Table 3: Yamhill County Solid Waste: Hazardous Waste Collection Events Summary

Year	City of Newberg Event (May)			City of McMinnville Event (October)		
	Hazardous Waste (pounds)	Paint (pounds)	Medications (pounds)	Hazardous Waste (pounds)	Paint (pounds)	Medications (pounds)
2018	32,697	22,500	36.3	31,679	9,500	480
2019	40,334	22,500	167.5	37,449	22,250	230
2020	0*	0*	0*	39,245	33,050	0**
2021	35,941	27,750	0**	31,097	28,500	0**
2022	24,897.7	23,250	0**	35,557	24,750	0**
Total	133,869.7	96,000	203.8**	175,027	85,000	710**

*Event did not occur due to the COVID-19 pandemic.

**Medications will no longer be collected at these events. Starting in July 2021, all pharmacies in Oregon will be required to have their own take back programs.

ID-4 Drug Take-Back Collection (Ongoing)

The City of Newberg has Medication Disposal drop boxes available at the police station and hospital. The safe drop box is for the public to dispose of unneeded or expired medications. Over the counter and pet medications are also accepted at the drop box location. Medications collected are incinerated so they do not end up in the garbage or flushed down the drain, avoiding contamination of soil and drinking water. Medication Take Back Program | Newberg Oregon

This year the lobby where the drug collection bin is located had to be open to the public for several months and could not be relocated due to restrictions on bin placement. The amount collected in 2022 is 841.7 pounds more considerably compared to previous years. Annual totals from the Medication Take-Back Program can be seen in Table 4.

Table 4: City of Newberg Medication Take-Back Program Summary

Year	Medication Collected (pounds)
2018	887.5
2019	887.2
2020	568.2
2021	418
2022	841.7
Total	3602.6

2022 Adaptive Management

The City of Newberg is not proposing to modify any measurable goals through adaptive management.

Looking Ahead – 2023 Activities

Under Measure No. 3, there is one measurable goals with completion dates in 2022. Eight of the nine measureable goals have a status of "ongoing" which means progress is made toward the goal each year via recurring activities.

Measure No. 4 – Construction Site Stormwater Runoff Control

The Construction Site Stormwater Runoff Control measure has two best management practices which include Training Staff in Erosion and Sedimentation Control (ESC) and Implementation of the Erosion and Sediment Control Program. These BMPs are comprised of two (2) strategies and four (4) measurable goals which are listed below, and. A status summary of the performance measures can be found in Appendix A:

Best Management Practice	Strategy	Measurable Goal	Performance Measure
Measure No. 4 – Construction Site Stormwater Runoff Control			
CS-1 Train Staff in Erosion and Sediment Control (ESC)	Train Staff in Plan Review, Site Inspection, and Enforcement of ESC Program	Train new staff whose responsibilities include erosion and sediment control plan review and enforcement. Provide refresher training to all staff involved in ESC every three years.	Document number of staff trained and type of training (on-the-job training, certification, or recertification).
CS-2 Implement Erosion and Sediment Control Program	Implement ESC Program	Conduct ESC plan review.	Document location and type (commercial, industrial, single-family residential, etc.) of all construction project plan reviews. Document which project obtained a DEQ 1200-C permit. Develop and send a notice letter to applicants on wet weather best management practices as weather conditions change.
		Conduct site inspections at least once during active construction by trained or experienced staff.	Provide number of erosion and sedimentation control inspections for each project. Document location and type (commercial, industrial, single-family residential, etc.) of construction project.
		Enforce ESC ordinances.	Report number of warning letters or non-compliance citations by project and resolution.

2022 TMDL Activities Completed

Activities completed in 2022 for each measurable goal are described below.

CS-1 Train Staff in Erosion and Sediment Control (Ongoing)

Each department or division within the City is responsible for their own employee training. No specific ESC training was attended in 2022, however the topic of ESC was discussed at several of the trainings noted in best management practice DS-2 Train Staff in Stormwater Management. One Engineering Division staff member is a Certified Erosion and Sedimentation Control Lead (CESCL)

CS-2 Implement Erosion and Sediment Control Program

The best management practice for implementing the ESC Program consists of three measureable goals.

Conduct ESC Plan Review (Ongoing)

Erosion and Sediment Control plans reviewed for major projects are listed in Appendix C. Projects exceeding 1-acre must obtain DEQ 1200-C permits and recorded. Inspections of these permits are conducted by DEQ. The City had 15 construction projects in 2022 that were more than a single-family home and less than 1-acre. These projects required City issued Erosion and Sediment Control Permits (see Appendix C). The remainder of the City issued Erosion and Sediment Control Permits in 2022, were issued for 57 single-family residential developments.

In 2022 staff gave verbal reminders about best management practices to permit holders on the upcoming wet weather season and for specific storm events.

Conduct Site Inspections (Ongoing)

In 2022 there were 646 inspection requests, 57 single-family residential ESC permits and inspections and 85 stormwater facility inspections throughout the City of Newberg. Also, the number of inspections for stormwater facility.

Enforce ECS Ordinances (Ongoing)

No warning letters or non-compliance citations were issued in 2022.

2022 Adaptive Management

The City of Newberg is not proposing to modify any measurable goals through adaptive management.

Looking Ahead - 2023 Activities

Under Measure No. 4, All four measurable goals have a status of “ongoing” which means progress is made toward the goal each year via recurring activities.

Measure No. 5 – Post-Construction Runoff Control

The Post-Construction Runoff Control measure has three best management practices which include Develop a Stormwater Management Program, Train Staff in Stormwater Management, and Implement the Stormwater Management Program These BMPs are comprised of five (5) strategies and eight (8) measurable goals which are listed below. A status summary of the performances measures can be found in Appendix A:

Best Management Practice	Strategy	Measurable Goal	Performance Measure
Measure No. 5 – Post-Construction Runoff Control			
DS-1 Develop Stormwater Management Program	Update Stormwater Development Manuals and Standard Details	Update stormwater design standards manual and standard drawings. Notify development community of proposed new requirements before adoption.	Provide a summary of changes and link to new design standards when adopted.
DS-2 Train Staff in Stormwater Management	Train Staff in Stormwater Management	Provide training opportunities for staff in watershed and stormwater management.	Track type of training (webcast, class, on-the-job, certification, etc.), number of employees trained, and the training subject (plan review, inspection, enforcement, etc.)
DS-3 Implement Stormwater Management Program	Require Stormwater Management for Development and Redevelopment	Require stormwater plan submittals and conduct plan reviews.	Document number of construction plan submittals, plan reviews, project type (commercial, institutional, residential, etc.), size, and location.
		Require stormwater management per the Stormwater Development Manuals and Standard Details.	Document number and type (detention basin, flow dissipater, raingarden, filtration swale, etc.) of stormwater facilities required for each project.
		Conduct pre-construction conferences to inform contractors about stormwater requirements.	Document number of pre-construction conferences, project type (commercial, institutional, residential, etc.), size, and location.
	Improve Watershed Management	Evaluate stormwater projects for treatment opportunities (new installations vs. existing infrastructure upgrades) i.e. Stormwater Master Plan.	Summarize hierarchy used for screening. Document location and number of sites reviewed, drainage area, and result of evaluation.
		Implement stormwater projects for treatment opportunities (new installations vs. existing infrastructure upgrades) i.e. Stormwater Master Plan.	Document number of projects including location, size, type (LIDA, traditional, etc.), and drainage area.
	Optimize Water Quality	Inspect public stormwater facilities post-construction.	Conduct a post-construction stormwater facility transfer. Complete final inspection at end of the two-year maintenance agreement. Document facility in GIS/asset management program, obtain and file stormwater as-built drawings, and facility maintenance plan.

2022 TMDL Activities Completed

Activities completed in 2022 for each measurable goal are described below.

DS-1 Develop Stormwater Management Program (Incomplete, but started)

This best management practice included updates to Standard Drawings and the Stormwater Design Standards in December 2021. As was noted in last 2021 TMDL report, edits had been made to the City's standard drawings to provide more clarity where necessary based on both staff feedback and feedback from the construction community, however they were not yet adopted at the time of the report submittal. Since that time, the City has undertaken the effort to update the City's Transportation, Water, Wastewater, and Stormwater Master Plans to align with the adoption of the Riverfront Master Plan which re-envisions the City's old mill site along the Willamette River. In order to align the stormwater Standard Drawing updates, updates to the Design and Construction Standards, and updates to the Stormwater Master Plan was occurred in a coordinated effort which completed in December 2023. It should be noted that the Standards Drawings and Design and Construction Standards update is independent from the Master Plan update process. As such the City is proposing Adaptive Management to adjust the completion timeline for Standard Drawing Updates to December 2023, and for the Standard Manual Amendments to December 2023.

DS-2 Train Staff in Stormwater Management (Ongoing)

The following stormwater related trainings were attended in 2022:

- Two Engineering Division staff members attended in person of the 2022 Oregon APWA Conference: Multi-Agency Water Quality Reserve Program and Summary of New Phase I and II
- One Engineering Division staff member attended the Pacific Northwest Clean Water Association (PNWCA) Annual Conference in April 2022
- Two Engineering Division staff members attended the Stormwater Summit 2022 sponsored by the Oregon Association of Clean Water Agencies (ACWA).
- One Engineering Division staff member attended the ACE Conference in May 2022.
- One Engineering Division staff members attended the PWX Conference in August
- One Engineering Division staff member attended the OSBEELS Symposium in September 2022.
- One Engineering Division staff member certified as CESL.

DS-3 Implement Stormwater Management Program

The best management practice DS-3, Implement Stormwater Management Program consists of three strategies; Require Stormwater Management for Development and Redevelopment, Improve Watershed Management, and Optimize Water Quality.

Require Stormwater Management for Development and Redevelopment

The strategy Require Stormwater Management for Development and Redevelopment consists of three measurable goals.

Require Stormwater Plan Submittals and Conduct Plan Reviews (Ongoing)

The City requires that all development/redevelopment projects that create a net new impervious surface area that exceeds five hundred square feet of either public or private property must treat and detain stormwater.

The projects found in Appendix D represent construction plans received and reviewed for stormwater management for development and redevelopment. The project type, size, and location are noted.

Additionally, the Engineering Division participated in 36 pre-application meetings in 2022 where City stormwater requirements were discussed with applicants.

Require Stormwater Management per the Stormwater Development Manuals and Standard Details (Ongoing)

Appendix D notes the number and type of stormwater facilities constructed for each project that was either completed or started in 2022. Public stormwater facilities are then added to the City's GIS system once a development's as-builts are provided to the City.

Private stormwater facilities are required to have recorded Stormwater Maintenance Agreements with the City of Newberg which provide guidance on maintenance activities in perpetuity.

Conduct pre-construction conferences to inform contractors about stormwater requirements (Ongoing)

The City typically holds pre-construction conferences for all public improvement projects, and for larger private development projects within the City. Pre-construction meetings recorded in Appendix D. The City held fourteen pre-construction meetings (ten private development meetings and four meetings for public improvement projects) for projects that were either completed or started in 2022.

Improvement Watershed Management

The strategy Improve Watershed Management consists of two measurable goals.

Evaluate stormwater projects for new treatment opportunities (Ongoing)

Each year the City establishes a 5-Year Capital Improvement Plan (CIP) that balances infrastructure needs based on a variety of sources including the Stormwater Master Plan, City Council goals, operational needs, and regulatory obligations.

The stormwater projects included in the fiscal year (FY) 2022-2023 project list include the following:

- **Misc. Storm Drain Repairs/Annual Pipe Replacement**
  Storm drainage issues will be addressed prior to the scheduled Pavement Rehabilitation projects. Annual pipe replacements for broken end of life pipes.

- **E Vermillion Street East of OR219**
  This project would install a new stormwater pipe to eliminate the flooding in this area.
- **West Franklin Storm (OR240/Railroad Tracks/Franklin: Study and Then Fix)**
  Maintenance issues with the diagonal pipe that runs through the building contribute to flooding in the area. The inlet north of the building overflows during storm events. South of the area where the storm lines go under the building the pipe is too long for it to be cleaned with the City's current equipment. This pipe may also need to be upsized.
- **Railroad Ditch; N College - N Meridian**
  This area has a variety of contributing flooding factors. Needs a study to determine what the "fix" would be and where to route the stormwater. Potential solution to flooding issues could include connecting the stormwater line north of the railroad tracks to E Vermillion Street
- **N Libra Street Improvement**
  Modeling shows flooding issues along N Libra Street Needs frequent maintenance to address silt accumulation. Upsize existing stormwater pipes along N Libra Street to 18" to convey current and future flows.
- **800 Block of Wynooski Street**
  Correct a current pipe and outfall that is eroding an area east of Wynooski Street.

In 2021 the City completed updating the Stormwater Master Plan as part of a larger planning effort to incorporate planning outcomes from the Riverfront Master Plan.
The City completed updating to the Capital Improvement Program (CIP), Standard Drawings and Design, and Construction Standards in December 2022.

Implement stormwater projects for treatment opportunities (Ongoing)

Pavement Fixes/ Annual Pipe Replacement Program identified increased sustainability as priorities for Newberg. Along with responding to community goals the project will increase health and safety and reduce costs. There are storm drainage repairs that need to be accomplished in tandem. This project placeholder will allow storm drainage projects to occur ahead of or with adjacent pavement projects.

To strategize the best use of city funds as the Pavement Rehabilitation projects move forward, there are storm drainage repairs that need to be accomplished in tandem. This project placeholder will allow storm drainage projects to occur ahead of or with adjacent pavement projects.

The N Springbrook Road project identified in 2021/2022 is an exploratory analysis of the existing conditions to determine what steps can be taken to correct storm drainage issues in advance of a larger million-dollar project in 2023/2024.

The 800 Block of Wynooski Street project was started in 2018 with the support of the George Fox University engineering program under the guidance of the City's Public Works Director. An engineering consultant was then brought on board in 2019 to finish the design and get the package ready for bid. The Joint Permit Applicant for the work occurring in both jurisdictional

waters of the state and wetland was received by the State in late-February 2023. The City of Newberg is redesigning the stormwater outfall just north of 740 Wynooski Road. The City is looking to bid on this project in early 2023 and construct it in summer during the in-water work period between July -September 2023.

Optimize Water Quality (Ongoing)

The City requires a two-year maintenance agreement for all private development of public stormwater facilities. As an example, if a subdivision is built and requires a detention pond to mitigate stormwater, the development enters into a two-year maintenance agreement with the City to maintain that stormwater facility through the establishment phase. When the two-year maintenance agreement is coming to an end, a final inspection is scheduled and completed to allow for the developer to correct any problems before the stormwater facility becomes the responsibility of the City.

In 2022 the following stormwater facilities were transferred from the private maintenance agreements to public stormwater maintenance:

- 1100 S. College St. (detention ponds)
- Friendsview Manor Providence Drive (2 detention ponds and a water quality flow through planter)
- The Wynooski subdivision/Harding School loft and apartments (Infiltration planters)
- King's Landing Ph 2, 3, 4 (2 regional stormwater ponds)
- Riverrun Subdivision Ph 1,2 (1 regional stormwater pond; serves all homes north of Weatherly Wy)

These facilities have been added to the City's asset management program (both GIS and Cartegraph OMS), and as-builts are available for review through an internal staff portal.

2022 Adaptive Management

The City of Newberg is modifying the completion date for the measureable goals listed under best management practice DS-1, updates to the stormwater Standard Drawings, from December 2022 to December 2023 and to the Design and Construction Standards, from December 2020 to December 2023.

Looking Ahead - 2023 Activities

Under Measure No. 5 there were three measurable goals with a completion date in 2020 that did not get completed. One goal under DS-1 and two goals under DS-3. All three goals are associated with the coordinated updates to the Standard Drawings, and Design and Construction Standards. This body of work to update these guidance documents is currently in process and is expected to be completed by December 2023. As such, we are proposing Adaptive Management to adjust the completion timeline on all three goals.

The remaining five of the eight total measureable goals have a status of "ongoing" which means progress is made toward the goal each year via recurring activities.

Measure No. 6 – Pollution Prevention in Municipal Operations

The Pollution Prevention in Municipal Operations has three best management practices which include the Operations and Maintenance (O&M) Manual, Operations and Maintenance Training, and Stormwater Infrastructure Maintenance. These BMPs are comprised of five (5) strategies and fourteen (14) measureable goals which are listed below. A status summary of the performance measures can be found in Appendix A:

Best Management Practice	Strategy	Measureable Goal	Performance Measure
Measure No. 6 – Pollution Prevention in Municipal Operations			
OM-1 Operations and Maintenance (O&M) Manual	Update O&M Policies	Review existing O&M practices.	Document current procedures in an O&M manual.
		Update O&M manual to optimize water quality.	Document modifications to manual.
	Update Infrastructure Procedures	Review and evaluate the need to update the catch basin cleaning program.	Document current procedures and any modifications to optimize water quality.
		Implement revised catch basin cleaning program.	Track progress.
	Update Street Sweeping Procedures	Review and evaluate the need to update the street sweeping program.	Document current procedures and any modifications to optimize water quality
		Implement revised street sweeping program.	Track progress.
OM-2 Operations and Maintenance Training	Train staff in infrastructure and street sweeping procedures that optimize water quality	Train new staff in stormwater maintenance duties in O&M procedures manual.	Track type of training (webcast, class, certification, on-the-job, etc.), number of employees trained, and the training subject (inspections, maintenance, repair, construction, etc.)
		Train all staff in revised O&M procedures manual every three years.	Track type of training (webcast, class, certification, on-the-job, etc.), number of employees trained, and the training subject (inspections, maintenance, repair, construction, etc.)
OM-3 Stormwater Infrastructure Maintenance	Maintain stormwater infrastructure	Clean catch basins.	Track number of catch basins cleaned per year.
		Place trash racks over major inlets.	Track number and percentage of major inlets installed with trash racks.
		Inspect, clean, repair, replace, and install stormline.	Track length of stormline inspected. Document length of stormline cleaned. Document length and location of stormline repaired or replaced. Track length, diameter, and location of stormline installed.

		Inspect, repair, and replace culverts.	Document location of repaired and replaced culverts and reason for repair or replacement. For newly installed culverts, document new culvert size, material, and elevation from culvert bottom to stream bottom.
		Inspect and repair public stormwater facilities.	Document number of inspections, type of facility (detention basin, LIDA facilities, vegetated swale, etc.) and whether facilities were categorized as excellent, fair, or poor condition.
		Sweep streets every 4-6 weeks.	Track curb miles swept, and debris collected per curb mile each year. Document disposal method.

2022 TMDL Activities Completed

Activities completed in 2022 for each measurable goal for the Pollution Prevention are described below.

OM-1 Operations and Maintenance Manual

The Operations and Maintenance Manual best management practice consists of three strategies: Update O&M Policies, Update Infrastructure Procedures, and Update Street Sweeping Procedures.

Update O&M Policies

The Update O&M Policies strategy consists of two measurable goals.

Review existing O&M practices (Completed)

The City developed an Operations and Maintenance Manual in 2018 to document current maintenance procedures for the stormwater utility system. The Manual was completed in early December and sent to DEQ on December 10, 2018. The Manual covers stormwater workflow, public participation in reporting stormwater issues, stormwater inspection and cleaning, stormwater repair and replacement, illicit discharge investigation and spill response, the catch basin cleaning program, the street sweeping program, and the newly deployed operations management program called Cartegraph OMS.

Update O&M manual to optimize water quality (incomplete, but started)

The Operations and Maintenance Manual is scheduled to be reviewed and updated every three years. The manual is scheduled for a review and update in December 2022, and this work has been started.

Update Infrastructure Procedures

The Update Infrastructure Procedures strategy consists of two measurable goals.

Review and evaluate the need to update the catch basin cleaning program (Completed)

As part of developing the Stormwater Operations and Maintenance Manual and the implementation of the City's new operations management program called Cartegraph OMS, the existing catch basin cleaning program was readdressed. Attribute tables for catch basins inside of the Cartegraph OMS system were modified to capture the data most relevant to our maintenance division and to support reporting as part of the TMDL plan. As was noted in 2021, a draft catch basin cleaning program was completed in December 2019. Due to the COVID19 pandemic, progress was delayed in the beginning of the year. However, the document was finalized in August 2020.

Implement revised catch basin cleaning program (Ongoing)

The City continues to implement the existing catch basin cleaning program annually. Information regarding catch basins cleaned annually can be found in section OM-3 Stormwater Infrastructure Maintenance.

Update Street Sweeping Procedures

The Update Street Sweeping Procedures strategy consists of two measurable goals.

Review and evaluate the need to update the street sweeping program (Completed)

As part of developing the 2018 Stormwater Operations and Maintenance Manual, the City documented current street sweeping practices at that time. A separate and more detailed guidance document for the Street Sweeping Program was finalized in October 2020. The 2020 Street Sweeping Program Document was incorporated into the Stormwater Operations and Maintenance Manual as an appendix.

Implement revised street sweeping program (Ongoing)

The City continues to implement the existing street sweeping program annually. Information regarding street sweeping activities can be found in Table 7.

OM-2 Operations and Maintenance Training

The Operations and Maintenance Training best management practice has one strategy which is to train staff in infrastructure and street sweeping procedures that optimize water quality. The strategy has two (2) measurable goals.

Train new staff in stormwater maintenance duties in O&M procedures manual (Ongoing)

The Maintenance Division proactively trains new employees in the day-to-day tasks associated with stormwater maintenance duties. Much of this training is "on-the-job" and is taught through the experience of completing tasks like cleaning catch basins or stormwater lines. Additional training was forgone in 2022.

Train all staff in revised O&M procedures manual every three years (Ongoing)

The City developed an Operations and Maintenance Manual to document current maintenance procedures as they relate to stormwater. The Manual was completed in December 2018 and sent to DEQ on December 10, 2018. A presentation of the manual was given to the entire Maintenance Division on March 14, 2019. Two hard copies of the

manual were provided (one for each maintenance building), and all staff members were sent an email with the location of the digital copy. This presentation will then be given every three years in coordination with the manual update.

OM-3 Stormwater Infrastructure Maintenance

The Stormwater Infrastructure Maintenance best management practice has one strategy which is to maintain stormwater infrastructure. The strategy has six (6) measurable goals.

Clean catch basins (Ongoing)

In 2022, there were 124 catch basins/grates cleaned, as is shown in Table 5.

Place trash racks over major inlets (Ongoing)

There was one trash racks installed in 2022, as is shown in Table 5.

Inspect, clean, repair, replace, and install stormline (Ongoing)

The quantity of stormline inspected, cleaned, repaired, replaced, and installed in 2021 can be seen in Table 5. The Maintenance Division has committed to inspecting and cleaning all stormwater lines on a six-year rotation and is doing much of this work in coordination with the City's Pavement Preservation Project.

Inspect, repair, and replace culverts (Ongoing)

The quantity of culverts inspected, repaired, and replaced in 2021 can be seen in Table 5. The City recognizes that storm culverts and storm pipe can be perceived as the same thing and in some instances information logged in our asset management system may not be fully capturing the work accomplished. As an example, if a length of storm pipe has a culvert in it, the storm pipe gets noted as cleaned but information may not get added to the culvert asset. This will be a point of focus in the coming year to modify our asset management system appropriately to capture the data accordingly.

Table 5: Stormwater Infrastructure Maintenance Activities from 2018 to 2022

Stormwater Maintenance Activity	2018	2019	2020	2021	2022
Catch Basin/Grates Cleaned	75	86	409	255	124
Trash Racks Installed	0	0	0	1	0
Stormline Inspected, feet	2,089	32,707	21,014	8,936	8,156
Stormline Cleaned, feet	4,390	33,121	22,267	12,441	5,333
Stormline Repaired, feet	0	13	1,172	20	0
Stormline Replaced, feet	0	12	34	0	350
Stormline Installed, feet*	0	0	1,615	0	0
Ditch Cleaned, feet	125	0	0	0	626
Culvert Inspected	0	0	0	0	0
Culvert Repaired	0	0	0	0	0
Culvert Replaced	0	0	0	0	0

*This value represents stormline installed by the City's Maintenance Division only and is not inclusive of new development within the City.

Inspect and repair public stormwater facilities (Ongoing)

The City inspects and repairs public stormwater facilities on an annual basis. Visual inspections of public stormwater facilities including detention areas, spillways, water quality swales, and bioretention ponds were done throughout 2022 to determine maintenance needs. Forty-nine public stormwater facilities were visually inspected and vegetative maintenance was performed at least once. 2022 activities can be seen in Table 6

George Fox University Serve Day occurred on Sept. 14, 2022. As such, City crews shifted focus toward stormwater facilities throughout the City and made good progress.
The City of Newberg also has a contract in place with Yamhill County to utilize Yamhill County Jail Work Crews to do some maintenance of stormwater facilities.
Fifteen water quality swales along Springbrook Road were in poor condition and repaired this past summer. These facilities were constructed as part of the Newberg-Dundee Bypass and when the facilities were given to the City to maintain many had dead or dying plants and trees. Dead trees and associated root balls were removed and replanted in 2022.

Table 6: Stormwater Facility Activities from 2018-2022

Stormwater Facility Activities		2018	2019	2020	2021	2022
Total Facilities (Detention Areas, Spillways, Water Quality Swales, and Bioretention Pond)		83	93	205	139	143
Inspections		26	17	49	138	142
Type	Detention Area	21	8	22	54	58
	Spillway	2	1	0	3	4
	Water Quality Swale	3	8	25	77	4
	Bioretention Pond	-	-	2	4	4
Condition	Excellent	4	3	5	5	83
	Fair	18	12	29	3	65
	Poor	4	2	15	2	8
Facility Repairs		4	2	15	0	0

Sweep streets every 4-6 weeks (Ongoing)

The City cleans streets once a month. In 2022, 988 cubic yards of debris were removed while sweeping 1,414 curb miles Based on the success of the third-party pilot program for street sweeping in the downtown along State highways. Information regarding both the City's Street sweeping activities and the contracted street sweeping activities can be found in Table 7.

Table 7: Street Sweeping Activities from 2018 to 2022

Street Sweeping Activities (Public and Private)	2018	2019	2020	2021	2022
Sweeping Debris (Cubic Yards)	1,009	943	523	777	988
Street Sweeping Miles (curb miles)	2,016	1,797	1,797	1,711	1,414
Cubic Yard per Mile Swept	0.50	0.52	0.29	0.45	0.70
Contracted Sweeping Debris (Cubic Yards)	95*	158**	199**	228.5**	93.5**
Contracted Street Sweeping Miles	64*	216**	216**	192**	157.5**
Contracted Cubic Yard per Mile Swept	1.5*	0.73**	0.92**	1.19**	0.6**

*A pilot program started in September 2019 to have OR99W swept between the western city limits and Villa Road using a third-party contractor. That section of OR99W swept twice a month.

