Minnesota Public Drainage Manual

Chapter 3 – VII. Engineering and Environmental Considerations - Repair/Maintenance of Drainage Systems

Summary

Deterioration of drainage systems over time is inevitable, requiring regular maintenance. If a drainage system is not sufficiently maintained, a minor or major repair of the system may be required. The term "repair" is defined within **Minn. Stat. 103E.701, subd. 1** and has a bearing how some drainage activates can be executed and regulated (see **Section VII, A**).

The "As Constructed and Subsequently Improved Condition" (ACSIC) of a public drainage system must be determined to understand if proposed work may be consider "repair" and what regulations are applicable. Determination of the ACSIC is discussed in more detail within **Section VII, B**.

Additionally, drainage law requires regular inspection of drainage system (**Minn. Stat. 103E.705**) to ascertain the need for repair and/or maintenance. (**Section VII, C**).

Drainage law does not require the appointment of an engineer for non-petitioned repair of drainage systems. This type of repair project is brought to the attention of the drainage authority by the inspection and written report. Non-petitioned repair includes (1) routine maintenance, and (2) less frequent and more extensive repair. See **Section VII, D** for more description.

Petitioned Repair may include "resloping ditches, incorporating multistage ditch cross-section, leveling spoil banks, installing erosion control, or removing trees" along with other activities. For petitioned repair projects, the drainage authority must appoint an engineer to be responsible for examining the drainage system to determine the extent of the repair. See **Section VII, E** for more information on this process.

Contracting and levying for maintenance and repair (**Section VII, F**) and drainage code provisions for private bridges and culverts (**Section VII, G**) are also further discussed in referenced sections.

A. General

Eventually, a minor or major repair of the system is required.

All drainage systems deteriorate with time, but at varying rates. Deterioration can be caused by a number of factors, including but not limited to wet and dry climatic periods, sedimentation, overgrowth of vegetation, erosion of the ditch bottom and side slopes, sloughing of side slopes due to soil instability, human activity (e.g., agricultural encroachment), or other factors not specifically listed here. Per **Minn. Stat. § 103E.705**, the drainage authority "shall maintain the drainage system that is located in its jurisdiction, including the permanent strips of perennial vegetation under **Minn. Stat. 103E.021**, and provide the repairs necessary to make the drainage system efficient." If sufficient periodic maintenance is performed on the system by the drainage authority, this requirement will be met. Unfortunately, many drainage systems are not sufficiently maintained for reasons such as inadequate inspection, lack of a maintenance schedule, limited repair funds due to need of redetermination, or difficult accessibility. The result is reduced drainage efficiency. Eventually, a minor or major repair of the system is required, and in some instances an Improvement may be warranted.

