17 HEC-RAS OUTPUT VARIABLES

Hydraulic Output Variables

Variable NameUnits Description

Barrels # Number of barrels in a culvert.
Alpha Alpha energy weighting coefficient.
Area sq ft Flow area of the entire cross section including ineffective flow.
Area Channel sq ft Flow area of the main channel including ineffective flow.
Area Left sq ft Flow area of the left overbank including ineffective flow.
Area Right sq ft Flow area of the right overbank including ineffective flow.
Base WS ft Water surface for first profile (used in comparison to encroachment profiles).
Beta Beta momentum weighting coefficient.
BR Open Area sq ft Total area of the entire bridge opening.
BR Open Vel ft/s Average velocity inside the bridge opening (Maximum of BU and BD).
Br Sel Mthd Selected bridge hydraulic modeling method.
Breach CL ft Center line of weir breach.
Breach WD ft Bottom width of weir breach.
Breach Bottom Elft Bottom Elevation of weir breach.
Breach Top El ft Top Elevation of weir breach.
Breach SSL ft Left side slope of weir breach.
Breach SSR ft Right side slope of weir breach.
C & E Loss ft Contraction or expansion loss between two cross sections.
Center Station ft Stationing of the center of the main channel.
Ch Sta L ft Left station of main channel.
Ch Sta R ft Right station of main channel.
Clv EG No Wr ft Energy grade elevation at the culvert when calculated without the weir.
Coef of Q WSPRO bridge method coefficient of discharge.
Conv. Chnl cfs Conveyance of main channel.
Conv. Left cfs Conveyance of left overbank.
Conv. Ratio Ratio of the conveyance of the current cross section to the conveyance of the downstream cross section.
Conv. Right cfs Conveyance of right overbank.
Conv. Total cfs Conveyance of total cross section.
Crit Depth ft Critical depth. Corresponds to critical water surface.
Crit E.G. ft Critical energy elevation. Minimum energy on the energy versus depth curve.
Crit Enrgy 1 ft Energy associated with first critical depth.
Crit Enrgy 2 ft Energy associated with second critical depth.
Crit Enrgy 3 ft Energy associated with third critical depth.
Crit Num # Number of critical depths found.
Crit W.S. ft Critical water surface elevation. Water surface corresponding to the minimum energy on the energy versus depth curve.
Crit W.S. 1 ft Water surface elevation of first critical depth.
Crit W.S. 2 ft Water surface elevation of second critical depth.
Crit W.S. 3 ft Water surface elevation of third critical depth.
Culv Crt Depth ft Critical depth inside the culvert.
Culv Depth Blockedft Depth of fill in a culvert.

