



## NORTH CAROLINA

Department of Transportation

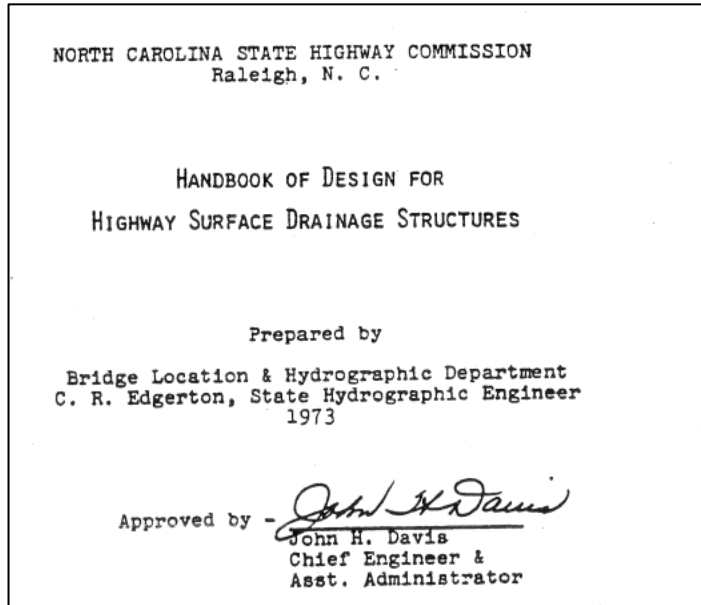


# Lessons Learned Updating the Hydraulics Guidelines

Brian Radakovic, PE, CFM

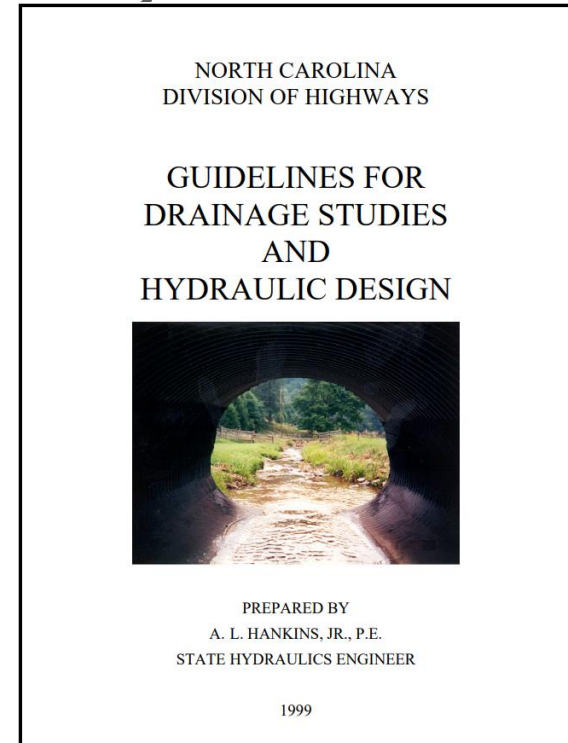
April 26, 2022

# Ancient History



1973

Handbook of Design  
for Highway Surface  
Drainage Structures



1999

Guidelines for  
Drainage Studies and  
Hydraulic Design

# Motivation to Update

In 2009, FHWA reviewed the Hydraulics Program.

- Overall, the review team was impressed with the Unit and its role within NCDOT.



**Process Review of the Hydraulics Program of the  
North Carolina Department of Transportation**

January 27 – 29, 2009

By

**Federal Highway Administration**

and

**North Carolina Department of Transportation**

# FHWA Suggestion

the Review Team also recognized a possible areas for improvement with the Hydraulics Manual.



- Portions of the 1999 manual were outdated and didn't reflect the current standards and practices within NCDOT nor FHWA.
- The online and printed versions were not consistently maintained.

# First Modern Update

In 2011 we started a 2-year process to update the 1999 guidelines.

## GOALS

- Review and update all hydrologic and hydraulic policies and procedures, currently written or unwritten
- Include the floodplain and environmental aspects of hydraulic design.





**Five years later ...**

# 2016 Update

Why did it take 5 years

- Limited personnel
- No schedule
- No set process to incorporate new and updated information

NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

## **GUIDELINES FOR DRAINAGE STUDIES AND HYDRAULIC DESIGN**



DAVID S. CHANG, Ph.D., P.E.  
STATE HYDRAULICS ENGINEER

NOVEMBER 21, 2016



# Commitments

NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

**GUIDELINES FOR  
DRAINAGE STUDIES  
AND  
HYDRAULIC DESIGN**



DAVID S. CHANG, Ph.D., P.E.  
STATE HYDRAULICS ENGINEER

NOVEMBER 21, 2016

Update on a 5-year cycle

No actual changes will be made to the electronic version until a new edition is published



# Travel to 2018-2019



**INTEGRATED  
PROJECT  
DELIVERY (IPD)**

# Preparing for Next Update

## Wants

- Review and update our guidance in support of the **Integrated Project Delivery (IPD)** initiative.
- Integrate policy and procedural changes
- Address comments collected over the past three years.
- Develop additional guidance needs



- How do we address Integrated Project Delivery (IPD)?
- What new guidance is need or wanted?
- How do we eliminate memos and additional documents between updates which may contradict the published Guidelines?
- How can we complete this effort efficiently?

# Answer

## STIC Incentive Program

Develop a detailed “roadmap” for comprehensive update of the collective Hydraulics Unit’s library of documents, and to make recommendation to transition the library to more of a “living document” format subject to a cycle of continuous improvement.





# Strategic Guideline Update Plan (SGUP)

## Major Objectives

- identifying any policies and procedures which are inconsistent with IPD workflows
- update guidance to reflect the state-of-the-practice
- address any needed corrections or inadequacies with the current guidance.
- Develop a procedure to make the guidance a “living document”

# Identify and Prioritize Updates

- Internal Review of Existing Guidance as it relates to the IPD, focusing on how the Guidelines tie into the overall Project Delivery Network (PDN)



- 3D Series Hydraulic Summary Plan Sheets
- Coastal Guidelines
- Drainage Summary Sheets
- BMP Support Matrix and Summary Table
- Hydraulic Planning Report Template and Guidance
- Guidance to Workflow for 15A-NCAC-04B.0109 Rule
- Concurrence Point (2A/4B) Meeting Guidance

