Total Maximum Daily Loads: Temperature TMDL Replacement project: **Lower Columbia-Sandy Subbasin**

March. 21, 2023, 2 p.m.

Technical Informational Webinar

Webinar purpose

- Provide background information on the technical work supporting the TMDL and TMDL allocations
- Answer questions on the technical work

Agenda

Time	Topic
2 p.m.	Welcome
2:05 p.m.	Agenda
2:10 p.m.	Zoom logistics, ground rules
2:15 p.m.	Lower Columbia-Sandy Subbasin Total Maximum Daily Load (TMDL) • Model Setup and Calibration • Model Scenarios
	Wrap-up
3:30 p.m.	Adjourn

Zoom logistics and meeting ground rules

Raise hand to be recognized for questions or comments; please speak for yourself when recognized, let others speak without interruptions

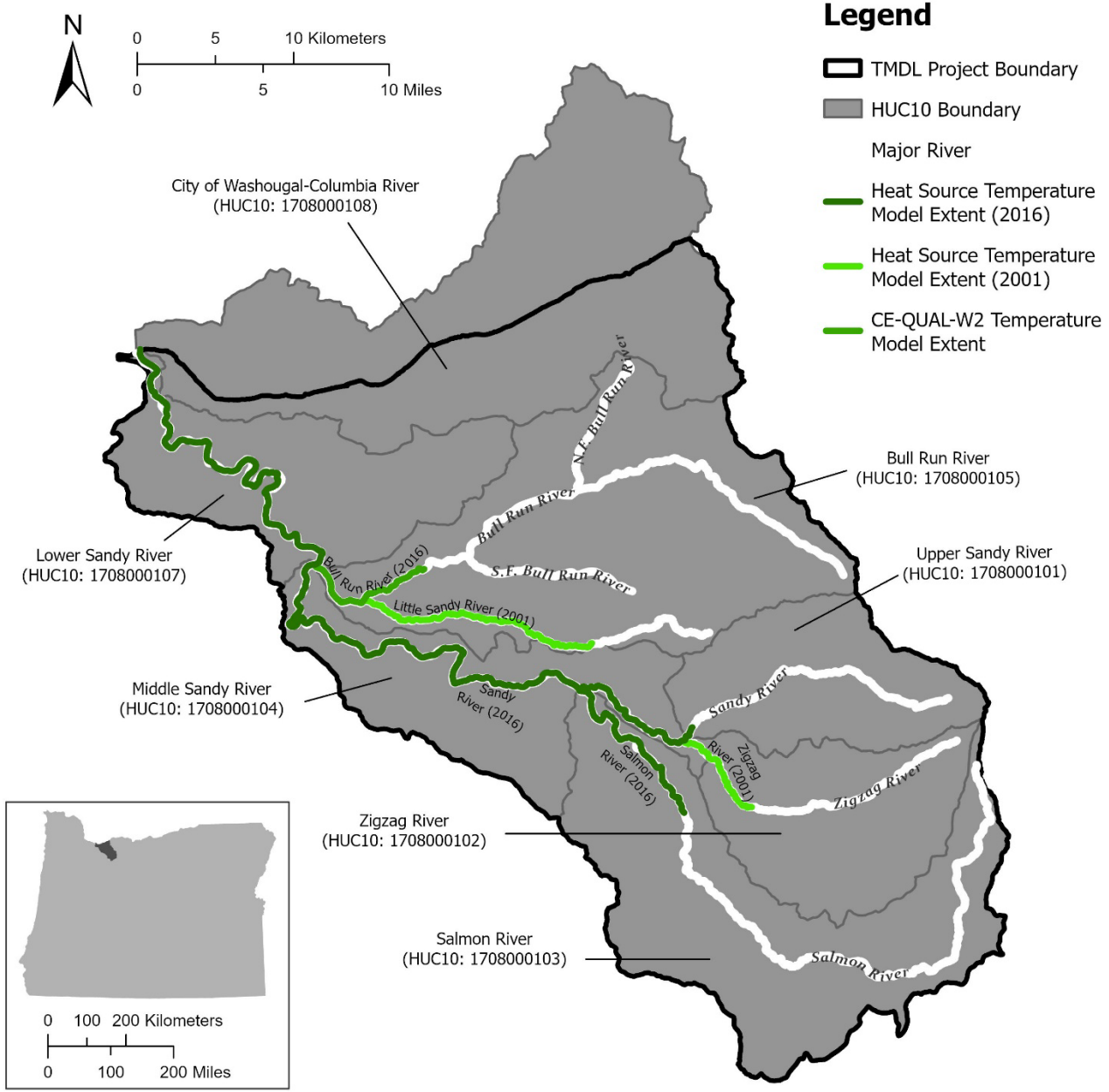
Use chat to: Ask questions, provide informational resources

Mute when not speaking

If using phone: press *9 to raise hand, *6 to mute/unmute

Models

- Sandy River
- Salmon River
- Bull Run River
- Little Sandy River
- Zigzag River

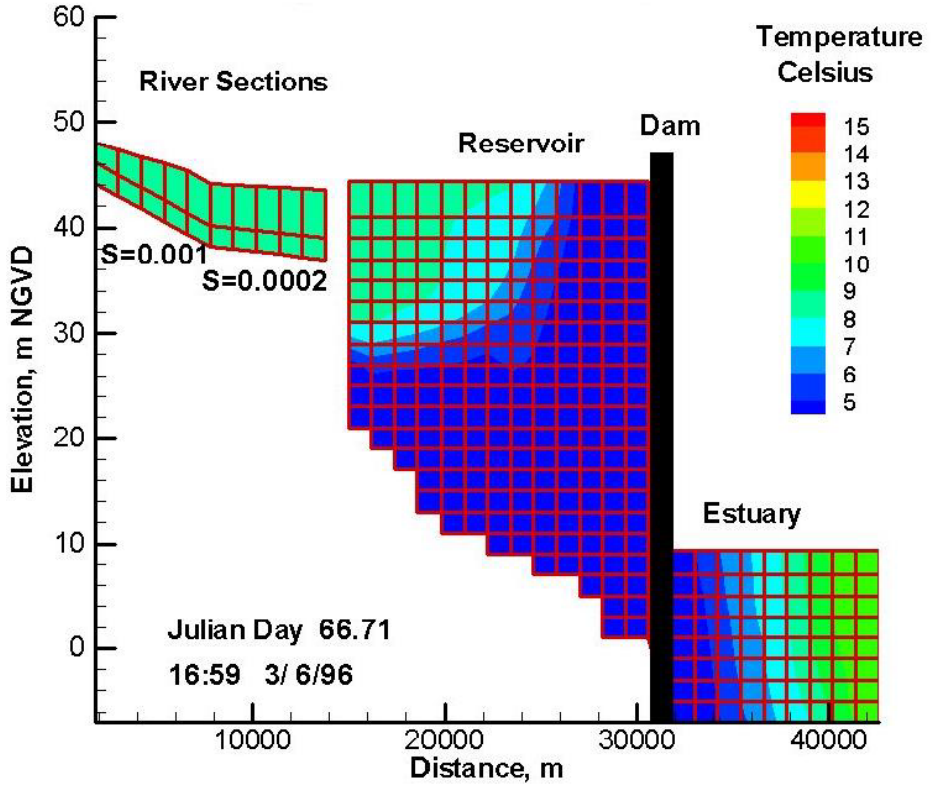


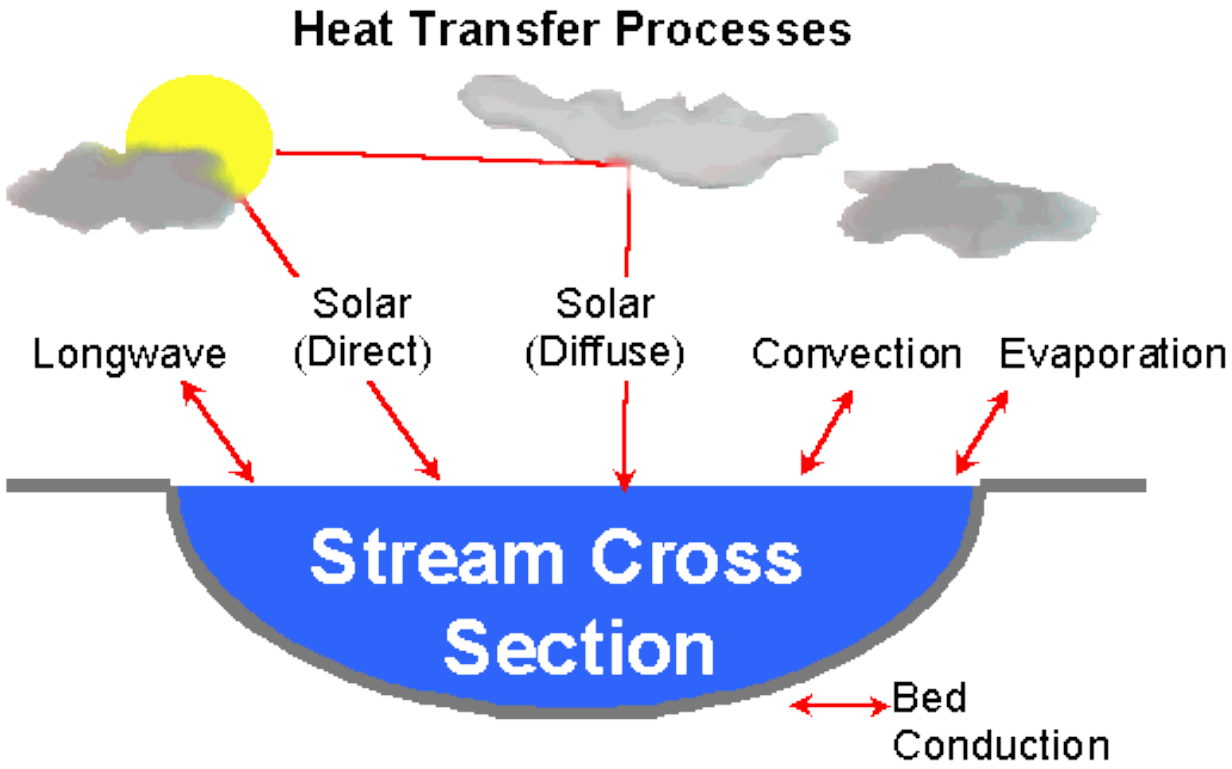
HEAT SOURCE

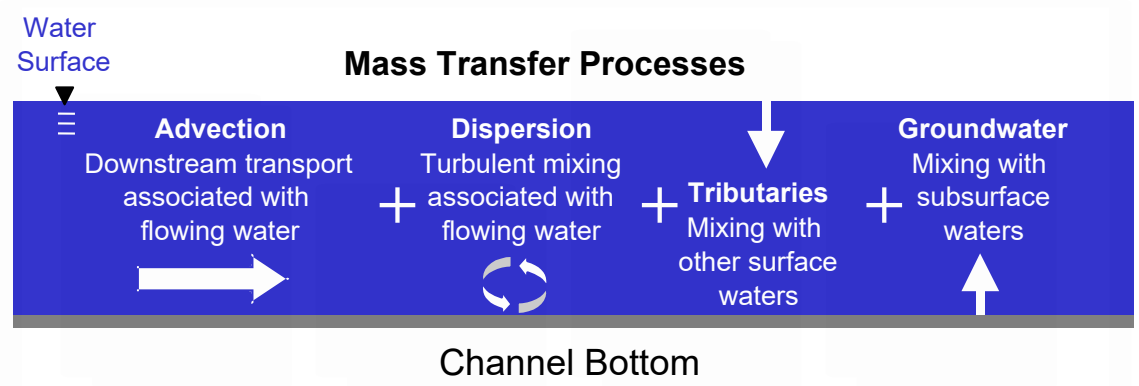
- Mechanistic model
- Simulates 1D open channel hydraulics, heat flux, mass transfer, and stream temperature
- Developed in 1996 at Oregon State University
- Independently peer reviewed, applied in multiple published studies all over the world.
- Model developed for Sandy River, Salmon River, Zigzag River, Little Sandy River

CE-QUAL-W2

- Mechanistic model
- Simulates 2D longitudinal and vertical hydrodynamics and water quality
- Developed by USACE and Portland State University
- Applied mostly for lakes, reservoirs, estuaries, or stratified waterbodies
- Model developed for Bull Run River and Reservoirs




Heat Transfer Processes
Solar
(Direct)
Solar
(Diffuse)
Longwave
Convection
Evaporation
Stream Cross
Section
Bed
Conduction


Water
Surface
Mass Transfer Processes
Advection
Downstream transport
associated with
flowing water
Dispersion
Turbulent mixing
associated with
flowing water
Tributaries
Mixing with
other surface
waters
Groundwater
Mixing with
subsurface
waters
Channel Bottom

Heat Source Model inputs

Land Use/Land Cover

- Height / Elevation
- Canopy Closure
- Overhang
- Topographic Shade Angles

Stream Position

- Longitude
- Latitude

Channel Morphology

- Stream Elevation
- Gradient
- Bottom Width
- Channel Angle Z

Boundary Conditions & In/Out Flows

- Stream Temperature
- Stream Flow

Met Data

- Cloudiness
- Wind Speed
- Wind Coefficients “a” & “b”
- Relative Humidity
- Air Temperature

Substrate

- Deep Alluvium Temperature
- Sediment Thermal Conductivity
- Sediment Thermal Diffusivity
- Hyporheic zone thickness
- Percent Hyporheic exchange
- Porosity

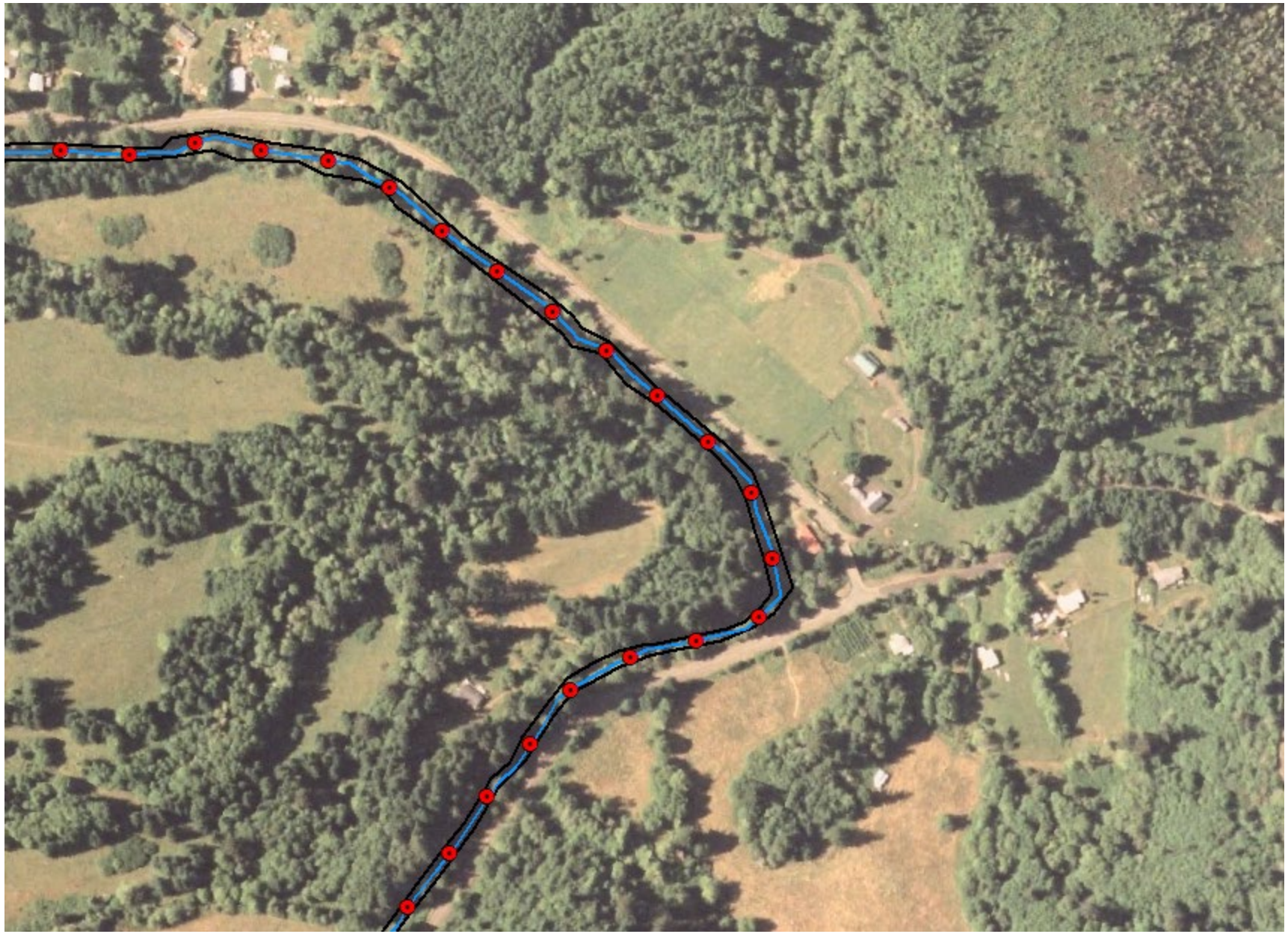
Heat Source Model outputs

Temperature
- Stream Temperature
- Sediment Temperature

Flux
- Streambed Conduction
- Convection
- Evaporation
- Solar Radiation (Above Topography)
- Solar Radiation (Blocked by LULC)
- Solar Radiation (Above Stream Surface)
- Solar Radiation (Penetrating Stream)
- Effective Shade
- Thermal Radiation (Total)