Culv EG In ft Energy gradeline inside the culvert at the inlet.
Culv EG Out ft Energy gradeline inside the culvert at the outlet.
Culv Ent Lss ft Culvert entrance loss (energy loss due only to entrance).
Culv Ext Lss ft Culvert exit loss (energy loss due to exit).
Culv Frctn Ls ft Friction loss through the culvert barrel.
Culv Ful Lngh ft The length that the culvert flows full.
Culv Inlet Mann n The composite n value at the culvert inlet.
Culv Inv El Dn ft Culvert inside invert elevation downstream.
Culv Inv El Up ft Culvert inside invert elevation upstream.
Culv Length ft Length of the culvert barrel.
Culv Nml Depthft Normal depth for this culvert (and flow).
Culv Outlet Mann n The composite n value at the culvert outlet.
Culv Q cfs Flow through all barrels in a culvert group.
Culv Vel DS ft/s Velocity inside of culvert at inlet.
Culv Vel US ft/s Velocity inside of culvert at outlet.
Culv WS In ft Water surface elevation inside the culvert at the inlet.
Culv WS Out ft Water surface elevation inside the culvert at the outlet.
Cum Ch Len ft Cumulative Channel Length.
Deck Width ft Width of bridge/culvert Deck (top of embankment), in direction of flow.
Delta EG ft Change in energy grade line through culvert(s) and bridge(s).
Delta WS ft Change in water surface through culvert(s) and bridge(s).
Dist Center L ft Distance from center of channel to left encroachment.
Dist Center R ft Distance from center of channel to right encroachment.
E.G. DS ft Energy grade elevation at downsteam end of bridge or culvert.
E.G. Elev ft Energy gradeline for calculated WS Elev.
E.G. IC ft Upstream energy gradeline at culvert based on inlet control.
E.G. OC ft Upstream energy gradeline at culvert based on outlet control.
E.G. Slope ft/ft Slope of the energy grade line.
E.G. US. ft Energy grade elevation at upstream end of bridge or culvert (final answer).
Enc Method Encroachment method used at this cross section.
Enc Sta L ft Left station of encroachment.
Enc Sta R ft Right station of encroachment.
Enc Val 1 ft Target for encroachment analysis.
Enc Val 2 ft Second target for encroachment analysis.
Encr WD ft Top width between encroachments.
Energy EG ft Energy grade elevation upstream of bridge for energy only method.
Energy WS ft Water surface elevation upstream of bridge for energy only method.
Energy/Wr EG ft Energy grade elevation upstream of bridge for low energy and weir method.
Energy/Wr WS ft Water surface elevation upstream of bridge for low flow energy method and weir flow.
Flow Area sq ft Total area of cross section active flow.
Flow Area Ch sq ft Area of main channel active flow.
Flow Area L sq ft Area of left overbank active flow.
Flow Area R sq ft Area of right overbank active flow.
Frctn Loss ft Friction loss between two cross sections.
Frctn Slope ft/ft Representative friction slope between two cross sections.
Frctn Slp Md Friction slope averaging method used.
Froude # Chl Froude number for the main channel.

Froude # XS Froude number for the entire cross section.
Gate #Open # The number of gates opened in the current group.
Gate Area sq ft The flow area in an opened gate.
Gate Group Q cfs Flow through all gate openings in a gate group.
Gate Invert ft Gate spillway invert elevation.
Gate Open Ht ft Height of gate opening.
Gate Submerg Degree of gate submergence. The ratio of the downstream depth above the gate to the upstream depth above the gate.
Headloss ft Total energy loss between two cross sections.
Hydr Depth ft Hydraulic depth for cross section (Area/Topwidth of active flow).
Hydr Depth C ft Hydraulic depth in channel (channel flow area/topwidth of channel flow).
Hydr Depth L ft Hydraulic depth in left overbank (left overbank flow area/topwidth of left overbank flow).
Hydr Depth R ft Hydraulic depth for right over bank (right overbank flow area/topwidth of right overbank flow).
Ice Btm Chan ft The bottom elevation of ice in the main channel.
Ice Btm LOB ft The bottom elevation of ice in the left overbank.
Ice Btm ROB ft The bottom elevation of ice in the right overbank.
Ice Err ft Convergence error in ice thickness for dynamic ice jam.
Ice Thick Chan ft Ice thickness in the main channel.
Ice Thick LOB ft Ice thickness in the left overbank.
Ice Thick ROB ft Ice thickness in the right overbank.
Ice Top Chan ft The top elevation of ice in the main channel.
Ice Top LOB ft The top elevation of ice in the left overbank.
Ice Top ROB ft The top elevation of ice in the right overbank.
Ice Vol Total cu ft Cumulative volume of ice in an ice jam.
Ice Vol. Chan cu ft Cumulative volume of ice in the main channel for an ice jam.
Ice Vol. LOB cu ft Cumulative volume of ice in the left overbank for an ice jam.
Ice Vol. ROB cu ft Cumulative volume of ice in the right overbank for an ice jam.
Ice WS Err ft Convergence error in water surface for dynamic ice jam.
Ineff El Left ft The elevation of the left ineffective area.
Ineff El Right ft The elevation of the right ineffective area.
Inflow cfs Net inflow into a storage area.
Invert Slope ft/ft The slope from the invert of this cross section to the next cross section downstream.
IW Gate Flow cfs Total flow through all of the gate groups of an inline weir/spillway.
K Perc L ft Conveyance reduction from left encroachment.
K Perc R ft Conveyance reduction from right encroachment.
L. Freeboard ft The freeboard in the main channel at the left bank (left bank elevation minus water surface elevation).
L. Levee Frbrd ft The freeboard before the left levee is overtopped.
Left Sta Eff ft Furthest left station where there is effective flow.
Length Chnl ft Downstream reach length of the main channel.
Length Left ft Downstream reach length of the left overbank.
Length Rght ft Downstream reach length of the right overbank.
Length Wtd. ft Weighted cross section reach length, based on flow distribution, in left bank, channel, and right bank.
Levee El Left ft The elevation of the left levee.
Levee El Right ft The elevation of the right levee.

