

Legal Aspects of Backwater from Culverts

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This paper deals with the effects of ponding immediately upstream of culverts and examines the problem of liability for damages to private property. It does this by citing several actual and hypothetical cases that illustrate at least three special conditions: (1) flooding caused only by natural runoff in excess of the design flood for the structure; (2) a progressive increase in runoff caused by urbanization of the watershed; (3) increased runoff caused by physical changes within the watershed, such as drainage improvements or diversion of flow from outside drainage areas. The legal responsibility for flood damages in each case is examined in the light of case histories. Finally, some guidelines are developed to assist the highway drainage engineer in coping with these problems.

•AN UNDERSTANDING of backwater from culverts and its legal implications involves, first, an elemental knowledge of the hydraulics of culverts and, second, a definition of backwater in relation to culvert operation.

Culverts are conduits for carrying natural and artificial watercourses through a roadbed. They are usually smaller in cross-section than the watercourses for which they substitute. This constriction in channel cross-section causes the water at the inlet of the culvert to rise, imparting sufficient energy to force the water into the culvert at the same rate that it approaches the inlet. The incremental rise in water level at the inlet of the culvert, above the level which would have prevailed if the watercourse were not influenced by the culvert, is called "backwater." A more common term is "ponding" or "ponding effect."

The depth of the backwater and the configuration of the terrain upstream of the culvert determine the areal extent of the ponding effect. Backwater depth depends on the hydraulic performance of the culvert and the amount of runoff, or flow, to which it is subjected; configuration of the terrain, whether the topographic relief is broad and flat or narrow and steep, establishes the relative magnitude of the ponding effect. The two factors are closely associated. Obviously, a small amount of backwater could have a widespread ponding effect, and, conversely, a large amount of backwater could have a limited ponding effect.

Backwater depth as a function of the hydraulic performance of a culvert is often a composite of several effects, some of which are not readily understood or precisely definable. The two most common influences, however, are (1) the size and shape of the culvert and (2) the amount of runoff relative to the capacity of the culvert.

The size of the culvert is an obvious factor; but, size for size, the shape has a more pronounced effect on backwater depth. For example, a box culvert which is high and narrow produces more backwater than a low and wide box culvert of the same cross-sectional area. Thus, the degree to which the watercourse is constricted at the culvert inlet is related to backwater depth.

The capacity of a culvert depends on the hydraulic conditions under which it must operate. Normally, a culvert is designed so that the expected runoff will not submerge the inlet. If the inlet becomes submerged, the backwater effect increases sharply with little increase in culvert capacity. Runoff, therefore, which exceeds the design capacity of a culvert causes a significant increase in backwater.

In the field, backwater effect is readily measured either by observed high water levels during a runoff period or from identifiable high water marks following a runoff event. The high water elevation on the upstream side of a culvert is known as the "headwater" level. The corresponding elevation on the downstream side is the "tailwater" level. The "head differential," or the difference between the headwater and tailwater levels, less any unsubmerged fall in the culvert, is the backwater effect. This would not be true for a culvert with a "free" outfall unaffected by tailwater. The backwater in such a case would be the headwater depth at the inlet less the normal depth of flow in the watercourse. The normal depth must be computed from the channel geometry assuming no highway culvert is in place.

The extent of backwater damage, obviously, is related to land use within the backwater area. A designer must weigh the cost of minimizing backwater effect against the probability of incurring damage claims. Sometimes it is more prudent to bear the cost of more capacity than to run the risk of extensive damage. For most installations, however, the damages are likely to be light; and it is more economical to take a calculated risk. (It should be added that backwater flooding is not the only risk evaluated by the culvert designer. The danger of building up a head against a highway embankment, possibly causing a washout of the roadway, interruption of traffic, and flood damages downstream, merits equal consideration.)

Standard practice requires that culverts be designed for floods that occur on the average of once in a given number of years. For major highways and freeways the criterion is once in 50 years, or higher if the risks warrant. The difficulty is predicting the magnitude of the 50-yr flood with accuracy because the science of hydrology, subject to the whims of Mother Nature, has not kept pace with advancements in hydraulics. More important are problems associated with runoff that exceeds design capacity. Such runoff might be caused by (1) "Act-of-God" rainfall, (2) developments within the watershed, or (3) diversion of runoff from one watershed to another.

