Texas 2D BLE Analysis QA/QC Checklist

Project Information

HUC-8 Watershed Name & ID:	Salt Draw (13070004) – SLDR_004
HUC-10 Watershed Name & ID:	N/A
Modeler:	AtkinsRealis
Reviewer:	Halff Associates

M1 Review: Terrain, Modeling and Preliminary Tie-In Review (QC Items 1-6)

Modeler Initials:	SD	Reviewer Initials:	SR (AECOM)
Submittal Date:	May 02, 2024	Review Submitted Date:	05/20/2024
Review Response Date:	June 18, 2024	Backcheck Complete Date:	06/28/2024
Review Response Date:	August 22, 2024	Backcheck2 Complete Date:	**08/23/2024; 10/24/2024**

M2 Review: Mapping and Completeness Review (QC Item 7) submittal

Modeler Initials:	SM	Reviewer Initials:	ES, SR
Submittal Date:	10/16/2024	Review Submitted Date:	**10/24/2024**;10/28/24 (2/19/25 sent)
Review Response Date:	4/16/2025	Backcheck Complete Date:	4/30/2025

(Modeler to populate with an "X" for items included in the QC submittal)

Level of Study	
X	2D BLE
	Enhanced BLE

Flood Events			
X	10% ACE (10-year)	X	0.2% ACE (500-year)
X	4% ACE (25-year)	X	1% plus
X	2% ACE (50-year)	X	1% minus
X	1% ACE (100-year)		Observed Rainfall

Instructions

Each section includes instructions to the modeler and reviewer regarding their responsibilities in the completion of this checklist. In the Methodologies / Data Sources tables, grey italic text is added as an example response. Additional sample responses are located in the Texas 2D BLE Guidelines Quick Guide.

Reviewer to indicate if Technical Review items generally comply using a "Pass". If the technical review observes an issue of noncompliance or an item that requires additional attention, an "Fail" should be utilized.

Submittal Checklist

Data submitted for each milestone should be carried through each subsequent milestone. All geospatial layers and models must have same defined projection system as terrain. Modeler to populate with an "X" for items included in the QC submittal.

QA/QC Comments Addressed	
X	M1 Comments have been addressed, we understand the comments are an example and not comprehensive of all the errors in the watershed. We have reviewed the entire HUC based on the QA/QC and revised our model accordingly.
X	M2 Comments have been addressed, we understand the comments are an example and not comprehensive of all the errors in the watershed. We have reviewed the entire HUC based on the QA/QC and revised our mapping accordingly.
M1: Base Map Data (QC items 1-6)	
X	Location Map (PDF): HUC-8 and HUC-10 boundaries and/or model domain boundary if different from HUC-10s, stream gages, dams (if applicable), mainstem streams (for reference)
X (RAS Mapper)	GIS Map (MXD or Map Package) with the following data included but not limited to: Stream centerlines, model breaklines, rainfall data, WSEL and Depth grids (10, 100, 500-yr), adjacent HUC mapping (available on the BLE viewer or currently studying), 2D connections for inflows/outflows, gages or points of flow comparisons (BFEs, highwater marks, etc.), profile lines, boundary condition lines, refinement regions, model domain boundary, model mesh, DFIRM mapping panels, base map data (roads, aerials, etc.), soils data, land use data, terrain
M1: Technical Report / Documentation (QC items 1-6)	
X	Technical Report / Project Notebook: assumptions, special considerations, and modeling concerns
X	Detailed explanation and support data of variances in methodologies and approaches from recommended guidelines (Should be included in Technical Report / Project Notebook)
X	Internal QA/QC Documentation: comments and responses
X	Flow comparison tables within the technical report
M1: Hydrology (QC items 1-6)	
X	Hydrologic Model (HEC-HMS) model with all associated DSS files for 7 required storm events
X	Hydrologic Data and Parameter Spreadsheets (rainfall calculations, curve number table, gage locations, gage analysis and flow validation)
X (Report/ Results spreadsheet)	Hydrologic modeling notebook including assumptions, notes, and special conditions (if not provided in report)
M1: Hydraulics (QC items 1-6)	
X	Hydraulic Model (HEC-RAS) with all associated files and 7 required storm events run and results available in RASmapper (remove non-final files) Exported Raster Grids for 10, 100-, 500 yr events (using sloping render mode, unless previously coordinated with TWDB) ~~Difference Raster for tie-ins? (for 10-, 100, 500yr events) (add some descriptions)~~
X	Hydraulic Data and Parameter Spreadsheets (Manning's n-value table, infiltration calculations support data-Soils, Land Use, Curve Number table, other calculations/data used in model)
X	Manning's n-value table
X	Precipitation data correctly linked to hydrologic model or hard coded from provided spreadsheet
X	Hydraulic modeling notebook including assumptions, notes, and special conditions (Draft BLE Report with sections related to terrain, modeling and validation)

M2: Mapping (QC item 7)	
X	Flood risk database
X	Modeler to complete topology validation as outlines in the guidelines
X	Modeler to verify mapping meets deliverable requirements as outlined in guidelines
M2: Completeness Review (QC item 8) *See Texas 2D BLE Guidelines Chapter 4 – Deliverables*	
X	Please submit items using the eBFE USGS format and MIP Terrain Folder (see example folder in BLE Resources)
X	Final Technical BLE Report
X	Final cleaned hydrologic model
X	Final cleaned hydraulic model
X	Flood risk database
X	CNMS updates
X	HAZUS results
X	Additional supplemental data: 1) ArcHydro outputs (if applicable), 2) Model domain shapefile, 3) LiDAR Extents Shp file,

Milestone 2 note to production team: Please complete the info on Page 1 and the Submittal Checklist above. Looks like this has not been updated for M2 Reviews.

1 – Model Terrain

Methodologies / Data Sources *(Modeler to populate)*

Terrain Source(s):	Please see technical memo for more detail: Pecos Dallas (2019), and West Texas (2019)
Data Gaps:	None
Source Resolution:	Cell size of 1 x 1 meter
Model Terrain Resolution:	Cell size of 10 x 10 feet
Terrain Horizontal Projection:	North American Datum (NAD) 1983 (2011) Texas State Plane Zone 3 (Central)
Terrain Vertical Projection:	NAVD88
Z Values:	Units of feet
Terrain Buffer:	2,500 feet
Other:	

Technical Review *(Reviewer to confirm with Pass/Fail)*

General Review	
P	LiDAR source matches the latest available data at time of project initiation
P	Large reservoir or lake extents included in model domain
P	Check visible seams, gaps or holes of LiDAR sources (if more than one source was used)

Review Comments

Modeler to Check Box of Acknowledgement during Response to Comments:	Acknowledge that review comments may be example comments and not a comprehensive of all required revisions. Consultant has reviewed provided comments and reviewed for applicability of comment throughout HUC-8.

1.