LOB Elev ft The ground elevation at the left bank of the main channel.
Mann Comp Composite Manning's n value for main channel.
Mann Wtd Chnl Conveyance weighted Manning's n for the main channel.
Mann Wtd Chnl Conveyance weighted Manning's n for the left overbank.
Mann Wtd Rght Conveyance weighted Manning's n for the right overbank.
Mann Wtd Total Manning's n value for the total main cross section.
Max Chl Dpth ft Maximum main channel depth.
Min Ch El ft Minimum main channel elevation.
Min El ft Minimum overall section elevation.
Min El Prs ft Elevation at the bridge when pressure flow begins.
Min Error ft The minimum error, between the calculated and assumed water surfaces when balancing the energy equation.
Min El Weir Flowft Elevation where weir flow begins.
Min Weir El ft Minimum elevation of a weir.
Momen. EG ft Energy grade elevation upstream of bridge for momentum method.
Momen. WS ft Water surface elevation upstream of bridge for momentum method.
Net Flux cfs Net inflow - outflow for a storage area.
Num Trials # Current number (or final number) of trials attempted before the energy equation is balanced.
Obs WS ft Observed water surface elevation.
Outflow cfs Net outflow into a storage area.
Perc Q Leaving Percentage of flow leaving through a lateral weir.
Piping Flow ft Flow from piping weir failure.
Power Chan lb/ft s Total stream power in main channel (main channel shear stress times main channel average velocity). Used in Yang's and other sediment transport equations.
Power LOB lb/ft s Total stream power in left overbank (left overbank shear stress times left overbank average velocity). Used in Yang's and other sediment transport equations.
Power ROB lb/ft s Total stream power in right overbank (right overbank shear stress times right overbank average velocity). Used in Yang's and other sediment transport equations.
Power Total lb/ft s Total stream power (total cross section shear stress times total cross section average velocity). Used in Yang's and other sediment transport equations.
Prof Delta EG ft Difference in EG between current profile and EG for first profile.
Prof Delta WS ft Difference in WS between current profile and WS for first profile.
Profile # Profile number.
Prs O EG ft Energy grade elevation upstream of bridge for pressure only method.
Prs O WS ft Water surface elevation upstream of bridge for pressure only method.
Prs/Wr EG ft Energy grade elevation upstream of bridge for pressure and/or weir method.
Prs/Wr WS ft Water surface elevation upstream of bridge for pressure and/or weir method.
Pumping Head ft Pumping head for the pump station.
Q Barrel cfs Flow through one barrel in a culvert group.
Q Bridge cfs Flow through the bridge opening.
Q Channel cfs Flow in main channel.
Q Culv cfs Total flow in all culvert groups.
Q DS cfs Flow in cross section downstream of lateral weir.
Q Lat RC cfs Lateral rating curve flow.
Q Leaving Totalcfs Total flow leaving in a lateral weir including all gates.
Q Left cfs Flow in left overbank.
Q Perc Chan ft Percent of flow in main overbank.