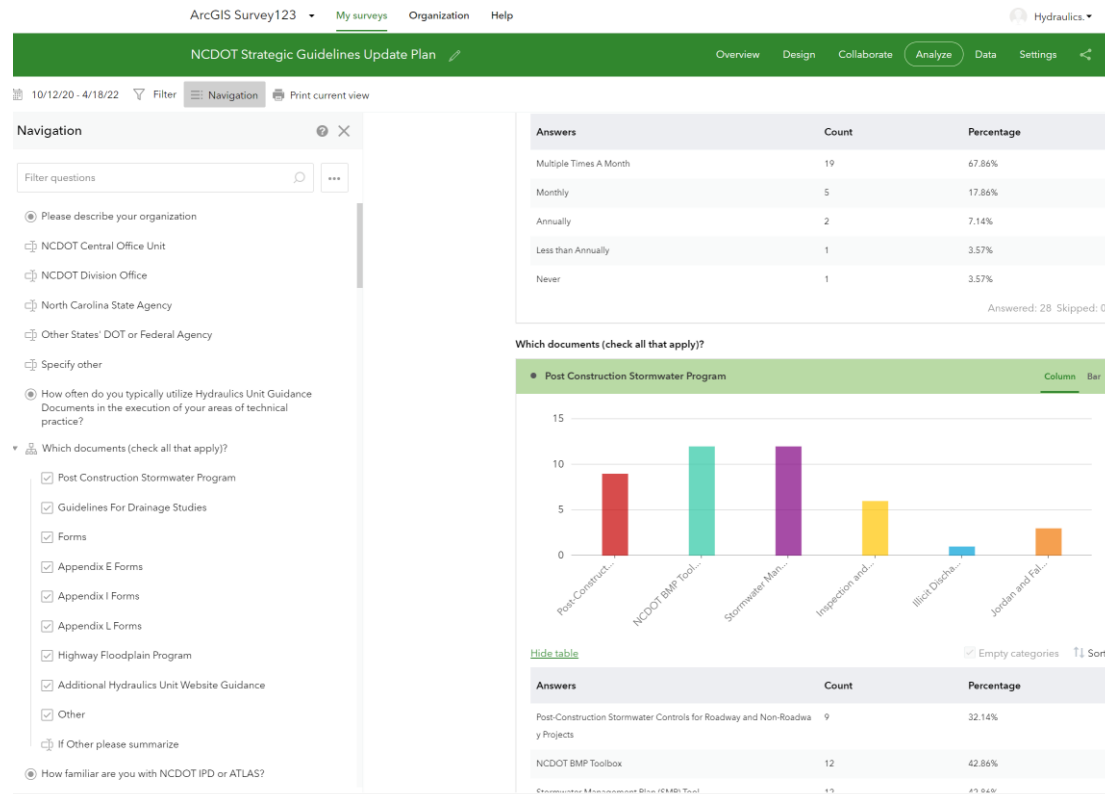
# Identify and Prioritize Updates

- Comments and questions collected since 2016

AutoSave On						20191216 POST-PUBLICATION 2016 GUIDELINES COMMENTS LOG.xlsx		Search (Alt+Q)	
File Home BR_Tools Insert Page Layout Formulas Data Review View Developer Help BLUEBEAM ProjectWise Acrobat Power Pivot									
E2									
Change "consistent depth" to "constant depth" in 16th bullet under STRUCTURE									
A	B	C	D	E			F		
DATE	Person	Chapter	Section	Comment or Question addressed or to be addressed [highlighted - orange: address in errata; yellow: needs further evaluation]			REMARKS/FOLLOW-UP		
11/28/2016	RDL	APPX	D-2	Change "consistent depth" to "constant depth" in 16th bullet under STRUCTURE					
11/30/2016	JLM	APPX	C	Chart 200.2 Q2 factor should be 0.76, not 0.75. [I disagree - can show how factors were derived from studies done.]					
11/30/2016	PA	10	10.3	Interpretation regarding spread criteria for 1' median gutter, etc. [See email correspondence.]					
12/1/2016	PAJ	APPX	E-1	Item 51 - Normal WSEL; doesn't like "If unavailable, report WSEL on date of survey" (Also Item 48 in CSR key)					
12/1/2016	PA	8	8.5	4th bullet - change "intermittent sections" to "intermediate sections"					
12/1/2016	KA[AMEC]	15	15.1	Stated John Dorman may object to "except for CMSWS" clause re: authority to issue FIRMs statewide, yet technically OK as stated.			Don't put this on website.		
12/1/2016	SRM	APPX	H	Duplicated pages from NEH noted in Item 3 pages 5-8 duplicates of pages 1-4					
12/1/2016	MIY	APPX	D-1	Does not address temporary detours preliminary hydraulics recommendations. [Should update form at some point and put on website. As interim guidance, can specify in notes section (or additional sheet if need more space). Also noted temp. detour recommendation listed in Appendix D, Item 3, in 7th bullet under 4.FIELD NOTES DELIVERABLES.]					
12/1/2016	SRM	APPX	Gen.	General comment: appears some appendices links broken [ Appx G and D-2 known at this time - any others? Can fix on web.]			Will be fixed on PDF on website when errata issued.		
12/1/2016	BZ	15	15.9	[NOT CHANGE TO G/L] Change NO-RISE CERTIFICATION FORM to just say "no rise" to be consistent with new Guidelines			I think BMR revised the form accordingly. Verify.		
12/6/2016	REL	2	2.4.5	Suggested incorporating notes from DRH re protocol for dealing with property owner for obstruction of pipe outlet off ROW.			Sent draft protocol to JWT to review on 12/13/16. No response		
12/7/2016	STB(SCDOT)	8	8.6	See email correspondence (2 emails) - several general questions about our approach to scour.			Partial response sent 12/7/16; will follow up more as time per		
12/8/2016	JWT	10	10.3	Is 4 in/hr intensity correct for sag inlets without relief?			Sent email to JWT 12/8/16 recommending change to actual int been additional discussions lately regarding sags w/o relief. TI (Guidelines are correct as is). The thinking is that the slot behi more than adequately compensate in the sag during a 50 yr. s		
12/12/2016	WSZ	7	7.4.2.3	Asked for clarification - appears states can use SIR 5030, WRI 96-4084 or FS 007-00 - not explicit latter 2 only in Region 2					
12/12/2016	SRM	15	15.6	Suggestion to have an Appendix item added - Checklist to cover the points listed here and check off or mark as N/A. Also could add section for comments, special provisions, etc.					
1/3/2017	BMR	APPX	E-3	Add units of "ft" to datum specification			I think BMR revised the form accordingly. Verify. [JMS 3/8/17 sure why this comment was made.]		
1/3/2017	MIY	10	10.4	Term "storm drain pipes" also used for Side Drains in Appx H Item 1 - specifies typ use Concrete - may be helpful to clarify concrete preferred unless justification for alternate pipe provided.			Per BZ, some (not all) Divisions prefer concrete only under cur universal consensus as to exactly what "clarification" should b errata for clarification.		
1/4/2017	MTS	APPX	E-1	Item 10 - Clarification: Although states "out-to-out" width no longer need be specified here, should specify it in typical bridge section inside because it is something that NCFMP reviewers are looking for.					
1/5/2017	AHM	APPX	O	Noted confusion of wording in Appx O - not clear if the "intake" or the "classification" [limit] controls the location of the HSB.			See 3/8/17 email corresp w/ AHM & RMM re discrep betw DW further whether HSP would prefer to address in errata possibl some discussion is underway in HSP to consider eliminating / away with) Hazardous Spill Basins. Need to follow up with A Consider for later version update.		
1/13/2017	BZ	TOC		Recommends including Appendices in TOC.					
1/24/2017	RDL	10	10.3	I would like to see a maximum bypass flow for an inlet on a curb and gutter system (or TB-2GI's along a concrete barrier wall, etc). We have 0.1 cfs specified for superelevation rollover - I suggest a design maximum (to be determined) for the low end of C&G systems.					
1/26/2017	PA	10	10.3	See email correspondence - questions about spread at turn lane and whether allowable spread width is same for sag with or without relief, only difference being the return period.					
1/27/2017	DCD(SDE)	10	10.3	In Table 10-1, noted "no such thing" as "Design Speed" of 45mph (no DS ends in "5")			Found AASHTO refs showing 45mph design speed.		

# Identify and Prioritize Updates

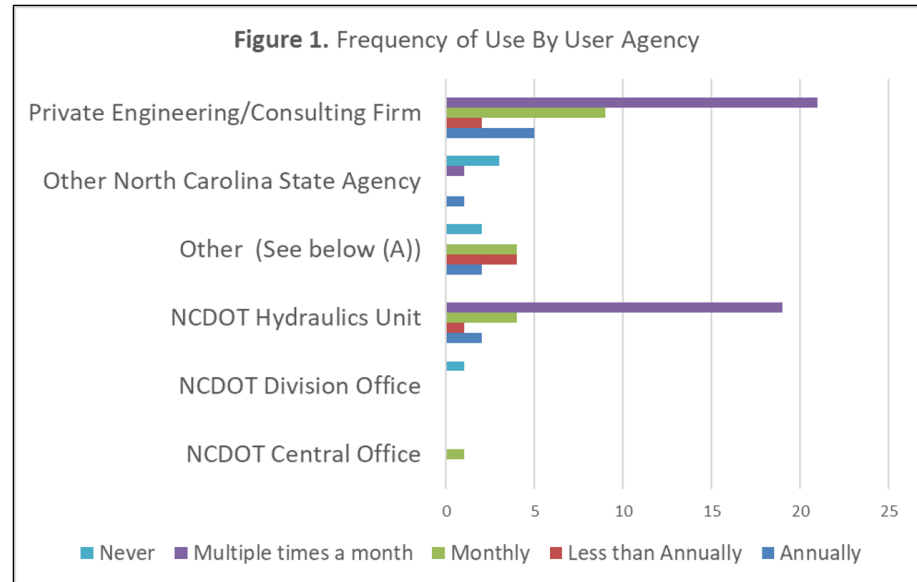
- Detailed Survey to Identify Critical Gaps and Needs in the Existing Guidance





# Survey

- 82 Responses
  - 28 NCDOT Staff
  - 54 External Sources



- Survey questions were tailored to a respondent's familiarity with a specific Guidance topic
  - Guidelines for Drainage Studies and Hydraulic Design, 2016
  - Post Construction Stormwater Program Guidance (PCSP)
  - Highway Floodplain Program (HFP)

