EF-A 03

Temperature and Groundwater Assessment – Conceptual Design

Reach: Lower mainstem EF Lewis and tributaries
River mile: 0.0 to 14.5
Reference page in main document: 75

Assessment Project Description

This conceptual study design describes stream temperature and groundwater monitoring and assessment activities that will support the identification and development of stream habitat enhancement efforts within the Lower East Fork Lewis River Basin. This project was moved forward to the conceptual design phase in front of other higher scoring projects because of its relevance to project planning in the basin (East Fork Lewis Working Group decision).

Summer temperatures in the mainstem East Fork Lewis are known to exceed the preferred range for salmon and trout. Although temperature assessment work has been conducted in the lower EF Lewis River as part of the WA Department of Ecology TMDL study, and other monitoring efforts, additional information is needed to support the development of restoration actions within the lower river. Specifically, there is a need to comprehensively describe the spatial and temporal distribution of the mainstem river temperature profile and the influence that cold/warm water sources have on the overall river temperature. Data is also needed to detect and describe potential sources for cold water refuge habitat in the lower river that may provide critical rearing conditions during periods of near-lethal water temperatures.

In combination with stream temperature assessment, groundwater monitoring is also necessary to help identify and prioritize potential habitat restoration areas that receive inputs of cool groundwater / hyporheic flow throughout the summer. These areas may include abandoned wall-based channels, old meander scars, or floodplain wetlands. Groundwater assessment should focus on areas where topographic, hydrologic, and geomorphic conditions suggest the potential for groundwater-fed off-channel areas. Monitoring will involve the installation of groundwater monitoring wells used to track water table elevations and groundwater temperatures throughout the dry period.

Implementation of this temperature and groundwater assessment is not an absolute requirement for restoration project advancement; however, this information will enhance the ability to compare project cost/benefit; and for projects that are carried forward, it will provide a robust dataset to be used in project design.

Species and Life Stages Addressed:

Steelhead, coho - summer rearing. All species and all freshwater life-stages affected to some degree

Limiting Factors Addressed:

Temperature, key habitat quantity, habitat diversity

Assessment Design & Data Collection

Baseline Temperature Monitoring

The objective of the baseline monitoring is to describe the spatial and temporal distribution of the mainstem river temperature profile and the influence that cold/warm water sources have (if any) on the overall river temperature. The results of this assessment can be used to pinpoint areas of cool water input that might be targeted for habitat enhancements or areas of warm water input that should be the target of temperature restoration efforts.

Temperature logger installed to monitor a cold water habitat site

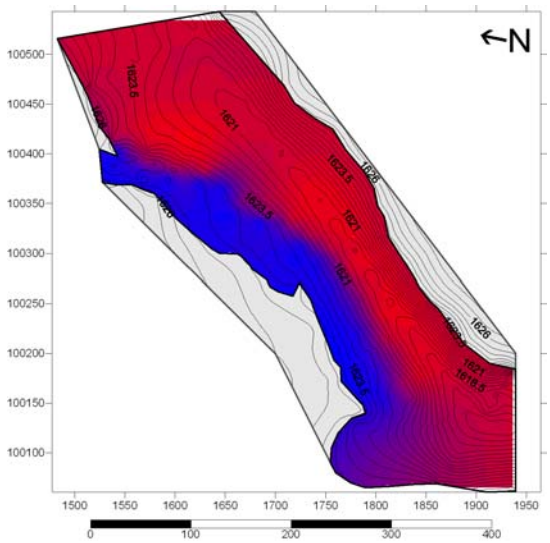
- Deploy continuous electronic temperature data loggers (i.e. HOBO) throughout the Lower East Fork Lewis River to describe the temporal and spatial temperature profile of the Lower River (RM 0.0 – RM 15.0).
- Build off of existing data collected by agencies and restoration practitioners.
- Survey period should extend from June 1st to October 31st. Logger calibration and deployment should follow WA Dept of Ecology temperature monitoring protocol and should include monthly data downloads to QA/QC equipment and reduce data loss.
- Data loggers should be installed at regular intervals in the mainstem (e.g. every mile) in thermally mixed waters. Loggers should be placed in order to determine tributary temperature influence (if any) on mainstem temperatures. A logger should be installed at the base of each tributary; and in the larger tributaries, a logger should be placed upstream where the tributary enters the East Fork valley bottom and experiences a change in channel and vegetation conditions. Logger locations should also be placed to correspond to locations used in the past for the TMDL or other monitoring efforts. The estimated number of temperature loggers required for mainstem, tributary, and off-channel monitoring is approximately 50. This does not include extensive sampling in the tributaries. See attached figures for initial recommended logger locations.
- Additional temperature information should be collected in the Ridgefield Pits reach to support restoration planning in that

