Project Delivery Network

Structure Hydraulics Design QC Checklist

Version
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QC Manager:
UDOT Central Hydraulics Engineer

Introduction

The Project Delivery Network Structure Hydraulics Design QC Checklist is to be used with the *UDOT QC/QA Procedures*. This checklist is a tool to assist the project team in verifying all work is produced with due diligence, using acceptable industry standard techniques, available resources and data, and reasonable decisions by competent professionals. The checklist is a tool and cannot replace the sound judgment and experience of competent professionals. It is the Design Team's responsibility to verify the quality of project documents **before** distribution.

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QC Documentation

Consistently documenting the QC process is an essential step to the QC procedures. The documentation provides the following benefits:

1. It confirms for project teams that each step in the QC process was completed correctly.
2. It confirms for UDOT that the QC procedures are followed consistently by all project teams.
3. It provides the opportunity for all to find ways of improving the QC/QA procedures.

Documentation has always been used by the project team to perform required quality assurance verification and has been maintained by the design team for reference during construction. It has also served as the way for UDOT to perform project audits to verify the design team followed the required QC/QA procedures. Providing this documentation in ProjectWise increases the opportunities to realize the benefits of QC documentation.

UDOT **requires** the Originator to upload all QC documentation for each deliverable into ProjectWise and attribute it as directed by this QC/QA Design Checklist (see *Recommended QC Documentation Table*). Every deliverable and applicable checklist item must have some form of documentation demonstrating the QC was completed. The QC documentation must be uploaded at or before each milestone review package distribution. The QC process is incomplete until all QC documentation is uploaded and attributed correctly.

The following recommendations are provided for creating QC documentation files:
- Provide all QC documentation required to review the QC process.
- Separate or combine QC documentation into files that are logical for the size and complexity of the project. For example, smaller projects can combine multiple disciplines' plan sheets into one QC file while larger projects should maintain separate files.
- Insert the entire final deliverable copy into the file before the QC check prints.
    > *Example*: M&P deliverable, M&P check prints
- Collate the plan sheets, specifications, and special provisions so that each sheet and spec. has the deliverable and check print redlines together.
    > *Example*: EC-01 deliverable, EC-01 check prints, EC-02 deliverable, EC-02 check prints, etc.

UDOT QC Documentation Recommendations and Instructions

A balance between consistency and flexibility is required to meet the demands of quality control and the variation in project scopes, teams, budgets, and methods. UDOT is not providing a list of requirements for QC documentation to help meet this balance. UDOT is only requiring that the project team provide all QC documentation, upload it to ProjectWise, and attribute it properly.

Recommended QC Documentation and *UDOT QC Instructions* are provided within the checklist to assist project teams, Checkers, and QA reviewers. These recommendations and instructions are given as guidance and are not meant to change the way a project team performs their QC process if the process meets all UDOT requirements. Project teams may adapt the recommendations and instructions as needed or use them to verify their process meets UDOT's requirements. The recommendations and instructions are not and cannot be completely comprehensive so it is necessary for project teams to make some alterations to the recommendations as needed to meet specific project challenges.

The *UDOT QC Instructions* for each checklist item or group of checklist items can be found italicized under the corresponding items followed by the right justified *Recommended QC Documentation.*

Not all checklist items have a recommended QC documentation. The completed checklist serves as the QC documentation for these items. Provide additional documentation when available.

Some checklist items require coordination, acceptance, or approval to be completed. A space has been provided for these items to identify the documentation being provided as evidence of completion.

The **Originator** is responsible to have all their work checked and to provide and upload all documentation. The **Checker** is responsible to complete a thorough check and provide all documentation to the Originator. Complete QC reviews **before** deliverable distribution.

QC Checklist Instructions

It is **required** to complete and upload into ProjectWise all 14 Design QC Checklists unless otherwise noted by the UDOT Project Manager on the Project QC/QA Plan (s*ee the UDOT QC/QA Procedures for the Project QC/QA Plan form and instructions*). The Checker must verify all items in the checklist are complete and correct for each deliverable listed along with any additional items the Checker deems necessary.