2 – Hydrology

Methodologies / Data Sources *(Modeler to populate)*

Software:	HEC-RAS 6.4.1
Rainfall Source:	NOAA Atlas 14
Rainfall Duration:	24 hours
Depth Selection:	Spatially Varied
Rainfall Temporal Distribution:	HEC-HMS
Areal Reduction:	None
Loss Methodology:	Spatially varied CN
Unit Hydrograph Transform Method:	N/A
Inflow Hydrograph Source:	
Any Deviations from TWDB Guidance? If yes, please describe	
Other: Precipitation spreadsheets are included with the submittal	

Statistical Data *(Modeler to populate)*

Stream Gage Name & ID:	No gages in this HUC8, many adjacent gages analyzed for Drainage Area – Flood Frequency analysis.
Stream Gage Name & ID:	
Stream Gage Name & ID:	

Technical Review *(Reviewer to confirm with Pass/Fail)*

Excess Rainfall	
P	Precipitation values are an aerial average of Atlas 14 values for the entire 2D area boundary for each storm event or other appropriate rainfall application
P	CN values appropriately reflect land use and soils for entire 2D area boundary
P	Losses are correctly calculated to establish the excess rainfall hyetographs by checking land use, soils and infiltration layers or other relative information
P	Total precipitation depths for 1%+ and 1%- are calculated correctly
P	Excess rainfall hyetographs are calculated for all storm events (10%, 4%, 2%, 1%, 0.2%, 1%+, and 1%-)
P	Cumulative excess rainfall values are in increasing order from 10%, 4%, 2%, 1%, to 0.2%
P	Cumulative excess rainfall values for the 1%+ and 1%- fall in order with the storm events matching the total precipitation values
Inflow Hydrographs	
P	Shape and time-to-peak of any inflow hydrographs resemble past documented large storm events
P	Hydrographs reasonable when compared to the other return periods. The shapes should be similar, and hydrographs from different events should not intersect unless there is an engineering reason. Peak flows from a lower return period event should not be higher than a higher return period event
P	Contributing hydrographs from another RAS model applied at coincident locations (Provide locations in base map data)
General Hydrology	
No	Any flow regulating dams in the model area? (Yes/No)
No	Dam modeling methodologies applied and explained? (Yes/No). If yes, provide discharge rating curve calculations and gage analysis documenting regulated versus unregulated records, if applicable.

NA	Model aligns with documentation of dam modeling approaches.
Other Notes: NA	

Review Comments

Modeler to Check Box of Acknowledgement during Response to Comments:

X	Acknowledge that review comments may be example comments and not a comprehensive of all required revisions. Consultant has reviewed provided comments and reviewed for applicability of comment throughout HUC-8.

1. Noted that the figures in draft report will be updated later for Salt Draw.
   AtkinsRealis Comment (05/22/2024): We have updated Sections 1, 2, and 3 of the BLE report to include additional documentation of model setup, modelling methodology, model results, validation, challenges etc. However, this report is still draft and will be refined further in the next submittal after mapping and subsequent products are developed.
   AECOM's Response: Pending.
   AtkinsRealis Response (07/29/2024): The Salt Draw M1 comments and report documentation were discussed in meetings between TWDB, AECOM, and AtkinsRéalis on 07/24, 0/25 and 07/26 and it was decided that BLE report related comments will be verified with M2 deliverables.
   AECOM's Response: Pass
   M2 AtkinsRéalis response (10/14/2024): Revised BLE report which included detailed discussion of methodology and results is included in the Reporting and Documentation folder of the M2 submittal.
   AECOM's Response (Milestone 2): There are some pending things in the report, that are already marked by you (A1-A5 checks CNMS). Please provide the final report in M2 backcheck.
   AECOM's Response (Milestone 2 backcheck 4/30/2025):The final report has track changes on. Please revise.
   AECOM's Response: Pass.

2. Please confirm that the precipitation description of Lower Pecos and Toyah is intentionally included in the Salt Draw report.
   AtkinsRealis Comment (05/22/2024): Since the Salt Draw HUC8 footprint is covered three model domains namely, Salt Draw, Toyah, and LP_Lower, precipitation data for all applicable domains is included this report.
   AECOM's Response: Pass.

3 – Hydraulic Geometry

Methodologies / Data Sources *(Modeler to populate)*

Software:	HEC-RAS 6.4.1
Loss Methodology:	Spatially varied CN
Soils Source:	SSURGO
Land Cover Source:	NLCD 2021
Manning's Roughness Source:	Assigned based on land use. Please see table in SDraw_FlowArea_Plot.xlxs
Nominal Mesh Cell Sizes:	300 x300 except for channel refinement regions, breaklines and urban regions, where 150 ft x150 ft was considered.
Any deviations from TWDB Guidance? If yes, please describe.	
Other:	

Technical Review *(Reviewer to confirm with Pass/Fail)*

2D Mesh	
~~F~~ **P**	2D Boundary delineated along watershed boundary or buffer to ensure all contributing area is included
~~F~~ **P**	Nominal cell size appropriate for model detail (generally 200 feet, minimum 50 feet for refinement areas)
P	Computation points are at default locations or changes documented
P	Mesh Cell and Face tolerances are default or changes documented
P	No mesh errors
P	Cell face relationships are calculated
Breaklines	
~~F~~ **P**	Breaklines are consistent with the terrain data
~~F~~ **P**	Breaklines sufficiently detailed to capture features (thalweg, banks, berms, etc.)
P	Cells do not overlap terrain features where appropriate (i.e., unwanted leaking)
P	Breakline cell sizing and parameters are appropriate
P	2D Area Connections placed at applicable benchmarks, gages, or dams
P	2D Area Connections set to use normal 2D equation domain for benchmarks and gages. Appropriate modeling approach used for dams.
Manning's N-Values	
P	Manning's n-values associated to land cover data provided
P	Land Cover classifications are sufficiently descriptive within the data table
P	Manning's n-value classifications generally match current aerial imagery
P	Manning's n dataset is associated with the geometry files
General	
~~F~~ **P**	All model datasets each have unique descriptive names

Review Comments

Modeler to Check Box of Acknowledgement during Response to Comments:

X	Acknowledge that review comments may be example comments and not a comprehensive of all required revisions. Consultant has reviewed provided comments and reviewed for applicability of comment throughout HUC-8.

1. A part of the Salt Draw HUC-8 is not covered in this RAS. It may be included in Toyah or Lower Pecos. Please confirm.
   AtkinsRealis Comment (05/22/2024): Figure 1.3 in the Salt Draw BLE report shows footprint of model domain vs HUC-8 boundaries. LP_ Lower model contains the remaining portion of the Salt Draw HUC-8 watershed. Model domain setup versus HUC8 watershed boundaries are discussed in Section 1 pages 2 and 3 of the report.
   AECOM's Response: Pending.
   AtkinsRealis Response (07/29/2024): The Salt Draw M1 comments and report documentation were discussed in meetings between TWDB, AECOM and AtkinsRéalis on 07/24, 0/25 and 07/26 and it was decided that BLE report related comments will be verified with M2 deliverables.
   AECOM's Response: Pass. Please provide final BLE report for Milestone 2 review.

