Guide for Items to Check in Review of Hydraulics Deliverables

(This is a general guide, and not absolute nor all-inclusive.)

October 11, 2018

PLANNING

HYDRAULIC PLANNING REPORT (HPR)/PRELIMINARY DESIGN REPORT (PDR)

1. Review guidance on the Hydraulics Unit website, Hydraulic Planning Report Scope of Work or Preliminary Design Report (PDR) Example Package, as appropriate.
2. PDRs should be used only for structure replacement projects. More involved projects, such as widening or new location (whether single or multiple structures), should follow the format of an HPR.
3. Verify report is complete (includes sketches, comps for sizing recommended str., Prelim. Recs. table etc.).
4. Note discrepancies/omissions in data (for example, blank lines on PDR form that should be filled in, utilities present in photos but not shown on plan view sketch, etc.).
5. Report should be organized by site, with clear recommendations on preferred recommended structure(s).
6. Existing site data should be complete, including existing condition. Use 2016 Drainage Guidelines Appx. D Item 3 for items that should have been reviewed in the field.
7. Sites should be labeled on all mapping.
8. Verify that future development was considered in discharge calculations.
9. Check adequacy of structure sizing comps. For culverts, generally HDS-5 w/ slope across culvert and assumed TW slope, and for bridges, setting min. bridge. In cases with existing overtopping or where hydraulic design may control grade, additional analysis may be required, such as HY-8 w/ assumed roadway grade, or HEC-RAS simple structure replacement if we have a model. Reduction in structure opening such as sills should be accounted for.
10. Check that sills and benches are recommended for pipes/culverts where appropriate. If required, sills should be included in recommended structure recommendation.
11. Unnecessary information should be removed. For example, it is not necessary to incorporate Routine Inspection Reports in their entirety; only include relevant pages (front page, structure sketches, photos etc.). Likewise, entire pages and maps of wetlands/JS copied from the planning doc. are not relevant to the structure sizing.
12. Note inconsistencies in report such as indicating an existing culvert is in poor condition but recommending to retain and extend it.
13. Verify that bridge recommendations follow minimum bridge length guidelines and are appropriately skewed.
14. If existing bridge overtops at or prior to 100 year event and roadway weir flow area will be reduced due to grade change, verify an appropriate amount of area is added to the proposed bridge opening.

DESIGN

DRAINAGE PLANS

Plans should be given a cursory review immediately upon receipt to ensure that the appropriate level of detail, comps etc. are included. Plans that are significantly lacking items needed for review, or that contain a significant number of basic errors, should be returned as "Incomplete – Returned without Review" with a list of deficiencies and a reminder of the expectation of adequate QA/QC prior to submittal.

Review Pre-design Meeting minutes to ensure design conforms to agreed-upon design assumptions and approach.

Existing Drainage Patterns

Existing drainage patterns should be complete and be sufficiently marked to clearly document existing conditions, not only for review but as a record of pre-project conditions. Existing drainage patterns (including contours) should extend beyond project site limits to give a clear picture of where drainage comes from and where it goes.

1. Verify if adequate existing drainage patterns are shown and that existing head and tail ditches and channels have appropriate descriptions to convey existing conditions. Proposed design should maintain existing drainage patterns wherever possible.
2. Check for project photos with locations and direction identified.
3. Spot check proposed top and inverts for agreement with storm drain output.
4. Look for drainage diversions.
5. Note any inconsistencies, questionable areas.
6. Check to see if pre and post analyses have been completed for potential problem outlets (existing outlets that will receive a significant amount of additional impervious area such as a new interchange, urban areas etc.). In the pre and post analysis check to see if all supporting documents are provided and assumptions documented. Review for completeness and if they are correct.
7. Check to ensure drainage area boundaries are shown for all drainage areas including large areas that continue off of plan sheets.
8. Check to ensure items identified on *Items to Include on Red Line Drainage Plans* are adequately shown.

