WATER ENVIRONMENT SERVICES

COPY

Gregory L. Geist
Director

September 19, 2019

Board of County Commissioners
Clackamas County

Members of the Board:

Approval of a Joint Funding Agreement between
Water Environment Services and the U.S. Geological Survey
for Tualatin River Monitoring

Purpose/Outcomes	This annual funding agreement between WES and the USGS supports the operation and maintenance of a continuous river flow monitoring gauge on the Tualatin River.
Dollar Amount and Fiscal Impact	$5,800 of WES funds are required from the District's approved FY 2019-2020 budget.
Funding Source	WES Surface Water Operating Fund
Duration	October 1, 2019 to September 30, 2020
Previous Board Action/Review	Previous Joint Funding Agreements have been signed by the Board authorizing the use of WES funds since October 1, 1999.
Counsel Review	This Joint Funding Agreement was reviewed and approved by County Counsel on August 15, 2019.
Strategic Plan Alignment	This action: 1. Aligns with WES's Watershed Protection program result to measure and improve stream health, and the Regulatory Management program result to fully implement compliance strategy measures. 2. Aligns with the Board's goal to Honor, Utilize, Promote and Invest in our Natural Resources.
Contact Person	Ron Wierenga, WES Environmental Services Manager, 742-4581
Contract No.	N/A

BACKGROUND:
A coordinated water resources monitoring project (Project) in the Tualatin River watershed has been underway since October 1999. In one element of this Project, Clean Water Services (CWS) of Washington County, the Cities of West Linn and Lake Oswego, and WES partner with the USGS to fund the operation and maintenance of a continuous Tualatin River flow measuring station in the WES service area. The operation of this station is the only element of the Project for which WES funds are allocated. The other elements of the Project, such as the operation of a continuous water quality monitoring station in the WES service area, are funded by CWS and the USGS. The benefits of the overall Project include:

- Compliance with Tualatin River Total Maximum Daily Load Implementation Plan strategy to monitor the Tualatin River.
- High quality flow data, which can be used to: 1) revise FEMA floodplain maps, and 2) calculate the river's pollutant mass loads (i.e. pounds of phosphorus/day) when combined with water quality data.

- Public access to real-time and historic water quality and flow conditions from various locations in the watershed via the USGS' website.

This agreement has been reviewed and approved by County Counsel.

RECOMMENDATION:
District staff respectfully recommends that the Board of County Commissioners of Clackamas County, acting as the governing body of Water Environment Services, approve the Joint Funding Agreement between Water Environment Services and the U.S. Geological Survey for Tualatin River Monitoring.

Respectfully submitted,

Greg Geist, Director
Water Environment Services

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Oregon Water Science Center
2130 SW 5th Avenue
Portland, OR 97201
http://or.water.usgs.gov/

August 8, 2019

Ron Wierenga
Surface Water Manager
Water Environment Service
150 Beavercreek Road
Oregon City, Oregon 97045

Dear Mr. Wierenga,

The U.S. Geological Survey (USGS), City of West Linn, City of Lake Oswego, Water Environment Services, Clackamas County (WES), and Clean Water Services (CWS) collaboratively maintain the operation of the Tualatin River gage (14207500) at West Linn, Oregon. This letter and subsequent joint-funding agreement (JFA) provide the mechanism to continue this relationship and collaboration in Federal fiscal year (FFY) 2020 (October 1, 2019 through September 30, 2020) between USGS and CWS.

The effort to maintain and operate the gage is a collaboration between USGS, City of West Linn, City of Lake Oswego, WES, and CWS. The total cost of operating the gage is $22,250.

Below is a summary of cooperator funding totals for maintaining and operating this gage in FFY2020:

FFY 2020 Tualatin River Gage (14207500)

Cooperator	Cooperator Funds	USGS CMF	Total
Clean Water Services	4,228	2,421	6,649
Clackamas County Water Environment Services	5,800	3,500	9,300
City of West Linn Engineering Department	1,911	1,240	3,151
City of Lake Oswego	1,950	1,200	3,150
Total	$13,889	$8,361	$22,250

Please sign and return one fully-executed original to Andrew Kerslake at kerslake@usgs.gov. The signed agreement is not a bill and no funds are required at this time; rather, the agreement is our legal authority that permits the work to be done and authorizes USGS to accept funds. The USGS Water Resources Cooperative Program operates under the authority of statute 43 USC 50, which allows us to perform this work. The Oregon Water Science Center DUNS number is 137883463.

Federal law requires that we have a signed agreement to continue this work; therefore, please return the signed agreement as soon as possible. If, for any reason, the agreement cannot be signed and returned in the near future, please contact Keith Overton at (503) 251-3246 or email koverton@usgs.gov to make alternative arrangements.

This is a fixed cost agreement to be billed annually via Down Payment Request (automated Form DI-1040). We can bill you on a specific date if that is more convenient relative to your fiscal year planning and budgeting process. Please allow 30 days from the end of the billing period for issuance of the bill. If you experience any problems with your invoice(s), please contact Andrew Kerslake at (503) 251-3253.

