Worksheet 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	**Blanchard River**	Location:	**XS2 (Karg)**
Date:	**7/1/2020**	Stream Type:	**C4**
Valley Type:	**C-AL-FD**		
Observers:	**J. Ricketts, J. Moyer, N. Uhl**	HUC:	**4100008**

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	**790.29**	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	**6.18**	d_{bkf} (ft)
Bankfull Riffle WIDTH	**127.90**	W_{bkf} (ft)	Wetted PERMIMETER $\sim (2 * d_{bkf}) + W_{bkf}$	**131.68**	W_p (ft)
D_{84} at Riffle	**103.82**	Dia. (mm)	D_{84} (mm) / 304.8	**0.34**	D_{84} (ft)
Bankfull SLOPE	**0.0006**	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	**6.00**	R (ft)
Gravitational Acceleration	**32.2**	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	**17.60**	R / D_{84}
Drainage Area	**345.0**	DA (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	**0.326**	u* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	**3.22**	ft / sec	**2546.15**	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49 * R^{2/3} * S^{1/2} / n$ ***n* =** **0.034**	**3.39**	ft / sec	**2675.92**	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-20) $u = 1.49 * R^{2/3} * S^{1/2} / n$ ***n* =** **0.019**	**6.06**	ft / sec	**4789.16**	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $u = 1.49 * R^{2/3} * S^{1/2} / n$ $n = 0.39 * S^{0.38} * R^{-0.16}$ **Note:** This equation is applicable to **steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems**; i.e., for ***n* =**	**-**	ft / sec	**-**	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) **Darcy-Weisbach (Leopold, Wolman and Miller)**	**3.33**	ft / sec	**2629.30**	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	**-**	ft / sec	**-**	cfs
4. Continuity Equations: a) Regional Curves u = Q / A **Return Period for Bankfull Discharge Q = year**	**-**	ft / sec	**-**	cfs
4. Continuity Equations: b) USGS Gage Data u = Q / A	**3.03**	ft / sec	**2391.00**	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1.	For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.
Option 2.	For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.
Option 3.	For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.
Option 4.	For **log-influenced** channels: Measure "**protrustion heights**" proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

Worksheet 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	**Blanchard River**	Location:	**XS4 (Cory St.)**
Date:	**7/1/2020**	Stream Type:	**C4**
Valley Type:	**C-AL-FD**		
Observers:	**J. Ricketts, J. Moyer, N. Uhl**	HUC:	**4100008**

INPUT VARIABLES			OUTPUT VARIABLES		
Bankfull Riffle Cross-Sectional AREA	737.16	A_{bkf} (ft^2)	Bankfull Riffle Mean DEPTH	6.00	d_{bkf} (ft)
Bankfull Riffle WIDTH	122.93	W_{bkf} (ft)	Wetted PERMIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	125.27	W_p (ft)
D_{84} at Riffle	77.00	Dia. (mm)	D_{84} (mm) / 304.8	0.25	D_{84} (ft)
Bankfull SLOPE	0.0006	S_{bkf} (ft / ft)	Hydraulic RADIUS A_{bkf} / W_p	5.88	R (ft)
Gravitational Acceleration	32.2	g (ft / sec^2)	Relative Roughness R(ft) / D_{84} (ft)	23.24	R / D_{84}
Drainage Area	345.0	DA (mi^2)	Shear Velocity $u^* = (gRS)^{½}$	0.323	u* (ft/sec)

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	3.41	ft / sec	2515.01	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49*R^{2/3}*S^{1/2} / n$; *n* = 0.032	3.55	ft / sec	2617.66	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-20) $u = 1.49*R^{2/3}*S^{1/2} / n$; *n* = 0.019	5.98	ft / sec	4408.22	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $u = 1.49*R^{2/3}*S^{1/2} / n$; $n = 0.39*S^{0.38}*R^{-0.16}$; **Note:** This equation is applicable to **steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems**; i.e., for *n* =	-	ft / sec	-	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) Darcy-Weisbach (Hey)	3.58	ft / sec	2636.62	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	-	ft / sec	-	cfs
4. Continuity Equations: a) Regional Curves u = Q / A Return Period for Bankfull Discharge Q = year	-	ft / sec	-	cfs
4. Continuity Equations: b) USGS Gage Data u = Q / A	3.24	ft / sec	2391.00	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1.	For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.
Option 2.	For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.
Option 3.	For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.
Option 4.	For **log-influenced** channels: Measure "**protrustion heights**" proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.

