

Attachment H: Engineering Documentation

Part 2: Hydrologic and Hydraulic Consistency Worksheet

Inland Water Resources Division Permit Activities

This worksheet has four sections; only complete the section(s) applicable to the proposed project. Where a question requires a "Yes" or "No" answer, select the appropriate response and explain your response, if required, in the space provided.

Section I: Floodplain Management *(if the proposed project involves a structure, obstruction, encroachment or work in a watercourse, floodplain, or coastal high hazard area)*

Section II: Stormwater Management *(if the proposed project involves stormwater drainage or stormwater runoff)*

Sections III: State Grants and Loans and Section IV: Disposal of State Land *(only if the applicant is a state agency seeking flood management certification approval for state grants and loans or disposal of state land)*

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Definitions of terms used in these worksheets are found in Section 25-68b of the Connecticut General Statutes and Section 25-68h-1 of the Regulations of Connecticut State Agencies and in the National Flood Insurance Program Regulations (44 CFR, Chapter 1, Subchapter B, Part 59.1).

Section I: Floodplain Management

Name of Applicant:

Name of Proposed Project:

1. **General Criteria**

- a. *Critical Activity* - Does the proposed project involve the treatment, storage and disposal of hazardous waste or the siting of hospitals, housing for the elderly, schools or residences, in the 0.2 per cent [500 year] floodplain? Yes No

If yes, the base flood for the critical activity shall have a recurrence interval equal to the 500 year flood event; if no, the base flood for the activity shall have a recurrence interval equal to the 100 year flood event.

- b. *Nonintensive Floodplain Uses* - Will the proposed project promote development in floodplains or will utilities servicing the project be located so as to enable floodplain development?

Yes No

Explain:

- c. *National Flood Insurance Program (NFIP)* - Will the proposed project be located within an area of special flood hazard designated by the Federal Emergency Management Agency (FEMA)?

Yes No If yes, list the FEMA flood zone(s):

Does the proposed project meet the NFIP minimum standards established in 44 CFR, Chapter 1, Subchapter B, Part 60.3, floodplain management criteria for flood-prone areas?

Yes No

- d. *Municipal Regulations* - Has the municipality in which the proposed project is to be located adopted floodplain regulations containing requirements that are more restrictive than the NFIP floodplain management criteria for flood-prone areas? Yes No

If yes, describe the more restrictive requirements:

Does the proposed project comply with the more restrictive standards of the municipality?

Yes No

Section I: Floodplain Management (continued)

2. Flooding and Flood Hazards

- a. *Flooding* - Will the proposed project pose any hazard to human life, health or property in the event of a base flood? Yes No

If yes, explain:

- b. *Flood Velocities* - Will the proposed project cause an increase in flow velocity or depth during the base flood discharge? Yes No

If yes, the increase in velocity is: fps
and/or the increase in depth is: ft.

Will such increase in velocity or depth cause channel erosion or pose any hazard to human life, health or property? Yes No

Explain:

- c. *Flood Storage* - Will the proposed project affect the flood storage capacity or flood control value of the floodplain? Yes No

If yes, describe the effects:

- d. *Degrading or Aggrading Stream Beds* - Is the streambed currently degrading or aggrading?

Degrading Aggrading Neither

Has the project design addressed degrading or aggrading streambed conditions?

Yes No

- e. *Ice Jams* - Is the watercourse prone to ice jams or floods due to ice? Yes No

Has the project design considered ice jams or floods due to ice? Yes No

Section I: Floodplain Management (continued)

- f. *Storage of Materials & Equipment* - Will the construction or use of the proposed project involve the storage of materials below the 500 year flood elevation that are buoyant, hazardous, flammable, explosive, soluble, expansive or radioactive, or the storage of any other materials which could be injurious to human, animal or plant life in the event of a flood?

Yes No

If yes, describe the materials and how such materials will be protected from flood damage, secured or removed from the floodplain to prevent pollution and hazards to life and property.

Storage of materials that could be injurious to human health or the environment in the event of flooding is prohibited below the elevation of the 500 year flood. Other material or equipment may be stored below the 500 year flood elevation provided that such material or equipment is not subject to major damage by floods, and provided that such material or equipment is firmly anchored, restrained or enclosed to prevent it from floating away or that such material or equipment can be removed prior to flooding.