The results of all work under this agreement will be available for publication by USGS in collaboration with the CWS. During the course of this jointly planned activity and partnership, USGS may provide unpublished USGS data or information to your office for scientific peer and (or) courtesy review. Guidance concerning USGS's non-disclosure policy will be provided with any review material and is further explained in USGS Fundamental Science Practices website (https://www.usgs.gov/about/organization/science-support/science-quality-and-integrity/fundamental-science-practices).

Sincerely,

JAMES CRAMMOND Digitally signed by JAMES CRAMMOND
Date: 2019.08.08 10:44:30 -07'00'

James D. Crammond
Center Director

Cc: To file, available upon request

Form 9-1366
(May 2018)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement
FOR
Water Resource Investigations

Customer #: 6000001801
Agreement #:
Project #:
TIN #: 93-6002286

Fixed Cost Agreement YES[X] NO[ ]

THIS AGREEMENT is entered into as of the October 1, 2019, by the U.S. GEOLOGICAL SURVEY, Oregon Water Science Center, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and Water Environment Services, party of the second part.

1. The parties hereto agree that subject to the availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation the operation of the Tualatin River gage at West Linn (14207500), herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50, and 43 USC 50b.

2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) include In-Kind-Services in the amount of $0.00

(a) $3,500 by the party of the first part during the period October 1, 2019 to September 30, 2020

(b) $5,800 by the party of the second part during the period October 1, 2019 to September 30, 2020

(c) Contributions are provided by the party of the first part through other USGS regional or national programs, in the amount of: $0

Description of the USGS regional/national program: 4 Way split + CMF

(d) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(e) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.

4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.

5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.

6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.

7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

8. The maps, records or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program, and if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at cost, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records or reports published by either party shall contain a statement of the cooperative relations between the parties. The Parties acknowledge that scientific information and data developed as a result of the Scope of Work (SOW) are subject to applicable USGS review, approval, and release requirements, which are available on the USGS Fundamental Science Practices website (https://www.usgs.gov/about/organization/science-support/science-quality-and-integrity/fundamental-science-practices).

Form 9-1366
(May 2018)

U.S. Department of the Interior
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Customer #: 6000001801
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9. Billing for this agreement will be rendered **annually**. Invoices not paid within 60 days from the billing date will bear Interest, Penalties, and Administrative cost at the annual rate pursuant the Debt Collection Act of 1982, (codified at 31 U.S.C. § 3717) established by the U.S. Treasury.

USGS Technical Point of Contact

Name: Keith Overton
Supv.Hydrologist Data Chief
Address: 2130 SW 5th Avenue
Portland, OR 97201
Telephone: (503) 251-3246
Fax: (503) 251-3470
Email: koverton@usgs.gov

Customer Technical Point of Contact

Name: Ron Wierenga
Environmental Services Manager
Address: Water Environmental Services 15941 S. Agness Avenue
Oregon City, Oregon 97045
Telephone: (503) 742-4581
Fax:
Email: rwierenga@clackamas.us

USGS Billing Point of Contact

Name: Andrew Kerslake
Administrative Officer
Address: 2130 SW 5th Avenue
Portland, OR 97201
Telephone: (503) 251-3253
Fax:
Email: kerslake@usgs.gov

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Telephone: (503) 742-4581
Fax:
Email: rwierenga@clackamas.us

U.S. Geological Survey
United States
Department of Interior

Signature

JAMES CRAMMOND Digitally signed by JAMES CRAMMOND Date: 2019.09.08 10:45:19 -07'00'

By_____ **Date:** _____
Name: James D. Crammond
Title: Center Director

Water Environment Services

Signatures

By_____ **Date:** _____
Name:
Title:

By_____ **Date:** _____
Name:
Title:

By_____ **Date:** _____
Name:
Title:

WATER ENVIRONMENT SERVICES

Gregory L. Geist
Director

COPY

September 19, 2019

Board of County Commissioners
Clackamas County

Members of the Board:

Approval of a Joint Funding Agreement between
Water Environment Services and the U.S. Geological Survey
for Johnson Creek Monitoring

Purpose/Outcomes	This annual funding agreement between WES and the USGS supports the operation and maintenance of a continuous creek flow monitoring gauge on Johnson Creek.
Dollar Amount and Fiscal Impact	$10,000 of WES funds are required from the District's approved FY 2019-2020 budget.
Funding Source	WES Surface Water Operating Fund
Duration	October 1, 2019 to September 30, 2020
Previous Board Action/Review	Previous Joint Funding Agreements have been signed by the Board authorizing the use of WES funds since October 1, 1999.
Counsel Review	This Joint Funding Agreement was reviewed and approved by County Counsel on August 15, 2019.
Strategic Plan Alignment	This action: 1. Aligns with WES's Watershed Protection program result to measure and improve stream health, and the Regulatory Management program result to fully implement compliance strategy measures. 2. Aligns with the Board's goal to Honor, Utilize, Promote and Invest in our Natural Resources.
Contact Person	Ron Wierenga, WES Environmental Services Manager, 742-4581
Contract No.	N/A

