HEC Review Checklist

Utilize the following checklist as a guide only. The checklist is NOT a substitute for the Uniform Development Code ("UDC") and only intends to summarize the UDC in a clear and cogent manner. To the extent that the checklist is in the conflict in any way with the UDC, the UDC takes precedence. It is incumbent upon the engineer of record to meet or exceed applicable UDC requirements, general engineering standards, and all applicable federal, state, and local laws and requirements.

HEC-RAS

- ☐ **Flow Regimes:**
  - Floodplain inundation limits to be established utilizing a subcritical flow regime.
  - Velocity Comparisons are to be comparisons of the mixed flow regime.
- ☐ **Distributed flows (optional):**
  - Downstream flows are to be applied at upstream cross-sections
  - Flow distribution to start at the upstream limit of the model
  - flow distribution is to be established throughout the model
  - Flow values are to match HEC-HMS output
- ☐ **Steady Flow Analysis:**

  Flow Optimization
  - All junctions, lateral structures, Reach-Storage areas, and pumps to be optimized

  Calculation Tolerances
  - Set to default values or provide justification in the report for values other than default values

  Set Method of calculating Conveyance
  - Set to n-values only

  Select Friction Slope Method for Steady Flow
  - State in report which method is utilized and why.

  Select Method of Computing Critical Depth
  - Set to Parabolic Method or provide justification in report for other selections.
- ☐ **Profile Review:**

  Channel Slope Review
  - Channels shall be modeled sloping downhill from cross section to cross section (unless verified and justified in report discussion)

  Structures
  - All proposed structures are to be modeled sloping downhill (existing structures are required to be modeled per record drawings or onsite surveys)
  - Flowlines are not to be shown as buried or floating above the channel bottom (unless verified)
- ☐ **Geometric Data Review:**

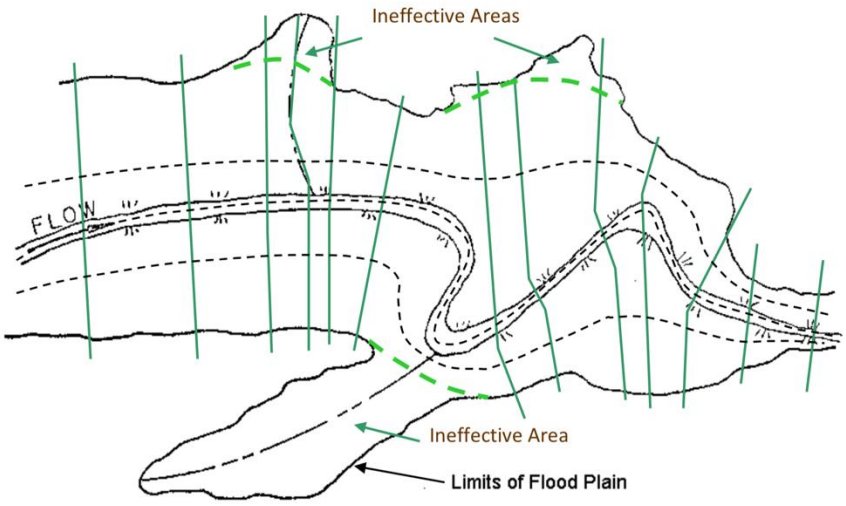


Figure 3-4 Example Cross Section Layout

Description:

- Add notes to Cross Sections, Bridges, and the main RAS window being Sections 1-4, Road names, Datum, year, version of HEC-RAS revisions (if any), original RAS data from (if applicable), project location, flow data profiles (ie. 500-yr, 100-yr, 50-year, etc.)

Flow direction

- Streams (upstream to downstream)
- Cross Sections (left to right looking downstream)

Flow Paths

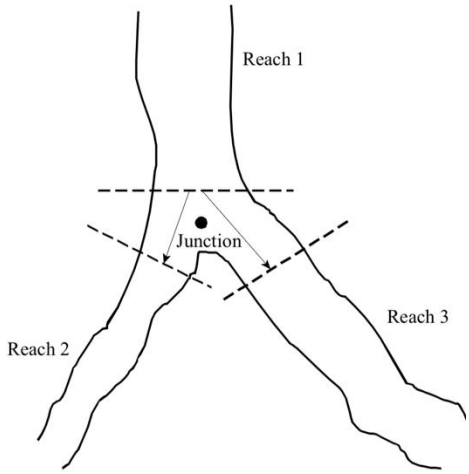
- Flow paths to be modeled in RAS Mapper in the overbank (See HEC RAS Hydraulic Reference Manual)

Bank Stations

- Bank stations are to be established at visual grade breaks (change in n-value) or established by environmental report

Junctions

Figure 3-10 Example of a Stream Junction



- Junctions to be run using Momentum equation (ensure proper Friction and Weight parameters selected)
- Set angles and lengths of Junctions per HEC RAS Hydraulic Reference Manual

Cross Sections

- Initial bounding cross sections (Sections 2 and 3) shall be placed within 10'± of Inlet/Outlet of all culverts/structures