   M2 AtkinsRéalis response (10/14/2024): Revised BLE report which included detailed discussion of methodology and results is included in the Reporting and Documentation folder. Section 1 of the BLE report discussed model domain boundaries versus HUC8 extents.
   AECOM's Response (Milestone 2): Pass

2. The model domain does not seem to have a sufficient buffer. Please confirm that this may not create an issue while tie-ins with adjacent/downstream HUCs.
   AtkinsRealis Comment (05/22/2024): Current model domain has localized buffer between 500ft – 1000ft at areas where there is ponding along the boundary. We have included the difference rasters which show tie-ins within 0.5' for majority of the locations with adjacent domains. The 10, 100 and 500YR. difference rasters are included under this path (\SaltDraw\Geospatial Data\Supplemental_Folder\Diff_Rasters)

   Salt Draw model outflows to into LP_Lower model domain, which is a Wave 2 model and we aer still addressing ITR comments for LP_Lower. In this submittal, we have made validation adjustments to Wave 2 models to get close to the final WSE. After Wave 2 model updates are complete will create updated difference rasters to show all final tie-ins are within 0.5' with the Wave 2 M1 backcheck submittals.
   AECOM's Response: I am unable to open tie-in rasters for Salt Draw. Can you confirm and resend the tie-in rasters. Let's discuss on a call to be sure we are looking at these correctly and as intended by submitter.
   AtkinsRealis Response (07/29/2024): Latest rasters will be submitted with M1.5 submittal, This comment was resolved during 07/24 during over the shoulder review calls.
   AECOM's Response: Pass

3. Streams are enforced as breaklines to 0.3 mile extent. Suggest to enforce breaklines to 1sqmi extent or please provide an explanation.
   AtkinsRealis Comment (05/22/2024): In our experience refining and using smaller cell spacing along stream centerlines produces more continuous mapping along streams and improves model results. Enforcing breakline at the 0.3 sq-mi extent captures mesh refinements and a more refined model mesh resolution. Since the 0.3 sq-mi extent also covers the entire extent of 1 sq-mi network, we did not make any change per this comment.
   AECOM's Response: Ok. Please include a mention of this in the updated report. Pending updated report submittal.
   AtkinsRealis Response (07/29/2024): Noted.
   AECOM's Response: Pass for Milestone 1. Final BLE report will be reviewed during Milestone 2.
   M2 AtkinsRéalis response (10/14/2024): Adding breaklines along streamlines reduces nominal cell spacing and produces more continuous floodplains. Lower stream break line threshold will extend the mapping continuity into upstream reaches, although it increases number of cells and lead to longer model run time. So, the 0.3 sq mi threshold was chosen to balance computational efficiency with model refinement along larger/more defined stream corridors. We added discussion in BLE report subsection 2.8.2 regarding this item.
   AECOM's Response (Milestone 2): Pass

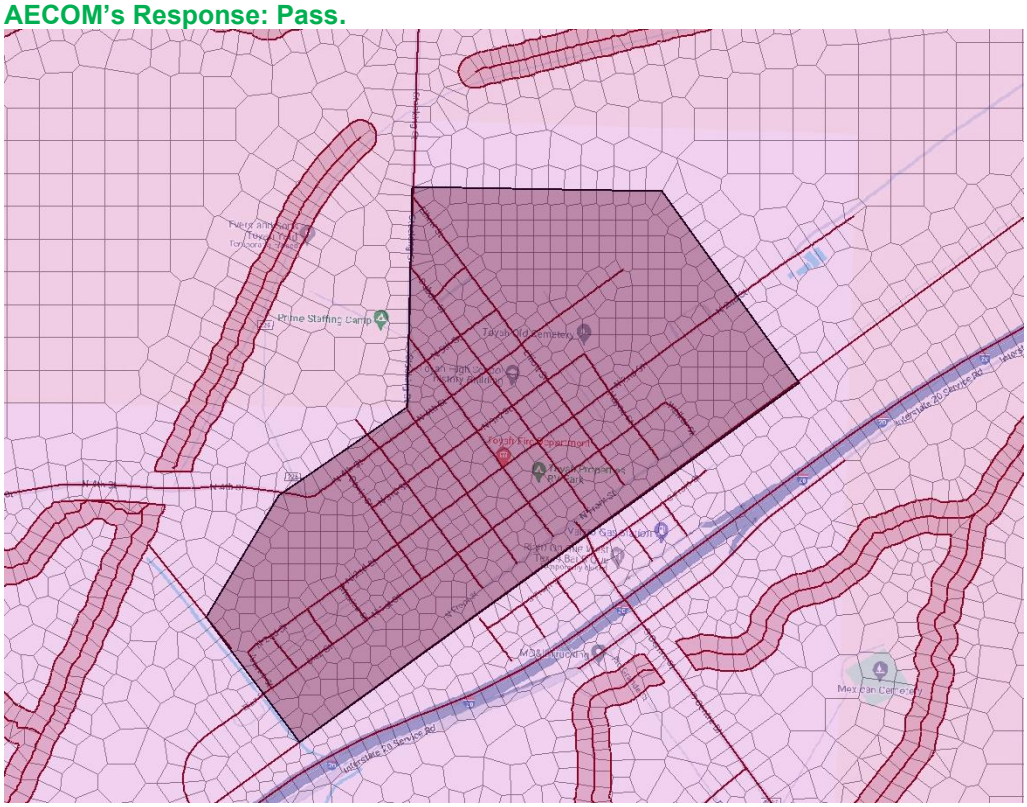
4. Please follow the TWDB naming convention as described in the TWDB 2D Guidance. The 1pct plan name differs from others.
   AtkinsRealis Comment (05/22/2024): We have updated the 1% plan name. There was updated guidance on naming convention as part of H&H workshop on 01/18/2023, which shortened model naming. We have been using the updated guidance.

AECOM's Response: Pass.

Naming Convention

- Keep model, file and folder names short
  - Models: Recommend 3 – 4 letter acronyms
  - **Revision to Section 2.5.2 of BLE Guidelines**
    - UpperFrio_123 → UPFR_(Last 3 Digits of HUC10)
- Recommendation: Provide a SHP of model domains with HUC8 and HUC10 IDs and model domain acronyms

5. At the location of Town of Toyah – breaklines are enforced. However, the report in Section 2.8.3 describes that refinement region is used for communities. Please update the report to be consistent or enforce a refinement region in the model.
   AtkinsRealis Comment (05/22/2024): The TxDOT communities shapefile does not contain the Town of Toyah as a community with a population greater than 1000. However, we have added a refinement region for this area in the revised model (please see screenshot below):
   AECOM's Response: Pass.



