R2CROSS UPDATE

eRAMS

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Share Your Geographic Perspective

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CO

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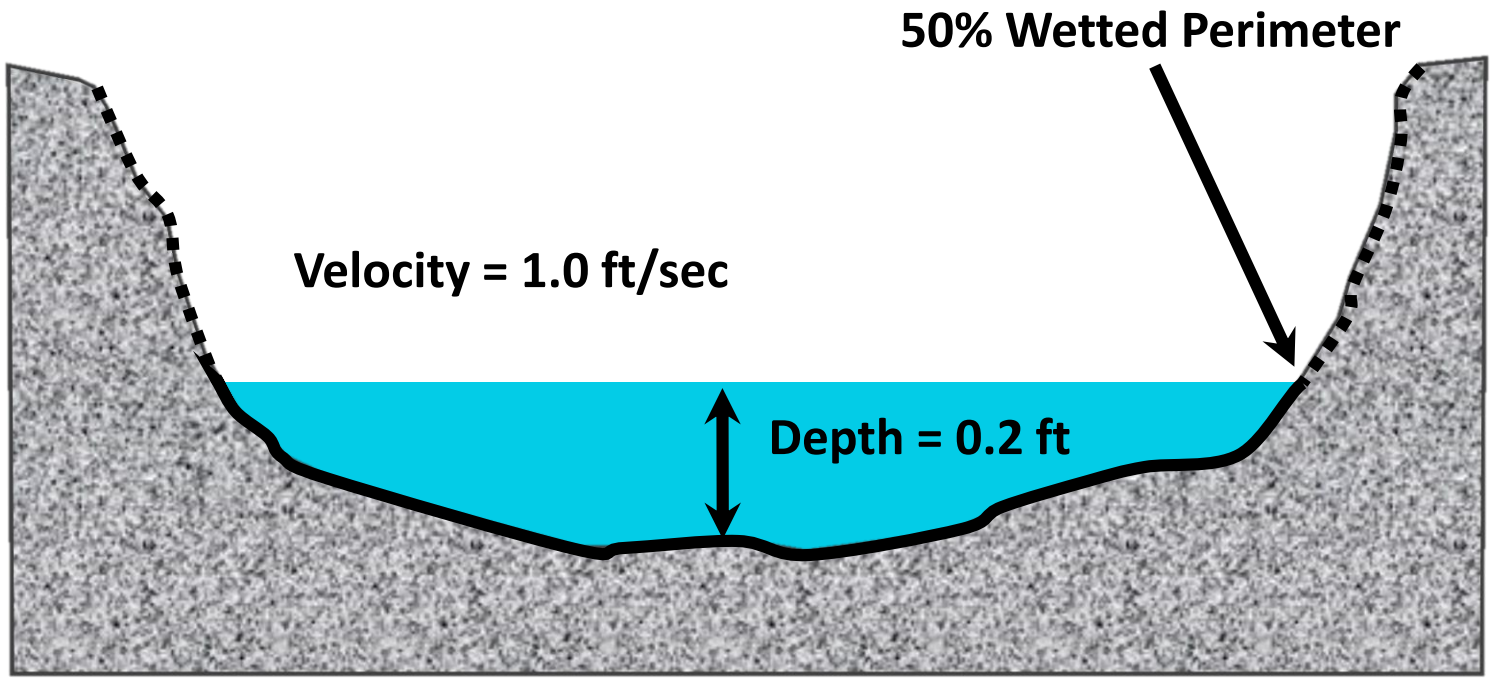
Colorado Water Conservation Board
Department of Natural Resources

Colorado State University

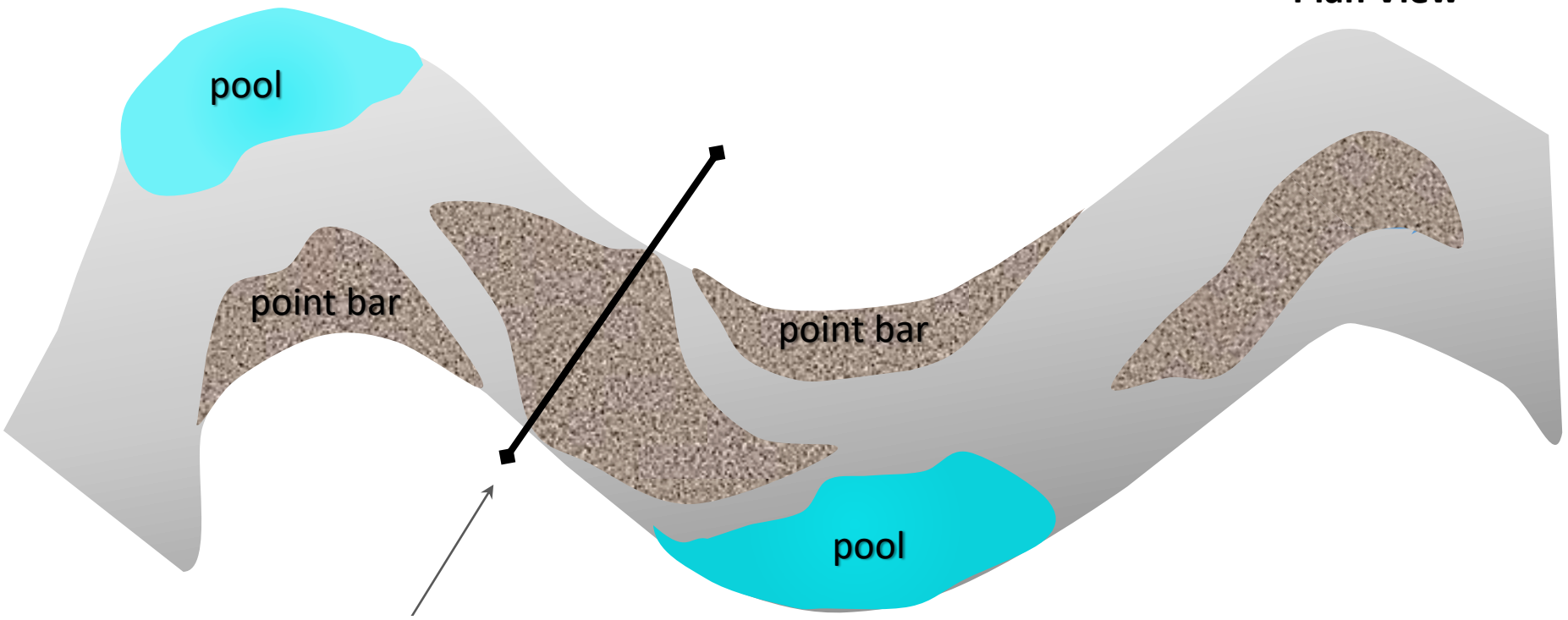
R2CROSS

- Primary way flow needs are determined for most ISFs
- Recommended amounts are based on the flows necessary to meet habitat criteria:



Requirements from Using R2CROSS Transect Method (Nehring 1979)