Plans/Drafting

Spot-check that appropriate notes/labels are shown, and that appropriate stds./min. sizes are used.

1. Verify max slopes shown on typical cross sections. (In general east of I-95 and in Sandhills 3:1 max. if Geotechnical recommendations aren't available.)
2. Review drafted pipe lengths along cut and fill slopes to see if they appear long enough or too long.
3. Verify that adequate R/W, PDE and TDE are shown. At minimum the flow line of a proposed lateral or cut ditch should be contained in R/W or PDE. TDE is usually sufficient for existing head/tail ditch work. For pipe installation or ditch construction generally 20' on one side of the drainage feature and 10' on the other of TDE is sufficient. As always TDE limits should be verified with the Division. Drainage structures (CBs, DIs, MHs…) that are needed to ensure the safety of the traveling public that may need future maintenance should be contained in R/W or

PDE. (Note: rip rap at pipe outlets is not necessarily shown to scale, unless in a jurisdictional feature, but easement should allow adequate room for construction.) Make sure easements are not going through buildings that are not anticipated to be taken by the project.

4. 36" pipes and larger should have a HW (unless equalizer pipes).
5. Outlet protection for pipes 36" and larger should use nothing smaller than Class I rip rap.
6. Min. cross pipe size should be 18" RCP.
7. Adjacent drainage, even if just outside of project limits, should be evaluated for adequacy.
8. Items (pipes, ditches, drainage structures) that appear on multiple sheets should be labeled on each sheet.
9. Verify design decisions (unusual situations or issues not readily apparent) are documented (brief description) on redlines.
10. Check slope stake lines for smooth transitions between cut and fill sections.
11. Spot check that rip rap is drawn to scale in jurisdictional areas (wetlands and JS).
12. Spot check that pipes (cross pipes or system pipes) have adequate cover.
13. For pipes in JS, verify that correct pipe burial amount is called for and is noted on plans.
14. Once final drainage is approved, ensure that PDF of redlines is delivered and tagged on Sharepoint as final (and project paperwork is completed).

Systems

Verify that system layout is logical, and is designed for ease of construction and maintenance.

1. For C&G, review box placement and pipe location. In general, keep pipes under C&G. Do not deflect pipes to keep pipe under C&G; add CBs to facilitate when possible (even on high side of super).
2. Drainage system pipes crossing the roadway at a heavy skew (less than 45 deg. acute angle) should be avoided, with a 90 degree skew preferred where possible.
3. Check to ensure that appropriate boxes are used (for example, Type A 2GI if 24" or greater is entering the narrow side of the box, TB box if within 4' of the travel lane, etc).
4. Check bypass at intersections, at the ends of medians/raised islands/shoulder berm gutter, and super rollovers. Max. bypass should be 0.1 cfs from a four (4) inch per hour rainfall intensity.
5. Check sag and crest locations at superelevation roll overs. Avoid having 0.02 or less cross-slope at sags or crest as this creates a flat roadway where water can collect and potentially produce hydroplaning conditions.
6. Systems released to natural ground (no defined outlet channel) should include outlet stability comps to ensure stability beyond the rip rap pad, particularly those released on steep slopes or highly erodible soils/ground cover.
7. Check for sags without relief and ensure that appropriate 25yr or 50yr pipe system design is made per table 10.1 in the 2016 Drainage Guidelines.
8. Scan plans to ensure that appropriate types of pipe material are used per the NCDOT Pipe Material Selection guide (2016 Drainage Guidelines Appx. H Item 1) and the appropriate metal pipe type (CSP or CAAP) is used.
9. Verify shoulder berm gutter (SBG) is called for where warranted (typically required where two or more lanes are draining towards the fill slope and the fill height is > 10 feet).

Ditches

1. Spot check ditch station on details and profiles for agreement with drafted locations. Look for gaps. All details should have respective alignments. Station ranges should not jump alignments

(e.g. L Sta. 25+00 to Y1 Sta. 12+00 Rt. should be broken at an equality station). Add new station range if needed.