- The checklist items are not to be interpreted as the only items that need to be checked.
- The Checker places his or her name in the space provided at the beginning of the checklist. Fill out one checklist and include all names if multiple Checkers are used for the same deliverable. Place the Checker's initials next to each item they checked. Use the text box to the left of the item number provided in the form for the Checkers' initials unless the item is not applicable.
- Check the checkbox next to each item that has been checked. Place an **NA** in the checkbox or the text box provided to the left of each item number if the item is not applicable to the project. **ALL** items must have check mark or NA.
- Provide documentation demonstrating the action occurred for checklist items that recommend **Approval Documentation, Coordination Documentation,** or **Acceptance Documentation**. Documentation may be formal communications, emails, meeting notes, phone conversation logs, or other forms that document communication process. Place the file name in the space provided and follow the attributing convention in the Recommended QC Documentation Table.
- Provided at the end of each checklist is an Estimate Review Checklist. Complete and submit this checklist when checking the estimate as well as completing any checkboxes found on the activity checklist.
- A comments sheet is provided at the end of each discipline's checklist for the Originator and Checker to make comments, notes, and clarifications. Only one comment sheet is provided to minimize space and printing when printing the entire checklist. Use this sheet to document and consolidate the QC check comments.
- Each discipline checklist is separated into activity checklists. Complete the activity checklists necessary for the phase of the project. The Recommended QC Documentation table recommends uploading each activity checklist as a separate file. The checklists may be combined, but each

checklist must be included in the file name and attributed properly (example: QC_4U1_4U3_Checklist_*ddmmyy*).

- Every checklist item in each section of all required Design QC Checklists (see the Project QC/QA Plan) must be completed. It is unacceptable to address an entire section with a blanket statement or a continuous line through all boxes. Each item must have "NA" next to it even if an entire activity or section is not applicable.
- Previously completed checklists may need to be completed again if, after a milestone, changes were made to elements checked on the previous checklist. Complete the necessary checklist items associated with the changed element and mark "NA" on all other items. Combine these checklists with the existing phase checklist into one file (example: QC_4R1_3R1_Checklist_*ddmmyy*).
- Do not recheck items that have been QC checked previously and have not changed or are not affected by a change.

The Originator is required to upload the completed checklist into ProjectWise and attribute it correctly (*see Recommended QC Documentation Table*) once all items are checked and verified. Properly attributed documents can be verified by checking the QC Saved Search folders in ProjectWise.

The following explanations are to aid in completing the QC checklist items:

- A checklist item deemed "complete," "correct," or "accurate" does not denote that the item is perfect, but rather that the item satisfies design criteria based on known information, acceptable techniques, and sound judgment."
- A checklist item deemed "addressed" denotes the item as "reviewed all known concerns and verified the concerns are appropriately mitigated and satisfy design criteria." Addressed concerns are not necessarily incorporated into the design, but satisfactorily mitigated.
- A checklist item deemed "identified" denotes the item as "an acceptable and economical approach to satisfy design criteria based on known information."
- A checklist item deemed "verified" denotes the item as "verified the approach/conclusion as acceptable based on known information."

QC Documentation ProjectWise/Attributing Instructions

ALL QC documentation must be uploaded into ProjectWise and attributed correctly. Please see [UDOT ProjectWise Online Training](#) for more information on ProjectWise and attributing documents.

There are three potential attributing scenarios for all QC documentation in ProjectWise:

1. Not in ProjectWise initially (e.g. scanned documents that will be uploaded/attributed)
2. Already in ProjectWise but either not attributed or attributed incorrectly
3. Already in ProjectWise and correctly attributed for another reason but also in need of a supplemental attribute specifically for QC

No matter how the required documents initially exist, all must be attributed for QC as directed below or the QC documentation is not considered complete as required

It is *required* to properly attribute **ALL** QC documentation. To assist project teams properly name and attribute each document, the following table *Recommended QC Documentation* provides naming and attributing conventions for all recommended QC documentation. These naming and attributing conventions can be adapted for use with all additional documentation or altered for combining documents. Name a file logically with all elements included in the file and follow the naming and attributing convention if altering or combining files. Remember, the goal of naming and attributing is to make the document searchable by someone not intimately associated with the project.

