Mare Brook Geomorphic Assessment

Geomorphic Assessment Component of Mare Brook Watershed Assessment and Community Engagement Project

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October 25, 2016

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1.0 INTRODUCTION

This report was prepared by Stantec Consulting Services Inc. (Stantec) as part of a reconnaissance-level assessment (RLA) of geomorphic conditions of Mare Brook and Merriconeag Stream in Brunswick, Maine. FB Environmental Associates (FB Environmental) is contracted to the Town of Brunswick, Maine (Town), to perform the Mare Brook Watershed Assessment and Community Engagement Project (Project). The objective of this RLA is to identify sediment sources and channel stability problems linked to specific processes influenced by land and river management activities. Stantec is performing the RLA of geomorphic conditions as a subcontractor to FB Environmental as part of the Project.

Field surveys and reporting for the RLA of geomorphic conditions of Mare Brook and Merriconeag Stream were performed as described in the survey implementation plan (SIP) titled "Survey Implementation Plan: Geomorphic Assessment of Mare Brook" dated June 15, 2016, that was prepared by Stantec as part of the Project (Appendix A).

2.0 METHODOLOGY

The RLA of geomorphic conditions was conducted based on visual observations of existing conditions, such as dominant stream substrate size classification, areas of stream bank erosion, areas of stream bed aggradation/degradation, and the location of major debris jams/dams affecting sediment transport processes, stormwater outfalls, and stream crossings. Locations of relevant features were collected using a Wide Area Augmentation System-enabled Global Positioning System (GPS) receiver. This RLA used the RLA methodology outlined in Watershed Assessment of River Stability and Sediment Supply (Rosgen 2006).

Digital photographs were taken during the study site visits at representative stream features, including stream crossings.

2.1 GEOMORPHIC RATING AND EVALUATED IMPAIRMENT TYPES

This section identifies and describes typical impairments to geomorphic condition that were identified during the field survey. Representative photographs are provided for each impairment type in Section 2.1.2.

2.1.1 Geomorphic Rating

The assessed geomorphic conditions and evaluated impairment types for each reach were assigned a qualitative rating; descriptions and brief definitions for these ratings are provided below.

- **Unstable**: this rating criteria is assigned where the channel appears to have lateral and/or vertical instability as compared with natural channel processes.
- **Moderately Unstable**: this rating criteria is assigned to a reach where the channel appears to be generally stable but some impairment was identified in subreaches within the study reach. Identified impairments may include lateral and/or vertical instability as compared to natural channel processes within the reach.
- **Stable**: this rating criteria is assigned to a reach where channel lateral and vertical stability appears to be in equilibrium with natural channel processes.

2.1.2 Geomorphic Impairment Types

Four geomorphic impairment types were considered in the assignment of a geomorphic rating. Explanations of the four geomorphic impairment types are provided below.

2.1.2.1 Excess Sediment Supply

Sediment supply in excess of the sediment transport capacity of a stream channel can result in aggradation of sediment in the stream channel and lateral instability. Excess sediment supply can result from multiple sources, such as landscape erosion, lateral and/or vertical channel instability, and direct input of sediment from point sources, such as storm drain outfalls.

In urbanized environments, stormwater drain outfalls can contribute significant sediment loading to downstream reaches through direct inputs from road drainage (e.g., curb drains) and from structural deficiencies in buried pipe networks (e.g., separated pipe joints). Stormwater drainage networks can result in significant inputs of sand-sized fractions of sediment, resulting in impairment to geomorphic condition through channel aggradation.

Photo 1. Example of excessive sediment supply. Stantec, August 15, 2016.

2.1.2.2 Stream Channel Alteration

Stream channel alteration occurs in many forms, including straightening, diverting, encroachment, filling, and damming. Stream channel alteration has the potential to destabilize stream channels through increased bed aggradation or degradation (vertical instability) and increased bank erosion or material deposition (lateral instability).

Photo 2. Example of stream channel alteration (and encroachment). Stantec, August 15, 2016.