Hydraulics
- Flow Rate
- Hyporheic Exchange (cms)
- Flow Velocity
- Top Wetted Width
- Average Wetted Depth
- Maximum Wetted Depth

Others
- Hydraulic Dispersion (square meters/second)
- Evaporation Rate (mm/hour)
- View To Sky

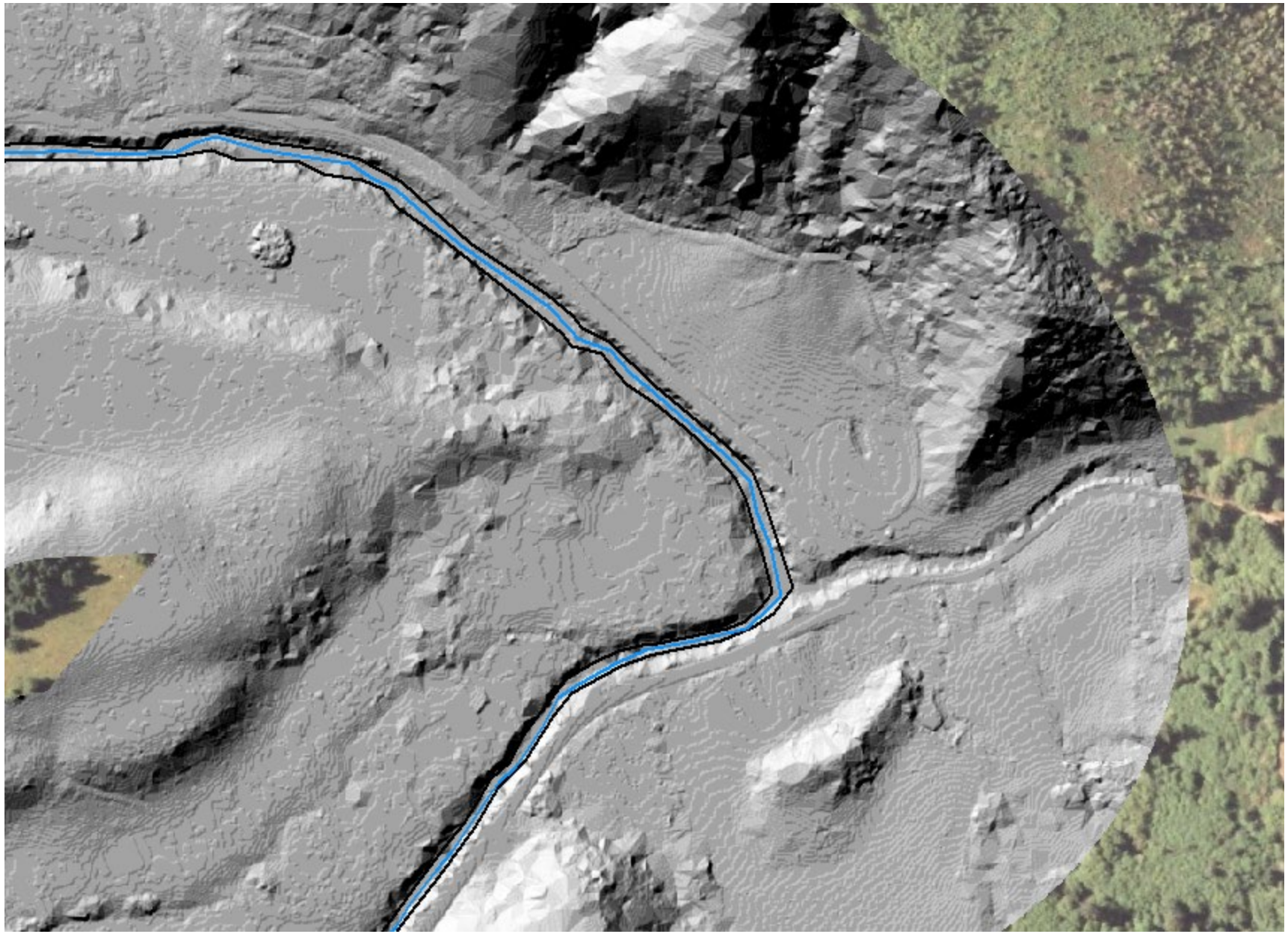


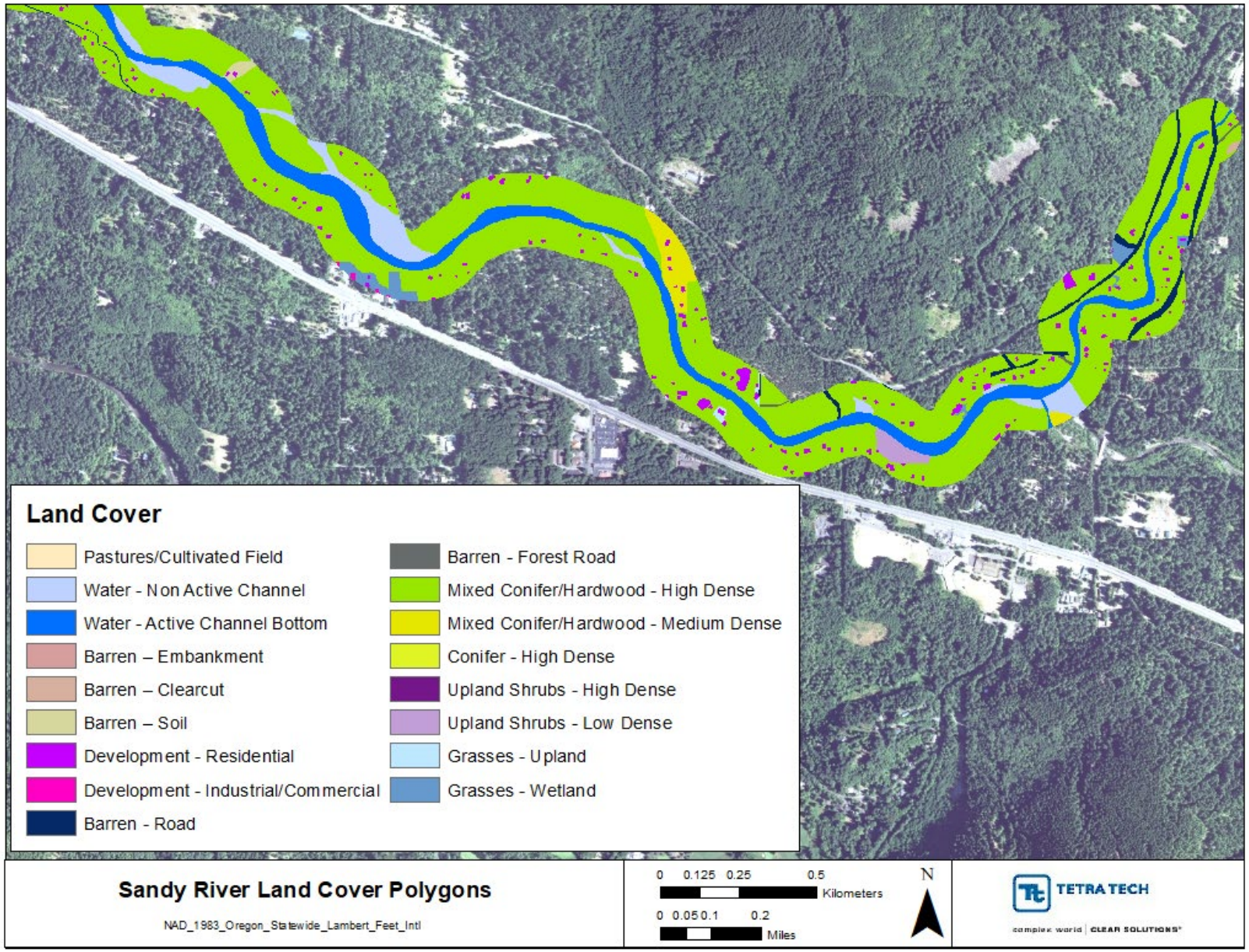
Digitize

- Stream Centerline
- Left Bank
- Right Bank

Model Node

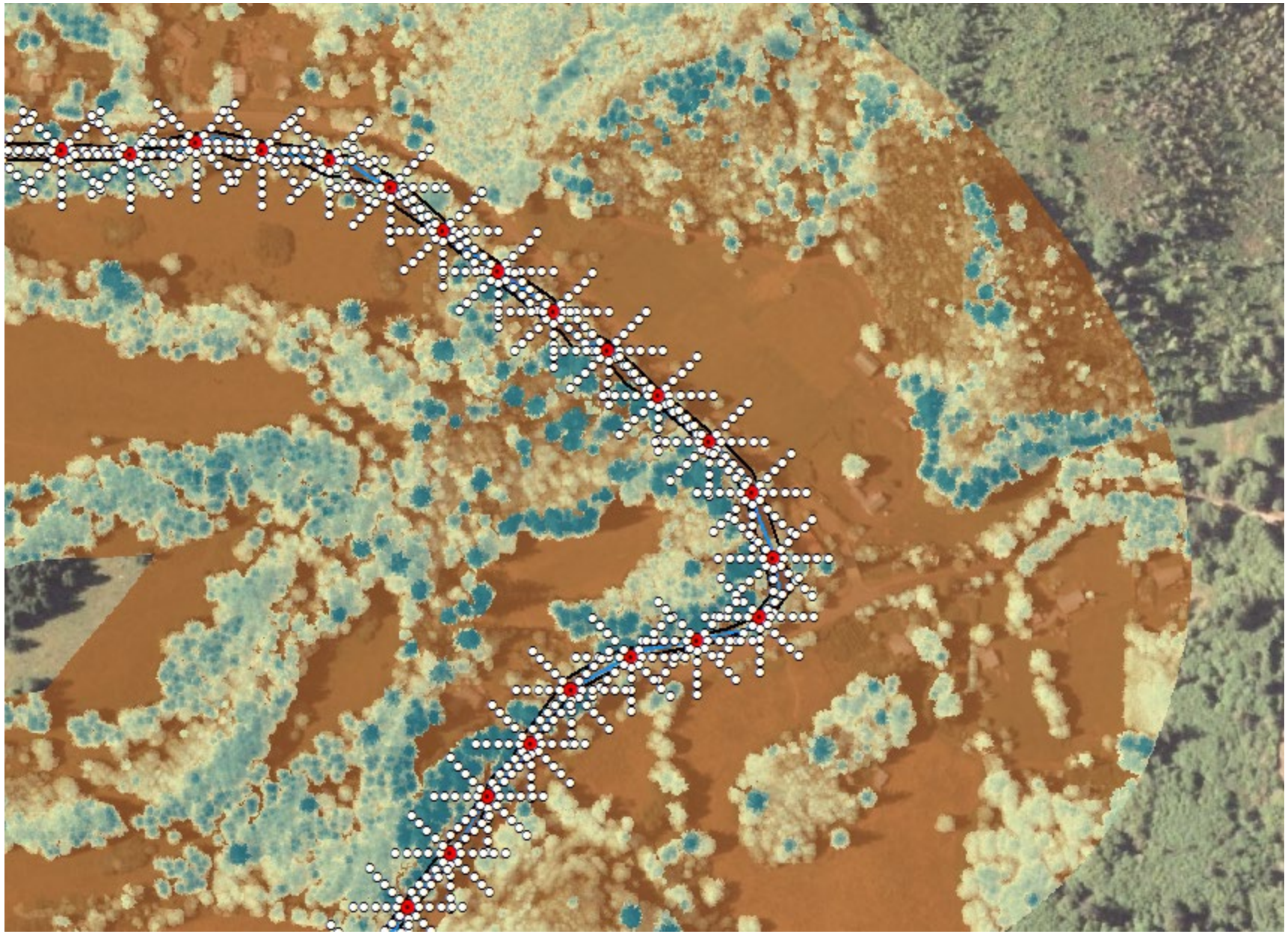
- Stream Position
- Land Cover
- Stream Elevation
- Gradient
- Channel Shape



