FHAD MODEL REVIEW MEETING MINUTES

Brantner Gulch MDP and FHAD
Tuesday, November 3, 2020
1:00 pm via Microsoft Teams

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The meeting was held to discuss the FHAD modeling comments provided by the Mile High Flood District. This summary is intended to reflect the key points raised, issues for further consideration, and action items resulting from the discussions. The non-bold items comprised the meeting agenda. The items in bold resulted from the discussions.

Comment Discussion Items

1) General Clarifications
   a) All flows will be updated in the model – FHAD model was submitted prior to receiving additional detention pond information. Final hydrology incorporated new detention pond information, which is why it changed. Also applies to data relevant to Detention Basin 365 and 360.

   b) Report is intended to be part of more comprehensive MDP report, not the FHAD report. The FHAD report will be submitted after the model reviews are completed and will start with the MDP report and then delete out extraneous information. That way, only one report needs updated until the end. Because of the dual nature of the MDP and FHAD reports, some sections were scoped in the MDP portion and the FHAD report scope was only intended to modify the MDP report. The crossing structure table, reach descriptions, and flood hazards sections are included in the alternatives analysis scope, which has not yet been authorized.

      i) **The information listed above should be included now to help with reviews and workflow moving forward, The items had been included in the MDP phase based on the way Olsson structured the fee estimate. Olsson will keep track of this work, but it should not be an issue as it is assumed the MDP will be authorized.**

2) General Modeling Approaches
   a) Limited drop structure survey in most areas – best way to approach? Some of the survey only includes one crest shot and one toe drop and does not include the sill elevation. Preference for how much of channel to adjust based on limited survey data? The original intent was to adjust the low flow between drops and structures. After seeing the channel generally conveyed the flows without lowering the channel invert, and considering the limited data, we generally just used LiDAR. In some cases we used drop structure survey shots at two drop structure cross sections, and then tied into LiDAR, but that ends up showing a short steep section at the interface of the data.
      i) **The cross sections in between the drops could be interpolated, but that information is not accurate based on the fact that there are no survey points for the sill of the drop.**
      ii) **Despite the floodplain being shown as well contained within the channel, the modeling for the drop structures is stringent. The survey data or as-built information must be used at hydraulic structures, or FEMA will not approve the model. The LiDAR and survey interface will be reviewed. Typically, the channel profile will be adjusted based on survey at the hard points (crossing structures and drop structures), unless that approach is questionable.**
      iii) As-builts can be used. Thornton will check to see whether any are available. The large vertical drops were constructed in the late 90's and early 00's when the development was moving very quickly and information might not be available, unless it was maintenance eligible
      iv) Adverse slopes are appropriate if there is something that we can base that information on, such as someone reporting it in the field. However, an adverse slope due to switching between data sources is not acceptable without justification. In the areas where there is a vertical concrete cutoff wall with a scour hole, based on visual inspection an adverse slope is appropriate.
      v) Olsson will evaluate which drops need additional survey information based on the working profile and request the additional survey.

   b) Drop structure cross section alignments were generally placed based on LiDAR at the surveyed crest points. Aerial and survey where available can be referenced to adjust alignments to better match crest configuration.
      i) Cross section alignment at the drop structures will be checked and updated as needed to ensure the alignment reflects the controlling section.

   c) Incorporating survey at crossings – preferences?

      i) Incorporating survey points into cross sections is more accurate. One drawback could be that the mapping might end up crossing contours and not always follow LiDAR when survey defines much of cross section.
      ii) The upstream cross sections will typically be updated to include the survey information in order to catch the low flow information. If the data appears it will cause a mapping issue later, Olsson will discuss with MHFD.
      iii) Typically, one survey shot downstream. Preference on incorporating survey?
         (1) The cross section downstream of culverts will be updated to match the culvert invert. The width should represent the natural channel geometry

without including any part of the structure. If the culvert width is a good approximation of the natural channel geometry, it can be used to adjust the ground based on the survey, but should be evaluated to make sure it is appropriate.

d) Structure IEFAs – recommend permanent IEFA up to culvert crown/bridge LC. Preference?
   i) **Downstream ineffective areas should have the elevations updated to be between the culvert crown/bridge low chord and the road elevation, and will be based on the flow events that are overtopping. Generally, once the flows are overtopping, it is considered effective flow. The upstream ineffective flow area is permanent and set to road deck elevation. The downstream ineffective flow area is not permanent and is in between the road deck elevation and the top of the culvert. The approach may vary where there are crossing profiles in order to eliminate them.**

e) Low flow crossings – did not model culverts with an opening of less than 36" based on discussions on past FHADs, agree with approach?
   i) Some culverts less than 36" may be significant if there are multiple culverts, or span a larger width. We will provide MHFD a list of recommended smaller culverts to include in the model for review.