- g. *Floodwater Loads* - Will structures, facilities and stored materials be anchored or otherwise designed to prevent floatation, collapse, or lateral movement resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy? Yes No

3. **Standards for Structures in Floodplains or Coastal High Hazard Areas**

Does the proposed project involve a new or substantially improved structure or facility located within a floodplain or coastal high hazard area? Yes No

If yes, complete this subsection; if no, skip to subsection 4 (**Topography Changes within Floodplain**).

- a. *Structures in Coastal High Hazard Areas* - Will the structure or facility be located within an NFIP coastal high hazard area? Yes No

If no, skip to paragraph 3(b); if yes:

1. Will the structure or facility be located landward of the reach of mean high tide?

Yes No

2. Will a new structure or facility be located on an undeveloped coastal barrier beach designated by FEMA? Yes No

3. If the structure or facility is/will be located within a coastal high hazard area, the structure or facility must be elevated on pilings or columns so that the bottom of the lowest horizontal structural member of the lowest floor (excluding the pilings or columns) is elevated to at least one foot above the base flood level and the pile or column foundation and structure attached thereto must be anchored to resist floatation, collapse and lateral movement due to the effects of wind, velocity waters, hurricane wave wash, and base flood water loads acting simultaneously on all building components.

Does the proposed structure or facility meet these standards? Yes No

The base flood elevation is: ft. (Datum:)

The elevation of the lowest horizontal structural member is: ft. (Datum:)

Section I: Floodplain Management (continued)

4. Will the space below the lowest floor be either free of obstruction or constructed with non-supporting breakaway walls? Yes No

5. Will fill be used for structural support of any buildings within coastal high hazard areas?

Yes No

b. *Structures in Floodplain Areas* - Are the structures residential or nonresidential?

Residential Nonresidential If *nonresidential*, skip to paragraph 3(d) below.

c. *Residential Structures* - If the structure or facility is for human habitation will the lowest floor of such structure or facility, including its basement, be elevated one foot above the level of the 500 year flood?

Yes No

The 500 year flood elevation is: ft. (Datum:)

The elevation of the lowest floor, including basement, is: ft. (Datum:)

d. *Non-residential Structures* - If the structure or facility is not intended for residential uses, will the lowest floor of such structure or facility, including its basement, be elevated to or above the 100 year flood height or be floodproofed to that height, or in the case of a critical activity, the 500 year flood height?

Yes No

If yes, the structure will be: Elevated Floodproofed

The base flood elevation is: ft. (Datum:)

The elevation of the lowest floor, including basement, is: ft. (Datum:)

The structure is floodproofed to: ft. (Datum:)

Note: for insurance purposes nonresidential structures must be floodproofed to at least one foot above the base flood elevation. DEP strongly encourages that the height of floodproofing incorporate one foot of freeboard.

e. *Utilities* - Will service facilities such as electrical, heating, ventilation, plumbing, and air conditioning equipment be constructed at or above the elevation of the base flood or floodproofed with a passive system? Yes No

f. *Water Supply Systems* - Does the proposed project include a new or replacement water supply system?

Yes No

If yes, is the water supply system designed to prevent floodwaters from entering and contaminating the system during the base flood? Yes No

g. *Sanitary Sewage Systems* - Does the proposed project include a new or replacement sanitary sewage or collection system? Yes No

If yes, is the sanitary sewage system designed to minimize or eliminate the infiltration of flood waters into the systems and discharges from the systems into flood waters during the base flood?

Yes No

h. *Foundation Drains* - Are foundation drains of buildings designed to prevent backflow from the 100 year frequency flood into the building?

Yes No No foundation drains

Section I: Floodplain Management (continued)

4. Activity within Floodplain

Does the proposed project involve activity in a floodplain including but not limited to filling, dumping, construction, excavating, or grading?

Yes No If no, skip to subsection 5 (**Alterations of Watercourses**).

If yes, does the proposed project include encroachments, including fill, new construction, substantial improvements, or other development within a NFIP adopted regulatory floodway?

Yes No If yes, skip to paragraph 4(b) below.

- a. *No Regulatory Floodway* - The NFIP requires that until a regulatory floodway is designated, that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zones A1-30 and AE unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point. (If no regulatory floodway has been adopted, project impacts may be evaluated by considering an equivalent conveyance loss on the opposite side of the river from the proposed project.)

Is the proposed project consistent with this requirement? Yes No

- b. *Floodway Encroachments* - Will the proposed encroachment into the floodway result in any increase in flood levels during either the 100 year or 10 year discharges?