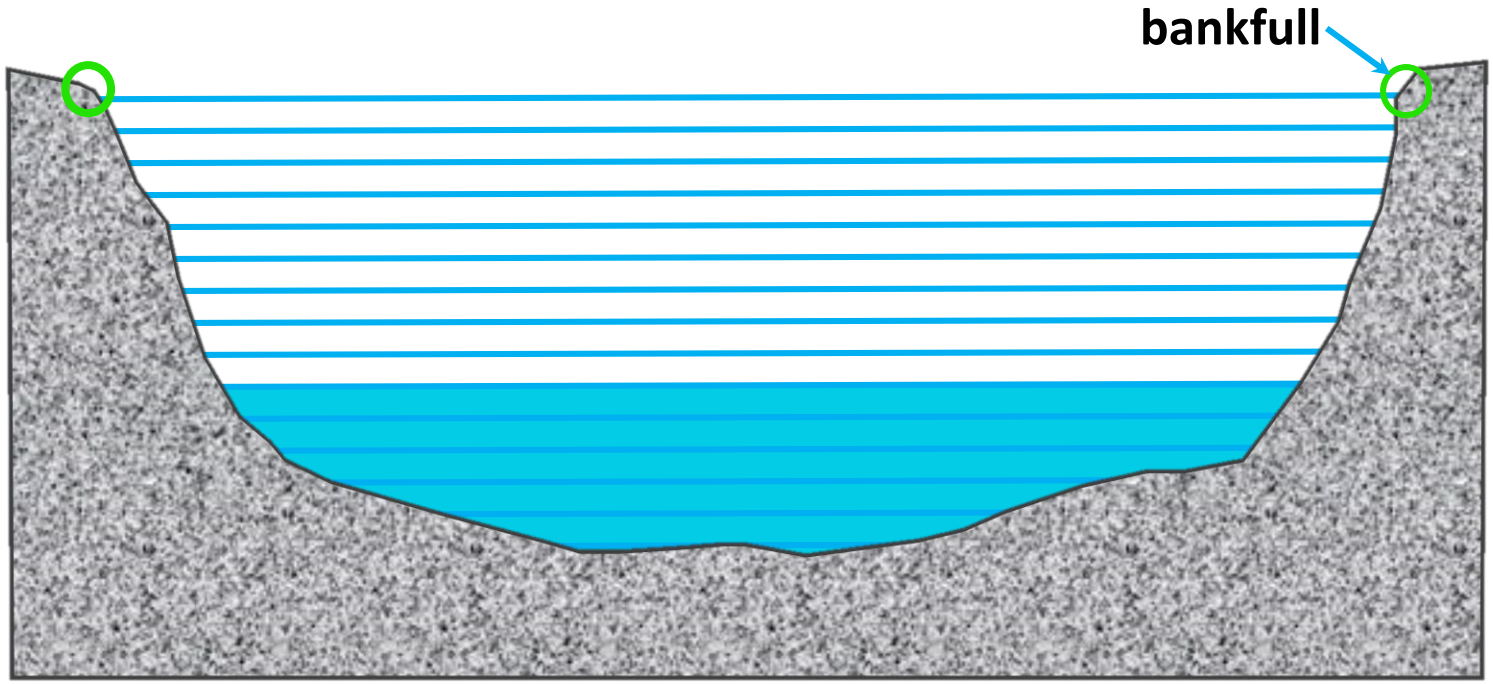
R2CROSS - RIFFLES



R2CROSS

Field Data Collection

- Survey the cross-section shape including bankfull indicators
- Measure velocity (discharge) through the cross-section
- Measure the slope

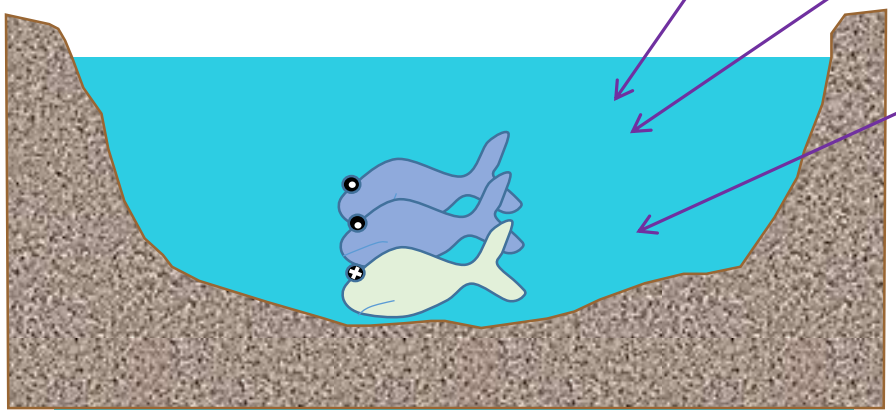


R2CROSS

Manning's Equation

$$Q = \frac{1.486 * A * R^{2/3} * S^{1/2}}{n}$$

Q = discharge (cfs)
A = cross-sectional area (ft)
R = hydraulic radius (ft)
S = slope (ft/ft)
n = Manning's n, a coefficient of roughness



DIST TO WATER (FT)	TOP WIDTH (FT)	AVG. DEPTH (FT)	MAX DEPTH (FT)	AREA (SQ FT)	WETTED PERIM. (FT)	PERCENT WET PERIM (%)	HYDR RADIUS (FT)	FLOW (CFS)	AVG. VELOCITY (FT/SEC)
1.55	37.12	1.21	1.7	44.95	37.97	100.00%	1.18	61.22	1.36
1.56	37.08	1.2	1.69	44.66	37.93	99.90%	1.18	60.6	1.36
1.61	36.88	1.16	1.64	42.81	37.69	99.30%	1.14	56.71	1.32
1.66	36.68	1.12	1.59	40.97	37.45	98.60%	1.09	52.94	1.29
1.71	36.48	1.07	1.54	39.14	37.2	98.00%	1.05	49.27	1.26
1.76	36.28	1.03	1.49	37.32	36.96	97.40%	1.01	45.71	1.22
1.81	36.09	0.98	1.44	35.51	36.72	96.70%	0.97	42.26	1.19
1.86	35.89	0.94	1.39	33.71	36.48	96.10%	0.92	38.93	1.15
1.91	35.69	0.89	1.34	31.92	36.24	95.40%	0.88	35.7	1.12
1.96	35.49	0.85	1.29	30.14	36	94.80%	0.84	32.59	1.08
2.01	35.14	0.81	1.24	28.38	35.61	93.80%	0.8	29.68	1.05
2.06	34.78	0.77	1.19	26.63	35.21	92.70%	0.76	26.9	1.01
2.11	34.42	0.72	1.14	24.9	34.81	91.70%	0.72	24.24	0.97
2.16	34.06	0.68	1.09	23.19	34.41	90.60%	0.67	21.69	0.94
2.21	33.64	0.64	1.04	21.49	33.98	89.50%	0.63	19.28	0.9
2.26	32.76	0.61	0.99	19.83	33.08	87.10%	0.6	17.16	0.87
2.31	31.93	0.57	0.94	18.22	32.23	84.90%	0.57	15.16	0.83
2.36	31.38	0.53	0.89	16.63	31.66	83.40%	0.53	13.18	0.79
2.41	30.83	0.49	0.84	15.08	31.09	81.90%	0.49	11.33	0.75
2.46	30.18	0.45	0.79	13.55	30.43	80.10%	0.45	9.62	0.71
2.51	27.55	0.44	0.74	12.08	27.79	73.20%	0.43	8.44	0.7
2.56	26.42	0.41	0.69	10.73	26.66	70.20%	0.4	7.12	0.66
2.61	25.29	0.37	0.64	9.44	25.52	67.20%	0.37	5.92	0.63
2.66	23.62	0.35	0.59	8.24	23.85	62.80%	0.35	4.94	0.6
2.71	22.86	0.31	0.54	7.07	23.08	60.80%	0.31	3.91	0.55
2.76	21.07	0.28	0.49	5.99	21.28	56.10%	0.28	3.13	0.52
2.81	20.27	0.24	0.44	4.96	20.47	53.90%	0.24	2.35	0.47
2.86	19.52	0.2	0.39	3.96	19.72	51.90%	0.2	1.66	0.42
2.91	18.73	0.16	0.34	3.01	18.92	49.80%	0.16	1.07	0.36
2.96	17.41	0.12	0.29	2.1	17.57	46.30%	0.12	0.62	0.3
3.01	13.93	0.09	0.24	1.28	14.07	37.00%	0.09	0.31	0.25
3.06	10.03	0.07	0.19	0.69	10.13	26.70%	0.07	0.14	0.2
3.11	6.81	0.04	0.14	0.27	6.87	18.10%	0.04	0.04	0.14
3.16	2.11	0.02	0.09	0.05	2.13	5.60%	0.02	0.01	0.1
3.21	0.38	0.02	0.04	0.01	0.39	1.00%	0.02	0	0.09

UPDATE GOALS

Improved

- User interface
- Graphs and tables display
- Model access and sharing
- Documentation

New functions

- Mapping functionality
- Particle size distribution calculator
- Discharge calculator
- Results interpolation
- Output reports and data

eRAMS

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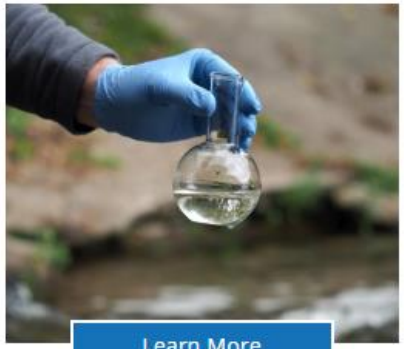
Environmental Resource Assessment and Management System

WATER QUALITY ASSESSMENT



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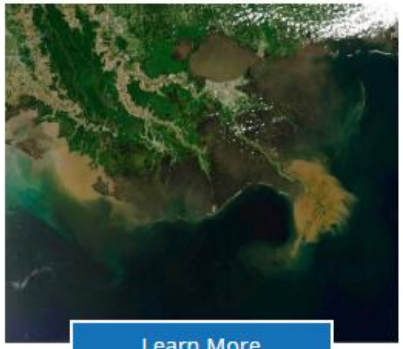

