Floodplain Development
Floodplain Regulations

• State: Part 31 of Public Act 451

Building Codes, Zoning and

• Local: Floodplain Management Ordinances

Federal: National Flood Insurance Program
What is a floodplain?

Floodplain:
That area of land adjoining a river or stream that will be inundated by a 100-year flood

100-year flood:
A flood with a magnitude which has a 1 % chance of occurring or being exceeded in a given year
Identifying Floodplains in Mapped Areas

Many flood-prone communities belong to the National Flood Insurance Program, and have floodplains mapped on Flood Insurance Rate Maps (FIRM’s).
Identifying Floodplains in Unmapped Areas

The DEQ may be able to provide estimates of flood elevations on streams when floodplain maps do not exist.

Information, such as a cross section of the stream is sometimes necessary to perform this service.
SO, What does a floodplain look like anyway?
City of Wakefield, 2002
Dead River Flooding, 2003
Great Lakes Flooding, 2013
Inland Lake Flooding-Mason County in 2008
Inland Lakes and Stream Crossings

• Look for signs of fluctuating water levels.
• Look for control structures (dams)
• Ask the applicant and neighbors about past flooding.
• Try to keep the invert of the new culvert the same as the old to maintain the lake level
• Work with the Inland Lake Association
Small streams and rivers
Floodplains on small streams

• Look for incised streams.

• Look at the stream crossings. What size? Plunge pools? High water marks?

• Ask the applicant and neighbors about past flooding.
High Water Marks
Large rivers
Floodplains on large rivers

- Flood stages vary from 5 to 20 plus feet above normal water levels.
- Characterized by wide floodplains.
- Have a history of flooding.
- Flood Insurance Study may be available
A Permit is required under Part 31 for the following activities

• Any Occupation,
• Any Filling,
• Any Grade Changes within the floodplain of a river
Floodway vs. Floodway Fringe

- The floodway is the river channel and the portions of the floodplain that are reasonable required to carry and discharge a 100 year flood.
Floodway Fringe Residential construction, including structural additions, is prohibited within the Floodway. An engineering analysis may be required to show that proposed non-residential development will not restrict flood flow and cause a harmful increase in flood elevations.

- Areas of active flow
Development within the Floodway Fringe

Filling

Construction within the floodplain

Stream crossings
Loss of Flood Storage
Cut and Fill in Unstudied Areas

Compensating cuts are required for volumes exceeding 300 cubic yards.

Cuts should be provided on site at approximately the same elevations as the filled areas.

-or-

A hydrologic analysis that shows no adverse affects to stage and discharge characteristic of the watercourse may be provided in lieu of cut and fill.
Residential Construction

The lowest floor of residential structures must be elevated to prevent flood damage.
Dead River Flooding, 2002
What’s that?

Harmful interference?
Harmful interference means:

Causing an increased stage or change in direction of flow that causes, or is likely to cause:

1. Damage to property
2. A threat to life
3. A threat of personal injury
4. Pollution, impairment, or destruction of water or other natural resources.
Water lapping at the door
High Velocities
Crystal Falls Dam, 2013
Part 31 Minor Projects

- Fill, grade changes or occupation of the floodway fringe

Floodway Fringe
Part 31 Minor Projects

Bridges

- **Clear Span**
- Lowest bottom of beam at or above the natural ground elevation on either bank
- approach fill sloping to natural ground elevations within 10 feet on either end of bridge

Approach fill 10’ or less

Bridge Clear Spans Channel. Lowest bottom of beam at or above the natural ground
Perch River-Baraga County
Part 31 Minor Projects

Culverts

- Effective Waterway Opening that equals or exceeds the cross sectional area of the channel
- Not more than 1.5 feet of fill over culvert
- Approach fill slopes to natural ground elevations within 10 feet of either side of the culvert

Approach fill 10’ or less

Culvert recessed and equals or exceeds channel waterway area 1.5’ or Less
Ontonagon County, 2002
Marquette County, 2002
Part 31 Exemptions*

• Watershed with a Drainage Area less than 2 square miles
• Bridge and culvert extensions up to 24 feet in length
• Bridge deck replacements and road resurfacing
• Some utility crossings
• Excavating where materials are placed in an upland area that is out of the floodplain

* These projects may require other federal, state or local permits
Contact:

Sheila Meier
District Floodplain Engineer
906-228-4803
WHEN DO YOU NEED A HYDRAULIC ANALYSIS?