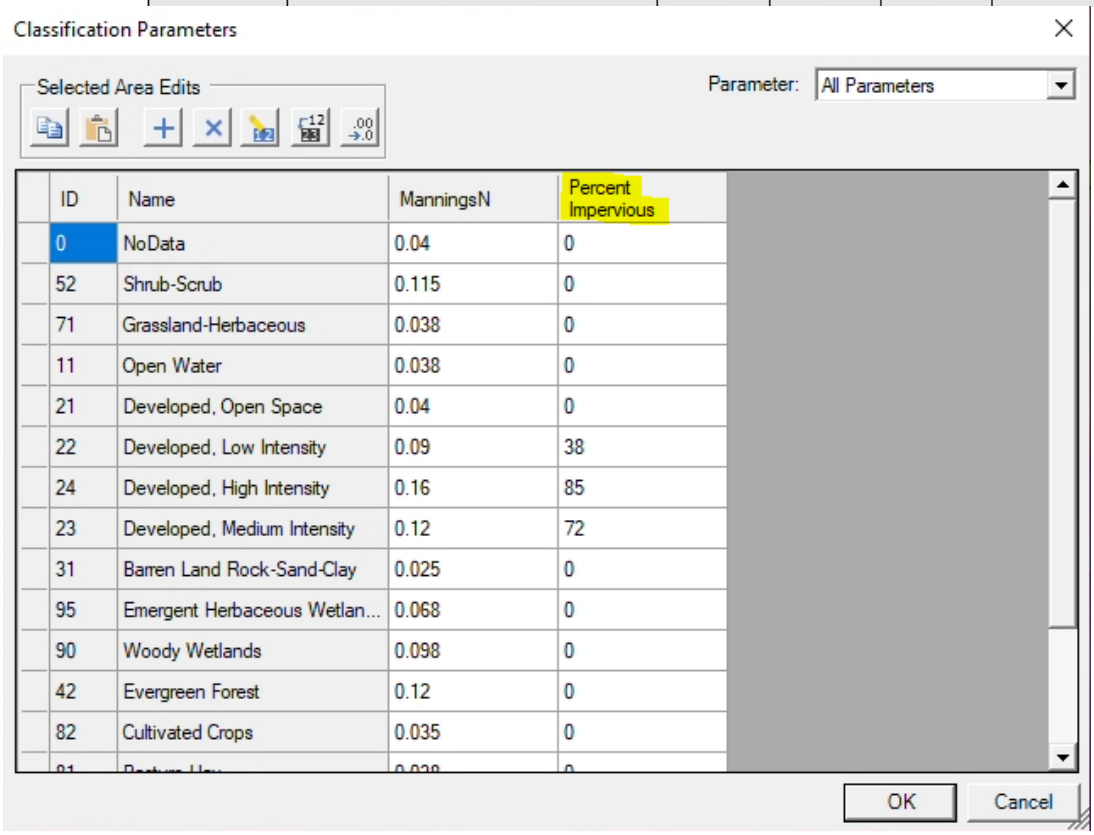
6. Section 2.8.2 and figure 2.18 talks about v-notches, however the breaklines and crossings were modified using terrain modification tools. Please update the write up.
   AtkinsRealis Comment (05/22/2024): We did not use V Notch approach, will remove refence from the report.
   AECOM's Response: Ok. Pending updated report submittal.

AtkinsRealis Response (07/29/2024): As mentioned in previous responses, the BLE report related comments will be verified with M2 deliverables.
AECOM's Response: Pass for Milestone 1. Final BLE report will be reviewed during Milestone 2.
M2 AtkinsRéalis response (10/14/2024): Please refer to revised break line discussion in BLE report subsection 2.8.2.
AECOM's Response (Milestone 2): Pass

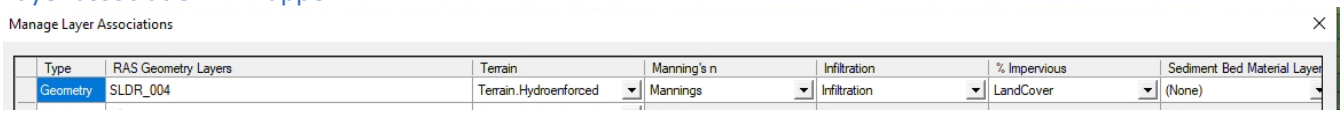
7. Please review "Layer Associations" in HEC-RAS. Under "% Impervious" it should be associated with"Percent Impervious" layer. Manning's layer doesn't have that information.
AtkinsRealis Comment (05/22/2024): In the TWDB guidance, % Imperviousness values are defined as part of land cover. So, In HEC-RAS % impervious values are defined as part of land cover layer and we associated LandCover layer with % imperviousness. (please see screenshots below):
AECOM's Response: Pass.

Table 2.4. Curve Number and Percent Impervious

Land Use Grid Code	NLCD Land Use Description	Hydrologic Soil Group				Percent Impervious
		A	B	C	D	
11	Open Water	99	99	99	99	
21	Developed Open Space	49	69	79	84	
22	Developed Low Intensity	39	61	74	80	38
23	Developed Medium Intensity	39	61	74	80	72
24	Developed High Intensity	39	61	74	80	85



Layer association in mapper



AtkinsRealis Response (07/29/2024): A curve number update was identified during M1 review of Coyanosa watershed, which is part of Atkinsrealis study area. The curve number update for low, medium and high intensity developed areas is performed to use same AMCI curve number value with varying % imperviousness. Please see screenshots from updated model.

	25	Developed, Low Intensity : NoData	63	0.2	
	26	Developed, Low Intensity : A	30	0.2	
	27	Developed, Low Intensity : B	40	0.2	
	28	Developed, Low Intensity : D	63	0.2	
	29	Developed, Low Intensity : C	54	0.2	
	30	Developed, Medium Intensity : NoData	63	0.2	
	31	Developed, Medium Intensity : A	30	0.2	
	32	Developed, Medium Intensity : B	40	0.2	
	33	Developed, Medium Intensity : D	63	0.2	
	34	Developed, Medium Intensity : C	54	0.2	
	35	Developed, High Intensity : NoData	63	0.2	
	36	Developed, High Intensity : A	30	0.2	
	37	Developed, High Intensity : B	40	0.2	
	38	Developed, High Intensity : D	63	0.2	
	39	Developed, High Intensity : C	54	0.2	

ID	Name	ManningsN	Percent Impervious
0	NoData	0.115	0
52	Shrub-Scrub	0.115	0
71	Grassland-Herbaceous	0.038	0
11	Open Water	0.038	0
21	Developed, Open Space	0.04	0
22	Developed, Low Intensity	0.09	38
23	Developed, Medium Intensity	0.12	72
24	Developed, High Intensity	0.16	85

AECOM's Response: Pass.