f) Rating curves versus set WSE – preference?
   i) Rating curves are better if a flow changes in future, rating curve should be able to reflect updated WSE versus a set WSE
      (1) Rating curves are preferred.
   ii) Set WSE are more visible in model and easier to see where they are versus the rating curve
   iii) Remove structures downstream of rating curves/set WSEs? Were included in model more for a visual reference of a structure. Detention basin discharge flow location was shown immediately upstream of the outlet pipe so that it would not interfere with the set WSE or rating curve. The discharge location will be moved downstream of the detention basin if the structures are going to be removed from the model.
      (1) Preference is to not include the culvert downstream of the rating curve for consistency. The use of culverts downstream of a rating curve deems providing valuable structure information. The model approach is OK only if the in-line facility was not overtopped by the events studied. However, the culvert hydraulics may not be calculated appropriately with known water surface elevations set at the inlet of the culverts. A clear description should be provided in the model for the future user to be aware of the model assumption and culvert capacities.
      (2) When the events overtop the structures, the model approach may not calculate the overflow condition appropriately.
      (3) Once additional data on the long pipes is received, the detention basin calculations will be double checked to see if any adjustments need to be made to the stage-discharge info.

3) Hydrology

   a) DP 160O diversion – pipe link shows a little less than actual capacity in it because n value was increased 25% per criteria and kinematic model uses Manning's equation to determine pipe capacity. Used more detailed rating curve to verify if flows overtop of not. Can decrease Manning's n value to keep pipe capacity more in line with outside calculations, but it will be a deviation from typical model setup. Updating Manning's n for this link should have negligible effect on peak flows. Update?
      i) The link flow was not used in the HEC-RAS model and SWMM does not need to be updated. A note will be added as to why there is a difference between the HEC RAS flow and the SWMM Model.
      ii) As mentioned in 2)f)iii)(2) additional data will be collected and the detention basin calculations verified and adjusted if necessary.

   b) P303 and F304 detention basin stage-storage-discharge from old study Brantner Gulch Northing Tribs Hydrology Update 2010). Elevations are similar to survey, but not exact. Since general agreement, utilized WSEs based on rating table in old study.
      i) Please verify the set water surface elevations that do not match the SWMM outputs. Please verify that the invert of design point P303 can calculated correct water surface elevations to be used in HEC-RAS.
         (1) Validate the elevations related to storage-discharge information, and if it is not matching, the information will be updated in the hydrology.
         (2) It appears that P303 assumes the WQCV is full at the start of the design event due to antecedent runoff (or clogging). MHFD will confirm that this approach is acceptable.

      ii) F304:
         - SWMM design point invert elevation does not match HEC-RAS culvert upstream invert elevation of 5309.45.
         - 1. Can the W.S.E. be used directly in the HEC-RAS model?
         - 2. Survey information shows outlet box elevation of 5117.8 (Table shows 5117.75. OK!)
         - 3. So, the rating curve indicates that spillway will be activated at elevation of 5120 and above.
         - 4. However, the surveyed roadway low point at approximate 5122.
         - Please verify if the detention overflows in the 100- and 500-year events.
            (1) Validate the elevations related to storage-discharge information, and if it is not matching, update the information in the hydrology.

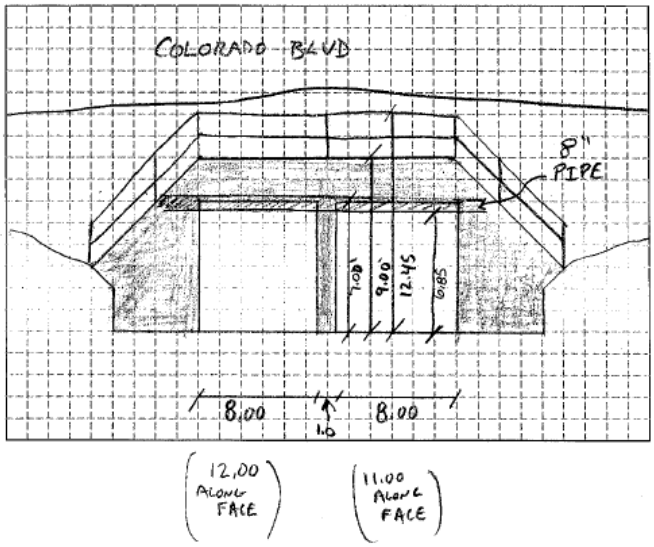
4) Specific Comments
   a) Brantner Gulch – missing survey data for Washington Street culvert. Prefer to get survey or trim model to downstream side of Washington?
      i) **Trim model to east of Washington Street.**
   b) XS 35429 to 35211, the cross section alignments are likely not perpendicular to the flow direction. Let's discuss.
      i) **Ignore the trail alignment, do not cut the cross section parallel to the trail since there is a low point. Cut the sections perpendicular to the flow,**

ignoring/crossing the trail. We will evaluate how the new aligned cross sections work and impact the model to make sure the new approach is reasonable.