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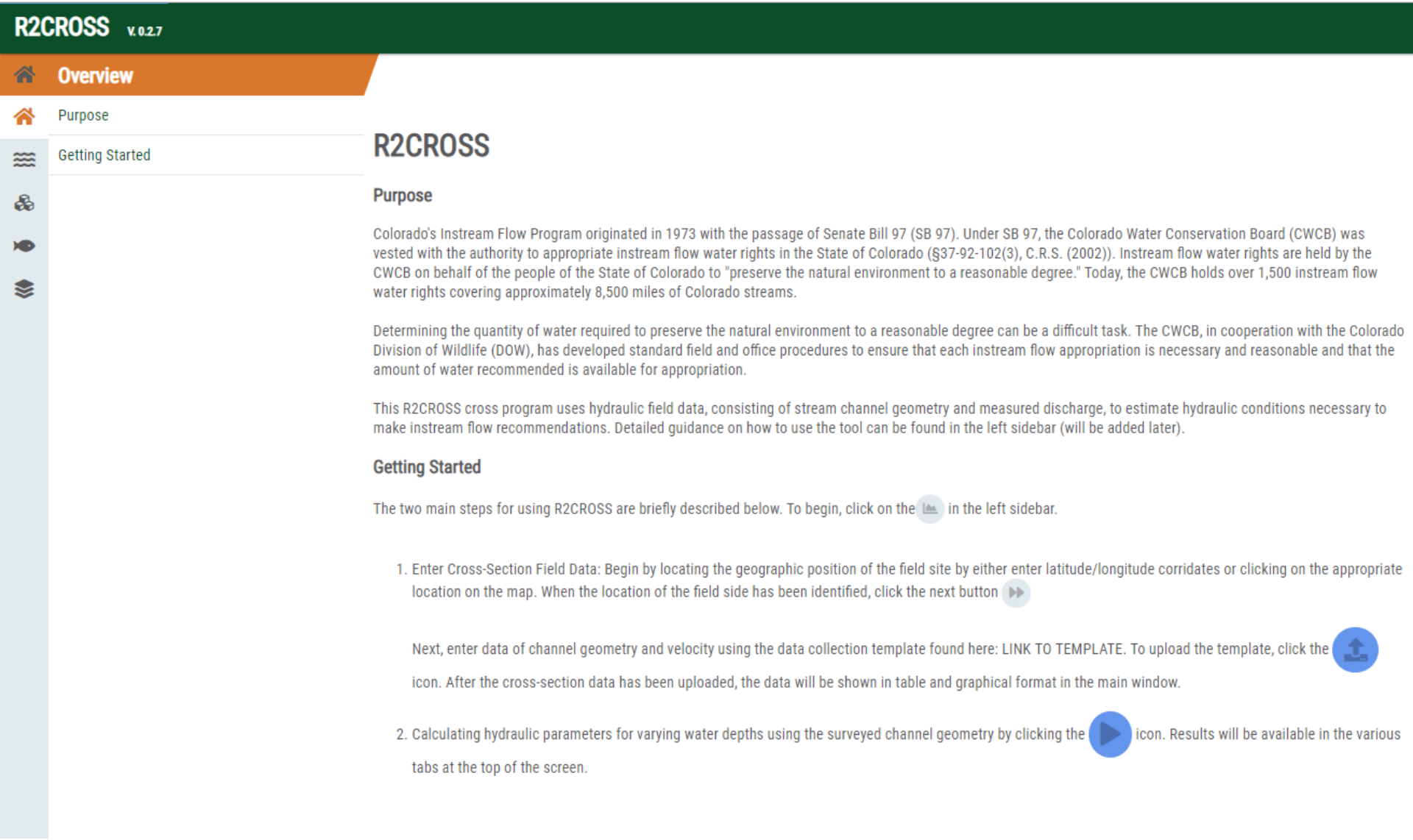
R2CROSS - eRAMS



IMPORT DATA

R2CROSS V. 0.2.7

R2CROSS

1 Upload cross-section

watson 2.xlsx uploaded successfully.

Download the template here

NEXT →

2 Run the model

3 Download Reports

Upload cross section

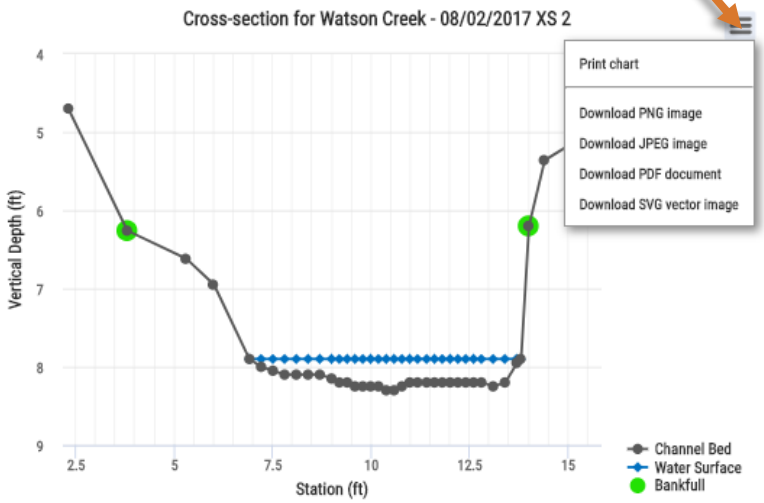
CROSS-SECTION | STAGING TABLE | R2CROSS SUMMARY | SUPPLEMENTARY RESULTS | HABITAT CRITERIA & RESULTS

Zoom to:

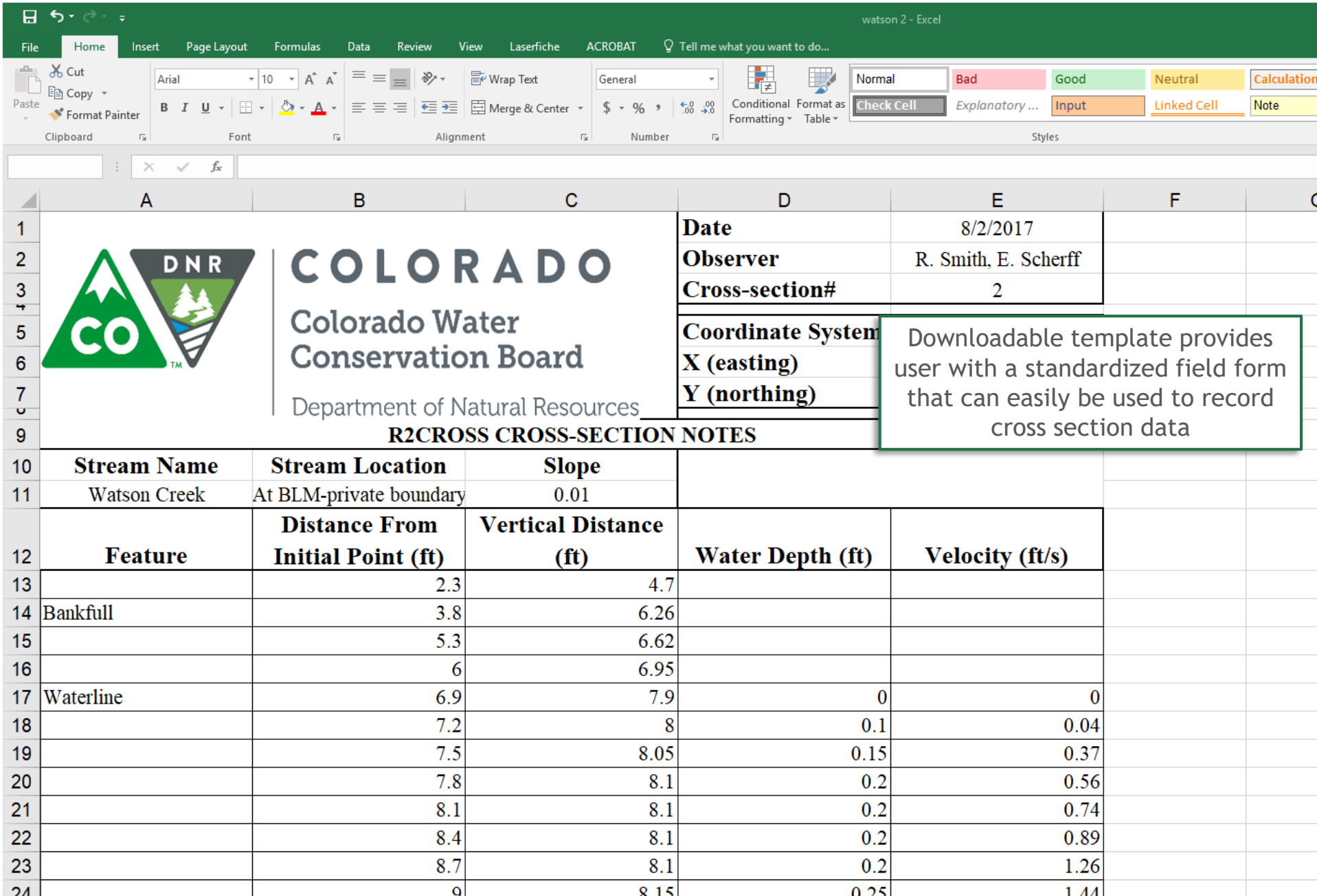
Stream Name: Watson Creek
Stream Location: At BLM-private boundary
Cross-section Number: 2
Slope: 0.01