BACKGROUND:
A cooperative, multi-jurisdictional hydrology study between the USGS and local governments in the Johnson Creek watershed is proposed to continue during Federal fiscal year 2020. In 1999, Clackamas County Service District No. 1, a part of Water Environment Services, joined this long-term study. Other local governments who plan to participate this year include the Cities of Gresham, Milwaukie, and Portland, Multnomah County, and the East Multnomah County Soil & Water Conservation District. Funds would be used by the USGS to maintain a notwork of several continuous creek water quality and/or flow monitoring stations, and to maintain an existing network of monitoring stations which measure groundwater levels. The benefits of the overall Project include:

- Compliance with Willamette River Total Maximum Daily Load Implementation Plan strategy for Johnson Creek.

- High quality and water quality data flow data, which can be used to: 1) revise FEMA floodplain maps, and 2) calculate the river's pollutant mass loads (i.e. pounds of phosphorus/day) when combined with water quality data.
- Public access to real-time and historic water quality and flow conditions from various locations in the watershed via the USGS' website.

This agreement has been reviewed and approved by County Counsel.

RECOMMENDATION:
District staff respectfully recommends that the Board of County Commissioners of Clackamas County, acting as the governing body of Water Environment Services, approve the Joint Funding Agreement between Water Environment Services and the U.S. Geological Survey for Johnson Creek Monitoring.

Respectfully submitted,

Greg Geist, Director
Water Environment Services

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Oregon Water Science Center
2130 SW 5th Avenue
Portland, OR 97201
http://or.water.usgs.gov/

August 8, 2019

Ron Wierenga
Surface Water Manager
Water Environment Service
150 Beavercreek Road
Oregon City, Oregon 97045

Dear Mr. Wierenga,

The U.S. Geological Survey (USGS), Multnomah County, City of Gresham, City of Portland, East Multnomah Soil and Water Conservation District, City of Milwaukie, and Clackamas County's Water Environment Services (WES) collaboratively maintain the operation of the Johnson Creek hydrologic monitoring program (14211400, 14211499, 14211500, 14211550) in the Johnson Creek Basin, Oregon. This letter and subsequent joint-funding agreement (JFA) provide the mechanism to continue this relationship and collaboration in Federal fiscal year (FFY) 2020 (October 1, 2019 through September 30, 2020).

The combined cost to maintain these gages for USGS and WES will be $15,400. The USGS will provide $5,400 of Cooperative Matching Funds and WES will provide $10,000. Enclosed is a signed original of our standard JFA for the project covering the period October 1, 2019 through September 30, 2020.

Please sign and return one fully-executed original to Peter Koestner at pkoestner@usgs.gov. The signed agreement is not a bill and no funds are required at this time; rather, the agreement is our legal authority that permits the work to be done and authorizes USGS to accept funds. The USGS Water Resources Cooperative Program operates under the authority of statute 43 USC 50, which allows us to perform this work. The Oregon Water Science Center DUNS number is 137883463.

Federal law requires that we have a signed agreement to continue this work; therefore, please return the signed agreement as soon as possible. If, for any reason, the agreement cannot be signed and returned in the near future, please contact Keith Overton at (503) 251-3246 or email koverton@usgs.gov to make alternative arrangements.

This is a fixed cost agreement to be billed annually via Down Payment Request (automated Form DI-1040). We can bill you on a specific date if that is more convenient relative to your fiscal year planning and budgeting process. Please allow 30 days from the end of the billing period for issuance of the bill. If you experience any problems with your invoice(s), please contact Andrew Kerslake at (503) 251-3253.

The results of all work under this agreement will be available for publication by USGS in collaboration with the CWS. During the course of this jointly planned activity and partnership, USGS may provide unpublished USGS data or information to your office for scientific peer and

(or) courtesy review. Guidance concerning USGS's non-disclosure policy will be provided with any review material and is further explained in USGS Fundamental Science Practices website (https://www.usgs.gov/about/organization/science-support/science-quality-and-integrity/fundamental-science-practices).

Sincerely,

JAMES CRAMMOND Digitally signed by JAMES CRAMMOND
Date: 2019.08.08 10:42:22 -07'00'

James D. Crammond
Center Director

Cc: To file, available upon request

Form 9-1366
(May 2018)

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Joint Funding Agreement
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1. The parties hereto agree that subject to the availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation the operation of the Johnson Creek hydrologic monitoring program (14211400, 14211499, 14211500, 14211550) in the Johnson Creek Basin, Oregon., herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50, and 43 USC 50b.