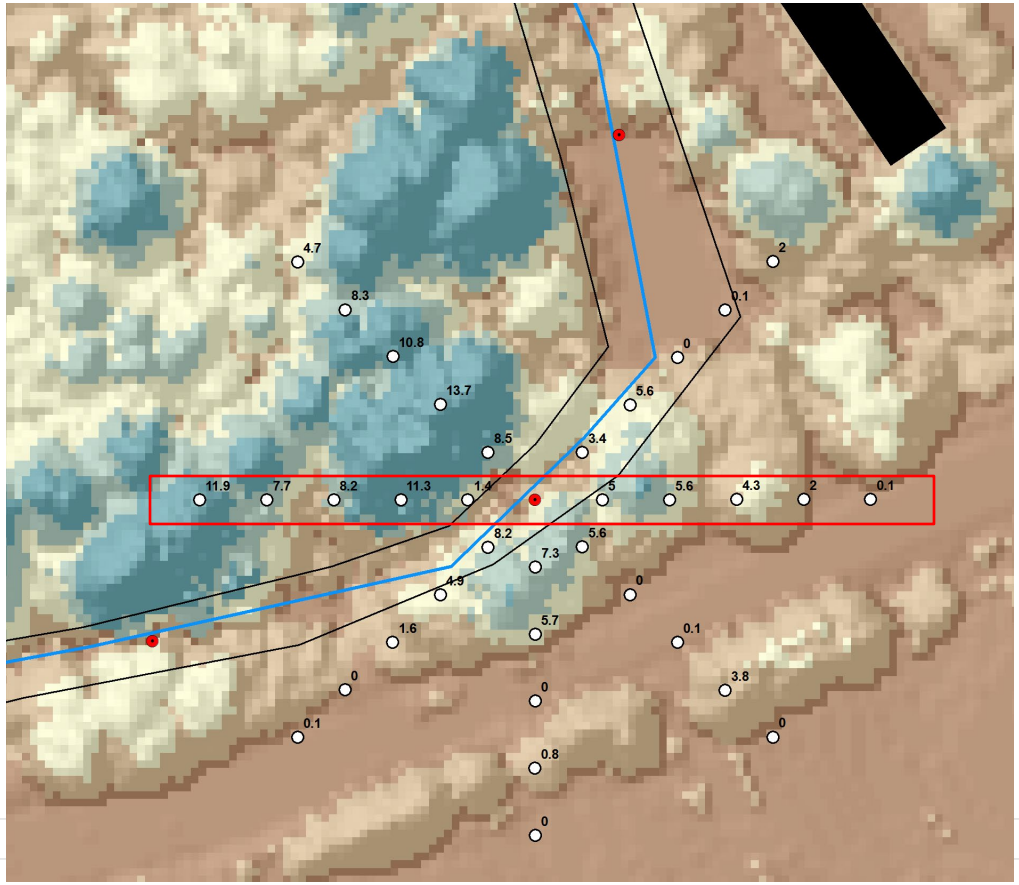


Digitize Landcover

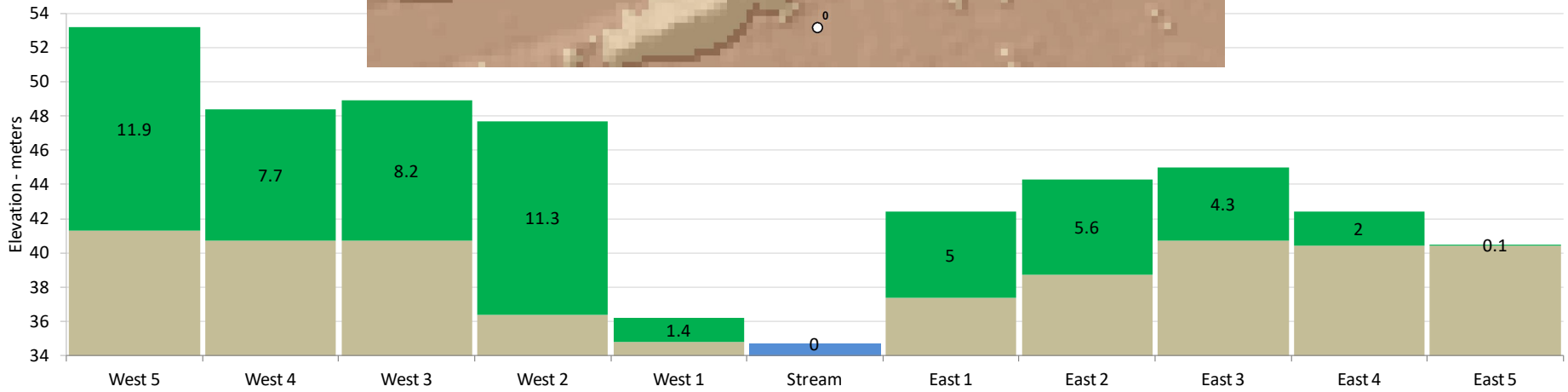
100 meters from each bank

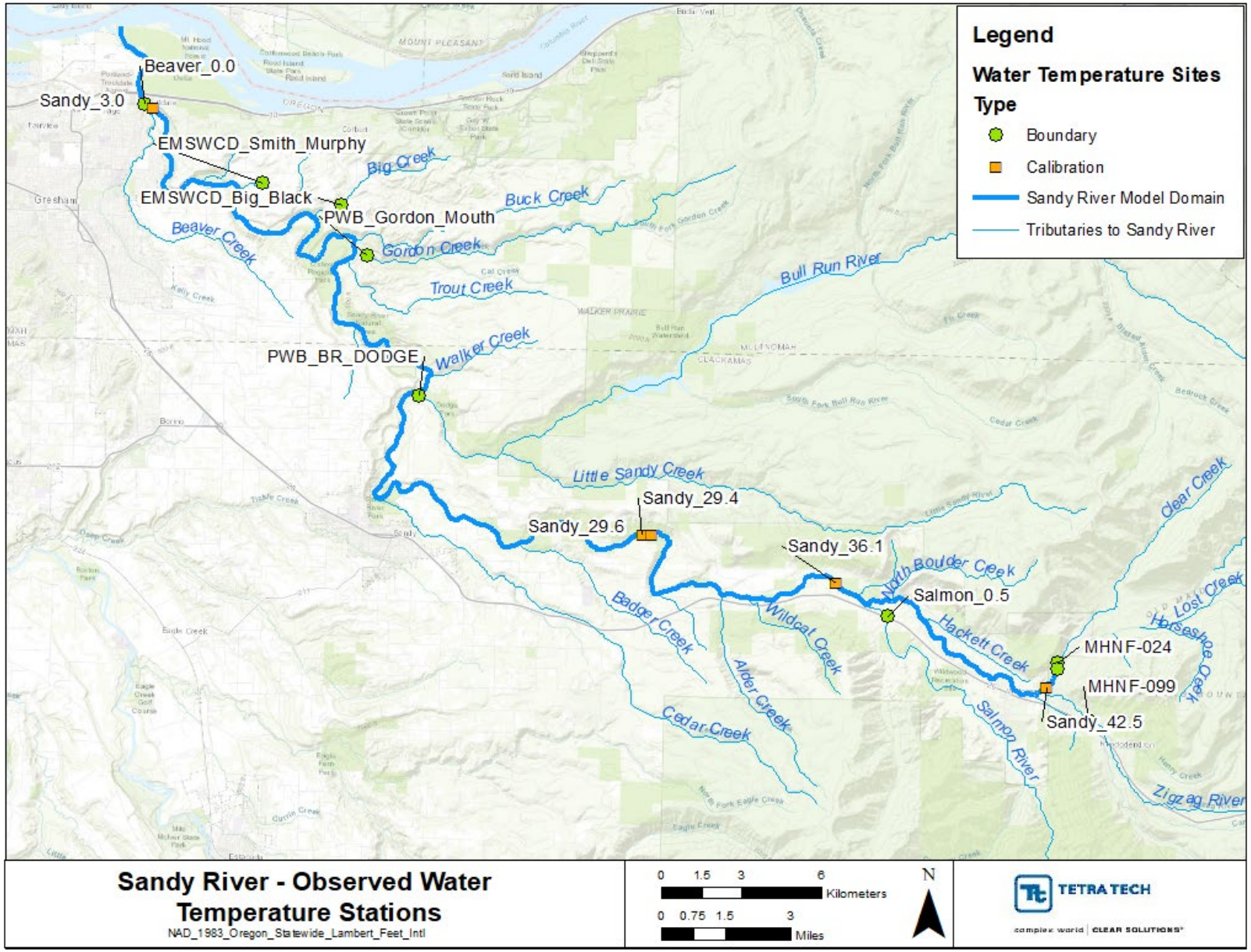


Derive vegetation height from LiDAR



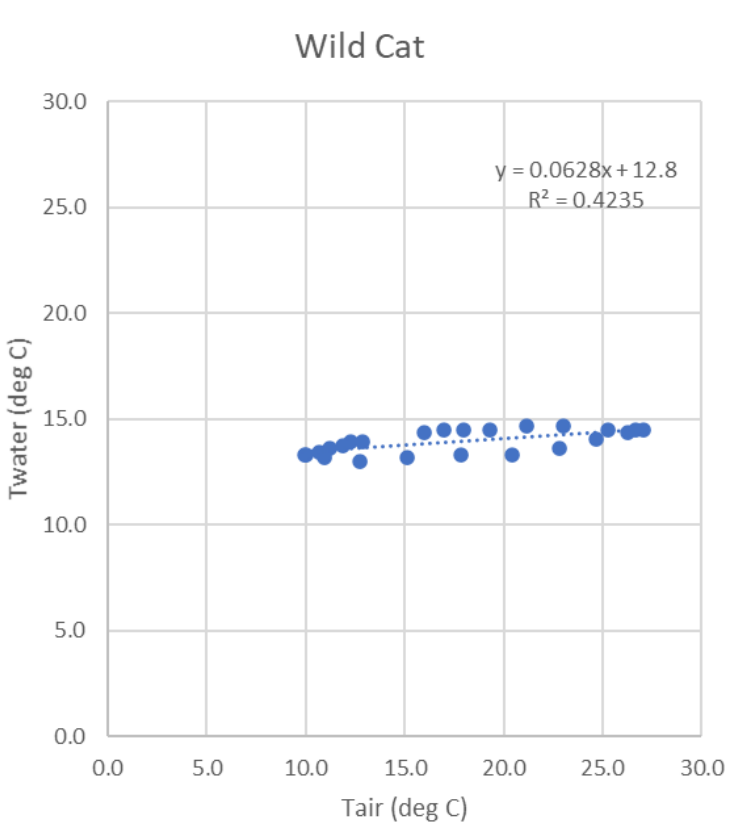
Example of model constructed land cover elevations for the West – East transect

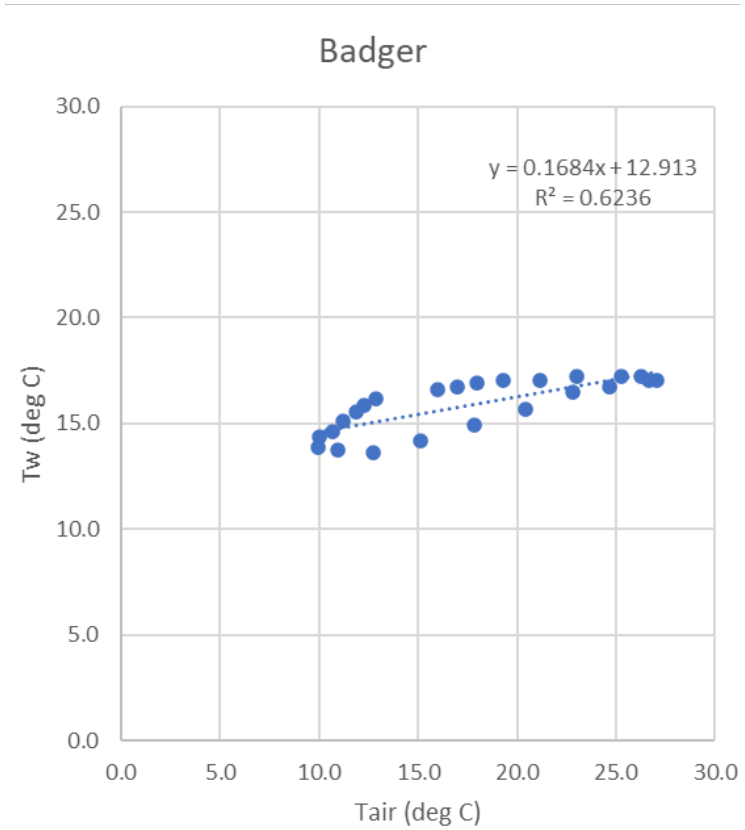


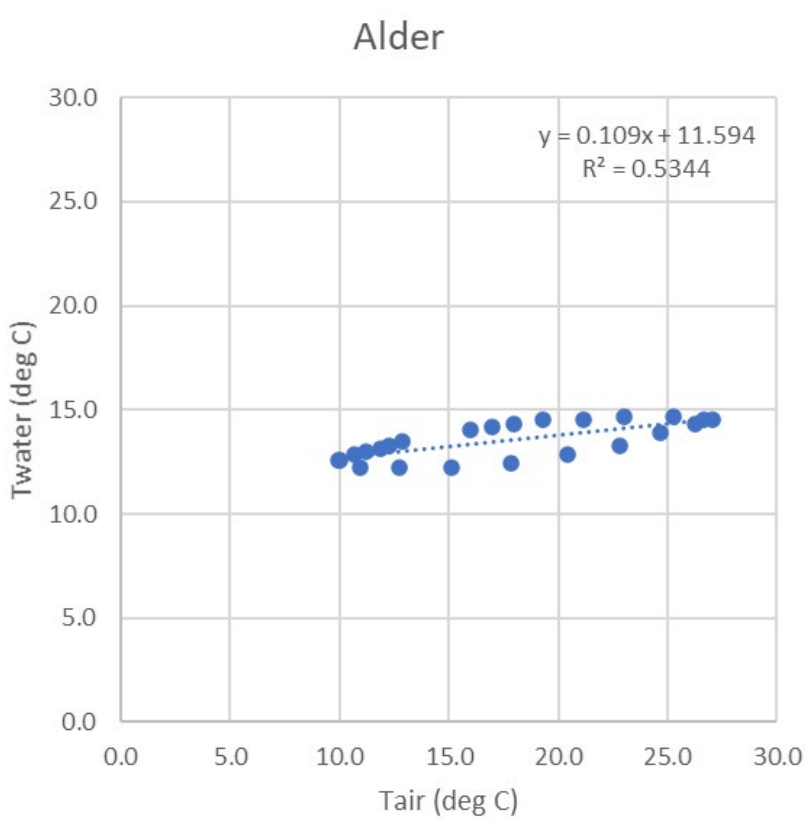


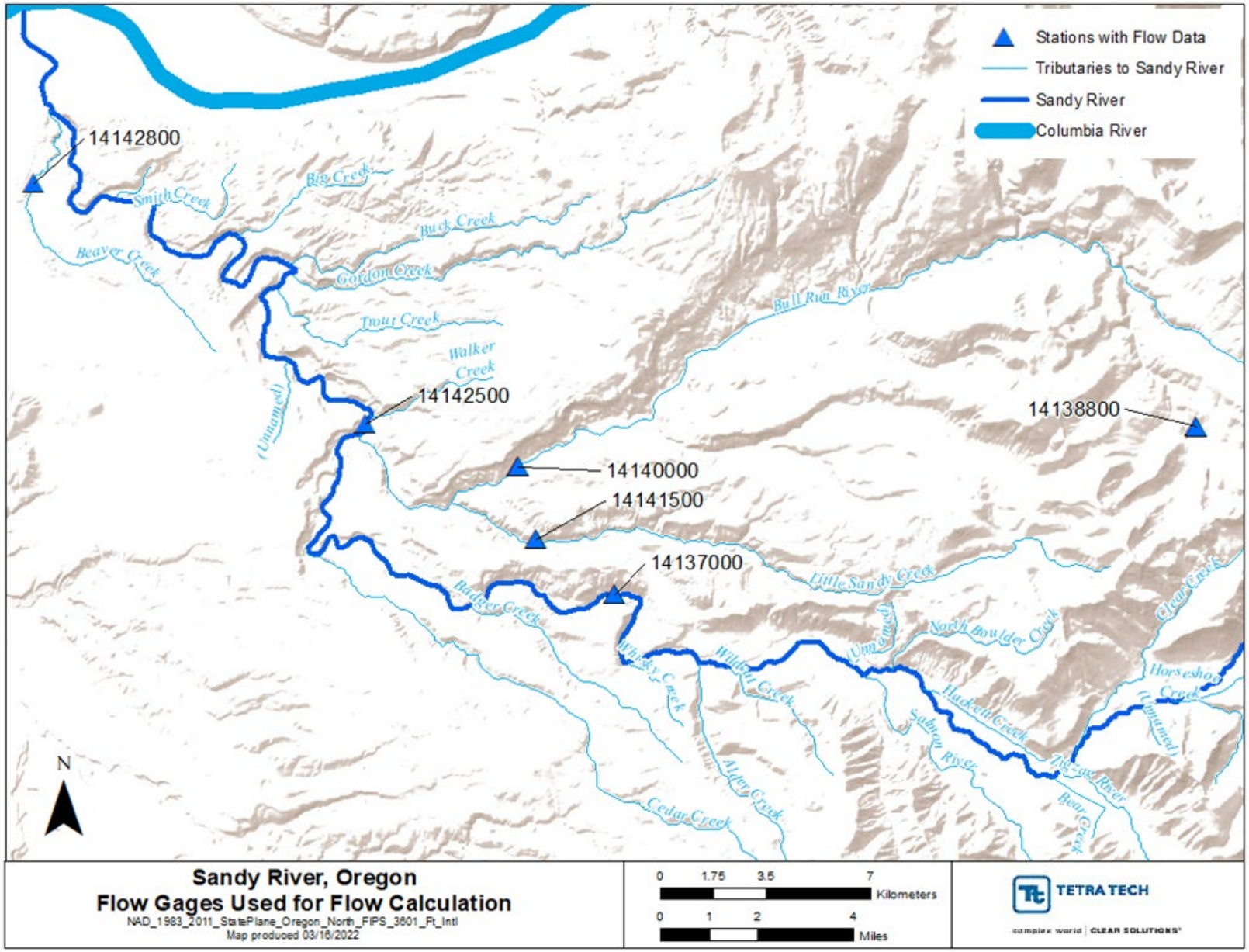
Temperature inputs and calibration sites