2.1.2.3 Stream Crossings

Stream crossings can result in interruption of natural sediment transport processes. Stream crossings installed with inlet elevations set above the natural stream bed result in a decrease in energy slope and therefore decrease the sediment transport capacity resulting in channel aggradation. Debris buildup at the inlet to a stream crossing structure also can result in channel aggradation upstream from the structure. Undersized and crossings installed at a slope steeper than the natural stream bed can result in vertical and lateral channel instability downstream from a crossing.

Photo 3. Example of a perched inlet condition (with debris on culvert inlet). Stantec, August 15, 2016.

2.1.2.4 Debris Jams

Debris can collect at specific locations along a channel and force flows into the channel bed and banks, leading to vertical and lateral channel instability around debris jams. Such features are typically a natural phenomenon (i.e., wood debris) that come and go with periodic floods or beaver activity, but they can also be affected by anthropogenic alteration, such as at culvert inlets.

Photo 4. Example of a debris jam. Stantec, August 15, 2016.

3.0 FIELD SURVEY EXTENTS AND ELEMENTS

Mare Brook was surveyed between Baribeau Drive and tidewater and Merriconeag Stream was surveyed from Beaver Pond Drive to the confluence with Mare Brook. Study reaches along each waterway were defined by road crossings and the airport runway. A list of reaches is provided in Tables 1 and 2. Geomorphic conditions and factors contributing to geomorphic condition within each reach were documented and are presented in Section 4.0.

Table 1: Surveyed Reaches on Mare Brook

Reach	Description
Reach 1	Baribeau Drive to Barrows Street
Reach 2	Barrows Street to MacMillan Drive
Reach 3	MacMillan Drive to Maine Street
Reach 4	Maine Street to Meadowbrook Road
Reach 5	Meadowbrook Road to State Route 123 (Harpswell Road)
Reach 6	State Route 123 (Harpswell Road) to Security Road
Reach 7	Security Road to Samuel Adams Drive
Reach 8	Samuel Adams Drive to Brunswick Executive Airport
Reach 9	Brunswick Executive Airport to Major Pope Avenue
Reach 10	Major Pope Avenue to Liberty Crossing

Table 2: Surveyed Reaches on Merriconeag Stream

Reach	Description
Reach 11	Beaver Pond Road to Purinton Road
Reach 12	Purinton Road to confluence with Mare Brook

The geomorphic characterization site visit included observations along Mare Brook for approximately 200 ft downstream from Liberty Crossing. The reach of the brook from Liberty Crossing downstream to Harpswell Cove is described in Section 4.3 (Mare Brook Tidal Reach) and was characterized based on review of aerial photographs.

3.1 SITE ACCESS

Access for surveys along Mare Brook and Merriconeag Stream was coordinated by FB Environmental and the Town. Access to one parcel immediately downstream from Baribeau

Drive was not granted and therefore the reach of stream adjacent to that parcel was not surveyed as part of this study.

3.2 SCHEDULE

Stantec performed the field survey component of this study on August 15, 16, and 17, 2016. The field survey was performed by Stantec staff with relevant experience in reconnaissance-level assessment of fluvial geomorphic conditions.

4.0 RESULTS

This section presents observations relevant to geomorphic condition made during field surveys and assignment of an overall rating of geomorphic condition of an assessed reach. A description of the geomorphic condition rating criteria is described below. The preliminary assessment of geomorphic stability of the surveyed stream reaches is based on qualitative observations made during study site visits and assigned a geomorphic rating as described in Section 2.1.1.

Information is presented for the 10 study reaches along Mare Brook downstream to Liberty Crossing (Mare Brook Riverine Reaches), the 2 study reaches along Merriconeag Stream downstream to its confluence with Mare Brook (Merriconeag Stream Reaches), and for the tidal reach of Mare Brook downstream from Liberty Crossing and into Harpswell Cove (Mare Brook Tidal Reach). Overview figures of channel stability by reach are provided in Appendix B. Representative photographs are provided in Appendix C.

4.1 MARE BROOK RIVERINE REACH

This section presents observations and assigned ratings for the 10 study reaches along Mare Brook between Baribeau Drive and Liberty Crossing.