2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) include In-Kind-Services in the amount of $0.00

(a) $5,400 by the party of the first part during the period October 1, 2019 to September 30, 2020

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Description of the USGS regional/national program: 4 Way split + CMF

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Form 9-1366
(May 2018)

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Email: rwierenga@clackamas.us

U.S. Geological Survey
United States
Department of Interior

Signature

JAMES CRAMMOND
Digitally signed by JAMES CRAMMOND
Date: 2019.08.08 10:42:53 -07'00'

By_____ **Date:** _____
Name: James D. Crammond
Title: Center Director

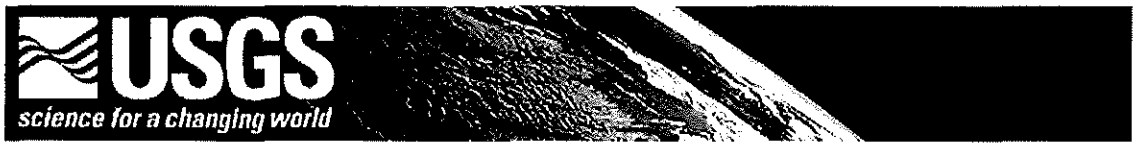
Water Environment Services

Signatures

By_____ **Date:** _____
Name:
Title:

By_____ **Date:** _____
Name:
Title:

By_____ **Date:** _____
Name:
Title:



Hydrologic Monitoring in the Johnson Creek Basin, Oregon

Water Years 2020-2024

Prepared by:

Adam Stonewall (*stonewal@usgs.gov*)
U.S. Geological Survey
Oregon Water Science Center
2130 SW 5th Ave
Portland, Oregon, 97201

Prepared for:

City of Portland, Bureau of Environmental Services
1220 SW 5th Ave, Room 1000, Portland, OR 97204

City of Gresham, Dept. of Environmental Services
1333 NW Eastman Pkwy, Gresham, OR 97030

City of Milwaukie
6101 SE Johnson Creek Blvd, Milwaukie, OR 97206

Multnomah County
1620 SE 190th Ave, Portland, OR 97233

Clackamas County's Water Environment Services
150 Beavercreek Road, Oregon City, OR 97045

East Multnomah Soil and Water Conservation District
5211 North Williams Avenue, Portland, Oregon 97217
July 12, 2019

PURPOSE

Numerous public agencies and organizations are responsible for water quality and stormwater management, endangered species and habitat protection, and watershed restoration and protection in the Johnson Creek watershed. To make wise land-use decisions for the benefit of people and wildlife ecology in the area, decision-makers need information and interpretation of the hydrology of the Johnson Creek basin.

A cooperative study between the U.S. Geological Survey (USGS) and municipalities in the Johnson Creek basin began in 1998. Current cooperators are the cities of Portland, Gresham, and Milwaukie, Multnomah County, East Multnomah Soil and Water Conservation District and Clackamas County's Water Environment Services including Happy Valley. This 5-year plan, for Water Year (WY) 2020-2024 (October 2019 through September 2024) builds on the understanding derived from two decades of study and anticipates needs for further understanding of hydrologic issues in the Johnson Creek watershed. Results from this study provide insight into interaction of the groundwater and surface-water systems, and implications for water quantity and quality in an urbanizing area.

BACKGROUND

A need to understand Johnson Creek flooding was the basis of the original study and cooperative agreement. Through the collection of surface and groundwater data, occurrences of Holgate Lake (an ephemeral lake in southeast Portland) and elevated streamflow levels of Crystal Springs Creek (a tributary located near the mouth of Johnson Creek) and other springs were attributed to elevated groundwater levels in the basin, which resulted from increased levels of recharge during the abnormally wet water years of 1996 and 1997 (Lee and Snyder, 2009). The same study also found that a disproportionate (relative to drainage area) amount of annual streamflow originates from the upper half of the watershed. This has relevance to land-use planning and management of stormwater in the watershed.

Results from the study provide understanding of low (summer) streamflows of Johnson Creek. Streamflow of the lower 5 miles of the creek is dominated by groundwater discharge, and varies depending on recharge conditions. Upstream of the Sycamore gage, which is located near the intersection of SE 148th & Foster Road in Portland, summertime streamflow is minimal.

In addition to providing insight into quantity of streamflow, data collection and interpretation have provided increased understanding of water quality in the Johnson Creek basin. Pesticide and sediment data collected in 1989 and 2002 indicated a linkage of suspended sediment to organochlorine pesticides (DDT, for example). The more recent sampling indicated a decline in pesticide concentration for a given sediment concentration.

Turbidity data and sediment data collected since 2006 were analyzed in a Scientific Investigations Report (Stonewall and Bragg, 2012). The study found that on average 1,890 and 4,640 annual tons of suspended-sediment are transported past the Gresham and Milwaukie streamflow gages, respectively. Although a disproportionately higher (relative to drainage area) amount of suspended-sediment originates upstream of the Gresham gage, the majority of this discrepancy can be explained by higher streamflow yield rather than higher suspended-sediment concentration. In addition, the study showed that approximately 50% of suspended-sediment is transported during the highest 1% of streamflows, suggesting that management of stormwater during flooding may be a more cost-effective solution for limiting sediment-borne contaminants in the creek than other options.