Temperature derivation at unmonitored tributaries





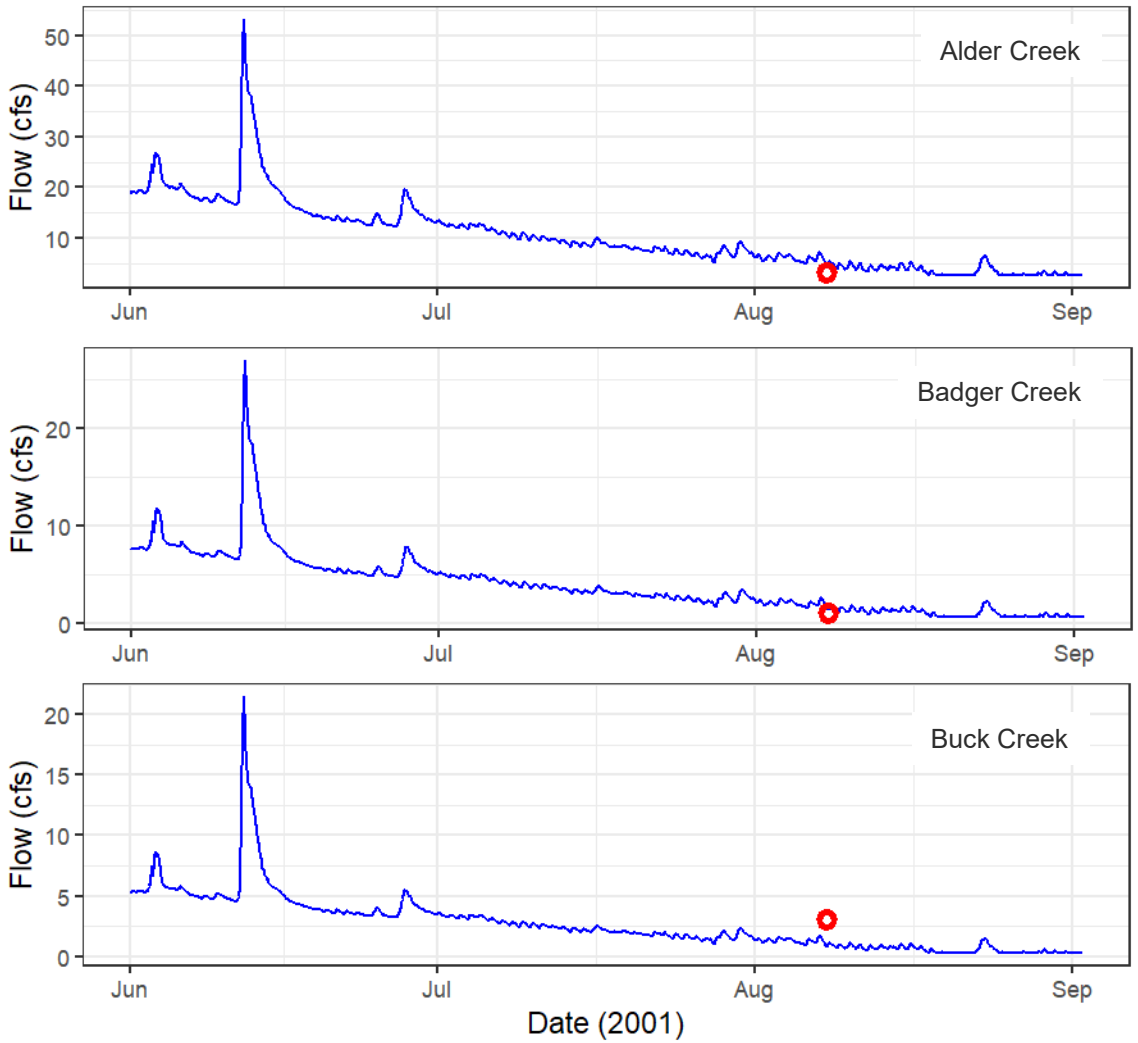




Flow inputs or calibration sites

- Gage data
- Flow mass balance
- Drainage area ratio
- QPPQ method

Flow derivation at ungaged sites

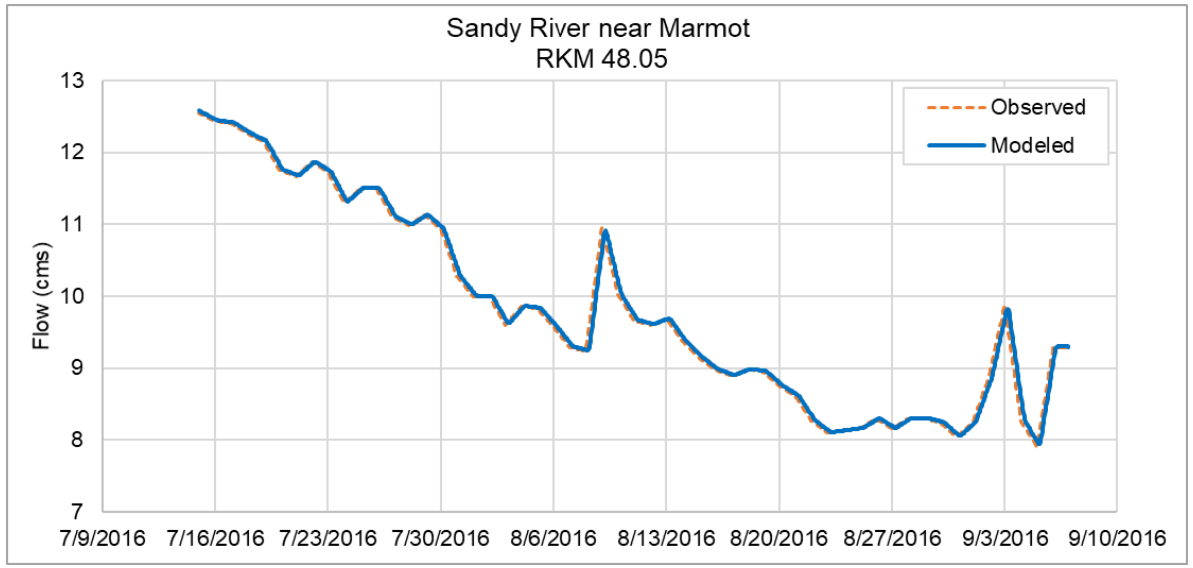


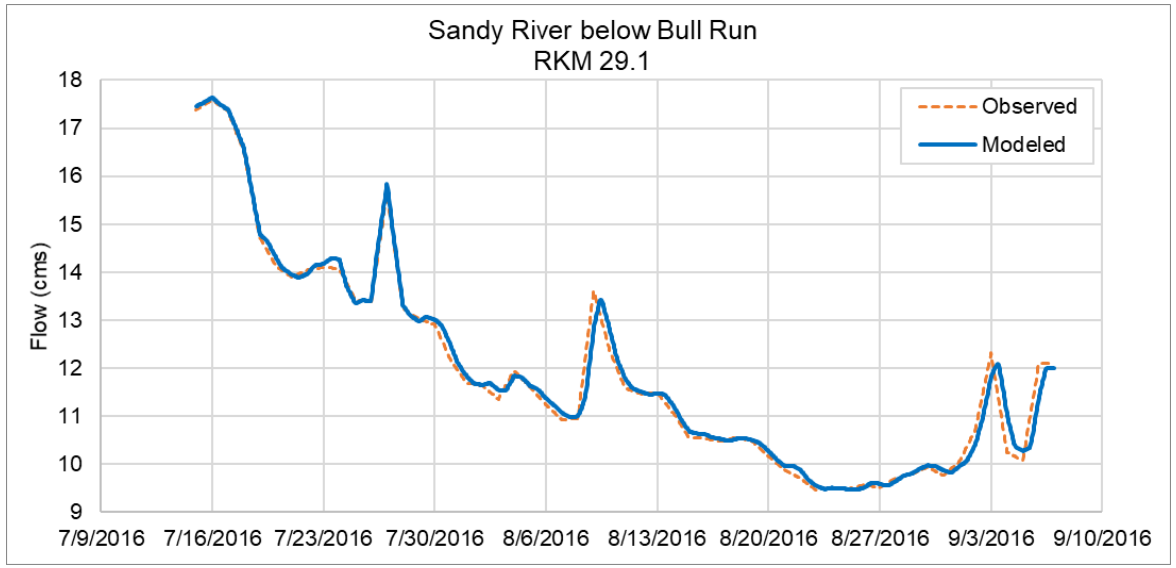
Name	2001 observed flow (cfs)	2001 estimated flow (cfs)
Alder Creek	3.2	4.8
Badger Creek	1.0	1.5
Bear Creek	8.0	0.2
Buck Creek	3.0	1.0
Cedar Creek	9.0	6.5
Clear Creek	8.0	8.8
Gordon Creek	14.0	11.1
Salmon River	96.1	83.4
Trout Creek	8.0	1.4
Walker Creek	3.0	0.1
Wildcat Creek	1.0	1.3
Zigzag River	98.4	65.7

Meteorological Sites

- Air Temperature
- Wind Speed
- Sky Conditions
- Relative Humidity

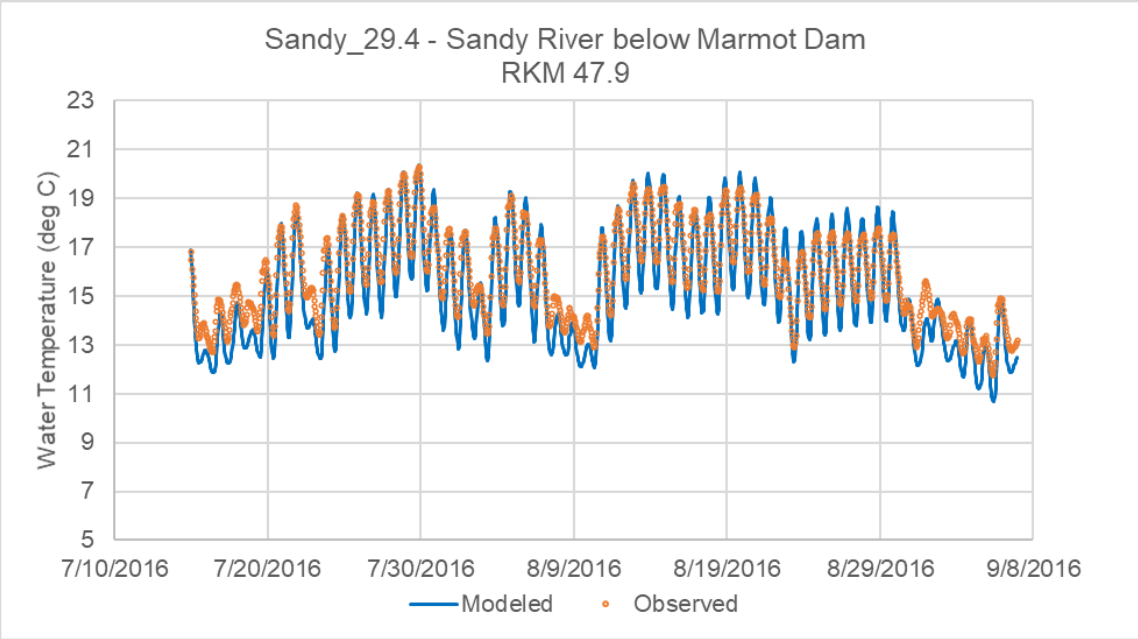
Flow calibration results

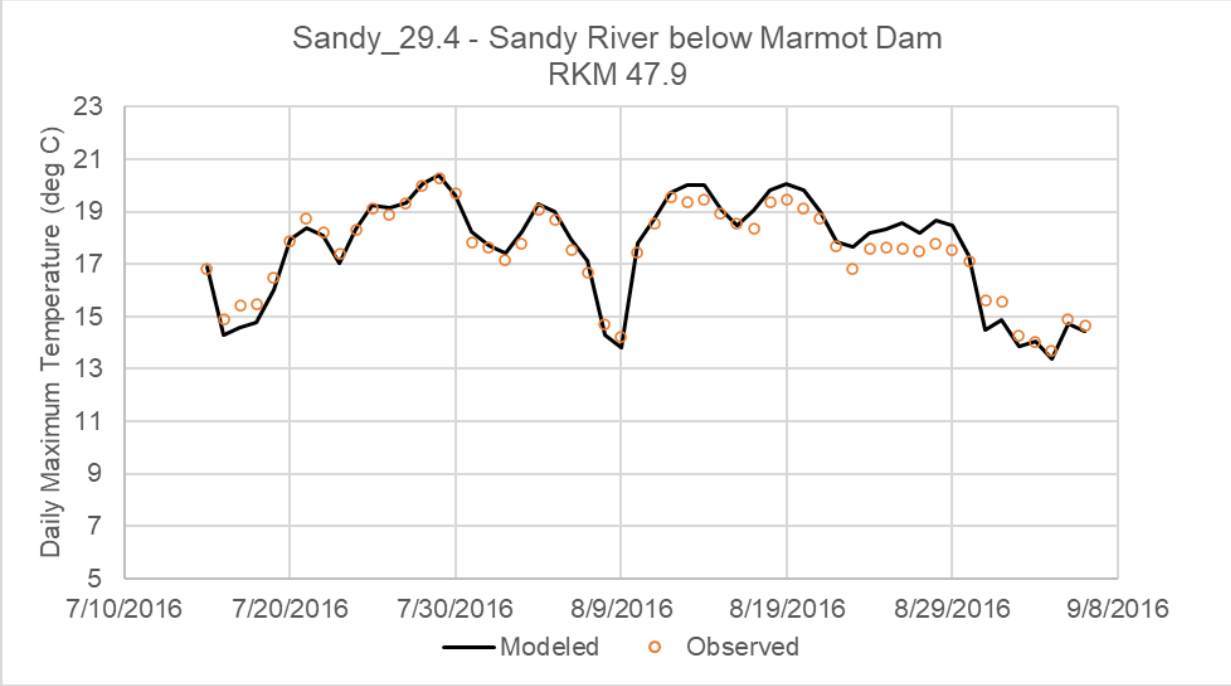




Flow cms (cfs)	Sandy River Near Marmot (USGS 14137000)	Sandy River Below Bull Run River, Near Bull Run (USGS 14142500)
MES	0.02 (0.8)	0.04 (1.29)
MAE	0.06 (2.17)	0.14 (4.78)
RMSE	0.09 (3.3)	0.21 (7.51)
NS	0.99	0.98