reach. Two loggers should be placed in each pond (one near the surface and the other near the bottom) to establish the temperature profile of each captured mine pit. At least 14 loggers should be placed throughout the reach in the mainstem river to detect changes in temperature related to the captured mine pits.

- Logger locations should be geo-referenced using GPS waypoints and aerial photographs, and other notes regarding their specific location.
- At least 2 temperature loggers should be used to collect ambient air temperatures throughout the season.
- An alternative assessment option is to conduct a thermal imaging flight (i.e. FLIR) for the mainstem East Fork Lewis. This alternative has been considered in the past by WA Department of Ecology. A thermal imaging assessment could provide useful information on the spatial variation of surface temperatures. This alternative warrants further consideration.

Detection and Monitoring of Thermal Refuge and Groundwater Sources

The objective of this portion of the assessment is to identify and describe persistent cold water refugia throughout the project area. Initial reconnaissance surveys are conducted throughout the mainstem and off-channel areas. Once a potential cold water location is identified, temperature loggers are installed.



Example of cool patch location in off-channel area

- Reconnaissance level cold water habitat detection surveys can be conducted using a digital or calibrated handheld thermometer (accuracy of $\pm 0.3^{o}$C). Any habitat feature with a temperature of 2.0^{o}C colder than the mainstem temperature should be flagged for further investigation.
- Reconnaissance surveys should be conducted at all the existing significant off-channel areas and on the mainstem, especially where topographic features suggest the potential for spring inflow (e.g. where topo lines denote depressions).
- Reconnaissance surveys need to be conducted during the warmest part of the day (12:00-4:00 pm) and during the warmest period of the year (July – August).
- Continuous data loggers should be deployed at sites identified during the reconnaissance survey to monitor for cold water persistence over the balance of the survey season. GPS coordinates should be collected to map the site. Additional habitat features such as shade measurement, water quality (D.O., pH, and mineral content) should also be collected depending on site conditions.

Groundwater / Hyporheic Flow Monitoring

Multiple sites have been identified for potential enhancement along the lower mainstem that may provide off-channel rearing and temperature refuge for steelhead, coho, and Chinook. These include wall-based channels, abandoned side-channels, flood overflow channels, previous main channel locations, and floodplain wetlands. For many of these sites, observations suggest there is suitable groundwater connectivity; however, specific water table depths, temperatures, water quality, and seasonal groundwater flow rates are unknown. Monitoring at these sites will help to identify suitable enhancement project locations and will support project design. In particular, information on groundwater table elevations and flow rates will help to determine the depth of required excavation for off-channel creation projects and will help determine the need for other design features such as groundwater collection galleries.

