Town of Bernardston, MA
State Community Compact of
Drainage Structures

Prepared for:
Town of Bernardston, MA
Selectboard

Prepared by:
Stantec Consulting Services, Inc.

October 11, 2017

Table of Contents

1.0 INTRODUCTION

1.1 GENERAL

The Town of Bernardston, MA is responsible for maintaining five hundred eight four (584) waterway crossings, culverts, and drainage structures within the Town limits. All structures were inspected by The Town and the following information was documented for all drainage structures maintained by the Town:

- GPS Coordinates (Latitude and Longitude)
- Crossing or Structure Type
- Approximate Elevation
- Structure Size
- Date of installation (in Decade)
- Condition
- Type of material

The summary of the Survey of Waterway Crossings and Structures, is located in Appendix A. In conjunction with this survey the following types of structures were identified:

- 4 Bridges
- 451 Culverts
- 60 Drop Inlets
- 13 Drywells
- 45 Major Culverts
- 11 Manholes

The condition of these Town maintained drainages structures were identified as Good, Fair, Poor or Very Poor, depending on the existing condition, capacity and functionality. A map of all the drainage structure locations by street with an associated ID number with a color-coded identification of the condition of each structure is provided in Appendix B. A tabulated summary of the information gathered as part of the Town's Survey is provided in Appendix C.

Stantec was hired by the Town to review the existing drainage structure data base, perform inspections of more critical drainage structures (structures identified as poor or very poor), update the assigned conditions of the structures, provide a prioritized list of repair or replacements of existing drainage structures, a time table to replace, expected level of permitting associated with repair or replacement work and approximate associated costs for anticipated repairs or replacement.

1.2 PURPOSE, SCOPE, AND OUTLINE

The purpose of this report is to summarize the inspection of the conditions of existing drainage structures identified by the Town as being poor or very poor and prioritize a list of locations requiring repairs or replacement of the existing drainage structures and/or culverts and to developed a timeline and approach to perform upgrades to the Town's existing drainage system.

We reviewed the following criteria during our inspection of the Town's existing drainage structures:

- Existing wetlands present requiring permitting,
- Existing stream crossing requiring major environmental permitting,
- Environmentally sensitive areas,
- Floodplains,
- Drainage structure material(s),
- Culvert end treatments (Flared End Sections of Headwalls),
- Approximate cover over Pipes,
- Roadway side slopes,
- Signs of flooding of the inlet/outlet,
- Signs of erosion and/or sedimentation of the drainage course,
- Signs of bank erosion,
- Rip rap location, size and material,
- Existence of and condition of the pipe end treatments, pipe joints, pipe alignment,
- Signs of settlement, heaving, washout in proximity to the structure,

- Overall conditional assessment of the structure,
- Approximate Sizing

Individual field reports summarizing the listed criteria above for each drainage structure maintained by the Town are located in Appendix D. Sample pictures of the drainage structures inspected are located in Appendix E.

2.0 DRAINAGE STRUCTURES CONDITION ASSESSMENT

2.1 CULVERTS

A majority of the drainage structures that were inspected were culverts, primarily cross culverts that convey storm water from one side of a road to the other, with some additional cross-country culverts that run through and in wooded areas outside of the roadway.

A high percentage of the culverts inspected were corrugated metal pipe (CMP) or 'metal' as identified as the material in the culvert inventory. Culvert condition designations were changed in the drainage structure inventory based on our inspections from poor to good for metal culverts that have been replaced with high density polyethylene pipe (HDPE) (plastic) since the previous inspection. The materials of the existing culverts documented by the Town are reinforced concrete pipe (RCP), Clay, Tile, HDPE, CMP and in some instances a combination of CMP and HPDE or RCP and HDPE pipe where repairs have been made with HDPE pipe. Over fifty percent of the Town maintained drainage structures are CMP culverts. Table 1 provides a breakdown of inspected culvert materials as compared to the Town wide culvert database noted material types.

Table 1: Stantec Inspected and Town Documented Culverts by Material

Culvert Material	Inventory Material Designation	# of Culverts Inspected	# of Culverts Town Wide	%-Culverts Poor/Very Poor
CMP	Metal	101	311	32%
HPDE	Plastic	0	202	0%
RCP	Concrete	0	46	0%
CMP/HDPE	Met/Plst	5	10	50%
RCP/HDPE	Conc/Plst	0	1	0%
Clay or Tile	Clay Tile	0	2	0%

Metal culverts are susceptible to corrosion, especially in locations of salt application and where a section of the culvert is exposed to ambient conditions. In general, most of the culverts that were inspected had some level of material corrosion on the bottom and outlet of the pipe. Photo 1 shows an example of corrosion observed at the outlet of one of the culverts that was

inspected. It should be noted that in the Town's existing inventory, all of the existing HDPE culverts are categorized as being in good condition.