Feature	Station (ft)	Vertical Depth (ft)	Water depth (ft)	Velocity (ft/s)
	2.3	4.7		
Bankfull	3.8	6.26		
	5.3	6.62		
	6	6.95		
Waterline	6.9	7.9	0	0
	7.2	8	0.1	0.04
	7.5	8.05	0.15	0.37
	7.8	8.1	0.2	0.56
	8.1	8.1	0.2	0.74
	8.4	8.1	0.2	0.89
	8.7	8.1	0.2	1.26
	9	8.15	0.25	1.44
	9.2	8.2	0.3	1.64
	9.4	8.2	0.3	1.76
	9.6	8.25	0.35	2.05
	9.8	8.25	0.35	2.18
	10	8.25	0.35	2.2
	10.2	8.25	0.35	1.89
	10.4	8.3	0.4	1.93
	10.6	8.3	0.4	2.12
	10.8	8.25	0.35	2.23
	11	8.2	0.3	2.29
	11.2	8.2	0.3	2.22
	11.4	8.2	0.3	2.17
	11.6	8.2	0.3	1.86
	11.8	8.2	0.3	1.53
	12	8.2	0.3	1.15
	12.2	8.2	0.3	0.66
	12.4	8.2	0.3	0.6
	12.6	8.2	0.3	0.7

User can download graphics



IMPORT FILE



watson 2 - Excel

File Home Insert Page Layout Formulas Data Review View Laserfiche ACROBAT Tell me what you want to do...

Cut Copy Format Painter Paste — Clipboard

Arial 10 — Font

Wrap Text Merge & Center — Alignment

General — Number

Conditional Formatting Format as Table

Normal Bad Good Neutral Calculation Check Cell Explanatory ... Input Linked Cell Note — Styles

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Date	8/2/2017
Observer	R. Smith, E. Scherff
Cross-section#	2
Coordinate System	
X (easting)	
Y (northing)	

Downloadable template provides user with a standardized field form that can easily be used to record cross section data

R2CROSS CROSS-SECTION NOTES

Stream Name	Stream Location	Slope
Watson Creek	At BLM-private boundary	0.01

Feature	Distance From Initial Point (ft)	Vertical Distance (ft)	Water Depth (ft)	Velocity (ft/s)
	2.3	4.7		
Bankfull	3.8	6.26		
	5.3	6.62		
	6	6.95		
Waterline	6.9	7.9	0	0
	7.2	8	0.1	0.04
	7.5	8.05	0.15	0.37
	7.8	8.1	0.2	0.56
	8.1	8.1	0.2	0.74
	8.4	8.1	0.2	0.89
	8.7	8.1	0.2	1.26
	9	8.15	0.25	1.44

RUN MODEL

R2CROSS V. 0.2.7

R2CROSS

CROSS-SECTION | STAGING TABLE | R2CROSS SUMMARY | SUPPLEMENTARY RESULTS | HABITAT CRITERIA & RESULTS

Zoom to:

Upload cross-section

2 Run the model

Select a method

- (•) Manning's n
- ( ) Jarret
- ( ) Thorne-Zevenbergen

▶

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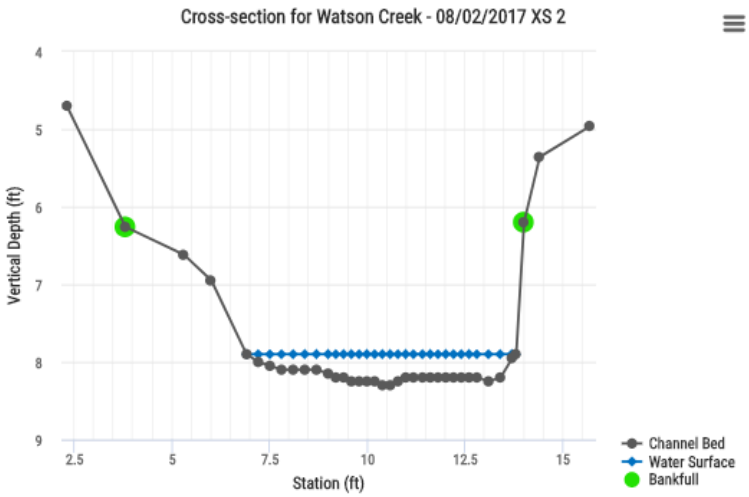
3 Download Reports

Stream Name: Watson Creek
Stream Location: At BLM-private boundary
Cross-section Number: 2
Slope: 0.01

Feature	Station (ft)	Vertical Depth (ft)	Water depth (ft)	Velocity (ft/s)
	2.3	4.7		
Bankfull	3.8	6.26		
	5.3	6.62		
	6	6.95		
Waterline	6.9	7.9	0	0
	7.2	8	0.1	0.04
	7.5	8.05	0.15	0.37
	7.8	8.1	0.2	0.56
	8.1	8.1	0.2	0.74
	8.4	8.1	0.2	0.89
	8.7	8.1	0.2	1.26
	9	8.15	0.25	1.44
	9.2	8.2	0.3	1.64
	9.4	8.2	0.3	1.76
	9.6	8.25	0.35	2.05
	9.8	8.25	0.35	2.18
	10	8.25	0.35	2.2
	10.2	8.25	0.35	1.89
	10.4	8.3	0.4	1.93
	10.6	8.3	0.4	2.12
	10.8	8.25	0.35	2.23
	11	8.2	0.3	2.29
	11.2	8.2	0.3	2.22
	11.4	8.2	0.3	2.17
	11.6	8.2	0.3	1.86
	11.8	8.2	0.3	1.53
	12	8.2	0.3	1.15
	12.2	8.2	0.3	0.66
	12.4	8.2	0.3	0.6
	12.6	8.2	0.3	0.7

Once model is run, outputs are displayed at the top of the browser screen



OUTPUT - STAGING TABLE

R2CROSS V. 0.2.7

R2CROSS

Upload cross-section

Run the model

3 Download Reports

Export the PDF Report EXPORT

Export Data EXPORT

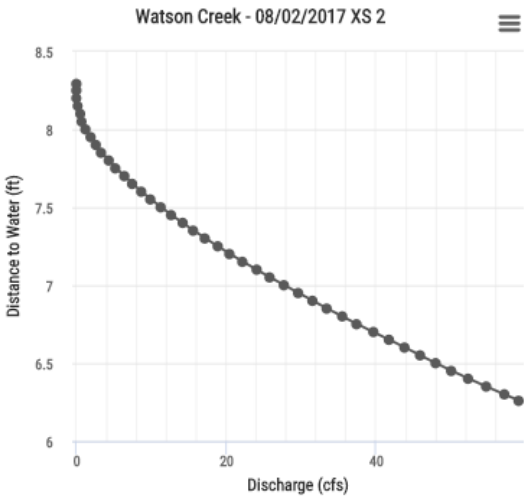
BACK

CROSS-SECTION | STAGING TABLE | R2CROSS SUMMARY | SUPPLEMENTARY RESULTS | HABITAT CRITERIA & RESULTS

Zoom to:

Stream Name: Watson Creek
Stream Location: At BLM-private boundary
Cross-section Number: 2
Manning's n: 0.043
Computation method: Manning's n

Change Y-axis
Distance to Water



Calculated staging table

Feature	Distance to Water (ft)	Top Width (ft)	Mean Depth (ft)	Maximum Depth (ft)	Area (SQ ft)	Wetted Perimeter (ft)	Percent Wetted Perimeter	Hydraulic Radius (ft)	Discharge (cfs)	Mean Velocity (ft/s)
Bankfull	6.26	10.19	1.47	2.04	14.99	12.35	100.00%	1.21	59.07	3.94
	6.3	10.02	1.46	2.0	14.58	12.13	98.28%	1.2	57.09	3.91
	6.35	9.81	1.44	1.95	14.09	11.87	96.14%	1.19	54.69	3.88
	6.4	9.59	1.42	1.9	13.6	11.61	94.00%	1.17	52.37	3.85
	6.45	9.38	1.4	1.85	13.13	11.34	91.85%	1.16	50.12	3.82
	6.5	9.16	1.38	1.8	12.66	11.08	89.71%	1.14	47.96	3.79
	6.55	8.95	1.36	1.75	12.21	10.81	87.57%	1.13	45.87	3.76
	6.6	8.74	1.35	1.7	11.77	10.55	85.42%	1.12	43.85	3.73
	6.65	8.58	1.32	1.65	11.34	10.34	83.75%	1.1	41.74	3.68
	6.7	8.47	1.29	1.6	10.91	10.17	82.40%	1.07	39.59	3.63
	6.75	8.36	1.25	1.55	10.49	10.01	81.04%	1.05	37.49	3.57
	6.8	8.25	1.22	1.5	10.07	9.84	79.68%	1.02	35.45	3.52