2. Check that proposed ditches replacing existing ditches are at a similar elevation (where appropriate) and have equal or greater capacity than the existing ditch.
3. Spot check ditch data blocks for flow depth versus min. d shown on details.
4. Check V10 for ditches discharging wetlands; should be less than 2 fps.
5. Spot check pipe outlet inverts that outlet to a proposed ditch to verify that elevations agree.
6. Excessively-deep ditches should be questioned whether better alternatives exist, particularly if taking a significant portion of residences' front yards, or other areas that would negatively impact the adjacent property, or require additional easement.
7. Ditches behind C&G should be avoided unless absolutely necessary.
8. Spot check ditches for appropriate Manning's n and c values, and ensure that all variables are reported on ditch comps. Scan velocities and shear stress to see if appropriate lining is recommended and ditch is stable.
9. Ditches should be fully drafted on plan sheets and cross sections. Ditch grades should appear on roadway profiles (with the exception of head/tail ditches not running parallel to alignment).

Wetlands/JS

1. In buffered locations check to see that BZ lines are shown (and drawn correctly). BZ1 (30') and BZ2 (20') and correct offsets are maintained through bends/acute angles, and following the TB, or in CAMA counties the High Water Line (HWL) or Normal Water Line (NWL). For CAMA BZ lines, the HWL or NWL will be determined by a DCM representative. Arcing around the ends of culverts and drafted through the existing transportation facility (only impacts outside of the existing transportation facility will be counted and hatched on permit drawings).
2. Verify adequate ditch length is provided prior to entering buffers. Question whether system outlet can be shifted to provide greater length if needed.
3. Verify equalizer pipes are used where needed. Pipes should not be buried in wetlands.
4. Verify pipe burial depths are in conformance with table (Appendix H, Item 4).

Structures

1. Check bridge spread. Review provided calculations for long bridges that use deck drains. Verify that spacing is correct based on the type of structure: Modified Bulb Tee (MBT), Girder, Cored Slab (CS), Box Beam (BB). (min. distance from end of bridge or interior bents).
    a. Avoid deck drains over open water or environmentally sensitive areas where practical. If direct discharge is proposed, verify written approval from the State Hydraulics Engineer per the NCDOT "Guidelines for Drainage Studies and Hydraulic Design", the Post-Construction Stormwater Program (PCSP), and the Stormwater Best Management Practices (BMP) Toolbox.
    b. If grade separation then no deck drains over railroad R/W, sidewalks, or travel lanes (verify if road under bridge will ever be widened and check for deck drain conflicts).
    c. If deck drains are proposed, ensure proper energy dissipation and conveyance is provided for at discharge locations.
    d. If crest is on the bridge, check spread at 10 ft. increments up to 50 ft. away from either side of the crest to see if spread is an issue.

e. Verify correct type and size of deck drain is used (rectangular slots for cored slab/box beam, circular for girder bridges).
f. Collection (closed) systems on bridges should be avoided if at all possible.

2. Verify drainage structures will not be placed in approach slab.

CROSS SECTIONS

1. Review cross sections and plans to identify areas where water may flow along or be concentrated against the fill slope and potentially cause erosion issues. (Recommend ditching or toe protection.)
2. Spot check cross sections for agreement with the plotted back slopes and flow lines of the proposed ditches and the proposed fill slopes.
3. Spot check drafted side slopes for agreement with respective ditch details.

INLET COMPS

1. Check spread values versus max. allowable spread. If raised median is used, ensure spread does not exceed 3' in the travel lane.
2. Spot check inlets for appropriate bypass assignment.
3. Check sag locations and make sure greatest spread is reported in the remarks column on the Geopak output. Either from the left or right or total when checked at a min. 0.003 ft/ft grade.
4. Spot check DA boundary area (rough calculation L x W) and compare to DA shown on inlet comps. If discrepancies are found, check additional locations and comment that all need to be verified.
5. Spot check c values to determine if future development was considered and if c values are justified.
6. Depth of flow at DIs should be reported in the remarks column on the Geopak Output.