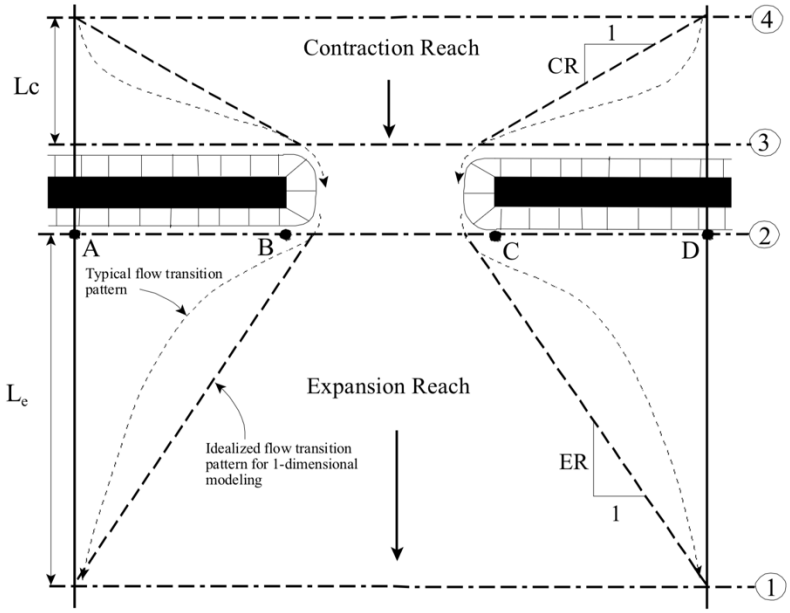


Figure 5-1 Cross Section Locations at a Bridge

- Cross sections shall be placed to model geometric changes including bends, channel widening, floodplain widening, channel contraction, floodplain contraction, and changes in channel slope

Geometry

- Cross sections to be on average 150' ± spacing (0'-300'), and such to capture geometric changes.
- Bounding cross sections to conform to table 5-1 HEC-RAS Hydraulic Reference Manual (start with CR=1 and ER= 2)
- Cut all sections to Surface (unless noted and verified otherwise)

Ineffective Flow Locations

- Placed upstream and downstream of all Structures
- Placed within cross sections in instances of floodplain storage with no conveyance

Manning's N Values

- Per HEC-RAS Technical Manual Table (Ven Te Chow pg 115)

Expansion/Contraction

Table 3-3

Subcritical Flow Contraction and Expansion Coefficients

	Contraction	Expansion
No transition loss computed	0.0	0.0
Gradual transitions	0.1	0.3
Typical Bridge sections	0.3	0.5
Abrupt transitions	0.6	0.8

- Set contraction and expansion coefficients per Table 3-3 in HEC RAS Hydraulic Reference Manual

Levees

- Levees are to be used at actual levee locations only. Levees will require justification in the report and a note in the cross-section in which it is located.

Points Filter

- Smooth out cross sections by reducing the number of cross-section points below 500.

Structures

- Require four (4) bounding cross-sections.
- Internal sections are required for bridges and can be used for culverts.
- Ineffective flow locations will be required or justified in the report as to why they are not required.
- All existing structures must have supporting surveys or record drawings with sufficient information for modeling.

Other

- Digital Elevation Models (DEM) file triangulation accuracy is required to be discussed and verified

- All models to be set at NAD 83 and NAVD 88 datums
- Inundation limits are to be drawn by RAS Mapper using DEM files for both existing and proposed conditions

Summary of Errors, Warnings, and Notes

- Provide the summary of errors, warnings, and notes
    - Rebuttal/Address all error and warnings
    - Cannot have critical flow in consecutive sections (change regime or add additional sections, etc.)

HEC-HMS

- **Drainage Area Divides:**
    - Established utilizing Digital Elevation Modeling (DEM) conditioning or established utilizing hand drawn divides utilizing contour data, and to account for flow patterns effected by watershed development
- **Land Uses/Conditions:**
    - Pre-Development (Existing)
    - Post-Development (Proposed)
- **Transform:**

Method - TR-55

- Tc Line Location
- Sheet Flow n-values and lengths established utilizing engineering judgment or per USDA NRCS Part 630 Chapter 15 – Time of Concentration manual, page 15-7, equation 15-9
- Shallow Concentrated lengths established between depths greater than 0.5 feet and not within a defined channel (to be denoted as paved/unpaved)
- Closed Pipe parameters established for representing the flow path. Careful consideration of bypass flows is to be discussed. If pipe sizes change, additional representative sections are to be modeled. Closed pipe to be established per record drawings, survey data, or proposed design plans
- Open Channel representative parameters are to be established utilizing existing topographic data, or proposed design sections. Open Channel geometric changes are to be accounted for by utilizing additional open channel representative sections
- Pre-Development conditions time of concentrations are to be different from post-development times

Method – Lag

- Lag method to be calculated as outlined per the USDA NRCS Part 630 Chapter 15 – Time of Concentration Manual.
- **Loss:**

Method - SCS CN

- NRCS Soil Data to be utilized

- Curve Numbers to be composite numbers per each sub-basin/sub-watershed
- Land use maps to be provided in the report to support the CNs

Method – Other must be discussed and justified in the drainage report

- **Routing:**

Method - Muskingum-Cunge or Modified-Puls

- Modified Puls:
    - Profile flows are to be compared to section geometry and presented in the report (sections are to "close", alternatively described as the flows are wholly contained within the cross sections geometry)
    - Stage-Storage discharge paired data input into the HEC-HMS model to be discussed and presented in the report.
- Muskingum-Cunge:
    - Channel shape to be set to 8-point sections or justified in the report.
    - Index flow/celerity established via general engineering practices via iterations or known values (celerity set to a value of 5 for an initial run for unknown/ungaged reaches)
    - n-values set to match HEC-RAS channels n-values
    - Tabular method comments to be shown and presented in the report

- **Geometry:**
    - To be Georeferenced to NAD 83 and NAVD 88 datums.
    - Established from DEM's saved and presented in the report
- **Meteorologic:**
    - 1-year through the 500-year storm events are required to be run
- **Control:**
    - Time interval set at 1 minute or justified if other.