In this discussion it should be noted that the law governing watercourses is substantially different from the law governing surface waters. Generally speaking, a riparian owner has a right to have a natural watercourse flow unimpaired in both quality and quantity. The common law regarded surface waters as a common enemy and one could rid himself of them in any manner without liability. The common law rule regarding surface waters has been modified in most jurisdictions. (See 24 Minnesota Law Review 891 for a discussion of the various holdings.) Minnesota follows the reasonable-use rule as laid down in the leading case of *Sheehan v. Flynn*, 59 Minn. 436, 61 N.W. 462. In the three cases which follow, Case I deals with a fact situation involving a watercourse, though legal cases involving surface waters are used also; Case II is assumed to relate to surface waters; and in Case III the facts involve both a watercourse and surface waters. In all three cases it is assumed that the immunity of the State was waived, thereby placing the State in the same position as a private party.

CASE I

Engineering Details

During September 1957, a heavy rainfall produced a small flood at a highway stream crossing. Subsequently, a farmer residing immediately upstream of the highway brought a claim against the State contending that the flooding was caused by insufficient culvert capacity. His claim amounted to \$8,475 and included losses to 123 acres of cropland, 90 acres of meadow, 40 acres of pasture, and damages to farm buildings and livestock.

An investigation revealed that the offending structure was a concrete box culvert 10 ft wide and 4 ft high. Newspaper accounts and pictures led to the conclusion that the maximum headwater level peaked 1 ft below the highway's profile grade and that the maximum head differential between headwater and tailwater was 1.3 ft. The runoff was generated by a rainfall of 5.8 in. as recorded at a nearby weather station. Weather Bureau records disclosed that the rainfall was the heaviest in 49 yr. Because the rainfall exceeded the previously recorded 24-hr maximum by 2 in. and the culvert had not been overtaxed since its construction in 1932, it was concluded that the runoff probably exceeded the 50-yr flood for the stream.

The terrain upstream of the culvert site is a slightly undulating, ancient lake bed, and the watercourse lies only about 4 ft below the level of the farmstead. It was apparent that widespread flooding would have occurred regardless of the highway backwater effect. Engineers investigating the claim approached the problem on the basis that the only responsibility attributable to the State was damage in excess of that which would have occurred without the highway influence. Accordingly, two contours were defined by survey, one at the backwater level and the other 1.3 ft lower. The area between the two contours defined the fringe area affected by backwater. Through the presentation of this evidence and other engineering details at the claim hearing, the State was successful in reducing the allowed damages to \$2,200.

Legal Comments

The manner of handling the claim and apportioning the damages attributable to the highway influence is in accord with a number of decisions in this country, provided the State was in some measure negligent in constructing or maintaining the highway and its drainage facilities. The theory of those cases providing for apportionment of damages is that the defendant should only be liable for the damages attributable to his negligence and not be liable for the damages which would have occurred without his negligence from a so-called "Act of God."

Minnesota does not follow the attributable-damages rule. In *Bibb Broom Corn Co. v. Atchison, Topeka and Santa Fe Ry.* 94 Minn. 269, 102 N.W. 709, the defendant railroad company delayed forwarding a carload of the plaintiff's broom corn; and because of the delay, the boxcar stood in the path of an unusual flood that destroyed the broom corn. The defendant claimed the damage was from an unforeseeable cause, namely an "Act of God." The court stated:

No wrongdoer should be allowed to apportion or qualify his own wrong; and, if a loss occurs while his wrongful act is in operation and force, and which is attributable thereto, he should be held liable.

Inasmuch as the defendant was negligent by reason of delaying the shipment, he was held liable.

In the case of *National Weeklies Inc. v. Jensen and Another* 183 Minn. 150, 235 N.W. 905, action was brought against the City of Winona and its contractor for negligent flooding of the plaintiff's basement while installing a storm sewer. The rule in the *Bibb Broom Corn Company* case was followed. Again there was an unusual storm that the defendants claimed to be an "Act of God" and therefore denied liability. The jury found the defendants negligent and, as a result, liable, even though the damages would not have occurred were it not for the so-called "Act of God." The court stated:

If the damage done was solely the result of an Act of God the city was not liable. If the negligence of the city proximately contributing and an act of God combined to produce the result, the city is liable.