Recommended QC Documentaion

Recommended Documentation	Naming Convention	Document Type Filter	Document Type	Document Subtype	Document Phase**
Prelimary Structure Hydraulics Design Redlines	*PIN* _QC_StrHydro_PrelimDesign_*mmddyy*	Struct Hydro	QC/QA +	Design	GR
Draft Structure Hydraulics Report Redlines	*PIN* _QC_StrHydro_DraftReport_*mmddyy*	Struct Hydro	QC/QA +	Project Documents	GR
Geometry Review Engineer's Estimate Redlines*	*PIN* _QC_Engineer's_Estimate_GR_*mmddyy*	Roadway Design	QC/QA +	Engineer's Estimate	GR
Checklist 2H1	*PIN*_QC_2H1_Checklist_*mmddyy*	Struct Hydro	QC/QA +	QC Checklist	GR
Plan-in-Hand Comment Resolution Form*	*PIN* _CRF_PIH_*mmddyy*	Roadway Design	QC/QA +	Comment Resolution	PS&E
Structure Hydraulic Design Redlines	*PIN*_QC_StrHydro_Design_*mmddyy*	Struct Hydro	QC/QA +	Design	PS&E
Structure Hydraulics Report Redlines	*PIN*_QC_StrHydro_Report_*mmddyy*	Struct Hydro	QC/QA +	Project Documents	PS&E
PS&E Engineer's Estimate Redlines*	*PIN* _QC_Engineer's_Estimate_PSE_*mmddyy*	Roadway Design	QC/QA +	Engineer's Estimate	PS&E
Checklist 4H1	*PIN*_QC_4H1_Checklist_*mmddyy*	Struct Hydro	QC/QA +	QC Checklist	PS&E

*Files typically combined with other disciplines into one documentation file. Coordinate with the other disciplines that will provide these documents and the Design Leader. If not combined into one project QC file, provide appropriate file name identifiers and attributing.

** Use *Pin _QC_SpecNo_SpecName_mmddyy* when separating spec files; maintain correct attributing.

UDOT Project Delivery Network
Structure Hydraulics QC Checklist

Recommended QC Documentation List
QA Verification Documentation

2H1 Develop Initial Structure Hydraulics (For Major Structures)

Develop preliminary structure hydraulics.

References

1. [Drainage Manual of Instruction](#)
2. [UDOT Project Delivery Network](#)
3. [UDOT QC/QA Procedures](#)
4. [Estimate Review Checklist](#)
5. [UDOT Practical Design Guide](#)

Draft Structure Hydraulics Report

Checker: _____

Date Completed: _____ **PIN:** _____

1. ☐ The preliminary hydraulic analysis conclusion meets drainage design criteria, design standards, and project requirements.

    a. ☐ Hydrologic methodology is appropriate.

    b. ☐ Initial structures geometry was accurately evaluated.

    c. ☐ The preliminary bridge type and span was evaluated.

    d. ☐ Existing scour history was accurately evaluated.

    e. ☐ FEMA Flood Mapping is included.

    f. ☐ Debris flow was considered.

Check the design following UDOT QC/QA Procedures Section 3 including design calculations and computer input. The design check may be completed on plan sheets or other method which demonstrating the QC check of the design.

<div align="center">

Recommended QC Documentation: Preliminary Structure Hydraulic Design Redlines

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2. ☐ The draft Structure Hydraulics Report contains all necessary information, including the following:

    a. ☐ Preliminary hydraulic section

    b. ☐ Preliminary scour depth

    c. ☐ Preliminary water surface elevations

    d. ☐ Preliminary velocities

    e. ☐ Preliminary low chord

Check the report following the UDOT QC/QA Procedures Section 3.4.

<div align="center">

Recommended QC Documentation: Draft Structure Hydraulics Report Redlines

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Preliminary Structure Hydraulics Cost Estimate

Checker: _____

Date Completed: _____ **PIN:** _____

1. ☐ The cost estimate was verified using the Estimate Review Checklist (found at the end of this document).

See the [Estimate Review Checklist](#) for recommended QC documentation and instructions.

Recommended QC Documentation: Geometry Review Engineer's Estimate Redlines

4H1 Complete Structure Hydraulic Design

Complete structure hydraulics design and report.

References

1. [Drainage Manual of Instruction](#)
2. [UDOT Project Delivery Network](#)
3. [UDOT QC/QA Procedures](#)
4. [Estimate Review Checklist](#)
5. [UDOT Practical Design Guide](#)

Structure Hydraulic Report

Checker: _____

Date Completed: _____ **PIN:** _____

1. ☐ All review comments are addressed and the comment resolutions sent to the Design Leader.

Verify all discipline related comments are addressed and all actions are implemented. Verify all comments not retired in previous stages are transferred to the current CRF. See the UDOT QC/QA Procedures section 6.0 for more information.

Recommended QC Documentation: Plan-In-Hand Comment Resolution Form (PIH-CRF)

2. ☐ All revisions meet design and project requirements.