Jim Watling
Environmental Engineer
AN ANALYSIS IS NEEDED...

. . . if there is any chance that your proposed structure would increase the flood elevations or water velocity compared to the existing conditions

• How do you know?
DESIGN CHANGES
FLAGGING THE NEED
FOR A HYDRAULIC ANALYSIS
Flow Area

Consider the flood water flowing through the structure and the water flowing around/over the structure. Weir flow is more efficient than flow through the structure.
Structural flow area

If you are reducing the end area of the culvert or bridge then you will need to do a hydraulic analysis.
Changing the end area dimensions

- If you are changing the span or rise of the culvert or bridge then you **may need to do a hydraulic analysis.**
Weir Flow

If you are reducing weir flow (changing the low point in the road) a hydraulic analysis may be needed. You first need to determine if there is weir flow.

- Will all of the flow pass through the structure? Or will some of the flood flow pass over the road (weir flow)?
FRICITION
Friction losses
Consider the surface that the water passes through or over.

Going from metal to concrete will increase the friction loss.

A hydraulic analysis will be required.
Will the **length of the culvert** change?

- If you are replacing a culvert and increasing its length then a **hydraulic analysis will be required**

- Exception: if you are extending an existing culvert/bridge by 24 feet or less then a **hydraulic analysis is not required**
Are the proposed *inverts* different?
ENTRANCE DESIGN
Is there a change in the **entrance design**?

- Headwalls (best), Mitered, Projecting (worse)
A reduction in flow area
An change in road elevation
A change in material type
A change in slope
A longer culvert or wider bridge
A change in the entry type

you may need to do a hydraulic analysis
DO THESE EXAMPLES NEED A HYDRAULIC ANALYSIS?
**EXAMPLE 1**

<table>
<thead>
<tr>
<th>Bridge</th>
<th>Existing</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of bridge spans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge type (concrete box beam, concrete I-beam, timber, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge span (length perpendicular to stream) (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge width (parallel to stream) (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom of bridge beam (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stream invert elevation at bridge (ft)</td>
<td>Upstream</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Downstream</td>
<td></td>
</tr>
<tr>
<td>Bridge rise from bottom of beam to streambed (ft)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Culvert</th>
<th>Existing</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of culverts</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Culvert type (arch, bottomless, box, circular, elliptical, etc.)</td>
<td>Box</td>
<td>Box</td>
</tr>
<tr>
<td>Culvert material (concrete, corrugated metal, plastic, etc.)</td>
<td>Concrete</td>
<td>Concrete</td>
</tr>
<tr>
<td>Culvert length (ft)</td>
<td>24’</td>
<td>24’</td>
</tr>
<tr>
<td>Culvert width × diameter (ft)</td>
<td>6’ × 8’</td>
<td></td>
</tr>
<tr>
<td>Culvert height prior to any burying (ft)</td>
<td>3’</td>
<td>4’</td>
</tr>
<tr>
<td>Depth culvert will be buried (ft)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Elevation of culvert crown (ft)</td>
<td>Upstream</td>
<td>602.01</td>
</tr>
<tr>
<td></td>
<td>Downstream</td>
<td>601.98</td>
</tr>
<tr>
<td>Higher elevation of □ culvert invert OR □ streambed within culvert (ft)</td>
<td>Upstream</td>
<td>599.01</td>
</tr>
<tr>
<td></td>
<td>Downstream</td>
<td>598.98</td>
</tr>
</tbody>
</table>

| Entrance design (mitered, projecting, wingwalls, etc.) | projecting | projecting |
| Total structure waterway opening above streambed (sq ft) | 18 | 24 |
| Total structure waterway area below the 100-year elevation (sq ft) (if known) | | |
| Elevation of road grade at structure (ft) | 604.87 | 604.87 |
| Elevation of low point in road (ft) | 604.87 | 604.87 |
| Distance from low point of road to mid-point of bridge crossing (ft) | 0 | 0 |
| Length of approach fill from edge of bridge/culvert to existing grade (ft) | 20 | 20 |

A Licensed Professional Engineer may certify that your project will not cause a harmful interference for a range of flood discharges up to and including the 100-year flood discharge. The “Required Certification Language” is found under “forms” on the “maps, forms and documents” link from the [www.mi.gov/jointpermit](http://www.mi.gov/jointpermit) page or a copy may be requested by phone, email, or mail. A hydraulic report supporting this certification may also be required.