**The City has fully implemented a permanent third-part street sweeping contract for services along State highways in the Downtown. The downtown swept twice a month.

2022 Adaptive Management

The City of Newberg is not proposing to modify any measurable goals through adaptive management.

Looking Ahead – 2023 Activities

Of the 14 total measurable goals under Measure No. 6, three goals have been completed, and the remaining eleven measureable goals have a status of "ongoing" which means progress is made toward the goal each year via recurring activities.

Temperature

The Temperature criteria includes Maintaining Existing Stream Vegetation, Increase Effective Shade, and conducting Stream Assessments. These three (3) best managements practices are comprised of three (3) strategies, and seven (7) measurable goals which are listed below. A status summary of the performance measures can be found in Appendix A:

Best Management Practice	Strategy	Measureable Goal	Performance Measure
Temperature			
T-1 Maintain Existing Stream Vegetation	Use Municipal Code and other Measures to Maintain Stream Vegetation	Update Municipal Code that can affect stream health.	Update ordinances that affect stream vegetation.
		Update Stream Corridor Overlay.	Document changes to the Stream Corridor Overlay map and code based on wetland inventory and property annexation.
T-2 Increase Effective Shade	Increase Shade along Streams within the City	Continue with established Trees for Streams Program. Provide incentives (free or reduce cost native plant materials) for citizens to plant trees, shrubs, and grasses along tributaries or streams within the City limits.	Document watershed and number of native plant types (trees, shrubs, grasses) planted per year.
T-3 Stream Assessment	Assess Stream Health and Canopy Coverage	Assess at least one stream mile annually for vegetative ground cover, stream channel configuration, and canopy coverage.	Document results of assessment.
		Complete a wetland inventory that encompasses the Urban Reserve areas. Update wetland inventory when Department of Land Conservation and Development (DLCD) provides funding for City's comprehensive plan periodic review.	Track progress. Provide link to wetland inventory and map.
		Develop stream temperature monitoring program.	Document procedures and identify locations for sampling.
		Implement stream temperature monitoring program.	Document sampling locations, dates, and results.

2022 TMDL Activities Completed

Activities completed in 2022 for each measurable goal are described below:

T-1 Maintain Existing Stream Vegetation

The best management practice Maintain Existing Stream Vegetation has one strategy which is to use the Municipal Code and other measures to maintain stream vegetation. The strategy has two (2) measureable goals.

Update Municipal Code that can affect stream health (Ongoing)

The City had no ordinances adopted in 2022 that would impact stream health.

Update Stream Corridor Overlay (Ongoing)

There were no code changes or map changes to the Stream Corridor Overlay in 2022. There were also no projects that went through the land-use process where the City's Stream Corridor Overlay code followed in 2022.

T-2 Increase Shade along Streams within the City (Ongoing)

In 2022 the City's reactivated the Trees for Stream Program after two years on hold due to the COVID19 pandemic and the City's travel restrictions. The City continues to promote and facilitate the Trees for Streams Program in coordination with the Yamhill Soil & Water Conservation District. In 2022, five Newberg community members participated in the Trees for Streams Program and plants were distributed through all three watersheds. These land owners planted native plants along a total of 0.3 miles of streams/tributaries and positively impacted a total of 1.56 riparian acres within the City of Newberg. The City paid that fee, to pick up plants in Spring 2023 can be seen in Table 8. For more information about the program visit City website: https://www.newbergoregon.gov/operations/page/trees-streams

Table 8: Trees for Streams Program Native Plant Totals from 2018 to 2022

	2018	2019	2020	2021	2022	Total
Chehalem Creek Watershed						
Trees	16	19	0*	-	7	45
Shrubs	49	24	0*	-	13	86
Groundcovers	20	5	0	-	0	30
Hess Creek Watershed						
Trees	-	5	0*	-	9	14
Shrubs	-	12	0*	-	12	24
Groundcovers	-	8	0*	-	0	8
Spring Brook Watershed						
Trees	-	5	0*	-	2	8
Shrubs	-	38	0*	-	6	44

Groundcovers	-	0	0*		0	0
Total	85	116	0*	-	40	259

*In spring 2020 plants were not delivered to property owners due to the emerging COVID19 pandemic and City's travel restrictions. This program has been put on hold until restrictions are lifted.

T-3 Stream Assessment

The best management practice Stream Assessment has one strategy to Assess Stream Health and Canopy Coverage. The strategy has four (4) measureable goals.

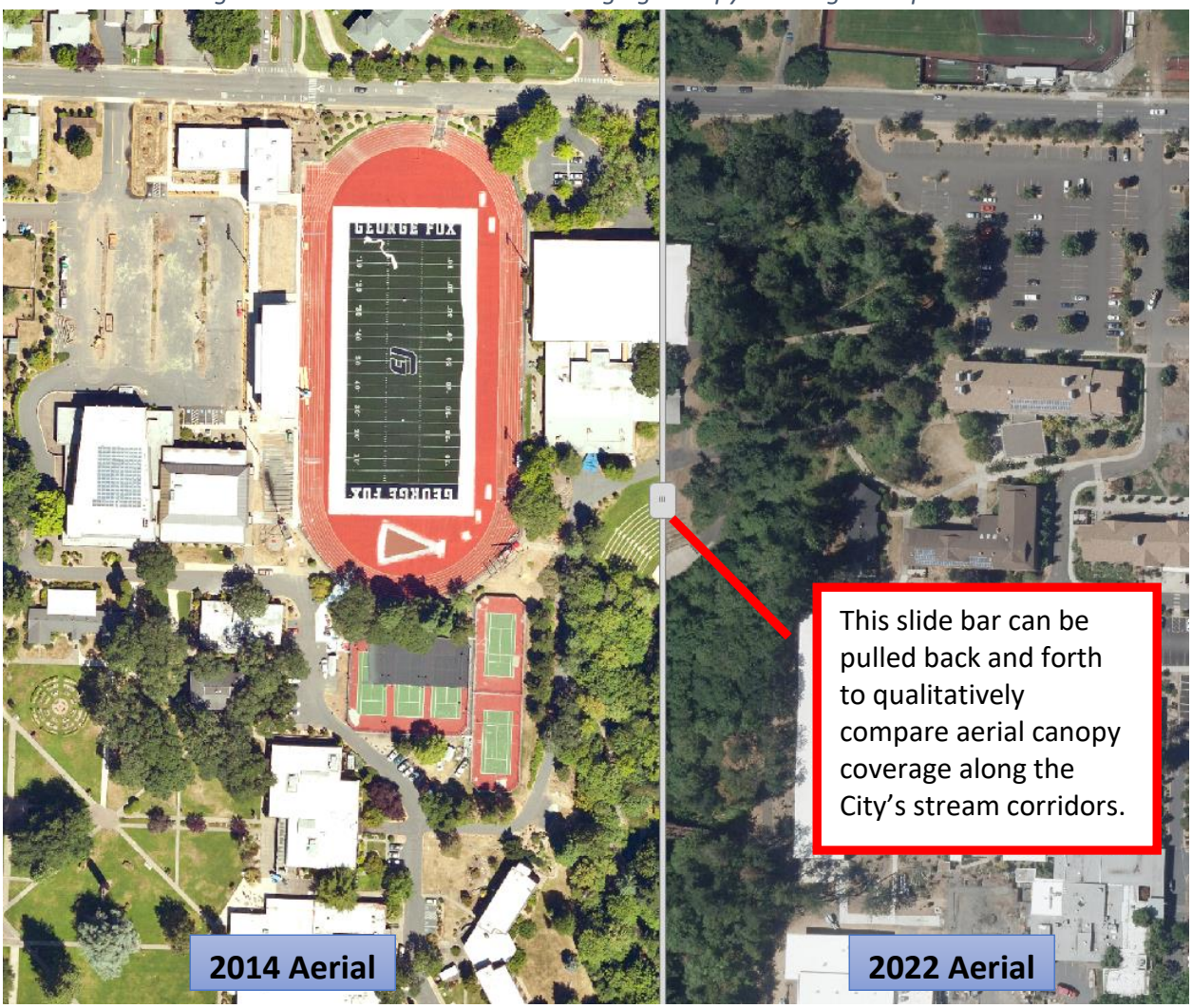
Assess at least one stream mile annually for vegetative ground cover, stream channel configuration, and canopy coverage. (Ongoing)

The city's staff did a field walk and investigation of approximately 1.3 stream miles on the lower section of Hess Creek was used to evaluate both the stream corridor and the City's wastewater infrastructure which follows the Hess Creek alignment. Qualitative assessments were done concerning vegetative ground cover, stream channel configuration, and canopy coverage.

Additionally in order to better evaluate stream canopy coverage, web mapping was developed to compare aerial imaging over time. The City of Newberg generally obtains a new aerial image of the City every two years as part of the GIS mapping program. These images can then be compared to evaluate stream canopy coverage over time. Images are typically captured during the spring/summer months so relative comparisons can be made. Currently the 2014, 2016, 2018,2020,2021, and 2022 aerials are available for viewing and comparison. This mapping was updated and evaluated to see the stream canopy coverage change over time comparing 2018 - 2022. The online mapping tool can be found here: Select the layer to appear within the spyglass.

https://newberg.maps.arcgis.com/apps/webappviewer/index.html?id=4a5f38bec812450fb0d91a54e37247bc.

Figure 2: Stream Corridor Aerial Imaging Canopy Coverage Comparison



Complete a wetland inventory that encompasses the Urban Reserve areas. Update wetland inventory when Department of Land Conservation and Development (DLCD) provides funding for City's comprehensive plan periodic review **(Ongoing)**

The City of Newberg completed an update to the Water Management and Conservation Plan in 2019 and as part of the correspondence with the Department of State Lands, it was noted that the City has not yet completed a Local Wetlands Inventory (LWI) for Goal 5. The City was made aware that the State now has some funding resources available to facilitate this process through the Department of Land Conservation and Development (DLCD) Community Technical Assistance Grant. At this time, the grant funding available is not enough to support the effort required to complete the Local Wetlands Inventory. However, the City will continue looking for opportunities and funding sources to complete this work.

As a proxy to a Local Wetland Inventory map, the City of Newberg does have a Stream Corridor Overlay Subdistrict with regulations about activities that can and cannot occur within the established boundary. Based on evaluation of the National Wetlands Inventory (NWI) online mapping tool, it appears that most areas with high wetland probability are located within the City's established Stream Corridor Overlay Subdistrict. The regulations around activities within this subdistrict can be read in Newberg Municipal Code (NMC) *Chapter 13.342 Stream Corridor Overlay (SC) Subdistrict*. The City also has an online interactive planning map where the Stream Corridor Overlay can be see here:
https://newberg.maps.arcgis.com/apps/mapviewer/index.html?webmap=569de429310b45d2acc98097f94d0de9

Develop stream temperature monitoring program (Completed)

The development of Stream Temperature Monitoring Program was done in coordination with the Greater Yamhill Watershed Council and online resources from DEQ and the Oregon Watershed Enhancement Board (OWEB). Procedures were developed based on both best practices and field experience deploying exploratory water loggers over the last few years. The completed Stream Temperature Monitoring Program document can be found in Appendix E and will be used by all future staff members to ensure consistency with collecting data.

Implement stream temperature monitoring program (Ongoing)

The implementation of the stream temperature monitoring program was started in May 2022, progress has been made on this goal. On the best available information related to safety protocols and procedures related to staffing availability, the proximity of staff members needed to deploy water loggers by climbing into and out of streams and creeks. The water loggers have been deployed by following the procedures established in the Stream Temperature Monitoring Plan See Appendix F.

2022 Adaptive Management

The City of Newberg is modifying the start date for the measurable goal of implementing the Stream Temperature Monitoring program under best management practice T-3 from May 2020 to May 2022

Looking Ahead - 2023 Activities

Of the seven total measurable goals under Temperature, one goal has been completed, one goal has not yet started, and the remaining five measurable goals have a status of "ongoing" which means progress is made toward the goal each year via recurring activities.

Next Steps

As has been documented in the annual report, the City of Newberg made a significant effort in 2022 to protect water quality and the environment within the City through seven focus areas. Looking forward to the 2023 plan year, the City will continue to make progress on the "ongoing" measurable goals, and has identified the following items to be completed in 2023:

- **PE-2 Public Signage**: Develop a public infrastructure signage program to determine sign locations and messaging (December 2023) – ***Adaptive Management***
- **DS-1 Develop Stormwater Management Program**: Update stormwater standard drawings and notify the development community of proposed new requirements/modifications before adoption (December 2023) – ***Adaptive Management***
- **DS-1 Develop Stormwater Management Program:** Update stormwater standards manual and notify the development community of proposed new requirements/modifications before adoption (December 2023) – ***Adaptive Management***
- **DS-3 Update the City's Stormwater Master Plan:** Update the City's Stormwater Master Plan and associated stormwater project lists (December 2023) – ***Adaptive Management***
- **T-3 Stream Assessment**: Develop stream temperature monitoring program, Implement stream temperature monitoring program. Document sampling locations, dates, and results (**May 2023) – Adaptive Management.**

We look forward to our continued stewardship of the Chehalem Creek, Hess Creek, and Spring Brook watersheds, and Willamette River.

Appendix Summary

Appendix A: Newberg TMDL Implementation Matrix 2018-2022

Appendix B: Illicit Discharge Investigations 2018-2022

Appendix C: Construction Site Stormwater Management 2018-2022

Appendix D: Post-Construction Stormwater Management 2018-2022

Appendix E - Stream Temperature Monitoring Program w Appendix

Appendix F - Newberg TMDL Implementation Matrix 2023-2028

Appendix A: Newberg TMDL Implementation Matrix 2018-2022

Appendix A: City of Newberg TMDL Implementation Matrix 2018-2022 (~~Update 11/28/2018~~) (~~Update 10/15/2021~~) (Update 08/16/2022 w/2019 Mercury TMDL Update per DEQ Comments)

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline	2022 Status	Pollutants		
						Mercury	Bacteria	Temperature
Measure No. 1 – Public Education								
PE-1 Stormwater Education	Website Education	Provide stormwater information on the City's website.	Provide general stormwater information and website links to the annual TMDL Implementation Plan.	Ongoing	Ongoing	X	X	X
	Citizen Group Education	Present stormwater information to interested citizen groups at local venues.	Track number of presentations, presentation messages, and number of participants (if available).	Ongoing	Ongoing	X	X	X
	Water Quality Report	Provide stormwater education in the City's annual Water Quality Report.	Provide website links to the annual Water Quality Report, and track stormwater messages included in the report.	Ongoing	Ongoing	X	X	X
PE-2 Watershed Education	Public Signage	Develop public infrastructure signage program.	Develop public infrastructure signage program to determine sign locations and messaging.	~~December 2020~~ **December 2023 – Adaptive Management**	Incomplete, but started.	X	X	X
		Make progress providing signage at stream crossings or LIDA infrastructure facilities consistent with signage program.	Track number of signs installed and associated messages.	~~December 2022~~ **December 2023**	Not Started	X	X	X
		Make progress marking 50 unmarked catch basins a year with "No Dumping, Drains to Stream" type language.	Track number of catch basins marked per year. Prepare GIS map showing coverage of locations that are permanently marked or marked with after-market plastic labels.	Ongoing	Ongoing	X	X	X
	Student Education	Provide watershed education to students.	Track number of presentations, presentation messages, and number of participants (if available).	Ongoing	Ongoing	X	X	X
Measure No. 2 – Public Involvement								
PI-1 Stormwater Utility Fee	Participate in Citizen Rate Review Committee (CRRC) Meetings	Present stormwater funding needs to CRRC.	Document meeting attendance, adopted rates, and effective dates of rate changes.	Ongoing; - Fall 2021/Spring 2022	Ongoing	X	X	X
PI-2 Public Participation in Stormwater Management	Provide Grant Funding for Water Quality Improvement or Watershed Awareness Projects	Provide a minimum of $2,000 in a grant program to fund non-profit projects that fulfill goals of the TMDL plan.	Track number of funded projects, amount disbursed per project, stream affected, and either the number of stream miles affected or the number of participants.	Ongoing	Ongoing	X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline	2022 Status	Pollutants		
						Mercury	Bacteria	Temperature
PI-3 Public Participation in Reporting Stormwater Issues	Public Participation in Stormwater, Illicit Discharge, and Erosion Control Issues	Provide methods for citizens to report concerns during and after business hours. Notify public of available reporting methods.	Document methods and frequency of public notifications.	Ongoing	Ongoing	X	X	X
		Respond to public concerns.	Document number of stormwater, erosion control, and illicit discharge complaints reported by citizens and note resolutions.	Ongoing	Ongoing	X	X	X
PI-4 Public Participation in Determining Stormwater Educational Focus	Determine Focus of Stormwater Educational Messages to the Public	Conduct a public survey to revise and refine educational messages related to stormwater and the TMDL Implementation Plan.	Provide copy or link to survey and report results of the survey.	~~June/July 2019~~ August 2020	Completed	X	X	X
Measure No. 3 – Illicit Discharged Detection and Elimination (IDDE)								
ID-1 Train Staff to Implement IDDE Plan	Train Staff in Illicit Discharge Investigation and Spill Response	Train new staff members in illicit discharge investigation and spill response. Provide training in some aspect of illicit discharge investigation and spill response every five years for all applicable staff.	Track type of training (webcast, class, certification, on-the-job, etc.), number of employees trained, and the training subject (maintenance, response, investigation, sampling, etc.).	Ongoing	Ongoing	X	X	X
ID-2 Implement IDDE Plan	Conduct Illicit Discharge Inspections	Field screen outfalls.	Inventory type, size, and location of public and private outfalls. Map existing and new development outfall locations in GIS.	Ongoing; December 2019 (Initial Mapping); December 2022 (Complete mapping and ongoing for new development)	Completed	X	X	X
		Investigate outfalls for illicit discharges.	Document location, date, cause, and resolution.	Ongoing	Ongoing	X	X	X
	Respond to Illegal Dumps	Clean up illegal dumps.	Track number of illegal dumps, citations issued, and resolution.	Ongoing	Ongoing	X	X	X
	Respond to Illicit Discharges/Spills	Fire Department spill response.	Track date and cause of spills that occur. Document whether the spill reached the stormwater system or a stream and if water sampling was conducted. Document response resolution.	Ongoing	Ongoing	X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline	2022 Status	Pollutants		
						Mercury	Bacteria	Temperature
		Public Works illicit discharge/spill response.	Track date and cause of illicit discharges/spills that occur, identified illicit discharges from private wastewater laterals or from failing public infrastructure. Document whether the pollutant reached the stormwater system or a stream and if water sampling was conducted. Document response resolution.	Ongoing	Ongoing	X	X	X
		Provide spill response cards and spill response kits on municipal trucks and sweepers.	Track number of municipal trucks and sweepers with spill response cards and spill kits. Document the number of spill kits used annually in response to spills.	Ongoing	Ongoing	X	X	X
ID-3 Hazardous Waste Collection	Promote opportunity for Residents to Dispose of Hazardous Waste	Promote free hazardous waste collection service twice per year to City residents (offered by Waste Management in Yamhill County).	Track volume of waste received during collection events.	Ongoing	Ongoing	X	X	X
ID-4 Drug Take-Back Collection	Provide Opportunity for Residents to Dispose of Unused Medication	Offer free unused medication collection service to City residents.	Track the volume of unused medication collected annually.	Ongoing	Ongoing	X	X	X
Measure 4 – Construction Site Stormwater Runoff Control								
CS-1 Train Staff in Erosion and Sediment Control (ESC)	Train Staff in Plan Review, Site Inspection, and Enforcement of ESC Program	Train new staff whose responsibilities include erosion and sediment control plan review and enforcement. Provide refresher training to all staff involved in ESC every three years.	Document number of staff trained and type of training (on-the-job training, certification, or recertification).	Ongoing	Ongoing	X	X	X
CS-2 Implement Erosion and Sediment Control Program	Implement ESC Program	Conduct ESC plan review.	Document location and type (commercial, industrial, single-family residential, etc.) of all construction project plan reviews. Document which project obtained a DEQ 1200-C permit. Develop and send a notice letter to applicants on wet weather best management practices as weather conditions change.	Ongoing	Ongoing	X	X	X
		Conduct site inspections at least once during active construction by trained or experienced staff.	Provide number of erosion and sedimentation control inspections for each project. Document location and type (commercial, industrial, single-family residential, etc.) of construction project.	Ongoing	Ongoing	X	X	X
		Enforce ESC ordinances.	Report number of warning letters or non-compliance citations by project and resolution.	Ongoing	Ongoing	X	X	X
Measure No. 5 – Post-Construction Runoff Control								

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline	2022 Status	Pollutants		
						Mercury	Bacteria	Temperature
DS-1 Develop Stormwater Management Program	Update Stormwater Development Manuals and Standard Details	Update stormwater design standards manual and standard drawings. Notify development community of proposed new requirements before adoption.	Provide summary of changes and link to new design standards when adopted.	~~December 2019~~ **December 2021 – Adaptive Management (Standard Drawing Updates)**; ~~December 2020~~ **December 2021 – Adaptive Management (Standard Manual Amendments)**	Incomplete, but started.	X	X	X
DS-2 Train Staff in Stormwater Management	Train Staff in Stormwater Management	Provide training opportunities for staff in watershed and stormwater management.	Track type of training (webcast, class, on-the-job, certification, etc.), number of employees trained, and the training subject (plan review, inspection, enforcement, etc.)	Ongoing	Ongoing	X	X	X
DS-3 Implement Stormwater Management Program	Require Stormwater Management for Development and Redevelopment	Require stormwater plan submittals and conduct plan reviews.	Document number of construction plan submittals, plan reviews, project type (commercial, institutional, residential, etc.), size, and location.	Ongoing	Ongoing	X	X	X
		Require stormwater management per the Stormwater Development Manuals and Standard Details.	Document number and type (detention basin, flow dissipater, raingarden, filtration swale, etc.) of stormwater facilities required for each project.	Ongoing	Ongoing	X	X	X
		Conduct pre-construction conferences to inform contractors about stormwater requirements.	Document number of pre-construction conferences, project type (commercial, institutional, residential, etc.), size, and location.	Ongoing	Ongoing	X	X	X
	Improve Watershed Management	Evaluate stormwater projects for treatment opportunities (new installations vs. existing infrastructure upgrades) i.e. Stormwater Master Plan.	Summarize hierarchy used for screening. Document location and number of sites reviewed, drainage area, and result of evaluation.	May 2014, and Ongoing; ~~June 2020 (Re-evaluate Stormwater Master Plan project list)~~ **December 2021 – Adaptive Management (Stormwater Master Plan project list)**	Ongoing; Incomplete, but Started	X	X	X
		Implement stormwater projects for treatment opportunities (new installations vs. existing infrastructure upgrades) i.e. Stormwater Master Plan.	Document number of projects including location, size, type (LIDA, traditional, etc.), and drainage area.	May 2014, and Ongoing; ~~June 2020~~ **December 2022– Adaptive**	Ongoing; Incomplete, but Started	X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline	2022 Status	Pollutants		
						Mercury	Bacteria	Temperature
				Management (Stormwater Master Plan project list)				
	Optimize Water Quality	Inspect public stormwater facilities post-construction.	Conduct a post-construction stormwater facility transfer. Complete final inspection at end of the two-year maintenance agreement. Document facility in GIS/asset management program, obtain and file stormwater as-built drawings, and facility maintenance plan.	Ongoing	Ongoing	X	X	X
Measure No. 6 – Pollution Prevention in Municipal Operations								
OM-1 Operations and Maintenance (O&M) Manual	Update O&M Policies	Review existing O&M practices.	Document current procedures in an O&M manual.	December 2018	Completed	X	X	X
		Update O&M manual to optimize water quality.	Document modifications to manual.	December 2022	Incomplete, but started.	X	X	X
	Update Infrastructure Procedures	Review and evaluate the need to update the catch basin cleaning program.	Document current procedures and any modifications to optimize water quality.	July 2020	Completed	X	X	X
		Implement revised catch basin cleaning program.	Track progress.	Ongoing	Ongoing	X	X	X
	Update Street Sweeping Procedures	Review and evaluate the need to update the street sweeping program.	Document current procedures and any modifications to optimize water quality	July 2020	Completed	X	X	X
		Implement revised street sweeping program.	Track progress.	Ongoing	Ongoing	X	X	X
OM-2 Operations and Maintenance Training	Train staff in infrastructure and street sweeping procedures that optimize water quality	Train new staff in stormwater maintenance duties in O&M procedures manual.	Track type of training (webcast, class, certification, on-the-job, etc.), number of employees trained, and the training subject (inspections, maintenance, repair, construction, etc.)	Ongoing	Ongoing	X	X	X
		Train all staff in revised O&M procedures manual every three years.	Track type of training (webcast, class, certification, on-the-job, etc.), number of employees trained, and the training subject (inspections, maintenance, repair, construction, etc.)	February 2019 (following manual completion, then every three years); August 2022	Ongoing	X	X	X
OM-3 Stormwater Infrastructure Maintenance	Maintain stormwater infrastructure	Clean catch basins.	Track number of catch basins cleaned per year.	Ongoing	Ongoing	X	X	X
		Place trash racks over major inlets.	Track number and percentage of major inlets installed with trash racks.	Ongoing	Ongoing	X	X	X
		Inspect, clean, repair, replace, and install stormline.	Track length of stormline inspected. Document length of stormline cleaned. Document length and	Ongoing	Ongoing	X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline	2022 Status	Pollutants		
						Mercury	Bacteria	Temperature
			location of stormline repaired or replaced. Track length, diameter, and location of stormline installed.					
		Inspect, repair, and replace culverts.	Document location of repaired and replaced culverts and reason for repair or replacement. For newly installed culverts, document new culvert size and material.	Ongoing	Ongoing	X	X	X
		Inspect and repair public stormwater facilities.	Document number of inspections, type of facility (detention basin, LIDA facilities, vegetated swale, etc.) and whether facilities were categorized as excellent, fair, or poor condition.	Ongoing	Ongoing	X	X	X
		The City's goal is to sweep streets every 4-6 weeks.	Track curb miles swept and debris collected per curb mile each year. Document disposal method.	Ongoing	Ongoing	X	X	X
Temperature								
T-1 Maintain Existing Stream Vegetation	Use Municipal Code and other Measures to Maintain Stream Vegetation	Update Municipal Code that can affect stream health.	Update ordinances that affect stream vegetation.	Ongoing	Ongoing	X	X	X
		Update Stream Corridor Overlay.	Document changes to the Stream Corridor Overlay map and code based on wetland inventory and property annexation.	Ongoing	Ongoing	X	X	X
T-2 Increase Effective Shade	Increase Shade along Streams within the City	Continue with established Trees for Streams Program. Provide incentives when available (free or reduce cost native plant materials) for citizens to plant trees, shrubs, and grasses along tributaries or streams within the City limits.	Document watershed and number of native plant types (trees, shrubs, grasses) planted per year through program activities.	Ongoing	Ongoing	X	X	X
T-3 Stream Assessment	Assess Stream Health and Canopy Coverage	The City's goal is to assess one stream mile annually for vegetative ground cover, stream channel configuration, and canopy coverage.	Document results of assessment.	Ongoing	Ongoing	X	X	X
		The City's goal is to complete a wetland inventory that encompasses the Urban Reserve areas. Update to the wetland inventory will occur when Department of Land Conservation and Development (DLCD) provides funding for City's comprehensive plan periodic review.	Track progress. Provide link to wetland inventory and map.	Ongoing	Ongoing	X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline	2022 Status	Pollutants		
						Mercury	Bacteria	Temperature
		Develop stream temperature monitoring program.	Document procedures and identify locations for sampling.	Completed December 2019	Completed	X	X	X
		Implement stream temperature monitoring program.	Document sampling locations, dates, and results.	~~May 2020~~ **May 2022 – Adaptive Management**, and Ongoing	Ongoing	X	X	X