Temperature calibration results





Temperature calibration results

Statistic	Sandy_42.5 - Sandy River upstream of Zigzag River	Sandy_36.1 - Sandy River at Barlow Trail bridge below Salmon River	Sandy_29.6 - Sandy River at Marmot Dam Site	Sandy_29.4 - Sandy River below Marmot Dam	Sandy_3.0 - Sandy River Above Beaver Creek
Hourly Temperature Statistics					
ME	0.04	-0.26	-0.60	-0.62	-0.79
MAE	0.30	0.44	0.69	0.76	1.04
RMSE	0.36	0.51	0.82	0.89	1.29
NS	0.98	0.94	0.823	0.78	0.56
Daily Maximum Temperature Statistics					
ME	0.01	0.31	-0.01	0.13	-0.69
MAE	0.13	0.52	0.37	0.40	0.99
RMSE	0.16	0.58	0.45	0.49	1.24
NS	0.99	0.90	0.93	0.92	0.64

Model scenarios

- No point sources
- Point sources at waste load allocations
- Restored Vegetation
- Restored Vegetation (except roads, buildings, utilities)
- Protected Vegetation
- Consumptive Uses / Natural Flow
- No Dam (Bull Run)

Sandy River Waste Load Allocations

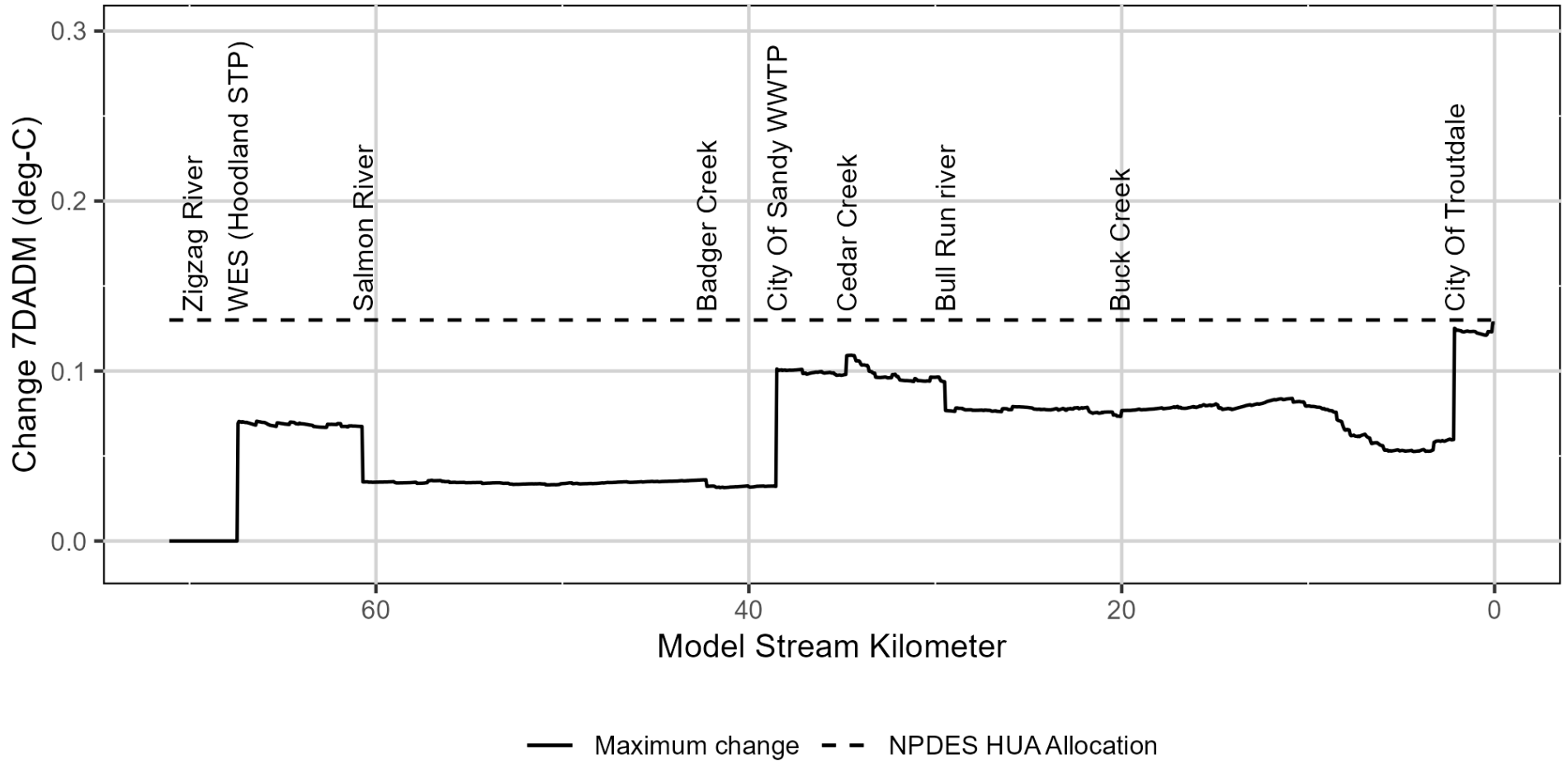
Permittee WQ File#: EPA #	HUA (°C)	Applicable criterion (°C)	WLA period start	WLA period end	Annual 7Q10 river flow (cfs)	Eff. discharge (cfs)	Min. WLA (kcal/day)
Government Camp STP 4136: OR0027791	0.20	16.0 13.0	5/1	10/31	5.6	0.4	$2.94*10^6$
Hoodland STP (WES) 89941: OR0031020	0.07	16.0 13.0	5/1	10/31	80.3	1.4	$1.40*10^7$
City of Troutdale WPCF 39750: OR0020524	0.07	18.0 13.0	5/1	10/31	277.3	4.6	$4.83*10^7$
City of Sandy WWTP 78615: OR0026573	0.07	18.0 13.0	5/1	10/31	215.9	1.9	$3.73*10^7$
ODFW Sandy River Fish Hatchery 64550: ORG130009	0.30*	18.0 13.0	5/1	10/31	4.9	3.5	$6.17*10^6$

Notes: Applicable criterion = Biologically-based numeric criteria (BBNC)
* When the minimum duties provision at OAR 340-041-0028(12)(a) applies, ODFW Sandy River Fish Hatchery $\Delta T = 0.0 \rightarrow$ WLA = 0 kcal/day.

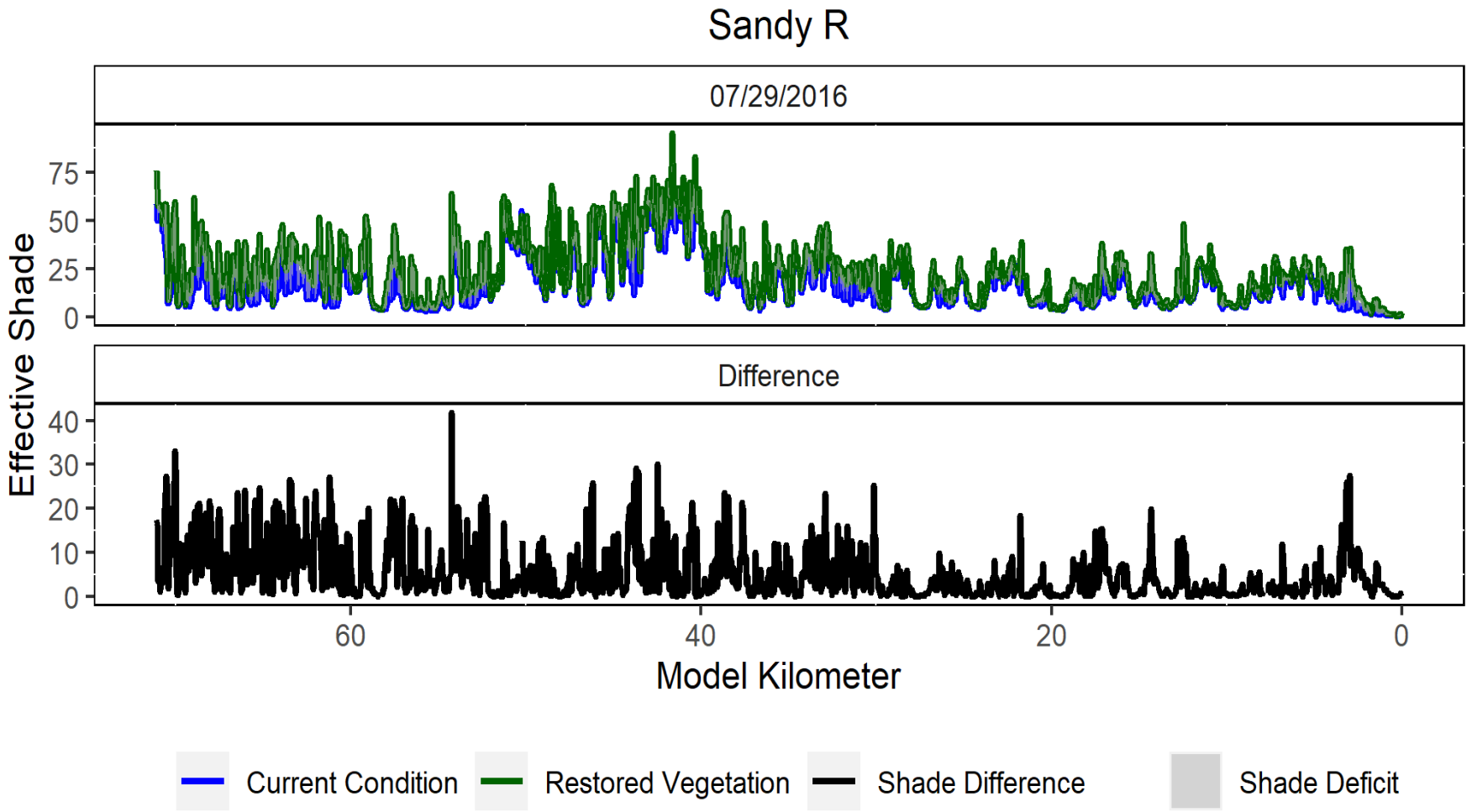
Sandy River Waste Load Allocations modeling assumptions

- Model Period: July - Sept 2016
- Point source WLA effluent flow is average dry weather facility design flow (except ODFW set to observed 2015 flow)
- Point source WLA effluent temperature is calculated to produce a change in temperature consistent with the point of discharge TMDL allocation and applicable temperature criteria. On some days effluent temperatures are capped at 32 deg-C per DEQ's mixing zone rules.
- Point source cumulative temperature impacts assessed based on 7DADM temperature difference between models with no point sources and with point sources discharging at WLA thermal loads.

Model Results: Sandy River
Point source Waste Load Allocations minus no point source scenario