c) 500-year spill channel and 100-year storm drain system downstream of detention ponds
   i) Plans or survey needed for storm drain system to verify alignment (based on GIS) and capacity with StormCAD
      (1) **Thornton will look for as-builts. If none are available, survey will be needed for the storm drain systems.**
      (2) **Near Washington Center Parkway, a small amount of flows overtop in a 100-year storm event. The overflows go to a sump in the road where two inlets convey the flow to a storm drain system. It is possible that the storm drain system may have capacity for the 100-year spill. MHFD will discuss and get back to Olsson on if this storm drain system can be included in the analysis, or if the 100-year flows need to be routed overland. Olsson noted that buildings are located near the overland path and may be impacted by the 100-year spill. If the storm drain system can be included, Olsson will need either as-builts or survey to complete the analysis.**
   ii) Develop spill reach for 500-year overtopping flows
      (1) Spill occurs at Eastlake #2 (DP 360) weir then into 123rd Avenue to 124th, perhaps across the tennis courts into pond. The swale that is shown in the LiDAR is incorrect. If this is a 500-year spill only, this would be a good place to use a 2D model to analyze spill path.

d) Alignments through large detention ponds
   i) **It is more important to follow the LiDAR than the aerial. If combined, and the aerial agrees with the LiDAR it may be acceptable to follow the aerial.**
   ii) **It is acceptable to not follow the thalweg through the detention basin, unless the detention basin is large enough that the downstream rating curve doesn't control, or if the 100-year floodplain does not contain the alignment in the model.**

e) Colorado Blvd modified inlet culvert – modeling preference? Not sure if culvert is also slope tapered and if it is face or throat controlled.
   i) There is a daycare facility located close to this area, in the southwest quadrant of the intersection, which is considered a critical facility.
   ii) **It is likely that the survey information is the skewed face dimensions of the culvert. In the model, a skewed faced culvert can be selected with chart number 11.**
   iii) **Model the whole culvert as 8x7, without the 8-inch utility pipe crossing the top of the culvert, since the culvert is outlet controlled.**



f) XS 27135 to 23980, the LiDAR may be inaccurate at the low flow area because of dense vegetation. Let's discuss the adjustment of the low flow area and channel invert using structure survey and field reconnaissance wherever needed.
   i) **The LiDAR information should overrule where there is conflict. But if the aerial can clarify, and it also agrees with the LiDAR, then the alignment will be adjusted to match both.**

g) Let's discuss model approach at E 128th Ave.
   i) Thornton's new Stormwater Utility's first CIP project has been completed at this crossing. A quadruple 48-inch RCP structure parallel with the existing structure was constructed. Low flows are directed exclusively to the original structure. Near the point this structure reaches "full pipe" flows, flow spills to the new structure. The goal of the project was for the combined structures, as modeled in HY-8, to convey the 10-year discharge per the preliminary FHAD hydrology. The low point/overflow in 128th Avenue is well to the east of the structures. As-built information is available with the updated contour information is available and will be incorporated into the model once provided. Post project, a conflicting utility was lowered, allowing city forces to excavate out a lower channel exit from the structures, removing backwater in low flow conditions from the new quad-culverts. This should not impact modeling in high flow conditions.

h) Junctions
   i) **Add a cross section closer so there is less distance along the junction.**
   ii) **Perhaps only use one junction instead of multiple where the junctions are close together. Either keep the junctions and add cross sections to see how that works or model the reach separately, whichever is more appropriate after iteration.**

i) Riverdale Rd - Let's discuss the culvert modeling and data information.
   i) The model is good, the topo was not provided for review. The as-built CAD files will be incorporated and stitched into the terrain for the next review.

j) South Platte River boundary condition – normal depth, set WSE, other?

i) 10-year effective WSEL for the South Platte River, though FEMA prefers normal depth.

k) Golf course area
   i) Trans-watershed flow
      (1) 2D model results make sense, but it will likely be difficult to replicate in a 1D model. It is a good starting point to try and figure out where water flows in this area.
      (2) There are plans for developing the channel along Brantner Gulch in the golf course, so it would be helpful to have a 2D model to identify the spills and flow paths and then regroup with the results.
      (3) The other two tributaries have less of a defined alignment, so these areas would benefit from a 2D model to provide potential flow paths.
   ii) Contraction/expansion coefficients
      (1) **Add a note "No significant contraction and expansion, values have not been updated to reflect as such."**

l) Let's discuss the model approach for the concrete check structures (like weir structure) in Plains Tributary.
   i) **Issues are related to survey elevations, as discussed previously.**

m) XS 65137 (maybe also XS 65147 & 65148) and XS 64800, please use permanent IEFA at low flow portion to account the impact from the downstream blocked obstruction. However, let's discuss which crossing structures are negligible.
   i) Olsson will send information on the crossing structures recommended to not be included in the model for concurrence with MHFD.