Worksheet 2-2. Computations of velocity and bankfull discharge using various methods (Rosgen, 2006b; Rosgen and Silvey, 2007).

Bankfull VELOCITY & DISCHARGE Estimates

Stream:	Blanchard River	Location:	XS5 (Centennial Park)
Date:	7/1/2020	Stream Type:	C4
Valley Type:	C-AL-FD	HUC:	4100008
Observers:	J. Ricketts, J. Moyer, N. Uhl		

INPUT VARIABLES

Variable	Value	Symbol (units)
Bankfull Riffle Cross-Sectional AREA	737.57	A_{bkf} (ft^2)
Bankfull Riffle WIDTH	135.54	W_{bkf} (ft)
D_{84} at Riffle	171.33	Dia. (mm)
Bankfull SLOPE	0.0006	S_{bkf} (ft / ft)
Gravitational Acceleration	32.2	g (ft / sec^2)
Drainage Area	274.0	DA (mi^2)

OUTPUT VARIABLES

Variable	Value	Symbol (units)
Bankfull Riffle Mean DEPTH	5.44	d_{bkf} (ft)
Wetted PERMIMETER ~ $(2 * d_{bkf}) + W_{bkf}$	137.85	W_p (ft)
D_{84} (mm) / 304.8	0.56	D_{84} (ft)
Hydraulic RADIUS A_{bkf} / W_p	5.35	R (ft)
Relative Roughness R(ft) / D_{84} (ft)	9.52	R / D_{84}
Shear Velocity $u^* = (gRS)^{½}$	0.308	u* (ft/sec)

ESTIMATION METHODS

ESTIMATION METHODS	Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor / Relative Roughness $u = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$	2.58	ft / sec	1900.05	cfs
2. Roughness Coefficient: a) Manning's *n* from Friction Factor / Relative Roughness (Figs. 2-18, 2-19) $u = 1.49 * R^{2/3} * S^{1/2} / n$ n = 0.033	3.23	ft / sec	2383.83	cfs
2. Roughness Coefficient: b) Manning's *n* from Stream Type (Fig. 2-20) $u = 1.49 * R^{2/3} * S^{1/2} / n$ n = 0.019	5.61	ft / sec	4139.98	cfs
2. Roughness Coefficient: c) Manning's *n* from Jarrett (USGS): $u = 1.49 * R^{2/3} * S^{1/2} / n$; $n = 0.39 * S^{0.38} * R^{-0.16}$ n = 0.017. Note: This equation is applicable to **steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems**; i.e., for	6.20	ft / sec	4572.93	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	-	ft / sec	-	cfs
3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.)	-	ft / sec	-	cfs
4. Continuity Equations: a) Regional Curves u = Q / A. Return Period for Bankfull Discharge Q = ____ year	-	ft / sec	-	cfs
4. Continuity Equations: b) USGS Gage Data u = Q / A	3.24	ft / sec	2391.00	cfs

Protrusion Height Options for the D_{84} Term in the Relative Roughness Relation (R/D_{84}) – Estimation Method 1

Option 1.	For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the D_{84} sand dune protrusion height in ft for the D_{84} term in method 1.
Option 2.	For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the D_{84} boulder protrusion height in ft for the D_{84} term in method 1.
Option 3.	For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the D_{84} bedrock protrusion height in ft for the D_{84} term in method 1.
Option 4.	For **log-influenced** channels: Measure "**protrusion heights**" proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the D_{84} protrusion height in ft for the D_{84} term in method 1.