# Critical Gaps Identified in Survey

Figure 6. GDS Updates Identified

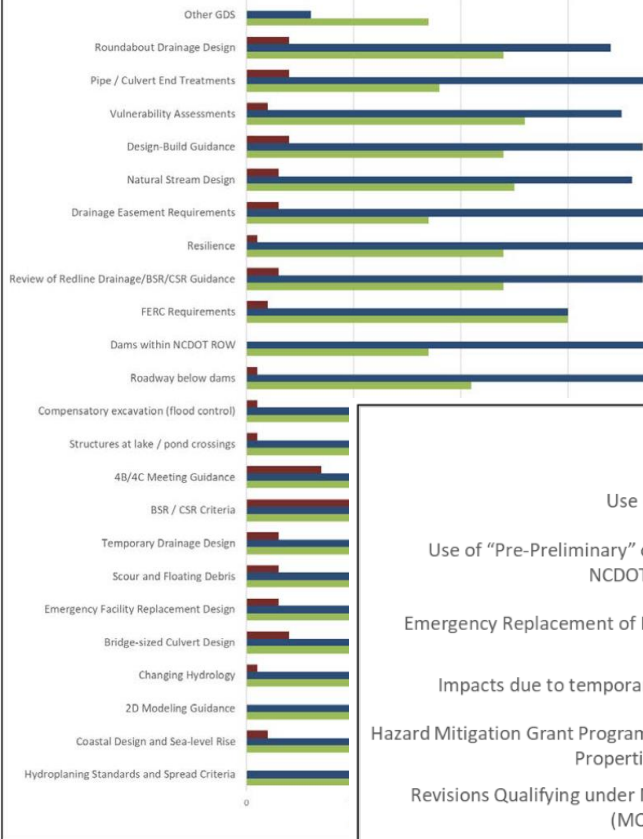


Figure 5. PCSP Updates Identified

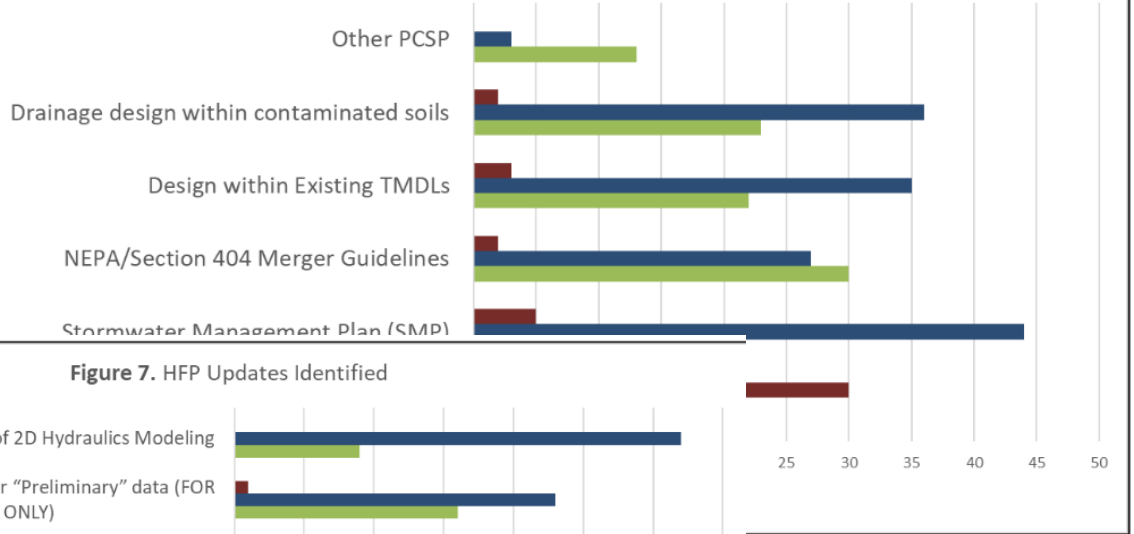
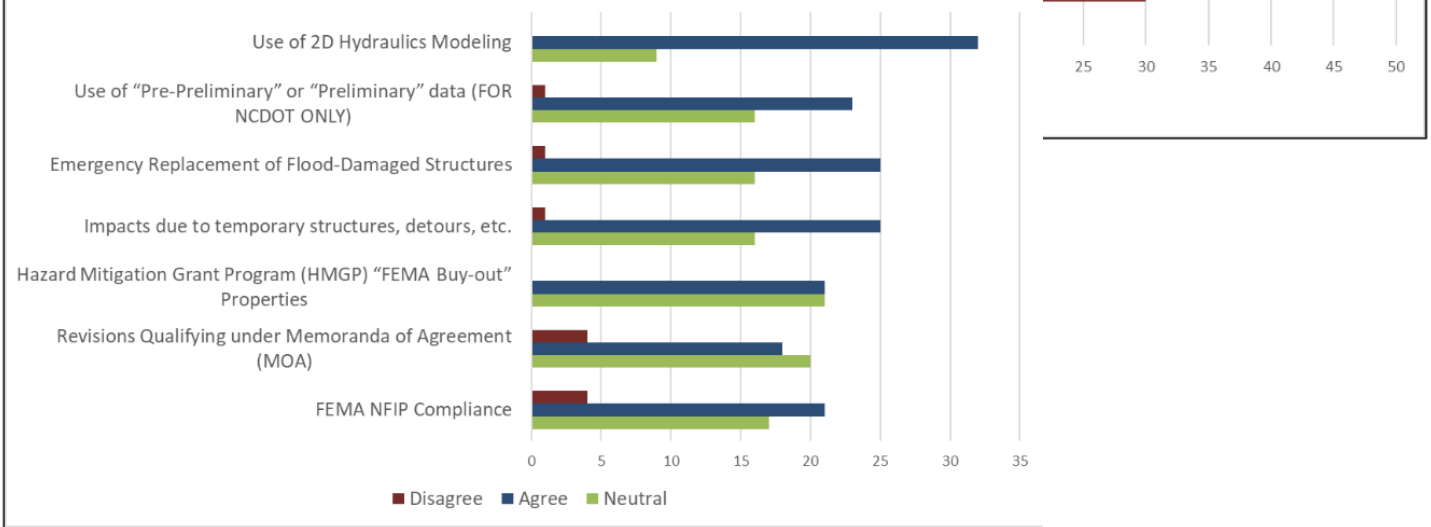


Figure 7. HFP Updates Identified



# Critical Gaps Identified in Survey

- Hydroplaning
- Coastal Design
- Risk Analysis / Performance-Based Standards
- Outlet Analysis Guidance and Downstream Impacts
- Pipe Liners
- Property Owners Obstructing Outlets that Impact NCDOT Right-of-Way (ROW)
- 2D Modeling
- Climate Change
- Pipe End Treatments
- Fish / Aquatic Organism Passage
- Spread Criteria
- Lakes / Dams / Impoundments
- Roundabout Drainage
- Nature-Based Design / Green Infrastructure / Low Impact Design

# Long List of Improvements

- Hydroplaning
- Coastal Design
- Risk Analysis / Performance-Based Standards
- Outlet Analysis Guidance and Downstream Impacts
- Pipe Liners
- Property Owners Obstructing Outlets that Impact NCDOT Right-of-Way (ROW)
- 2D Modeling
- Climate Change
- Pipe End Treatments
- Fish / Aquatic Organism Passage
- Spread Criteria
- Lakes / Dams / Impoundments
- Roundabout Drainage
- Nature-Based Design / Green Infrastructure / Low Impact Design
- Definition of Major Structures
- Drainage Summary Sheet
- BMP Support Matrix
- New MOA Guidance
- Updates to Permit Drawings
- BSR / CSR Format Revisions
- Hydraulic Planning Report
- Sample Scope of Work for General Hydraulics Projects
- Use of Stochastic Empirical Loading and Dilution Model (SELDM)
- Pipe Selection Criteria
- Scour Monitoring Update
- Traffic Bearing Grates (Steel vs Iron)
- Appendices Tables
- Conceptual Design Cost Estimates
- Floodplain Bench Modeling
- Gage Relocation
- Culvert Backfill
- **and more.....**



# Prioritization

Prioritized improvements to next updated based on:

- Importance indicated in survey results
- Project Delivery Network (PDN)
- HFP and HSP updates
- The Unit Head's preference

# Implementing the SGUP or “the light update”

- Created a SharePoint Site to collaborate and track update tasks

The screenshot shows a SharePoint site interface. At the top left is the site logo and title: "Hydraulic Documents: Development and Maintenance" with a "Private group" label. On the right, there is a star icon and a user count of "42". Below the header is a navigation bar with options: "+ New", "Send to", "Promote", "Page details", and "Analytics". The main content area features a large orange banner image with the title "Hydraulics Guidelines 2022 Sandbox". Below the banner are three buttons: "2021 Guidelines Sandbox Documents", "Published Chapters", and "Complete 2021 Guidelines Update Status List". At the bottom, there is a social interaction bar with "Like", "Comment", "1011 Views", and "Save for later" options. Below that is a "Comments" section with a text input field and a "Post" button.

# Update Status List

## 2021 Guidelines Update ☆














Attachm... ▾	Name ▾	Hydro Project Manager ▾	Guidance to be Incorporated into Guidelines ▾	Draft Guidance Status ▾
	Soil Material ID Guidance - 15A NCAC 04B .0109	Andy McDaniel	Yes	Completed
	Guidance for Completing 3D Series Hydraulic Summary Plan Sheets	Brian Lipscomb	Yes	Completed
	Hydraulic Predesign Meeting Guidance	Brook Anderson	Yes	Completed

IN Review ▾	Hydraulic Management Review ▾	Integrated into Sandbox Guidelines ▾	Descriptions ▾
✓	✓	Yes	Includes explanation of the rule; resources for determining soil conditions; general instructions for completing the workflow
✓	✓	Yes	Includes instructions for how to fill out the two summary sheets, proper formats, sheet numbering, and submittal instructions. This guidance will be provided to/coordinated with Roadway

Remarks ▾	PDN v.2 Critical ▾	PEF Support Needed ▾
7/6 - archived on IPD site and moved to Hydro Management review site	✓	✓
	✓	
Hydro staff and HNTB have reviewed. The guidance is ready for Management Review.		
Management Review Meeting on 10/20. Management agrees with		

# Sandbox Library

- Draft Chapters

GuidanceSandbox 					
 Name 	Modified By 	Modified 	Status 	Notes 	
 Chapter 4.docx	Leah Young	January 17	<span>Published</span>	PA, Brook, & Matt have finished revising the chapter guidance and are ready for SRM to sign off. LMY - Comments addressed; moved to Published	
 Chapter 4 draft final 2-1-22.docx	Leah Young	February 3	<span>Published</span>		
 Chapter 3.docx	Leah Young	January 21	<span>Published</span>	LMY - HPR SOW, FSM Discussion and links added. PA reviewed. SRM- incorporate all comments and ready to publish	
 Chapter 2.docx	Leah Young	January 28	<span>Published</span>	SRM- note one minor citation comment, otherwise ready for publishing	
 Chapter 17.docx	Leah Young	January 3	<span>Draft</span>	LMY - Reserved for future updates	
 Chapter 16.docx	Leah Young	January 19	<span>Published</span>	PA reviewed. SRM- note the proposed text changes will need to be incorporated before publishing LMY - Edits made	



# Sandbox Library

## Document Status

Draft

Ready for KCI to Format

Ready for Final review

Ready for S. Morgan Sign Off

SRM OKs

Published












## Version History

Version history

Delete All Versions

No. ↓	Modified	Modified By	Size	Comments
72.0	1/21/2022 5:35 PM	<input type="checkbox"/> Leah Young	2.5 MB	
	Status	Published		
71.0	1/21/2022 5:35 PM	<input type="checkbox"/> Leah Young	2.5 MB	
70.0	1/20/2022 9:15 PM	<input type="checkbox"/> Morgan, Stephen R	2.4 MB	
	Notes	LMY - HPR SOW, FSM Discussion and links added. PA reviewed. SRM- incorporate all comments and ready to publish		
69.0	1/20/2022 9:14 PM	<input type="checkbox"/> Morgan, Stephen R	2.4 MB	
	Status	SRM OKs		
68.0	1/20/2022 2:13 PM	<input type="checkbox"/> McDaniel, Andrew H.	2.4 MB	
67.0	1/10/2022 2:30 PM	<input type="checkbox"/> York, Matthew J	2.4 MB	
66.0	1/10/2022 2:18 PM	<input type="checkbox"/> York, Matthew J	2.4 MB	
65.0	1/10/2022 1:59 PM	<input type="checkbox"/> York, Matthew J	2.3 MB	
64.0	1/7/2022 4:05 PM	<input type="checkbox"/> Atkinson, Paul	2.4 MB	
	Notes	LMY - HPR SOW, FSM Discussion and links added. PA reviewed.		
63.0	1/7/2022 3:28 PM	<input type="checkbox"/> York, Matthew J	2.3 MB	
62.0	1/7/2022 3:17 PM	<input type="checkbox"/> Atkinson, Paul	2.4 MB	
61.0	1/7/2022 3:07 PM	<input type="checkbox"/> Atkinson, Paul	2.4 MB	

# Published Library

Name	Chapter	Date Published	Modified	Modified By	Notes	Working Copy
 Chapter6-Resilience.pdf	Chapter 06	2/13/2022	February 17	Leah M. Young		
 Chapter7-Hydrology.pdf	Chapter 07	2/14/2022	February 17	Leah M. Young		
 Chapter8-Bridges.pdf	Chapter 08	2/16/2022	February 17	Leah M. Young		
 Chapter9-Culverts.pdf	Chapter 09	2/16/2022	February 17	Leah M. Young		
 Checklist for Drainage Study and Hydraulic ...	Chapter 05	1/1/2022	December 17, 2021	Leah Young	Not revised from previous version	Working Copy
 ChecklistforDrainageStudyandHydraulicDes...	Chapter 05	1/1/2022	December 17, 2021	Leah Young	Not modified from pervious version	
 CSR_Guide.pdf	Chapter 09	2/22/2022	February 21	Radakovic, Brian M		
 DrainageDesignFieldInvestigationChecklist...	Chapter 05 Chapter 04	2/10/2022	February 13	Leah M. Young	Referenced in Chapter 5 - Should this be combined with Preliminary Hydraulic Field Visit Checklist in Chapter 3? SRM- yes. I updated language accordingly in Chapter 3. Also keep in Chapter 5.	
 DSR_Guide.pdf	Chapter 08	2/22/2022	February 21	Radakovic, Brian M		
 ExampleNCDOTHydroplaningAssessment.xlsx	Chapter 04	2/3/2022	February 16	York, Matthew J		
 GroutingHostSpecialProvision.pdf	Chapter 09	1/1/2022	December 17, 2021	Leah Young	No revisions made from previous version	
 Guidance for CP2A.docx	Chapter 03	1/3/2022	January 3	Leah Young	SRM- note this may be published without additional formatting if necessary.	Working Copy
 Guidance for CP4B.docx	Chapter 04	1/3/2022	January 3	Leah Young	4B guidance from Hydro Connect page, planned	Working Copy

# Draft to Published

Workflow for Updating Guideline Chapters and Content (in general)

<https://ncconnect.sharepoint.com/sites/HydraulicsProductsDevMaint/GuidenceSandbox/Forms/AllItems.aspx>

1. While content updates are being made the chapter is marked as **Draft**



2. Once all the content changes have been made the status is changed to **KCI Ready to Format**. KCI will update the format, references, errata, ~~ect...~~

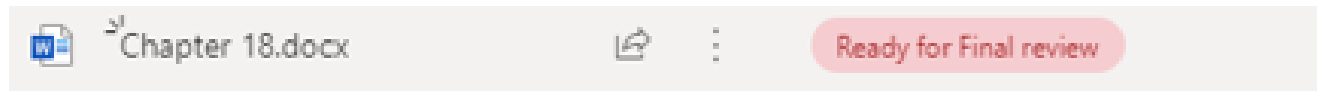


3. Once formatted KCI will change status to **Ready for S. Morgan Sign Off**. At this time Stephen adjust the content as needed or provide KCI comments to change items. Once Stephen has completed his review, KCI will incorporate any changes or comments making sure they follow the correct formatting.



# Draft to Published

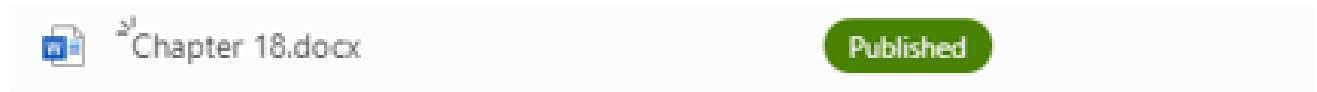
4. Once the changes from step 3 have been completed the status is set to **Ready for Final Review**. At the time the content writers and Stephen can view the document one last time.



5. Stephen then informs KCI that the Chapter ready to be published. Status is set to **SRM OKs**



6. KCI creates a published version of the [Chapter](#) and the status is set to **Published**



7. KCI Saves the Published content to the sandbox site [here](#)
8. Once all the published chapters and content have been completed the files will be copied to the new Hydraulics Guidelines Connect page for everyone to access.

# Published

## Drainage Studies Guidelines

Guidance in the methods, procedures, policies, and criteria for Drainage Studies and Hydraulic Design.

🏠 ▶ Connect NCDOT ▶ Resources ▶ Hydraulics ▶ Drainage Studies Guidelines

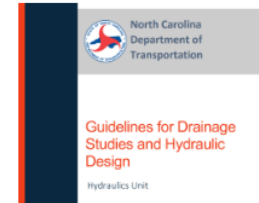
### About the Guidelines

Guidelines for Drainage Studies and Hydraulic Design provides guidance in the methods, procedures, policies, and criteria that must be followed, and the information that is to be developed during a drainage study and hydraulic design. It is not intended to be an all-inclusive document on the practice of hydraulic engineering, and the designer must reference other materials and use good judgment in its application to ensure that the design is complete and appropriate for the site. The Guidelines are intended to be dynamic & continually improved upon and updated to ensure alignment with the PDN. As such, the Hydraulics Unit encourages suggestions and comments from users to improve the Guidelines by submitting comments and suggestions using CLEAR.

### Drainage Studies Guidelines Chapters

Name	Date Updated
▶ Chapter : Chapter 00: Title page and Foreword (1)	
▶ Chapter : Chapter 01: Introduction (1)	
▶ Chapter : Chapter 02: Legal Aspects (2)	
▶ Chapter : Chapter 03: Preliminary Hydraulic Studies (3)	
▶ Chapter : Chapter 04: Preliminary Roadway Plans (6)	
▶ Chapter : Chapter 05: Drainage Plans Development (2)	
▶ Chapter : Chapter 06: Resilience (1)	
▶ Chapter : Chapter 07: Hydrology (1)	
▶ Chapter : Chapter 08: Bridges (4)	
Chapter&Bridges	2/22/2022
BSR_Guide	2/22/2022
BSR_Cell_Placement_Guide ✖	2/22/2022
DSR_Guide	2/22/2022

### Full Guidelines Download



### Revision Summary

[2022 Guidelines – Major Changes Handout](#)

[2022 Guidelines - Detailed Revision Summary](#)

[Preconstruction Workshop Recording on Update](#)

[Preconstruction Workshop Presentation on Update](#)

### Guidelines Comments or Innovation ideas?

[Submit via the CLEAR Guidelines Comments or Innovation Ideas Form](#)

### Questions/Issues with the Guidelines?



# Major Objectives

- ~~identifying any policies and procedures which are inconsistent with IPD workflows~~
- ~~update guidance to reflect the state of the practice~~
- ~~address any needed corrections or inadequacies with the current guidance.~~
- Develop a procedure to make the guidance a “living document”