4.1.1 Reach 1: Baribeau Drive to Barrows Street

Mare Brook flows from the culvert at Baribeau Drive with limited sediment supply due to a perched inlet culvert condition that limits sediment supply from the upstream reach. However, the brook within this reach is supplied with sediment from various stormwater and/or subsurface drainage systems, as evidenced by sand aggradation downstream from such features, and from channel bed and bank erosion adjacent to accumulations of wood debris. The low-gradient nature of this reach combined with ample wood debris supply and excess sediment supply within this reach have resulted in channel aggradation and channel widening through bank erosion along the upper half of this reach.

A berm consisting of asphalt refuse and earthen fill located downstream from a foot bridge effects sediment transport and results in minor channel braiding. Several stone and concrete debris weir structure apparently installed as "stepping stone" channel crossings for local residents further affects sediment transport. Lateral channel migration resulted in channel impingement against the valley wall near one residence at some point in the past; however, this condition appears to have been remedied by installation of wood debris revetment. The downstream end of the reach is affected by a perched culvert inlet at Barrows Street, which contributes to channel aggradation and lateral instability.

Due to numerous examples of lateral and vertical channel instability within this reach, this reach of channel is assigned an "unstable" rating.

4.1.2 Reach 2: Barrows Street to MacMillan Drive

Mare Brook between Barrows Street and MacMillan Drive receives a limited sediment supply from the upstream reach due to a perched culvert inlet condition. However, lateral channel adjustment is occurring downstream from Barrows Street, as evidenced by areas of bank erosion. High-energy flows resulting from a potentially undersized stream crossing at Barrows Street are a potential driver for bank erosion processes within this reach.

Sediment transport processes appear to be functional within this reach due to sufficient stream energy due to the moderate channel slope through this reach. A "moderately unstable" condition is assigned to this reach due to the presence of areas of lateral instability that could result in a condition downgrade to "unstable" if bank erosion rates increase or sediment transport processes are interrupted (e.g., by wood debris addition).

4.1.3 Reach 3: MacMillan Drive to Maine Street

The slope of Mare Brook flattens between MacMillan Drive and Maine Street, resulting in decreased energy to transport sediment through the reach. Channel aggradation has occurred immediately downstream from MacMillan Drive as a result of sediment sourced from the upstream reach being deposited within this reach. Wood debris jams within this reach have resulted in a multi-channel condition, decreasing sediment transport capacity. A perched culvert inlet condition at Maine Street further exacerbates this issue and results in lateral instability due to channel aggradation issues within the small backwater created by the perched inlet to the Maine Street culvert.

This reach is assigned a "moderately unstable" rating due to the multi-channel condition and lateral instability associated with the constraints to sediment transport identified above. A "moderately unstable" condition is assigned in lieu of an "unstable" condition as this reach appears to be trending towards a stable condition through vegetation control of the channel under the existing Maine Street culvert inlet condition. A "moderately unstable" rating was also assigned over a "stable" rating due to the potential for the Maine Street culvert inlet condition to change, and therefore result in channel adjustment within the reach.

4.1.4 Reach 4: Maine Street to Meadowbrook Road

The stream channel immediately downstream from Maine Street is confined between granite block retaining walls and anthropogenic fill for a distance of a few hundred feet. Increased energy resulting from a potentially undersized culvert impinging upon downstream retaining walls and channel confinement results in increased shear forces on the channel bed and banks within the walled section of this reach. Vertical channel degradation has formed a scour pool through this reach, undermining and destabilizing adjacent granite block retaining walls. The scour pool at this location is partially held in check by wooden sheet piling and brick debris spanning the channel downstream from the scour pool.

Lateral channel instability is also apparent near the downstream extent of the channel revetment. Scour countermeasures consisting of bundled metal pipes have previously been installed to assist with bank protection in this area. However, this revetment technique appears to be ineffective as bank erosion in the vicinity of the pipes is actively occurring during high flow events. Anthropogenic straightening of the channel is also apparent in this area. A large, mid-channel stump with roots continuing into either bank of the stream is noted as evidence of the channel being anthropogenically forced to the current alignment at some time prior. An anthropogenic berm across the floodplain downstream from this reach in proximity to a parcel property line is further evidence of historic channel manipulation in this area.