STORM DRAIN COMPS

1. Check for reasonable Tc. If short system Tc should not be greater than the minimum 10 min. Sometimes inlets with small DA (0.07 ac) the inlet Tc should be set to 5 min. to help reduce artificially high Tc later down the system. Ensure that any Tc other than the minimum 10 min. or 5 min. mentioned above have Tc calculations provided.
2. Check to see if standard or close to standard boxes depths are used. If box depths exceed 8', review system to see if a constraint is causing this or if an error was made.
3. Check flagged items in the output. Pipe capacity and slopes greater than 10%.
4. Check to ensure that all items are filled in on the output and if any are blank that appropriate comments are added to explain why items are missing.
5. Avoid use of user supplied discharges. Use correct DA and adjust c-value to achieve desired Q (10yr, 25yr, 50yr…) that was calculated outside of Geopak. (Usually applies to offsite drainage)

6. Review HGL to see if min. 0.5' of freeboard has been obtained. The top elevation of the structure may be used as an upper limit if obtaining 0.5' of freeboard is not practical.
7. Spot check that designer matched pipe crowns.
8. Verify that sealed systems are called for on pipes located in contaminated areas.
9. Check that concrete pipes are not used on grades > 10% (unless anchored with a drainage box on the downstream end).

BMP DESIGN

1. Review current version of the BMP tool box to evaluate if acceptable design criteria have been met (applies to all BMP devices).
2. If designing infiltration basins, verify that correct soil conductivity rates are used based on geotechnical borings.
3. Ensure conveyances designated as 'Swales' are within regular mowing limits for maintenance operations (e.g. not located behind guardrail, not at bottom of steep fill slopes, etc.).
4. If designing detention basins (dry or wet) review Seasonal High Water Table (SHWT) and compare to basin bottom to see if entire basin is able to be used for storage or if part of the basin will already be inundated with groundwater.
5. If media filters (bio-retention, filtration, or bio-swales) are proposed review SHWT compare to elevation of underdrain outlet. Ensure that design will not drain groundwater.
6. If stormwater wetlands are proposed, ensure that the wetland will maintain a minimum water level either through interception of water table or that a constant source of water is available to maintain water in the deep pools even during drought conditions.
7. Ensure outlet structure elevations are appropriate:
    a. Orifices/underdrains
    b. Top of structure
    c. Emergency Spillway
8. All features requiring grading, including but not limited to special ditches, stormwater BMPs etc., shall have a grading plan including, at minimum, slope stake lines. Inclusion of proposed contours is preferred. For stormwater BMPs with a basin component proposed contours are required. All basins should have a North and South & East and West cross section of the basin.
9. Ensure appropriate values for pre/post routing are entered in any modelling.
10. Check to ensure that there is sufficient right-of-way (ROW) or permanent drainage easement (PDE) around all BMPs. Recommended minimum of 10 ft. around BMPs.
11. Ensure access in the post-construction phase is provided to the BMPs for maintenance equipment. Driveways or access roads may be needed.
12. Construction of BMPs should be entirely in cut where feasible. If a portion of proposed BMP embankment is required to be a fill section instead of cut, ensure that the berms/embankments have been designed in accordance with Section 2.3 of the 'NCDOT Stormwater Best Management Practices Toolbox' for structural stability. Consideration should be given to relocating BMPs if embankment failure would result in damage to downgradient structures or property.
13. Ensure anti-seep measures are included for outlet pipes through fill sections.