Is Certification Language attached? □ No □ Yes
**EXAMPLE 2**

Complete this form for each bridge / culvert location.

<table>
<thead>
<tr>
<th></th>
<th>Existing</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of bridge spans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge type (concrete box beam, concrete I-beam, timber, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge span (length perpendicular to stream) (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge width (parallel to stream) (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom of bridge beam (ft)</td>
<td>Upstream</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Downstream</td>
<td></td>
</tr>
<tr>
<td>Stream invert elevation at bridge (ft)</td>
<td>Upstream</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Downstream</td>
<td></td>
</tr>
<tr>
<td>Bridge rise from bottom of beam to streambed (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of culverts</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Culvert type (arch, bottomless, box, circular, elliptical, etc.)</td>
<td>Circular</td>
<td>Box</td>
</tr>
<tr>
<td>Culvert material (concrete, corrugated metal, plastic, etc.)</td>
<td>CMP</td>
<td>Concrete</td>
</tr>
<tr>
<td>Culvert length (ft)</td>
<td>24'</td>
<td>352'</td>
</tr>
<tr>
<td>Culvert width (ft)</td>
<td>3'</td>
<td>7'</td>
</tr>
<tr>
<td>Culvert height prior to any burying (ft)</td>
<td>3'</td>
<td>4'</td>
</tr>
<tr>
<td>Depth culvert will be buried (ft)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Elevation of culvert crown (ft)</td>
<td>Upstream</td>
<td>602.01</td>
</tr>
<tr>
<td></td>
<td>Downstream</td>
<td>601.98</td>
</tr>
<tr>
<td>Higher elevation of culvert invert OR streambed within culvert (ft)</td>
<td>Upstream</td>
<td>599.01</td>
</tr>
<tr>
<td></td>
<td>Downstream</td>
<td>598.89</td>
</tr>
<tr>
<td>Entrance design (mitered, projecting, wingwalls, etc.)</td>
<td>projecting</td>
<td>projecting</td>
</tr>
<tr>
<td>Total structure waterway opening above streambed (sq ft)</td>
<td>7.07</td>
<td>21</td>
</tr>
<tr>
<td>Total structure waterway area below the 100-year elevation (sq ft) (if known)</td>
<td>7.07</td>
<td>21</td>
</tr>
<tr>
<td>Elevation of road grade at structure (ft)</td>
<td>604.87</td>
<td>607.87</td>
</tr>
<tr>
<td>Elevation of low point in road (ft)</td>
<td>604.87</td>
<td>607.87</td>
</tr>
<tr>
<td>Distance from low point of road to mid-point of bridge crossing (ft)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Length of approach fill from edge of bridge/culvert to existing grade (ft)</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

A Licensed Professional Engineer may certify that your project will not cause a harmful interference for a range of flood discharges up to and including the 100-year flood discharge. The “Required Certification Language” is found under “forms” on the “maps, forms and documents” link from the [www.mi.gov/jointpermit](http://www.mi.gov/jointpermit) page or a copy may be requested by phone, email, or mail. A hydraulic report supporting this certification may also be required.

Is Certification Language attached? □ No □ Yes
## Example 3

Complete this form for each bridge / culvert location.

<table>
<thead>
<tr>
<th>Bridge</th>
<th>Existing</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of bridge spans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge type (concrete box beam, concrete I-beam, timber, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge span (length perpendicular to stream) (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge width (parallel to stream) (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom of bridge beam (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upstream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downstream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stream invert elevation at bridge (ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upstream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downstream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bridge rise from bottom of beam to streambed (ft)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Culvert</th>
<th>Number of culverts</th>
<th>Existing</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culvert type (arch, bottomless, box, circular, elliptical, etc.)</td>
<td>Circular</td>
<td>Arch</td>
<td></td>
</tr>
<tr>
<td>Culvert material (concrete, corrugated metal, plastic, etc.)</td>
<td>CMP</td>
<td>CMP</td>
<td></td>
</tr>
<tr>
<td>Culvert length (ft)</td>
<td>24'</td>
<td>24'</td>
<td></td>
</tr>
<tr>
<td>Culvert width</td>
<td>6'</td>
<td>12'</td>
<td></td>
</tr>
<tr>
<td>Culvert diameter (ft)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culvert height prior to any burying (ft)</td>
<td>6’</td>
<td>6’</td>
<td></td>
</tr>
<tr>
<td>Depth culvert will be buried (ft)</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Elevation of culvert crown (ft)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upstream</td>
<td>706.92</td>
<td>706.64</td>
<td></td>
</tr>
<tr>
<td>Downstream</td>
<td>706.67</td>
<td>706.56</td>
<td></td>
</tr>
<tr>
<td>Higher elevation of culvert invert OR streambed within culvert (ft)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upstream</td>
<td>700.92</td>
<td>700.89</td>
<td></td>
</tr>
<tr>
<td>Downstream</td>
<td>700.57</td>
<td>700.75</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complete for both Bridges and Culverts</th>
<th>Entrance design (mitered, projecting, wingwalls, etc.)</th>
<th>Existing</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total structure waterway opening above streambed (sq ft)</td>
<td></td>
<td>56.54</td>
<td>60</td>
</tr>
<tr>
<td>Total structure waterway area below the 100-year elevation (sq ft) (if known)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation of road grade at structure (ft)</td>
<td></td>
<td>708.22</td>
<td>709.19</td>
</tr>
<tr>
<td>Elevation of low point in road (ft)</td>
<td></td>
<td>708.21</td>
<td>708.82</td>
</tr>
<tr>
<td>Distance from low point of road to mid-point of bridge crossing (ft)</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Length of approach fill from edge of bridge/culvert to existing grade</td>
<td></td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

A Licensed Professional Engineer may certify that your project will not cause a harmful interference for a range of flood discharges up to and including the 100-year flood discharge. The "Required Certification Language" is found under "forms" on the "maps, forms and documents" link from the [www.mi.gov/jointpermit](http://www.mi.gov/jointpermit) page or a copy may be requested by phone, email, or mail. A hydraulic report supporting this certification may also be required.

Is Certification Language attached? □ No □ Yes
Jim Watling
Transportation and Flood Hazard Unit
Contact:
517-284-5508
watlingj@michigan.gov
Hydraulic Design and Report

You have determined that a hydraulic analysis is needed. What is the next step?

Minmin Shu, Environmental Engineer
• Confirm the site location
• Obtain the Design flow
• Field inspection and survey
• Preliminary design of road and structure*
• Conduct the hydraulic computation; refine the proposed design and hydraulic computation/modeling.
• Summarize the conditions and the findings into the hydraulic report.
Location Map

- Identify Site Location
- County, Township names
- Town/Range, Section
- Road name and stream name at the crossing
- Mark the flow direction
- USGS quad map is preferred
Submit a Discharge Request to the DEQ-HSU

- [http://www.michigan.gov/deq/0,4561,7-135-3313_3684_3724-168812--,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_3684_3724-168812--,00.html)

- Turn around time approximately 30 days.

- You will be provided the drainage area and the flows you selected

- If the drainage area is under 2 square miles then a hydraulic analysis is not required under Part 31, although you still have the liability for your design.
Request a Flood or Low Flow Discharge Form

Discharge Request

Important:

- Please email any additional information to deg-wrd-qreg@michigan.gov with "Discharge Request" in the subject line. Our email attachment size limit is 25 MB.
- A confirmation e-mail will be sent to you. If you do not receive it, please e-mail your form information directly to deg-wrd-qreg@michigan.gov?subject=Discharge Request. You must click the Submit button at the end of the form to send the request to us and get a confirmation e-mail.