The court does indicate that if all the damages would have occurred in any event without the concurrence of defendant's negligence, by reason of the "Act of God," then the defendant would not have been liable. The Minnesota Supreme Court had previously stated in *Van Wilgren v. Albert Lea Farms Co.* 176 Minn. 339, 223 N.W. 301, that:

If the rainfall was of such a character that the damage to plaintiff's crops would have been equally as great if defendant had made no change in conditions, the acts of defendant could not be said to be the proximate cause of the damage and it could not be held liable therefor.

In Case I, the State denied any negligence. The final payment of \$2,200 was a good compromise because the question would have been a fact question for the jury had the case been tried. Had the jury found negligence by reason of inadequate culvert capacity, the State would have been liable for the entire damages.

What is the rule where there is no negligence on the part of the State in constructing and maintaining roadway and drainage facilities, and damages to property are caused by an unprecedented rainfall?

In the Van Wilgren case, the court held:

...If defendant provided a reasonably sufficient outlet for the water from such rainfalls as in the exercise of ordinary prudence and foresight it ought to have anticipated as likely to occur, and the damage resulted from a downpour so unprecedented that defendant could not reasonably be expected to have anticipated and provided for it, defendant is not liable therefor.

In *Poynter v. County of Otter Tail*, 223 Minn. 121, 25 N.W.2d 708, the court was concerned with a stream or watercourse. It cited the Van Wilgren case with approval and held the county not liable because there was no negligence shown.

The rule, therefore, in Minnesota is that the State is not liable for damages caused by unprecedented rainfall when the State was not negligent in constructing and maintaining its roadway and drainage facilities. This is true in matters involving either watercourses or surface waters. As stated in *Poynter v. County of Otter Tail*:

If defendant provided a proper outlet for the water from such rainfalls as it reasonably ought to have anticipated, it is not liable; but if it failed to provide a proper outlet for the water from such rainfalls as it ought to have expected, it is liable and is not relieved from liability by the fact the rainfall in question happened to be of unprecedented character, for in that case its negligence added to the overflow.

The *Poynter* case cited and quoted from 2 Farnham, *Waters and Water Rights*, Section 577, as follows:

The one about to erect a structure over a watercourse is entitled to act upon the assumption that natural conditions will continue as they have existed within a reasonable time prior to that at which he proceeds with his undertaking. He is not bound to anticipate convulsions of nature, nor floods which have not previously been known to occur. Therefore, where his structure becomes injurious to his neighbor because of an unprecedented flood, he must be shown to have been guilty of negligence in the manner of constructing it, in order to be held liable for the injury.

It is important to point out that the Minnesota Supreme Court, in the *Poynter* case, held it was an error for the trial court to charge the jury that:

...If the defendant, Otter Tail County constructed the embankment and culverts so as to interfere with the natural flow of the water and by reason of it the waters backed up on the land occupied by the plaintiff and did it damage, the defendant county would be liable irrespective of negligence.

In closing Case I, it should be borne in mind that the question of negligence and what could be reasonably foreseen is a jury question.

CASE II

Engineering Details

A small highway culvert was installed near a city at a time when the drainage area of the culvert was rural in character. The culvert served adequately for many years until gradual urbanization increased storm water runoff. The upper reaches of the watershed became a housing project with paved streets, and a toy distributing company built a warehouse in the lower reaches adjacent to the highway. During July 1957, a high-intensity, short-duration rainfall measuring 0.8 in. at an airport two miles away produced flooding at the culvert site. Water backed up to a depth of 20 in. on the floor

of the toy warehouse causing extensive damage to packaged merchandise. Ultimately, the owners of the toy firm brought a claim against the State and the city alleging flood damages to the building and contents in the amount of \$12,000.

Engineers investigating the claim in cooperation with the attorney general's office approached the problem on the premise that flooding was caused by urbanization of the watershed and that the State was not negligent in failing to provide sufficient culvert capacity. Through surveys of highwater marks and culvert geometry, the engineers were able to estimate the maximum runoff occurring from the storm. Using accepted design procedures, the probable maximum runoff was also estimated for the same storm with the watershed in its original rural state. By hydraulic computation, it was shown that the backwater effect for rural conditions was more than 20 in. less than that for urban conditions.