OUTPUT - STAGING TABLE

R2CROSS V. 0.2.7

R2CROSS

- Upload cross-section
- Run the model
- 3 Download Reports
  - Export the PDF Report — EXPORT
  - Export Data — EXPORT

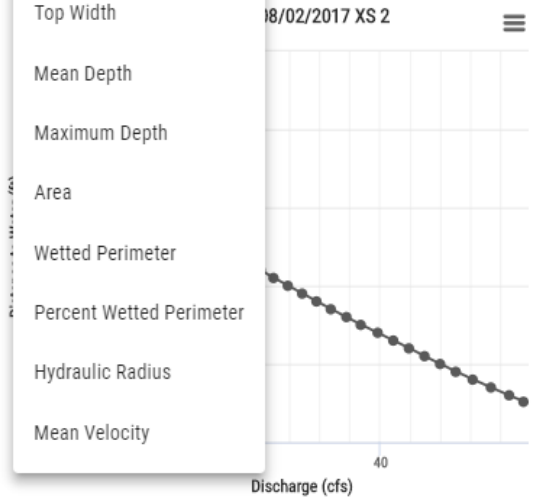
← BACK

CROSS-SECTION | STAGING TABLE | R2CROSS SUMMARY | SUPPLEMENTARY RESULTS | HABITAT CRITERIA & RESULTS

ability to graph several parameters against discharge (Q)

Stream Name: Watson Creek
Stream Location: At BLM-private boundary
Cross-section Number: 2
Manning's n: 0.043
Computation method: Manning's n

Distance to Water
Top Width
Mean Depth
Maximum Depth
Area
Wetted Perimeter
Percent Wetted Perimeter
Hydraulic Radius
Mean Velocity



Calculated staging table

Feature	Distance to Water (ft)	Top Width (ft)	Mean Depth (ft)	Maximum Depth (ft)	Area (SQ ft)	Wetted Perimeter (ft)	Percent Wetted Perimeter	Hydraulic Radius (ft)	Discharge (cfs)	Mean Velocity (ft/s)
Bankfull	6.26	10.19	1.47	2.04	14.99	12.35	100.00%	1.21	59.07	3.94
	6.3	10.02	1.46	2.0	14.58	12.13	98.28%	1.2	57.09	3.91
	6.35	9.81	1.44	1.95	14.09	11.87	96.14%	1.19	54.69	3.88
	6.4	9.59	1.42	1.9	13.6	11.61	94.00%	1.17	52.37	3.85
	6.45	9.38	1.4	1.85	13.13	11.34	91.85%	1.16	50.12	3.82
	6.5	9.16	1.38	1.8	12.66	11.08	89.71%	1.14	47.96	3.79
	6.55	8.95	1.36	1.75	12.21	10.81	87.57%	1.13	45.87	3.76
	6.6	8.74	1.35	1.7	11.77	10.55	85.42%	1.12	43.85	3.73
	6.65	8.58	1.32	1.65	11.34	10.34	83.75%	1.1	41.74	3.68
	6.7	8.47	1.29	1.6	10.91	10.17	82.40%	1.07	39.59	3.63
	6.75	8.36	1.25	1.55	10.49	10.01	81.04%	1.05	37.49	3.57
	6.8	8.25	1.22	1.5	10.07	9.84	79.68%	1.02	35.45	3.52

OUTPUT - R2CROSS SUMMARY

R2CROSS V. 0.2.7

R2CROSS

CROSS-SECTION | STAGING TABLE | R2CROSS SUMMARY | SUPPLEMENTARY RESULTS | HABITAT CRITERIA & RESULTS

Zoom to:

- Upload cross-section
- Run the model
- 3 Download Reports
  - Export the PDF Report — EXPORT
  - Export Data — EXPORT

BACK

Stream Name: Watson Creek
Stream Location: At BLM-private boundary
Cross-section Number: 2
Manning's n: 0.043
Computation method: Manning's n

Provides summary of model results

Summary Results

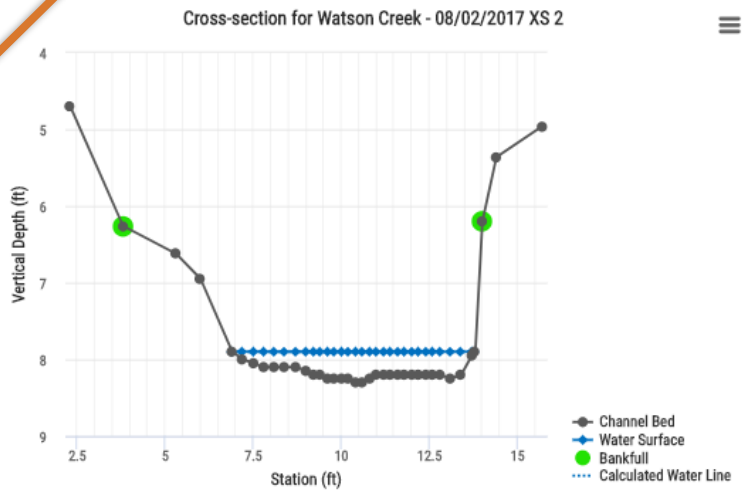
Measured Flow (Qm) = 2.57
Calculated Flow (Qc) = 2.57
(Qm-Qc)/Qm * 100 = 0.04%

Measured Waterline (WLm) = 7.9
Calculated Waterline (WLc) = 7.9
(WLm-WLc)/WLm * 100 = -0.00%

Max Measured Depth (Dm) = 0.4
Max Calculated Depth (Dc) = 0.4
(Dm-Dc)/Dm * 100 = 0.02%

Mean Velocity = 1.41
Manning's n = 0.043
Slope = 0.01

0.4 * Qm = 1.03
2.5 * Qm = 6.42



OUTPUT - SUMMARY RESULTS

R2CROSS V. 0.2.7

R2CROSS

- Upload cross-section
- Run the model
- 3 Download Reports
  - Export the PDF Report — EXPORT
  - Export Data — EXPORT

← BACK

CROSS-SECTION | STAGING TABLE | R2CROSS SUMMARY | SUPPLEMENTARY RESULTS | HABITAT CRITERIA & RESULTS

Zoom to:

Stream Name: Watson Creek
Stream Location: At BLM-private boundary
Cross-section Number: 2

Supplementary results are used to produce the calculated staging table

Measured Data					Value Computed from Measured Field Data				
Feature	Station (ft)	Vertical Depth (ft)	Water depth (ft)	Velocity (ft/s)	Wetted Perimeter (ft)	Water Depth (ft)	Area (SQ ft)	Discharge (cfs)	Percent Discharge
	2.3	4.7			0	0	0	0	0
Bankfull	3.8	6.26			0	0	0	0	0
	5.3	6.62			0	0	0	0	0
	6	6.95			0	0	0	0	0
Waterline	6.9	7.9	0	0	0	0	0	0	0
	7.2	8	0.1	0.04	0.32	0.1	0.03	0	0.05
	7.5	8.05	0.15	0.37	0.3	0.15	0.04	0.02	0.65
	7.8	8.1	0.2	0.56	0.3	0.2	0.06	0.03	1.31
	8.1	8.1	0.2	0.74	0.3	0.2	0.06	0.04	1.73
	8.4	8.1	0.2	0.89	0.3	0.2	0.06	0.05	2.08
	8.7	8.1	0.2	1.26	0.3	0.2	0.06	0.08	2.94
	9	8.15	0.25	1.44	0.3	0.25	0.06	0.09	3.5
	9.2	8.2	0.3	1.64	0.21	0.3	0.06	0.1	3.83
	9.4	8.2	0.3	1.76	0.2	0.3	0.06	0.11	4.11
	9.6	8.25	0.35	2.05	0.21	0.35	0.07	0.14	5.59
	9.8	8.25	0.35	2.18	0.2	0.35	0.07	0.15	5.94
	10	8.25	0.35	2.2	0.2	0.35	0.07	0.15	6
	10.2	8.25	0.35	1.89	0.2	0.35	0.07	0.13	5.15
	10.4	8.3	0.4	1.93	0.21	0.4	0.08	0.15	6.01
	10.6	8.3	0.4	2.12	0.2	0.4	0.08	0.17	6.6
	10.8	8.25	0.35	2.23	0.21	0.35	0.07	0.16	6.08
	11	8.2	0.3	2.29	0.21	0.3	0.06	0.14	5.35
	11.2	8.2	0.3	2.22	0.2	0.3	0.06	0.13	5.19
	11.4	8.2	0.3	2.17	0.2	0.3	0.06	0.13	5.07
	11.6	8.2	0.3	1.86	0.2	0.3	0.06	0.11	4.35
	11.8	8.2	0.3	1.53	0.2	0.3	0.06	0.09	3.58
	12	8.2	0.3	1.15	0.2	0.3	0.06	0.07	2.69
	12.2	8.2	0.3	0.66	0.2	0.3	0.06	0.04	1.54
	12.4	8.2	0.3	0.6	0.2	0.3	0.06	0.04	1.4