Appendix B: Illicit Discharge Investigations 2018-2022

Appendix B: Illicit Discharge Investigations 2018-2022

Date	Cause	Watershed	Resolution
1/2018	Concern about an existing oil-water separator and petroleum releasing to a storm drain ditch.	Chehalem Creek	A DEQ Hazardous Waste coordinator come out on site and did a field investigation. It was determined that the oil-water separator was in good working order, but there were other site conditions that need to be corrected. A Complaint Investigation #18-141 letter was sent to the owner.
1/2019	A motor vehicle spilling/leaking oil drove through the gas station parking lot and covered the area with an oil sheen.	Chehalem Creek	The City of Newberg maintenance crew deployed absorbent socks around the nearby catch basins. No additional action was taken.
4/2019	Dumping of floor wax and stripping compound into the storm drain in a private parking lot. Private storm drain connects to public storm drain along E 2nd Street and illicit discharge was found flowing along the curb line.	Chehalem Creek	The City of Newberg maintenance staff cleaned the illicit discharge from the catch basin and gutter line along E 2nd Street. They also flushed the private catch basin in parking lot in order to access all of the dumped material with the City's vactor truck. A Notice of Municipal Code Violation was sent to the Contractor responsible for the illicit discharge and a fine of $400.45 covering the clean-up cost was assessed and then paid.
6/2019	Restaurant was improperly disposing of grease. Grease containers by the dumpster were improperly maintained and grease on ground was being washed into private onsite storm drain.	Spring Brook	The City of Newberg is still actively working with this restaurant. Contact began with outreach and education and has escalated to imposing fines for continued violations of improperly maintained grease disposal methods.
7/2019	Anonymous DEQ Complaint 19-1678: Employee dumping windshield washing fluid into a private onsite catch basin at a gas station at the end of their work day.	Spring Brook	The City of Newberg made contact with the manager of the gas station and provided education about proper disposal methods and how to avoid illicit discharges. Verbal warning.
7/2019	Restaurant was pouring mop water into a private onsite storm drain.	Spring Brook	The City of Newberg made contact with employees and owner. Through education and outreach they were informed

			that mop water needs to go into the mop sink only and that dumping in the storm drain is an illicit discharge. Verbal warning.
10/2019	Phone call from public about diesel fuel spill running into storm drain in the Terra Estates Subdivision.	Chehalem Creek	The City of Newberg received a phone call from a concerned citizen about a fuel spill. Maintenance employees determined the spill was minor and deployed two absorbent bags to soak up the spilled fuel.
10/2019	A medical office building was under construction when a sewer manhole was pumped into a private stormwater detention basin/drainage system.	Spring Brook	The City of Newberg was made aware of this violation and had the contractor stop immediately. An OERS report was filed: OERS 2019-2800. The contractor was assessed and then paid the City fine of $1,000. DEQ will be following up with any state enforcement action.
10/2019	Grocery store was improperly maintaining their grease disposal container and grease was flowing into private stormwater drain.	Spring Brook	The City of Newberg made contact with the store manager. Through education and outreach they were made aware of proper care of grease containers and the spilled grease was cleaned from the pavement leading to the storm drain. Verbal warning.
2/2020	Phone call complaint was received by the City concerning a mud covered work truck being cleaned in a driveway with mud being directed to a storm drain.	Spring Brook	The City of Newberg made contact with the truck owner and informed them about purpose of storm drains and the potential consequences of continued dumping.
3/2020	Phone call from the public about soapy bubbles floating down a tributary to Chehalem Creek.	Chehalem Creek	The City of Newberg received a phone call from a concerned citizen about soapy bubbles in a Chehalem Creek tributary behind their house. Engineering staff investigated upstream of the event and were not able to identify a point source. No further action was taken.
5/2020	Anonymous DEQ Complaint 20-1111: DEQ received a complaint about paint dumping into a private onsite catch basin at Springbrook Apartments	Spring Brook	The City of Newberg made contact with the manager of the apartment complex and it was determined that the white water was a result of power washing sidewalks within the complex as part of routine maintenance. The apartment maintenance crew was directed to put in BMPs around catch basins prior to power washing. No further action was taken.

7/2020	Anonymous DEQ Complaint 20-1461: DEQ received a complaint about construction/drywall material being directed to a storm drain at the base of a driveway.	Chehalem Creek	The City of Newberg investigated the complaint and did not see evidence of construction materials or drywall in the storm drain. A door hanger was left at the residence explaining the purpose of storm drains and the potential consequences of continued dumping.
9/2020	DEQ Complaint 20-2292: DEQ received a complaint about a trash compactor associated with a grocery store, that was leaking, and the contents were running into the storm system.	Chehalem Creek	The City of Newberg made contact with the grocery store manager, and it was determined the trash compactor needed to be replaced and the existing oil/grease on the surface need to be cleaned and removed. The grocery store followed City guidance and the issue was resolved.
11/2020	A City employee noticed what appeared to be new drainpipes leaving a commercial building and entering an adjacent private property	Chehalem Creek	The City of Newberg made contact with the business owner, and it was determined that the new pipes leaving the building were related to a heating/cooling system and were not contributing to the existing stormwater drainage system on the adjacent property. No further action was taken.
12/2020	City maintenance crews noticed oil presence around a loop in our downtown streets that they were able to trace back to an Auto Repair shop.	Hess Creek	City crews immediately deployed BMPs around catch basins and applied kitty litter where the oil was pooled. The City of Newberg then made contact with the business owner, and it was determined that a gas cap was not secured property on a car they were repairing. The City assessed a fine in the amount of $747.52 to the business owner to cover the cost of materials and labor for City crews to mitigate the spill.
1/2021	A complaint from a City employee about construction project site pumped water from retention pond into SW system.	SpringBrook	The City of Newberg investigated the complaint and reached out to DEQ concerning the illicit discharge that occurred and contacted with the project manager and informed him that was unacceptable pumping occurred without any notification or coordination with the City. The pumping should only occur if needed and will have a filter sack on the outlet. The pump will discharge onto the existing parking lot to the south with filter bags in the catch basins.
2/2021	A complaint from neighbors about Silica released from manufacturing plant coating everything.	Hess Creek	The City of Newberg investigated the complaint and referred to and worked with DEQ Hazardous Waste coordinator and did a field investigation. Resolution was extra containment

			measures and repairs to sand blatting equipment and work area at the plant.
4/2021	Complaint from renter about broken sewer pipe bubbling up in neighbors' back yard.	Chehalem Creek	The City of Newberg investigated the complaint, and the ruptured pipe was repaired.
4/2021	City maintenance crews noticed Weedman lawn care truck had dumped unknown substance into storm drain.	Hess Creek	The City of Newberg contacted the business owners and gave a verbal warning and informed them about purpose of storm drains and the potential consequences of continued dumping.
4/2021	A complaint from public Works about drains from washing machines emptying on ground.	Hess Creek	City crews immediately rerouted the drain to not leave the property and into City limits.
01/2022	Vehicle accident, general cleanup	Hess Creek	T21 responded C1 for fluids from a non-injury MVC. T21 assisted a tow truck driver by putting down absorbant. T21 cleared
05/2022	Gasoline or other flammable liquid spill	SpringBrook	T21 was dispatched to a service call. Dispatch notes indicated that Police were on scene and there was a leaking diesel from a pickup. T21 arrived at PD on scene with a older Ford F250 that had been vandalized with small hole punctured in the fuel tank and diesel leaking out. There was approximately 3 gallons on the asphalt. T21 used a galvanized bucket wrapped in a trash bag to catch the still leaking fuel, put absorbant on the fuel on the ground, and proceeded to stop the leak with a 16-penny nail and duct tape with success. The owner of the vehicle was made aware of the situation and our fix and stated that he was going to follow up with the local ford dealership. T21 cleared with PD on scene
07/2022	Vehicle accident, general cleanup	Hess Creek	T21 dispatched to a MVC; arrived to two vehicle rear end accident. M21 triaged all RP's and found no pt's.T21 cleaned up fluid/debris and pushed vehicle to side road.
11/2022	Gasoline or other flammable liquid spill	Hess Creek	Propane that was leaking from tank of motor home. E20 arrived and was able to turn off the bleeder valve and stop the leak.

12/2022	Hazardous condition, other		E20 was dispatched to a possible hazardous material by NDPD. On arrival, an officer was stopped on the side of First street. There was a 5-gallon bucket on the sidewalk near the vehicle. The officer stated that the bucket was in the middle of the road earlier. He stopped and picked it up and carried it to the side of the road. He then went back to the police station and washed his hands prior to returning to the scene. The bucket had a lid on it and had not broken. There was approximately 2 gallons of a clear liquid in it. The chemical name on the bucket was CASCHLOR. HazMat was contacted by phone and responded to the scene. They were taking the bucket and disposed of it properly. There were no injuries and no spills. E20 cleared.HM34 dispatched for a hazardous material incident with initial reports of a gallon-sized bucket of some type of corrosive found in a roadway on Hwy. 99 in Newberg. HM34 contacted E20 via phone and provided decon guidance based on a product identified as sodium hypochlorite 12.5%. HM34 advised by E20 that the bucket was a 5-gallon bucket less than half full, was not leaking and had a tight-fitting lid on. Per E20, a police officer found the bucket on its side in the road and carried it to the sidewalk. Officer is not having any s/s of any kind. HM34 collected the bucket, overpacked it and took it back to the station for proper disposal in a dumpster at station 34. HM34 clear.

Appendix C: Construction Site Stormwater Management 2018-2022

Appendix C: Construction Site Stormwater Management 2018-2022

Project Name	Location	Watershed	1200-C Permit (Yes/No)	ESC Inspections					Completed
				2018	2019	2020	2021	2022	
Gracie's Landing, Ph 1	North Valley Rd/Chehalem Dr	Chehalem Creek	Yes	NA	-	-	-	-	2018
Gracie's Landing, Ph 2 & 3	North Valley Rd/Chehalem Dr	Chehalem Creek	Yes	NA	-	-	-	-	2018
Chehalem Pointe Apartments	1317 Villa Rd	Hess Creek	Yes	NA	-	-	-	-	2018
CPRD Pool Expansion	1802 Haworth Ave	Hess Creek	Yes	NA	-	-	-	-	2018
Freeman Manufacturing Building	1001 Wilsonville Rd	Hess Creek	Yes	NA	-	-	-	-	2018
GFU Student Activity Center	1400 E Sherman St	Hess Creek	Yes	NA	-	-	-	-	2018
GFU Austin Sports Complex	1953 N Center St	Hess Creek	Yes	NA	-	-	-	-	2018
Grace Baptist Church	1619 E 2nd St	Hess Creek	Yes	NA	-	-	-	-	2018
Hazelwood Farms	E Henry Rd	Hess Creek	Yes	NA	-	-	-	-	2018
Villa Rd Improvements	Villa Rd	Hess Creek	Yes	NA	-	-	-	-	2018
Dayton Avenue Pump Station	840 S Dayton Ave	Chehalem Creek	No	144	-	-	-	-	2018
Old Mill Development	2401 Portland Rd	Hess Creek	No	30	-	-	-	-	2018
South Park	609 Wynooski St	Hess Creek	Yes	NA	-	-	-	-	2018
Dutchman Ridge, Ph 1	25300 NE North Valley Rd	Chehalem Creek	Yes	NA	NA	-	-	-	2019
Page Landing	400 E Columbia Dr	Chehalem Creek	Yes	NA	NA	-	-	-	2019
Airport Commercial Building	1000 S Commerce Pkwy	Hess Creek	No	1	2	2	-	-	2020
GFU Edwards Hall	617 N Villa Rd	Hess Creek	Yes	NA	NA	-	-	-	2019
McCann Apartments	800 E 2nd St	Hess Creek	No	1	27	5	-	-	2020
Harding School	601 Wynooski St	Hess Creek	Yes	NA	NA	NA	-	-	2020
Providence Medical Office Building	1001 Providence Dr	Spring Brook	Yes	NA	NA	-	-	-	2019
CPRD Friends Park	1800 N Kennedy Dr	Hess Creek	Yes	-	NA	NA	-		2020
GFU Health Occupations Building	879 N Providence Dr	Spring Brook	Yes	-	NA	NA	75		2021

Project Name	Location	Watershed	1200-C Permit (Yes/No)	ESC Inspections					Completed
				2018	2019	2020	2021	2022	
Dutchman Ridge, Ph 2	25300 NE North Valley Rd	Chehalem Creek	Yes	-	NA	NA	-		2020
King's Landing, Ph 1, 2, 3	25020 NE North Valley Road	Chehalem Creek	Yes	-	NA	NA	-		2020
Riverrun, Ph 1, 2	101 W Weatherly Way	Hess Creek	Yes	-	NA	NA	-		2020
Hancock Commons	200 E Hancock Street	Chehalem Creek	No	-	13	15	-		2020
Crestview Crossing	Parcel Numbers: 3216AC, 13800, & 1100	Spring Brook	Yes	-	-	NA	300		Under Construction
Crestview Drive CIP	Chehalem Drive	Spring Brook	Yes	-	-	NA	115		Under Construction
Longplay Wine	888 South Industrial Pkwy	Hess Creek	No	-	-	10	30		2021
Friendsview Springbrook Meadows II	Providence Drive	Spring Brook	Yes	-	-	NA	NA		Under Construction
Beaudry's Cabinets	502 S St Paul Hwy	Hess Creek	Yes	-	-	NA	15		2021
Flats at Rodger's Landing	1109 S River Street	Chehalem Creek	No	-	-	31	95		2021
Eastlands Subdivision	1546 E 3rd Street	Hess Creek	No	-	-	6	-		2020
E Crestview Drive Improvement	Chehalem Drive	Spring Brook	Yes					87	2022
Crestview Crossing 99W Frontage Improvements	99W frontage	Spring Brook	Yes					105	2022
Crestview Crossing Offsite Sewer Extension	Parcel Numbers 1100	Spring Brook	Yes					75	2022
Crestview Crossing PH1 Planting Plans	Parcel Numbers: 3216AC	Spring Brook	Yes					12	2022
Crestview Crossing PH1A Planting Plans	Parcel Numbers: 13800	Spring Brook	Yes					12	2022
Crestview Crossing PUD Phase 1	4505 e Portland rd.	Spring Brook	Yes					200	2022
Meadow Brook Villas Phase 1	1306 N Springbrook Rd	Spring Brook	Yes					90	2022
New PV System 399 kWp City of	2301 NE Wynooski rd.	Hess Creek	Yes						2022

Project Name	Location	Watershed	1200-C Permit (Yes/No)	ESC Inspections					Completed
				2018	2019	2020	2021	2022	
Newberg WWTP									
S River St Storm	E 10th St & S River St	Chehalem Creek	Yes					5	2022
South College Commons	1100 South College Street	Chehalem Creek	Yes					60	2022

Under Construction: The public improvement permit is still active and has not yet been closed out.

Appendix D: Post-Construction Stormwater Management 2018-2022

Appendix D: Post-Construction Stormwater Management 2018-2022

Project Name	Location	Acres	Project Type-Zoning	Pre-Construction Meeting	Project	Stormwater Facility	Completed
Freeman Manufacturing Building	1001 Wilsonville Rd	2.04 (1200-C)	Commercial	No	Commercial Building	3 public stormwater planters, 3 private flows through planters, private Contech underground detention	2018
Chehalem Pointe Apartments	1317 Villa Rd	5.8 (1200-C)	Residential	Yes	Apartment Complex	4 public stormwater planters, detention pond, underground detention	2018
Page Landing	400 E Columbia Dr	3.19 (1200-C)	Residential	Yes	25 Lot Subdivision	1 detention pond	2018
South Park	609 Wynooski St	1.21 (1200-C)	Residential	No	13 Lot Subdivision	None required. No new impervious surface areas.	2018
1002 S Pacific Partition	1002 S Pacific St	0.16	Residential	No	Partition	1 raingarden	2018
Gracie's Landing, Ph 1	North Valley Rd/Chehalem Dr	10.6 (1200-C)	Residential	Yes	24-lot Subdivision	Detention pond, water quality swale	2018
Gracie's Landing, Ph 2 & 3	North Valley Rd/Chehalem Dr	See Gracie's Ph 1 1200-C permit	Residential	No	29-lot Subdivision	Detention pond, water quality swale	2018
CPRD Pool Expansion	1802 Haworth Ave	5.1 (1200-C)	Residential	Yes	Recreation Facility	Private detention facilities, public stormwater planter	2018
GFU Student Activity Center	1400 E Sherman St	2.4 (1200-C)	Institutional	Yes	Activity Center	1 detention pond, stormwater planters	2018
GFU Austin Sports Complex	1953 N Center St	3.8 (1200-C)	Institutional	Yes	Sports Complex	Vegetated strips, vegetated swales	2018
Grace Baptist Church	1619 E 2nd St	3.0 (1200-C)	Residential	No	Church Expansion	None required. No new impervious surface areas.	2018
Hazelwood Farms	E Henry Rd	4.9 (1200-C)	Residential	No	19-lot Subdivision	Detention pond	2018
Villa Rd Improvements	Villa Rd	(1200-C)	NA	Yes	Roadway Improvement	Stormwater planters, detention pond,	2018

Project Name	Location	Acres	Project Type-Zoning	Pre-Construction Meeting	Project	Stormwater Facility	Completed
						underground detention	
Dayton Avenue Pump Station	840 S Dayton Ave	0.28	Public Facility	Yes	Pump Station	Detention pond	2018
Shelly Cate Partition	1305 Newall Rd	0.38	Residential	No	Partition	1 raingarden	2019
GFU Edwards Hall	617 N Villa Rd	6.6 (1200-C)	Institutional	No	Residence Hall	Vegetated water quality/detention basin	2019
Providence Medical Office Building	1001 Providence Dr	5.10 (1200-C)	Institutional	Yes	Medical Office Building	6 private water quality facilities, 2 underground detention tanks, and flow control manholes	2019
Harding School	601 Wynooski St	0.77	Residential	Yes	Multi-family residential and 5 single-family lots	5 public stormwater planters, and 3 private raingardens	2020
Dutchman Ridge, Ph 1	25300 NE North Valley Rd	13.3 (1200-C)	Residential	Yes	35-lot Subdivision	1 detention pond	2019
Airport Commercial Building	1000 S Commerce Pkwy	0.5	Light Industrial	No	Commercial Building	Detention Pond	2020
McCann Apartments	800 S 2nd St	0.31	Commercial	No	Apartment Complex	None required. No new impervious surface areas.	2020
CPRD Friends Park	1800 Kennedy Dr	9.0 (1200-C)	Open Space	Yes	Park	Vegetated filter strip (for pathway)	2020
GFU Health Occupations Building	879 N Providence Dr	1.53 (1200-C)	Residential-Professional	Yes	Medical Office Building	6 flows through rain garden	2021
Dutchman Ridge, Ph 2	25300 NE North Valley Rd	13.3 (1200-C)	Residential	Yes	35-lot Subdivision	Note: Detention Pond constructed in Ph 1.	2020
King's Landing Ph 1-3	25020 NE North Valley Rd	15.4 (1200-C)	Residential	Yes	76-lot Subdivision	2 regional stormwater ponds	2020

Project Name	Location	Acres	Project Type-Zoning	Pre-Construction Meeting	Project	Stormwater Facility	Completed
Riverrun, Ph 1 & 2	101 Weatherly Wy	7.24 (1200-C)	Residential	Yes	91-lot Subdivision	1 regional stormwater pond; serves all homes north of Weatherly Wy	2020
Hancock Commons	200 E Hancock St	0.13	Commercial	Yes	Commercial Building/Residential Units	1 infiltration planter	2020
Single Family Home	207 W Fourth Street	0.08	Residential	No	Residential Home	1 raingarden	2019
Single Family Home	809 S Willamette St	0.08	Residential	No	Residential Home	1 raingarden	2019
Single Family Home	811 S Willamette St	0.08	Residential	No	Residential Home	1 raingarden	2019
Crestview Crossing	Parcel Numbers: 3216AC, 13800, & 1100	33.13 (1200-C)	Residential	Yes	250-lot Subdivision	3 stormwater ponds, 14 flow through planters, 1 off-site water quality swale	2022
Crestview Drive CIP	Chehalem Drive	(1200-C)	Public	Yes	Public Street Construction	7 roadside water quality flow through planters	2022
Longplay Wine	888 South Industrial Pkwy	0.06	Commercial	No	Commercial Building	Mechanical treatment, and underground detention	2021
Friendsview Springbrook Meadows II	Providence Drive	6.67 (1200-C)	Residential	Yes	14-duplexes	4 detention ponds and a water quality flow through planter	2022
Beaudry's Cabinets	502 S St Paul Hwy	1.14 (1200-C)	Industrial	No	Building Expansion	2 stormwater planters, underground detention, flow control manhole	2021
Flats at Rodger's Landing	1109 S River Street	1.33 (1200-C)	Residential	Yes	45-unit apartment complex	Detention Pond	2021
Eastlands Subdivision	1546 E 3rd Street	0.48	Residential	No	4-lot	1 water quality swale	2020

Project Name	Location	Acres	Project Type-Zoning	Pre-Construction Meeting	Project	Stormwater Facility	Completed
					Subdivision		
Single Family Home	900 N Williams Street	0.08	Residential	No	Residential Home	1 raingarden	2022
Single Family Home	1541 E 3rd Street	0.08	Residential	No	Residential Home	1 raingarden	2020
Single Family Home	1904 Birch Lane	0.08	Residential	No	Residential Home	1 raingarden	2020
Meadowbrook Villas Phase 1&2	1151 E Coffey Ln	3.18(1200-C)	Residential	Yes	52- unit apartment complex	4 stormwater planters, underground detention, flow control manhole	2022
Riverrun Phase 3	WATERFRONT ST	7.24 (1200-C)	Residential	Yes	91-lot Subdivision	1 regional stormwater pond; serves all homes north of Weatherly Wy	2022

Appendix E: Stream Temperature Monitoring Program w Appendix

Stream Temperature Monitoring Program

Total Maximum Daily Load (TMDL) Plan – Best Management Practice T-3 Stream Assessment

December 2019

Contents

Appendix

TMDL Background

The Oregon Department of Environmental Quality (ODEQ) created a Water Quality Management Plan (WQMP) for the Willamette Basin in 2006 which sets Total Maximum Daily Loads (TMDLs) i.e. water quality standards within the Willamette Basin (OAR 340-042-0040-(4)).

Any agency or municipality that has legal authority over activities or areas that are sources of pollutants that impact water quality are known as Designated Management Agencies (DMAs). DMAs that are responsible for areas draining into a water body with a TMDL, must develop an Implementation Plan describing activities or Best Management Practices (BMPs) to be undertaken to address TMDLs. The City of Newberg, is located in the Middle Willamette Subbasin and is a DMA that complies with this requirement.

In 2006, ODEQ issued a TMDL for nine of the 12 subbasins within the Willamette River Basin in an effort to protect and restore the beneficial uses of the Willamette River. Mercury, bacteria, and temperature were identified as problematic constituents for the Willamette River and the City developed an Implementation Plan to address the TMDL accordingly.