Photo 1: Corroded Metal Culvert at Outlet

Roughly sixty-five percent (65%) of the culverts inspected are twelve-inch diameter pipes or smaller, with nine existing culverts being six-inch and eight-inch diameter pipes. Table 2 provides a breakdown of inspected culvert sizes as compared to town wide database of culvert sizes.

Table 2: Stantec Inspected and Town Maintained Culverts by Size

Culvert Size (in)	# of Culverts Inspected (Very Poor/Poor)	# of Culverts Town Wide	%-Culverts Poor/Very Poor
< 12"	9	9	100%
12"	58	280	21%
15"	39	155	25%
18"	4	12	33%
24"	6	23	26%
30"	0	1	0%
36"	5	13	38%
48"	0	1	0%
72"	0	1	0%

Inlet flooding, sedimentation and outlet scour conditions were observed at a number of culverts inspected, these conditions appear to be attributed to limited culvert capacities, either due to sediment/silt blocking the inlet or the diameter of the existing culvert is undersized to convey the tributary stormwater flows. Photo 2, shows a culvert with limited inlet capacity due to sedimentation build up at the inlet.

Photo 2: Culvert Inlet with Limited Capacity

Roughly half of the inspected culvert locations are on gravel roads, where it is more common that sedimentation and erosion will accumulate in the ditch, limiting capacity of the existing culvert. At the cross culvert locations on Haigis Branch Road it was observed that the shoulder and side slopes on the outlet side of the existing culverts are eroding. This appears to be attributed to water backing up in the ditch due to the limited capacity of the cross culverts, overtopping the road and eroding the downhill side slopes. Photo 3 shows an example of this occurrence at Haigis Branch Road culvert#5.

Culvert repairs consisting of multiple pipe materials, i.e. concrete and plastic or metal and plastic should be considered temporary and can be problematic. The inspection of these structures identified some misalignment of the culvert at the pipe material transition joint.