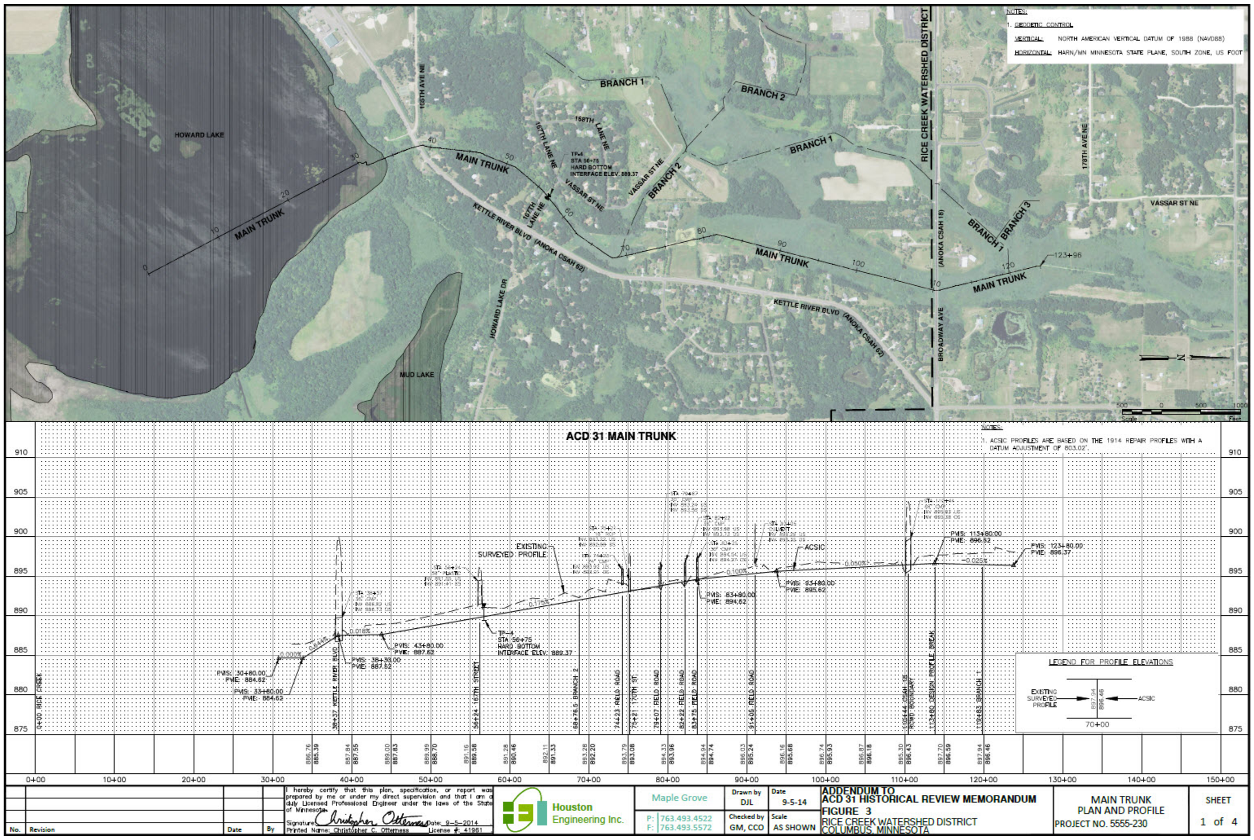
The definition of Repair found in **Minn. Stat. § 103E.701, Subd. 1**, is:

> *to restore all or a part of a drainage system as nearly as practicable to the same hydraulic capacity as originally constructed and subsequently improved, including resloping of ditches and leveling of spoil banks if necessary to prevent further deterioration, realignment to original construction if necessary to restore the effectiveness of the drainage system, and routine operations that may be required to remove obstructions and maintain the efficiency of the drainage system.*
>
> *''Repair" also includes:*
>
> *(1) incidental straightening of a tile system resulting from the tile-laying technology used to replace tiles;*
>
> *(2) and replacement of tiles with the next larger size that is readily available, if the original size is not readily available*.

As noted in the above definition of a repair, resloping is allowed as part of a repair proceeding. Resloping (i.e., constructing to a flatter side slope) is commonly justified because of its ability to preclude future repairs due to soil instability or high flows during spring snowmelt. The resloped ditch is also easier for the drainage authority to inspect and maintain as related to weed and vegetation management, and for grass harvesting operations by private landowners. For resloped ditches, spoil piles adjacent to the ditch may provide some additional benefit by redirecting water on the field side to nearby side-inlet controls to meter water into the ditch.

Note: Drainage Law distinguishes between two types of repair: non-petitioned (repair/maintenance) and petitioned repair. However, that distinction is not made by the Minnesota Department of Natural Resources (DNR) and the US Army Corp of Engineers (USACOE). Please see the note below and Section B and contact the agencies as necessary to meet the requirements of federal and state law and/or rule.

*Note: Persons proposing any activity (including maintenance or repair of drainage systems) that may involve work affecting a Navigable Water of the U.S., or a discharge of dredged or fill material into any wetland or water area, should contact the U.S. Army Corps of Engineers (USACOE) to determine if their project will require a USACOE's permit or authorization. These activities may also impact landowner benefits under the Food Securities Act of 1985, as subsequently amended. A more detailed discussion of these issues can be found in **Chapter 3, Section II**.*



B. Determination of As-Built Condition (Original Grade)

The engineer is often responsible for determining the As Constructed and Subsequently Improved Condition" (ACSIC).

Since by definition a repair is the restoration to the "As Constructed and Subsequently Improved Condition" (ACSIC), the engineer is often placed in the position of determining that condition. Repair activity beyond the ACSIC can affect adjacent natural resources, such as public waters, navigable waters, and wetlands. Consequently, the regulatory authorities that administer these resources (LGU, DNR and USACOE) have the responsibility to monitor drainage system repairs.