Newberg Watersheds

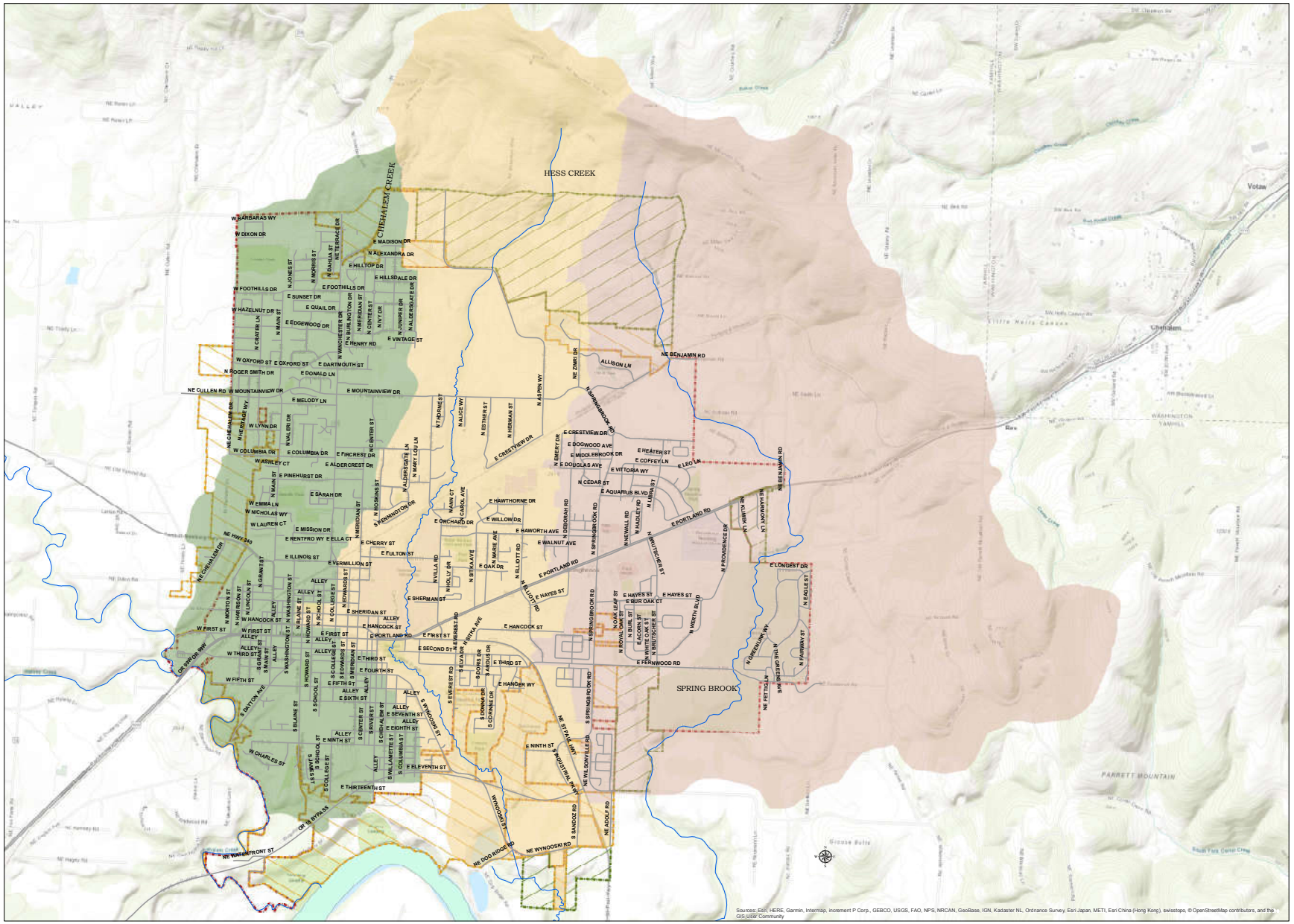
The City of Newberg has three major watersheds shown in Figure 1, Chehalem Creek, Hess Creek, and Spring Brook. All creeks and tributaries flow into the Willamette River which runs along the southern City boundary. The three major watershed boundaries extend outside of the City's urban growth boundary into upland areas north of the City. These waterbodies and their watersheds are part of the Middle Willamette Subbasin.

Naming Convention – Streams, Creeks, Brooks, and Tributaries

For the purpose of this document the words "stream" and "creek" will be used interchangeably. However, the word "stream" is most commonly used throughout the document. Formal names for Chehalem Creek, Hess Creek, and Spring Brook will be used where appropriate, and when used are meant to be inclusive of their respective tributaries.

Figure 1: City of Newberg Major Watersheds

Stormwater Subcatchment Areas



Temperature TMDL

Elevated temperatures in waterways can compromise several beneficial uses for surface waters. ODEQ reported that resident fish and aquatic life, salmonid spawning, rearing and migration, and anadromous fish passage are the most sensitive beneficial uses related to high temperatures. ODEQ has focused the temperature TMDL on the protection of the cold water salmonids. Per the Willamette River TMDL, the temperature criteria for tributaries is 18°C (64.4°F) to provide for salmon and trout rearing and migration, and 20°C (68°F) for the main stream Willamette (River Mile (RM) 0 to RM50) to provide for salmon and steelhead migration corridors. [1,2]

As a strategy to reduce temperature loading, shade targets were set. Mature riparian vegetation produces shade and creates a microclimate around the waterway that regulates and minimizes solar radiation. Although other techniques are available for reducing water temperatures, the installation of native riparian corridors provides a cost-effective, relatively simple approach that provides multiple benefits beyond temperature regulation. Other benefits include primary production of organic materials, source debris for in-stream channel complexity and habitat features, wildlife corridor connectivity, displacement of noxious vegetation, and visual aesthetics.

Stream Temperature Monitoring Program, BMP T-3

As part of the City's TMDL Implementation Plan, Best Management Practice (BMP) T-3 was established to Assess Stream Health and Canopy Coverage. One of the measureable goals under that BMP was to develop a stream temperature monitoring program to document procedures and identify locations for stream temperature sampling/monitoring. This goal has a target completion date in 2019, and this Stream Temperature Monitoring Program document fulfills this measurable goal. The purpose of this document is to inform City staff members of the Stream Temperature Monitoring Program procedures for consistency of data collection and analysis.

City of Newberg Stream Temperature Monitoring History

The City of Newberg has been deploying temperature monitoring equipment on an exploratory basis in preparation for creating a formal written Stream Temperature Monitoring Program. Three HOBOware® Temperature Monitors[3] were deployed in 2015, which were originally borrowed from the Greater Yamhill Watershed Council (GYWC). In following years, the City has purchased its own HOBOware® temperature monitoring equipment and has experimented with the equipment/software and monitoring locations to develop a baseline understanding of the stream temperature monitoring process.

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[1] DEQ Chapter 340, Division 41 Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon. https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=244176 Accessed November 1, 2019.
[2] Division 41: Water Quality Standards – Rule Tables and Maps Referenced in OAR Chapter 340, Division 41. https://www.oregon.gov/deq/Regulations/Pages/OARDiv41.aspx Accessed November 1, 2019.
[3] ONSET. HOBOware® Temperature Monitors. HOBO® Water Temperature Pro v2 Data Logger and HOBO® Water Level (13 ft) Data Logger. https://www.onsetcomp.com/products/data-loggers. Accessed March 26, 2019.

"What is the goal of Newberg's Stream Temperature Monitoring Program?"

The City of Newberg is not currently an ODEQ MS4 Phase II permittee, so efforts to quantitatively measure water quality standards are voluntary and are being done proactively in anticipation of future requirements. As such, the City's effort to monitor and collect stream temperatures is being done on an exploratory basis with the goal to establish a baseline understanding of stream temperature in the City's watersheds taking an "upstream/downstream approach" where temperature is monitored near locations where streams enter and exit the City limits.

The City's methodology for collecting stream temperature data follows the Level B data collection procedure per the ODEQ Data Acceptance Criteria methodology as discussed in the Accuracy Check procedure noted in Chapter 6 of the OWEB, Water Quality Monitoring Guidebook Version 2.0, July 1999.

The City plans to implement the Stream Temperature Monitoring Program and collect field data following the methodology laid out in this document starting in May 2020 and will continue to collect data over the remaining 5-year TMDL Plan horizon through December 2022. Information collected is intended for the City's informational purposes only and the City is not required to submit data to ODEQ or any other entity.

It is anticipated that the Stream Temperature Monitoring Program goals and collection methods may change in the next TMDL Plan cycle (2023-2027) based on the information collected and the ease of the process established in this original effort.

Stream Temperature Monitoring Activities

Below is an overview of stream temperature monitoring activities associated with the stream temperature monitoring program. More detailed information regarding equipment deployment, monitoring locations, field equipment, deployment methods, conducting a field visit, data analysis, and resources and can be found in the following sections.

Stream Temperature Equipment Deployment

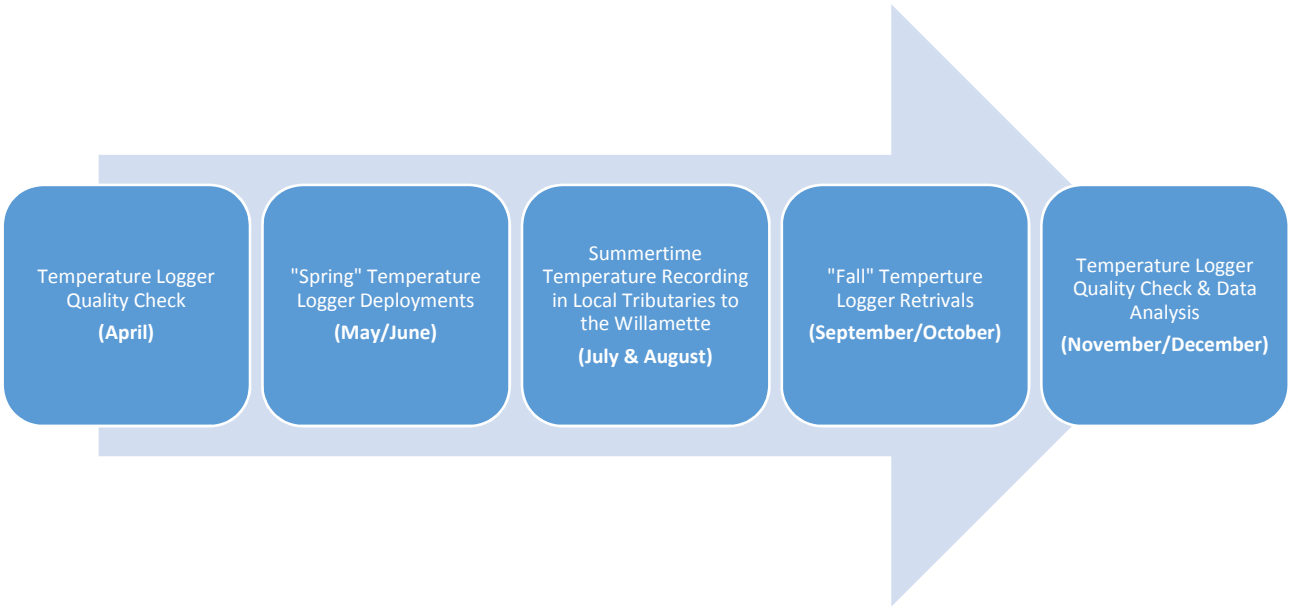
The purpose of measuring stream temperatures is to understand locally how tributaries to the Willamette River (Chehalem Creek, Hess Creek, and Spring Brook) relate to state regulations regarding temperature and more importantly to establish a baseline for stream temperature since data has not previously been captured and processed according to an established standard.

Per the Willamette River TMDL, the temperature criteria for tributaries is 18°C (64.4°F) to provide for salmon and trout rearing and migration, and 20°C (68°F) for the main stream Willamette (River Mile (RM) 0 to RM50) to provide for salmon and steelhead migration corridors. The City of Newberg is located in northeast Yamhill County at Willamette River mile 50.2, approximately 25 miles southwest of the City of Portland and follows the standard set forth in OAR340-041-0028(4)(c) and (d). [4,5]

[4] DEQ Chapter 340, Division 41 Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon. https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=244176 Accessed November 1, 2019.
[5] Division 41: Water Quality Standards – Rule Tables and Maps Referenced in OAR Chapter 340, Division 41. https://www.oregon.gov/deq/Regulations/Pages/OARDiv41.as`px Accessed November 1, 2019.

Stream temperature monitoring equipment will be deployed in late spring (May/June) after high winter waters have begun to recede, and retrieved in fall (September/October) before the first big rains begin to raise creek levels. This deployment timeline will vary from year to year based on specific weather patterns, but generally speaking the goal is to have the monitoring equipment in the water during the hottest ambient air temperature season i.e. summer. Hot ambient air temperatures most often correspond to the heat loading in local waterbodies especially when those water bodies are not fully shaded. All temperature monitoring equipment goes through an "accuracy check" both before and after deployment to verify that the readings recorded are within a margin of error during a simulated deployment event where water temperatures are checked independently using a National Institute of Standards and Technology (NIST) certified temperature probe. See Figure 2 depicting the stream temperature equipment deployment schedule.

Figure 2: Stream Temperature Equipment Deployment Schedule



Stream Temperature Monitoring Locations

As a Designated Management Agency, the City of Newberg is concerned with temperature loading within city limits. Therefore the ideal stream temperature monitoring locations should be located at the northern and southern boundaries of the City where the boundary limit intersects Chehalem Creek, Hess Creek, and Spring Brook (six total monitoring locations). The temperature difference between the northern and southern boundaries on each creek system, by proxy, should best represent temperature loading that can be associated with activities within the city limits within their associated watersheds and is consistent with an "upstream/downstream" approach.

Establishing these ideal monitoring locations must be done with both knowledge of the watershed as well as support by, and collaboration with, private property owners. The City of Newberg owns very few parcels of land that are inclusive of Chehalem Creek, Hess Creek, or Spring Brook and therefore must work with private property owners to establish locations at the City's northern and southern boundaries. These relationships are important and are often built slowly over time. As land ownership changes, re-establishing relationships with new property owners to gain access to the watershed system

is imperative. As of the writing of this document (July 2019), the City has established monitoring locations on the northern and southern boundaries of Hess Creek and Spring Brook, but does not have monitoring locations on Chehalem Creek due to a lack of interest in collaboration by private property owners.

In addition to private property ownership collaboration, it should be noted Spring Brook does not have continuous water flows at the northern city limit boundary during summer months, which was discovered through exploratory efforts As such, a location further downstream was identified where continuous water flows were present throughout the summer.

A "cut sheet" has been developed for each temperature monitoring location to describe the location, document the granted access by private property owners, and rate each location on ease of access. Some monitoring locations are more difficult to access due to creek incising, poisonous plants (i.e. poison ivy, poison oak, and stinging nettle), nutria holes along the banks, and/or distance from the parked vehicle to the monitoring site. Efforts should be continuously made to find more accessible monitoring sites or to improve the monitoring sites where access has been granted. Temperature monitoring site cut sheets from the 2018 monitoring season are attached in Appendix A.

Field Equipment

Field equipment consists of equipment moved into and out of the field during each season, equipment permanently installed in the field, and equipment needed to be prepared to conduct field visits. More details and checklists are provided in the following sections.

Temperature Monitoring Equipment & Software

The City uses two types of equipment to monitor stream temperature, the HOBO® Water Temperature Pro v2 Data Logger and HOBO® Water Level (13 ft) Data Logger which can be seen in Figure 3 and Figure 4. Manufacturer information about each sensor can be found in Appendix B. Although the City has two different equipment types, they are both used exclusively to measure temperature, currently the water level functionality of the HOBO® Water Level (13 ft) Data Logger is not being utilized. A summary of the City's temperature monitoring equipment can be found in Appendix C, currently the City owns four (4) HOBO® Water Temperature Pro v2 Data Loggers and six (6) HOBO® Water Level (13 ft) Data Loggers. For consistency the City tries to deploy the same equipment serial numbers at the same monitoring sites each year. Procedures for downloading the data off the temperature monitoring equipment can be found in Appendix F.

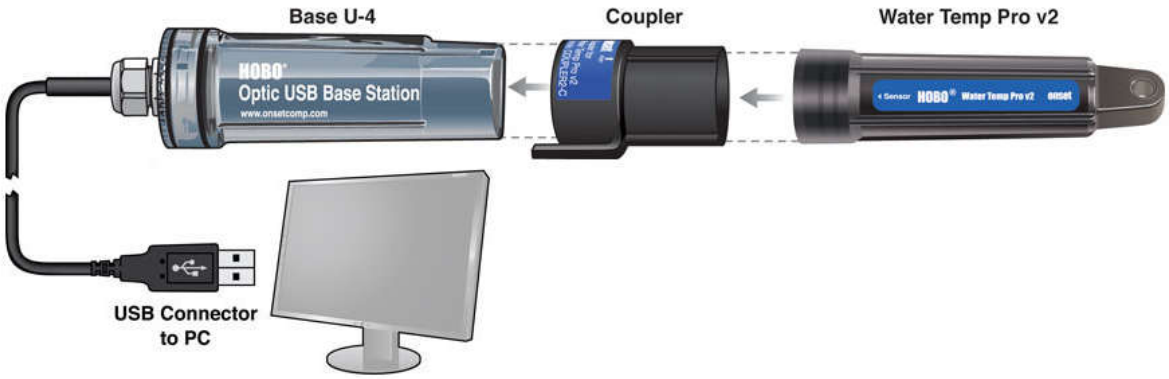
Figure 3: HOBO® Water Temperature Pro v2 Data Logger

Figure 4: HOBO® Water Level (13 ft) Data Logger

In addition to the monitoring equipment discussed above, a HOBO® Waterproof Shuttle is also required to download the data from the collection devices and import it into analysis software, see Figure 5 and Figure 6. The user manual for the HOBO® Waterproof Shuttle can be found in Appendix B.

Figure 5: HOBO® Waterproof Shuttle

Figure 6: HOBOware Data Downloading Configuration



The City of Newberg has also purchased the accompanying software, HOBOware Pro®, used to analyze the data collected. The license key for the software can be found in Appendix E along with detailed directions on how to complete a data transfer. Support guidance on using the HOBOware Pro software and data transfer can be found in the USGS, Monitoring Stream Temperatures, A Guide for Non-Specialists, 2018 manual as well as the HOBOware® User's Guide both of which can be found online. The HOBOware Pro® software works best when installed on an independent laptop and not on the City's network drive (Citrix® server).

Accuracy Check Procedure

To verify the accuracy of the HOBO® Water Temperature Pro v2 Data Logger and HOBO® Water Level (13 ft) Data Logger they must be checked both before deployment and after deployment. This accuracy check is sometimes incorrectly referred to as "calibration" however, the instruments cannot be changed

to agree with a known standard (i.e., calibrated) so "calibration" is the wrong terminology. A testing procedure has been developed by the Oregon Watershed Enhancement Board (OWEB) to test equipment accuracy. Deviations from a known temperature are recorded and this procedure is referred to as an accuracy check. Accuracy checks should be made at two temperatures; one between 5-15°C (42-62°F) and the other between 15-25°C (62-82°F). Testing is done using a stable thermal mass such as a water-filled cooler.

A National Institute of Standards and Technology (NIST) traceable (calibrated and maintained) thermometer accurate to ±0.2°C shall be used as the independent check during the accuracy test. The City of Newberg borrows the NIST temperature probe from the GYWC[6] since their probe is calibrated on an annual basis. The detailed steps of the accuracy check can be found in Appendix G and in Chapter 6 of the OWEB, Water Quality Monitoring Guidebook Version 2.0, July 1999.

Performing the accuracy check allows the temperature data collected to be "graded" at a higher level. Data grading and the steps to produce Level A data vs Level B data will be discussed in more detail in a following section.

Temperature Monitoring Deployment Methods

The City currently uses two methods to deploy temperature monitoring equipment; stilling wells and weighted plates. The deployment method depends on the preference of the property owner and/or the direct sunlight present at the location.

An ideal monitoring location has a full tree canopy covering the creek with no direct sunlight hitting the water's surface. Solar radiation can increase the water temperature at a micro-location and skew data collection/analysis, so it is important to identify a monitoring location with shade coverage. The ideal location within a creek is center of the channel where the water is continuously flowing the fastest, slack water should be avoided. Although in some circumstances the fastest running water in a channel does not occur at the center of channel, but instead on an inside or outside corner/bend. When establishing a monitoring site, visiting the site multiple times throughout the data collection season is the best way to select a preferred location in the stream channel.

Stilling Well

The preferred temperature monitoring deployment method is to install a stilling well. The City has constructed "low-tech" stilling wells made from two pieces of concentric PVC pipe with a staff gauge and end topper as shown in Figure 7. Using a power drill, holes are drilled in the 2-inch and 4-inch PVC pipes that are then embedded into the creek bed. The holes allow water to run freely through the PVC and provide accurate readings from the temperature monitoring loggers. Installing the stilling well requires the use of a T-post pounder to embed both the 4-inch and 2-inch PVC pipe into the stream bed. Once the PVC pipes have been installed, clothesline wire[7] is then used to suspend the temperature probe or water logger inside the 2-inch pipe without the monitor resting on the stream bed, see Figure 8.

[6] Contact information for the Greater Yamhill Watershed Council (GYWC) can be found at their website http://www.gywc.org/ The Executive Director of GYWC, Luke Westphal can be contact at 503-474-1047.
[7] Clothesline wire can be purchased at any hardware or home improvement store. Typically it is a 15-guage wire with blue coating.

Figure 7: Stilling Well Temperature Logger Deployment Method

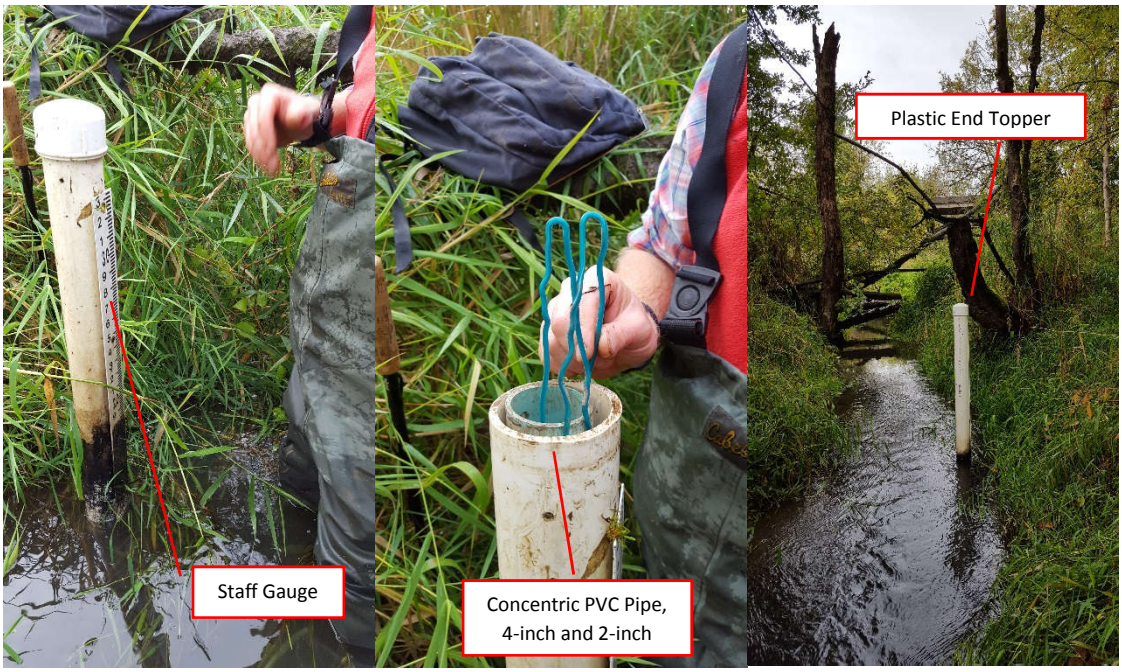
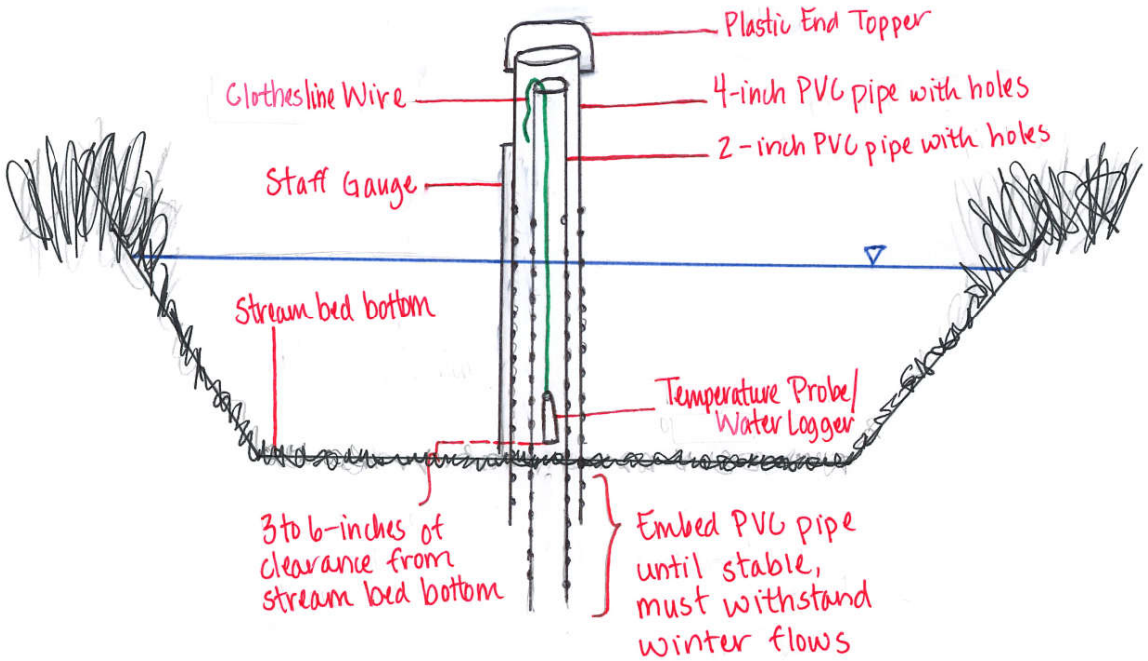


Figure 8: Stilling Well Deployment Diagram



When visiting the site, remove any debris that could impact the stilling well during high flows and check the sturdiness of the installation i.e. does the PVC pipe "wiggle or move" when leaned on. The stilling well stays in place throughout the year, so it is important that it is sturdy enough to withstand high

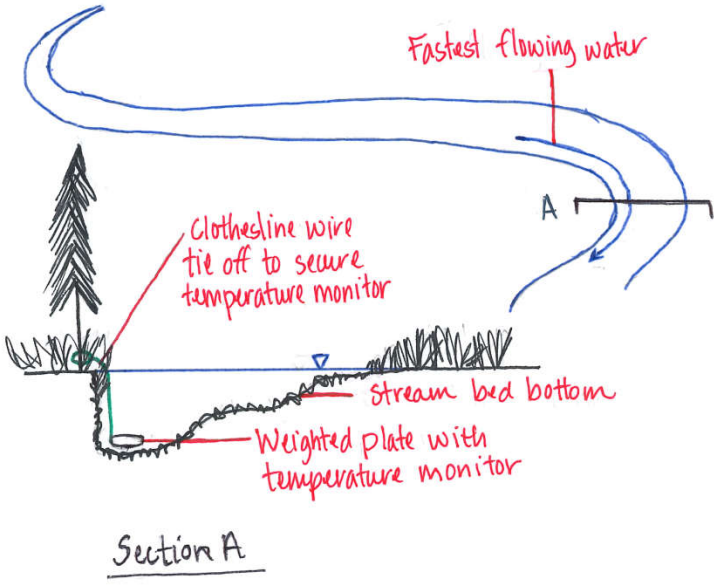
winter flows. In the spring, if it is found that the stilling well is loosely imbedded into the stream bed take corrective action to remedy the condition, this may include removing and reinstalling the stilling well.

Weighted Plate

A weighted plate is the second method used to deploy temperature monitoring equipment. Weighted plates can be purchased from second hand stores and reused year after year, typically a 5-10 pound plate is used based on flows. Figure 9 shows the deployment setup using a weighted plate. A 2-inch PCV pipe has been cut into 6-inch lengths with holes drilled through the pipe to allow water to flow freely. A white PVC pipe is used to shield the temperature monitor from any direct sunlight that may hit the water's surface (do not use a black or dark color PVC that can absorb heat). Zip ties are then used to secure the temperature monitor inside the PVC shield, clothesline wire can also be used. Clothesline wire is then used to secure the PVC shield to the weighted plate. The weighted plate is then positioned in the stream bed in a preferred location. Rocks can be used to support or secure the weighted plate, or the plate can be tucked up under the stream channel bank on an inside or outside corner/bend with the fastest flowing water. It's recommended that clothesline wire then be used to secure the weighted plate to a secure object along the creek like a tree trunk see Figure 10.