100 year: Yes; the increase is: (in 1/100ths of a foot) No

If yes, has the applicant received approval of such increase in accordance with 44 CFR, Chapter 1, Subchapter B, Part 65.12? Yes No

10 year: Yes; the increase is: (in 1/100ths of a foot) No

- c. *Coastal Areas* - Flood hazard potential in coastal areas shall be evaluated considering surface profiles of the combined occurrence of tides, storm surges, and peak runoff. The starting water surface elevation for the base flood in watersheds with time of concentrations of over 6 hours shall be the 10 year frequency tidal surge level.

If the proposed project is in a coastal area, have the hydraulic analyses incorporated these criteria?

Yes No Not in Coastal Area

5. Alterations of Watercourses

Does the proposed project include the construction or alteration to a natural perennial watercourse or man-made channel?

Yes No If no, skip to subsection 6 (**Culverts and Bridges**); if yes, complete the following subsection:

- a. *Topography Change* - Is the watercourse or channel located within a regulatory floodway or Zone A1-30 or AE as designated by the NFIP? Yes No

- b. *Hydraulic Capacity* - Does the channel have a minimum flow capacity of a flood equal to at least the 25 year frequency flood? Yes No

The channel capacity is designed for the: year flood.

Does the channel have an inner channel with a capacity of a 2 year frequency flood? Yes No

Section I: Floodplain Management (continued)

- c. *Aquatic Habitat* - Channel alterations should be designed to create aquatic habitats suitable for fisheries, including suitable habitat for maintaining fish populations and to enable fish passage, and to maintain or improve water quality, aesthetics, and recreation.

Has the applicant had any pre-application meetings or correspondence with DEP Fisheries?

Yes No

Check each of the following criteria that have been incorporated into the project design:

- 1. artificial channel linings have been avoided;
- 2. the channel will encourage ecological productivity and diversity;
- 3. the channel and its banks will be compatible with their surroundings;
- 4. the channel will vary in its width, depth, invert elevations, and side slopes to provide diverse aquatic habitat;
- 5. straightening existing channels and thereby decreasing their length has been avoided;
- 6. the channel will not create barriers to upstream and downstream fish passage;
- 7. the channel will contain pools and riffles and a low flow channel to concentrate seasonal low water flows;
- 8. the channel will contain flow deflectors, boulders and low check dams to enhance aquatic habitat;
- 9. stream bank vegetation will be preserved where feasible and disturbed stream bank areas will be replanted with suitable vegetation;
- 10. clean natural stream bed materials of a suitable size will be incorporated in the new channel; and
- 11. construction of the proposed project will be scheduled to minimize conflicts with spawning, stocking, and recreational fishing seasons.

Describe how the above aquatic habitat design criteria have been incorporated into the project design:

Section I: Floodplain Management (continued)

6. Culverts and Bridges

Does the proposed project involve the repair or new construction of a culvert or bridge?

Yes No If no, go to subsection 7 (*Temporary Hydraulic Facilities*).

If yes, complete this subsection:

- a. *Fish Passage* - Does the culvert design allow for the passage of fish? Yes No

If yes, describe the specific design provisions for fish passage:

- b. *Depressed Structural Floors* - Is the rigid structural floor of the culvert or bridge depressed below the normal stream bed to allow a natural stream bed to form over the floor?

Yes No No rigid structural floor

- c. *Multiple Openings* - The use of a single large culvert or bridge opening is preferred over the use of multiple small openings. Has the design minimized the use of multiple small openings?

Yes No

If no, explain:

- d. *Sag Vertical Curves* - Does the design utilize solid parapet walls in the sag part of a vertical curve?

Yes No Not located in a sag vertical curve

- e. *Debris Blockage* - Is the culvert or bridge prone to blockage by debris? Yes No

If yes, has the project design incorporated measures to minimize the potential for debris blockage?

Yes No

- f. *Topography Change* - Is the culvert or bridge located within a regulatory floodway or Zone A1-30 or AE as designated by the NFIP? Yes No

Section I: Floodplain Management (continued)

g. *State Highways* - Does the watercourse pass under a state roadway?

Yes No If no, skip to paragraph 6(g)(2).