4 – Hydraulic Boundary Conditions

Technical Review *(Reviewer to confirm with Pass/Fail)*

Boundary Review	
P	External boundaries connected to 2D mesh
P	Boundary conditions everywhere flow could build up at the boundary of the 2D mesh
P	Boundary conditions have a hydrograph or elevation/slope data assigned
P	Input hydrographs consistent with hydrologic data (DSS, manual entry)
P	Precipitation data is consistent with hydrologic data (DSS, manual entry)
P	Downstream boundary consistent with ground slope or known downstream WSEL
P	Flow hydrographs applied at appropriate locations
P	Energy grade slope for hydrograph distribution is reasonable
NA	Internal rating curves appropriate and documented for control structures (if applicable)
	Modeling Tie-ins: Check for flow continuity between upstream/downstream model domains for all profiles (e.g. matching flow hydrographs)

Review Comments

Modeler to Check Box of Acknowledgement during Response to Comments:

X	Acknowledge that review comments may be example comments and not a comprehensive of all required revisions. Consultant has reviewed provided comments and reviewed for applicability of comment throughout HUC-8.

1.

5 – Hydraulic Model Execution

Methodologies / Data Sources *(Modeler to populate)*

Unsteady Plan Names			
10% ACE (10-year):	10pct	0.2% ACE (500-year):	0.2pct
4% ACE (25-year):	4pct	1% plus:	1plu
2% ACE (50-year):	2pct	1% minus:	1min
1% ACE (100-year):	1pct		
Other:			

Statistical Data *(Modeler to populate)*

Time Step:	Advanced time step based on Courant condition (7.5-60 Seconds)				
Courant Value:	Min: 0.45	Max: 2	Simulation Length:	96	hours
Computation Interval:	30	seconds	Model Runtime:	1-8	hours
Hydrograph Output Interval:	10	minutes	Mapping Output Interval:	60	minutes

Technical Review *(Reviewer to confirm with Pass/Fail)*

Execution Review	
P	Appropriate 2D parameters are used (Boundary Conditions, Time Step, Simulation Length, etc.)
P	Hydrograph Output Interval and Mapping Output Interval set at a reasonable interval to capture peaks
P	Model runtime is reasonable (< 12 hours, but dependent upon model size)

Review Comments

Modeler to Check Box of Acknowledgement during Response to Comments:

X	Acknowledge that review comments may be example comments and not a comprehensive of all required revisions. Consultant has reviewed provided comments and reviewed for applicability of comment throughout HUC-8.

1. Suggest moving HMS DSS files under HEC-RAS model, so that paths don't get broken while re-running or sharing the model.
   AtkinsRealis Comment (05/22/2024): Per the ITR comment co-ordination call on 05/14/2024, we have moved the Hydrology folder under Input folder. For Salt Daw model validation we have applied 5% areal reduction factor to NOAA 14 rainfall depths. The DSS file under hydrology folder included PRECIP_INC data series for all modeled events that include 5% areal reduction factor.
   AECOM's Response: Pass.

6 – Hydraulic Model Results

Methodologies / Data Sources *(Modeler to populate)*

Flow Validation/Gage Analysis	
Software:	*N/A*
Methodology	Refer to the BLE Report
Removal of Outliers and Justification	*N/A*
Review of Appropriateness of Gage Analysis results: 1) Check if there is a control structure upstream build in period of record, 2) Is the period of record sufficient, 3) Are there any gaps in the period of record, 4) Q vs A plot included 5) Wide confidence bands relative to flows?	
Validation Notes (describe parameter adjustments): Refer to the BLE Report	
Other:	

Technical Review *(Reviewer to confirm with Pass/Fail)*

Computation Checks	
P	Model runs with no cell errors
P	Volume balance is within tolerance (ΔV < 1% is ideal, however 2% to 3% can be acceptable for rain on mesh)
Results Spot Checks *Check at all critical structures, major confluences, a handful of headwater tributaries, downstream end, at benchmarks, and a handful of randomly selected locations.*	
P	No visible spikes in WSEL visibly present with a single cell
P	WSEL and depth grids appear reasonable (no artificial dips or spikes)
P	Visual verification flooding is connected downstream for all significant contributing areas (> 64 acres)
~~F~~ **P**	Velocity grids appear reasonable (no unusually high velocity areas or Courant values greater than 2)
P	No crossing profiles between all events
P	Inflow and outflow hydrograph timing is reasonable as compared to the peak
P	Spills into/from adjacent HUCs appropriately accounted for
~~F~~ **P**	WSEL tie-in between model domains and HUCs along major rivers/streams where inflows are applied
Results Full Checks	
P	Computational time step meets ideal Courant condition
P	Diffusion Wave: $\frac{V\Delta T}{\Delta X} \leq 2$ (Up to 5) (Results are unit-less)

P	Model simulation is long enough to pass the entire hydrograph through the model (minimum of 12 hours past the peak, preferably 24 hours)
P	Hydrographs at internal and external boundaries are smooth
P	Contributing areas are contained with 2D mesh or accounted for with inflow hydrographs
P	No flow trapped at 2D boundary
P	Visual verification mapping is reasonable compared to effective
Flow Verification	
NA	Peak flow gage analysis performed on all gages in the watershed with sufficient data
NA	All gages used have an appropriate period of record (10 to 20+ years)
NA	All gages used have no extensive gaps in record which would impact the analysis
NA	Gage analysis results validated to other sources (Regression, USGS, etc.)
~~F~~ **P**	Results at applicable benchmarks justified (gages, HWMs, effective BFEs)
~~F~~ **P**	Peak discharges comparable to gages, effective/prior studies, regional regression equations

Review Comments

Modeler to Check Box of Acknowledgement during Response to Comments:

X	Acknowledge that review comments may be example comments and not a comprehensive of all required revisions. Consultant has reviewed provided comments and reviewed for applicability of comment throughout HUC-8.

1. Suggest reviewing the tie-ins with the adjacent and downstream HUCs and provide tie-in rasters when those are addressed/finalized.
   AtkinsRealis Comment (05/22/2024): Refer to response to comment 3-2.
   AECOM's Response: Ok. All tie-ins to be reviewed together, anticipate a quick call to discuss tie-in rasters.
   AtkinsRealis Response (07/29/2024): Tie-in updates were made to achieve WSE within 0.5' between Salt Draw and adjacent model domains. During M1.5 submittal updated difference rasters will be submitted.
   AECOM's Response: Pass for Milestone 1. HUC8 tie-ins to be fully reviewed in M1.5/M2.
   M2 AtkinsRéalis response (10/14/2024): The M1.5 submittal for this watershed was approved on 08/26/2024. Raw model outputs, Differences rasters, split lines are included under supplemental folder of the M2 package.
   AECOM's Response (Milestone 2): Pass

2. Although discussed on our recent call, leaving this comment here so that it gets addressed. Unable to create a courant map based on the peak flow conditions (max). Please review. The option is greyed out while trying to do so.
   AtkinsRealis Comment (05/22/2024): We have investigated and determined that the HEC-RAS 6.4 or 6.5 does not allow extraction of maximum courant values. Instead, we can view at each mapping interval, which is every 10 mins for Atkinsrealis models. Maximum Face Courant values are available in HEC-RAS.
   AECOM's Response: Pass.