Figure 9: Weighted Plate Temperature Logger Deployment Method

Figure 10: Weighted Plate Deployment Diagram



Weighted plate deployments can be used for a variety of reasons, some of which are listed below:

- Locations where a property owner does not want a permanent stilling well installed
- Locations where a stilling well has been previously tampered with or field equipment has been stolen/removed by the public
- Locations where testing of a permanent stilling well location is being vetted
- Locations with low flows during summer
- Locations with high winter water flows and it is anticipated a stilling well may not withstand the flows
- Locations where the stream channel has historically moved
- Locations above and below intersecting tributaries to learn more about the watershed system (these are more temporary installations and may only be deployed for one season).

When a weighted plate method is used, if possible, record GPS coordinates for the location of the deployment or take good pictures and provide detailed documentation of the deployment location. Enough information should be provided that a staff member who was not present for a temperature monitor deployment could find and retrieve field equipment at the end of the monitoring season. Take necessary precautions to avoid losing monitoring equipment.

Conducting a Field Visit

Timing for field visits can be challenging depending on work load, so making the most of a field visit is very important. The following sections discuss preparing for a field visit, what to do during a field visit, and how to finish up documentation after a field visit.

Preparing for a Field Visit

Prior to deploying monitoring equipment in the spring, conducting a mid-season site check, or retrieving monitoring equipment in the fall, it is important to successfully prepare for each field visit. A field

equipment checklist can be found in Appendix D. Below are general guidelines to consider when preparing for a field visit.

1. Prior to deploying monitoring equipment, turn on data logging and verify the recording interval (temperature collection once every 5 minutes).
2. Evaluate weather forecast and identify a day to conduct field work without precipitation and with no precipitation the proceeding three to five days.
3. A field visit must be conducted with at least two people using the "buddy system." Deploying, retrieving, or monitoring field equipment without at least two people is strictly prohibited.
4. Coordinate and notify property owners of access to the site and provide them the date and approximate time of the field visit. Try to notify property owners three to five days before the field visit if possible. Same day notification of a field visit should be avoided.
5. Determine what sites will be visited and the order that they'll be visited during the field day.
6. Review Field Equipment Checklist and gather equipment needed to perform identified field work.
7. Review notes from the previous field visit (when available) to familiarize yourself with site conditions or any notes made about the location.
8. Notify your supervisor or a coworker in the office about your plan for the day with locations for deployment. This person will be your office "check-in/check-out" to make sure that if something goes wrong in the field, the appropriate authority can be notified.

Field Visit Activities

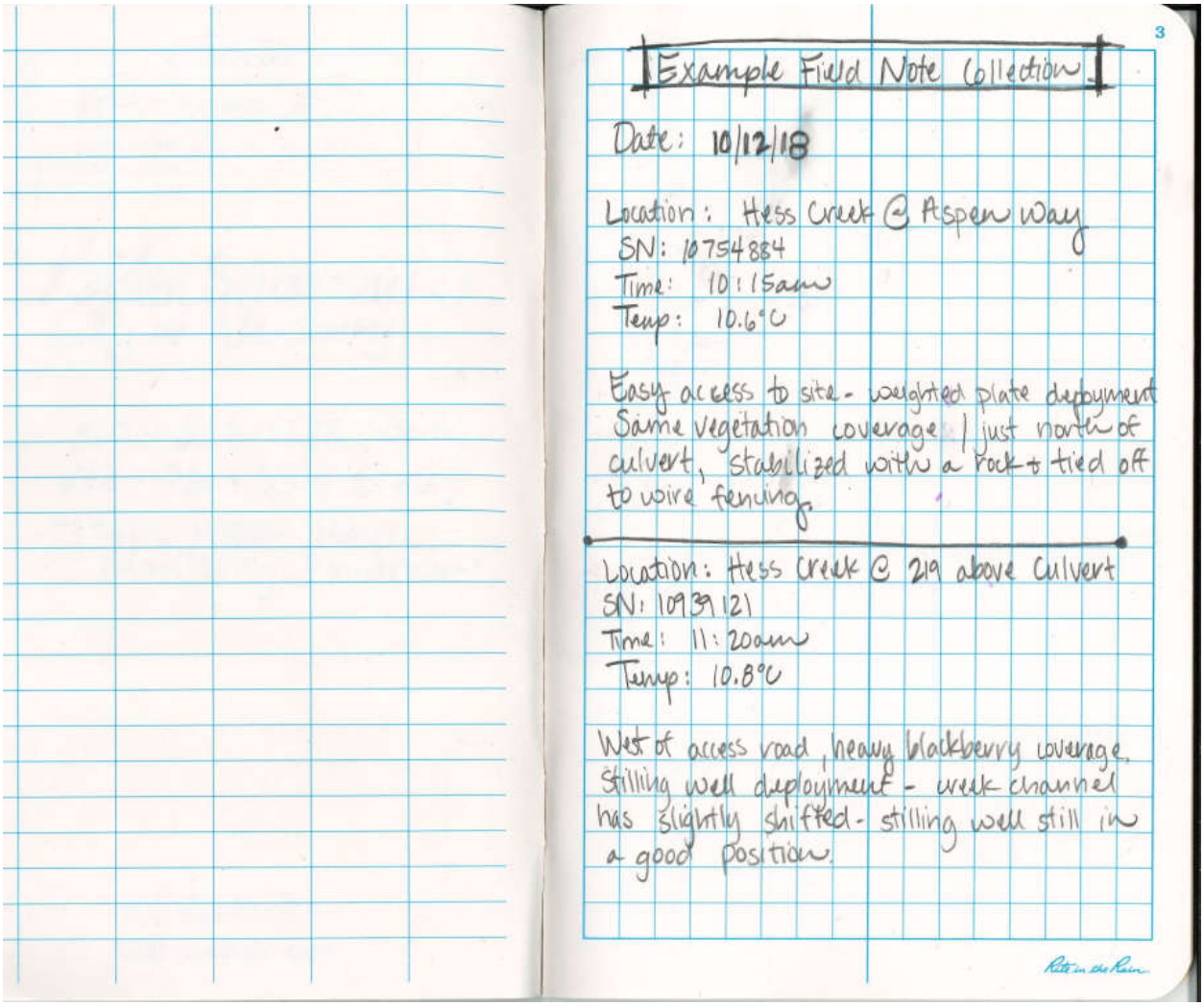
Once arriving at a monitoring site below is a list of activities that should be conducted:

1. Upon arriving at a monitoring site have a quick informal "tailgate safety meeting" to discuss the tasks to be performed and draw attention to any hazards, processes, equipment, tools, environment and materials at the site that could pose a risk to field crew members.
2. Make sure each field crew member has a telecommunication device on their person that could be used to call for help in the event of an emergency.
3. Observe access into and out of the monitoring location and evaluate for any new debris or collapsed bank conditions. Make a plan on how best to get down into the creek and go into the monitoring site/water one at a time i.e. both people do not enter the water at the same time. Before entering the monitoring site identify at least two feasible ways to get out of the site.
4. Deploy or retrieve monitoring equipment. See Figure 7 through Figure 10.
5. Make notes of the field condition in a Rite in the Rain book, see Figure 11.
    a. Note the name of the monitoring site ex. Hess Creek Northern Location – N Aspen Way
    b. Note site condition and any improvements need to be made i.e. remove poison oak, need rope to access site, etc.
    c. Note any significant changes to the site since it was last accessed.
    d. Record the serial number on the temperature probe/water logger.
    e. Using a NIST Temperature Probe take a temperature reading of the water and note the time the temperature reading was taken.
    f. Take pictures of the site (upstream/downstream/directly above) and note the shade/tree coverage (no coverage, partial coverage, or full coverage).
    g. If possible, note the GPS coordinates if setting a new monitoring location.

h. Provide a description of where exactly the temperature probe/water logger is located if using the weighted plate method ex. what tree is the plate tied off to?

6. Remove loose debris which may impact a monitoring site ex. floating debris that got hung up on a stilling well.

Figure 11: Example of Note Taking During Site Visit



Returning from a Field Visit

After returning from the field, the following list of activities that should be conducted:

1. Dry out all field equipment. Special care needs to be taken with chest waders and boots to avoid mold from growing.
2. At the end of monitoring season, download the temperature data and perform accuracy checks.
3. Download all pictures and label/name them according to monitoring site locations.
4. Scan all field notes and save them in the directory.
5. Update any site location cut sheets if monitors have been removed or relocated.

Data Analysis

The City of Newberg is voluntarily collecting stream temperature data as part of the TMDL Program and while goal T-3 in the TMDL Program exists, temperature monitoring is not an ODEQ requirement. As such, the City is in an exploratory stage when it comes to its temperature monitoring program.

Data Level

ODEQ has a Data Quality Matrix and classifies data collected as Level A, Level B, or Level C. Level A data requires a Quality Assurance Project Plan (QAPP) approved by ODEQ, which is beyond the scope of the City's TMDL obligations and funding. Therefore, at this time, the City is following methodology to collect Level B temperature data. Level B temperature data needs to be collected per the ODEQ Data Acceptance Criteria methodology as discussed in the Accuracy Check procedure noted in Chapter 6 of the OWEB, Water Quality Monitoring Guidebook Version 2.0, July 1999. The NIST Temperature Probe is accurate to ±0.2°C and the difference between the NIST recorded temperature and the data logger's temperature has precision not to exceed ±0.5°C. Level B data is generally characterized as being used as an early warning sign of potential problems or for screening information.

Data Evaluation

Once the stream temperature data has been collected and the accuracy check confirms that Level B data was collected, the data can then be evaluated. The evaluation of stream temperature data supports the City's effort to establish a baseline of stream temperatures entering and leaving the city limits. A variety of analysis can be done to the data which is described below:

- Stream temperatures can be numerically evaluated and compared to the Willamette River Temperature TMDL i.e. how often did stream temperatures (tributaries to the Willamette River) exceed 18°C (64.4°F)?
- Stream temperatures can be compared using an "upstream/downstream" approach were the data collected at the northern city limit is compared to data collection at the southern city limit over the same time frame.
- Stream temperatures collected can be compared to ambient air temperature of a nearby weather station.
- Stream temperatures can be compared across watersheds.

Graphing temperature data is a useful way to understanding the data collected and can be used to help tell the story of stream temperatures within the City of Newberg.

Next Steps

The City of Newberg will begin implementing the Stream Temperature Monitoring Program in May 2020 and will continue to collect data over the remaining 5-year TMDL Plan horizon through December 2022. Information collected is intended for the City's informational purposes only and the City is not required to submit data to ODEQ or any other entity. However, the City does plan to evaluate this data to begin to establish temperature baselines for our three watersheds. Additionally, the City will continue to work with private property owners to identify and establish preferred monitoring locations throughout the City.

Resources

The City of Newberg has worked closely with the Director of the Greater Yamhill Watershed Council (GYWC) to develop and document the activities required to perform steam temperature monitoring based on the Oregon Water Enhancement Board (OWEB) Water Quality Monitoring Guidebook.[8] Data collected within the City of Newberg is shared with the GYWC to fulfill the objectives of their regional watershed monitoring program. Furthermore, field visits are often conducted in collaboration with the Director of the Watershed Council to streamline monitoring activities as well as quality checks.

The City of Newberg submits annual TMDL reports to ODEQ. As part of that requirement, the ODEQ Willamette Basin Coordinator (Nancy Gramlich) is a point of contact and resource for all TMDL requirements.

Other stream temperature monitoring resources available online are included below:

Oregon Watershed Enhancement Board (OBEW) – Field & Technical Guides

- *USGS, Monitoring Stream Temperatures, A Guide for Non-Specialists, 2018*
- *OWEB, Oregon Watershed Assessment Manual, July 1999*
- *OWEB, Water Quality Monitoring Guidebook Version 2.0, July 1999*
- *OWEB, Water Quality Monitoring Guidebook, Chapter 14 Addendum*

Oregon Department of Environmental Quality (ODEQ) – Volunteer Water Quality Monitoring

- *ODEQ, Water Quality Volunteer Monitoring Quality Assurance Project Plan, November 2009*

[8] Oregon Watershed Enhancement Board (OWEB). Field & Technical Guides. *Water Quality Monitoring Guidebook, Version 2.0*. https://www.oregon.gov/oweb/resources/Pages/Field-Tech-Guidance.aspx. Accessed August 7, 2019.

Appendix

Appendix A: Monitoring Site Cut Sheet Examples

Appendix B: HOBO®ware Equipment Manuals

Appendix C: City of Newberg HOBO®ware Equipment Inventory

Appendix D: Field Equipment Checklist

Appendix E: HOBO®ware Pro License Key and Download Instructions

Appendix F: Downloading Temperature Data Instructions

Appendix G: Temperature Monitoring Equipment Accuracy Check

Appendix A: Monitoring Site Cut Sheet Examples

Upper Hess Creek at 3612 NE Aspen Way

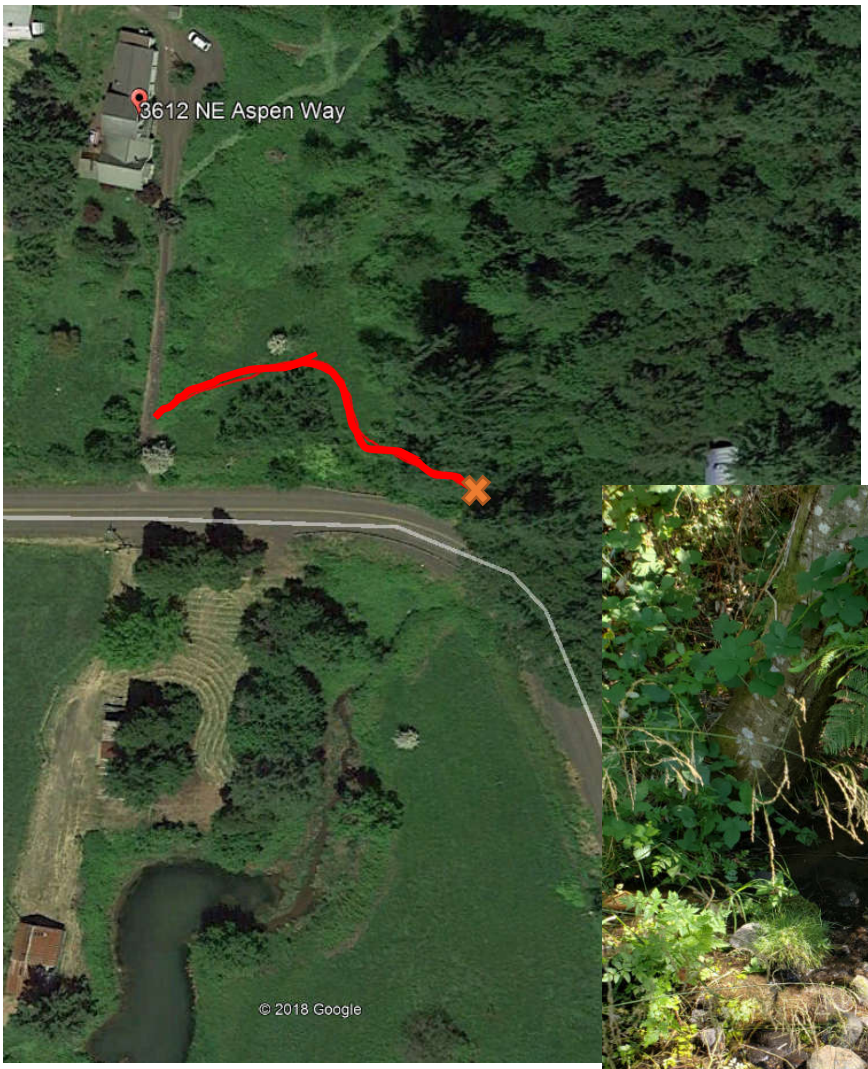
Temperature Probe S/N: 10754884

Device: Temperature Probe

Site Description: Address is *3612 NE Aspen Way*. Pull into driveway/or park along Aspen Way (talk with property owner before arrival). Walk east down to the creek. The owner has cut back the blackberries

Rating: 1 (1=easiest access, 5=hardest access)

Access: Private Access, contact is Robert Simokovic 3612 NE Aspen Way (818)-298-2669 (see email in file)



Hess Creek above 219 Culvert

Temperature Probe S/N: 10939121

Device: Water Level Logger with a Stilling Well (white PVC pipe)

Site Description: Access using NE Hash Rd, eastside of 219 (comes up on you quick while driving). Will need to unlock gate or walk into the site.

Park at location shown, walk along the north side of the creek west of the roadway

Rating: 3 (1=easiest access, 5=hardest access)

Access: Private Access, land owned by CPRD previous coordination with Jim McMaster 503-209-2222. Coordination is now with Casey Creighton 503-519-6154, ccreighton@cprdnewberg.org

OR219 Bridge Structure

Hess Creek – North Fork

Temperature Probe S/N: 10911416 – Water Level Logger with a Stilling Well (white PVC pipe)

Site Description: Access using NE Hash Rd, eastside of 219 (comes up on you quick while driving). Will need to unlock gate or walk into the site.

Park at location shown, walk along the north side of the creek west of the roadway

Rating: 3 (1=easiest access, 5=hardest access)

Access: Private Access, land owned by CPRD previous coordination with Jim McMaster 503-209-2222. Coordination is now with Casey Creighton 503-519-6154, ccreighton@cprdnewberg.org

Springbrook Creek at Benjamin Road

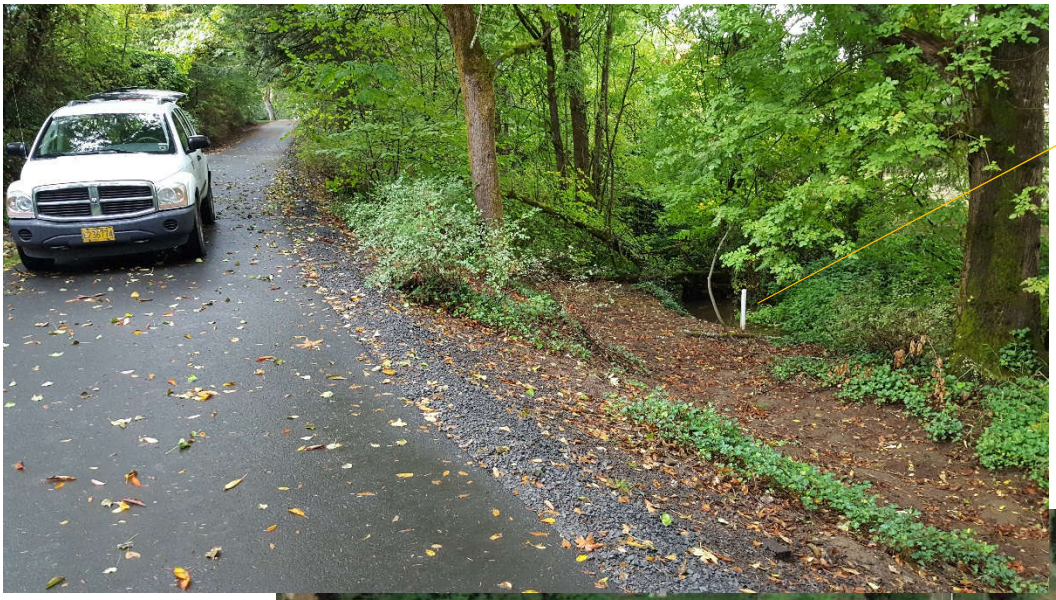
Temperature Probe S/N: 10939122

Device: Water Level Logger with a Stilling Well (white PVC pipe)

Site Description: Address is *30230 NE Benjamin Road*. Pull into driveway and stilling well is visible from the driveway. Stilling well is located on the north side of the driveway.

Rating: 1 (1=easiest access, 5=hardest access)

Access: Private Access, contact is Vicki Shepherd 30230 NE Benjamin Rd Newberg OR 97132 (503)-538-9466 (see email in file)



Springbrook Creek at 219

Temperature Probe S/N: 10911415

Device: Water Level Logger with a Stilling Well (white PVC pipe)

Site Description: Access using NE Hash Rd, eastside of 219 (comes up on you quick while driving). Will need to unlock gate or walk into site.

From roadway to "X" mark, there is a lot of posion oak, keep hands high. Bring rope from tool kit to tie off to t-post, the back is steep and the rope will help getting into and out of the creek. The bottom of the creek is super silty, keep moving your feet so you don't sink in too far and loose a shoe.

Rating: 4 (1=easiest access, 5=hardest access)

Access: Private Access, land owned by CPRD previous coordination with Jim McMaster 503-209-2222. Coordination is now with Casey Creighton 503-519-6154, ccreighton@cprdnewberg.org

Appendix B: HOBO®ware Equipment Manuals

HOBO® Waterproof Shuttle (U-DTW-1) Manual

The HOBO Waterproof Shuttle performs several major functions:

- Reads out all logger information (serial number, deployment number, data, etc.) from loggers in the field for transfer to host computer, and stores each logger's data in a "bank"
- Nonvolatile memory preserves data, even if batteries are depleted
- Relaunches the logger, resetting the logger's time to the shuttle's time and synchronizing the logging interval on relaunch
- Can be used as an optic-to-USB base station
- Can be used to read out and relaunch loggers underwater

Although the HOBO Waterproof Shuttle is easy to use, Onset strongly recommends that you spend a few minutes reading this manual and trying out the procedures described here before taking the shuttle into the field.

HOBO Waterproof Shuttle

U-DTW-1

Included Items:

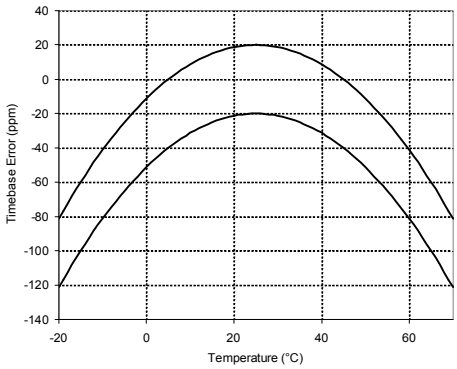
- USB cable
- Set of couplers;
  - For UA Pendant (COUPLER2-A)
  - For U20 Water Level (COUPLER2-B)
  - For U20L Water Level, U22 Water Temp Pro v2, U24 Conductivity, and U26 DO (COUPLER2-C)
  - For UTBI TidbiT v2 (COUPLER2-D)
  - For U23 HOBO Pro v2 (COUPLER2-E)

Required Items:

- HOBOware Pro 2.2 or later
- Compatible logger and matching coupler

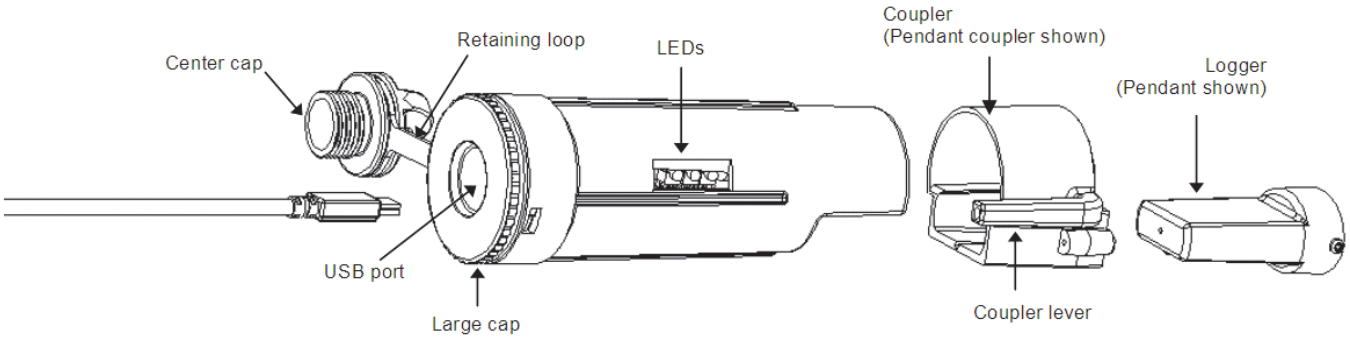
Specifications

Compatibility	All HOBO U-Series loggers with optic USB. Not compatible with the HOBO U-Shuttle (U-DT-1).
Data Capacity	63 logger readouts of up to 64K each
Operating Temperature	0° to 50°C (32° to 122°F)
Storage Temperature	-20° to 50°C (-4° to 122°F)
Wetted Materials	Polycarbonate case, EPDM o-rings and retaining loop
Waterproof	To 20 m (66 feet)
Time Accuracy	±1 minute per month at 25°C (77°F); see Plot A
Logger-to-Shuttle Transfer Speed	Reads out one full 64K logger in about 30 seconds
Shuttle-to-Host Transfer Speed	Full shuttle offload (4 MB) to host computer in 10 to 20 minutes, depending on computer
Batteries	2 AA alkaline batteries required for remote operation
Battery Life	One year or at least 50 complete memory fills, typical use
Weight	150 g (4 oz)
Dimensions	15.2 x 4.8 cm (6.0 x 1.9 inches)
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU). To maintain CE compliance, this product must be used with the supplied USB cable or equivalent (less than 3 m long).



Plot A

HOBO Waterproof Shuttle Features



Preparing to Go on Location

Before using the shuttle for the first time, you must launch it with HOBOware 2.2 or greater. You must also launch any compatible loggers that were last launched with an earlier version of HOBOware, or have never been launched at all.

1. Use HOBOware 2.2 or greater to launch each logger you wish to read out and relaunch with the shuttle later. (Read "Using the shuttle as a base station" for instructions if you do not have another base station for the loggers.) The shuttle cannot relaunch loggers that were last launched with an earlier version of HOBOware. (You only have to do this once for each logger.)
2. Plug the large end of a USB interface cable into a USB port on the computer. (Avoid using a USB hub, if possible.)
3. Unscrew the center cap on the shuttle. If the cap is too tight to loosen by hand, insert a screwdriver through the lanyard hole and rotate counterclockwise until the cap is loosened.
4. Plug the small end of the USB interface cable into the USB port in the shuttle. (If the shuttle has never been connected to the computer before, it may take a few seconds for the new hardware to be detected.)
5. Follow the instructions in the *HOBOware User's Guide* to access the **Manage Shuttle** dialog. Make sure the battery level is good, and change the batteries now if they are weak.

Important: If you change the batteries in the field, the shuttle's clock will stop, and the shuttle will not read out loggers again until you relaunch it in HOBOware.

6. If you are using the shuttle for the first time, launch the shuttle as described in the *HOBOware User's Guide*. Launching synchronizes the shuttle's clock to the host computer and initializes the shuttle's header.

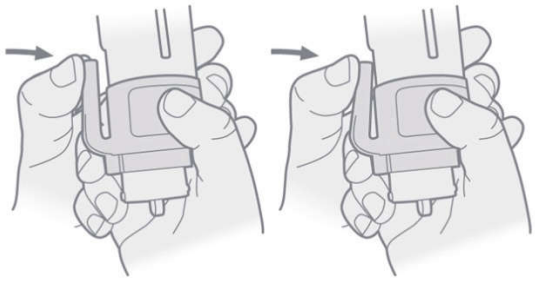
Important: The shuttle's clock is used to set the logger's clock at relaunch. For most accurate results, make sure the host computer's clock is correct before launching the shuttle. If you need to adjust the computer's clock, quit HOBOware, set the computer's clock, then reopen HOBOware and launch the shuttle.

7. If you have used the shuttle before, make sure there are enough banks available to accommodate the loggers you plan to read out.
8. Disconnect the USB cable from the shuttle and replace the center cap securely.

Reading Out and Relaunching Loggers in the Field

After you have ensured that the shuttle's batteries are good, there is sufficient memory available, and the shuttle's clock is synchronized, follow these steps to read out and relaunch a logger in the field:

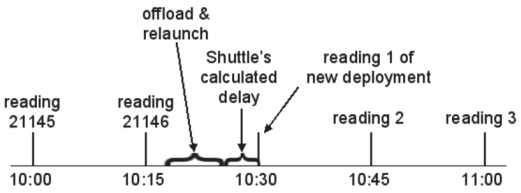
1. Make sure the shuttle's large cap and center cap are closed securely. Tighten the center cap until it is just flush with the large cap, or until the O-ring is no longer visible.
2. Make sure the communication end of the shuttle is clean. Attach the correct coupler for the logger, and ensure that it is seated properly.
3. Insert the logger into the coupler, following the instructions that came with the coupler.
4. Momentarily press the coupler lever (pressing hard enough so the lever bends).



Readout should begin immediately. The amber LED blinks continuously while readout and relaunch are in progress. Do not remove the logger when the amber LED is blinking.

5. After reading out the logger, the shuttle synchronizes the logger's clock to the shuttle's internal clock and relaunches the logger, using the description, channels to log, logging interval, and other settings that are already in the logger. (If the logger was launched with multiple logging intervals, the final defined logging interval will be used.) The logger is

launched with a slight delay that causes its readings to be synchronized with those of the previous deployment, as shown in the following diagram.



Important: If the logger was launched with multiple logging intervals, there will be no synchronizing delay. The logger will start immediately with the last defined logging interval.

6. When the relaunch has completed, the green LED blinks for 15 minutes, or until you momentarily press the coupler lever to stop it (press hard enough so the lever bends). If the red LED blinks instead, there was an error, and the logger may have stopped. Refer to "Troubleshooting" in this manual for details.
7. Remove the logger from the coupler.

Checking Shuttle Status in the Field

The shuttle's memory has 63 "banks." One logger readout can be stored in each bank. To check the shuttle's memory and batteries in the field, remove the logger and press the coupler's lever for at least three seconds (pressing hard enough so the lever bends). When you release the lever, the green LED blinks once for each unoccupied bank in the shuttle's memory. (Press the lever momentarily to stop the blinking, pressing hard enough so the lever bends.)

If the shuttle's batteries are running low, all of the shuttle banks are full, or the clock has not been set, the red LED blinks. (Press the lever momentarily to stop the blinking, pressing hard enough so the lever bends) Use HOBOware to check the shuttle's battery level, available memory, and clock. You may need to change the batteries, or offload the datafiles to the host computer and delete them from the shuttle to free up memory before you can continue reading out loggers.

Offloading Data to the Host Computer

You can offload the data stored in the shuttle even when the batteries are depleted. Take the following steps:

1. Connect the shuttle to a host computer running HOBOware.
2. Follow the instructions in the *HOBOware User's Guide* to offload the new datafiles or access the **Manage Shuttle** dialog. The **Manage Shuttle** dialog shows you how many banks are occupied, and whether they have already been offloaded and saved to the host computer.
3. Offload and save data from the banks of your choice. Refer to the *HOBOware User's Guide* for details on saving datafiles offloaded from the shuttle.
4. Review the list of banks and delete any that are no longer needed. Make sure the battery level is good, and change the batteries now if they are weak. (If you change the batteries in the field, the shuttle's clock will stop, and the shuttle will not read out loggers.) Update the shuttle's clock, if necessary.
5. When finished, disconnect the shuttle from the computer and close the center cap securely.

Using the Shuttle as a Base Station

You can use the shuttle as a base station for any U-Series logger with an optic USB interface. (This function is available even when the batteries are depleted.) To use the shuttle as a base station:

1. Connect the shuttle to the host computer running HOBOware.
2. Attach a compatible logger and coupler.
3. Momentarily press the coupler's lever (pressing hard enough so the lever bends).
4. The amber LED blinks momentarily, then the green LED should glow steadily to indicate that the logger is ready to communicate with HOBOware. (If the red LED blinks instead, the logger was not found. Make sure the logger and coupler are aligned and seated properly, and that there is no dirt or strong sunlight interfering with communications.)
5. When finished, remove the logger from the coupler. The green LED stops glowing when you disconnect the logger or the USB cable.

Important: The Waterproof Shuttle cannot be used *as a base station* with Pendant logger models UA-001 and UA-003 (including rain gauges RG3 and RG3-M) with serial numbers less than 988278. These loggers require a BASE-U-1 for communication with the host computer.

Indicator Lights

Green "OK" LED
The green "OK" LED blinks when HOBOware recognizes it as a base station; when it finishes reading out and relaunching a logger; and when you press the coupler lever to check the shuttle's status (see "Checking shuttle status in the field" for details). Momentarily press the coupler lever to stop the blinking (pressing hard enough so the lever bends).

The green LED glows steadily when the shuttle is being used as a base station.

Amber "Transfer" LED
The amber "Transfer" LED blinks when the shuttle is reading out a logger and relaunching it. Do not remove the logger when the Transfer light is lit.

Red "Fail" LED
The red "Fail" LED blinks whenever the shuttle encounters an error condition. Refer to "Troubleshooting" for details.

All LEDs
All LEDs blink in unison when the shuttle has just been powered up, either by installing fresh batteries or (if batteries are not installed) by connecting to the computer's USB port.

Troubleshooting

This section describes problems you may encounter while using the shuttle.

Shuttle is not recognized by host computer
If HOBOware does not recognize the shuttle when you connect it to the computer, simply disconnect and reconnect the shuttle.

Red "Fail" LED blinks
The red "Fail" LED blinks (for 15 minutes, or until you press the coupler lever, pressing hard enough so the lever bends) whenever the shuttle encounters an error. There are several conditions that might cause an error:

- **Shuttle is full:** If the red LED blinks when you try to read out a logger, check whether all of the banks are full, as described in "Checking shuttle status in the field." Or, use HOBOware to check the shuttle's memory.
- **Shuttle batteries are low:** If you cannot read out any loggers at all, check the logger's status, as described in "Checking shuttle status in the field," or use HOBOware to check the shuttle's batteries. The batteries may simply need to be replaced.
- **Compatibility:** The shuttle cannot read out or relaunch loggers that were last launched from HOBOware prior to version 2.2. You will need to read out these loggers on the host computer and relaunch them in HOBOware 2.2 or greater before you can use them with the shuttle.
- **Shuttle clock is not set:** The shuttle has experienced a power failure that caused the clock to reset. You must use HOBOware to offload the files that are already on the shuttle, then relaunch the shuttle before you can read out another logger.
- **Can't communicate with logger:** Remove the logger and coupler. Inspect them and the shuttle to ensure that all are free of dirt that could block the optic communication sensor. Carefully reassemble the shuttle, coupler, and logger, and make sure they are all seated properly. Shield the shuttle from strong sunlight, if applicable, which can interfere with optic communications.
- **Other logger problems:** If you can read out some loggers but not others, or if you cannot read out any loggers even with fresh batteries in the shuttle, check the loggers in HOBOware. Make sure their batteries are at acceptable levels and that there is no "corrupted header" message.

Amber "Transfer" LED stays on without blinking
The amber light is magnetically activated when you press the coupler lever. If it glows steadily at any other time, the magnet in the lever may be too close to the magnetic switch in the shuttle, or another strong magnet may be present. Try bending the lever away from the coupler to reduce the magnet's effect.

LEDs do not function
If the LEDs are not functioning at all, the batteries may be completely exhausted. To test this, attach the shuttle to the host computer and check the battery level. The shuttle should be able to communicate with the host computer, blink its LEDs normally, and perform as a base station even when the batteries are missing or depleted.

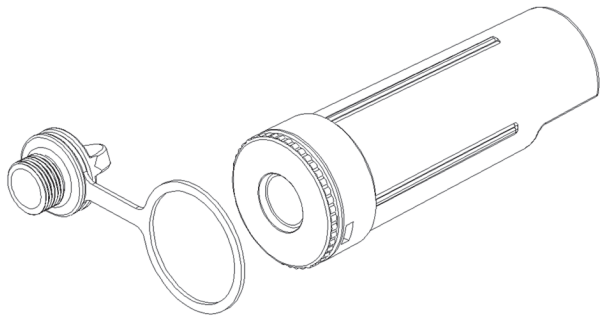
Replacing the Shuttle's Batteries

The shuttle's batteries should last about one year or at least 50 complete memory fills in typical conditions. When the shuttle's batteries run low (2.2 V or less), any logger data that is already in the shuttle will remain safe, but the shuttle will not read out another logger until its batteries are replaced.

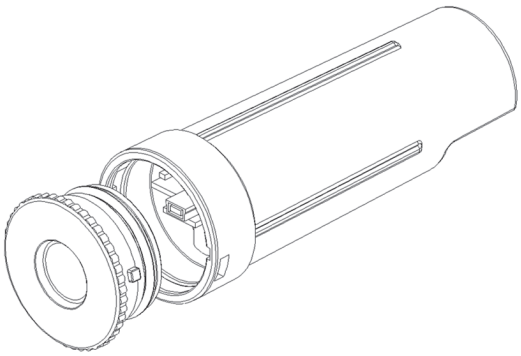
To avoid battery problems, always check the shuttle's batteries in HOBOware before going into the field, and replace them if needed. If you cannot replace the bad batteries right away, you should remove them as soon as possible to ensure that they do not leak and damage the shuttle.

To change the shuttle's batteries:

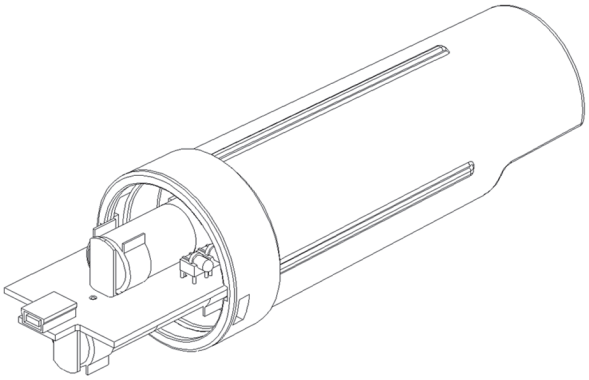
1. Work over a clean surface to provide a safe platform for the disassembly.
2. Unscrew the center cap on the shuttle. If the cap is too tight to loosen by hand, insert a screwdriver through the lanyard hole and rotate counterclockwise until the cap is loosened.
3. Use the center cap to help you carefully pull the rubber loop free of the large cap. The large cap cannot be removed while the rubber loop is in place.



4. Turn the large cap counter-clockwise slightly, then pull it off.



5. Turn the shuttle over and tap it gently. The circuit board should slide into your hand.



6. Remove the old batteries and install two new ones in the correct orientation. Both batteries should be turned the same way, with their positive ends facing the USB port on the board. (When the second battery makes contact, all of the shuttle's LEDs will blink in unison.) It is recommended that you replace the desiccant (DESICCANT2) when replacing the batteries.
7. Put the board back into the case, taking care not to bend the communication LEDs. Align the circuit board with the runners in the case. The USB port should face the open end of the shuttle, and the LEDs should show through the window on the label.
8. Close the shuttle's case. Line up the tabs on the large cap with the slots on the case, press gently, and turn slightly clockwise until the large cap is closed securely.
9. Replace the rubber loop and center cap. Tighten the center cap until it is just flush with the large cap, or until the O-ring is no longer visible.
10. Using HOBOware, offload any datafiles that are on the shuttle and launch the shuttle before going into the field again. The shuttle will not read out and relaunch loggers until the clock has been synchronized.

WARNING: Do not install batteries backwards, recharge, put in fire, expose to extreme heat, or mix with other battery types, as the batteries may explode or leak. Contents of an open or leaking battery can cause chemical burn injuries. **Replace all used batteries at the same time.** Recycle or dispose of batteries according to applicable federal, state, and local regulations.

HOBO® Water Temp Pro v2 (U22-001) Manual

The HOBO Water Temp Pro v2 logger is designed with a durable, streamlined, UV-stable case for extended deployments measuring temperature in fresh or salt water. The small size of the logger allows it to be easily mounted and/or hidden in the field. It is waterproof up to 120 m (400 feet) and rugged enough to withstand years of use, even in stream conditions. It has enough memory to record over 42,000 12-bit temperature measurements.

The logger uses an optical USB communications interface for launching and reading out the logger. The optical interface allows the logger to be offloaded without compromising the integrity of the seals. The USB compatibility allows for easy setup and fast downloads.

HOBO Water Temp Pro v2

U22-001

Included Item:

- Communications window protective cap

Required Items:

- Coupler (COUPLER-C) and USB Optic Base Station (BASE-U-4)
  or
  HOBO Waterproof Shuttle (U-DTW-1)
- HOBOware® (go to www.onsetcomp.com/hoboware-free-download)

Accessories:

- Protective boot; black (BOOT-BLK) or white (BOOT-WHT)
- Replacement communications window protective caps (U22-U24-CAP)

Specifications

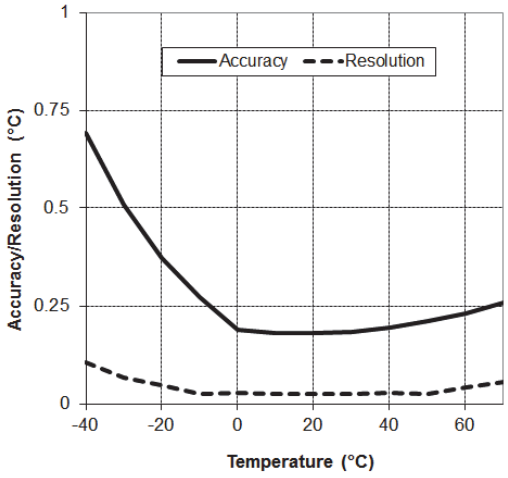
Temperature Sensor

Operation Range	-40° to 70°C (-40° to 158°F) in air; maximum sustained temperature of 50°C (122°F) in water
Accuracy	±0.21°C from 0° to 50°C (±0.38°F from 32° to 122°F), see Plot A
Resolution	0.02°C at 25°C (0.04°F at 77°F), see Plot A
Response Time (90%)	5 minutes in water; 12 minutes in air moving 2 m/sec (typical)
Stability (Drift)	0.1°C (0.18°F) per year

Logger

Real-time Clock	± 1 minute per month 0° to 50°C (32° to 122°F)
Battery	2/3 AA, 3.6 Volt Lithium, factory-replaceable ONLY
Battery Life (Typical Use)	6 years with 1 minute or greater logging interval
Memory (Non-volatile)	64K bytes memory (approx. 42,000 12-bit temperature measurements)
Weight	42 g (1.5 oz)
Dimensions	3.0 cm (1.19 in.) maximum diameter, 11.4 cm (4.5 in.) length; mounting hole 6.3 mm (0.25 inches) diameter
Wetted Materials	Polypropylene case, EPDM o-rings, stainless steel retaining ring
Buoyancy (Fresh Water)	+13 g (0.5 oz.) in fresh water at 25°C (77°F); +17 g (0.6 oz.) with optional boot
Waterproof	To 120 m (400 ft.)
Shock/Drop	1.5 m (5 ft.) drop at 0°C to 70°C (32°F to 150°F)
Logging Interval	Fixed-rate or multiple logging intervals, with up to 8 user-defined logging intervals and durations; logging intervals from 1 second to 18 hours. Refer to the HOBOware software manual.
Launch Modes	Immediate start and delayed start
Offload Modes	Offload while logging; stop and offload
Battery Indication	Battery voltage can be viewed in status screen and optionally logged in datafile. Low battery indication in datafile.
Environmental Rating	IP68
NIST Certificate	Available for additional charge
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

Specifications (continued)

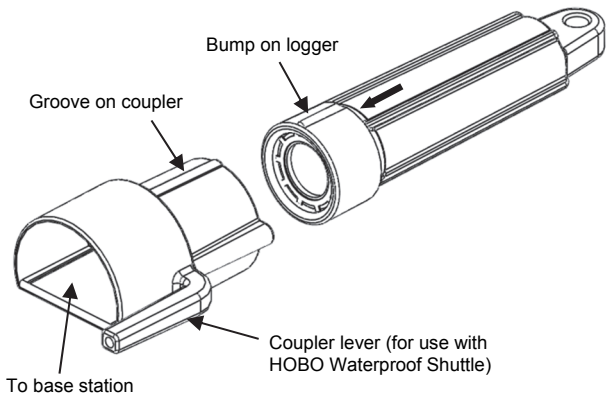


Plot A

Connecting the Logger

The HOBO Water Temp Pro v2 requires a coupler and USB Optic Base Station or HOBO Waterproof Shuttle to connect to the computer.

1. Install the logger software on your computer before proceeding.
2. Follow the instructions that came with your base station or shuttle to attach the base station or shuttle to a USB port on the computer.
3. Make sure the logger's communications window is clean and dry. (Use a clean, nonabrasive cloth, if necessary.) If the logger is wet, wipe off excess moisture.
4. Attach the coupler to the base station or shuttle, then insert the logger into the coupler so that the bump on the logger slides into the groove of the coupler. There is also an arrow etched on the logger case showing the direction the logger should be inserted into the coupler.



If you are using an older model of this logger and the arrow is not visible, hold the curved side of the coupler up as shown above. Insert the logger with the flat side up (the side in line with the flat side of the mounting hole).

5. If you are using the HOBO Waterproof Shuttle, briefly press the coupler lever to put the shuttle into base station mode.
6. If the logger has never been connected to the computer before, it may take a few seconds for the new hardware to be detected by the computer.
7. Use the logger software to launch the logger. You can check the logger's status, read out the logger while it continues to log, stop it manually with the software, or let it record data until the memory is full.

Refer to the software user's guide for complete details on launching, reading out, and viewing data from the logger, including multiple logging intervals.

Important: USB communications may not function properly at temperatures below 0°C (32°F) or above 50°C (122°F).

Note: The logger consumes significantly more power when it is "awake" and connected to a base station or shuttle. To conserve power, the logger will go into a low-power (sleep) mode if there has been no communication with your computer for 30 minutes. To wake up the logger, remove the logger from the coupler, wait a moment, then re-insert the logger.

Note: The first time you launch the logger, the deployment number will be greater than zero. Onset launches the loggers to test them prior to shipping.

Operation

A light (LED) in the communications window of the logger confirms logger operation. (In brightly lit areas, it may be necessary to shade the logger to see the LED blink.) The following table explains when the light blinks during logger operation:

When:	The Light Does this:
The logger is logging	Blinks once every one to four seconds (the shorter the logging interval, the faster the light blinks); blinks when logging a sample.
The logger is awaiting a start because it was launched in Start At Interval or Delayed Start mode	Blinks once every eight seconds until logging begins

Sample and Event Logging

The logger can record two types of data: samples and events. Samples are the sensor measurements recorded at each logging interval (for example, temperature every minute). Events are independent occurrences triggered by a logger activity, such as Bad Battery or Host Connected. Events help you determine what was happening while the logger was logging.

The logger stores 64K of data, and can record over 42,000 12-bit temperature measurements.

Deploying and Protecting the Logger

Follow these guidelines for deploying and protecting the logger:

Some monitoring applications require precise placement of the temperature sensor, such as measuring the temperature of a flow at the bottom of a stream or river. Ensure that the logger is appropriately secured so that the temperature sensor is in the desired measurement location.

Important: The plastic case will become brittle at temperatures lower than -20°C. If the logger is deployed in a location where the temperature drops below -20°C, make sure the logger remains stationary and is not pulled on or struck. Return the logger to above -20°C before handling.

- The opening at the sensor end of the logger accepts 1/4 inch (6.35mm) diameter nylon cord or other strong cable. If wire is wrapped through the sensor end to secure the logger, make sure the wire loop is snug to the sensor end. Any slack in the loop may cause excessive wear.
- The logger is slightly positive buoyant so that it will float if it is inadvertently dropped in the water or breaks free from its mooring. You may want to mark or label the logger with contact information in case the logger is lost.
- Use the included cap to protect the communications window in the logger from fouling and abrasion. Place the protective cap over the communications window before deploying the logger.
- As an alternative to the included protective cap, use the optional boot (Part # BOOT-BLK or BOOT-WHT) for high fouling environments and for protection against very cold temperatures (which can make the case brittle and prone to fracture) or repeated pounding and abrasion caused by turbulent flow. The boot slides over the logger, has a removable end cap, and is flexible enough to allow you to attach the coupler without removing the boot. To attach the base station, remove the end cap and firmly insert the logger until the boot folds back. Insert the logger into the coupler so that the bump on the logger slides into the groove of the coupler as shown on page 2.

  Although the boot does not cover the sensor end of the logger, the temperature response time (to 90% of final value) in water increases slightly from 5 to 8 minutes due to the increased mass.
- Depending on water conditions and desired measurement location, the logger should be appropriately weighted, secured, and protected.
- An alternative to the optional boot in high fouling environments is to protect the logger with plastic wrap that can be removed and replaced as needed.
- This logger should not be immersed for extended periods in any liquid other than fresh or salt water. To do so may void the warranty (refer to the Service and Support section). If you have any questions about chemical resistance, call Onset.
- Prolonged exposure to chlorinated water is not recommended.
- To clean the logger, rinse it in warm water. Use a mild dishwashing detergent if necessary. Do not use harsh chemicals, solvents, or abrasives, especially on the communications window.

Battery

The battery in the HOBO Water Temp Pro v2 is a 3.6 Volt lithium battery. The battery life of the logger should be about six years. Actual battery life is a function of the number of deployments, logging interval, and operation/storage temperature of the logger. To obtain a six-year battery life, a logging interval of one minute or greater should be used and the logger should be operated and stored at temperatures between 0° and 25°C (32° and 77°F). Frequent deployments with logging intervals of less than one minute, and continuous storage/operation at temperatures above 35°C, will result in significantly lower battery life. For example, continuous logging at a one-second logging interval will result in a battery life of approximately one month.

The logger can report and log its own battery voltage. If the battery falls below 3.1 V, the logger will record a “bad battery” event in the datafile. If the datafile contains “bad battery” events, or if logged battery voltage repeatedly falls below 3.3 V, the battery is failing and the logger should be returned to Onset for battery replacement.

To have your logger’s battery replaced, contact Onset or your place of purchase for return arrangements. Do not open the case or attempt to replace the battery yourself. There are no user-serviceable parts inside. If you open the case, the warranty will be voided, and the logger may no longer be waterproof.

WARNING: Do not cut open, incinerate, heat above 100°C (212°F), or recharge the lithium battery. The battery may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery case. Do not dispose of the logger or battery in fire. Do not expose the contents of the battery to water. Dispose of the battery according to local regulations for lithium batteries.

ONSET
1-800-LOGGERS (564-4377) • 508-759-9500
www.onsetcomp.com/support/contact

Patent #: 6,826,664

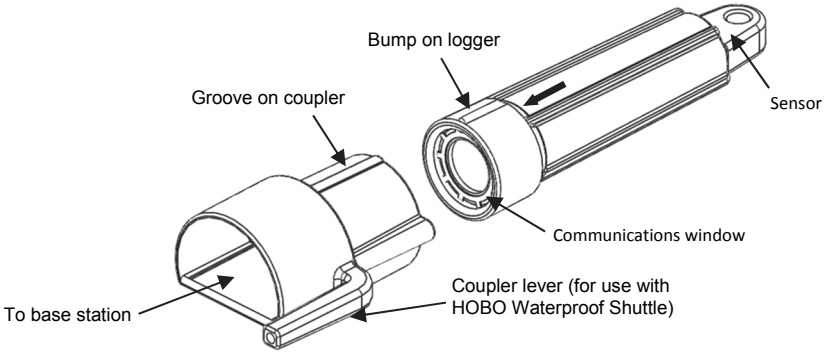
10366-I

HOBO® Water Temp Pro v2 (U22-001) Quick Start

1 Open HOBOware software. (Get the latest software at www.onsetcomp.com/hoboware-free-download.)

2 Attach the USB Optic Base Station (BASE-U-4) or HOBO Waterproof Shuttle (U-DTW-1) to a USB port on the computer (refer to the hardware manual at www.onsetcomp.com/support/manuals for details).

3 Attach the coupler (COUPLER-C) to the base station or shuttle, then insert the logger into the coupler so that the bump on the logger slides into the groove of the coupler. There is also an arrow etched on the logger case showing the direction the logger should be inserted into the coupler. If you are using the HOBO Waterproof Shuttle, make sure it is connected to the USB port on the computer and briefly press the coupler lever to put the shuttle into base station mode. It may take a few seconds for new hardware to be detected by the computer.



4 From the Device menu, select Launch. Select the logging options and click Start. Logging will begin based on the settings you selected.

5 Deploy the logger. Depending on water conditions and desired measurement location, the logger should be appropriately weighted, secured, and protected. Place the included cap over the communications window to protect it from fouling and abrasion or use the optional boot (BOOT-BLK or BOOT-WHT) for high fouling environments and for protection against very cold temperatures (which can make the case brittle and prone to fracture) or repeated pounding and abrasion caused by turbulent flow. See the logger manual at www.onsetcomp.com/support/manuals/u22-001 for complete deployment details.