Downstream from the floodplain berm, Mare Brook flows to Meadowbrook Road in a largely "stable" condition. A few minor debris jams result in bank and/or bed erosion adjacent to those features. However, these are natural features providing habitat diversity and they do not appear to hinder sediment transport processes or significantly affect overall channel geomorphic condition. Low to moderate channel slope results in functional sediment transport processes through this reach.

With the exception of the anthropogenically altered upstream extent of this reach, which is assigned a "moderately unstable" rating due to signs of lateral and vertical instability, this reach appears to be "stable". The upstream reach was given a "moderately unstable" rating as revetment measures are currently semi-functional; however, this rating may change rapidly to "unstable" in the event of revetment structure failure during flood flows.

4.1.5 Reach 5: Meadowbrook Road to State Route 123

This reach is from Meadowbrook Road to State Route 123 (Harpswell Road) and includes Coffin Pond Dam. Coffin Pond Dam bisects this reach and decreases the effective gradient over the reach between Meadowbrook Road and Coffin Pond Dam. As a result of sediment deposition and numerous debris jams within this reach, the channel is overly wide and highly braided upstream from Coffin Pond. Depositional features near the confluence of the brook with Coffin Pond are indicative that sediment transported from the reach upstream from Meadowbrook Road and/or sourced from lateral instability downstream from Meadowbrook Road are aggrading within Coffin Pond.

Downstream from Coffin Pond Dam, coarse sediment apparently sourced from erosion of the dam structure during high flow events has aggraded within the channel resulting in a lack of a well-defined channel through the adjacent wetland complex. Debris loading within this reach further interrupts channel forming processes. A perched culvert inlet condition at State Route 123, combined with debris jamming at the inlet and within this culvert, contributes to the reduced sediment transport capacity within this reach and results in channel aggradation.

This reach is assigned a “moderately unstable” rating upstream from Coffin Pond Dam and an “unstable” rating downstream from the dam due to channel aggradation and debris loading. A “moderately unstable” rating was applied to the reach upstream from Coffin Pond due to the channel in this reach trending towards a “stable” rating through vegetative influence. However, failure or removal of Coffin Pond Dam may result in upstream channel adjustment.

4.1.6 Reach 6: State Route 123 to Security Road

Mare Brook flows through an undersized corrugated metal pipe culvert under State Route 123. Evidence of the pipe being undersized include a well-developed plunge pool located on the downstream side of State Route 123. A mid-channel bar formed from alluvial material dislodged from the channel bed and banks during formation of the plunge pool forces flow within the brook towards the left and impinges on well-vegetated stream banks. From this point to Security Road, Mare Brook flows through a well-defined channel containing few debris jams or areas of bank erosion. A perched inlet condition and grates on the Security Road culverts collecting debris interrupt sediment transport processes through the lower portion of this reach.

Despite minor aggradation of material (e.g., sand) within the channel along the lower portion of this reach, this reach is assigned a “stable” rating due to lack of apparent negative influences on overall geomorphic condition.

4.1.7 Reach 7: Security Road to Samuel Adams Drive

Mare Brook flows over riprap fill downstream from the Security Road culverts into an anthropogenically altered channel. The channel appears to have been straightened for approximately 200 feet downstream from the Security Road culvert outlet. Immediately downstream from this apparent channel alteration, the channel braids around a small island. Minor bank erosion occurs in this area.

Downstream from this area the brook flows through an area formerly impounded by beavers at the Samuel Adams Drive culvert. A berm along the right bank of the channel is indicative of anthropogenic channel straightening through a portion of the former beaver impoundment. Minor bank erosion associated with channel re-meandering is evident. However, the bank materials are composed of cohesive material with the root system of overlying herbaceous growth adding to bank stability. Bank erosion rates were not determined during this study but appear to be low due to the above identified factors.