If yes, culverts and bridges for state highways shall be designed in accordance with the Connecticut Department of Transportation (DOT) Drainage Manual and all applicants should refer to it for specific design criteria. In general, however, the Drainage Manual requires the following:

(Place a check mark for all applicable criteria utilized)

Minor Structures - Minor structures have a drainage area of less than one square mile in which there is no established watercourse. They shall be designed to pass the 25 year frequency discharge.

Small Structures - Small structures have a drainage area of less than one square mile in which there is an established watercourse. They shall be designed to pass the 50 year frequency discharge.

Intermediate Structures - Intermediate structures have a drainage area greater than one square mile and less than 10 square miles. They shall be designed to pass the 100 year frequency discharge with reasonable underclearance.

Large Structures - Large structures have a drainage area greater than 10 square miles and less than 1000 square miles. They shall be designed to pass the 100 year frequency discharge with an underclearance not less than two feet.

Monumental Structures - Monumental structures have a drainage area greater than 1000 square miles. They shall be designed to meet the requirements of the Connecticut Department of Environmental Protection, U.S. Army Corps of Engineers, and the U.S. Coast Guard.

Tidal Structures - Tidal structures are subject to tidal action and shall be classified as minor, small, intermediate, etc. depending on their drainage area. These structures shall be designed in accordance with the previously listed *classifications*. However if the highway is subject to frequent tidal flooding, the design storm may be made consistent with the frequency of flooding by tidal action. The proposed culvert or bridge is classified as:

Tidal, minor

Tidal, small

Tidal, intermediate

Tidal, large

Tidal, monumental

1. Has the structure been designed in accordance with the criteria established in the DOT Drainage Manual? Yes No

If no, describe the lower design standards and the reasons for not complying with the DOT Drainage Manual:

Section I: Floodplain Management (continued)

2. Will the proposed culvert or bridge increase upstream water surface elevations in the event of a base flood above that which would have been obtained in the natural channel if the highway embankment were not constructed? Yes No

If yes, is the increase in elevation more than one foot? Describe:

3. Will the proposed culvert or bridge be designed so that flooding during the design discharge does not endanger the roadway or cause damage to upstream developed property? (NOTE: The design discharge for culverts and bridges on state highways should be that which was determined by FEMA. If the applicant judges that the FEMA discharge is inappropriate, the project should be analyzed for both the applicant's computed flow and the FEMA discharge. The project, however, must still meet the standards of the NFIP.) Yes No

Explain:

- h. *Local Roads & Driveways* - Local roads (not state highways) and driveways may be designed for flood frequencies and underclearances less stringent than those specified in the DOT Drainage Manual when (check all that have been incorporated into the project design):

- 1. the road is at or close to the floodplain grade
- 2. water surface elevations are not increased by more than one foot nor cause damage to upstream properties
- 3. provisions are made to barricade the road when overtopped
- 4. the road or driveway is posted as being subject to flooding
- 5. the road or driveway has low traffic volume
- 6. alternate routes are available

The culvert or bridge has been designed to pass the: _____ year frequency discharge with an underclearance of: _____ feet.

Utilizing the DOT Drainage Manual classifications listed under paragraph 6(g) above, the culvert or bridge is classified as a: _____ structure.

Section I: Floodplain Management (continued)

- h. If the culvert or bridge is designed to standards lower than which is stipulated in the DOT Drainage Manual, list such standards and the reasons for the lower design standards:

- i. *Downstream Peak Flows* - Will the proposed culvert or bridge increase downstream peak flows by decreasing existing headwater depths during flooding events? Yes No

If yes, describe the selected design criteria and the impacts to downstream properties:

7. *Temporary Hydraulic Facilities*

Temporary hydraulic facilities include all channels, culverts or bridges which are required for haul roads, channel relocations, culvert installations, bridge construction, temporary roads, or detours. They are to be designed with the same care which is used for the primary facility.

If the proposed activity involves a temporary hydraulic facility(s), has such facility been designed in accordance with Chapter 6, Appendix F, "Temporary Hydraulic Facilities," of the DOT Drainage Manual?

Yes No No temporary hydraulic facilities

If yes, the design flood frequency is the: _____ year flood.