6 To read out the logger, remove it from the water. Follow steps 1–3 and select Read Out from the Device menu in HOBOware or use the Waterproof Shuttle. Refer to the HOBOware Help for complete details on reading out and viewing data.

For more information about this logger, scan the code at left or go to www.onsetcomp.com/support/manuals/u22-001.

ONSET
1-800-LOGGERS (564-4377) • 508-759-9500
www.onsetcomp.com/support/contact

This product has been manufactured by Onset Computer Corporation and in compliance with Onset's ISO 9001:2015 Quality Management System.

21827-B MAN-U22-QSG

HOBO® U20L Water Level Logger (U20L-0x) Manual

The HOBO U20L Water Level Logger is used for monitoring changing water levels in a wide range of applications, including streams, lakes, wetlands, tidal areas, and groundwater. Using HOBOware® Pro, you can easily configure this logger to record absolute pressure and temperature data. This logger features a ceramic pressure sensor, durable housing, and a protective end cap for deployment in existing wells or stilling wells. Without cumbersome vent tubes or desiccants to maintain, this easy-to-use logger is an ideal solution for water level studies and research.

HOBO Water Level Logger

Models:

- U20L-01 (30-foot depth)
- U20L-02 (100-foot depth)
- U20L-04 (13-foot depth)

Required Items:

- Coupler (COUPLER2-C) with USB Optic Base Station (BASE-U-4) *or* HOBO Waterproof Shuttle (U-DTW-1, firmware version 3.2.0 or later)*
- HOBOware® Pro, version 3.5 or higher

Accessories:

- Cable (CABLE-1-300 or CABLE-1-50) and Cable Crimp (CABLE-1-CRIMP)
- Replacement Coupler (COUPLER2-C)

**If shuttle firmware version 3.2.0 or later is needed, see the Onset website or contact Onset Technical Support.*

Specifications

Pressure (Absolute) and Water Level Measurements U20L-01

Operation Range	0 to 207 kPa (0 to 30 psia); approximately 0 to 9 m (0 to 30 ft) of water depth at sea level, or 0 to 12 m (0 to 40 ft) of water at 3,000 m (10,000 ft) of altitude
Factory Calibrated Range	69 to 207 kPa (10 to 30 psia), 0° to 40°C (32° to 104°F)
Burst Pressure	310 kPa (45 psia) or 18 m (60 ft) depth
Water Level Accuracy*	Typical error: ±0.1% FS, 1.0 cm (0.03 ft) water Maximum error: ±0.2% FS, 2.0 cm (0.06 ft) water
Raw Pressure Accuracy**	±0.3% FS, 0.62 kPa (0.09 psi) maximum error
Resolution	<0.02 kPa (0.003 psi), 0.21 cm (0.007 ft) water
Pressure Response Time (90%)***	<1 second at a stable temperature; measurement accuracy also depends on temperature response time

Pressure (Absolute) and Water Level Measurements U20L-02

Operation Range	0 to 400 kPa (0 to 58 psia); approximately 0 to 30.6 m (0 to 100 ft) of water depth at sea level, or 0 to 33.6 m (0 to 111 ft) of water at 3,000 m (10,000 ft) of altitude
Factory Calibrated Range	69 to 400 kPa (10 to 58 psia), 0° to 40°C (32° to 104°F)
Burst Pressure	500 kPa (72.5 psia) or 40.8 m (134 ft) depth
Water Level Accuracy*	Typical error: ±0.1% FS, 3.0 cm (0.1 ft) water Maximum error: ±0.2% FS, 6.0 cm (0.2 ft) water
Raw Pressure Accuracy**	±0.3% FS, 1.20 kPa (0.17 psi) maximum error
Resolution	<0.04 kPa (0.006 psi), 0.41 cm (0.013 ft) water
Pressure Response Time (90%)***	<1 second at a stable temperature; measurement accuracy also depends on temperature response time

Pressure (Absolute) and Water Level Measurements U20L-04

Operation Range	0 to 145 kPa (0 to 21 psia); approximately 0 to 4 m (0 to 13 ft) of water depth at sea level, or 0 to 7 m (0 to 23 ft) of water at 3,000 m (10,000 ft) of altitude
Factory Calibrated Range	69 to 145 kPa (10 to 21 psia), 0° to 40°C (32° to 104°F)
Burst Pressure	310 kPa (45 psia) or 18 m (60 ft) depth
Water Level Accuracy*	Typical error: ±0.1% FS, 0.4 cm (0.013 ft) water Maximum error: ±0.2% FS, 0.8 cm (0.026 ft) water
Raw Pressure Accuracy**	±0.3% FS, 0.43 kPa (0.063 psi) maximum error
Resolution	<0.014 kPa (0.002 psi), 0.14 cm (0.005 ft) water
Pressure Response Time (90%)***	<1 second at a stable temperature; measurement accuracy also depends on temperature response time

Specifications (continued)

Temperature Measurements (All Models)

Operation Range	-20° to 50°C (-4° to 122°F)
Accuracy	±0.44°C from 0° to 50°C (±0.79°F from 32° to 122°F), see Plot A
Resolution	0.10°C at 25°C (0.18°F at 77°F), see Plot A
Response Time (90%)	10 minutes in water (typical)
Stability (Drift)	0.1°C (0.18°F) per year

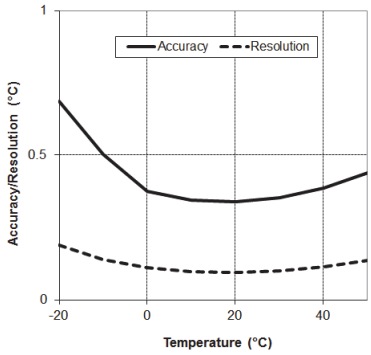
Logger

Real-time Clock	±1 minute per month 0° to 50°C (32° to 122°F)
Battery	2/3 AA, 3.6 Volt lithium, factory-replaceable
Battery Life (Typical Use)	5 years with 1 minute or greater logging interval
Memory (Non-volatile)	64K bytes memory (approx. 21,700 pressure and temperature samples)
Weight	Approximately 154 g (5.43 oz) in air Approximately 53.9 g (1.9 oz) in fresh water
Dimensions	3.18 cm (1.25 inches) diameter, 15.24 cm (6.0 inches) length; mounting hole 6.3 mm (0.25 inches) diameter
Wetted Materials	Polypropylene housing and lanyard; Viton and Buna-N O-rings; ceramic sensor in acetal end cap; stainless steel screws suitable for saltwater
Logging Interval	Fixed-rate or multiple logging intervals, with up to 8 user-defined logging intervals and durations; logging intervals from 1 second to 18 hours. Refer to the *HOBOware User's Guide* for details.
Launch Modes	Immediate start and delayed start
Offload Modes	Offload while logging; stop and offload
Battery Indication	Battery voltage can be viewed in status screen and optionally logged in datafile. Low battery indication in datafile.
Environmental Rating	IP68
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

* Water Level Accuracy: With accurate reference water level measurement, known water density, accurate Barometric Compensation Assistant data, and a stable temperature environment.

** Raw Pressure Accuracy: Absolute pressure sensor accuracy includes all sensor drift, temperature, and hysteresis-induced errors.

*** Changes in Temperature: Allow 20 minutes in water to achieve full temperature compensation of the pressure sensor. Maximum error due to rapid thermal changes is approximately 0.5%.

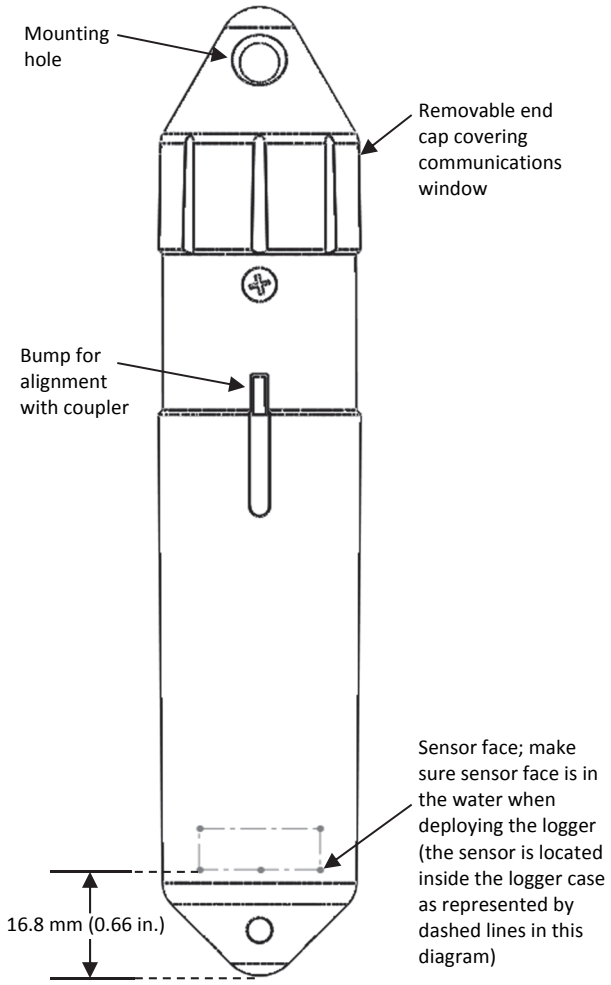


Plot A

Logger Operation

HOBOware Pro software is required for logger operation. Using a reference water level, HOBOware Pro automatically converts pressure readings into water level readings (see *Barometric Compensation* for more detail). The software also supports compensation for temperature, fluid density, and barometric pressure.

An LED in the communications window of the logger confirms logger operation. When the logger is logging, the LED blinks once every one to four seconds (the shorter the logging interval, the faster the LED blinks). The LED also blinks when the logger is recording a sample. When the logger is awaiting a start because it was configured to start "At Interval," "On Date/Time," or "Using Coupler," the LED blinks once every eight seconds until logging begins.



The logger can record two types of data: samples and events. Samples are the sensor measurements recorded at each logging interval (for example, the pressure every minute). Events are independent occurrences triggered by a logger activity, such as Bad Battery or Host Connected. Events help you determine what was happening while the logger was logging.

Barometric Compensation

The logger records absolute pressure, which is later converted to water level readings by HOBOware Pro software. In this application, absolute pressure includes atmospheric pressure and water head. Atmospheric pressure is nominally 100 kPa (14.5 psi) at sea level, but it changes with weather and altitude. Left uncompensated, barometric variations could result in errors of 0.6 m (2 ft) or more.

To compensate for barometric pressure changes, you can use another HOBO U20L Water Level logger as a barometric reference. The barometric reference is typically deployed in the same well or at the same location as the water level of interest, but rather than being placed in the water column, it is deployed above the water in air.

Barometric pressure readings are consistent across a region (except during fast-moving weather events), so you can generally use barometric pressure readings that are taken within 15 km (10 miles) of the logger or more without significantly degrading the accuracy of the compensation.

Therefore, one HOBO U20L or U20 Water Level logger or weather station (HOBO U30 recommended) can be used to compensate all the water level loggers in an area. The U20L-01 model with its 0–9m (0–30 ft) range or the U20L-04 with its 0–4 m (0–13 ft) range are both good barometric references due to their smaller range and temperature-compensated accuracy. HOBOware Pro includes a Barometric Compensation Assistant for easy and accurate barometric compensation. See *Processing Water Level Data using Barometric Pressure Data* for more details.

Calibration

The pressure sensor in each HOBO U20L Water Level logger is individually calibrated. During calibration, raw pressure sensor data is collected at multiple pressures and temperatures over the calibrated range of the logger (see the specifications table). This data is used to generate calibration coefficients that are stored in the logger's non-volatile memory. The calibration coefficients are then checked to be sure that the logger meets its stated accuracy over the calibrated range.

The pressure sensor can be used at pressures and temperatures that are outside of the calibrated range, but the accuracy cannot be guaranteed.

Important: Never exceed the burst pressure of the sensor!

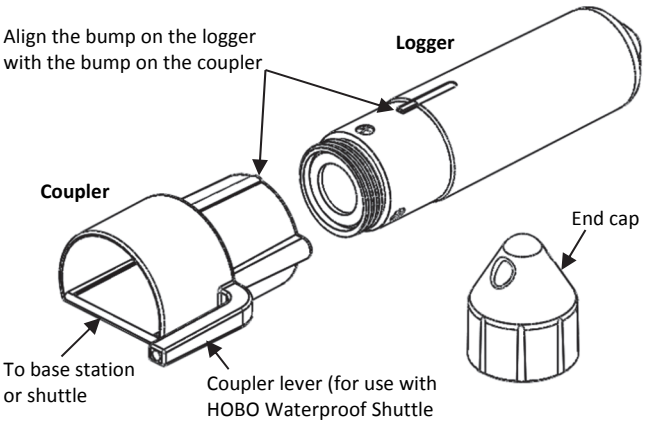
Connecting the Logger to a Computer

The HOBO Water Level Logger requires a coupler (COUPLER2-C) and Optic Base Station (BASE-U-4) or HOBO Waterproof Shuttle (U-DTW-1, firmware version 3.2.0 or later) to connect to the computer. The optical interface allows the logger to be offloaded without breaking the integrity of the seals. The USB compatibility allows for easy setup and fast downloads.

Important: USB communications may not function properly at temperatures below 0°C (32°F) or above 50°C (122°F).

1. Follow the instructions that came with your base station or shuttle to attach it to a USB port on the computer.
2. Unscrew the black plastic end cap from the logger by turning it counter-clockwise. **Note:** If the logger has been deployed, there may be water in the end cap. This is normal; this water will not penetrate the waterproof seal around the communications window in the logger.
3. Attach the coupler to the base station or shuttle.
4. Insert the logger into the coupler so that the alignment bump on the logger slides into the alignment bump on the coupler. Be sure it is properly seated in the coupler. It may take a few seconds for the new hardware to be detected by the computer.

NOTE: If you are using the Waterproof Shuttle, briefly press the coupler lever to put the shuttle into base station mode.



If the logger has never been connected to the computer before, it may take a few seconds for the new hardware to be detected by the computer.

WARNING: Do not leave the logger in the coupler for extended periods of time. When connected to a coupler, the logger is "awake" and consumes significantly more power than when it is disconnected and considered "asleep." Always remove the logger from the Optic Base Station or HOBO Waterproof Shuttle as soon as possible after launching, reading out, or checking the status to avoid draining the battery. To "wake up" the logger, remove it from the coupler, wait a moment and then re-insert the logger.

Launching the Logger

Before deploying the HOBO U20 Water Level Logger in the field, perform the following steps in the office:

1. Open HOBOware.
2. Connect the logger to the computer as described in the previous section.
3. From the Device menu, select Launch.
4. In the Launch Logger window, make sure both the Abs. Pressure and Temperature sensors are selected (temperature is required for temperature compensation of pressure).
5. Select any other launch settings as desired, including when to start logging and the logging interval. Click the Start button in the lower right corner of the Launch Logger window to send the launch settings to the logger (note that the Start button text changes based on the Start Logging selection).

Deploying the Logger

The HOBO Water Level Logger is designed to be easy to deploy in many environments. The logger uses an absolute pressure sensor, so no vent tube is required. The small size of the logger is convenient for use in small wells and allows the logger to be mounted and/or hidden in the field. Follow these guidelines when deploying the logger:

- The pressure sensor is temperature compensated over the range of 0° to 40°C (32° to 104°F). To obtain the highest level of accuracy, the logger should be allowed to come to full temperature equilibrium (approximately 20 minutes) before the reference level is recorded.
- Sudden temperature changes should be avoided. When deploying a HOBO U20L Water Level Logger for barometric pressure reference, some consideration should be made to minimize the rate of temperature fluctuations. Ideally, the barometric pressure reference logger should be hung several feet below ground level in an observation well where ground temperatures are stable (while making sure the logger remains above the water level). If that is not possible (or if a well is not used), try to put the logger in a location where it will not be subject to rapid daily temperature cycles.
- When deploying a HOBO Water Level logger in a well, make sure the well is vented to the atmosphere. Typically, a small hole can be drilled in the well cap to ensure that the pressure inside and outside the well is at equilibrium. If this is not possible, the barometric pressure reference logger should be used inside the same well.
- Use a no-stretch wire to hang the water level logger. Any change in length of the wire will result in a 1-to-1 corresponding error in the depth measurement. Always pull-test a cable prior to deploying a logger in a well to make sure it does not stretch.
- If you are deploying the logger in a lake, river, or stream, you must first build a stilling well to protect the logger from vibration, shock, and movement. A simple stilling well can be constructed with PVC or ABS pipe. A properly constructed stilling well helps to protect the logger from currents, wave action, and debris. Suspend the logger in the stilling well so it is always underwater, but not on the bottom to be buried by silt.

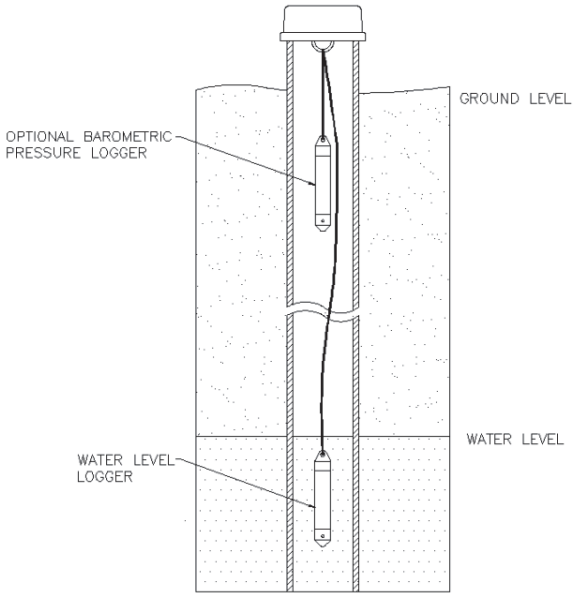
  For more information, see the Technical Application Note for Constructing a Stilling Well at: http://www.onsetcomp.com/water_level_stilling_well.html
- To prevent the logger from moving in currents and to ensure the support cable is kept straight during deployment, you may need to add a weight to the suspension cable or hang a weight below the logger.

Alternatively, you could deploy the logger in a stilling well as described above.

- Be very careful not to exceed the burst pressure for the logger. The pressure sensor will burst if the maximum depth is exceeded (see specifications table). The logger should be positioned at a depth where the logger will remain in the water for the duration of the deployment, but not exceed the rated bursting depth.

To deploy the logger:

1. Cut wire to suspend logger.
   a. Measure the physical depth to the surface of the water from the suspension point.
   b. Cut a piece of stranded, stainless steel wire (Teflon coated is best) so that the logger will be deep enough to always be in the water. Estimate the low water level and make the cable length such that the logger will be about 2 feet below that level.
2. Attach the wire to the suspension point and to the logger cap.
3. Relaunch the logger if desired (if a laptop or a HOBO U-Shuttle is available).
4. Lower the logger into the well or stilling well.



5. Measure the water depth from the desired reference point (top of pipe, ground level, or sea level).
   - To maximize accuracy, allow 20 minutes after deploying the logger before measuring water depth to allow the logger to reach temperature equilibrium with the water.
   - If the well is too small in diameter to measure the water depth after deployment, measure the water depth before deployment, then deploy the logger immediately and record deployment time.
   - For well deployments: If the water level surface is below the reference point (such as referencing groundwater measurements to the top of the well), record the water level as a negative number. If the water level surface is above the reference point (such as height above sea level), record the water level as a positive number.
   - For lake, stream, and river deployments: If the water level is being referenced to some point above the logger (such as the top of the stilling well), record the water level as a negative number. If the water depth is being referenced to a point below the water surface such as the bottom of the stream, record the water level as a positive number.
6. Record the reference measurement date and time.

Deploying a Water Level Logger for Barometric Pressure Data (Optional)

If you are using a U20 or U20L logger to record barometric pressure data, install one logger in one of the wells as follows:

1. Cut wire for suspending the logger.
   a. Measure the physical depth to the surface of the water from the suspension point.
   b. Cut a piece of stranded, stainless steel wire (Teflon coated is best) so that the logger will hang about 2 feet below the ground surface but always above the water surface.
2. Attach the wire to the suspension point and to the logger cap.
3. Relaunch the logger if desired (if a laptop or a HOBO U-Shuttle is available).
4. Lower the logger into the well or stilling well. Make sure the logger does not go below the water surface. See the diagram in the previous section.
5. Record the deployment time.

Reading Out the Logger

To read out the logger for water level data (see later in this section for steps to read out a water level logger used for barometric pressure data):

1. Measure the water depth using the original reference point with the correct sign.
2. Record depth and date and time.
3. Pull the logger out of the well.
4. Remove the logger from its cap, leaving the suspension undisturbed. Check the communications window for any fouling and wipe it off if necessary. **Note:** There may be water in the end cap. This is normal; this water will not penetrate the waterproof seal around the communications window in the logger.
5. Read out the data using a laptop or shuttle.
6. Save the data in a test folder location.
7. Redeploy the logger (optional) as described later in this section.

To read out a U20L logger used for barometric pressure data:

1. Remove the logger from the well.
2. Read out the data using a laptop or shuttle.

3. Save the data in a test folder location.
4. Redeploy the logger (optional) as described below.

If you are redeploying the logger, you must first make sure that it is launched. If you used the HOBO Waterproof Shuttle to offload data, the shuttle automatically performs a synchronized relaunch of the logger so that data is logged on the same measurement intervals. If you wish to change the launch settings, you must launch the logger using HOBOware Pro.

The existing suspension can be reused as long as the water level logger remained in the water and the barometric logger remained out of the water for the entire test interval. Take a new reference reading with the date and time as described in this section. Record this information in your field notebook to use later to calibrate the data, which will zero out any drift error.

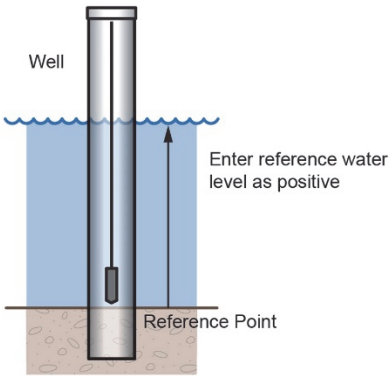
Processing Water Level Data using Barometric Pressure Data

To determine water level using barometric pressure data, use the Barometric Compensation Assistant in HOBOware Pro as described below.

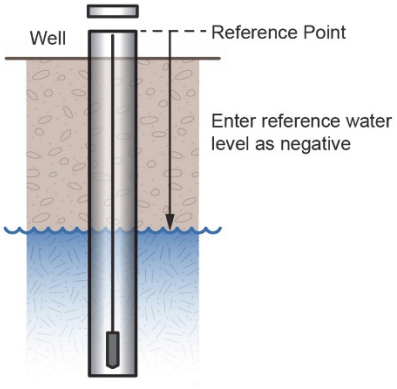
If you are using barometric pressure data from a HOBO weather station, you can use the data file as if it were U20L barometric data. For data from sources other than Onset products, see *Barometric Data from Other Sources* below.

1. In HOBOware Pro, open the water depth data file. The Plot Setup window appears.
2. Uncheck all boxes except “Abs. Pressure. “
3. Run the Barometric Compensation Assistant.
   a. Select the assistant and click the Process button.
   b. Select the water density box that best describes the water that you are measuring or enter the actual water density.
   c. Check the Use a Reference Water Level box and enter the reference water level that you measured at the beginning of the deployment.

      Enter the water level as a positive number if it is measured upward from a reference point below the water's surface, such as the water's height above sea level. This illustration shows an example of when to enter the water level as a positive number.



      Enter the water level as a negative number if it is measured downward from a reference point above the water's surface, such as the top of the well. This illustration shows an example of when to enter the water level as a negative number.



   d. Select the date and time from the pull-down menu that is closest to the recorded date/time for the measurement. If you measured the depth before deployment because of pipe size, then select a date/time after the start of the deployment.
   e. Check “Use Barometric Data file.”
   f. Click the Choose button. This will allow you to select the data file to use for barometric pressure compensation.
   g. Select and open the data file.
   h. Click the Create New Series button. A new Plot Setup window appears.
4. Select the Water Level checkbox and any other series that you want plotted. Click the Plot button to obtain a plot of the resulting water level data.

Measurement error can be caused by manual measurement error, sensor drift, or change in the suspension cable length.

To quantify measurement error (which is ideally zero), compare the calculated water level at the end of the plot with the water level measured just before you removed the water level logger.

Barometric Data from Other Sources

If you choose to use barometric pressure from a third-party weather station or barometric logger, you need to convert the date, time, and pressure data to a text file with special header requirements. For information on how to set up the text file, see the HOBOware Help or User Guide. It is easiest to do this work in Microsoft® Excel® and then save it as a text file.

If you choose to use barometric pressure from an online weather station, such as the National Weather Service, the measured barometric pressure is modified to be at sea level. This sea level pressure is useable since all pressure offsets are zeroed when you enter the reference measurement.

When you select the barometric data file in the Barometric Pressure Assistant (see previous section), select the text file that you generated. Select tab or comma for the data format and data separation characters and then import the barometric data.

Maintenance

The logger requires the following periodic maintenance to ensure optimal operation:

- **Protect the logger. This logger can be damaged by shock.** Always handle the logger with care. The logger may lose its calibrated accuracy or be damaged if it is dropped. Use proper packaging when transporting or shipping the logger.

  Important: Do not attempt to open the logger housing! Unscrewing the nose cone of the logger will cause serious damage to the pressure sensor and logger electronics. There are no user serviceable parts inside the case. Contact Onset Technical Support if your logger requires servicing.

- **Periodically inspect the logger for biofouling**. Biological growth on the face of the pressure sensor will throw off the pressure sensor's accuracy. Organisms that grow inside the sensor nose cone and on the sensor itself can interfere with the sensor's operation and eventually make the sensor unusable. If the deployment area is prone to biofouling, check the logger periodically for marine growth.

- **Be careful of solvents.** Check a materials-compatibility chart against the wetted materials listed in the Specifications table before deploying the logger in locations where untested solvents are present. The logger has Viton and Buna-N O-rings, which are sensitive to polar solvents (acetone, ketone), ammonia, chlorine, and brake fluids. The sensor is housed in an acetal end cap. Acetal is resistant to most solvents, fuels, and lubricants. The black polypropylene cap is provided to help protect the communications window. The polypropylene communications window is sealed as an additional barrier to prevent water and dirt from entering the logger housing.