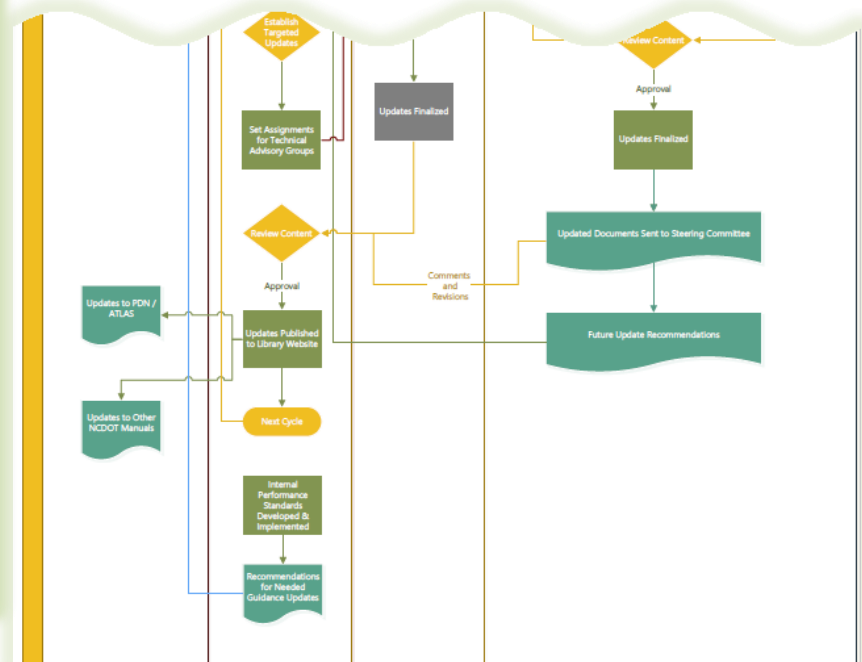
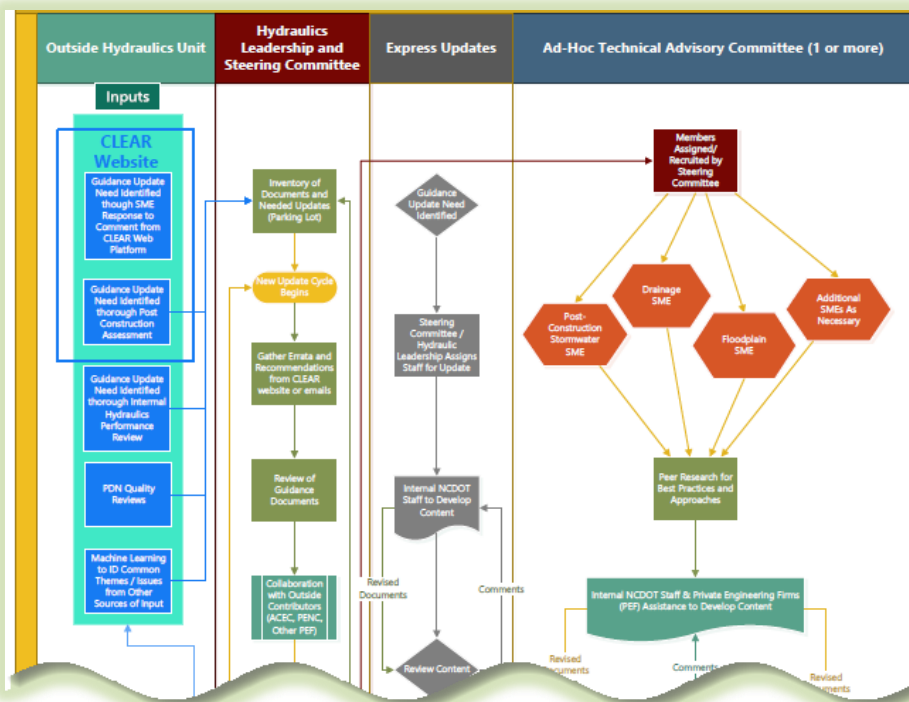
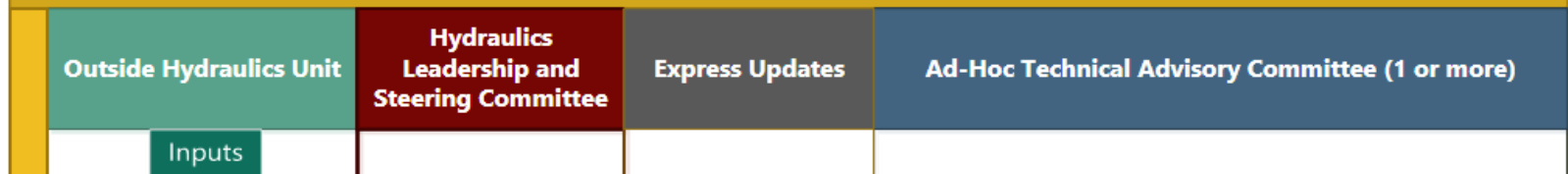
# “Living Document”



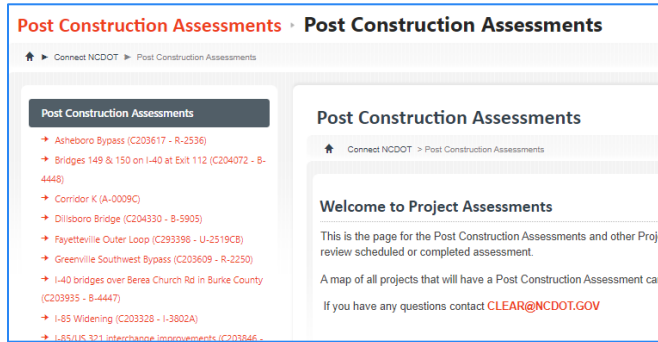
# GLUW

## Guidance Library Update Workflow

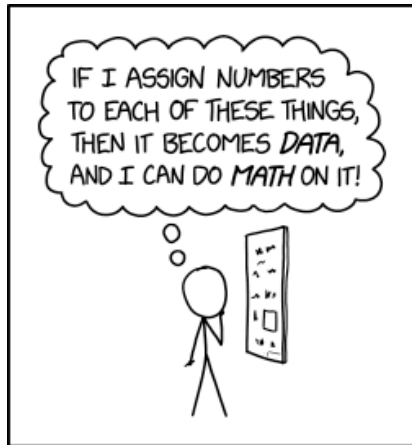
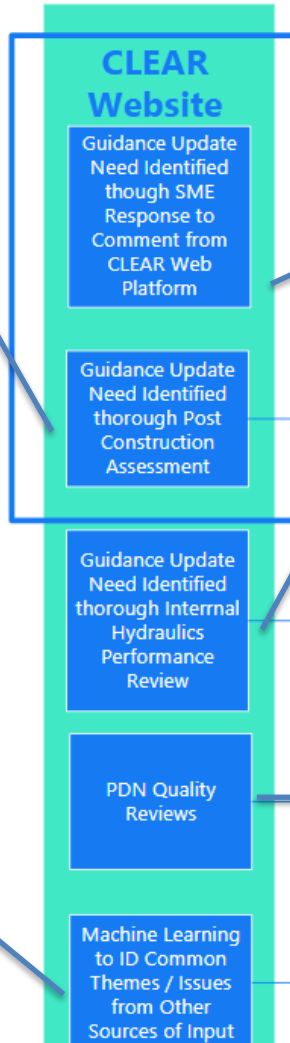
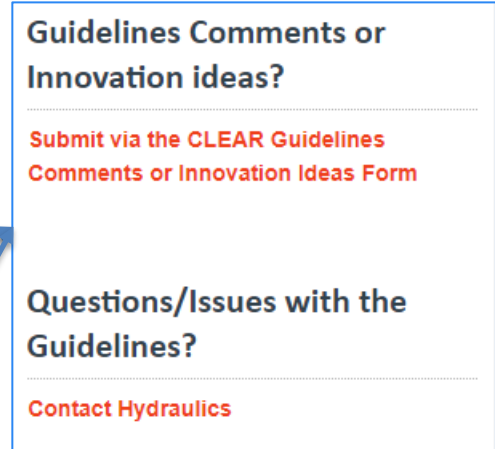
### NCDOT HYDRAULICS UNIT GUIDANCE LIBRARY UPDATE WORKFLOW



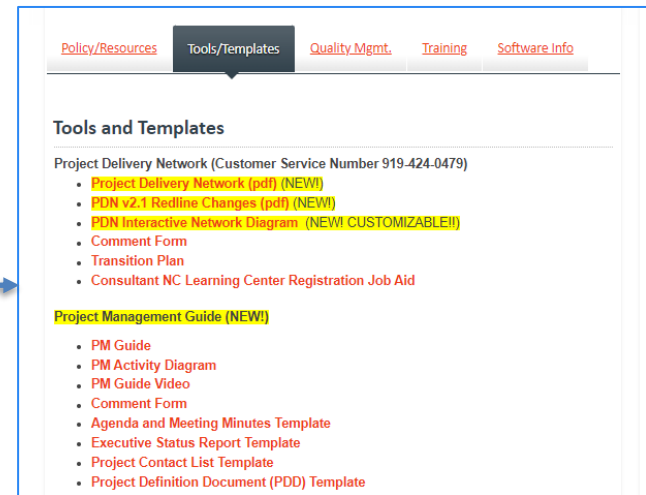
# Input



## Hydraulics Connect Website



THE SAME BASIC IDEA UNDERLIES GÖDEL'S INCOMPLETENESS THEOREM AND ALL BAD DATA SCIENCE.