There is no single best method for establishing the ACSIC. Original construction plans are seldom complete and frequently reference benchmarks which in most situations have been destroyed or removed. "As-built" construction plans rarely exist on older systems, and the actual grades constructed may not match those shown on the construction plans. Therefore, establishment of the original grade line is very challenging and becomes a matter of professional judgment. The drainage authority is ultimately responsible for making this determination, after consultation with their engineer.

However, if the repair may affect a public water, **Minn. Stat. § 103E.701, Subd. 2**, stipulates that before a repair is ordered the commissioner of DNR must be notified about the proposed repair and its associated repair depth. The DNR may request additional information to support their review. If the commissioner disagrees with the repair depth as provided to the drainage authority, a 3-member panel, consisting of the engineer, a representative of the DNR, and a local soil and water conservation district technician will make a joint recommendation to the drainage authority.

There are several methods of utilizing field data to determine the grades of the ACSIC. These methods (in order of expected reliability) include:

1. Test pits;
2. Soil borings;
3. Existing culvert comparison; and
4. Natural ground/cut sheets

1. Test Pits

Test pits are one of the most reliable ways to observe the depth and cross-section of construction.

One of the most reliable ways to observe the depth and cross-section of the original construction (or as subsequently improved) of an open channel system is through the use of test pits. A test pit is an excavation perpendicular and through the open channel bottom and sideslopes, typically completed using a backhoe or excavator. Ideally, the test pit should be excavated to a depth extending at least 1 foot below the bottom of the historic channel bottom (and into parent base soils). The excavation should reveal soil horizons which include native organic soils (e.g. topsoil), native mineral (inorganic) soils, spoil materials, and accumulated sediment. In most cases, the historic channel bottom can be observed at the interface between the accumulated sediment and native mineral soils. This interface can then be surveyed to determine the ACSIC grade at the location of the test pit.

Because of the expense of contracting excavation equipment for test pits, it is typically impractical to complete a sufficient number of test pits to describe the as-constructed channel profile solely based on the test pit observations. Instead, the preferred methodology is to utilize the test pit data to correlate historic design plans to a common sea level datum (e.g. NAVD 88). A minimum of four test pits is recommended to develop this datum correlation, although more may be required if the data is inconclusive or if multiple historic plan sets were used to construct the system.

There are several limitations to test pit determinations of the ACSIC. First, the open channel section must be situated in native mineral soils to yield a conclusive result. Where the open channel crosses deep organic soils (e.g. peat), it is difficult to distinguish the interface between the sediment (usually organic) and the organic native soils at the historic channel bottom. Likewise, test pit excavations where the open channel bottom is partially submerged can be challenging or even infeasible, as the water in the excavation may not allow for the interface of the sediment and the native soils to be viewed. Finally, the use of test pits is impractical for portions of the public drainage system that were deepened through undocumented modifications, since this methodology relies on the use of historic plans to develop the ACSIC profile.

2. Soil Borings

Well executed soil borings are also a good way to identify the historic open channel bottom as it was originally constructed or subsequently improved.

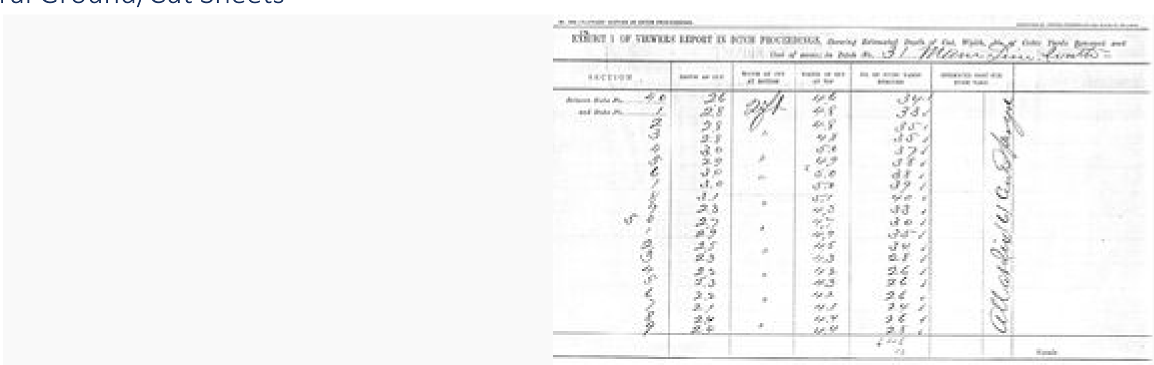
Like test pits, soil borings can be utilized to identify the interface between the organic soils in the channel bottom and the native mineral soils, which is evidence of the historic open channel bottom as it was originally constructed or subsequently improved. Similar to the test pit methodology, the surveyed soil borings can be used to develop a correlation between the historic design plans and a common sea level datum. However, since soils borings are relatively inexpensive, they can also be utilized to define the ACSIC open channel profile **without** a design plan, by completing the soil borings at intervals along the entire length of the public drainage system open channel and creating best-fit profile lines through the surveyed elevations.