Q Perc L ft Percent of flow in left overbank.
Q Perc R ft Percent of flow in right overbank.
Q Pump Group cfs Pump group flow.
Q Pump Stationcfs Total flow in all pump groups in a pump station.
Q Right cfs Flow in right overbank.
Q Total cfs Total flow in cross section.
Q US cfs Flow in cross section upstream of a lateral weir.
Q Weir cfs Flow over the weir.
R. Freeboard ft The freeboard in the main channel at the right bank (right bank elevation minus water surface elevation).
R. Levee Frbrd ft The freeboard before the right levee is overtopped.
Rght Sta Eff ft Furthest right station that still has effective flow.
ROB Elev ft The ground elevation at the right bank of the main channel.
SA Area acres Surface area of a storage area.
SA Chan acres Cumulative surface area for main channel from the bottom of the reach.
SA Left acres Cumulative surface area for left overbank from the bottom of the reach.
SA Min El ft Minimum elevation of a storage area.
SA Right acres Cumulative surface area for right overbank from the bottom of the reach.
SA Total acres Cumulative surface area for entire cross section from the bottom of the reach.
SA Volume acre-ft Storage volume of a storage area.
Shear Chan lb/sq ft Shear stress in main channel ($\gamma R_{CH} S_f$).
Shear LOB lb/sq ft Shear stress in left overbank ($\gamma R_{LOB} S_f$).
Shear ROB lb/sq ft Shear stress in right overbank ($\gamma R_{ROB} S_f$).
Shear Total lb/sq ft Shear stress in total section ($\gamma R_T S_f$).
Spc Force PR cu ft Specific force prime. For mixed flow, the specific force at this cross section for the flow regime that does not control.
Specif Force cu ft The specific force for this cross section at the computed water surface elevation. SF = $A_T Y_{cent} + (Q^2)/(gA_{act})$
Sta W.S. Lft ft Left station where water intersects the ground.
Sta W.S. Rgt ft Right station where water intersects the ground.
Std Stp Case # Standard step method used to determine WSEL (1 = successful convergence, 2 = minimum error, 3 = resorted to critical depth).
Top W Act Chanft Top width of the wetted channel, not including ineffective flow.
Top W Act Leftft Top width of the wetted left bank, not including ineffective flow.
Top W Act Rightft Top width of the wetted right bank, not including ineffective flow.
Top W Chnl ft Top width of the main channel. Does not include 'islands', but it does include ineffective flow.
Top W Left ft Top width of the left overbank. Does not include 'islands', but it does include ineffective flow.
Top W Right ft Top width of the right overbank. Does not include 'islands', but it does include ineffective flow.
Top Wdth Act ft Top width of the wetted cross section, not including ineffective flow.
Top Width ft Top width of the wetted cross section.
Total Gate Flowcfs Total flow through all of the gate groups of an inline/lateral weir.
Trvl Tme Avg hrs Cumulative travel time based on the average velocity of the entire cross section, per reach.
Trvl Tme Chl hrs Cumulative travel time based on the average velocity of the main channel, per