- Recommended sites for groundwater monitoring are included in the attached figures. A total of 20 well locations are included at a total of 9 sites. These sites should be considered a preliminary list of sites that may be amended depending on more detailed site investigations and depending on the potential for future project work at the site.
- Sampling should target low water periods, typically July through September.
- Sampling can be conducted using electronic continuous data recorders to record water table elevation (stage) as well as temperature. At most sites, two or more wells should be used, one nearer the main channel (e.g. beginning of the backwater channel/scar) and one at the more distant end of paleo-channel features or wetlands. Additional wells will be needed for large sites. Multiple wells at a site helps to portray a complete picture of water table elevations and also allows for the calculation of groundwater flow rates / substrate transmissivity.
- Groundwater wells will typically require an excavator or backhoe to install, but in some sites they may be able to be installed using hand tools. Access conditions may limit the ability to install wells at some sites.
- The electronic data recorders should be downloaded once during mid-sampling season and given QA/QC review in order to reduce data loss.

- Water quality parameters for dissolved oxygen, mineral content, and pH can also be collected at sites that are fed by groundwater but that have little surface flow influence in order to detect potential water quality concerns that would affect aquatic biota.
- Logger locations should be geo-referenced using GPS waypoints and aerial photographs, and other notes regarding their specific location.

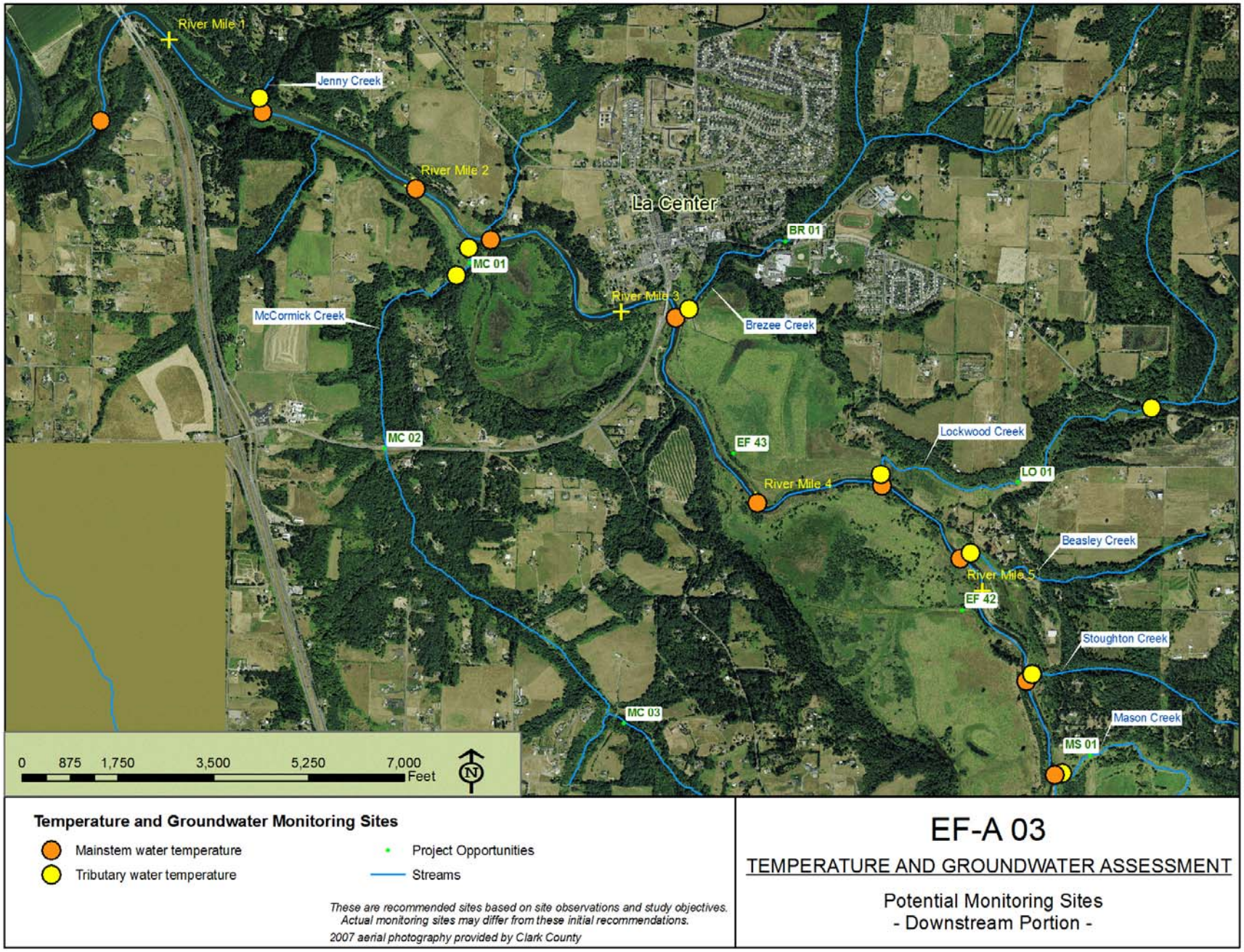
Access and Landownership

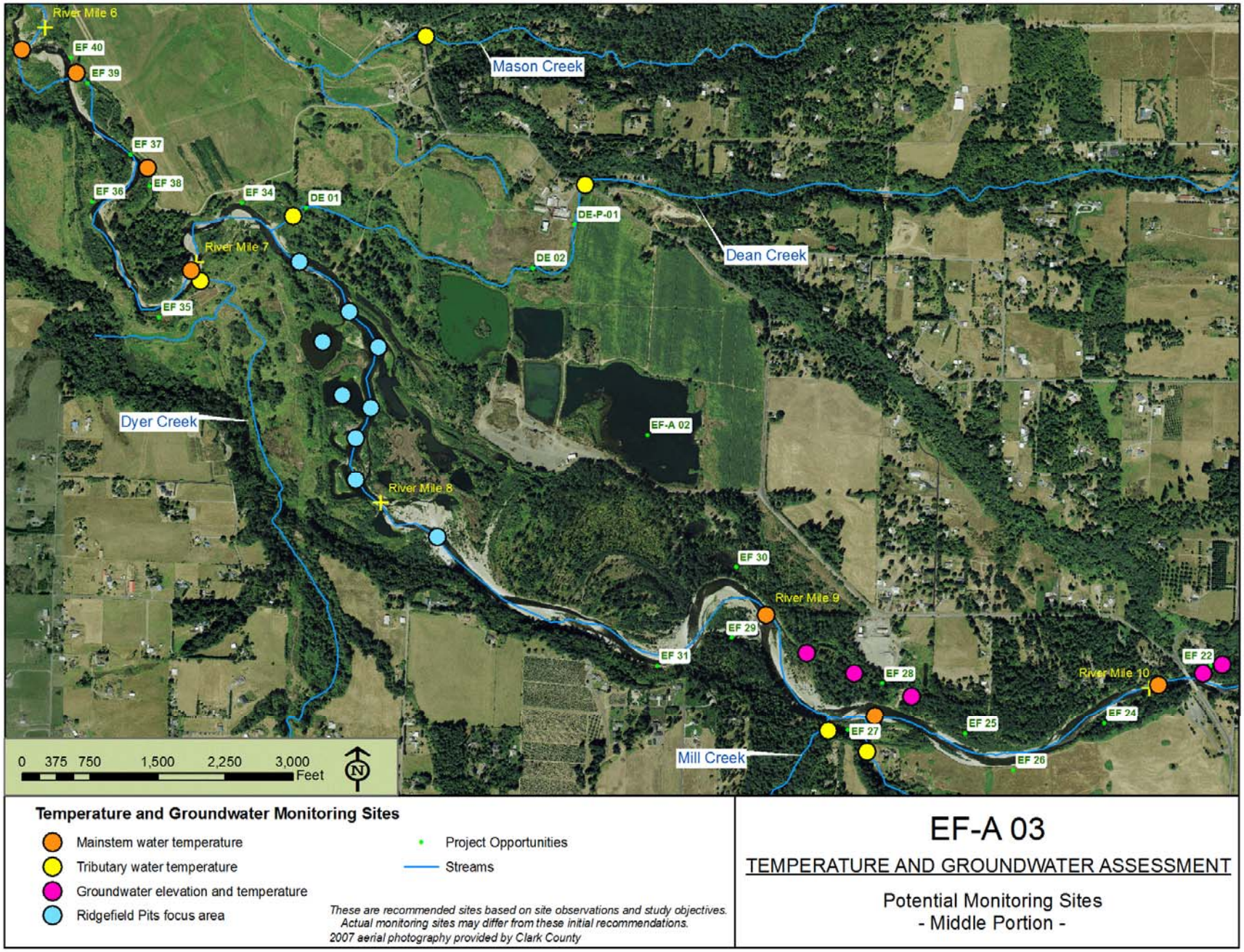
Some potential monitoring sites are located on private lands. No temperature or groundwater monitoring work will be conducted without full landowner willingness.

