

April 1, 2011

Ms. Jennifer R. Perry, P.E., Director  
Exeter Public Works  
13 Newfields Road  
Exeter, NH 03338

RE: Water Street and Swazey Parkway Culverts over Norris Brook  
KLF/SEA Reference No.: 2002445.02-A

Dear Ms. Perry:

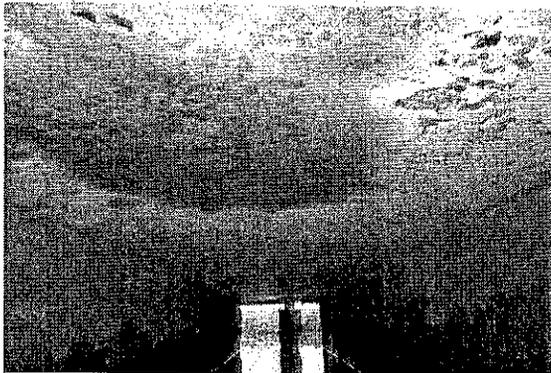
As a follow up to our 2004 evaluation, Kleinfelder / S E A completed a supplemental structural and project site evaluation on March 28, 2011 for the Water Street and Swazey Parkway Culverts. Our findings and recommendations, which are based on deficiencies identified by visual observations only, are summarized below.

**A. Existing Conditions:**

Upon your request, S E A performed a brief supplemental field reconnaissance visit on March 28, 2011 to document the current structural condition of the Water Street and Swazey Parkway culverts. Electronic photographs were also taken to document current conditions. Detailed information regarding culvert geometry, roadway geometry and other site conditions can be found in our original letter report dated April 6, 2004. Only the changes to the structural condition of the culverts have been identified in this letter report. These changed conditions are outlined below.

**Water Street**

Since our inspection in 2004 the culvert has continued to deteriorate at an accelerated rate. The overall condition has gone from pour to serious. The portion of the underside of the top slab near the inlet that showed signs of significant leakage and deterioration back in 2004 has now completely spalled off and left the bottom mat of slab reinforcing steel exposed.



Bottom of Top Slab -- April 2004



Bottom of Top Slab -- April 2011

The larger hole with exposed reinforcing steel that was observed in the southern wall of the culvert near the inlet during our original inspection has more than doubled in size since 2004. The hole in the SW corner is now approximately 8 feet in length with a maximum height of approximately 30 inches. A

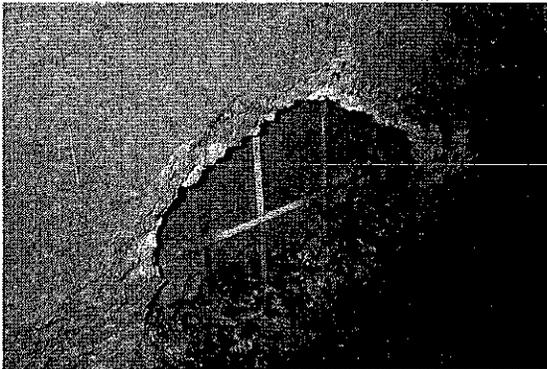
similar condition exists on the northern wall near the inlet. The hole in the NW corner is approximately 7 feet in length with a height of approximately 24 inches in the worst location. Holes in both walls start approximately 4 to 6 inches below the normal water elevation. Steel plates have been installed behind these voided sections of wall to help minimize the migration of fines and reduce the potential for sinkholes in the paved driving surface. The walls are also severely deteriorated at each corner on the outlet end and several smaller holes were observed over the entire length of the culvert.