reach.
Vel Chnl ft/s Average velocity of flow in main channel.
Vel Head ft Velocity head.
Vel Left ft/s Average velocity of flow in left overbank.
Vel Right ft/s Average velocity of flow in right overbank.
Vel Total ft/s Average velocity of flow in total cross section.
Vol Chan acreft Cumulative volume of water in the channel (including ineffective flow).
Vol Left acreft Cumulative volume of water in the left overbank (including ineffective flow).
Vol Right acreft Cumulative volume of water in the right overbank (including ineffective flow).
Volume acreft Cumulative volume of water in the direction of computations (including ineffective flow).
W.P. Channel ft Wetted perimeter of main channel.
W.P. Left ft Wetted perimeter of left overbank.
W.P. Right ft Wetted perimeter of right overbank.
W.P. Total ft Wetted perimeter of total cross section.
W.S. DS ft Water surface downstream of a bridge, culvert, or weir.
W.S. Elev ft Calculated water surface from energy equation.
WS Inlet ft WS at the inlet of a pump station.
WS Outlet ft WS at the outlet of a pump station.
W.S. Prime ft Water surface prime. For mixed flow, the water surface of the flow regime that does not control.
W.S. US. ft Water surface elevation upstream of bridge or culvert.
Weir Avg Depthft The average depth of flow over the weir.
Weir Max Depthft The maximum depth of flow over the weir.
Weir Sta DS ft Downstream station where weir flow ends.
Weir Sta Lft ft Station where flow starts on the left side of weir.
Weir Sta Rgt ft Station where flow ends on the right side of weir.
Weir Sta US ft Upstream station for weir flow starts.
Weir Submerg The ratio of the downstream depth above the weir to the upstream depth above the weir.
Wr Flw Area sq ft Area of the flow going over the weir.
Wr Top Wdth ft Top width of water over the weir.
WS Air Entr. ft Water surface elevation accounting for air entrainment.
WSPRO EG ft Energy grade elevation upstream of bridge for the WSPRO method.
WSPRO WS ft Water surface elevation upstream of bridge for the WSPRO method.
Wtd. n Chnl Conveyance weighted Manning's n for the main channel.
Wtd. n Left Conveyance weighted Manning's n for the left overbank.
Wtd. n Right Conveyance weighted Manning's n for the right overbank.
XS Delta EG ft Change in energy gradeline between current section and next one downstream.
XS Delta WS ft Change in water surface between current section and next one downstream.
Yarnell EG ft Energy grade elevation upstream of bridge for Yarnell method.
Yarnell WS ft Water surface elevation upstream of bridge for Yarnell method.

Sediment Transport Output Variables

Variable Name Units Description
Ch Invert El ft Minimum elevation of the main channel at each output time step.
Wsel ft Elevation of the water surface at each output time step.

Observed Data ft Observed elevation of main channel bed, entered by the user.
Invert Change ft Delta change in the minimum elevation of the main channel.
Mass Out: All tons Total sediment mass, for all grain size classes, going out of the sediment control volume, per individual computational time step.
Mass Out: Class 1-20 tons Sediment mass leaving the sediment control volume per grain size fraction, per computational time step.
Mass In: All tons Total sediment mass, for all grain size classes, coming into the sediment control volume, per individual computational time step.
Mass In: Class 1-20 tons Sediment mass entering the sediment control volume per grain size fraction, per computational time step
Flow cfs Total flow at the cross section for each output time step.
Velocity ft/s Average velocity of the movable portion of the bed at each time step.
Shear Stress lb/sq ft Average shear stress of the movable portion of the bed at each time step.
EG Slope ft/ft Slope of the energy gradeline at each output time step. This can be a point value at the cross section or an average value between cross sections.
Mass Bed Change Cum: All (tons)Cumulative mass of the change in the bed elevation over time.
Mass Bed Change Cum: class 1-20 (tons) Cumulative mass of the change in bed elevation over time, per grain size fraction (Bins 1 – 20). This only displays the size fraction bins that are being used.
Mass Bed Change: All tons Incremental total mass change in the bed for the current computational time step.
Mass Bed Change: Class 1–20 (tons) Incremental mass change in the bed for the current time step, by individual grain size fraction.
Mass Out Cum: All tons Cumulative total sediment mass leaving the sediment control volume for a specific cross section, per individual computational time step.
Mass Out Cum: Class 1-20 (tons)Cumulative sediment mass leaving the sediment control volume per grain size fraction, at a cross section, per computational time step.
Mass In Cum: All tons Cumulative total sediment mass entering the sediment control volume for a specific cross section, per individual computational time step.
Mass In Cum: Class 1-20 (tons)Cumulative sediment mass entering the sediment control volume per grain size fraction, at a cross section, per computational time step.
Mass Capacity: All tons/dayTransport capacity in total mass at the current computational time step.
Mass Capacity: Class 1-20 (tons/day)Transport capacity in mass, by grain size fraction, at the current computational time step.
Mean Eff Ch Invertft Average channel invert elevation computed by subtracting the effective depth of the main channel from the water surface elevation.
Mean Eff Ch Invert Change (ft)Change in the average channel invert elevation, which is computed by subtracting the effective depth of the main channel from the water surface elevation.
Long. Cum Mass change (tons) Total change in bed mass, cumulative in space and time. Spatial accumulation is from the current cross section to the upstream end of the river reach in which this cross section resides.
d50 Cover mm d50 of the cover layer at the end of the computational increment. Used in the Exner 5 bed sorting and armoring routine.
d50 Subsurface mm d50 of the surface layer material at the end of the computational time step. Used in the Exner 5 bed sorting and armoring routine.
d50 Active mm d50 of the active layer of the simple active layer bed sorting and armoring routine.
d50 Inactive mm d50 of the inactive layer at the end of each computational time step. Used in the Exner 5 and simple active layer bed sorting and armoring routine.
Cover Thickness ft Thickness of the cover layer at the end of each computational time step. Used in