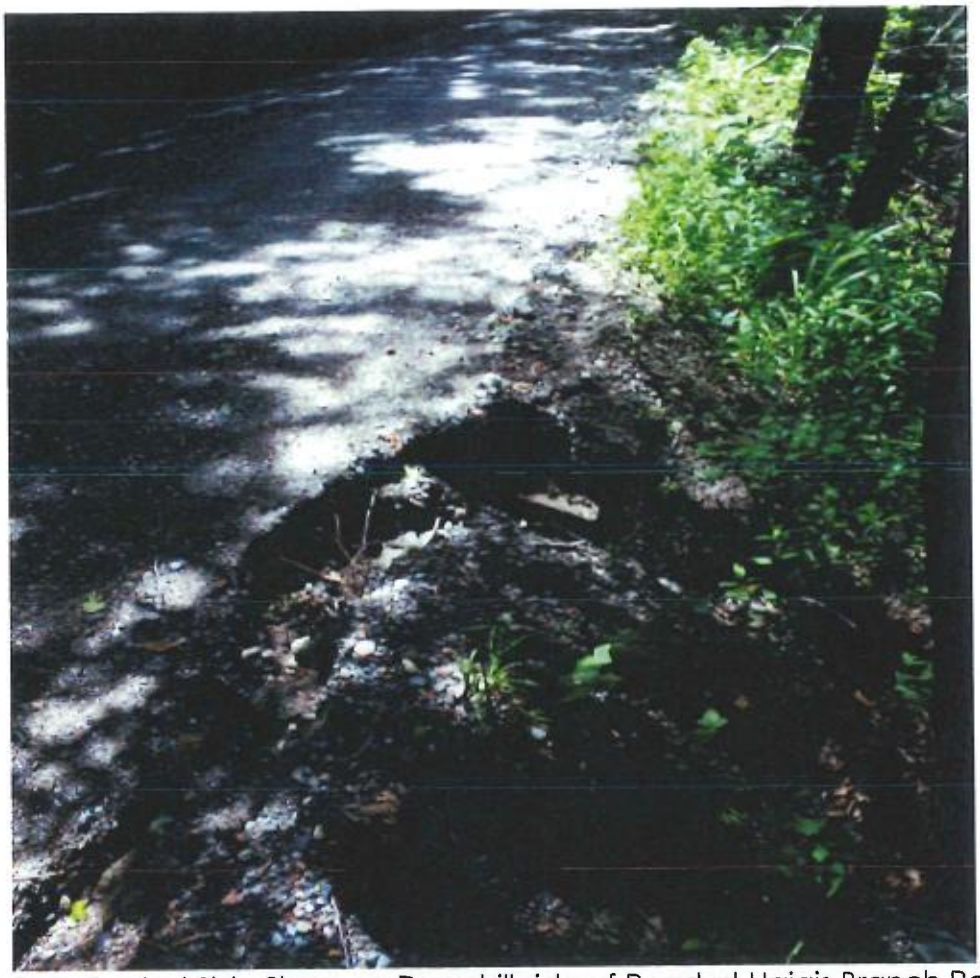

Photo 3: Eroded Side Slope on Downhill side of Road at Haigis Branch Road

Approximately ten percent of the Town's culvert inventory has been installed since 2000, but none of the culverts inspected or identified as poor or very poor have been installed within the last 30-years. Table 3 provides a breakdown of approximate age of the culverts inspected as compared to the age of culverts identified in the Town wide database. A majority of the culverts identified as poor or very poor were installed between the 1960's and 1980's.

It should be noted that all of the existing concrete culverts are categorized as good or fair regardless of the age of the culvert. The drainage structure inventory indicates that the Town started installing plastic culverts in the 1960's, given that plastic pipe was not available until the 1980's it is more likely that these plastic culverts were install from 1980 or later. Additionally, four culverts with drop inlets on South Street were installed post 2000, all are currently classified as in fair condition, despite only being roughly 10-12 years since they were installed.

Table 3: Inspected and Town Maintained Culverts by Material

Year Installed	# of Culverts Inspected	# of Culverts Documented	%-Culverts Poor/Very Poor
Pre 1950	2	3	67%
1950's	4	44	9%
1960's	48	254	19%
1970's	51	141	36%
1980's	17	28	61%
1990's	1	28	0%
Post 2000	0	71	0%

In general, the culverts inspected are provided with approximately two to three feet of cover over the pipe. Ditches were observed as typically being narrow and shallow. Ledge outcrops were generally not observed during inspections but the Town Highway department identified locations where the depth or size of the existing culverts were based on the existing shallow depth of ledge under the roadway.

The full summary of the culvert information for poor and very poor culverts is provided in the culvert inventory, summarized by culvert location and ID# in Appendix C.

2.2 DROP INLETS

Although not listed in the Town's drainage structure inventory or shown on the drainage structure location plans, a number of existing cross culverts are connected to custom fabricated drop inlet structures, installed in the ditch of roadways to collect ditched stormwater. There are other drop inlets identified in the drainage structure inventory and on the drainage structure locations plans but not associated with the inspected culverts.

The drop inlets that we inspected were 'custom' fabricated, consisting of concrete block structure with no bottom and tops varying from concrete, to steel plates to a combination of steel plates and concrete blocks. A majority of the custom fabricated drop inlets that were inspected are in working condition but are partially silted in and require cleaning.

It appears that the drop inlets have been installed in lieu of catch basins or deeper ditches and headwalls due to the shallow depth to ledge, to provide an inlet for stormwater without requiring the depth of a catch basin. For all drop inlets inspected, sediment was observed either blocking the inlet or blocked inside culvert.

It should be noted that these structures should be considered deficient due to the lack of a sump for sediment collection to maintain the pipe and structure inlet clear of debris. Photo 4 provides an example of a custom drop inlet structure that was identified during inspections.

Photo 4: Drop Inlet

2.3 HEADWALLS

A majority of the drainage structures inspected did not have end treatments. Two types of headwalls were observed during inspection, a loose block retaining wall/headwall (see Photo 5) and a loose rubble rock headwall (see Photo 6). Although none of these constructed walls were observed as currently being in need of repair there is concern with the long-term stability during larger storm events of these structures and the possible need to repair/replace these structures as a result of flooding conditions.

Pipe culvert outlets were generally observed as extending out of the roadway side slope without an end treatment, a small percentage of culvert outlets have been installed with a stone rubble