Describe the temporary facilities:

Section II: Stormwater Management

Name of Applicant:

Name of Proposed Project:

1. *Stormwater Runoff*

The proposed project will (check all that apply):

- Increase the area of impervious surfaces
- Increase runoff coefficients
- Alter existing drainage patterns
- Alter time of concentrations
- Change the timing of runoff in relation to adjacent watersheds

Will the proposed project impact downstream areas by increasing peak flow rates, the timing of runoff, or the volume of runoff? Yes No

If yes, describe the downstream impacts for the 2, 10 and 100 year frequency discharges:

The pre and post development peak flow rates at the downstream design point are as follows:

Return Frequency (Year)	Peak Discharges (CFS)	
	Pre-Development	Post-Development
2		
10		
100		

The above peak discharges were computed utilizing the: _____ hour duration storm. This duration storm was selected because:

Section II: Stormwater Management (continued)

Describe the location of the design point and why this location was chosen:

2. Stormwater Detention Facilities

Does the proposed project include the construction of any stormwater detention facilities?

Yes No If no, skip to subsection 3 (**Storm Drainage Systems**).

If yes, has the DEP determined whether a dam construction permit is required? Yes No

The pre and post development peak flow rates at the downstream design point are as follows:

Return Frequency (Year)	Peak Discharges (CFS)		
	Pre-Development	Post-Development (without detention)	Post-Development (with detention)
2			
10			
100			

The above peak discharges were computed utilizing the: _____ hour duration storm. This duration storm was selected because:

Describe the location of the design point and why this location was chosen:

Section II: Stormwater Management (continued)

If the proposed project increases peak flow rates for the 2, 10 or 100 year frequency discharges, describe the impacts to downstream areas:

Will the detention facility aggravate erosion along the downstream channel? Yes No

In certain situations, detention of stormwater aggravates downstream flooding. This occurs when the discharge from a subwatershed is delayed by a detention facility so that it adds to the peak discharge from another subwatershed. Adding the hydrographs of the two subwatersheds results in a higher peak discharge over that which would occur if detention were not present.

Is the location of the detention facility within the watershed suitable for detention? Yes No

Explain:

3. Storm Drainage Systems

Does the proposed project include the construction of subsurface storm drainage systems?

Yes No If no, you have completed Section II of the worksheets.

If yes, complete this subsection:

- a. *DOT Standards* - Is the proposed storm drainage system designed in accordance with the Connecticut Department of Transportation's (DOT) Drainage Manual? Yes No

If no, describe the lower design standards and the reasons for not complying with the Drainage Manual:

- b. *Design Storm* - Is the storm drainage system designed for a ten year frequency storm without closing the use of the facility? Yes No

- c. *Future Development* - Has the design of the system considered future development of adjacent properties? Yes No

Section III: State Grants and Loans

Name of Applicant:

Name of Proposed Project:

1. This Flood Management Certification concerns a: grant loan

2. Total amount of grant or loan: \$

3. The recipient of the grant or loan will be:

Name:

Mailing Address:

City/Town:

State:

Zip Code:

Phone:

ext.

Fax:

Recipient Contact person:

Name:

Mailing Address:

City/Town:

State:

Zip Code:

Phone:

ext.

Fax:

4. The recipient will use the grant or loan to (check all that apply):

- construct a structure, obstruction or encroachment or conduct other work within a floodplain or coastal high hazard area.
- construct a facility or develop a site affecting drainage and stormwater runoff.
- conduct a study or prepare a report concerning land use or land use planning affecting a floodplain, drainage or stormwater runoff.

5. If the grant or loan is for a study or report, describe the anticipated effects on floodplains, drainage or stormwater runoff if the recommendations are implemented:

6. Will the proposed project promote development in floodplains or will utilities servicing the project be located so as to enable floodplain development? Yes No

Explain:

If the grant or loan is for construction of a structure, obstruction or encroachment or other work within a floodplain, or if it is for construction of a facility or development of a site that will affect drainage and stormwater runoff, Sections I and/or II of this Worksheet must be completed and the engineering report (Attachment H) and plans (Attachment G) must be provided as part of this application.

Section IV: Disposal of State Land

Name of Applicant:

Name of Proposed Project:

1. The grantee will be:

Name:

Mailing Address:

City/Town:

State:

Zip Code:

Phone:

ext.

Fax:

Contact Person:

Phone:

2. Describe the current state of development and use of the land to be disposed.

3. Why is the agency disposing of the land?

4. Describe the grantee's intended use of the land.

5. Will the disposal of the land promote development in floodplains? Yes No

Explain:

6. Will the grantee's use of the land be consistent with the state's flood management statutes and regulations?

Yes No Explain: