Drainage	Chapter: Miscellaneous Topics
	Subject: Temporary Drainage Structures

DR 1101-1 INTRODUCTION

Culverts or bridges that are required for temporary public roads or detours should be hydraulically sized according to this policy. However, this policy may also be applied to temporary channels, culverts or bridges that are used for haul roads or any other purpose. These designs are to be included in the plans and drainage folders for the project.

Usually, the design storm return interval recommended for temporary hydraulic facilities is much lower than that used for permanent hydraulic facilities. The procedures used in determining the design storm return interval for temporary hydraulic facilities will be explained in detail in the following Section.

Temporary hydraulic facilities should be designed to accommodate floods larger than the design storm event in order to:

- avoid undue liability for damages from excessive backwater, and
- reduce the probability of losing the temporary hydraulic facility during a larger flood.

These problems can be avoided by providing a low roadway profile that allows overtopping without creating excessive velocities or backwaters. Therefore, it is highly recommended to design the structure to overtop for the next return interval above the design storm (2, 5, 10, 25, 50 or 100 year) determined via the procedures in this section. For example, if the design storm for a temporary structure was determined to be a 5 year storm, the structure and road profiles should be designed to overtop for the 10 year storm. Other measures that should be considered include:

- posting warnings that the road is expected to be under water during certain rainfall events for undetermined lengths of time; and
- anchoring the temporary hydraulic facility, if needed.

DR 1101-2 SELECTION FACTORS

The selection of a design flood frequency for temporary hydraulic facilities involves consideration of several factors shown in Table 1101-1. These factors are rated by the Impact Rating Values (IRV).

Table 1101-1 Rating Selection					
Factor			**Impact Rating Values (IRV)**		
Average Daily Traffic (ADT) (number of vehicles per day)	Urban	ADT	0–400	401–1500	> 1500
		IRV	1	2	3
	Suburban	ADT	0–750	751–1500	> 1500
		IRV	1	2	3
	Rural	ADT	0–1500	1501–3000	> 3000
		IRV	1	2	3
Loss of Life (cross-checked with roadway ADT)	Yes → IRV		15	30	45
	No → IRV		1	2	3
Property damage (cross-checked with roadway ADT)	IRV for residential, commercial, industrial areas, waste, and storm and water supply systems		10	20	30
	IRV for croplands, parking and recreational areas		5	10	15
	IRV for all others (pasture, meadow, bare soil, etc.)		1	2	3
Detour Length	Length (mi)		< 5	5–9	> 9
	IRV		1	2	3
Height above streambed	Height (ft)		< 10	10–20	> 20
	IRV		1	2	3
Drainage Area	Area (mi2)		< 1	1–65	> 65
	IRV		1	2	3
Traffic Interruptions (see instructions)			IRV for ADT multiplied by IRV for detour length.		

The major factors used to determine the Impact Rating Value (IRV) are:

AVERAGE DAILY TRAFFIC (ADT)

The ADT is the average number of vehicles traveling through the area in both directions in a 24-hour period. Table 1101-1 shows that the IRV is not only dependent on the ADT but also on the location of the highway (urban, suburban or rural).

POTENTIAL LOSS OF LIFE

If there is a potential loss of life caused by the destruction of the temporary drainage structure or by the roadway overtopping flood, the IRV due to this factor will be equal to the ADT IRV multiplied by 15.

If there is no potential loss of life caused by the destruction of the temporary drainage structure or by the roadway overtopping flood, the IRV due to this factor will be equal to the ADT IRV only.

PROPERTY DAMAGE

The property damage IRV caused by the destruction of the temporary drainage structure or by the roadway overtopping flood to private and public structures (houses, commercial or manufacturing); appurtenances such as sewage treatment and water supply systems; and utility structures either above or below ground is equal to the roadway ADT IRV multiplied by 10.

The property damage impact rating caused by the destruction of the temporary drainage structure or by the roadway overtopping flood to active cropland, parking lots and recreational areas is equal to the roadway ADT IRV multiplied by 5.

All other areas (pasture, meadow, bare land, etc.) shall have the same rating as the roadway ADT IRV.

DETOUR LENGTH.

The length in miles of an emergency detour by other roads should the temporary facility fail.

HEIGHT ABOVE STREAMBED

The difference in elevation in feet between the traveled way and the bed of the waterway.

DRAINAGE AREA
The drainage area is the total area contributing runoff to the temporary hydraulic facility, in mi^2.

TRAFFIC INTERRUPTION

Traffic interruption includes consideration for emergency supplies and rescue, delays, alternative routes, busses, etc. Short-duration flooding of a low-volume roadway might be acceptable. If the duration of flooding is long (more than one day) and there is a nearby good quality alternative route, then the flooding of a higher volume highway might also be acceptable. The IRV of this factor is determined by the detour length IRV multiplied by the roadway ADT IRV.

DR 1101-3 DESIGN STORM RETURN INTERVAL

The IRV for each factor is determined and entered in the Impact Rating Table shown in Table 1101-2. Once the Total Impact Rating Value is determined, the designer then can find the Percent Design Risk from Figure 1101-1.

The designer must then estimate the anticipated time of use for the temporary structure. Using the Percent Design Risk and the anticipated time of use (months), the designer can then determine the recommended design frequency for the temporary hydraulic facility from Figure 1101-2. As previously mentioned, the structure should be designed to overtop for the next return interval above the design storm.

Table 1101-2 Impact Rating Table

Factor	Impact Rating Value
Roadway ADT	
Loss of Life	
Property Damage	
Detour Length	
Height Above Streambed	
Drainage Area	
Traffic Interruptions	
TOTAL IMPACT RATING VALUE	

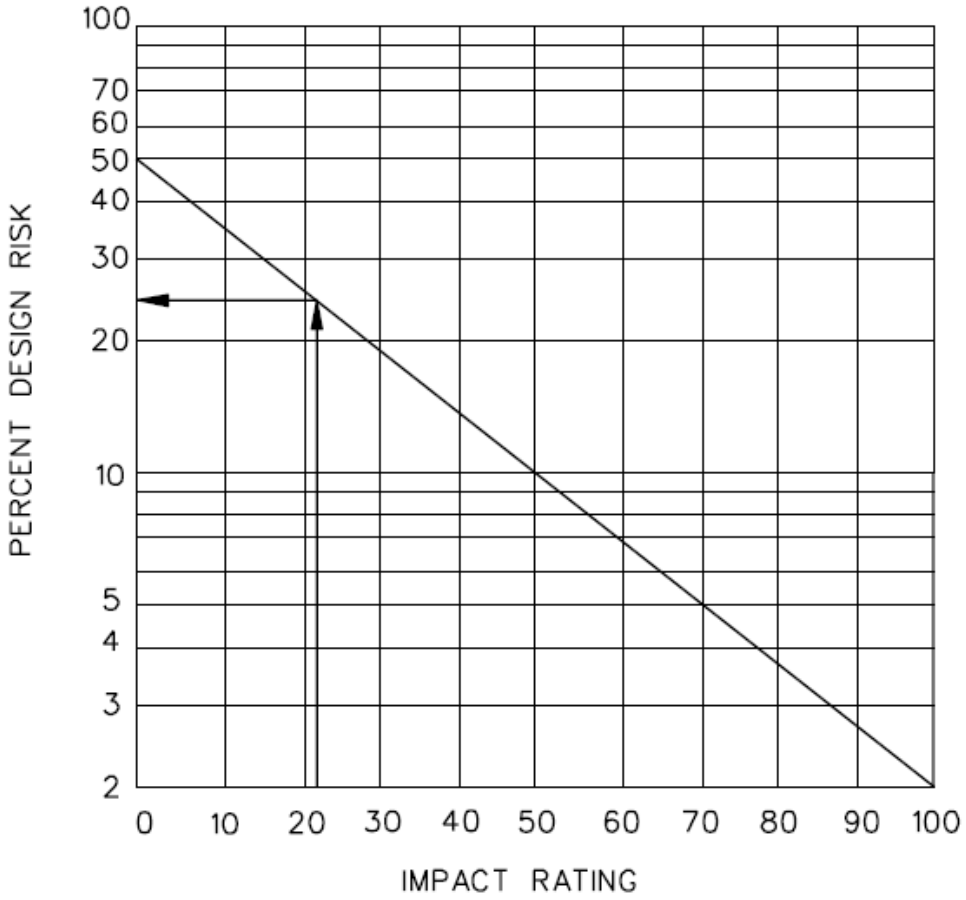

FIGURE 1101-1 DESIGN RISK VERSUS IMPACT RATING

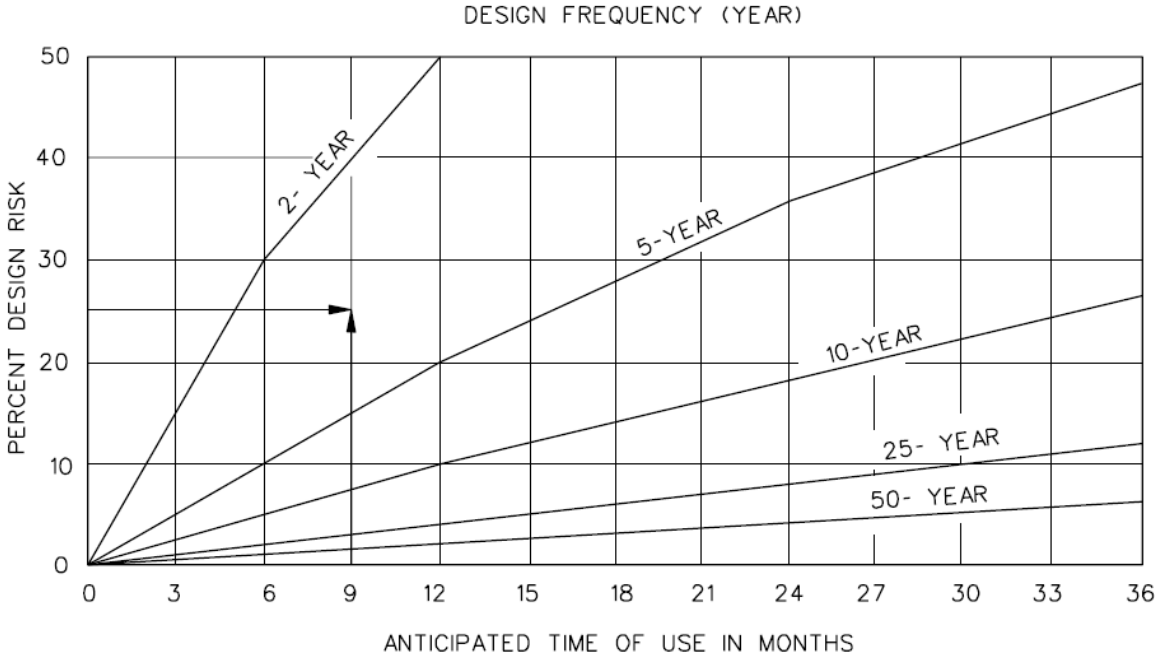

FIGURE 1101-2 RECOMMENDED DESIGN FREQUENCY

DR 1101-4 EXAMPLE APPLICATION

The following example illustrates the procedure to determine the design frequency recommended for a temporary hydraulic facility.

Given:

A section of a rural roadway will be widened. There is an existing 8 ft × 4 ft × 40 ft box culvert with a drainage area of 320 acres that must be replaced. A detour will be provided on the downstream side of the existing box. The Average Daily Traffic (ADT) of the highway is 2,000 vehicles per day (VPD). The top of the detour lane is approximately 8 ft above the streambed. The land use on the upstream side of the proposed temporary hydraulic facility is predominantly croplands. The detour length is about 6 mi. The danger of loss of life due to the destruction of the temporary hydraulic facility is minimal. The anticipated use of the detour lanes is nine months.

Problem:

Find the design frequency for the temporary hydraulic facility.

Solution:

A. Compute the Impact Rating Value (IRV) based on Table 1101-1:

- For a rural roadway with ADT of 2000 vpd, the IRV is 2.
- The IRV for no loss of life with this type of highway is 2.
- The IRV for property damage is 10 (croplands).
- For detour length equal to 6 mi, the IRV is 2.
- For height above streambed of 2.4 m, the IRV is 1.
- For drainage area = 320 ac, the IRV is 1.
- The IRV for traffic interruption is the product of the Roadway ADT IRV (2) times the Detour Length IRV (2) equals 4.

B. Total Impact Rating Value (IRV) is shown in Table 1101-3.

C. Compute the Percent Design Risk Value: From Figure 1101-1, for a Total Impact Rating Value = 22, the value of the Percent Design Risk is 25 percent.

D. Compute the Design Frequency: From Figure 1101-2, for a Percent Design Risk of 25 percent and a construction time of nine months, the recommended design frequency for the temporary hydraulic facility is a five-year return period.

E. The structure should also be sized so that the 10 year storm overtops.

Table 1101-3 Impact Rating Table (Example Problem)	
Factor	Impact Rating Value
Roadway ADT	2
Loss of Life	2
Property Damage	10
Detour Lengths	2
Height Above Streambed	1
Drainage Area	1
Traffic Interruptions	4
TOTAL IMPACT RATING VALUE	22