# Questions / Issues

## HydroConnect ☆

Commenter Name ▾	Commenter Em... ▾	Comments ▾	Created ▾	Response ▾
Anne Gamber	agamber@gfnet.com	I have a question about the "living" guidelines. If a PEF has a contract using the most current guidelines for their estimate and the guidelines are updated after that with a new or more detailed procedure, will a supplemental contract be required or can the PEF firm use the guidelines as posted when they did the estimate?	February 23	The PEF firm can use the guidelines as posted when project was assigned/contracted. As the guidelines are updated, a dated version of the guidelines will be archived on the <a href="#">[link]</a>
Stephen Morgan	smorgan@ncdot.gov	Is Chapter 5 in the new guidelines titled correctly?	February 24	Chapter title on site has been changed to match actual chapter title.
Ray Lovinggood	rlovinggood@ncdot.gov	Add spaces or underscores to chapter titles in new Hydraulic Guidelines. Also, do not use all upper case letters except in abbreviations such as NCDOT, AASHTO, R/W, etc.  For example, see the page at: <a href="https://connect.ncdot.gov/resources/hydro/Pages/DrainageStudiesGuidelines.aspx">https://connect.ncdot.gov/resources/hydro/Pages/DrainageStudiesGuidelines.aspx</a>	March 7	The chapter and support material current configurations are tied to the links with in the chapters. In order to add spaces or underscores would require every link in every chapter to <a href="#">[link]</a>
Ray Lovinggood	rlovinggood@ncdot.gov	Add to the new Guidelines wording similar to that in the 1999 Guidelines regarding frequency of flooding. See page 18 of those guidelines for: If within 5% of the 200 or 500-year estimated discharge, list as 200-year +/- or 500-year +/- If greater than 100-year flood but not within 5% of 200-year, list as 100-year +. If greater than 5% of the 200-year but not within 5% of the 500-year, list as the 200-year +.	March 15	Added to tracker
Ernest Hahn	ejhahn@ncdot.gov	Please consider renumbering pages within the new Guidelines according to printing conventions... namely, Chapters should begin on odd-number pages. (the convention for page numbering puts an odd-numbered page on the front of a sheet and the following even-numbered page on the back of that sheet... that is, when a book is opened, the even-numbered page is always on the left)  Also, if all Chapters begin on page one, consider using a chapter-page numbering system; for example, 2-1, 2-2, 2-3...	March 29	BMR For the individual chapters, the intent was to make the document more web friendly and not print friendly. In order to follow the typical Printed <a href="#">[link]</a>
Adam	Anfreeman@ncdot.gov	I am looking for information on installing pipe with camber. is there an NCDOT educational "how to" or best practices? Drainage manual describes how to calculate/ when to use, but does not show best field practice. Thanks	April 12	The Hydraulics Unit is not the Subject Matter Experts on camber. The Drainage Manual you referenced is actually the Material and Tests guidance on the materials selection, <a href="#">[link]</a>

Submit





# CLEAR Form

## Guidelines Comments or Innovation Ideas

↑ ▶ Connect NCDOT ▶ Projects ▶ Value Management ▶ CLEAR Program ▶ Guidelines Comments or Innovation Ideas

Name \*

Email \*

Phone \*

\*(Name, Office, Email, Phone) - For Gatekeeper to get back in case of needing additional information. Contact information will not be shared.

### Select the Discipline that manages this guidance

Applicable Disciplines

### Describe the suggested guideline improvement or comment

Describe the suggested guideline improvement or comment

You may also submit an attached markup of the guidelines section.

Location

Example: Chapter 3 section 3.3.2 or Chapter 4 reference document NCDOT Hydroplaning Assessment Tool.

Attach Issue Reference Document(s)  No file chosen

### Do you have an idea on what next steps the Department should take to implement this submission?

Open next steps

### Should this lesson require additional development and implementation - do you wish to be a part of this effort?

Do you wish to be a part of this effort?

# CLEAR Lists

All Items myview **Guideline Submissions** ...

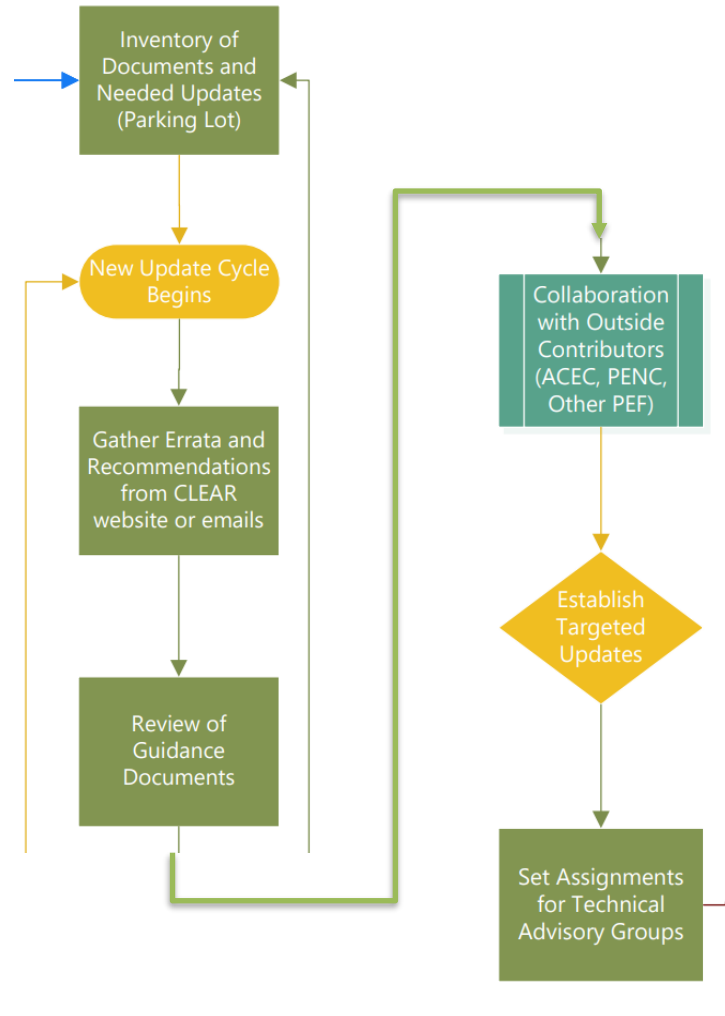
ID	Title	Name:	Applicable Disciplines	Task Force Comments	Gatekeeper Comments	Describe the issue, problem, or obstacle you encountered	Status	Applicable Disciplines Email
222	Lessons Learned	Ryan Mahjoub	Hydraulics	Brian Radakovic - Is the Hydraulics Unit already working on this endeavor? What would be automated and how?		Online Permit Drawings and Corridor Permit Drawing -Automate preliminary permit work through different design and avoidance minimization measures as we work towards permitting our projects. This would be a great tool for 4B and 4C meetings and when possible.	TF-Respond to Gatekeeper	mjyork@ncdot.gov; ahmcdaniel@ncdot.gov; bmradakovic@ncdot.gov; pajordan@ncdot.gov

+ new item

Accepted **Accepted Guidelines** my view ...

Title	ID	Describe the issue, problem, or obstacle you encountered	Applicable Disciplines	Rating (0-5)	Office:
Lessons Learned	156	This is a test submission for the public Guidelines CLEAR form	Hydraulics	☆☆☆☆☆   0	Guidelines
Lessons Learned	158	Full Guidelines download needs a TOC to know where the info is you're looking for, and to be able to jump to it without having to scroll through chapter after chapter.	Hydraulics	☆☆☆☆☆   0	Guidelines
Lessons Learned	159	4B guidance needs to be updated to include posting of pSMP with 4B plans for agency reps.	Hydraulics	☆☆☆☆☆   0	Guidelines
Lessons Learned	160	Suggested clarification and background on storm drain pipe maximum capacity table. Formerly Appendix I item 6 have maximum capacity values which state for use on concrete pipes, inlet control, standard depths.	Hydraulics	☆☆☆☆☆   0	Guidelines
Lessons Learned	161	Add information on when pipes require rod and lug with sleeve gasket. In some previous versions of standard specs, all CSPs were required to have Rod & Lug w/ Sleeve Gaskets. Current specs say these are only required where called for on plans. It would be helpful if guidelines specified if all CSPs should have these (and be labeled) or only those greater than a certain slope.	Hydraulics	☆☆☆☆☆   0	Guidelines

# Steering Committee



# Steering Committee

- Members are SMEs from each internal group (Operations, Design, Stormwater, Floodplain)
  - Supervisors and Engineer III
  - PEF (they help keep us on track)
- Currently meeting weekly
- Limit to one hour

# Tracking Board

Guidance Update Tracking ★

Unassigned items (1) +

Improvement Identified  
Roadway below Dams and Structu...

Priority  
Low

Improvement Source  
SGUP

New (24) +

Improvement Identified  
Culvert Alignment / Cross Pipes a...

Priority  
Normal

Status  
New

Improvement Source  
Internal Review

Date reported  
2/1/2022

Improvement Identified  
Project Commitments Regarding ...

Priority  
Normal

Status  
New

Improvement Source  
Internal Review

Date reported  
2/1/2022

Improvement Identified  
Typical Section - Bridge Spread Cr...

Priority  
Normal

Status  
New

Improvement Source  
Internal Review

With Steering Committ... +

Improvement Identified  
Scour Related Improvements

Priority  
High

Status  
With Steering Committee

Improvement Source  
Consultant review

Date reported  
3/2/2022

Improvement Identified  
Overtopping discharge frequencies

Priority  
Normal

Status  
With Steering Committee

Date reported  
3/16/2022

Improvement Identified  
Stream Relocation Guidelines (For...

Priority  
High

Status  
With Steering Committee

Improvement Source  
Internal Review

Date reported  
2/1/2022

Assigned to TAG (1) +

Improvement Identified  
Guidance for estimating man-day...

Priority  
Express


Status  
Assigned to TAG

Assigned To  
Ryan Mullins - project champion  
TEA ?...

Improvement Source  
Internal review

Date reported  
4/1/2022

Research (0) +



You can add items by dragging them here or by selecting the plus symbol above.

Development and Revi... +

Improvement Identified  
Acronym Section

Priority  
Normal

Status  
Development and Review

Assigned To  
KCI

Improvement Source  
Internal Review

Date reported  
2/1/2022

Improvement Identified  
Adjacent Property Owners Obstru...

Priority  
Express

Status  
Development and Review

Assigned To  
Jon Moore

Improvement Source  
SGUP

Date reported  
1/1/2022

Improvement Identified  
New Hydroplaning Tool

Priority

Leadership Review (2) +

Improvement Identified  
Revised - Pipe Material Selection ...