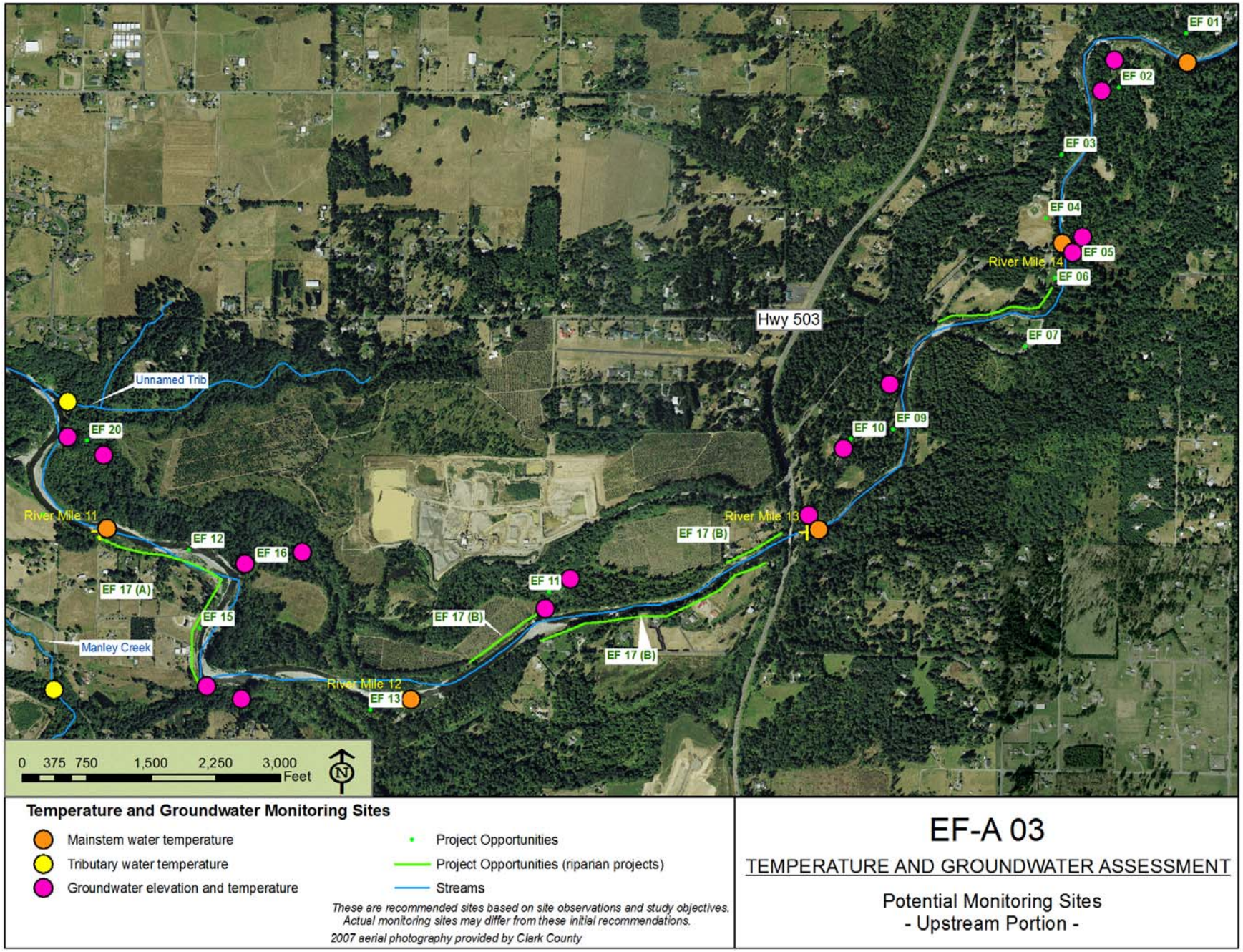
Data and Analysis Requirements

Temperature Analysis: Temperature data should be stored in a computer database and GPS locations should be downloaded into a Geographical Information System (GPS) and overlaid onto digital aerial photographs. Prior to analysis, data from each logger will require QA/QC to identify and remove any anomalous data. Data analysis should include calculation of the maximum 7-day maximum (max 7DMAX) and maximum 7-day average (max 7DAVG) for the period of monitoring, as well as other metrics as determined as part of the study. Results should include a detailed description of the temperature profile (maximum and average) throughout the sampling season in both the mainstem and off-channel sites and identification of persistent cold water sites.

Groundwater Analysis: Well data should be stored in a computer database and GPS locations should be downloaded into ArcGIS and overlaid onto digital aerial photographs. Prior to analysis, data from each logger will require QA/QC to identify and remove any anomalous data. Data analysis will determine water table elevations, thermal profiles at the site, low-season flow volumes and residence time of water traveling through the project area.


River Mile 1
Jenny Creek
River Mile 2
La Center
BR 01
MC 01
River Mile 3
McCormick Creek