Historic streamflow data, high water marks and local knowledge were used for inundation studies in the Johnson Creek watershed. Annual exceedance probabilities and flood inundation maps were developed for Crystal Springs Creek (Stonewall, 2014; Stonewall and Hess, 2014). Digital flood-inundation maps were created for a 12.9-mile reach of Johnson Creek. The flood-inundation maps depict estimates of water depth and areal extent of flooding from the mouth of Johnson Creek to just upstream of Southeast 174th Avenue in Portland, Oregon (Stonewall and Beal, 2017). Each flood-inundation map is based on a specific water level and associated streamflow at the USGS streamgage, Johnson Creek at Sycamore, Oregon (14211500), which is located near the upstream boundary of the maps. The maps produced by the USGS and the forecasted flood hydrographs produced by National Weather Service River Forecast Center can be accessed through the USGS Flood Inundation Mapper Web site (http://wimcloud.usgs.gov/apps/FIM/FloodInundationMapper.html).

Stream temperature data indicate general warming of Johnson Creek from the upper basin to the lower basin, and a distinct effect from groundwater discharge to the creek. Large, relatively shallow ponds in the Johnson Creek watershed result in summertime warming of the Creek. Although the source of flow to Crystal Springs Creek is relatively cool groundwater, summertime warming due to ponds results in a net increase in temperature of Johnson Creek downstream of the inflow of Crystal Springs Creek.

Crystal Springs Lake is fed by a number of cold-water springs that average around 13.0 °C. However, solar heating and the residence time in the lake result in elevated temperatures that routinely exceed the 18.0 °C Oregon Department of Environmental Quality summer criterion for salmonid rearing and migration. Model results have shown that improved lake management scenarios may result in a decrease in 7-day average of daily maximum values by about 2.0–4.7 °F (1.1 –2.6 °C) for outflow from Crystal Springs Lake during warmest part of the year (Buccola and Stonewall, 2016) .

Products from the cooperative study since 1998 include both data and interpretive reports. Groundwater data include both periodic water-level observations and records from continuous water-level recorders. Surface-water data include streamflow, temperature, turbidity and suspended-sediment data. Interpretive products consist of a report on pesticides and sediment (Tanner and Lee, 2004), a report on the groundwater and surface water hydrology of the Johnson Creek basin (Lee and Snyder, 2009), a report on sediment loading at the Gresham and Milwaukie sites on Johnson Creek (Stonewall and Bragg, 2012), a fact sheet intended for a less technical audience summarizing findings from the past decade's study (Williams and others, 2010), a webpage detailing the calculation of annual exceedance probabilities in Crystal Springs Creek (Stonewall, 2014), a report detailing the development of a temperature model used to evaluate management scenarios for Crystal Springs Creek (Buccola and Stonewall, 2016), a report detailing the evaluation of flood inundation maps for Crystal Springs Creek (Stonewall and Hess, 2016), a report detailing the development of flood-inundation maps for Johnson Creek (Stonewall and Beal, 2017), a report detailing sub-basin hydrology in upper Johnson Creek (in progress) and a follow-up report on streamflow, turbidity and suspended-sediment in the upper Johnson Creek basin (in progress).

PROBLEM

To make wise land-use decisions for the benefit of people and wildlife ecology in the area, decision-makers need information and interpretation of the hydrology of the Johnson Creek basin. Streamflow data are needed to:

- assess real-time flooding hazards,
- access the effectiveness of restoration efforts,
- quantify water-borne contaminants, also
- historical streamflow data are needed for engineering and watershed management designs.

Water quality data such as temperature, turbidity and suspended-sediment data are needed to:

- evaluate efforts at meeting Total Maximum Daily Load (TMDL) standards, and
- evaluate and prioritize restoration efforts.

Groundwater data are needed to:

- predict low and high streamflow at key springs in the lower watershed,
- design stormwater facilities,
- predict flooding around Holgate Lake,
- update groundwater elevation maps,
- evaluate the effects of regional development on groundwater levels,
- determine the direction of groundwater flow in the basin,
- monitor short and long-term changes in groundwater recharge, storage and flow direction, and
- monitor the effects of climate variability in the basin.

Previous studies and reports have detailed suspended sediment at the USGS gages 14211400 (Johnson Creek at Regner Road, at Gresham, Oregon), and 14211550 (Johnson Creek at Milwaukie, OR), but a more detailed investigation of basin-wide sediment transport would be beneficial. Some sediment data are collected by local agencies (Cities of Portland and Gresham, and the East Multnomah Soil and Water Conservation District), but these data are not currently incorporated into a basin-wide analysis. In addition, local agencies collect sediment by examining Total Suspended Solids (TSS). The method for determining TSS was originally analysis of wastewater, and research by the USGS has shown that TSS is "fundamentally unreliable" for the analysis of natural-water samples (Gray and others, 2000). An analysis is needed to examine and quantify the local relationship between TSS and Suspended-Sediment Concentration (SSC). In addition, little is known about the types of contaminants sorbed to suspended-sediment in Johnson Creek.