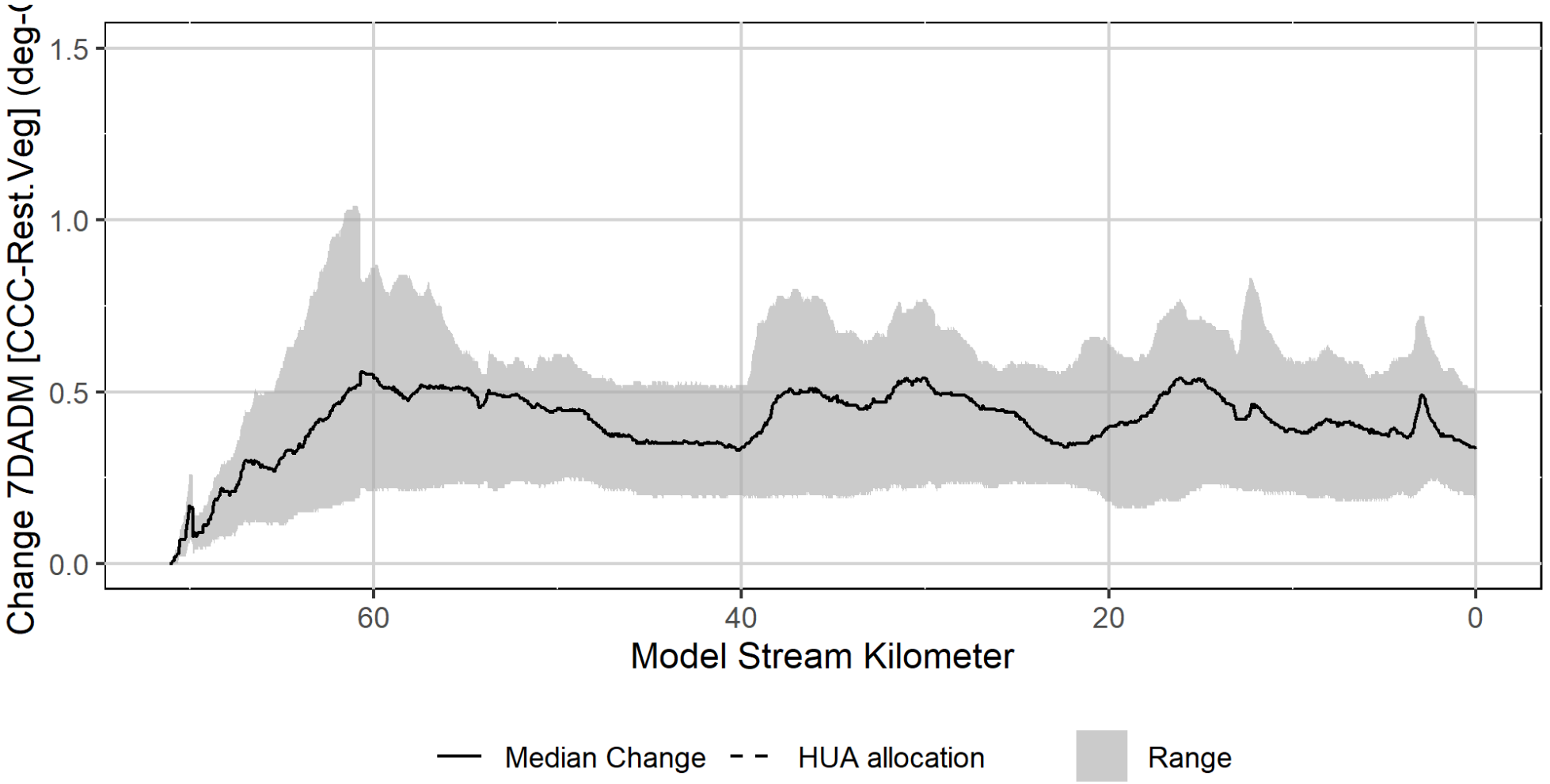


Model results: Sandy River restored vegetation minus current

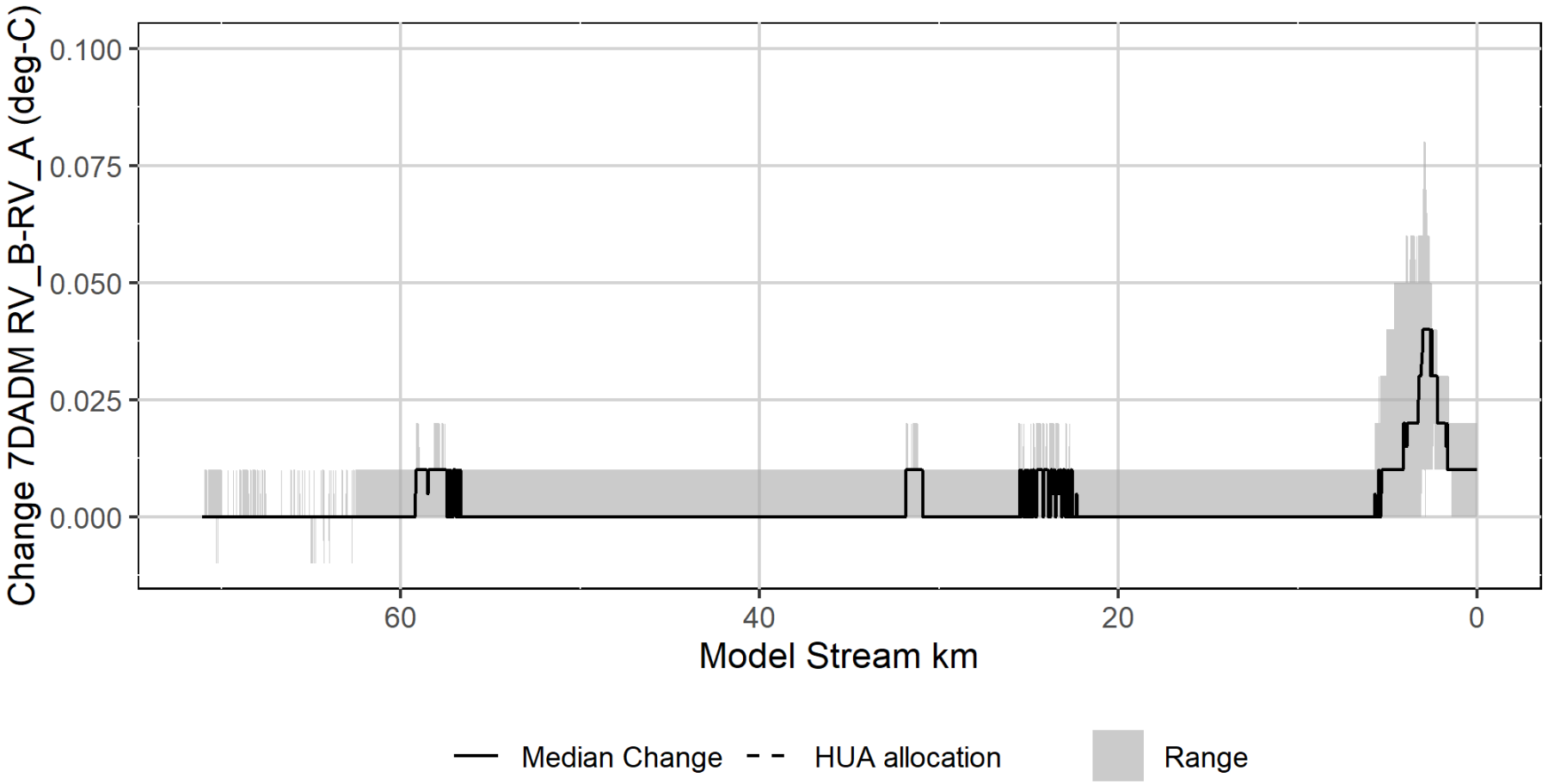


Mean Current Condition Effective Shade	Mean Restored Vegetation Effective Shade	Mean Shade Gap
18.8%	24.1%	5.3%

Model results: Sandy River
restored vegetation minus current, change in 7DADM



Model Results: Sandy River
restored vegetation (except roads, buildings, utilities) minus restored vegetation

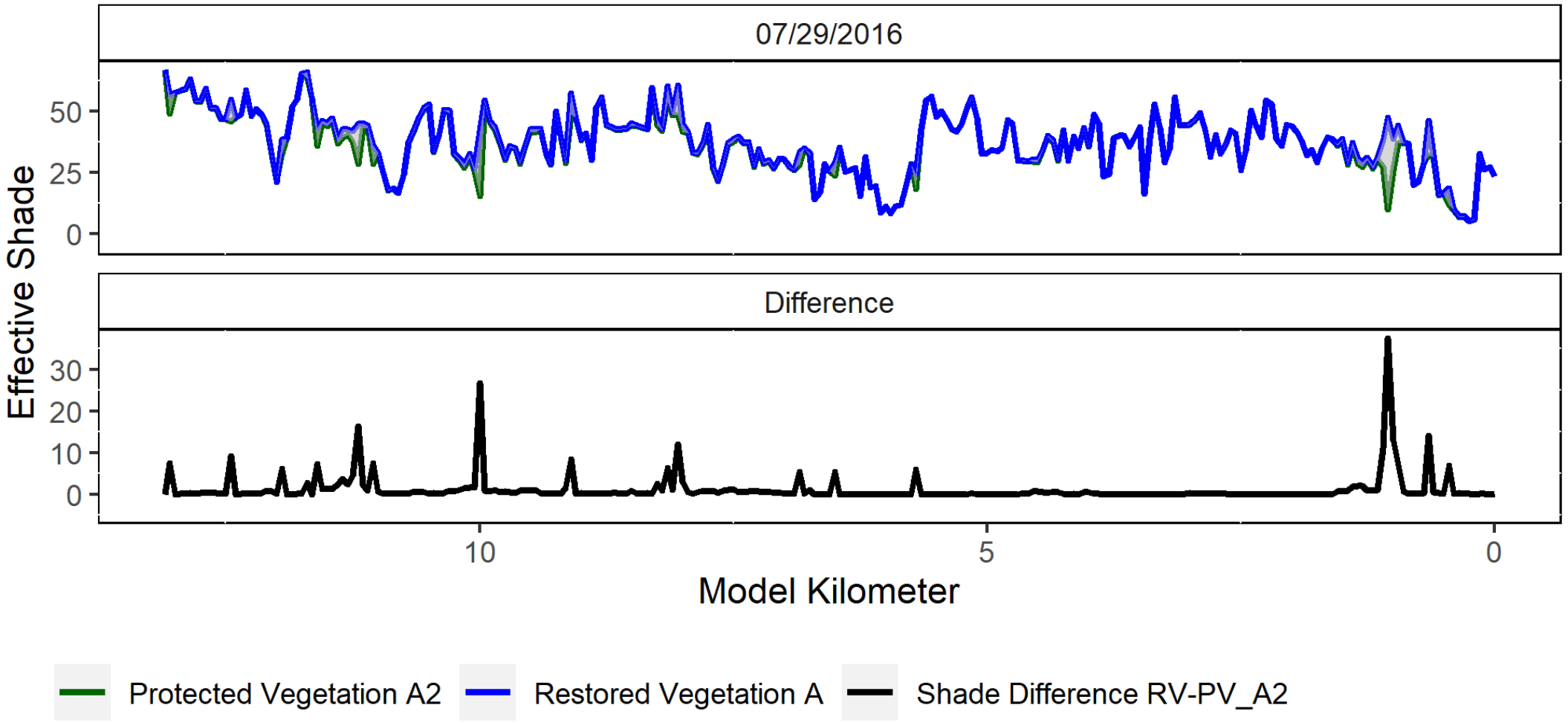


Protected vegetation scenario (Salmon River)

Evaluates the temperature and shade response from streamside vegetation that is currently protected by statue, rule, ordinance, or some other approved management plan (voluntary or regulatory).

DMA	Protected Veg A2 Buffer width (ft)
Clackamas County	110
ODF - Private	
US BLM	300
USFS	
ODOT	0

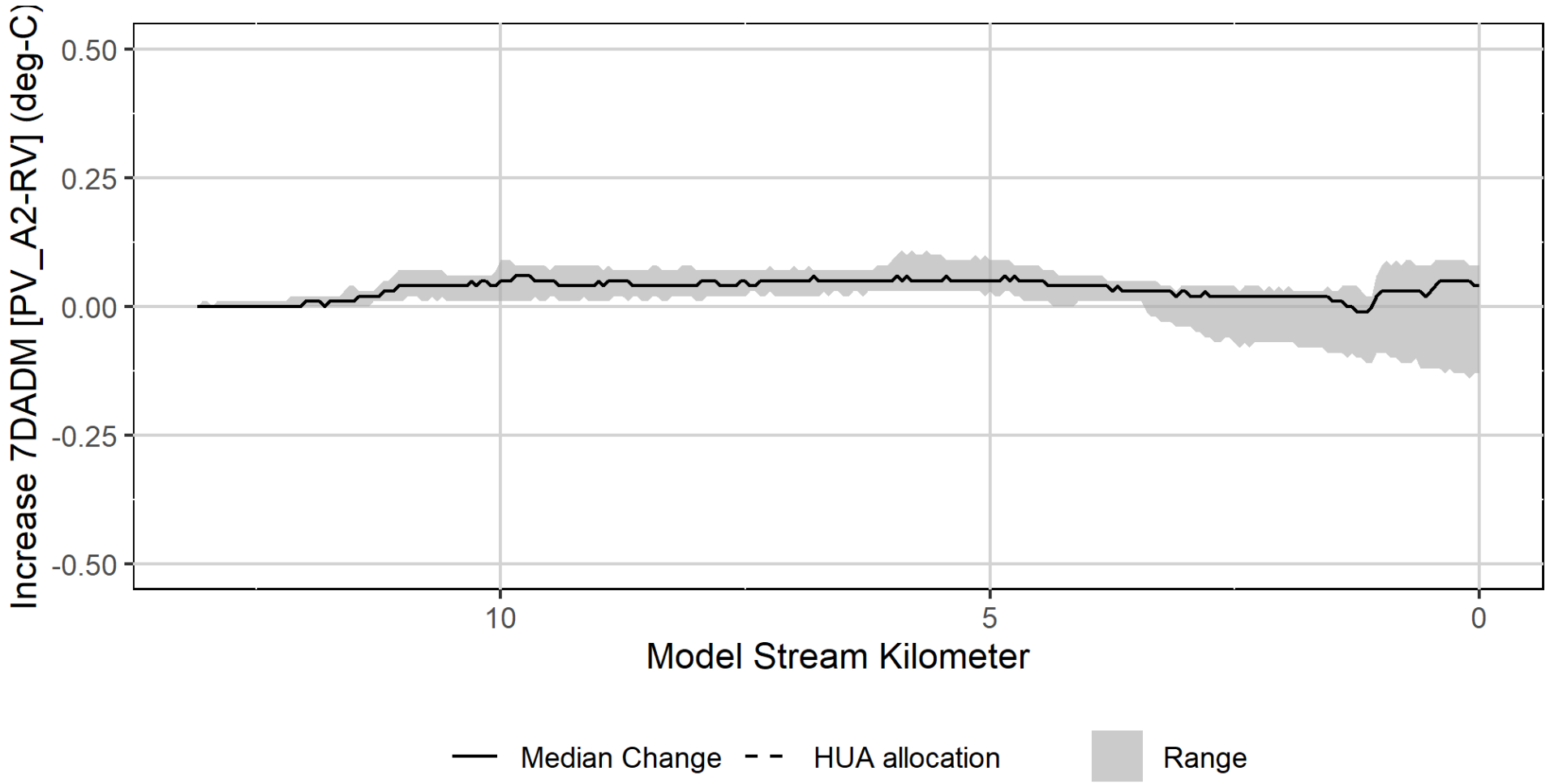
Model Results: Salmon River
restored vegetation minus protected vegetation scenario A2



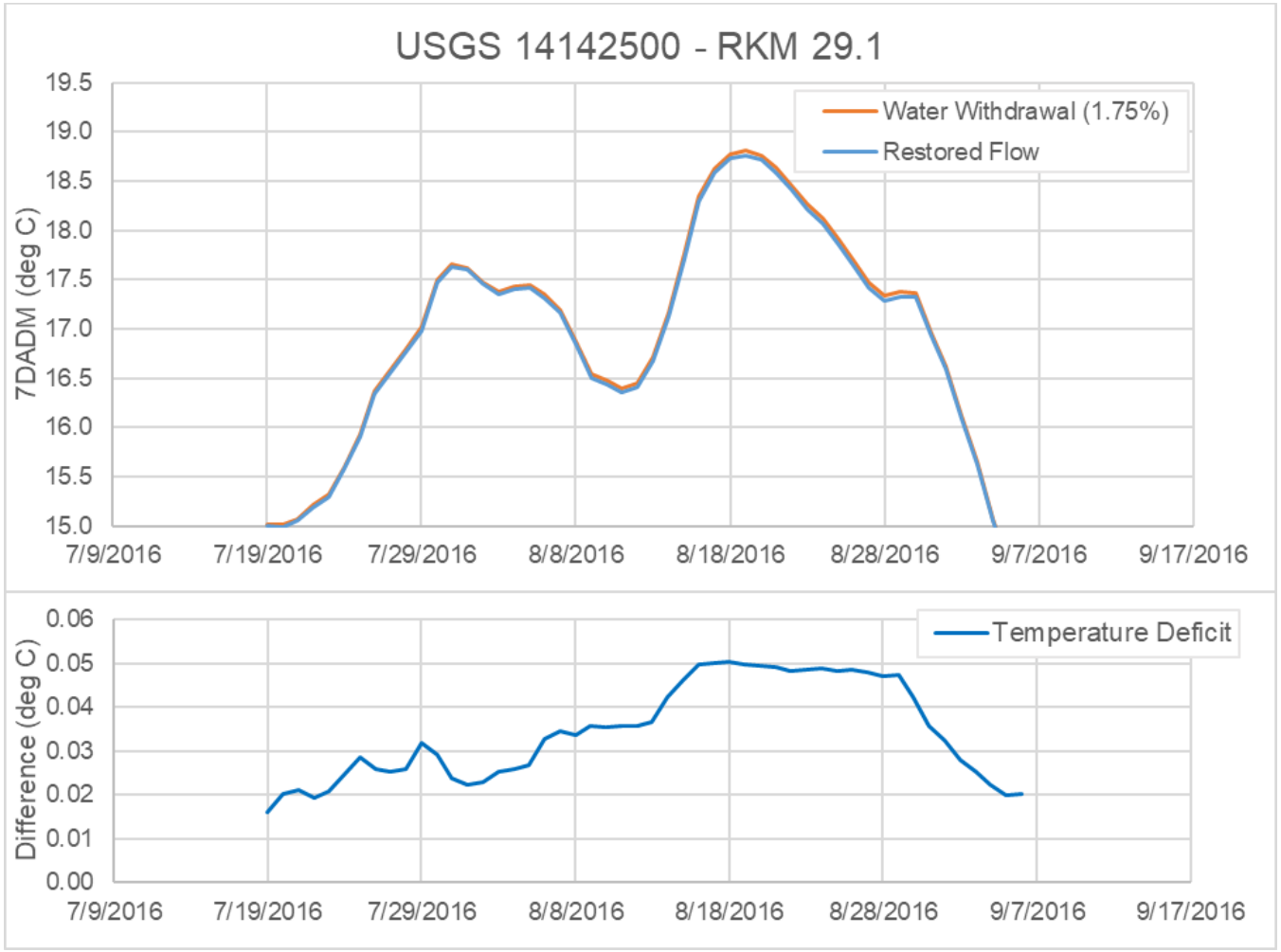
Model Results: Salmon River
restored vegetation minus protected vegetation scenario A2 by DMA

Designated Management Agency	Salmon Protected Veg A2	Salmon Restored Veg	Shade Gap	Total Stream Kilometers Assessed
Clackamas County	35	37	2	4
Oregon Department of Forestry - Private	39	40	1	0.6
Oregon Department of Transportation	10	48	38	0
U.S. Bureau of Land Management	35	35	0	4.3
U.S. Forest Service	57	59	2	0.2

Model Results: Salmon River
restored vegetation minus protected vegetation scenario A2