Priority  
Express

Status  
Leadership Review

Assigned To  
Charles Smith

Improvement site  
[https://nconnect.sharepoint.com/b/...](https://nconnect.sharepoint.com/b/)

Improvement Source  
Internal Review

Date reported  
3/11/2022

Improvement Identified  
DUE: Apr 8th - PCSP Update

Priority  
High

Status  
Leadership Review

Assigned To  
Brian Lipscomb - project Champion  
AECOM is the supporting PEF

Date reported  
4/1/2022



# Improvement

Improvement Identified

Guidance for estimating man-day...

Priority

↗ Express

Status

Assigned to TAG

Assigned To

Ryan Mullins - project champion  
TEA ?...

Improvement Source

Internal review

Date reported

4/1/2022

## Improvement Details

### Improvement Identified

Guidance for estimating man-days for stormwater control measures

### Assigned To

Ryan Mullins - project champion  
TEA ?  
Andy McDaniel  
others in Hydro as needed

### Priority

 Express

### Status

 Assigned to TAG

### Notes

TEA ? will design a spreadsheet to contain man-day design and other information from the Retrofit Program files. She will data mine the files to populate the spreadsheet with the goal of developing statistics on man-day estimates for designing various types of stormwater controls.

*Alternatively, she may review Ch. 7 of the 2010 bridge report and create a website or other means of providing more.*  
See more

### Improvement site

Enter value here

### Date reported

4/1/2022

### Improvement Source

Internal review

### Improvement logged by

Andy McDaniel; ahmcdaniel@ncdot.gov

### Interest of Submitter

✓

## Priority

 Express

High

Normal

Low

## Status

New

With Steering Committee

Assigned to TAG

Research

Development and Review

Leadership Review

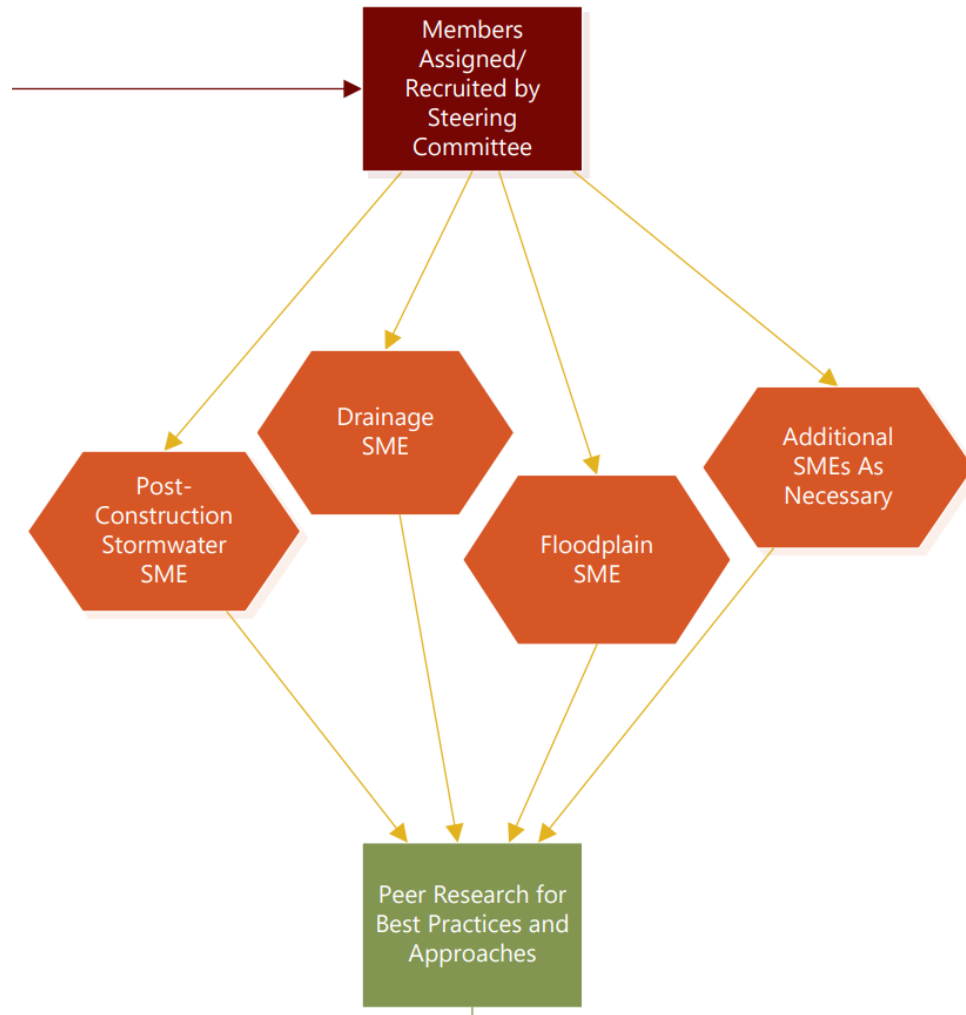
To be Published

Published

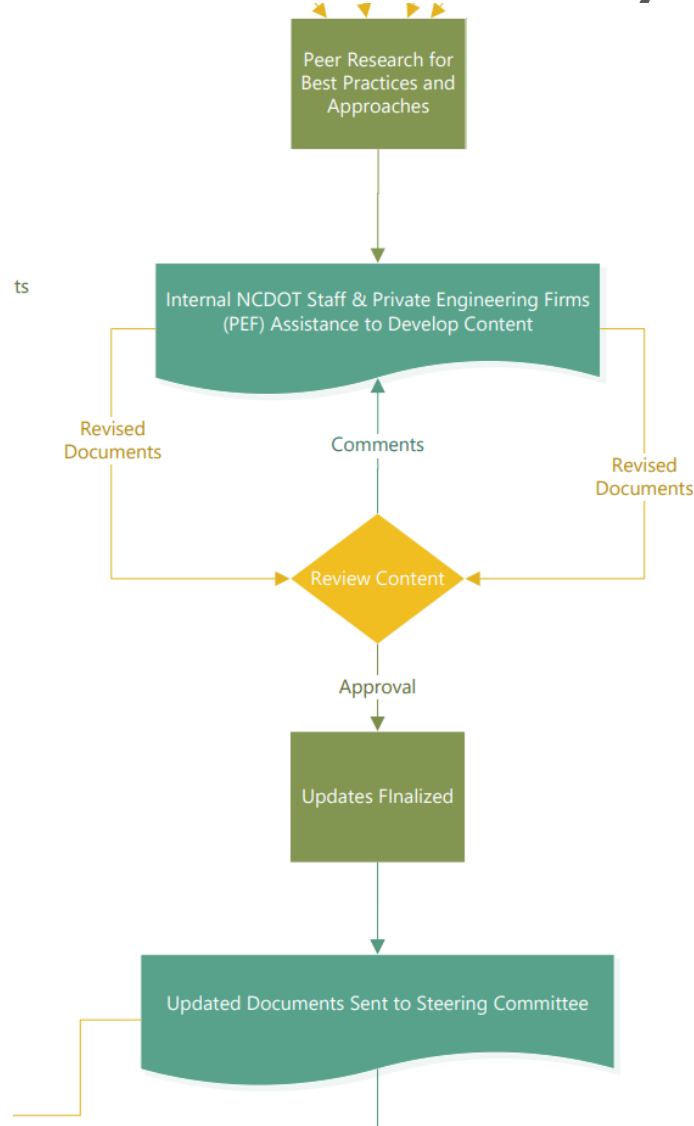
No Change

# Technical Advisory Groups

(People who do the actual work)