Please fill-in this form to request a flood or low flow discharge. Note that a site location map is required. You may send it by email, fax it to (517) 241-9003 (please note Discharge Request on the cover sheet), or mail it to

Water Resources Division
PO Box 30458
Lansing, MI 48909-7958

If you have questions about requesting a flood discharge, please call Susi Greiner at (517) 284-5579. If you have questions about requesting a low flow discharge, please call Mario Lesmez at (517) 284-5580.
Field Inspection and Survey

• Road profile
• Existing structure type and dimensions invert and low steel elevation, entrance type
• Average stream width at OHWM and bankfull width
• Obtain cross section(s) of the stream and overbank area

HY-8: need 1 representative downstream cross section
HEC-RAS: At least 2 cross sections upstream and 2 cross sections downstream
Field Inspection and Survey
Continued

• Obtain distances between the cross sections and to your structure
• Existing structure dimensions
• Estimate the manning coefficient values for the channel and overbank areas.
• Field pictures
Standing on the east side of the road, looking easterly upstream.

Photo 1 – Upstream channel looking upstream
CS: 23052  JN: 105923C
ROUTE: M-50
LOCATION: M-50 OVER MUD CREEK
SUNFIELD TOWNSHIP   EATON COUNTY
APRIL 2011

Standing on the east side of the road, looking westerly downstream

Photo 2 – Upstream face of the existing structure
Standing in the southwest quadrant, looking northeast.

Photo 3 – Downstream face of existing structure
CS: 23052  JN: 105923C
ROUTE: M-50
LOCATION: M-50 OVER MUD CREEK
SUNFIELD TOWNSHIP EATON COUNTY
APRIL 2011

Standing on the west side of the road, looking westerly downstream.

Photo 4 – Downstream channel looking downstream
Check with property owners, local official for flooding history
Hydraulic Computation/Modeling

- Conduct the hydraulic computation for both existing and proposed conditions, up to and include 100 year flows.
- Compare the results, refine the proposed design if it is needed.
- Update the hydraulic computation/model to represent the final design.
Options for Hydraulic Calculations

• Hand Calculation
• Chart: Federal Highway Administration, Hydraulic Design of Culvert, Series No.5
• HY8: Culvert Analysis.
• HEC-RAS, River Analysis System.
HY8 Culvert Analysis

See Handout

- HY-8 Version 7.2 Build Date January 17, 2012
- HY-8 Version 7.3 Build Date August 18, 2014
- Federal Highway Administration
HEC-RAS, River Analysis System


• See handout special PowerPoint presentation HEC-RAS: 10 Steps

  This presentation introduces you to the model and will help you get familiar with HEC-RAS.
Hydraulic Report Requirements

http://www.michigan.gov/deq/0,4561,7-135-3313_3684_15299-11304--,00.html

• Conduct your analysis comparing existing and proposed conditions.
• Submit your findings—briefly discuss, method of analysis, assumptions, and conclusions.
Engineer Certification and Affected Property Owner Statement

If the hydraulic calculations show an increase in the energy grade line. elevation, one or both above documents are required to apply Part 31 permit.
- If the flood elevation increase is limited in the applicant’s property, or the increase is beyond the applicant property but is below the stream bank, the design engineer (P.E.) must sign and submit a certification of “no harmful interference”.

- Sample certification language can be found in Hydraulic Report Guidelines.

- If the flood elevation increase is 0.01 feet or greater, is over the bank and goes beyond the applicant’s property, the design engineer (P.E.) must sign and submit a certification of “no harmful interference”.

- In addition, copies of the “Affected Property Owner Statement”, must be sent to all property owners impacted by the proposed increase.

- Sample statements can also be found at http://www.michigan.gov/documents/deq/wrd-trans-hydraulic-report-guide_411699_7.pdf
Final Document for Part 31 Permit Application

- For preliminary hydraulic review
  Electronic file of the computer model
  Hydraulic report
- For permit application
  Electronic file of the computer model
  Hydraulic report
  Fill out the permit application form, especially section 14
  Engineer Certification and Affected Property Owner Statement if they are needed