Soil borings are best utilized where the open channel is well-defined and is situated in native mineral soils. As with test pits, soil borings are often inconclusive in locations where the open channel crosses through deep organic soils. Soil borings can also be inaccurate if they are not located close to the historic excavated channel bottom. Over time (particularly when the public drainage system has not been maintained) the open channel bottom can shift laterally as sedimentation and erosion occurs. This lateral movement of the channel bottom can typically be observed through a test pit, but a soil boring placed in the current channel bottom may actually be located in the historic channel sideslope and infer a channel bottom elevation higher than it actually was constructed. For this reason, it is important when using this methodology to plot the soil borings in profile along the open channel and use statistics and engineering judgment to remove “outliers” where necessary. Providing good documentation of these decisions is critical.

3. Existing Culvert Comparison

When test pits and soil borings are infeasible, the ACSIC channel profile can be determined by surveying existing culverts along the public drainage system and use the elevations to either 1) correlate the historic plans to a common sea level datum, or 2) independently define grades along the ACSIC profile. This methodology assumes that the culverts were installed at the as-constructed channel bottom. While this generally has been the preferred placement in a standard roadway crossing design, in practice, culverts often were placed at the elevation of the current open channel bottom. This channel bottom elevation may be substantially higher than the ACSIC due to sedimentation, particularly when the culvert is installed without an engineered design (e.g. private driveway and field crossings). Culverts also could have been placed after excavation to provide bedding foundation, in which case the culvert could be lower than ACSIC. When using existing culverts to establish the ACSIC, preference should be given to “major” (collector and arterial) roadway crossings and documentation provided as to how the culvert represents an accurate, reliable, or defendable reference point.

4. Natural Ground/Cut Sheets



Historic cut sheets from Anoka County Ditch 31 in Rice Creek Watershed District.

One other methodology that has been utilized to determine the ACSIC is to survey the natural ground elevation adjacent to the open channel, and subtract the excavation depth from cut sheets in the original engineer’s report to calculate the design channel bottom elevation. This methodology assumes that 1) the natural ground elevation can be accurately identified and surveyed in the field and is using the same datum as the original survey; and 2) the natural ground elevation has not changed since the construction of the ditch. Because of spoil piles, vegetation, and undulating topography, it can be difficult to ascertain what portion of the adjacent topography (if any) would be representative of natural ground elevation at the location of the open channel. This problem is compounded when the adjacent grades have changed due to land use practices or subsistence of organic soils. Because of these factors, this methodology can be highly inaccurate and should only be used to verify the ACSIC grades determined through other methodologies.

5. Drainage Records Modernization

Because the determination of the ACSIC is critical to defining the depth and cross-section for repairs and maintenance of the public drainage system, and since these determinations rely on the historic record of the drainage system from its inception to its most recent repairs, it is imperative that the drainage authority develop an efficient and sustainable system to manage these historic records. Modern record-keeping practice includes scanning historic and current drainage system files into an electronic format (typically .pdf) and organizing these files via an electronic database. Many drainage authorities have also created GIS layers, geodatabases, and applications to map the public drainage systems they manage and provide georeferenced attribute data (including as-designed or as-constructed dimensions and grades) along the drainage system alignments. These electronic databases greatly increase efficiency and accuracy in managing repairs and maintenance to the public drainage systems and streamline the processes for regulatory review. The State of Minnesota has created (August of 2016) a geodatabase template for any drainage authority to use to organize and store their drainage system hydrographic and management data. Click **here** to find more information regarding drainage records modernization.

For an example of a public drainage system portal, see the **RCWD Drainage System Information Portal**.