Compensating for Drift

All pressure sensors drift over time. The drift for the pressure sensor and electronics in the HOBO U20L Water Level logger is less than 0.5% FS (worst case) per year. In most applications, drift is not a significant source of error, because the offset created by any drift is zeroed out when you take a manual reference level measurement and use the logger software to automatically calculate the level readings relative to the reference measurement. In effect, you are re-zeroing the sensor each time you apply a reference reading to the data file.

Pressure sensor drift matters only when absolute pressure values are needed, or if there are no recent reference level or depth measurements available. For example, if the logger is deployed for one year and no new reference level readings are taken during the deployment, it is possible that the sensor could have drifted as much as 0.5% FS by the end of the deployment.

It is possible to determine the actual amount of drift during a deployment if a reference level is taken at the beginning and the end of a long-term deployment. The results of applying the two different reference levels (once at the beginning of the data file, and again at the end of the data file) can be compared. Any difference between the files indicates the amount of sensor drift (assuming accurate reference levels).

Verifying Accuracy

You can check the *differential accuracy* of your loggers for water level measurements by deploying the loggers at two depths and comparing the difference in level readings. When verifying the accuracy this way, be sure to allow the loggers' temperature to stabilize at each depth. Use the logger software to convert the readings from pressure to level. The level readings should be taken close enough together that the barometric pressure does not change.

You can check the *absolute pressure accuracy* of your HOBO U20L Water Level Logger by comparing its ambient pressure readings to a second HOBO logger. Their readings should be within each other's specified accuracy. Alternatively, you can check the pressure reading against an accurate local barometer. If you use a non-local source of barometric information, such as the NOAA website, adjust for altitude.

Battery Guidelines

The battery in the HOBO U20L Water Level Logger is a 3.6 Volt lithium battery.

- **Battery Life.** The battery life of the logger should be about five years or more. Actual battery life is a function of the number of deployments, logging interval, and operation/storage temperature of the logger. Frequent deployments with logging intervals of less than one minute, and continuous storage/operation at temperatures above 35°C will result in significantly lower battery life. For example, continuous logging at a one-second logging interval will result in a battery life of approximately one month.

  To obtain a five-year battery life, a logging interval of one minute or greater should be used and the logger should be operated and stored at temperatures between 0° and 25°C (32° and 77°F).

- Battery Voltage. The logger can report and log its battery voltage. If the battery falls below 3.1 V, the logger will record a "bad battery" event in the datafile. If the datafile contains "bad battery" events, or if logged battery voltage repeatedly falls below 3.3 V, the battery is failing and the logger should be returned to Onset for battery replacement.

- Replace the Battery. To have your logger's battery replaced, contact Onset or your place of purchase for return arrangements. Do not attempt to replace the battery yourself. Severe damage to the logger will result if the case is opened without special tools, and the warranty will be voided.

WARNING: Do not cut open, incinerate, heat above 100°C (212°F), or recharge the lithium battery. The battery may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery case. Do not dispose of the logger or battery in fire. Do not expose the contents of the battery to water. Dispose of the battery according to local regulations for lithium batteries.

ONSET
1-800-LOGGERS (564-4377) • 508-759-9500
www.onsetcomp.com/support/contact

Quick Start for the HOBO® U20L Water Level Logger

Before you begin: Barometric pressure data at the site where the logger is being deployed is required for accurate water level data. Using a HOBO logger for recording barometric pressure data is recommended.

If using a HOBO Waterproof Shuttle (U-DTW-1) with this logger, the shuttle must have firmware version 3.2.0 or later installed. See the Onset website or contact Onset Technical Support if your shuttle needs this upgrade.

1

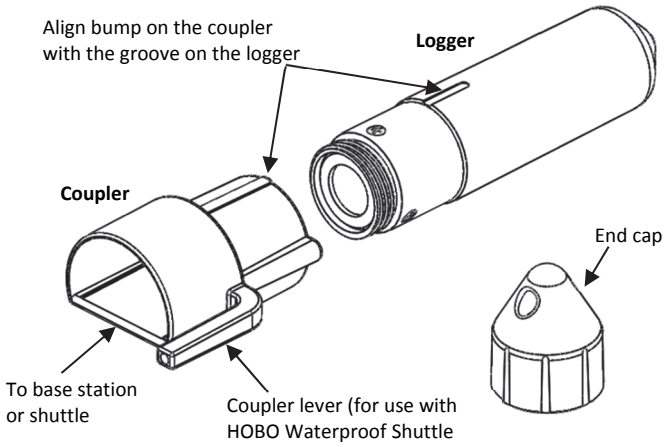
Open HOBOware® Pro software. (Install first if necessary.)

2

The HOBO Water Level Logger requires a coupler (COUPLER2-C) and USB Optic Base Station (BASE-U-4) or HOBO Waterproof Shuttle (U-DTW-1) to connect to the computer. Follow the instructions that came with your base station or shuttle to attach the base station or shuttle to a USB port on the computer.

1. Unscrew the black plastic end cap from the logger by turning it counter-clockwise.
2. Attach the coupler to the base station or shuttle.
3. Insert the logger into the coupler, aligning the bump on the coupler with the groove on the logger. Be sure it is properly seated in the coupler. It may take a few seconds for the new hardware to be detected by the computer.

Note: If you are using the HOBO Waterproof Shuttle, briefly press the coupler lever to put the shuttle into base station mode.



3

From the Device menu in HOBOware, select Launch and configure the launch settings. Make sure both the Abs. Pressure and Temperature sensors are selected (temperature is required for temperature compensation of pressure) and click the Start button in the lower right corner to send the launch settings to the logger. Note that the Start button text changes based on your Start Logging selection.

4

Deploy the logger, making sure the end cap is in place. Take water level reference readings at the beginning and end of each deployment.

5

Use the HOBO Waterproof Shuttle or base station to read out the logger.

6

Relaunch and redeploy logger as needed.

7

Plot data from logger. Print the plot, export data, save it as a project file, and more.

For detailed specifications and information about this logger, refer to the complete product manual. Go to http://www.onsetcomp.com/support/manuals/u20l_17153 or scan the code below.

ONSET
1-800-LOGGERS (564-4377) • 508-759-9500
www.onsetcomp.com/support/contact

This product has been manufactured by Onset Computer Corporation and in compliance with Onset's ISO 9001:2015 Quality Management System.

17150-D MAN-QSG-U20L

Appendix C: City of Newberg HOBO®ware Equipment Inventory

City of Newberg Water Logger Summary

November 2019

Logger Number	Status	Logger Type	Watershed	Logger Location
10754884	Recovered - 2018	Water Temp Pro v2	Hess Creek	Hess at Aspen Way
10939122	Recovered - 2018	Water Level Logger	Springbrook	Springbrook at Benjamin Rd
10911415	Recovered - 2018	Water Level Logger	Springbrook	Springbrook at 219
10939121	Recovered - 2018	Water Level Logger	Hess Creek	Hess at 219 above Culvert
10911416	Recovered - 2018	Water Level Logger	Hess Creek	Hess at 219 - North Fork

Other Available Equiptment	Status	Logger Type
10988963	Not in use Summer of '18	Water Temp Pro v2
10972672	Not in use Summer of '18	Water Temp Pro v2
10988964	Not in use Summer of '18	Water Temp Pro v2
20099164	Not in use Summer of '18	Water Level Logger
20099163	Not in use Summer of '18	Water Level Logger

Appendix D: Field Equipment Checklist

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TMDL Temperature Monitoring Field Equipment Checklist

- ✓ Temperature Probes/Water Level Loggers
- ✓ Maps/Data Sheets/etc.
- ✓ Water Logger Shields
- ✓ Clothesline Wire for Stilling Well/Weighted Plate Installations
- ✓ NIST Temperature Probe
- ✓ Camera/Phone with Waterproof Case
- ✓ Chest Waiters/Hip Boots
- ✓ Wadding Poles
- ✓ Machete w/Leather Gloves
- ✓ Loppers
- ✓ Hand Clippers
- ✓ Wire Cutters
- ✓ Multi-Tool
- ✓ Hat, Sunglasses, Sunscreen
- ✓ Rite in the Rain Notebook
- ✓ Backpack
- ✓ First Aid Kit
- ✓ Traffic cones x2
- ✓ Tape Measure
- ✓ Measuring Pole
- ✓ Towels/Drop Cloths for City Vehicle
- ✓ 5-gallon Bucket for Wet Gear
- ✓ Life Jacket/Reflective Safety Vest
- ✓ Site Access Keys
- ✓ Rope/T-Posts/T-Post Pounder
- ✓ Surveyors Marking Tape

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Downloading Data from a Temperature Monitor

Below are instructions for downloading data from a temperature monitor. These instructions were written based on the actual experience of downloading data and the steps taken. Additional information about downloading data from temperature monitors can be found on the ONSITE HOBOware Pro® website or by referencing the *USGS, Monitoring Stream Temperatures, A Guide for Non-Specialists, 2018* manual.

Equipment Needed:

- HOBO® Water Temperature Pro v2 Data Logger or HOBO® Water Level (13 ft) Data Logger
- HOBO® Waterproof Shuttle and USB connector
- Computer with HOBOware Pro® software installed

Steps to Follow:

1. Open HOBOware Pro® on your computer. It should be noted that the software may need to be installed on a laptop. Previous problems arose trying to download the software onto the City's network.
2. Insert USB cord into computer and attach to the HOBO® Waterproof Shuttle
3. Attach the blue "ONSET coupler for U22/U22/U26/U20L" to the HOBO® Waterproof Shuttle
    a. HOBO® Water Temperature Pro v2 Data Logger – Line up "notch" with coupler to attach
    b. HOBO® Water Level (13 ft) Data Logger – Unscrew cap and then line up "notch" with the coupler to attach
4. Depress "side hook" on the blue coupler until the yellow transfer light turns on the HOBO® Waterproof Shuttle, then let go. The green light will then turn on when the data transfer is complete.
5. In HOBOware Pro®, check the bottom left corner of the screen, the devise should show up as registered i.e. "Dev: HOBO U20L-04 Water Level, S/N: 20099163"
6. At the top of the software program on your computer select "Device", then "Readout"
    a. A popup box will ask "Do you wish to stop logging before reading out the logger?"
    b. "Don't Stop" – if you're planning to do a beginning or end of season quality check
    c. "Stop" if you want to stop logging data (to save battery over the winter)
7. The logger data will then start to download onto the computer.
8. Once complete, safe the file
    a. SN_Location Description_Date (upload the date after the download to include the date range i.e. 2017_01_12_2017_05_06
    b. The saved file produces a ".hobo" file
9. In the Plot Setup Box select "Plot"

10. Then convert the file to a ".cvs" file
    a. "File" -> "Export Table Data" -> "Export" -> Save file with file name; ".csv" file is produced
11. Open the ".csv" file and then "save as" an "Excel Worksheet" file. Sometimes data will corrupt in a ".csv" file and comma separated data will revert back to a text file. It's important to safe ".csv" file to an Excel Worksheet to protect the data and to make future analysis of the data easier without having to use the HOBOware Pro® software.
12. While in HOBOware Pro® the data recording interval can be check along with the battery life of the loggers. Intervals should be set to collect at 5-minutes.
13. When completed be sure to tighten the waterproof cap over the USB port on the HOBO® Waterproof Shuttle. The shuttle can be used to collect data live in the field underwater, but the internal components are not waterproof so it's important that the waterproof cap is secure.

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Monitoring Equipment Accuracy Check

To verify the accuracy of the HOBO® Water Temperature Pro v2 Data Logger and HOBO® Water Level (13 ft) Data Logger they must be checked both before deployment and after deployment. A testing procedure has been developed by the Oregon Watershed Enhancement Board (OWEB) to test equipment accuracy. The detailed steps of the accuracy check can be found below and in Chapter 6 of the *OWEB, Water Quality Monitoring Guidebook Version 2.0, July 1999.* Accuracy checks should be made at two temperatures; one between 5-15°C (42-62°F) and the other between 15-25°C (62-82°F). Testing is done using a stable thermal mass such as a water-filled cooler.

Equipment Needed:

- NIST (National Institute of Standards and Technology) traceable (calibrated and maintained) thermometer accurate to ±0.2°C. The City of Newberg borrows a NIST temperature monitor from the Greater Yamhill Watershed Council (GYWC) because their probe is calibrated on an annual basis as part of the Oregon Watershed Enhancement Board (OBEW).
- HOBO® Water Temperature Pro v2 Data Logger or HOBO® Water Level (13 ft) Data Logger
- Medium Size Cooler
- Paper or excel file to document temperature recordings
- Small weights to submerge temperature monitors
- Bag of ice
- Colander to hold temperature monitors under water

Steps to Follow:

1. The collection interval at which your temperature probe is set will dictate how long the accuracy check will take. If possible it is recommended to use 1-minute intervals.
2. Fill the cooler with water at your desired temperature (try 20°C Room Temperature and 0°C Ice Bath), ice or warm water may need to be added to adjust the temperature.
3. Put the NIST Temperature Probe wire into the cooler and gently shut the lid. Wait approximately 30-45 minutes for the water temperature to stabilize. Do not let the NIST Temperature Probe site on the bottom of the cooler.
4. Record NIST Temperature Probe temperatures every minute for 5 to 10-minutes. A 5-minute interval can also be used.
5. Download the temperature results from the temperature recorders and compare them to the NIST Temperature Probe readings (see next page for example). The average of both the NIST Temperature Probe readings and the temperature recorder readings should then be subtracted from one another to determine the difference.
6. Water temperatures should not vary more than ±0.5°C between the NIST recorded temperature and the data logger's temperature. Units not passing the accuracy test should not be used.
7. Keep the accuracy check data for pre and post deployment in the same folder with the raw data collected in the field.

Appendix F: Newberg TMDL Implementation Matrix 2023-2028

City of Newberg TMDL Implementation Matrix 2023-2028- w/2023 Mercury TMDL Update

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline						Pollutant		
				Ongoing	2023	2024	2025	2026	2027	Mercury	Bacteria	Temperature
Measure No. 1 – Public Education												
PE-1 Stormwater Education	Website Education	Provide stormwater information on the City's website.	Provide general stormwater information and website links to the annual TMDL Implementation Plan.	Ongoing						X	X	X
	Citizen Group Education	Present stormwater information to interested citizen groups at local venues.	Track number of presentations, presentation messages, and number of participants (if available).	Ongoing						X	X	X
	Water Quality Report	Provide stormwater education in the City's annual Water Quality Report.	Provide website links to the annual Water Quality Report, and track stormwater messages included in the report.	Ongoing						X	X	X
PE-2 Watershed Education	Public Signage	Develop public infrastructure signage program.	Develop public infrastructure signage program to determine sign locations and messaging.	Incomplete, but Started	December					X	X	X
		Make progress providing signage at stream crossings or LIDA infrastructure facilities consistent with signage program	Track number of signs installed and associated messages.	Not Started	December					X	X	X
		Make progress marking 50 unmarked catch basins a year with "No Dumping, Drains to Stream" type language.	Track number of catch basins marked per year. Prepare GIS map showing coverage of locations that are permanently marked or marked with after-market plastic labels.	Ongoing						X	X	X
	Student Education	Provide watershed education to students.	Track number of presentations, presentation messages, and number of participants (if available).	Ongoing						X	X	X
Measure No. 2 – Public Involvement												

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline						Pollutant		
				Ongoing	2023	2024	2025	2026	2027	Mercury	Bacteria	Temperature
PI-1 Stormwater Utility Fee	Participate in Citizen Rate Review Committee (CRRC) Meetings	Present stormwater funding needs to CRRC.	Document meeting attendance, adopted rates, and effective dates of rate changes.	Ongoing						X	X	X
PI-2 Public Participation in Stormwater Management	Provide Grant Funding for Water Quality Improvement or Watershed Awareness Projects	Provide a minimum of $2,000 in a grant program to fund non-profit projects that fulfill goals of the TMDL plan.	Track number of funded projects, amount disbursed per project, stream affected, and either the number of stream miles affected or the number of participants.	Ongoing						X	X	X
PI-3 Public Participation in Reporting Stormwater Issues	Public Participation in Stormwater, Illicit Discharge, and Erosion Control Issues	Provide methods for citizens to report concerns during and after business hours. Notify public of available reporting methods.	Document methods and frequency of public notifications.	Ongoing						X	X	X
		Respond to public concerns.	Document number of stormwater, erosion control, and illicit discharge complaints reported by citizens and note resolutions.	Ongoing						X	X	X
PI-4 Public Participation in Determining Stormwater Educational Focus	Determine Focus of Stormwater Educational Messages to the Public	Conduct a public survey to revise and refine educational messages related to stormwater and the TMDL Implementation Plan.	Provide copy or link to survey and report results of the survey.	Completed						X	X	X
Measure No. 3 – Illicit Discharged Detection and Elimination (IDDE)												
ID-1 Train Staff to Implement IDDE Plan	Train Staff in Illicit Discharge Investigation and Spill Response	Train new staff members in illicit discharge investigation and spill response. Provide training in some aspect of illicit discharge investigation and spill response every five years for all applicable staff.	Track type of training (webcast, class, certification, on-the-job, etc.), number of employees trained, and the training subject (maintenance, response, investigation, sampling, etc.).	Ongoing						X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline						Pollutant		
				Ongoing	2023	2024	2025	2026	2027	Mercury	Bacteria	Temperature
ID-2 Implement IDDE Plan	Conduct Illicit Discharge Inspections	Fieldscreen outfalls.	Inventory type, size, and location of public and private outfalls. Map existing and new development outfall locations in GIS.	Completed						X	X	X
		Investigate outfalls for illicit discharges.	Document location, date, cause, and resolution.	Ongoing						X	X	X
	Respond to Illegal Dumps	Clean up illegal dumps.	Track number of illegal dumps, citations issued, and resolution.	Ongoing						X	X	X
	Respond to Illicit Discharges/Spills	Fire Department spill response.	Track date and cause of spills that occur. Document whether the spill reached the stormwater system or a stream and if water sampling was conducted. Document response resolution.	Ongoing						X	X	X
		Public Works illicit discharge/spill response.	Track date and cause of illicit discharges/spills that occur, identified illicit discharges from private wastewater laterals or from failing public infrastructure. Document whether the pollutant reached the stormwater system or a stream and if water sampling was conducted. Document response resolution.	Ongoing						X	X	X
		Provide spill response cards and spill response kits on municipal trucks and sweepers.	Track number of municipal trucks and sweepers with spill response cards and spill kits. Document the number of spill kits used annually in response to spills.	Ongoing						X	X	X
ID-3 Hazardous Waste Collection	Promote opportunity for Residents to Dispose of Hazardous Waste	Promote free hazardous waste collection service twice per year to City residents (offered by Waste Management in Yamhill County)	Track volume of waste received during collection events.	Ongoing						X	X	X
ID-4 Drug Take-Back Collection	Provide Opportunity for Residents to Dispose of	Offer free unused medication collection service to City residents.	Track the volume of unused medication collected annually.	Ongoing						X	X	

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline						Pollutant		
				Ongoing	2023	2024	2025	2026	2027	Mercury	Bacteria	Temperature
	Unused Medication											
Measure 4 – Construction Site Stormwater Runoff Control												
CS-1 Train Staff in Erosion and Sediment Control (ESC)	Train Staff in Plan Review, Site Inspection, and Enforcement of ESC Program	Train new staff whose responsibilities include erosion and sediment control plan review and enforcement. Provide refresher training to all staff involved in ESC every three years.	Document number of staff trained and type of training (on-the-job training, certification, or recertification).	Ongoing						X	X	X
CS-2 Implement Erosion and Sediment Control Program	Implement ESC Program	Conduct ESC plan review.	Document location and type (commercial, industrial, single-family residential, etc.) of all construction project plan reviews. Document which project obtained a DEQ 1200-C permit. Develop and send a notice letter to applicants on wet weather best management practices as weather conditions change.	Ongoing						X	X	X
		Conduct site inspections at least once during active construction by trained or experienced staff.	Provide number of erosion and sedimentation control inspections for each project. Document location and type (commercial, industrial, single-family residential, etc.) of construction project.	Ongoing						X	X	X
		Enforce ECS ordinances.	Report number of warning letters or non-compliance citations by project and resolution.	Ongoing						X	X	X
Measure No. 5 – Post-Construction Runoff Control												
DS-1 Develop Stormwater Management Program	Update Stormwater Development Manuals and Standard Details	Update stormwater design standards manual and standard drawings. Notify development community of proposed new requirements before adoption.	Provide a summary of changes and link to new design standards when adopted.	Ongoing (Incomplete, but started)						X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline						Pollutant		
				Ongoing	2023	2024	2025	2026	2027	Mercury	Bacteria	Temperature
DS-2 Train Staff in Stormwater Management	Train Staff in Stormwater Management	Provide training opportunities for staff in watershed and stormwater management.	Track type of training (webcast, class, on-the-job, certification, etc.), number of employees trained, and the training subject (plan review, inspection, enforcement, etc.)	Ongoing						X	X	X
DS-3 Implement Stormwater Management Program	Require Stormwater Management for Development and Redevelopment	Require stormwater plan submittals and conduct plan reviews.	Document number of construction plan submittals, plan reviews, project type (commercial, institutional, residential, etc.), size, and location.	Ongoing						X	X	X
		Require stormwater management per the Stormwater Development Manuals and Standard Details.	Document number and type (detention basin, flow dissipater, raingarden, filtration swale, etc.) of stormwater facilities required for each project.	Ongoing						X	X	X
		Conduct pre-construction conferences to inform contractors about stormwater requirements.	Document number of pre-construction conferences, project type (commercial, institutional, residential, etc.), size, and location.	Ongoing						X	X	X
	Improve Watershed Management	Evaluate stormwater projects for treatment opportunities (new installations vs. existing infrastructure upgrades) i.e. Stormwater Master Plan.	Summarize hierarchy used for screening. Document location and number of sites reviewed, drainage area, and result of evaluation.	Ongoing						X	X	X
		Implement stormwater projects for treatment opportunities (new installations vs. existing infrastructure upgrades) i.e. Stormwater Master Plan.	Document number of projects including location, size, type (LIDA, traditional, etc.), and drainage area.	Ongoing						X	X	X
	Optimize Water Quality	Inspect public stormwater facilities post-construction.	Conduct a post-construction stormwater facility transfer. Complete final inspection at end of the two-year maintenance agreement. Document facility in	Ongoing						X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline						Pollutant		
				Ongoing	2023	2024	2025	2026	2027	Mercury	Bacteria	Temperature
			GIS/asset management program, obtain and file stormwater as-built drawings, and facility maintenance plan.									
Measure No. 6 – Pollution Prevention in Municipal Operations												
OM-1 Operations and Maintenance (O&M) Manual	Update O&M Policies	Review existing O&M practices.	Document current procedures in an O&M manual.	Completed						X	X	X
		Update O&M manual to optimize water quality.	Document modifications to manual.	Incomplete, but started						X	X	X
	Update Infrastructure Procedures	Review and evaluate the need to update the catch basin cleaning program.	Document current procedures and any modifications to optimize water quality.	Completed						X	X	X
		Implement revised catch basin cleaning program.	Track progress.	Ongoing						X	X	X
	Update Street Sweeping Procedures	Review and evaluate the need to update the street sweeping program.	Document current procedures and any modifications to optimize water quality	Completed						X	X	X
		Implement revised street sweeping program.	Track progress.	Ongoing						X	X	X
OM-2 Operations and Maintenance Training	Train staff in infrastructure and street sweeping procedures that optimize water quality	Train new staff in stormwater maintenance duties in O&M procedures manual.	Track type of training (webcast, class, certification, on-the-job, etc.), number of employees trained, and the training subject (inspections, maintenance, repair, construction, etc.)	Ongoing						X	X	X
		Train all staff in revised O&M procedures manual every three years.	Track type of training (webcast, class, certification, on-the-job, etc.), number of employees trained, and the training subject (inspections, maintenance, repair, construction, etc.)	Ongoing			August			X	X	X
OM-3 Stormwater Infrastructure Maintenance	Maintain stormwater infrastructure	Clean catch basins.	Track number of catch basins cleaned per year.	Ongoing						X	X	X
		Place trash racks over major inlets.	Track number and percentage of major inlets installed with trash racks.	Ongoing						X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline						Pollutant		
				Ongoing	2023	2024	2025	2026	2027	Mercury	Bacteria	Temperature
		Inspect, clean, repair, replace, and install stormline.	Track length of stormline inspected. Document length of stormline cleaned. Document length and location of stormline repaired or replaced. Track length, diameter and location of stormline installed.	Ongoing						X	X	X
		Inspect, repair, and replace culverts.	Document location of repaired and replaced culverts and reason for repair or replacement. For newly installed culverts, document new culvert size and material.	Ongoing						X	X	X
		Inspect and repair public stormwater facilities.	Document number of inspections, type of facility (detention basin, LIDA facilities, vegetated swale, etc.) and whether facilities were categorized as excellent, fair, or poor condition.	Ongoing						X	X	X
		The City's goal is to sweep streets every 4-6 weeks.	Track curb miles swept and debris collected per curb mile each year. Document disposal method.	Ongoing						X	X	X
Temperature												
T-1 Maintain Existing Stream Vegetation	Use Municipal Code and other Measures to Maintain Stream Vegetation	Update Municipal Code that can affect stream health.	Update ordinances that affect stream vegetation.	Ongoing						X	X	X
		Update Stream Corridor Overlay.	Document changes to the Stream Corridor Overlay map and code based on wetland inventory and property annexation.	Ongoing						X	X	X
T-2 Increase Effective Shade	Increase Shade along Streams within the City	Continue with established Trees for Streams Program. Provide incentives when available (free or reduce cost native plant materials) for citizens to plant trees, shrubs, and grasses along tributaries or streams within the City limits.	Document watershed and number of native plant types (trees, shrubs, grasses) planted per year through program activities	Ongoing						X	X	X

Best Management Practice	Strategy	Measureable Goal	Performance Measure	Expected Implementation Timeline						Pollutant		
				Ongoing	2023	2024	2025	2026	2027	Mercury	Bacteria	Temperature
T-3 Stream Assessment	Assess Stream Health and Canopy Coverage	The City's goal is to assess one stream mile annually for vegetative ground cover, stream channel configuration, and canopy coverage.	Document results of assessment.	Ongoing						X	X	X
		The City's goal is to complete a wetland inventory that encompasses the Urban Reserve areas. Update to the wetland inventory will occur when Department of Land Conservation and Development (DLCD) provides funding for City's comprehensive plan periodic review.	Track progress. Provide link to wetland inventory and map.	Ongoing						X	X	X
		Develop stream temperature monitoring program.	Document procedures and identify locations for sampling.	Completed						X	X	X
		Implement stream temperature monitoring program.	Document sampling locations, dates, and results.	Ongoing						X	X	X