3. Its mentioned that the model results are validated with Fathom 3m floodplain maps. A comparison of the floodplain map as an image or raster would be beneficial for final report. Is a comparison of peak flows possible as well for model validation.
   AtkinsRealis Comment (05/22/2024): After mapping database is developed, we will compare the final floodplain results with Fathom.
   AECOM's Response: Pass. .This can be reviewed once available during Milestone 2
   M2 AtkinsRéalis response (10/14/2024): Comparisons between BLE and Fathom data are discussed in section 3.0 of the BLE report. Model validation flow comparison are discussed in subsection 3.1. Please refer to revised BLE report.
   AECOM's Response (Milestone 2): Pass

4. The report mentions that "it was difficult to determine reliable drainage areas" in Section 3.1 of the report. Please review if this statement is correct, as it appears delineation of drainage basin is possible in this area. It is our understanding that another planned validation method is to use DA/Q ratios established via gage analysis, and so reasonable DA delineation will be important for that. Additionally, if comparison to regression flows are used as another validation point, DA is a primary variable in those equations (re: USGS 2009-5087).
   AtkinsRealis Comment (05/22/2024): We will remove this language from the report.
   AECOM's Response: Ok. Pending submittal of update Salt Draw report.
   AtkinsRealis Response (07/29/2024): The BLE report related comments will be verified with M2 deliverables.
   AECOM's Response: Pass for Milestone 1. Final BLE report will be reviewed during Milestone 2.
   M2 AtkinsRéalis response (10/14/2024): Additional clarity has been added to the text about the regression equations at the beginning of section 3.1.2 in the report. In addition, the discussion about the validation task workflow, found in sections 3.1, 3.1.1, and 3.1.2, has been significantly expanded and provides a full explanation about how the validation task was completed for this task order. The validation discussion in the report was previously submitted to the ITR team in August as a stand-alone memo ahead of approval of the M1.5 packages. Outside of the addition of a summary section in the report and some minor edits in the report, the validation discussion in the Salt report is the same as the discussion included in the August memo.
   AECOM's Response (Milestone 2): Pass

5. Can you explain how the 1% peak flows for Trib Point 1, Trib Point 2, Trib Point 3 and Salt Draw Outlet were estimated? Section 2.7.1 explains how flows in Table 2.5 were estimated (Bulletin 17C).
   AtkinsRealis Comment (05/22/2024): There are not many gages available to validate flows in the study area. Since the study area is very arid, the regression flows may not produce reliable results. So, we selected gages with more than 10 years of flow records within and surrounding study area to develop flow-drainage area relationships and used that for flow validation of unagaged tributaries. We used the PeakFQ to obtain the 1% plus and 1% minus flows at the selected gage locations then developed flow-drainage area relationship using trendlines in excel. Using the drainage area then we estimated bounds for ungagged locations. At validation locations we added SA/2D connections to obtain flow values.
   AECOM's Response: Pass.

6. Suggest to redraw Outlet 1 2D connection. The 1pct floodplain is wider than the 2D conn.
   AtkinsRealis Comment (05/22/2024): The SA2D outfall connections have been modified and moved further upstream of the Salt Draw model (please see screenshots below). At divided flow locations we split the Sa/2D connections to have similar flow distribution in downstream model. We split the SA/2D on high grounds outside floodplain but if the floodplain (500YR) is continuous we try use a high spot with shallow depth to split the connection.
   AECOM's Response: SA/2D connections OF1_SLDR_004, OF2_SLDR_004, OF3_SLDR_004, and OF5_SLDR_004 are acceptable. However, OF4_SLDR_004 crosses/drawn along multiple streams. Please account for multiple streams in estimating the range of Qs based on Gage. Note that since this location is tricky, if it is appropriate, you may add this in the challenges section in the report. Pending submittal of revised Salt Draw report.
   AtkinsRealis Response (07/29/2024): We will add discussion for this item in the BLE report and as discussed during the over the shoulder review call the BLE report related comments will be verified with M2 deliverables
   AECOM's Response: Pass for Milestone 1. Final BLE report will be reviewed during Milestone 2.
   M2 AtkinsRéalis response (10/14/2024): Refer to revised subsection 2.8.2 of the BLE report for discussion on this topic.
   AECOM's Response (Milestone 2): Pass

7. Suggest to redraw 2D Conn 2 & 3. Less than 100cfs flows through the Outlet 2 2D conn. This connection can also be removed completely and outlet 3 2D conn can be redrawn again capturing the entire floodplain.
   AtkinsRealis Comment (05/22/2024): The SA2D outfall connections have been modified and moved further upstream. We use the 500-yr flow to determine if apply the flow downstream. The 500-YR flow connection was less 100 then we may not apply it downstream however, we prefer to keep the Sa/2D in place in case model results change.
   AECOM's Response: Pass.

8. The new 2D connections will alter the boundary condition lines used in the downstream model. Please ensure those get updated in the downstream model accordingly.
   AtkinsRealis Comment (05/22/2024): We will update the LP_Lower Boundary condition lines to per the Salt Draw SA2D Connection changes.
   AECOM's Response: Pass

7 – M1.5 Minor Post Processed Grids

Review Comments – 8/24/2024

The comments below must be addressed, and revised M1.5 minor post processed grids resubmitted in order to allow TWDB to count Independence as "SMA":

- Depth Rasters – No comments – Noted
- WSEL Rasters – No comments – Noted

The notes below are for documentation and to potentially alert the production team to issue that may need to be addressed during Milestone 2 final BLE map production – they do NOT require response or revised submittal for this M1.5 process:

- Reviewer notes/confirmation:
  -M1 backcheck is complete and comments are closed out – Noted
  -All files (other than documentation of approach) are present and viewable – Noted
  -Please confirm during M2 production that inland threshold is used in processing final mapping. It was noted through use of an in house script that some areas smaller than approximately 0.33-acres exist in the minor post processed depth grids, however, there were few enough that its likely due to clipping. Please just be aware during final map production.
  M2 AtkinsRéalis response (10/14/2024): Inland mapping threshold metric was applied for this watershed. A readme file was submitted on 08/28/2024 following initial M1.5 mapping submittal package. All polygons smaller than 0.33 acres are due to data clean up: clipping, smoothing, etc.
  AECOM's Response (10/24/2024): Pass

  -Reviewed internal tie-ins (Salt Draw – LP Lower model areas) and they look reasonable. No other tie-ins (at HUC8 to HUC8 locations) were reviewed at this time, those will be further examined during MS2. It was noted that one difference raster layer "TOY_SLT_100yr.tif" appears to have the same data in it as the "LPL_TOY_100yr.tif", fyi. – The raster is replaced with correct difference raster.