OUTPUT - HABITAT CRITERIA & RESULTS

R2CROSS V. 0.2.7

R2CROSS

- Upload cross-section
- Run the model
- 3 Download Reports
  - Export the PDF Report — EXPORT
  - Export Data — EXPORT

← BACK

CROSS-SECTION | STAGING TABLE | R2CROSS SUMMARY | SUPPLEMENTARY RESULTS | HABITAT CRITERIA & RESULTS

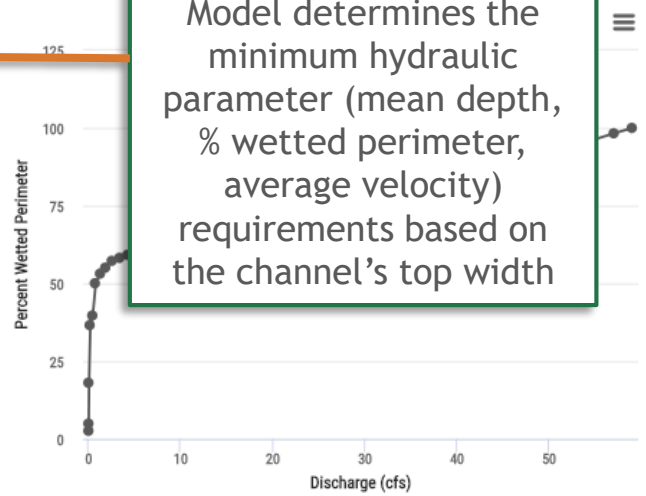
Zoom to:

Habitat Criteria (Nehring 1979)

Stream Top Width $(ft)_1$	Mean Depth (ft)	Percent Wetted Perimeter	Average Velocity (ft/s)
1-20	0.2	50	1.0
21-40	0.2-0.4	50	1.0
41-60	0.4-0.6	50-60	1.0
61-100	0.6-1.0	>70	1.0

1 At bankfull discharge

Model determines the minimum hydraulic parameter (mean depth, % wetted perimeter, average velocity) requirements based on the channel's top width



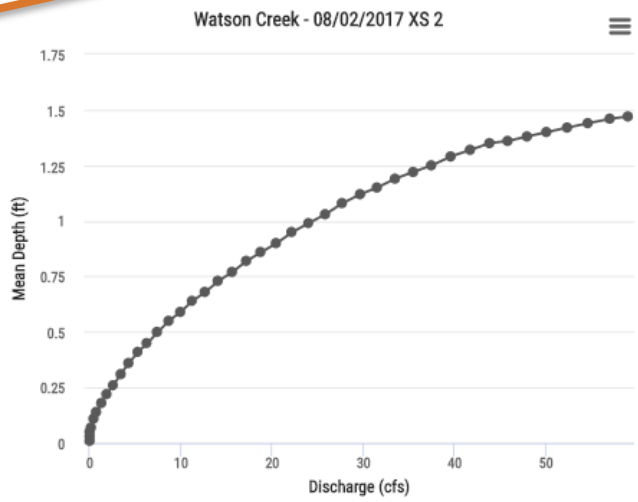
Habitat Criteria Results

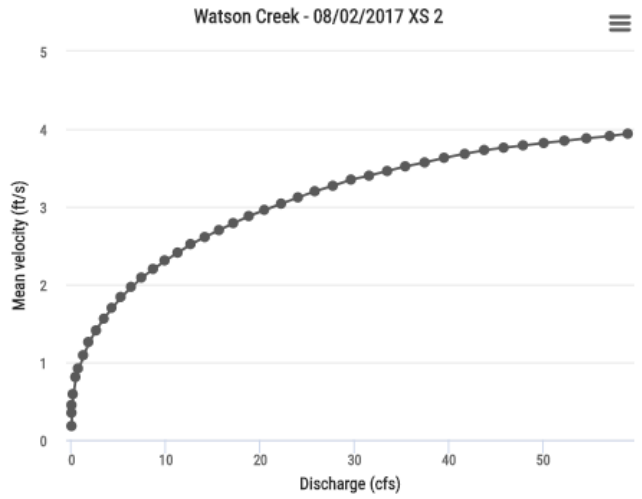
Habitat Type	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	1.54
Mean Velocity (ft/s)	1.0	1.01
Percent Wetted Perimeter (%)	50.0	0.78

Cross-section top width (ft) = 10.19

Then, discharge values that meet requirements are calculated

These discharges are then used to make the winter flow recommendation (2 of 3) and the summer flow recommendation (3 of 3)





OUTPUT - HABITAT CRITERIA & RESULTS

R2CROSS V. 0.2.7

R2CROSS

CROSS-SECTION | STAGING TABLE | R2CROSS SUMMARY | SUPPLEMENTARY RESULTS | HABITAT CRITERIA & RESULTS

Zoom to:

- Upload cross-section
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← BACK

Reports can then be downloaded to a PDF or excel file

Habitat Criteria (Nehring 1979)

Stream Top Width $(ft)_1$	Mean Depth (ft)	Percent Wetted Perimeter	Average Velocity (ft/s)
1-20	0.2	50	1.0
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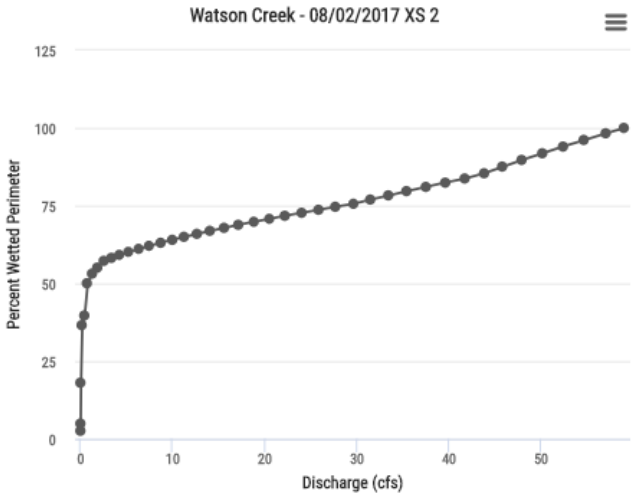
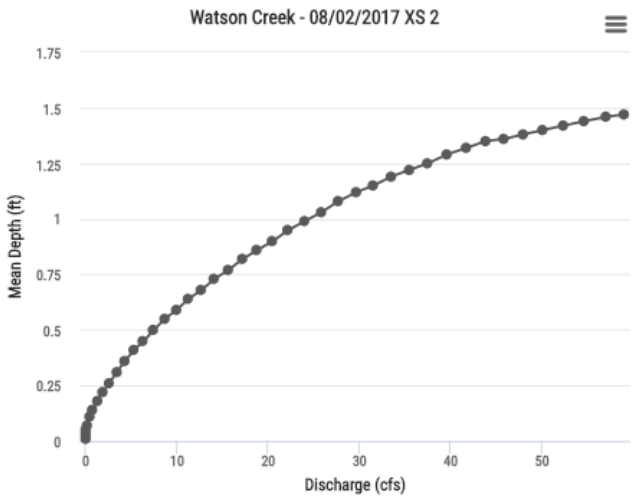
1 At bankfull discharge

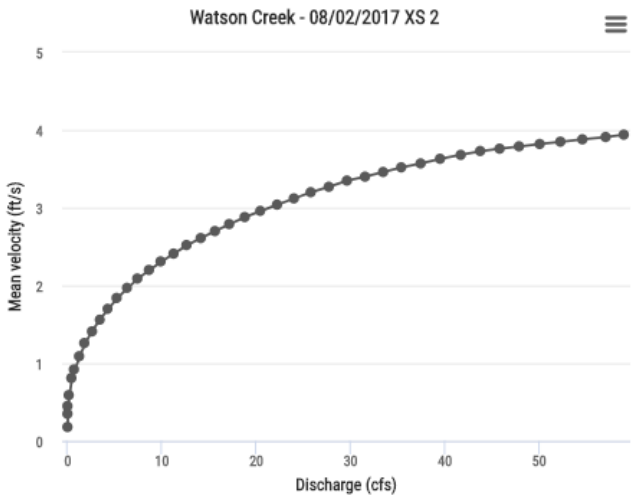
Habitat Criteria Results

Habitat Type	Habitat Criteria	Discharge (cfs) Meeting Criteria
Mean Depth (ft)	0.2	1.54
(ft/s)	1.0	1.01
ed Perimeter	50.0	0.78