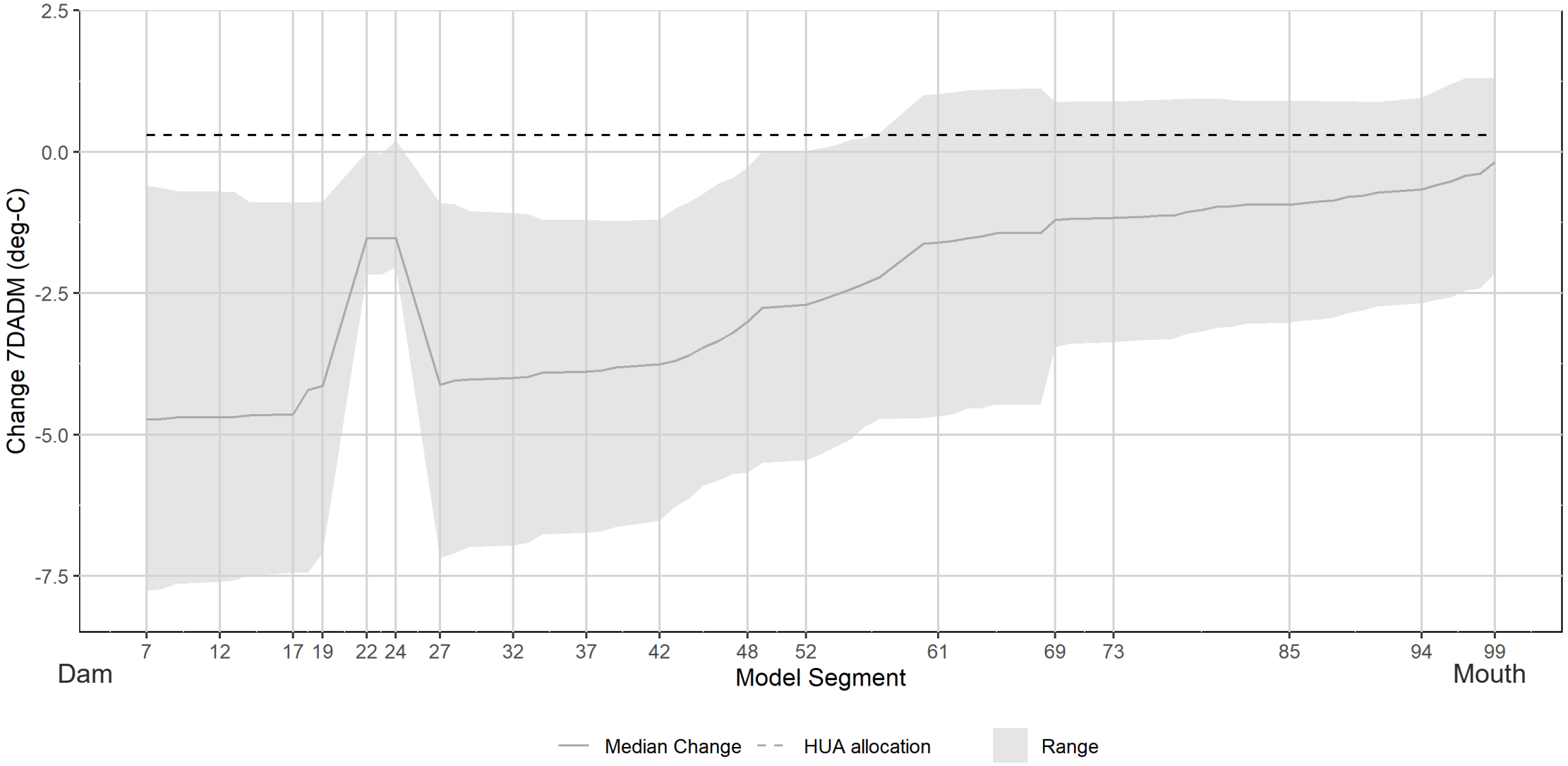
Model Results: Sandy River
1.75 percent consumptive use withdrawal minus Natural stream flow



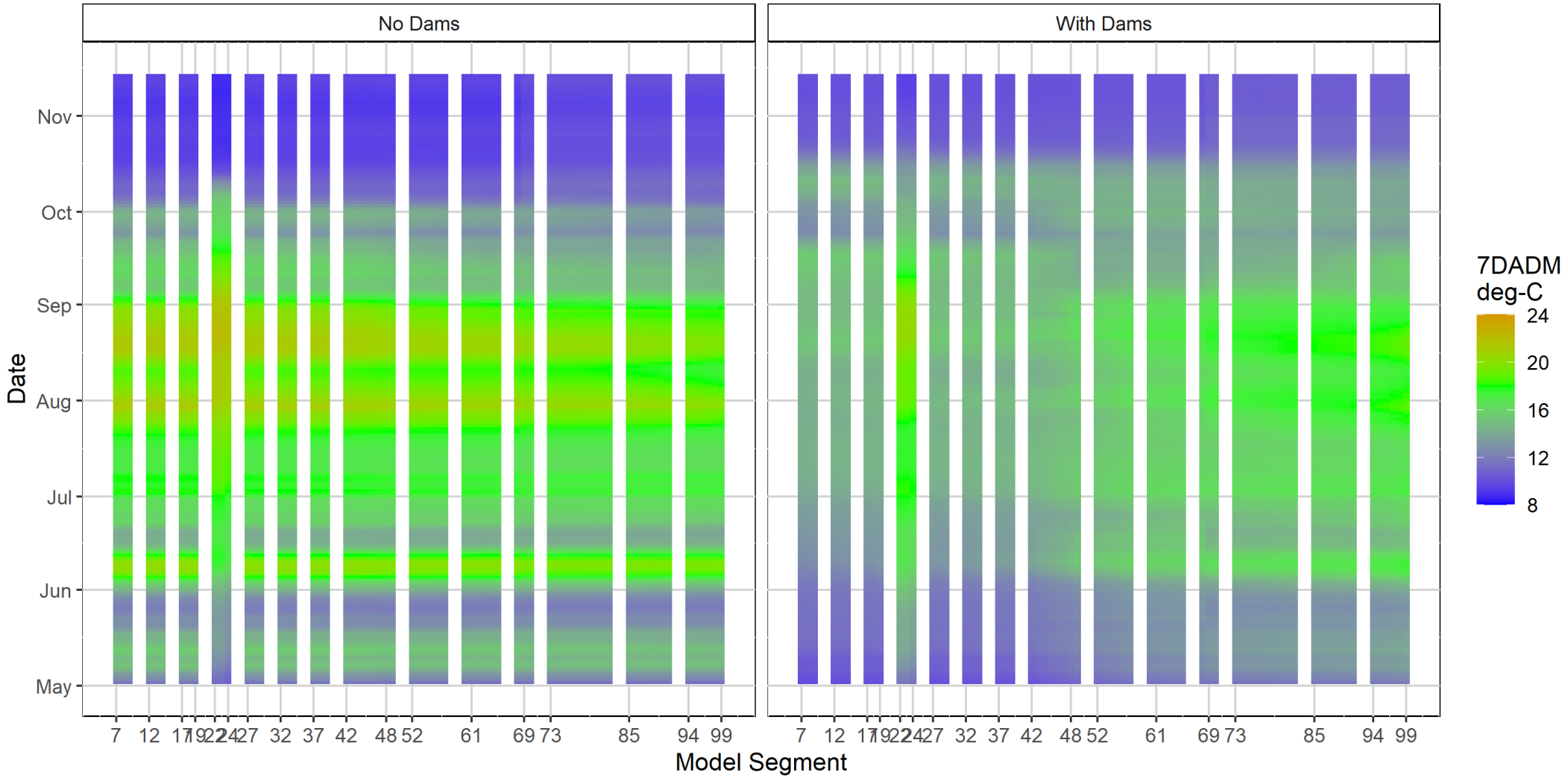
Monthly Median (50th percentile duration) natural flow at USGS 1414250.

Month	Flow cfs [cms]
July	1,020 [28.88]
August	557 [15.77]
September	483 [13.68]

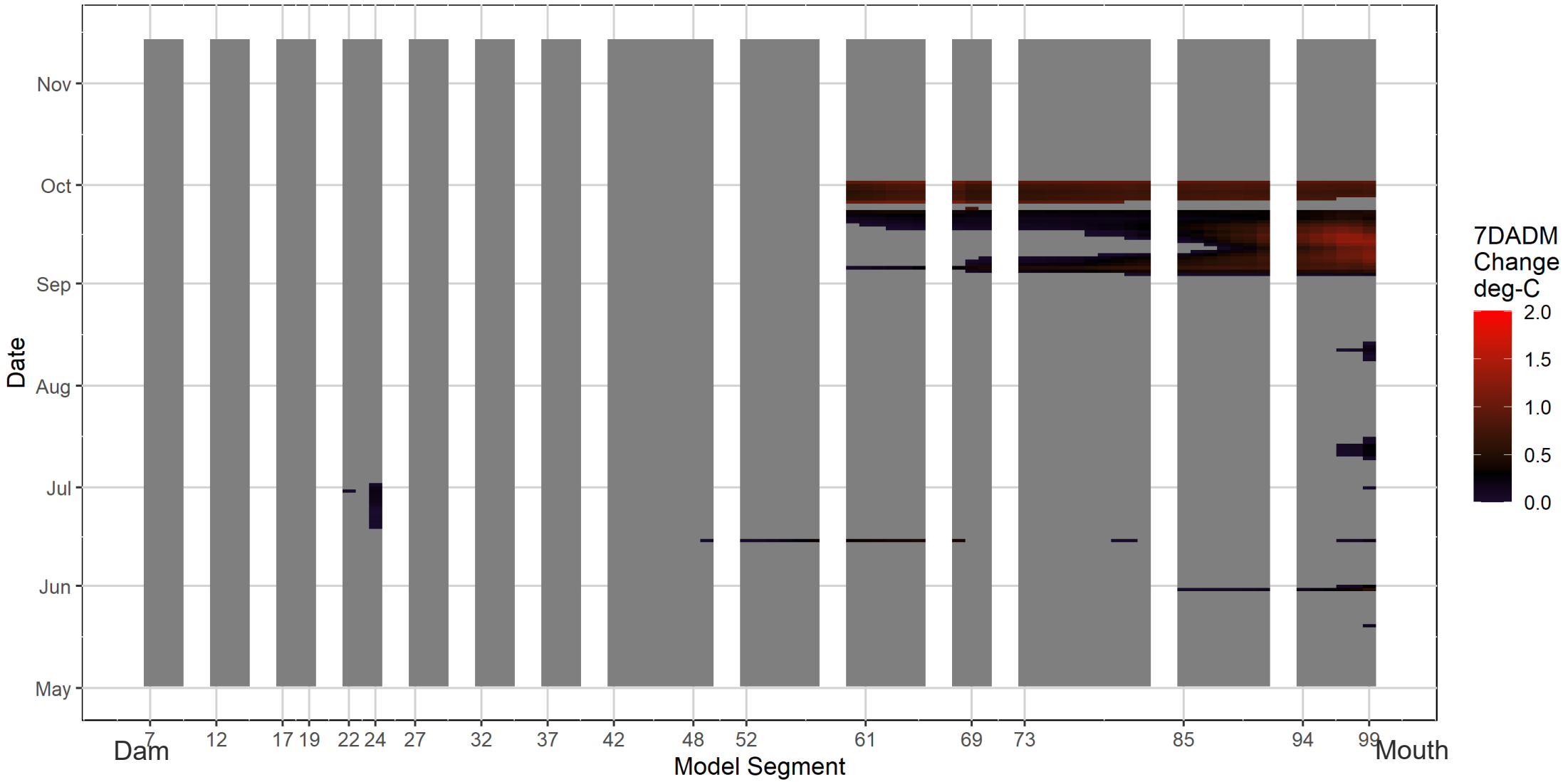
Bull Run 7DADM change from dam removal, May 1 – Nov 15, 2016
sim 1 Current - sim 3 No Dam