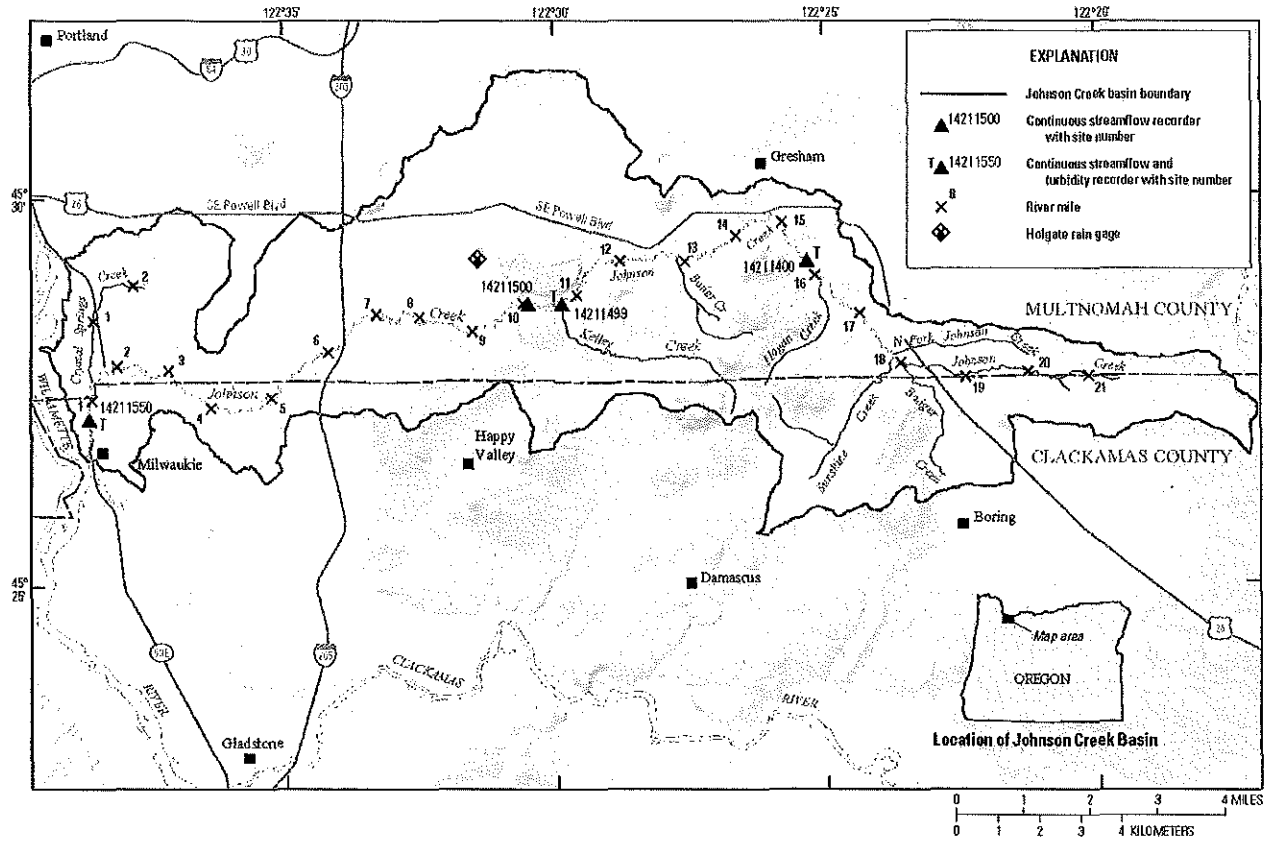


Figure 1. Location of study area and streamflow-gaging stations used for temperature and turbidity monitoring, Johnson Creek basin, Oregon.

OBJECTIVES

- Continue to collect streamflow data to assess flooding hazards real-time, and to further inform management decisions.
- Continue to collect temperature and turbidity data to assess restoration efforts and monitor stream health.
- Continue to collect groundwater data to predict spring streamflow, flooding at Holgate Lake, and to provide groundwater data to UIC Program/Stormwater WPCF Permit Programs .
- Collect sediment and turbidity data to further the understanding of processes that drive sediment transport in the Johnson Creek watershed, and to predict where restoration efforts may result in the greatest reduction in unwanted sediment transport.

CURRENT RELEVANCE AND BENEFITS

The project is relevant to the objectives of the USGS Federal-State Cooperative Program:

- HYDROLOGIC HAZARDS: One focus of the study in this highly urbanized basin relates to hydrologic hazards in an area that is undergoing significant changes in land use. Flooding, both from rainfall events and from rising ground-water levels has damaged properties. Real-time data from monitoring sites in the basin are being used by cooperating agencies to make decisions regarding these hazards.