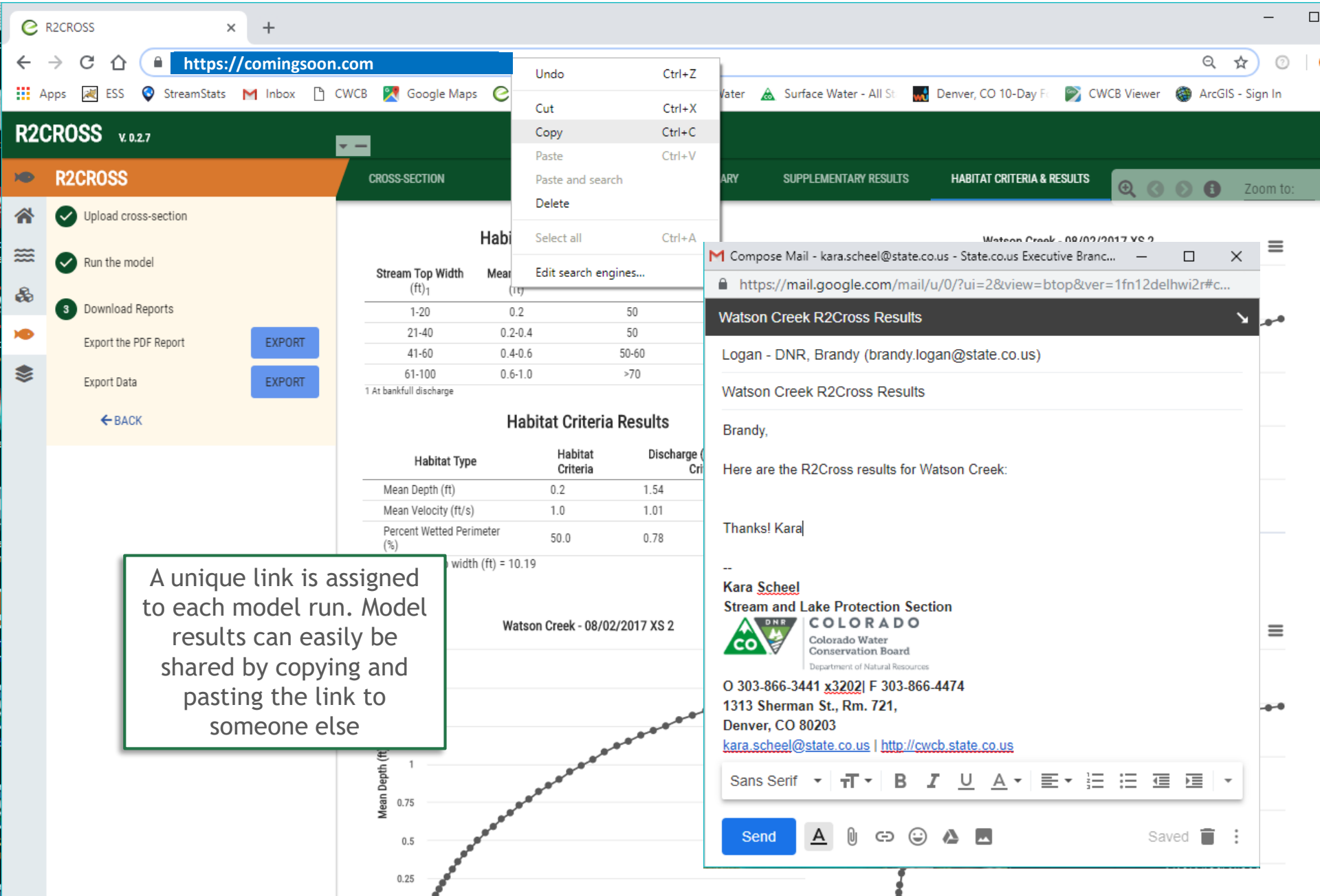
width (ft) = 10.19





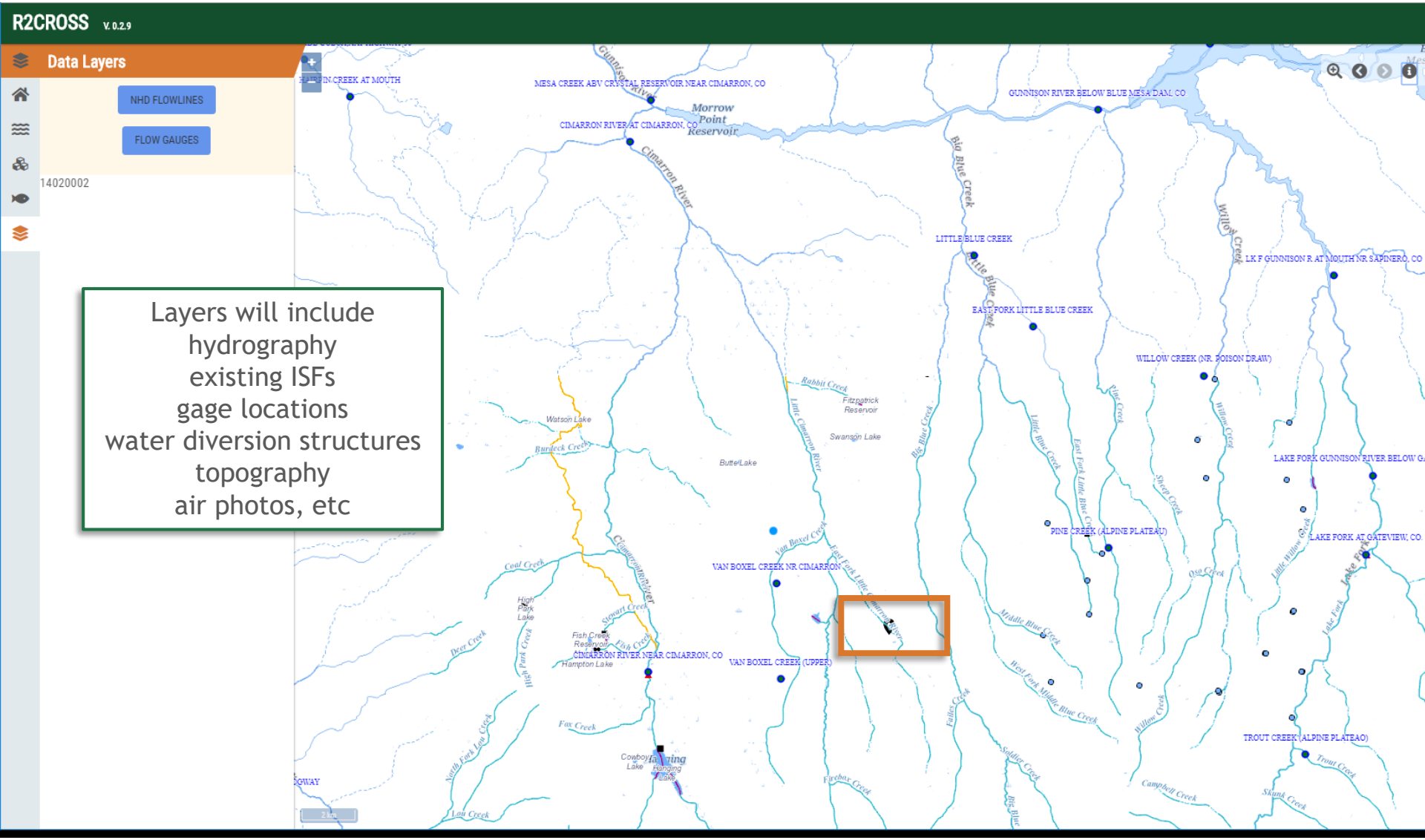


SHARE RESULTS

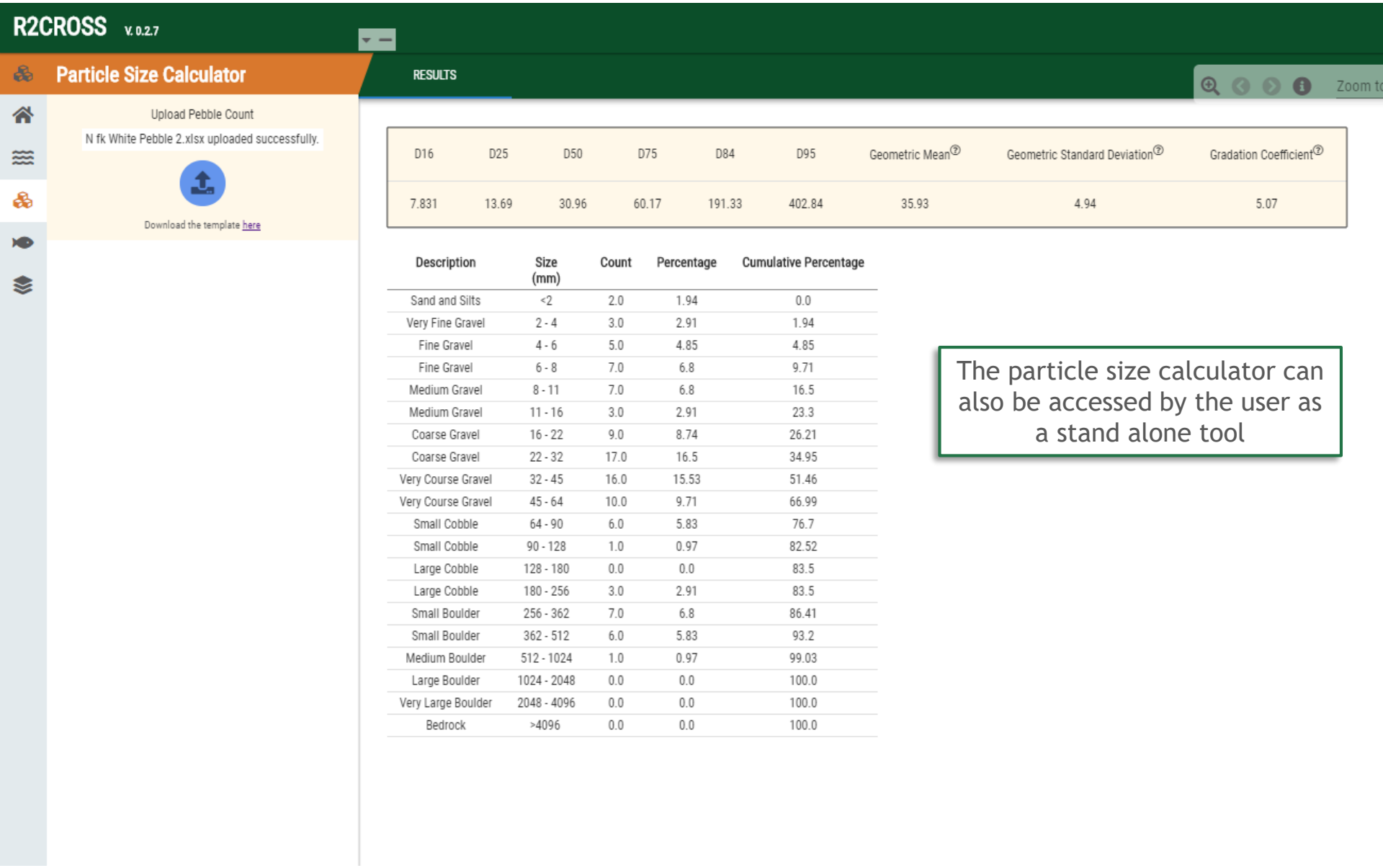


A unique link is assigned to each model run. Model results can easily be shared by copying and pasting the link to someone else

MAPPING AND DISPLAY



PARTICLE SIZE CALCULATOR

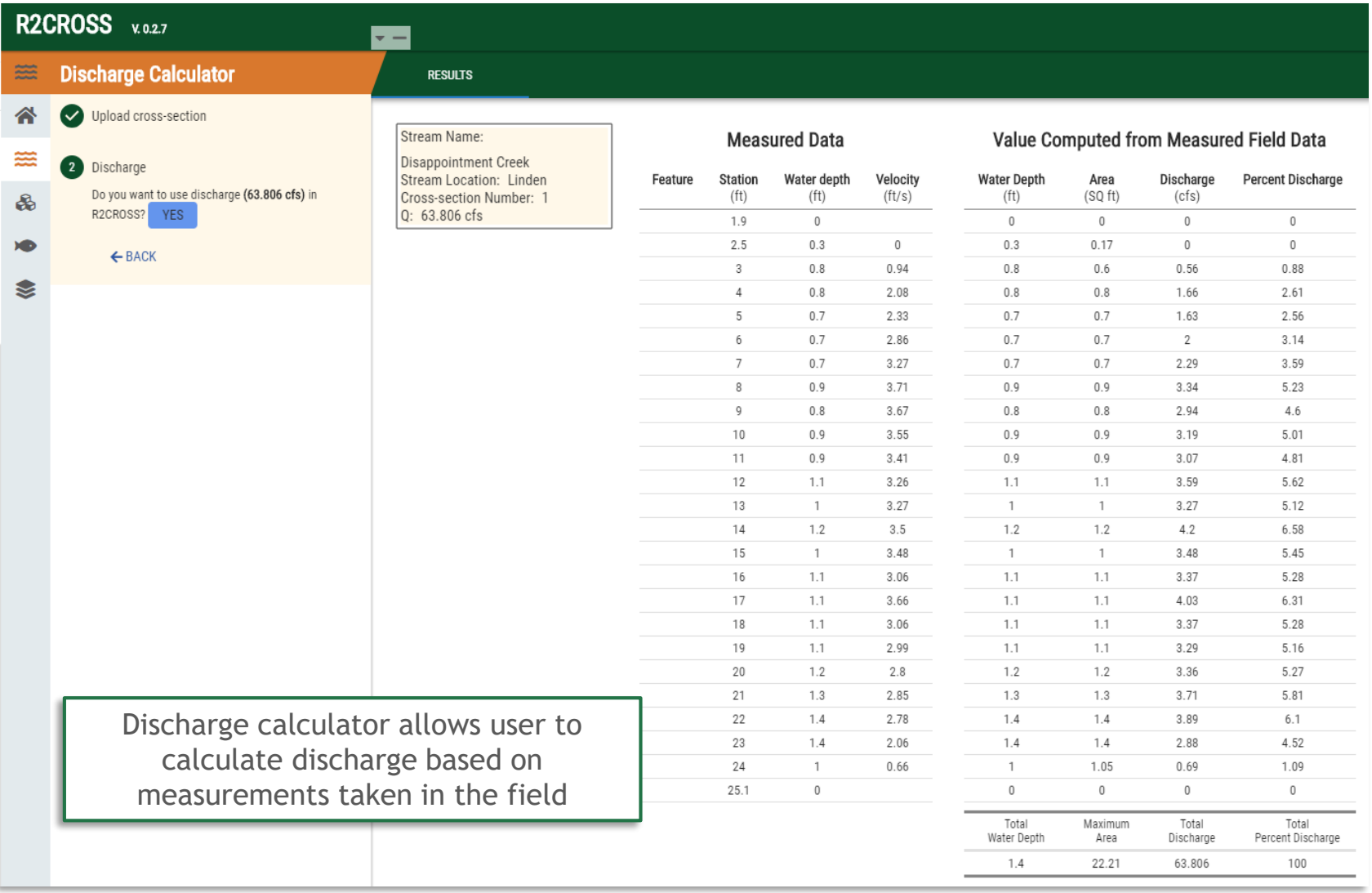


D16	D25	D50	D75	D84	D95	Geometric Mean	Geometric Standard Deviation	Gradation Coefficient
7.831	13.69	30.96	60.17	191.33	402.84	35.93	4.94	5.07

Description	Size (mm)	Count	Percentage	Cumulative Percentage
Sand and Silts	<2	2.0	1.94	0.0
Very Fine Gravel	2 - 4	3.0	2.91	1.94
Fine Gravel	4 - 6	5.0	4.85	4.85
Fine Gravel	6 - 8	7.0	6.8	9.71
Medium Gravel	8 - 11	7.0	6.8	16.5
Medium Gravel	11 - 16	3.0	2.91	23.3
Coarse Gravel	16 - 22	9.0	8.74	26.21
Coarse Gravel	22 - 32	17.0	16.5	34.95
Very Course Gravel	32 - 45	16.0	15.53	51.46
Very Course Gravel	45 - 64	10.0	9.71	66.99
Small Cobble	64 - 90	6.0	5.83	76.7
Small Cobble	90 - 128	1.0	0.97	82.52
Large Cobble	128 - 180	0.0	0.0	83.5
Large Cobble	180 - 256	3.0	2.91	83.5
Small Boulder	256 - 362	7.0	6.8	86.41
Small Boulder	362 - 512	6.0	5.83	93.2
Medium Boulder	512 - 1024	1.0	0.97	99.03
Large Boulder	1024 - 2048	0.0	0.0	100.0
Very Large Boulder	2048 - 4096	0.0	0.0	100.0
Bedrock	>4096	0.0	0.0	100.0

The particle size calculator can also be accessed by the user as a stand alone tool

DISCHARGE CALCULATOR



Discharge calculator allows user to calculate discharge based on measurements taken in the field

QUESTIONS?

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COLORADO
Colorado Water Conservation Board
Department of Natural Resources