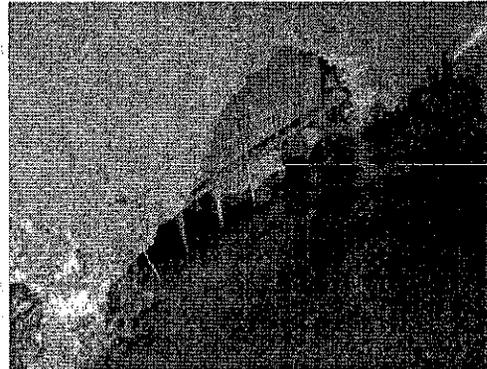
Deteriorated Southern Wall (Inlet End) – April 2004



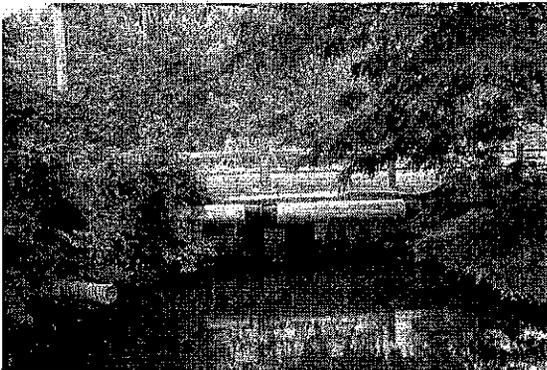
Deteriorated Southern Wall (Inlet End) – April 2011



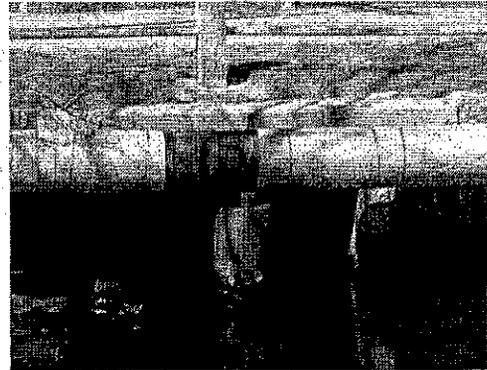
Deteriorated Northern Wall (Inlet End) – April 2004



Deteriorated Northern Wall (Inlet End) – April 2011



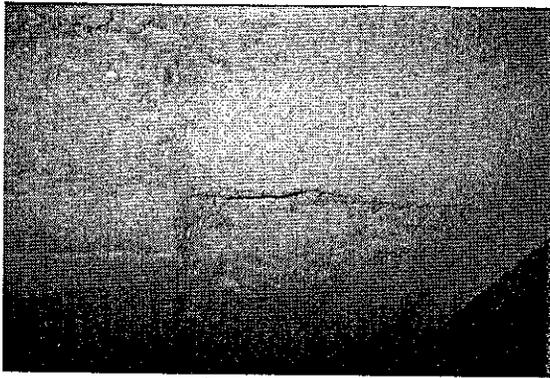
Deteriorated Outlet – April 2004



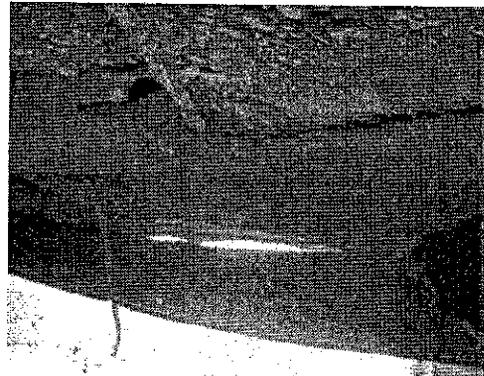
Deteriorated Outlet – April 2011

Swazey Parkway

The concrete portion of the culvert remains in poor condition. The underside of the slab has several severely deteriorated and spalled sections. There is an extensive amount of bottom slab rebar that is exposed and corroded. Two layers of bottom steel were visible in the spalled sections. The slab was cast with little or no concrete cover on the bottom mat of rebar. Pieces of the original wood formwork are visible within the slab. Other sections have voids where the formwork has probably rotted away. There was a significant portion of slab that was missing underneath the upstream headwall that has since been patched.



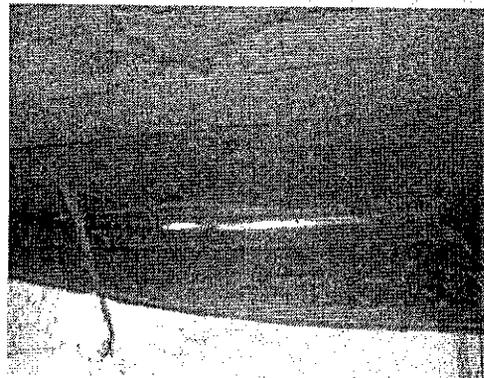
Deteriorated Bottom of Top Slab – April 2004



Deteriorated Bottom of Top Slab – April 2011



Deteriorated Slab at Upstream Headwall – April 2004



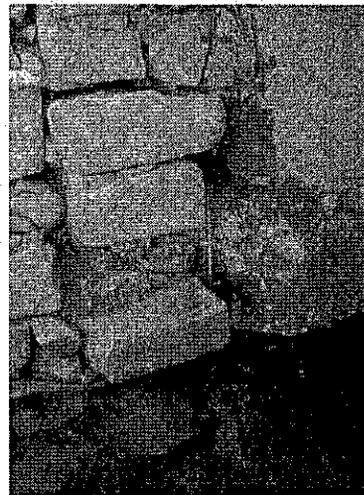
Patched Slab at Upstream Headwall – April 2011



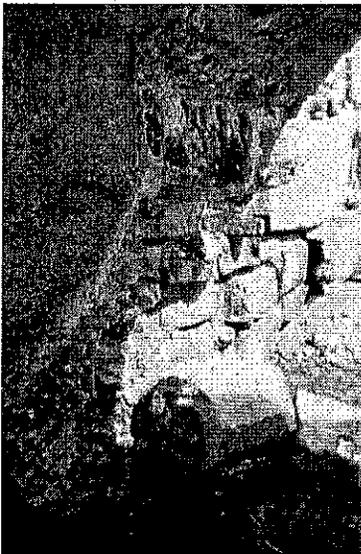
The walls remain severely deteriorated at each corner on the outlet end. The deteriorated upstream corners were recently patched. Increased deterioration with exposed aggregate can be seen along the bottom (near the channel) over the entire culvert length. The stone/concrete interface at the culvert openings is in poor condition at the outlet end of the culvert. Since the concrete has already undergone significant deterioration in these locations, the potential for collapse of the stonework is greatly increased, particularly during the winter months with the exposure to the fluctuating tide and freeze/thaw cycles. This stone/concrete interface was recently patched on the inlet end.



Deteriorated South Wall (Outlet End) – April 2004



Deteriorated South Wall (Outlet End) – April 2011



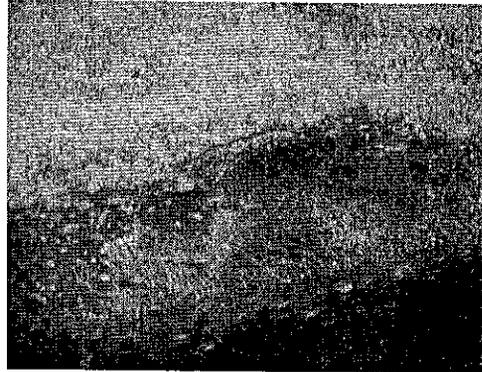
Deteriorated North Wall (Outlet End) – April 2004



Deteriorated North Wall (Outlet End) – April 2011



Deteriorated Walls – April 2004



Deteriorated Walls – April 2011

The culvert headwalls and tops (above grade portion) of the wingwalls are constructed of large, mortared rectangular granite "Ashlar" blocks that sit on 6" granite top slabs. Large granite pedestals are located at each end of the inlet and outlet headwalls as well as on the top of each downstream wingwall end. All of these above grade components still appear to be in good condition.