> *Note: In support of these efforts, the engineer, when carrying out surveys, is strongly encouraged to geo-reference and report all benchmarks and centerline alignments with a common coordinate system and datum (e.g. county coordinates, state plane, & NAD83 UTM).*

C. Inspection of Drainage Systems

Drainage Law requires regular inspection of drainage systems (**Minn. Stat. § 103E.705**) to ascertain the need for repair/maintenance. Inspections are accomplished by an appointed inspection committee or drainage inspector (appointed per **Minn. Stat. § 103E.065**). It also stipulates that "open drainage ditches be inspected at least once every 5 years when no violation of section **Minn. Stat. § 103E.021** is found and annually when a violation of section **Minn. Stat. § 103E.021** is found, until one year after the violation is corrected." Section **Minn. Stat. § 103E.021** specifies the establishment of Vegetated Ditch Buffer Strips, which are required when viewers are appointed or as established incrementally by the drainage authority under section **Minn. Stat. § 103E.021, Subd. 6** (may or may not require appointing viewers).

The inspection report requirements are found in Minn. Stat. § 103E.705:
"For each drainage system that the board designates and requires the drainage inspector to examine, the drainage inspector shall make a drainage inspection report in writing to the board after examining a drainage system, designating portions of a drainage system that need repair or maintenance of the permanent strips of perennial vegetation and the location and nature of the repair or maintenance."

D. Non-Petitioned Repair of Drainage Systems

Minor routine maintenance of public drainage systems will help avoid costly repairs and mitigate other future issues.

Non-petitioned Repair is any repair or maintenance that is not instigated by a repair petition. Drainage Law does not require the appointment of an engineer for this type of repair. Non-petitioned Repair needs are brought to the attention of the drainage authority via the inspection and written report of the appointed inspection committee and/or drainage inspector. It is possible that an affected landowner will contact the drainage authority with repair concerns, but the inspection committee and/or the drainage inspector are charged with verification of the repair needs and for reporting to the drainage authority in writing.

Non-petitioned Repair covers both **(1) routine maintenance**, and **(2) less frequent and more extensive repair**. Routine maintenance of ditches includes, but is not limited to, removal of isolated sediment deposits and vegetation in the open channel, bridge and/or culvert cleaning, replacement of small culverts, and maintaining vegetation along the ditch bank. This type of work is minor in nature but can be costly if it is not routine.

Examples of more extensive non-petitioned Repair include, but are not limited to, cleaning of continuous sediment deposits in the ditch bottom, fixing of isolated side slope damage due to sloughing, replacing bridges and large diameter culverts, and clearing of trees for access. This type of work is required less frequently.

Non-petitioned repair must meet the definition of repair and not accrue costs that exceed the limits of a repair levy in **Minn. Stat. § 103E.705, Subd. 5 and 6**.

E. Petitioned Repair of Drainage Systems

A petitioned repair of a drainage system requires the appointment of an engineer to examine the system and determine the extent of the repair required.

A Petitioned Repair is any drainage system repair instigated by a petition. That petition can be generated by "an individual or an entity interested in or affected by a drainage system". (**Minn. Stat. § 103E.715**) It can include "resloping ditches, incorporating multistage ditch cross-section, leveling spoil banks, installing erosion control, or removing trees" along with other repair activities.

When a drainage authority receives a Petition for Repair and determines that the drainage system needs repair, it shall appoint an engineer. In this case the engineer is required to examine the drainage system to determine the extent of the repair required including determination of the original grade or depth of the ditch (See **Section B**).

Recommended System Examination:

- A review of any original records on file with the drainage authority pertaining to the original or as improved dimensions of the drainage system;
- A ditch centerline elevation survey to establish the existing ditch profile;
- An estimate of the original ditch grade and profile;
- Documentation of known locations of slope failure; and
- Documentation of structures requiring repair.

If the engineer appointed in relation to a petitioned repair finds that bridges and/or culverts in the drainage system provide inadequate hydraulic capacity for the efficient operation of the drainage system to serve its original purpose, the engineer shall make a hydraulic capacity report to the drainage authority. The hydraulic capacity report must include plans and specifications for the recommended replacement of bridges and culverts, the necessary details to make and award a contract, and the estimated cost." (**Minn. Stat. § 103E.721**)

Upon completing the survey, the engineer must make a written report to the drainage authority. Drainage Law requires that the engineer's repair report document:

- The necessary repair(s);

- The estimated cost of repair;
- All details, plans, and specifications necessary to prepare and award a contract for the repair; and
- In a proceeding to repair a drainage system, if the engineer determines or is made aware that property that was not assessed for benefits for construction of the drainage system has been drained into the drainage system or has otherwise benefited from the drainage system, the engineer shall submit a map with the repair report. The map must show all public and private main ditches and drains that drain into the drainage system, all property affected or otherwise benefited by the drainage system, and the names of the property owners to the extent practicable. **Minn. Stat. § 103E.741, Subd. 1.**

Following is a suggested outline for the repair report.