  -Extents of 1% WSE and Depth grids align, and extents of 0.2% WSE and Depth grids align – Noted
  -Full mapping exists through entire HUC8 – Noted

AECOM's Response (10/24/2024): Pass

7 – Mapping Results – MILESTONE 2

Technical Review *(Reviewer to confirm with Pass/Fail)*

Hydraulic Model	
	HEC-RAS model with results, pertinent data and required storm events
Flood Risk Database	
P	All features fully populated per current FEMA guidelines
P	All features aligned and clipped to USGS HUC-8 boundary including: -Mapping should extend through entire HUC-8 -No mapping beyond HUC-8 boundary
F	Mapping (FLD_HAZ_AR) consistent between depth and WSE grids to polygons for all three required mapped events. The depth grid, water surface elevation grid and floodplain polygon extents must match per FEMA requirements, including the filling of holes, spillways, lake/pooled areas.
P	Containment within Events: (10% floodplain contained within 1% and 0.2%)
P	Centerline Containment within the 1% floodplain extents
P	Holes filled in polygon, depth and WSE grids: Holes Filled within the contiguous floodplain anything less than or equal to 2 acres in the 1- and 0.2% floodplain extents and anything less than or equal to 0.5 acres in the 10% floodplain extents. This should be clearly documented in the report.
P	Tie-ins **Clarification:** Tie-Ins realted to WSEL must be within 0.5ft for the following scenarios: 1) with currently studied HUCs (within the Team), 2) 2D HUCs available on the EBFE viewer, 3) Model Domain Tie-Ins must be 0.5 feet for all reoccurrence intervals 4)FEMA requires water surface elevation tie-ins within 0.5 ft for the mapped event of 10%, 1% and 0.2%. If mapping tie ins cannot be achieved: 1)Adjacent study not completed, 2) Adjacent study completed in 1D, or 3) Adjacent study completed with different modeling and mapping methodology causing tie in achievement to be difficult 1) Need to add AOMI area as AOMI_TYP = NP and AOMI_INFO = Spill area. In need of further engineering analysis. Where complex mapping tie ins between domains/HUCs exist, prior coordination with TWDB at M1 is recommended. (Ex. Braided channels) **Please verify for Model Tie-Ins (Flow):** o Each event needs to achieve flow continuity at the SA/2D connection. (E.g. Flow hydrographs must match at SA 2D connection between model domains). o A SA/2D connection line may be used to obtain a flow hydrograph between two model domains. The flow hydrograph obtained from the SA/2D connection line should match the Inflow Hydrograph Boundary condition to the downstream model domain. **Please verify for Model/ Mapping Tie-Ins (WSEL):** o Mapping tie ins (WSEL, Depth) are required for all modeled events across the entire floodplain's width at one location in the model's overlap region. This is validated using a raster calculation between both models' WSEL grids. You must meet the WSEL tie in requirements and the SA/2D connection flow continuity between models.

	The WSEL tie ins requirement of ±0.5 ft. must be met in all model profiles (10, 25, 50, 100, and 500 yr.) and for 10, 100 and 500-yr for mapping products. Review of fringe mapping tie ins between study HUCs and other adjacent HUCs are within the ±0.5 ft. Both Model domains/HUC boundaries need to be in the ±0.5 ft.
	Waterbodies Added (Lakes/Ponding Areas/Reservoirs) Water bodies of lake and reservoir inundation areas of 20 acres or greater or named (NHD waterbodies dataset) should be merged into final floodplains (FLD_HAZ_AR) and water areas (WTR_AR).
P	Boundary interfaces align matching or identified as AOMI
P	Centerline Containment (WTR_LN) within 1% floodplain extents
P	Schema
P	Review that DTL_STUD_AR and DTL_STUD_LN to ensure coverage of the NFHL effective detailed studies.
P	Reviewed that BFE feature values against the 1% annual chance event (ACE) water surface elevation (WSE) grid within +/- 1 foot

Review Comments

Modeler to Check Box of Acknowledgement during Response to Comments:

	Acknowledge that review comments may be example comments and not a comprehensive of all required revisions. Consultant has reviewed provided comments and reviewed for applicability of comment throughout HUC-8.

1. Please note that it doesn't appear that the most up-to-date version of this QAQC ITR checklist has been used in the submittal, please plan to transfer all information from this copy to the updated/correct version upon resubmittal of Milestone 2 for backcheck.

   Response 20250403: QC Document Updated

   Backcheck – Approved, EDS

2. Please review BFE_2D_Testpoints provided. 20% of the test points fail. This is likely due to steep slope and cupping, but should be reviewed.

   Response 20250403: The test points were reviewed and all failed areas are related to steep slopes and cupping. As part of a review, additional thresholds were reviewed and the results are as follows:

   Total Points: 1,430,151
   Total above abs|1|: 132,920, 9.3%
   Total above abs|2|: 26,117, 1.8%
   Total above abs|5|: 1,898, 0.13%
   Total above abs|10|: 189, 0.01%

   Backcheck – Approved, EDS

3. Please see 01PCT_Extent_Check provided, one raster cell in WSE grid that does not have a polygon touching, it's not present in the depth grid.

   Response 20250403: WSE 01% is corrected. No change needed for Depth 01%.

   Backcheck – Approved, EDS

4. Please see 0_2PCT_Extent_Check provided, same raster cell as 01PCT, plus 2 other areas. Both are found in the Depth raster, but not the WSE.
   Response 20250403: WSE 0.2% corrected. Depth 0.2% corrected.
   Backcheck – OBJECTID'S 1 and 3 pass. OBJECTID = 2, there is a 0.2% polygon in FLD_HAZ_AR. The polygon is significant in size to not be filtered out. Please include raster data in both WSE and DEP raster for 0.2%
   AR response 20250508: WSE 0.2% corrected. Depth 0.2% corrected.
   Backcheck2 – Approved, EDS

5. Please see TENPCT_FP_Containment_Check provided, small slivers of 10% exceeding the 1%.
   Response 20250403: TENPCT_FP_Containment_Check featureclass reviewed and none of the 10% polygons actually extend beyond Zone A boundaries. No issue.
   Backcheck – Approved, EDS

6. All feature classes VERSION_ID field should be named as 'BLE_MMYYYY' based on the submittal date (note this issue discussed with Atkins on follow-up Toyah call – okay to respond/address consistent with that discussion).
   Response 20250403: Agreed, no changes made
   Backcheck – Approved, EDS

7. TENPCT_FP, V_DATUM and LEN_UNIT field should be empty or NULL
   Response 20250403: Emptied both fields.
   Backcheck – Approved, EDS

8. The submittal checklist at the top of the document for M2 submittal (section 7/section 8) is incomplete, please fill out for backcheck submittal.
   Response 20250403: QC Document Updated
   Backcheck – Approved, EDS