n) Culvert 62946 (Plains Tributary, E 128 Ave), let's discuss the model approach. It appears that only the 500-year event will overtops the eastern berm.
   i) Keep the main model along the storm culvert, then estimate the overtopping flow and culvert capacity with outside calculations. If it is insignificant, then no split flow will be necessary.
   ii) A FlowMaster calculation will likely be sufficient for the floodplain mapping.

o) Culvert 82364 (Horizons Tributary, E 136th Avenue), the current model approach is not able to calculate the potential highest W.S.E. upstream of the culvert. The highest W.S.E. should be equal or higher than the berm crest elevation at left bank. Let's discuss.
   i) **Use a similar approach as item 4n.**

p) Culvert 79518 (Horizons Tributary, Pedestrian Sidewalk), please provide the full title of the design plans. Is there a drop structure at XS 79592 and design grading? Let's discuss using parallel bounding XSs, skew and a lateral structure for 500-year event.
   i) This culvert was built per plan. MHFD will look into providing as-builts. The 500-year overtopping flows will be routed to the east and then down to the main channel farther downstream. The full flow will still be used downstream of the culvert. A FlowMaster calculation will be used to determine the limits of the 500-year floodplain.

q) Culvert 78519 (Horizons Tributary, Pedestrian Sidewalk), please provide the full title of the design plans. Is there a drop at XS 78668? Please incorporate the design grading and revise the bounding cross sections accordingly. Let's discuss.
   i) **This structure was not built per plan. MHFD will look into providing as-builts.**
   ii) **Incorporate drop structure on upstream side once the as-builts for the drop structure are provided.**

r) Is the as-built grading at ROB of the XS 73331 to XS 72852 available? The new development seems not impacting the 100- and 500-year floodplains. Please verify.
   i) **Channel should not have been modified. As long as the cross sections are contained, then the cross sections will be shortened so that they are not in the area that has been updated.**
s) XS 73252 & XS 72500 to72478, let's discuss the alignments for modeling drop structures.
   i) **Previously discussed.**
t) XS 116428 to 116404 in Fairgrounds Tributary, let's discuss the cutline alignments for modeling the drop structures.
   i) **Previously discussed.**
u) Culvert 131763 under 136th Ave in SPR S Tributary 6, the 100-year overland flow is significant because the private owned detention was not modeled or assumed clogged. Let's discuss the model approach and potential split flow in 136th Ave.
   i) **Cut off model south of 136th Avenue.**
v) Culvert 127662 in Yosemite St in SPR S Tributary 6, let's discuss the model approach for the long culvert and the as-built/proposed grading of the channel tie in to the culvert.
   i) **FHAD model will start downstream of the culvert. Upstream of the culvert, the MDP model is for information only for development. A StormCAD model will be used to evaluate the pipe capacity.**
w) SPR S Tributary 6, from XS 125200 to the confluence with SPR N Tributary 7, let's discuss the model approach, profile baseline and cross section alignments.
   i) **See Item 4k, above.**
x) XS 137357 in SPR N Tributary 7 to the confluence with SPR, let's discuss the model approach.
   i) **The SPR 10-year water surface elevation will be used.**

5) Other
   a) **Developed Area south of 128th avenue, new development should be added to the modeling. Thornton to provide the development As-Built information. If the design information is provided before the As-Built information is provided, then this will be helpful to update model, then the as-builts can be reviewed later to confirm the design and update the model as needed.**

Action Items:

Thornton:

1. **Provide PDFs and CAD files of the drainage, as-built, and design information for the areas below:**
   a. **Drop structure as-built information (Olsson will confirm location of drop structures in question)**
   b. **Storm Drain as-built information**
   c. **CIP Project Number 1**

MHFD:

1. **Confirm whether or not water quality should be assumed to be clogged when verifying the stage-storage-discharge information.**

2. **Discuss if the storm drain system can be counted for the 100-year and 500-year spills downstream of Washington Center Parkway**
3. **Provide as-built information in AutoCAD and PDFs for culverts along Horizons Tributary.**

Olsson:

1. **Develop a request for additional survey information.**
2. **Send a list of crossings that were excluded from the model to MHFD.**
3. **Develop a 2D model for the golf course to help determine flow paths.**

Please contact Olsson at 303-237-2072 with changes or questions regarding these meeting minutes. These minutes will be considered final unless comments are received within seven days of distribution. Although comments will be incorporated, as appropriate, only major revisions will be redistributed.

Minutes prepared by: Hannah Pring
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