- WATER QUALITY: Analysis of stream temperature and turbidity data provide insight into the effects of land-use practices. Stream and riparian-area restoration projects, conversion of agricultural land to urban uses, changes in land use that affect recharge (and eventual discharge to streams), and modification of the network of urban storm-drains may have effects on both stream temperature and turbidity.
- INTERACTION BETWEEN SURFACE WATER AND GROUND WATER: Understanding the groundwater flow system is necessary to analyze changes in streamflow in the basin. Spring flows have caused flooding in the lower part of the basin. Groundwater discharge to streams is the primary source of summertime streamflow. Understanding the movement of groundwater and its eventual discharge to streams helps maintain both the quantity and quality of summertime streamflow in the Johnson Creek basin.

The project is relevant to the objectives of the following municipalities:

City of Gresham

- Surface monitoring: to inform design and on-going effectiveness of restoration and engineering projects
- Groundwater monitoring: to determine effectiveness of stormwater management in developing communities
- Water quality: provides data to evaluate whether TMDL and other goals are being met.

City of Milwaukie

- Surface monitoring: to inform design and on-going effectiveness of restoration and engineering projects
- Flooding: real-time streamflow data used to predict and prepare for flood events.

City of Portland

- Sub-watershed planning: to provide baseline and ongoing data to determine effectiveness of restoration and stormwater management practices
- Continuation of data on surface and groundwater: to inform design and on-going effectiveness of restoration and engineering projects
- Water quality: provides data to evaluate whether TMDL and other goals are being met.
- Flooding: real-time streamflow data used to predict and prepare for flood events.

Clackamas County Water Environment Services

- Surface water monitoring: to inform design and on-going effectiveness of restoration and engineering projects
- Continue to collect groundwater data to support the Stormwater WPCF Permit Program
- Surface Water quality: provides data to assist with evaluating whether TMDL WLAs/LAs and Watershed Health goals are being met.

Multnomah County

- Water quality: understanding water quality impacts from rural unincorporated County areas for TMDL pollutants.
- Water quantity: understanding drainage issues and needs from rural areas and their impact on County road drainage systems.
- Watershed health: provides baseline and ongoing data to determine the effectiveness of coordinated restoration activities through the Interjurisdictional Committee of Johnson Creek.

East Multnomah Soil and Water Conservation District

- Water quality: understanding water quality impacts from rural unincorporated areas for TMDL pollutants.
- Water quantity: understanding drainage issues and needs from rural.
- Watershed health: provides baseline and ongoing data to determine the effectiveness of coordinated restoration activities through the Interjurisdictional Committee of Johnson Creek.

APPROACH

In general, the network of groundwater, streamflow, stream temperature and turbidity sites developed over the previous several years will be continued. Focused data-collection efforts occur in some years, and are followed by interpretive reports. All data and reports are available at: https://or.water.usgs.gov/proj/or175/index.html.

Groundwater data collection and analysis will build upon the work done in the Portland Basin Groundwater Study (McFarland and Morgan, 1996), by Snyder (2008), and specifically in the Johnson Creek basin by Lee and Snyder (2009), providing understanding of the interaction between the aquifer system, springs, and Johnson Creek. The groundwater data collection network will consist of two continuous water-level recorders, monitoring water-level changes that occur in response to specific precipitation (recharge) events and that may result in increased discharge to springs. The current network of recorders will be augmented by 10 observation wells.

Streamflow measurements are made to provide understanding of the temporal and spatial distribution of groundwater discharge to Johnson Creek and tributary streams. Streamflow measurements other than those made at stream gages for surface water records are typically made on an ad hoc basis, such as those made in the summers of 2012 and 2013 in support of the Johnson Creek Watershed Council/IJC bacteria study, and those made in conjunction with suspended-sediment studies.

The surface water network consists of streamflow sites on Johnson Creek at Regner Road in Gresham, Sycamore in Portland, and at SE Milport Road in Milwaukie, and on Kelley Creek. Another gage will be added at Crystal Springs Creek near Bybee Street in late FY 2019. Data from each site consists of real-time water level, streamflow, and stream temperature. Turbidity sensors are located at the Gresham and Milwaukie sites.

Continuation of the streamflow sites amounts to about one third of the budget for each year and is critical to understanding long-term trends in the basin. Streamflow data from the Sycamore site, operated continuously since 1940, represents one of the longest periods of record on an urban stream in Oregon. Streamflow data have been collected at the Milwaukie site since 1989. More recently, data collection began at Johnson Creek in Gresham (1998), and on Kelley Creek (2000). The streamflow monitors in the upper part of the Johnson Creek basin and on Kelley Creek are in place to track flow-response characteristics in areas undergoing (or expected to undergo) changes in land use. Annual streamflow volume at each site contributes to understanding of the water balance in the basin, and relative contribution of runoff and ground-water discharge to the upper, middle, and lower parts of the Johnson Creek basin. As changes continue to occur in the basin, such as increases in impervious area, and routing of storm runoff to drywells and stormwater detention ponds, flow volume calculated at the streamflow sites will help identify the affects of these changes on the hydrology of Johnson Creek. Peak streamflow is

used for calculation of flood frequency and assessment of the effect of ongoing land-use change in the basin. Low-flow streamflow data provide baseflow information, critical in understanding the contribution of groundwater to the stream. In real time, stream level is used for emergency planning and preparedness of residents and businesses in the area. Long-term stream temperature data will provide insight into the effectiveness of measures to mitigate the effects of stream warming that is characteristic of an urban setting. Modeling, both hydraulic (flow and water level), and water quality (primarily stream temperature) has been done in the basin over the past decades for multiple purposes by various agencies, researchers, and consultants. The foundation of successful modeling is the long-term data such as is collected in this project. Finally, streamflow data, especially from sites with relatively stable land-use patterns can be used to evaluate and track the effects of climate change.