the Exner 5 bed sorting and armoring routine.
Subsurface Thicknessft Thickness of the surface layer at the end of each computational time step. Used in the Exner 5 and simple active layer bed sorting and armoring routine.
Active Thickness ft Thickness of the active layer at the start of each computational time step. Used in the simple active layer bed sorting and armoring routine.
Mass Cover: All tons Total tons of material in the cover layer at the end of each computational time step. Used in the Exner 5 bed sorting and armoring routine.
Mass Cover: Class 1-20 (tons) Tons of material in the cover later at the end of each computational time step, by individual grain size fraction. Used in the Exner 5 bed sorting and armoring routine.
Mass Subsurface: All tons Total tons of material in the surface layer at the end of each computational time step.
Mass Subsurface: Class 1-20 (tons)Tons of material in the surface layer at the end of each computational time step, by individual grain size fraction.
Mass Inactive: Alltons Total tons of material in the inactive layer at the end of each computational time increment.
Mass Inactive: Class 1-20 (tons)Tons of material in the inactive layer at the end of each computational increment, by individual grain size fraction.
Armor Reduction: All (fraction)Fraction that the total sediment transport capacity is reduce to, based on the concepts of a cover layer computation.
Armor Reduction: Class 1-20 (fraction) Fraction for each individual grain size, that the transport capacity is reduce to, based on the concepts of a cover layer computation.
Sediment Discharge tons/dayTotal sediment discharge in tons/day going out of the sediment control volume for a specific cross section, per individual computational time step.
Sediment Concentration (mg/l) Total sediment concentration in mg/liter going out of the sediment control volume at the end of the computational time step.
Eff Depth ft Effective depth of the water in the mobile portion of the cross section, at the end of the computational time step.
Eff Width ft Effective width of the water in the mobile portion of the cross section, at the end of the computational time step.
Ch Manning n - Main channel manning's n value.
Ch Froude Num - Main channel Froude number at the end of the current computational time step.
Shear Velocity u* ft/s Shear velocity. Used in Shields diagram and several sediment transport potential equations.
d90 Cover mm d90 of the cover layer at the end of the computational increment. Used in the Exner 5 bed sorting and armoring routine.
d90 Subsurface mm d90 of the surface layer material at the end of the computational time step. Used in the Exner 5 bed sorting and armoring routine.
d90 Active mm d90 of the active layer of the simple active layer bed sorting and armoring routine.
d90 Inactive mm d90 of the inactive layer at the end of each computational time step. Used in the Exner 5 and simple active layer bed sorting and armoring routine.
Dredge Vol Cumft3 Total volume of sediment removed from each cross section by the dredging routines.