Repair Report Outline

- Assessment of the general condition of the drainage system and its ability to perform its original function;
- Location and description of required repair work along the alignment of the drainage system;
- Plan and profile of the ditch, including:
  - The existing profile of the ditch bottom;
  - The estimated original profile (grade) of ditch bottom;
  - The invert elevations of all centerline structures; and
  - Benchmark locations and elevations, measured from a single mean sea level datum.
- An assessment of the as-constructed or subsequently improved hydraulic capacity;
- An estimated cost to complete the required repairs; and
- A recommendation that either:
  - The repair work should be accomplished per the Petition; or
  - Further investigations should be authorized; or
  - The work is beyond the scope of a repair and that an Improvement is required.

Although the scope of the engineer's Repair report is limited (relative to an engineer's report required for a Drainage Project (see **Section 3**)), it still must contain sufficient information to be useful as a decision making tool for the drainage authority, and it must be presented at a hearing on the proceeding, as required by law (**Minn. Stat. § 103E.715, Subds. 2, 3, and 4**).

The content of the engineer's Repair report is, therefore, left up to the judgment of the engineer. Because of the nature of a Repair project, hydrologic and hydraulic design is not required by statute (as the original design has already been established). However, the engineer may determine that modeling or other design efforts may be necessary to meet the requirements of the DNR and/or USACOE, or determine the original drainage capacity.

Generally, there is no requirement for the engineer's Repair report to be reviewed by the commissioner of the DNR or the commissioner's staff. However, **Minn. Stat. § 103E.701, Subd. 2** requires the drainage authority to notify the commissioner if the repair would affect public waters. At that point, the DNR may become involved in the proceeding if there is a dispute over the original "as constructed condition" if public waters may be affected). (See **Section B**)

Examples of repair reports can be found in **Appendix 14**.

Note: It is recommended that the engineer consider coordinating with DNR personnel early in the Repair proceeding, even if it appears unlikely DNR will become involved.

F. Contracting and Levying for Maintenance and Repair

If the recommended maintenance and repair costs in any given year for a particular drainage system are less than the greater of the dollar amount requiring the solicitation of sealed bids under **Minn. Stat. § 471.345 subd. 3**, or $1,000 per mile of open ditch in the system, the work may be accomplished by force account (i.e., hired labor and equipment) without a bid letting for a contract. However, it is a common and recommended practice for the drainage authority to obtain quotes from three or more contractors, when feasible and practical. Repairs resulting from a disaster also may be accomplished without sealed bids if (1) the drainage system is destroyed or impaired by floods, natural disaster, or unforeseen circumstances; (2) federal disaster funds have been made available; and (3) the public interests would be damaged by the repair being delayed.

The drainage authority is also limited in the amount of funds available for levying. The levy on any given public drainage system in a calendar year may not exceed the maximum amount of the following: (1) 20% of the benefits of the drainage system; (2) $1,000 per mile of open ditch in the drainage system, or (3) the dollar amount requiring the solicitation of sealed bids under **Minn. Stat. § 471.345 subdivision 3**, except under the disaster provisions noted above.

G. Bridges and Culverts

Bridges and culverts require additional consideration as part of maintenance or a repair project.

The drainage code provides that private bridges and culverts constructed as a part of a public drainage system after March 24, 1947 must be maintained by the drainage authority. Private bridges and culverts crossing the public drainage system but not constructed by the public system are the responsibility of the landowner to maintain. Highway bridges and culverts, however, are a maintenance responsibility of the respective road authority (township, county, state, or federal government body).

If, during a major Repair proceeding, the engineer determines that an existing bridge or culvert along the system lacks sufficient hydraulic capacity because additional lands now drain into the system (which were not originally part of the benefitted area), the engineer shall make a report on the hydraulic capacity of bridges and culverts to the drainage authority (see **Minn. Stat. § 103E.721, Subd. 1**, and **Minn.**

Stat. § 103E.741). The guidance provided in **Section VI.B.2** of this chapter should be followed in conducting this evaluation and in presenting the results.