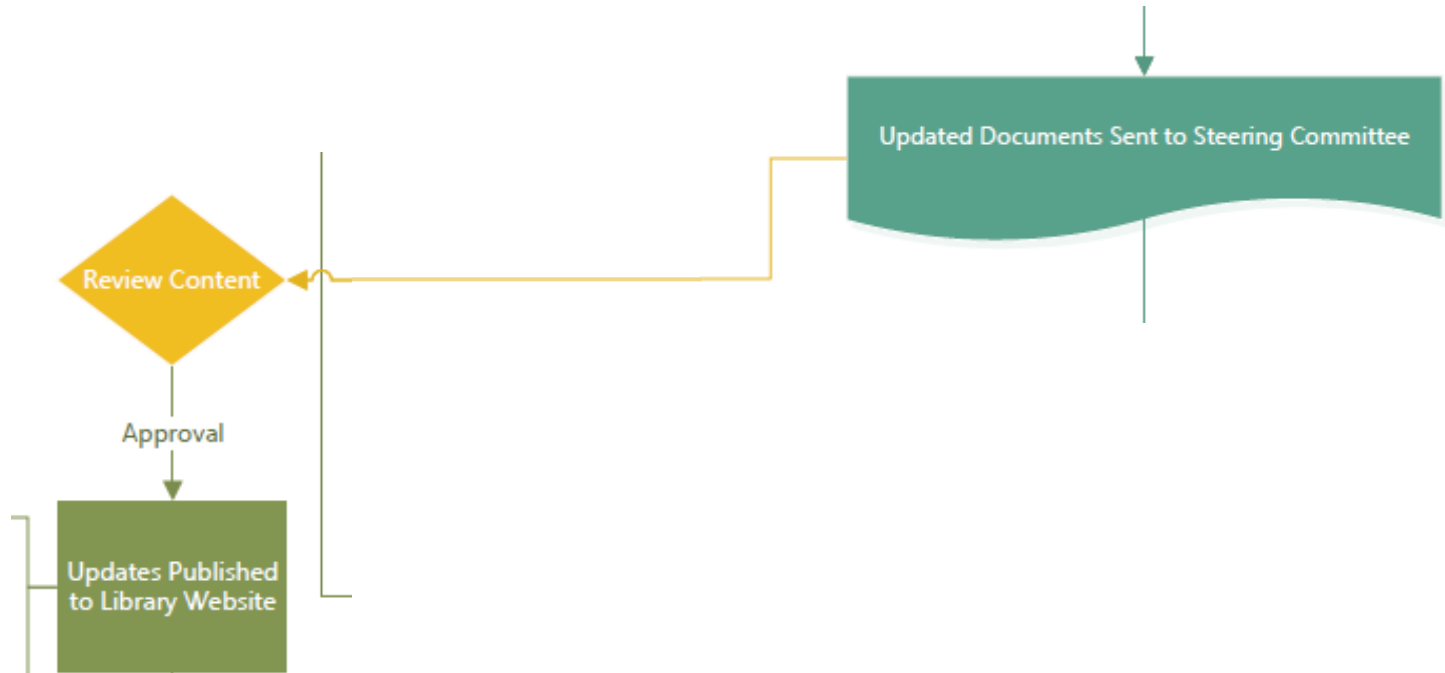


# Technical Advisory Groups



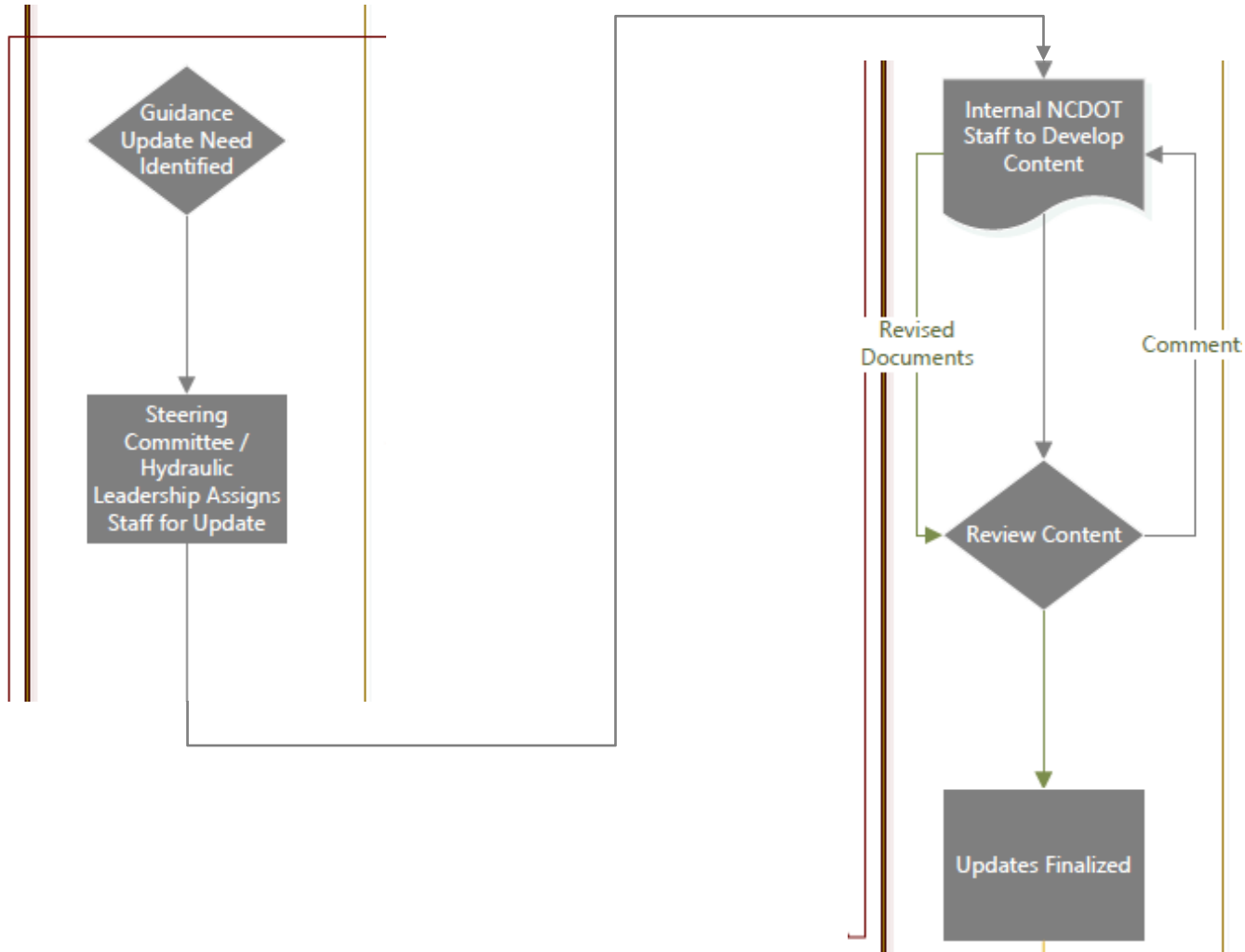
# Hydraulics Leadership

Unit Manager and Assistants











# Express



# Guideline Issue Tracker

## Guideline Issue Tracker ★

Issue ▾	Issue description ▾	Location ▾	Status ▾	Assigned to ▾	Date reported ▾	Associated files ▾	Corrected Document ▾
Add chapter to Page number	using a chapter-page numbering system; for example, 2-1, 2-2, 2-3...	All Chapters	New		3/30/2022		
BSR/CSR Lat/long	BSR and CSR templates have coordinates as Longitude and Latitude. We typical list Latitude first. The flip in coordinates happened during the 2016 update in the Guidelines appendix  3/11/2022 EH has updated the Cells	BSR/CSR Guides and Cells	In progress	 Hahn, Ernest J  Radakovic, Brian M	3/9/2022		
Ch 03 formatting errors	- 3.4 pg 6,7 the word "drainage is split between the two pages		New	 Leah M. Young	4/12/2022	0	
Ch 04 formatting errors	- 4.2 pg 2 last item on Typical Sections: Missing bullet point in front of "Complete a Hydroplaning Assessment if required per section 4.3 below."	Chapter 4	New	 Leah M. Young	3/11/2022		
Ch 08 formatting errors	- 8.8.2.3 Abutment Scour- missing reference on page 23. see attached image	Chapter 8	New	 Leah M. Young	3/7/2022	0	
Ch 09 formatting errors	- pg 11 first sentence, reference printing error	Chapter 9	New	 Leah M. Young	3/25/2022		
Ch 10 link errors	Following Links point to the old connect libraries. MIGHT BE A MISTAKE		New		4/8/2022		

# Publishing Cycle

- Express – as soon as its ready
- Quarterly – Minor updates or Major updates that are ready (per chapter)
- Major updates on a two years cycle (republish every chapter)

# Keeping everyone up to date

## Stay in the Flow

Keep up-to-date on the Hydraulics Unit policies, procedures, innovations, updates, advertisements, etc.... by signing up to receive the **Hydraulics Unit Newsletter**. To sign up, just complete the simple form @ [Hydraulics Unit Announcement Notifications](#).



## NCDOT Hydraulics Unit Announcements and Updates

Here you can sign up to be put on an email list to receive announcements/updates with regards to NCDOT Hydraulics Unit. You can also use this to remove/update your existing contact information if you are already on the email list.

### Inquiry

1. Please choose the option that you wish to do.

- I would like to be added to the email list
- I would like to remove/update my existing contact information for the email list

Next

Never give out your password. [Report abuse](#)

This content is created by the owner of the form. The data you submit will be sent to the form owner. Microsoft is not responsible for the privacy or security practices of its customers, including those of this form owner. Never give out your password.

Powered by Microsoft Forms |  
The owner of this form has not provided a privacy statement as to how they will use your response data. Do not provide personal or sensitive information.  
[Terms of use](#)

# Currently have over 340 signed up

# Keeping everyone up to date

Name	Date Updated
◄ Chapter : Chapter 00: Title page and Foreword (1)	
<a href="#">Title Page</a>	2/22/2022
◄ Chapter : Chapter 01: Introduction (1)	
<a href="#">Chapter1-Introduction</a>	2/22/2022
▸ Chapter : Chapter 02: Legal Aspects (2)	
▸ Chapter : Chapter 03: Preliminary Hydraulic Studies (3)	
▸ Chapter : Chapter 04: Preliminary Roadway Plans (6)	
◄ Chapter : Chapter 05: Drainage Plans Development (2)	
<a href="#">Chapter5-DrainagePlansDevelopment</a>	2/22/2022
<a href="#">ChecklistforDrainageStudyandHydraulicDesign</a>	1/1/2022
◄ Chapter : Chapter 06: Resilience (1)	
<a href="#">Chapter6-Resilience</a>	2/22/2022
◄ Chapter : Chapter 07: Hydrology (1)	
<a href="#">Chapter7-Hydrology</a>	2/22/2022
◄ Chapter : Chapter 08: Bridges (4)	
<a href="#">Chapter8-Bridges</a>	2/22/2022
<a href="#">BSR_Guide</a>	2/22/2022
<a href="#">BSR_Cell_Placement_Guide</a>	2/22/2022
<a href="#">DSR_Guide</a>	2/22/2022







[This Photo](#) by Unknown Author is licensed under [CC BY-SA](#)

Brian Radakovic, PE, CFM  
Highway Floodplain Manager

[bmradakovic@ncdot.gov](mailto:bmradakovic@ncdot.gov)