Brezee Creek
MC 02
EF 43
Lockwood Creek
LO 01
River Mile 4
Beasley Creek
River Mile 5
EF 42
Stoughton Creek
MC 03
Mason Creek
MS 01
0 875 1,750 3,500 5,250 7,000 Feet
N
Temperature and Groundwater Monitoring Sites
Mainstem water temperature
Tributary water temperature
Project Opportunities
Streams
These are recommended sites based on site observations and study objectives.
Actual monitoring sites may differ from these initial recommendations.
2007 aerial photography provided by Clark County
EF-A 03
TEMPERATURE AND GROUNDWATER ASSESSMENT
Potential Monitoring Sites
- Downstream Portion -


River Mile 6
EF 40
EF 39
Mason Creek
EF 37
EF 38
EF 36
EF 34
DE 01
DE-P-01
River Mile 7
DE 02
Dean Creek
EF 35
Dyer Creek
EF-A 02
River Mile 8
EF 30
River Mile 9
EF 29
EF 31
EF 28
EF 22
River Mile 10
EF 24
EF 27
EF 25
Mill Creek
EF 26
0 375 750 1,500 2,250 3,000 Feet
N
Temperature and Groundwater Monitoring Sites
Mainstem water temperature
Tributary water temperature
Groundwater elevation and temperature
Ridgefield Pits focus area
Project Opportunities
Streams
These are recommended sites based on site observations and study objectives.
Actual monitoring sites may differ from these initial recommendations.
2007 aerial photography provided by Clark County
EF-A 03
TEMPERATURE AND GROUNDWATER ASSESSMENT
Potential Monitoring Sites
- Middle Portion -