PIPE DATA SHEETS (PDS)

1. Verify that information shown on the PDS agrees with information shown on the redline plans and profiles.
2. Spot check station locations. In general, stations should be close to location on plans (to nearest foot).
3. Check for appropriate pipe material and Manning's n value.
4. Check for appropriate hydrologic method based on DA and future land use, especially if headwaters are to be balanced between structures.
5. Spot check HW control elevations and overtopping elevations. If overtopping occurs at a lower frequency, check if the discharge should be accounted for elsewhere such as at another cross-pipe or ditch, and that adjacent PDSs balance headwater where appropriate.
6. In general, check PDS elevations for agreement with other locations on the PDS. Sometimes notes at the bottom of the sheet identify one OT but a different OT is shown in the information to be shown on plans section.
7. Check OT freq. with calculations and Qs.
8. Spot check TW calculations and determine if correct Ho is used: greater of TW or (dc+D)/2.
9. Check that calculated Qs are reflected on the PDS computations.
10. Cross-pipe-size drainage areas should have a PDS completed, even if part of a closed drainage system, for at least the pipe under the road, and be designed for the appropriate frequency (25 yr. or 50 yr.). This could consist of an open-end inlet picking up a sizeable D.A. to system outlet, or a system pipe crossing the road that carries significant D.A. contributed from multiple smaller inlets.
11. If pipe is in outlet control check outlet control HW/D to see if it is excessive.
12. Ensure that any Tc appears appropriate and that any non-standard Tc (10-min minimum) has calculations provided.

PROFILES

1. Spot check to verify that Hydraulic Data Blocks are shown on the profiles and that the pipes are plotted at the centerline elevation on the profiles. Also, verify that pipes sizes agree with PDS and are labeled correctly (such as 2@.... etc.).
2. Spot check ditch profiles and stationing for agreement with plan view and ditch details.
3. Check Bridge Survey Report (BSR) and Culvert Survey Report (CSR) information to be shown on plans for agreement with the approved BSR and/or CSR.

BRIDGE SURVEY REPORT (BSR)

1. Refer to Appendix E Item 1 of the 2016 Drainage Guidelines for information to be shown on the BSR.
2. Should be sealed prior to review.
3. Check that current BSR cell was used.

4. Check agreement of drafting among plan view and profile views (structure alignment & elevation). Horiz. and vert. scales should be identified.
5. Ensure data on report is complete with no discrepancies. Check that water surface elevations agree.
6. Check that appropriate HW control elevation was used (typically match existing 100 yr. water surface elev. for widening/replacement, or existing 100 yr. water surface elev. + 1' for new location).
7. Ask whether Historical Flood Info was gathered if none shown; should include local residents/frequent road users, Div. staff, and field-observed high water marks.
8. Drainage area should be stated in acres (with sq. mi. in parentheses) if less than one sq. mi.
9. If stream crossing is regulated by FEMA, ensure discharges from both FEMA and appropriate hydrologic methodology (Rational/USGS) are shown under Additional Info, with justification for which method was selected for design. Large discrepancies in discharge should be explained. Additional notes should be added explaining unusual circumstances (such as lowered design frequencies, unusual site conditions, etc.).
10. If MOA is applicable, ensure appropriate MOA Type is specified.
11. Scour comps should be shown on BSR and documentation provided of where the values came from in HEC-RAS. Verify appropriate frequencies were analyzed and scour cone of influence is plotted at correct slope for bridge tier (1.4:1 for sub-regional).
12. Verify 4' bridge cap is used unless exception applies that would require a 2.5' cap.
13. Verify appropriate slope is used for spill-through abutments.
14. Verify rip rap wraparounds for spill through abutments are taken to appropriate station and elevation.
15. Ensure statement is included on BSR that no upstream structures in place at the time of design will be adversely affected by the proposed drainage structure; or, if it is not practical to avoid structures being adversely affected, that consultation with the State Hydraulics Engineer is performed.