The State legislative claims commission on hearing the evidence of both parties declined to render a judgment and recommended that the State legislature by legislative action waive the State's immunity from suit in the matter. The legislature ultimately granted the claimant the right to sue the city and State jointly. After thorough investigation by the attorney general's office and the city attorney, it was determined that the applicable law was not sufficiently conclusive to warrant the risk of an unfavorable verdict. The plaintiff agreed to an out-of-court damage settlement in the amount of \$3,500. The State's share was \$2,333.33.

Legal Comment

There are only a few cases in the country that have actually considered the legal questions raised by Case II. Most of these cases involve municipalities rather than the State itself. Even in cases involving municipalities, the authorities are divided. Some authorities hold that a municipality is not liable when, by reason of increased improvements and general urbanization of the area, a storm sewer becomes inadequate and results in flooding. Reasons for the rule are immunity of suit and statutory provisions and holdings that municipalities are not liable for defective plans. Therefore, the problem does not arise in most jurisdictions. There are a few cases that have held a municipality liable for damages occasioned by an inadequate storm sewer, although the storm sewer was adequate when constructed and the inadequacy was the result of the city's growth (See *Louisville v. Leezer*, 143 Ky. 244, 136 S.W. 223). It was held that the city's obligation extended to making such changes as the changed conditions made necessary.

It is apparent that there is a difference in the fact situation between the State constructing a highway and a municipality constructing a street and providing storm sewer service. The municipality grants building permits and actually authorizes the growth that causes the drainage facilities to become inadequate. It, of course, has notice of the growth because it is a party to that growth. The State of Minnesota, on the other hand, does not control the growth of the municipality. If areas surrounding truck highways become urbanized, the highway department has little means, if any, at its disposal to control the growth. It usually does not have much notice of impending urbanization until it is largely an accomplished fact. For that reason, it is not believed that the State is legally in the same position as a municipality under the fact situation stated in Case II. In no event should it be an insurer of the adequacy of its facilities under changing conditions.

This does not mean, however, that the State has only to provide drainage facilities adequate to meet present needs. As stated by the Minnesota Supreme Court in the *Van Wilgren* case and the *Poynter* case (both cited and quoted from in Case I), a defendant in a drainage action involving the adequacy of a drainage structure must provide a outlet for the water from rainfalls as reasonably anticipated. The *Poynter* case involved a watercourse; the *Van Wilgren* case, surface waters. The *Van Wilgren* case seemed to follow the law of watercourses. Yet it could be the authority for future decisions involving surface waters. If so, it would not be stretching the legal principle involved to conclude that the State, in constructing its highways and the drainage facilities appurtenant thereto, is required to construct drainage facilities adequate to handle surface water from such area development as can be reasonably foreseen.

There are no Minnesota Supreme Court cases directly in point. However, the language in other cases as well as the Van Wilgren case may serve as a guideline.

As mentioned previously, with reference to surface waters, Minnesota is committed to the reasonable-use rule. A landowner may rid his land of surface waters and cast them on the lands of others, together with waters that otherwise would not have gone there, if:

- (a) There is a reasonable necessity for such drainage;
- (b) If reasonable care is taken to avoid unnecessary injury to the land receiving the burden;
- (c) If the utility or benefit accruing to the land drained reasonably outweighs the gravity of the harm resulting to the land receiving the burden; and
- (d) If when practicable, it is accomplished by reasonably improving and aiding the normal and natural system of drainage according to its reasonable carrying capacity, or if, in the absence of a practicable natural drain, a reasonable and feasible artificial drainage system is adopted....What is a reasonable use is a question of fact to be resolved according to the special circumstances of each particular case. *Enderson v. Kelehan* (1948) 226 M. 163, 32 N.W. 2d 286.

In *Bush v. City of Rochester* (1934), 191 Minn. 591, 255 N.W. 256, the city was held liable for damage by reason of not reasonably providing for the disposal of surface water when it constructed a city street. The court held that the disposition of surface waters must be "reasonable under all the circumstances."