9. Modeler initials and submittal date need to be filled in for Mapping Review section at the beginning of this document

Mapping Review (QC Item 7) – not included i

Modeler Initials:	
Submittal Date:	
Review Response Date:	

Response 20250403: QC Document Updated
Backcheck – Approved, EDS

8 – Completeness Review

Technical Review *(Reviewer to confirm with Pass/Fail)*

File Structure and Naming	
P	Deliverables provided in TWDB/FEMA required file folder structure and naming convention
P	Data missing (if any) documented in report and ReadMe file within the required folder

Report	
F	Technical 2D BLE report documents all assumptions, special considerations, etc.
P	Flow validation and difference discussed in report
P	Flow comparisons discussed in report
Hydrologic Model	
	HEC-HMS model with results, pertinent data and required storm events
Hydraulic Model	
	HEC-RAS model with results, pertinent data and required storm events
Flood Risk Database	
F	All features fully populated per current FEMA guidelines
CNMS	
P	Updated correctly with new centerlines
P	A1-A5 checks complete
P	CNMS Post- Processing Complete
HAZUS	
P	Run per FEMA guidance

Review Comments

Hazus

1. S_FRAC_Ar should not be clipped by watershed. According to the Flood Risk Assessment Guidance, exported Hazus data should include any census blocks that intersect the watershed and should not be clipped.

   Response 20250403: FRAC is now selected by census blocks that intersect the HUC8 boundary, but not clipped by the boundary.

   Backcheck – Approved, EDS

2. Additionally, the census blocks that were considered inventory of the project footprint / watershed, but were not considered a loss, should have their loss populated as -8888 rather than 0.

   Response 20250403: the census blocks that were considered inventory of the project footprint / watershed, but were not considered a loss populated as -8888 rather than 0

   Backcheck – Approved, EDS

File Structure and Naming

3. Modeler initials and submittal date need to be filled in for Completeness Review section at the beginning of the document

   Completeness Review (QC Item 8) – not inclu

Modeler Initials:	
Submittal Date:	
Review Response Date:	

   Response 20250403: QC Document Updated
   Backcheck – Approved, EDS

Report

4. There are a couple of comments added into the report to address.
   FPM, CNMS, Hazus - Backcheck – Approved, EDS

Flood Risk Database

5. See comments in Section 7.
   Backcheck – Approved, EDS

CNMS

6. S_Studies_Ln is empty.
   Response 20250403: Populated.
   Backcheck – Approved, EDS

7. Production team noted that A1-A4 (data/report) is not complete, A5 in the report is incomplete – will verify and review with backcheck submittal.
   Response 20250403: Report coimments have been addressed.
   Backcheck – Approved, EDS

8. Post Processing is incomplete with the empty S_Studies_Ln
   Response 20250403: S_Studies_Ln Populated.
   Backcheck – Approved, EDS

Terrain

1. Source_Index does not fully cover all tiles delivered in 'Bare_Earth_DEM' raster. Please add necessary tiles to cover.
   AR response 20250508: Source_Index corrected, tiles now cover full extent of 'Bare_Earth_DEM' raster
   Pass – confirmed over a phone call.

2. S_Submittal_Info is much larger than the extents of the Source_Index and raster deliverable in 'Bare_Earth_DEM'. Please consider clipping to the revised Source_Index (see comment above)
   AR response 20250508: Updated
   Pass – confirmed over a phone call.

3. S_Submittal_Info should also follow FEMA Data Capture Guidance where TERRAIN CAPTURE tasks should not have overlapping polygons from different sources.

5.4. S_Submittal_Info

Each type of elevation data submitted should be accompanied by S_Submittal_Info polygons that represent the spatial extents of each data source. The S_Submittal_Info TASK_TYP field will be used to document whether the data footprint represents newly purchased lidar data (New Topographic Data Capture), existing topo data (Existing Topographic Data Capture), or processed terrain data (Terrain Data Capture).

In the example above, if the processed terrain data were blended from three different existing sources and one new data collection to create the final terrain data, the S_Submittal_Info layer

submitted with the Existing Topographic Data Capture task would have four polygons, each describing the source and the accuracy of the data, and three attributed with the TASK_TYP of "EXISTING TOPO CAPTURE" and one with the TASK_TYP of "NEW TOPO CAPTURE". The New and Existing Topo submittal info polygons may overlap if the original source data overlapped.

An S_Submittal_Info layer should also be submitted with the Terrain Data Capture task describing the extents of the processed terrain data. It would also have four polygons, each describing the source and the accuracy of the data and each attributed with the TASK_TYP of "TERRAIN CAPTURE". The polygons representing the processed terrain data should not overlap other polygons corresponding to the finished terrain surface. In other words, for any given location there should be only one polygon representing the final source for the finished terrain surface.

AR response 20250508: Updated
Pass – confirmed over a phone call.

4. Metadata comments
   a. The <pubdate> in the <citation> and <timeperd> sections should be set to the MIP Submission Date.
      AR response 20250508: Updated
      Pass – confirmed over a phone call.

   b. Update bounding coordinates based on changes made in comments above about Source_Index and S_Submittal_Info
      AR response 20250508: bounding coordinates updated
      Pass – confirmed over a phone call.

   c. <placekey> entries are missing some values. Please ensure the REGION, STATE, COUNTY, COUNTY-FIPS, COMMUNITY, FEMA-CID and HUC8 code is entered for each community in the purchase geography.
      AR response 20250508: FEMA-CID updated for communities without CID, populated with 00000 per conversation with ITR
      Pass – confirmed over a phone call.

   d. Replace miphelp@riskmapcds.com in all locations with updated MIPHelp address of fema-riskmap-ithelp@fema.dhs.gov
      AR response 20250508: Email address updated.
      Backcheck: Approved, EDS

e. <srccontr> text should be input in the CONTRIB field in L_Source_Cit for each TOPO#
AR response 20250508: Updated
Backcheck: Approved, EDS

f. In the <eainfo> section, an entry should be added for the Source_Index deliverable
AR response 20250508: Updated
Backcheck: Approved, EDS

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QA/QC Checklist Approval

This 2D Base Level Engineering Analysis QA/QC Review is in compliance with the contract requirements and all task checkpoints are complete. The independent QC Team has reviewed the analysis, presented review comments to the Production Team Task Leader, and discussed any problems or issues. The Task Leader, QC Manager, QC Reviewer, and Project Manager have signed the QA/QC Checklist to confirm that all comments have been received, addressed, and documented appropriately.

QA/QC Team – AECOM		**Production Team – AtkinsRéalis**	
Rana, Samagra Digitally signed by Rana, Samagra DN: cn=Rana, Samagra, ou=USAUS2, email=Samagra.Rana@aecom.com Date: 2025.06.11 12:45:00 -07'00'			
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QC Manager	Date	Task Lead	Date
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QC Reviewer	Date	Project Manager	Date