CULVERT SURVEY REPORT (CSR)

1. Refer to Appendix E Item 2 of the 2016 Drainage Guidelines for information to be shown on the CSR.
2. Check that current CSR cell was used.
3. Should be sealed prior to review.
4. Check agreement of drafting among plan view and profile views (structure alignment & elevation). Culvert profile view should include proposed channels, and NG should be drafted along the prop. culvert CL, prop. channel CL, and finally along the ex. channel CL. Roadway profile view should reflect prop. culvert and prop. channel at inlet end. Horiz. and vert. scales should be identified.
5. Evaluate if culvert appears to be appropriately sized (for channel and for capacity) and aligned for channel as well as floodplain and whether channel work is adequate to ensure fully effective width.
6. Check that invert elevations appear appropriate for channel (not buried in scour hole). Verify structure is buried appropriately and sills and floodplain benches are used when appropriate.

7. Verify appropriate details are included for channel work, sills etc. and all dimensions are provided.
8. Ensure data on report is complete with no discrepancies. Check that water surface elevations agree. Ask whether Historical Flood Info was gathered if none is shown; should include local residents/frequent road users, Div. staff, and field-observed high water marks.
9. Recommended structure should include required minimum burial depth and sill height(s).
10. Drainage area should be stated in acres (with sq. mi. in parentheses) if less than one sq. mi.
11. If stream crossing is regulated by FEMA, ensure discharges from both FEMA and appropriate hydrologic methodology (Rational/USGS) are shown under Additional Info, with justification for which method was selected for design. Large discrepancies in discharge should be explained. Additional notes should be added explaining unusual circumstances (such as lowered design frequencies, unusual site conditions, etc.)
12. Check that buried/ineffective portion of culvert is not included in computations, and that an appropriate Manning's 'n' has been used for the backfill material (if buried).
13. Construction phasing (submitted upon agreement on culvert size) – ensure adequate easement is provided and included on drainage plans.
14. If using HDS-5 or HY-8 and multiple barrels with different openings are used, the reported comps should be based off of the dominant structure and a note added to the report indicating such.
15. If culvert is to be backfilled, then verify that appropriate backfill notes are shown.
16. Ensure statement is included on BSR that no upstream structures in place at the time of design will be adversely affected by the proposed drainage structure; or, if it is not practical to avoid structures being adversely affected, that consultation with the State Hydraulics Engineer is performed.

HEC-RAS MODELS

1. Review HEC-RAS model with the MOA Common Issues Checklist on the Hydraulics Unit website.
2. Review MOA DGN file for appropriate ineffective lines based on floodplain characteristics.
3. Review file naming structure and convention per the Hydraulics Unit website guidance.
4. Check to see if bridge and roadway elevations agree with the BSR (existing and proposed).
5. Check to see if guardrail is blocked out correctly.
6. Check WSE for agreement with the BSR/CSR.
7. Verify that the ineffective flows are acting together with the up and downstream sections. If roadway is overtopped then ineffective flows should not be active up or downstream.
8. Look for divided flows and verify that flow is contributing in the downstream direction.
9. For CSRs, verify if appropriate burial depths are shown and correct structure sizes are shown per the CSR. If an aluminum box culvert (ABC) is recommended, please refer to section 9.5.2.1.1 in the 2016 Drainage Guidelines for modeling guidance for the ABC.
10. Check encroachments to ensure they are contained in the 100yr WSE and are not within the TBs.
11. Check pier width and see if it is in agreement with the Geotech Foundation Rec. If Geotech Foundation Rec. is not available, then see if it seems reasonable based on past projects in the area.