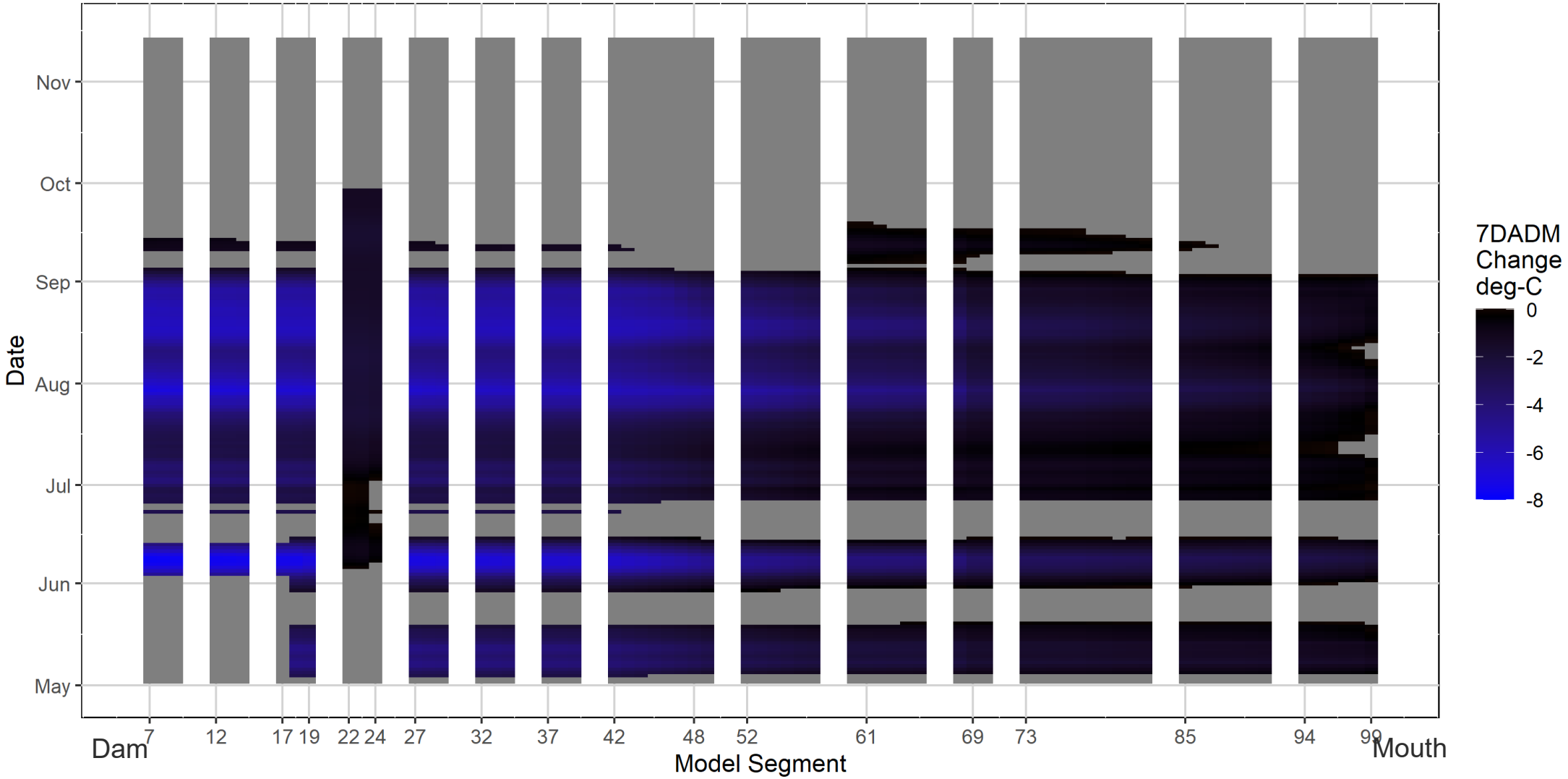
Bull Run May 1 – Nov 15



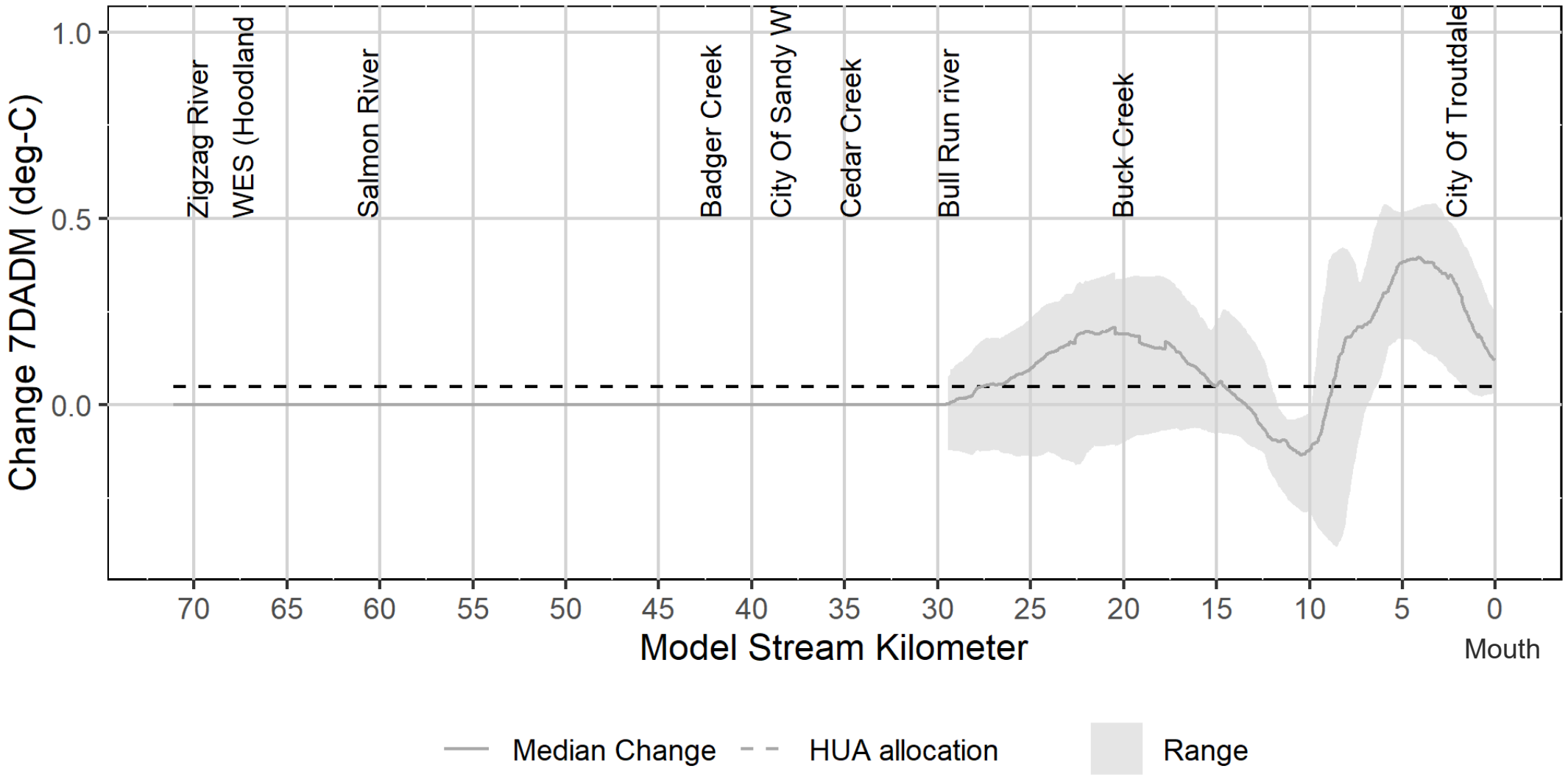
Bull Run 7DADM increases, May 1 – Nov 15, 2016, sim 1 Current - sim 6 No Dam



Bull Run 7DADM decreases, May 1 – Nov 15, 2016
sim 1 Current - sim 6 No Dam



Sandy River 7DADM change from dam removal, July 13 – Sept 6, 2016
sim 1 Current - sim 6 No Dam



Sandy River7DADM increases, July 13 – Sept 6, 2016
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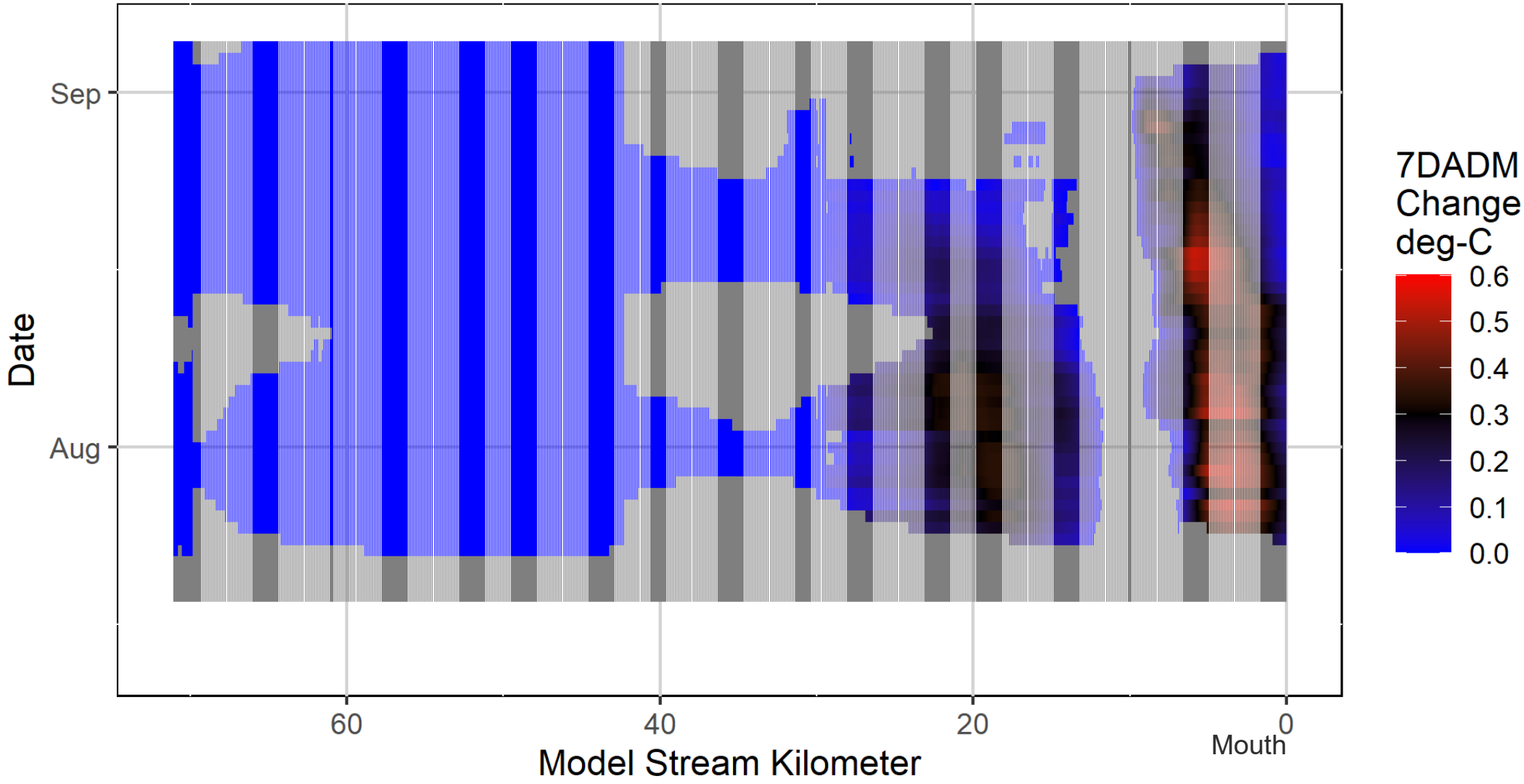
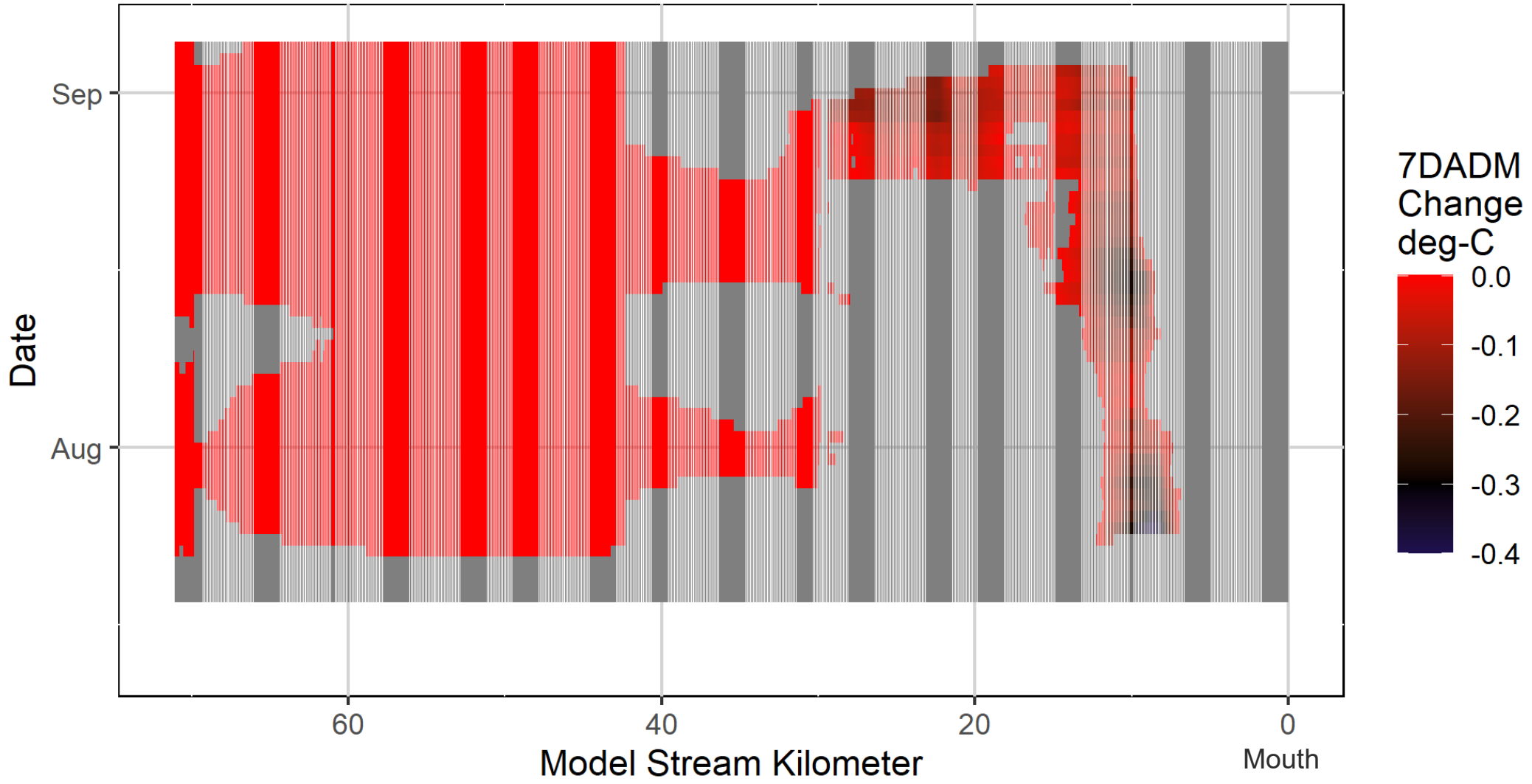
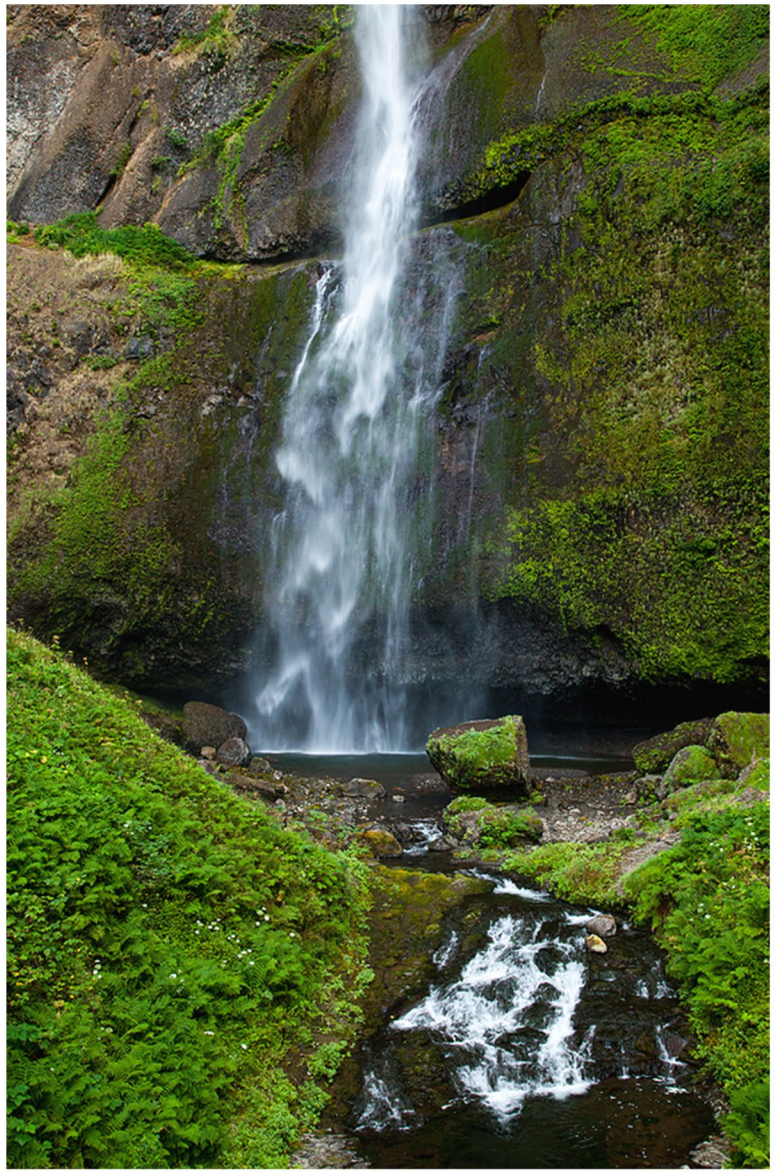


Bull Run 7DADM decreases, July 13 – Sept 6, 2016
sim 1 Current - sim 3 No Dam



Preliminary results

- Dam and reservoir operations in 2016 resulted in cooler 7dadm temperatures for most of the TMDL period relative to the “no dam” 7dadm temperatures. Aka dam operations mostly cool the Lower Bull Run River
- 7dadm warming in 2016 was focused downstream of Larson’s Bridge (segment 61 +) Sept-Oct.
- Model shows 7dadm warming and cooling in the Sandy River



Contacts and resources

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Michele Martin, Project Manager Michele.martin@deq.oregon.gov

Web pages (links to rulemaking pages, Quality Assurance Project Plans, more)

Project page: https://www.oregon.gov/deq/wq/tmdls/Pages/tmdlRlc-sandy.aspx

Rulemaking webpage:
https://www.oregon.gov/deq/rulemaking/Pages/sandytempTMDL.aspx

Committee input and rulemaking email:
Sandy.SubbasinTMDL@DEQ.oregon.gov

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