EF 01
EF 02
EF 03
EF 04
EF 05
EF 06
EF 07
EF 09
EF 10
EF 11
EF 12
EF 13
EF 15
EF 16
EF 17 (A)
EF 17 (B)
EF 17 (B)
EF 17 (B)
EF 20
Hwy 503
River Mile 11
River Mile 12
River Mile 13
River Mile 14
Unnamed Trib
Manley Creek
0 375 750 1,500 2,250 3,000 Feet
N
Temperature and Groundwater Monitoring Sites
Mainstem water temperature
Tributary water temperature
Groundwater elevation and temperature
Project Opportunities
Project Opportunities (riparian projects)
Streams
These are recommended sites based on site observations and study objectives.
Actual monitoring sites may differ from these initial recommendations.
2007 aerial photography provided by Clark County
EF-A 03
TEMPERATURE AND GROUNDWATER ASSESSMENT
Potential Monitoring Sites
- Upstream Portion -

Planning-level cost estimate for EF-A 03

Note: This is a preliminary cost estimate for planning purposes. Actual costs may vary substantially from these estimates. This estimate is based on assumptions for time requirements and material quantities. Additional information obtained during site investigations will be needed to determine actual quantities and costs. Estimates are based on 2009 costs.

Description	Unit	Quantity	Unit Cost	Total Cost	Comment
Monitoring Design Development	LS	1	$5,000	$5,000	Includes preparation of detailed sampling plan and schedule
Baseline sampling: temperature logger purchase	EA	50	$150	$7,500	Includes mainstem and tributary surface water temperature sites
Baseline sampling: logger deployment supplies and prep	EA	50	$25	$1,250	Includes time and materials for preparing deployments
Baseline sampling: temperature logger servicing	LS	1	$18,000	$18,000	Assumes 3 site visits to each of 50 locations for 1) deployment, 2) mid-season download and QA/QC, 3) retrieval. (contracted wages)
Cold water refugia sampling: temperature logger purchase	EA	15	$150	$2,250	Assumes monitoring of 15 cold water refugia sites
Cold water refugia sampling: field reconnaissance	LS	1	$7,500	$7,500	Does not include tributary surveys (mainstem and connected off-channels only). (contracted wages)
Cold water refugia sampling: temperature logger servicing	LS	1	$1,500	$1,500	Only retrieval. Assumes deployment covered in reconnaissance.
Groundwater monitoring: logger purchase	EA	20	$600	$12,000	Used in wells for monitoring water table elevation and water temperature
Groundwater monitoring: well materials	EA	20	$100	$2,000	PVC, accessories, and tools for construction
Groundwater monitoring: well construction	EA	10	$3,000	$30,000	Assumes 10 sites with 2 wells per site. Assumes a small excavator or backhoe is used to dig wells. Assumes easy access conditions.
Groundwater monitoring: logger servicing	LS	1	$6,000	$6,000	Assumes 3 site visits to each of 20 locations for 1) deployment, 2) mid-season download and QA/QC, 3) retrieval. (contracted wages)
Data reduction and analysis	LS	1	$5,000	$5,000	Includes data entry, QA/QC, and basic data analysis
Implementation Sub-Total				**$98,000**	
Concept Level Implementation Contingency (20%)				$19,600	
Implementation Total				**$117,600**	
Project Delivery					Items below are calculated as a percent of the construction sub-total
Development of final report (15%)				$14,700	
Contract Administation (5%)				$4,900	
Project Delivery Sub-Total				**$19,600**	
TOTAL ESTIMATE				**$137,000**	rounded to nearest $1,000

General Notes:

Cost includes a 20% implementation contingency

This estimate assumes only basic data analysis and reporting is conducted. In-depth analysis and correlation of data with environmental variables is not included.

This estimate does not include water quality monitoring of parameters other than water level and temperature.

Assumes an excavator or backhoe is necessary to dig wells into gravel/cobble substrate. Savings could be gained if wells can be dug with hand tools.

Reducing the number of sites will reduce costs

Key

LS = Lump sum

EA = Each