3. ☐ Structures hydraulic design meets design and project requirements.

   a. ☐ Recurrence interval breakout includes the Q_{design}, Q_{100} and Q_{500} analysis flows

   b. ☐ Design storm frequency per table 3.1 is analyzed correctly (D-MOI)

   c. ☐ The preliminary channel analysis was conducted using existing and proposed bridge/culvert geometry $Q_{existing}$, Q_{design}, Q_{100}, and Q_{500}

   d. ☐ Adequate freeboard (≥ 2 feet) is provided for debris passage

   e. ☐ Appropriate analysis of the backwater for increase and/or damage for existing and proposed conditions

   f. ☐ The design does not increase FEMA flood elevation

   g. ☐ Non-FEMA locations do not increase the backwater elevation by more than 1'

   h. ☐ The hydraulic profile is deemed suitable by both the hydraulics and structures design teams

4. ☐ Scour protection/remediation measures meet design and project requirements.

   a. ☐ Foundation depth reflects total scour depth for Q_{100}

   b. ☐ Bank scour mitigation measures

   c. ☐ Final design was reviewed by using the 500 year check flood to determine the bridge stability

   d. ☐ Stream alterations/restorations

4H1 Continued

Check the design following UDOT QC/QA Procedures Section 3, including design calculations and computer input. The design check may be completed on plan sheets or other format.

Recommended QC Documentation: Structure Hydraulic Design Redlines

5. ☐ The Structure Hydraulics Report contains all required information and is ready for distribution.

Print and review the report following UDOT QC/QA Procedures Section 3.4.

Recommended QC Documentation: Structure Hydraulic Report Redlines

Structure Hydraulics Cost Estimate

Checker:_____

Date Completed: _____ **PIN:** _____

1. ☐ The cost estimate was verified using the Estimate Review Checklist (found at the end of this document).

See the [Estimate Review Checklist](#) for recommended QC documentation and instructions.

Recommended QC Documentation: PS&E Engineer's Estimate Redlines

Estimate Review Checklist

Provide review checklist of all design cost estimates.

References

1. [Estimating – Roadway Design Manual of Instruction](#) (Section 7.19)
2. [Estimator's Corner Website](#)
3. [UDOT Project Delivery Network](#)
4. Project Development Business System

Estimate (applies to every stage for updating the estimate)

Checker:

Date Completed: _____ **PIN:** _____

1. ☐ All required bid items are included.
2. ☐ All quantities and units are correct.
3. ☐ All standard bid items match UDOT standard bid items exactly.
4. ☐ Unit prices were estimated using UDOT approved methods (PDBS, local contractors, etc.).
5. ☐ All unit price estimates are documented.
6. ☐ Unit prices reflect the following: (1)

a. ☐ Location	e. ☐ Limitations of operation	i. ☐ Specialty equipment
b. ☐ Inflation	f. ☐ Current bidding environment	j. ☐ Risk to contractor
c. ☐ Quantity of item	g. ☐ Familiarity of a process	k. ☐ Availability of materials
d. ☐ Construction Complexity	h. ☐ Time of year for advertising	l. ☐ Construction schedule

7. ☐ Lump sum bid prices are used only when appropriate (i.e. unit pricing is too difficult).
8. ☐ All lump sum bid prices considered the following:

   a. ☐ Contractor risk due to unknown quantity

   b. ☐ Difficulty in making it a unit price pay item

Additional PS&E Estimate

9. ☐ All bid items, quantities, and units match the plan sheet callouts, summary sheets, and M&P exactly.

Check the engineer's estimate following the UDOT QC/QA Procedures Section 3.4. The way the engineer's estimate is QC checked may vary depending upon the project scope and project team. Provide documentation demonstrating that every item and all quantities in the engineer's estimate were QC checked. Provide spreadsheets, hand calculations, notes, etc. as necessary to explain methods, assumptions, etc. It is recommended that all engineer's estimate redlines for each project phase be given to the Design Leader and uploaded together.

Recommended QC Documentation: Engineer's Estimate Redlines

QC Check Comments

Provide comments, methods, assumptions, explanations, file locations, and any other information needed to facilitate the QC check. Print and attach this sheet to the checklist. Upload this sheet with the associated checklist.

PIN: _____ Activity: _____ Deliverable(s): _____

Originator: _____

Checker: _____

Additional Commenter(s): _____