In *Greenwood v. Evergreen Mines Company* (1945), 220 Minn. 296, 19 N.W.2d 726, the plaintiff brought action against the Evergreen Mines Co. and the Village of Crosby. The Evergreen Mines Co. was dismissed out. The facts were that the village had placed a 42-in. culvert under a road at Serpent Creek that was the natural outlet from Serpent Lake. Thereafter, and during the dry years of the 1930's, additional culverts were placed downstream to handle the flow in Serpent Creek at locations where additional roads were built. These culverts varied in size from 9 to 36 in. They were adequate for the flow at the time of construction. When the dry spell was over and rainfall increased, the level of Serpent Lake rose and the culverts were no longer adequate. Some of the culverts were plugged up, some intentionally so. The result was flooding of the plaintiff's property. The court quoted "McQuillan on Municipal Corporations," Section 2877, with approval:

...The duty of a municipality with respect to culverts to take care of surface water coming through a natural drain does not end with the original installation, but is a continuing one, to be exercised with due regard to changed conditions affecting the flow of water to be accommodated by the culverts.

The Greenwood case involved a natural watercourse. Nevertheless, it gives an indication of the court's thinking; and, together with the other cases, it would appear that the State in constructing its highways must make reasonable provision for disposing of surface waters. In making such provision, reasonable care to prevent unnecessary injury to others may require that it take into consideration changing conditions that are reasonably foreseeable. If, considering all the factors of a particular location, it can be reasonably foreseen that the area will develop, provisions should be made in constructing the highway to provide drainage facilities reasonably adequate to handle the anticipated increase in runoff due to the anticipated urbanization of the area. The test is reasonableness. Consideration probably can be given to anticipation of the probable construction of storm sewers to handle much or all of the increased surface waters. Agreements can sometimes be worked out with municipalities for sharing the costs of larger culverts when development within the municipality is imminent. Each case must be decided on the basis of its individual facts. Few, if any, contemplated in the 1940's the vast commercial and residential expansion into suburban and rural areas that is taking place in the 1960's. This should be taken into consideration in exercising reasonable prudence.

A problem suggests itself: Assume that the State could not reasonably have anticipated the increase in surface waters caused by the urbanization of the area and assume no negligence in maintenance. The urbanization of the area becomes an accomplished fact. Would the State then be legally required to make changes to accommodate the increased flow of surface waters? The answer would be in the negative. However, more often than not, the increased surface waters adversely affect the highway; and to protect the highway, the road authority makes the necessary changes. In many instances the municipality or political subdivision takes the necessary steps to provide other means of surface-water disposal. And there are instances where the property owners themselves have provided the means of carrying the water away.

In settling Case II the State and the city avoided the possibility of a much greater liability than the actual settlement. There was evidence too, not mentioned in the engineering details, that the culvert in question had become partly plugged with mud and silt and that weeds and reeds had grown up adjacent to both its inlet and outlet, thereby decreasing its efficiency and raising the question of negligence. The actual fact situation, from which hypothetical Case II is taken, was more complicated than the facts stated in this paper. It should further be borne in mind that what constitutes a watercourse and what is merely surface water is sometimes difficult to determine. These comments in Case II are limited to surface waters. A stricter rule of law applies to watercourses.

CASE III

Engineering Details

Two major highways are joined above the mouth of an intermittently flowing stream at the outskirts of a small city. The watershed covers 4,350 acres and is rural in character. The terrain is undulating in the upper reaches but falls sharply in a deepening valley at the highway junction. A box culvert 10 ft high and 10 ft wide constructed in 1924 carries runoff through the junction to a riprapped channel parallel to the highway and another box culvert of equal size under an intersecting street. The capacity of these culverts was overtaxed in 1953, and in an effort to control the backwater effect of future floods, the road authority constructed retaining walls over the inlets and along the approach channels to contain the backwater.

On Memorial Day, 1959, a sudden storm broke over the watershed and, according to available reports, 5.1 in. of rain fell within a 2-hr period. The swiftly concentrating runoff overtaxed the box culverts, and the rapidly rising backwater quickly overflowed the retaining walls and highway. A greenhouse, drive-in business, veterinarian's quarters, and a number of houses were damaged by the sudden flood. Claims totaling more than \$40,000 were ultimately filed against the State.