The culvert openings are faced with stone rubble masonry. The wingwalls and retaining walls are made of stone rubble masonry. Stones above the high tide mark are mortared and the ones below were either dry laid originally or have lost all of their mortar as a result of exposure to the fluctuating river and ice levels. Although large voids are present in several locations of the wingwalls, retaining walls and culvert openings, no signs of sinkholes were evident during the site visit. This indicates that the backfill material is stable and not undergoing erosion/migration.

### **B. Recommendations:**

#### Water Street

The existing concrete culvert and stone masonry wingwalls are now in serious condition and immediate corrective action is needed. The following short-term recommendations are not long term solutions but they are intended to help prolong the service life of the culvert until the culvert can be replaced with a precast concrete box culvert system as outlined in our April 2004 letter report.

- Reduce traffic over the culvert to one lane by shutting down the upstream lane. Wheel lines for the upstream lane are currently traveling over the most severely deteriorated section of the culvert. The backfill material in this area continues to wash out because large portions of both vertical legs of the culvert are missing on the upstream side. The roadway has been patched but the differential settlement in the roadway surface is resulting in additional vehicle impact loads on the culvert. The steel plates that were added on the top of the slab should remain in place. There are a couple of options for maintaining and protecting traffic that should be evaluated. One potential option is one way alternating traffic over the Water Street culvert using temporary signals. A second option includes allowing one way southbound traffic on the Water Street culvert while using Swazey Parkway to handle one way northbound traffic.
- Continue monitoring the paved roadway for settlement, particularly in the sections where there are voids in the walls of the culverts. Roadway settlement indicates that the backfill material is



migrating through the voids in the culvert and/or wingwalls. Settled areas should be patched with asphalt when settlement is observed.

- Cut out portions of rough pavement and repave. The smoother the approaches the less impact loading there is on the structure.
- Continued monitoring of the condition of the structural concrete in the walls and slab. Based on the current condition it is recommended that the culvert be inspected every three months with particular focus on the inlet portion of the culvert. The recommended frequency could change based the results of the subsequent inspections. It is also recommended that the culvert be inspected after any significant storm events or anytime sudden settlements in the backfill are observed.
- Minimize heavy truck loads as much as practicable by adding weight limit signs on the approaches and by increasing weight restriction enforcement. The culvert is not currently posted and at a minimum it is recommend that an "E-2" posting be added to keep certified loads off the culvert. The next posting down would be "Weight Limit 15 Tons". From there it drops to 10 Tons, 6 Tons and then 3 Tons respectively. I have attached a sheet from NHDOT that summarizes what these weight restrictions mean in general terms.

#### Swazey Parkway

The existing concrete culvert remains in extremely poor condition. Considerable deterioration of the concrete and reinforcing steel was observed at several locations in the slab. Severe concrete deterioration was also found in the walls along the entire length of the culvert and at the interface with the stone masonry wingwalls at each corner of the downstream opening. It is recommended that the culvert be rehabilitated as outlined in our 2004 letter report. Until the rehabilitation work can be completed we offer the following short-term recommendations.

- Reduce traffic over the culvert to one lane by shutting down the upstream lane. Wheel lines for the upstream lane are currently traveling over the most severely deteriorated section of the culvert. The backfill material near the upstream headwall has washed out in the past but appears to have stopped with the recent patch. Channeling traffic to the downstream lane is even more crucial if Swazey Parkway is to be used as part of the detour route for Water Street as described above.
- Continue monitoring the paved roadway for settlement as outlined above for Water Street.
- Continued monitoring of the condition of the structural concrete in the walls and slab as outlined above for Water Street.
- Minimize heavy truck loads as outlined above for Water Street.

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We trust that this information will be helpful to the Town in making an informed decision and in taking the next step to alleviate the condition of the existing structures. We look forward to your comments.

Respectfully yours,

KLEINFELDER/S E A CONSULTANTS

A handwritten signature in black ink that reads 'Thomas J. Marshall'. The signature is written in a cursive, flowing style.

Thomas J. Marshall, P.E.  
Project Manager

Attachment

cc: file