In addition to the core data collection of surface water, groundwater and water quality data, other specific elements of the program for WY 2020-2024 are identified below:

WY 2020-2023

Sediment: Three 'roving' turbidity gages will be installed in the watershed and moved to new locations each year. These gages will provide 15-minute turbidity data and be placed in areas that either have known sediment issues, are of particular interest to one or more cooperators, provide insight into current, recent or future restoration efforts, or provide insight into the overall sediment budget of Johnson Creek or one of its main tributaries.

Suspended-sediment sampling will take place at the roving gages in order to develop a relationship between turbidity and suspended-sediment concentration (SSC). In addition, a select number of samples will also be analyzed for TSS in order to develop as TSS-SSC relationship, and to ascertain if this relationship is relatively constant throughout the watershed. The computed turbidity-SSC relations will be used to calculate suspended sediment loads at the roving gages. These loads will be compared against the sediment loading at the long-term stations (Regner Road at Gresham and Millport Road at Milwaukie) to ascertain how 'productive' each location is (pounds of sediment per square mile of drainage area), and to evaluate how much sediment was transported in Johnson Creek compared to average years.

WY 2024

Report: Sediment Analysis for the Johnson Creek Basin. This report will analyze the four years of sediment, turbidity and streamflow data collected in the Johnson Creek Watershed.

QUALITY ASSURANCE/QUALITY CONTROL

Streamflow data will be collected according to the Oregon Water Science Center Surface Water Quality Assurance/Quality Control Plan. Temperature, sediment and turbidity data will be collected according to Wagner and Others (2006). Groundwater data will be collected according to the Quality-Assurance Plan for District Groundwater Activities of the U.S. Geological Survey (Brunett and others, 1997). All data collected by volunteers will be reviewed by qualified USGS personnel.

REPORTING AND PRODUCTS

Progress will be relayed to the cooperators through regular meetings. The primary contact is through the Johnson Creek Interjurisdictional Committee, which meets monthly. Updates will occur as needed throughout the project. All data collected will be archived in the USGS National Water Information System, and through the interpretive report indicated above.

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TIMELINE

Standard time series of surface-water, water-quality and groundwater data will be archived on an annual basis. Sediment and turbidity data collection and the associated report will follow the proceeding timeline:

Calendar year	2020-2023	2024

Federal Fiscal Year	2020-2023				2024			
Fiscal Year Quarter	1	2	3	4	1	2	3	4
Sediment/Turbidity Data Collection								
Technical Documentation								
In-house and Section Chief Review								

PERSONNEL

The project chief will be a Hydrologist with experience in collecting hydrology data and writing hydrology reports. The project chief will be assisted by Oregon Water Science Center staff including: Hydrologists, Hydrologic Technicians, the Surface-Water Specialist, the Water-Quality Specialist and the Groundwater Specialist.

BUDGET SUMMARY

Federal fiscal year/ Project element	2020 10/19 to 9/20	2021 10/20 to 9/21	2022 10/21 to 9/22	2023 10/22 to 9/23	2024 10/23 to 9/24
Streamflow and temperature sites: Johnson Creek at Gresham, Sycamore, Milwaukie, and Kelley Creek	$103,040	$107,080	$111,320	$114,560	$117,400
Turbidity (Gresham and Milwaukie)	$38,090	$39,610	$41,200	$42,850	$44,560
Groundwater sites: Periodic and continuous recorders	$8,820	$9,090	$9,360	$9,640	$9,930
Sediment Focus	$12,200	$12,200	$12,200	$12,200	
Report					$13,000
Project management	$12,150	$12,220	$11,920	$13,050	$13,710
Total	$174,300	$180,200	$186,000	$192,300	$198,600
Funding distribution					
USGS	$61,100	$63,300	$65,500	$67,800	$70,200
City Portland	$47,100	$48,700	$50,400	$52,200	$54,000
City Gresham	$24,400	$25,300	$26,200	$27,100	$28,000
City Milwaukie	$11,000	$11,400	$11,800	$12,200	$12,600
Water Environment Services (includes City of Happy Valley)	$10,000	$10,000	$10,000	$10,000	$10,000
Multnomah County	$8,100	$8,400	$8,600	$9,000	$9,300
East Multnomah SWCD	$12,600	$13,100	$13,500	$14,000	$14,500
Cooperator total	$113,200	$116,900	$120,500	$124,500	$128,400