The engineering investigation revealed that while the rainfall causing the flood was virtually unprecedented, the culverts were in fact too small for a flood of much less magnitude. A contributory fact, bearing on the responsibility for the inadequacy of the structures, however, was brought out. A few years preceding the flood, a farmer had ditched an extensive slough into the watershed. The slough had a drainage area of 830 acres, roughly 20 percent of the total watershed. Runoff from this drainage overtaxed a 4-ft square box culvert at a township road intersection and overflowed the road to a depth of several feet. The ditch had been constructed as a private project and there was no evidence that any public authority had granted permission for the outlet.

In hearings before a legislative committee on claims, the State denied total liability on the basis that the rainfall was an "Act of God" and the illegally diverted drainage contributed to the damages. The committee ultimately recommended a substantial reduction in the payment of alleged claims, but the question of illegal diversion of drainage was never pursued.

Legal Comment

Case III involves a watercourse. The recited facts would indicate that the State in placing the culvert in 1924 did not provide a reasonably sufficient outlet for the water from rainfalls as ought to have been reasonably anticipated. Assuming the facts as

indicated, the State would be liable unless all of the damage would have occurred irrespective of the State's negligence (See comments in Case I and cases cited therein).

The State also claimed that another and intervening cause was responsible, at least in part, for the damages; namely, the diversion of surface waters from the slough into the watercourse.

Case II cited and quoted from the *Poynter v. Otter Tail County* case when the Minnesota Supreme Court cited "2 Farnham on Waters and Water Rights" to the effect that "one about to erect a structure over a watercourse is entitled to act on the assumption that natural conditions will continue as they have existed within a reasonable time prior to that at which he proceeds with his undertaking."

The State could not have foreseen the drainage of the slough in 1924. Had the culvert been adequate, when installed, for reasonably anticipated waters that the State could have foreseen, the State would not have been legally liable for flooding caused solely by the overtaxing of its culvert due to the increased flow of water from the slough.

The claims committee of the legislature allowed a part of the claims presented. The damage award was not pursued because there is no statutory appeal provided for the allowance of a legislative claim; and even if there were, the failure of the State to provide an adequate opening would have weighed heavily in determining whether to appeal or not.

CONCLUSION

The lesson to be learned from Cases I and II is that there is no substitute for the adequate design of culverts if the road authority is to escape or mitigate its liability for damage from backwater. From a legal standpoint "adequate design" would mean that there could be no finding of negligence if the adequacy of a culvert became a matter for litigation.

The engineering approach to "adequate design" of culverts involves professional judgment and skill in the application of the principles of hydrology and hydraulics. Certainly an engineer should determine the design runoff on the basis of rare past runoff events, increased, if warranted, to allow for such developments as can be reasonably foreseen. Equally important for all major culvert structures is the need to analyze the hydraulic performance with respect to the design runoff and to determine the probable backwater effect. If the risk of backwater damage is high, the engineer might well weigh the cost of increasing the size of the culvert against gaining control of the backwater area through a flowage easement or other means.

There are many culverts on public highways throughout the country that have not had the benefit of a through hydrologic and hydraulic analysis. Many of these are likely to be sources of future damage claims. Likewise, urbanization will affect many of the watersheds and problems like Case II will arise. Each situation will call for presentation of the facts by an engineer-lawyer team. Gathering the evidence is the engineer's job, but it requires close liaison with the lawyer to obtain the facts pertinent to a defense of each case. Local jurisdictions may well determine what evidence is admissible, but the lawyer will attempt to have admitted all facts pertinent to the defense.

This paper emphasizes that liability for damaging backwater at culverts is a question of negligence, either wholly or in part. It further emphasizes that if runoff occurs that could not be reasonably foreseen at the time the culvert was installed, the road authority should not be held liable. Runoff that cannot be reasonably foreseen, assuming no man-made interference such as covered by Cass III, is given expression by the phrase "Act of God." There is nothing magical about it that automatically relieves the road authority of responsibility. What is needed to escape liability is evidence to prove that the storm, flood, or other convulsion of nature could not have been reasonably anticipated.