12. Review HEC-RAS narrative for completeness and agreement with model information.
13. Verify that the friction slope method is set to the default value and is consistent across plans.
14. Review the view cross section tab to see if a warning "geometry is newer than output" is present. If it is then there have been changes since the model was last run and needs to be updated.
15. Review starting water surface elevations/boundary conditions to ensure they are consistent across plans. Watch for datum conversions when converting from HEC-2.
16. Scan for Manning's "n" value changes from the Duplicate Effective to the Corrected Effective to the Revised model and check for justification in the narrative if differences are found.
17. Review proposed excavation shown on the BSR/CSR to see if HEC-RAS model is in agreement. Excavation should agree or justification provided in the narrative as to why it does not. Excavation below natural ground under the bridge (for inspection purposes) should generally not be modeled in the HEC-RAS bridge internal sections unless justification for why it should be considered effective flow is provided.
18. If a HEC-RAS model is submitted, then a narrative should be provided even if it is not on a FEMA regulated stream to help the reviewer understand how the model was developed.

MOA PACKAGE

1. Review the submitted MOA package per the MOA package Submittal Requirements on the Hydraulics Unit website.
2. Check for correct file naming convention and structure.
3. Check that all required documents are present and that they appear to be the most current version. (If No Rise, then will need No Rise certification.)
4. Briefly review HEC-RAS model and see if it agrees with the model for the approved BSR/CSR. There should be no differences unless changes were made at the field inspection. The detail of the review for the MOA HEC-RAS model will depend on the changes made at the field inspection.
5. Review the MOA DGN file to ensure that extra information that FMP does not want to see is removed to improve readability.
6. Check that correct method for determining increases and rounding procedures was followed.

PERMIT DRAWINGS

1. Review submitted permit drawings for consistency with the guidance in Appendix P in the 2016 Drainage Guidelines.
2. Ensure that JS lines shown are the L&S line style and not the EAU (NES) line style.
3. Ensure that wetland boundary and grass symbology are shown at appropriate scale.
4. Verify if adequate mechanized clearing is shown beyond the toe of fill for erosion control measures which are generally decided at the field inspection. Limits needed should be documented. For bridge sites, hand clearing (HC) should be shown to the limits of the R/W from approach slab to approach slab unless Division has requested otherwise.

5. Ensure that adequate 'Temporary Impacts in Surface Water' (TS) is shown for culvert installation (refer to culvert construction sequence for limits) and bridge construction if temporary cofferdams, work pads, work bridges will be utilized.
6. Scan summary sheet and sites to ensure that types of impacts are reflected correctly. (If TS is shown in plan view, then it should be shown on the summary sheet.)
7. If within an area of environmental concern (AEC) within a CAMA County, check for appropriate Major Permit (MP) forms and review for completeness.
8. Spot check that rip rap fill impacts are based on actual size of rip rap since rip rap is not always shown to scale on plans.
9. Verify if any areas are illegible and require enlargement
10. Make sure all required sheets are included (profiles for culverts and bridges, XPL for each site if applicable, etc.)

STORMWATER MANAGEMENT PLAN (SMP)

1. Ensure the most recent version of the SMP form is being used.
2. Review SMP to ensure that planning and design minimum measures and BMPs are noted in the narrative. Items in the General Project Narrative should be related to minimization of water quality impacts. It is not intended to be a project description (e.g. X# of bridge spans, etc.)
3. Make sure project description is accurate (e.g. Proposed (New) vs. Existing Built-Upon Area (BUA))
4. If swales are required then scan for highlighted areas on the swale tab that indicate min. and max. values are not met and provide justification in the notes section.
5. Spot check swales listed in SMP are reflective of the plans. Only items specifically called out and detailed as swales on the plans (and required for treatment) should be listed in the SMP as such. Ditches not required for treatment should not be listed as swales in the SMP. However, ditches can be noted in the project narrative as a minimum measure (use of vegetative conveyance).
6. If other BMPs are used (HSB, infiltration basins, level spreader…), ensure that those items are included in the SMP, specifically on the appropriate tabs and generally in the project narrative.
7. Review BMP tabs for highlight "flags" and ensure that explanation for these are provided.
8. If a culvert is proposed in place of an existing bridge, ensure the 'Bridge to Culvert Avoidance and Minimization' tab is fully and accurately filled out.