The Samuel Adams Drive culverts were replaced recently with a pair of 6-foot-diameter concrete pipe culverts. The culvert invert elevations are set approximately 2.5-foot difference in elevation to enable sediment transport through the lower (primary) culvert, while enabling passage of flood flows through the higher (secondary) culvert. Security grates installed on the culvert inlets catch debris and could lead to damming of the stream in the future if not cleared of debris.

Despite apparent straightening of the channel along two segments of this reach and minor bank erosion associated with channel re-meandering, this reach is assigned a “stable” rating due to lack of apparent negative influences on overall geomorphic condition.

4.1.8 Reach 8: Samuel Adams Drive to Brunswick Executive Airport

Mare Brook flows a short distance between Samuel Adams Drive and the inlet to concrete pipe culverts under Brunswick Executive Airport. A review of aerial imagery available on Google Earth indicates that this reach was likely straightened for a few hundred feet downstream from Samuel Adams Drive and again for a few hundred feet upstream from the inlet to the airport runway culverts. Anthropogenic hardening of the channel bed and banks via use of stone armoring exists near the upstream extent of the lower straightened reach. The valley form through this reach is unusually narrow and potentially encroached upon by historic filling activities associated with construction of the airport runway.

Field survey indicators such as minor bed and bank erosion indicate that the stream appears to be attempting to re-meander as a result of natural channel processes and influences applied from beaver activity (past and present) within this reach. A robust stand of bankside woody vegetation currently aids stream bank stability. An active beaver dam was noted being constructed at the inlet to the airport culverts at the time of field survey, slowing sediment transport processes. Beaver activity within this reach could destabilize the stream banks.

Despite apparent straightening of the channel along two segments of this reach and minor bank erosion associated with channel re-meandering, this reach is assigned a “stable” geomorphic condition rating due to lack of apparent negative influences on overall geomorphic condition. However, this rating may change as a result of beaver activity within this reach.

4.1.9 Reach 9: Brunswick Executive Airport to Major Pope Avenue

Excessive loading of the channel with sand-sized and smaller fractions of material has resulted in substantial aggradation of the channel downstream from the Brunswick Executive Airport culverts. The source of the sediment was not readily apparent at the time of survey, but it appears the sediment loading is occurring between the inlet and outlet of the runway culverts.

Much of the channel between the outlet of the runway culverts and Major Pope Avenue has been channelized. The overly widened constructed stream channel results in reduced sediment transport capacity, resulting in channel aggradation. In addition, earthen berms, a legacy of channelization, exist along much of this reach. These berms isolate the stream channel from adjacent floodplain resources (where excess sediment could otherwise be deposited) until in-channel flow depths are deep enough to overtop the adjacent berms. This increase in flow depth results in increased shear stresses on the channel bed and banks during flood flows. A review of imagery available on Google Earth indicates that the pre-straightening channel was more sinuous, with a portion of the original channel still visible as off-channel habitat.

A perched culvert inlet condition at Major Pope Avenue, combined with debris jamming on security grates installed at the inlet and outlet of this culvert, contributes to the reduced sediment transport capacity within this reach and further results in channel aggradation.

This reach is assigned an “unstable” geomorphic condition rating due to channel aggradation, channelization, and loss of access to the adjacent floodplain during lower-spectrum flood events. Further, the failure, removal, or replacement of the Major Pope Avenue culvert may result in upstream channel adjustment.

4.1.10 Reach 10: Major Pope Avenue to Liberty Crossing Drive

A significant plunge pool exists downstream from Major Pope Avenue, as a result of a perched (and possibly undersized) culvert outlet at Major Pope Avenue. Mare Brook exhibits flows through a well-defined, vegetation-controlled channel downstream from Major Pope Avenue to Liberty Crossing Drive. One oxbow meander was noted cut-off from the main channel due to a channel evulsion and is now acting as a depositional feature (sediment depository).

The brook becomes tidally influenced between the confluence with Merriconeag Stream and Liberty Crossing Drive, influencing sediment transport through the lower portion of this reach. The floodplain transitions from a forested floodplain to a herbaceous covered floodplain as a result of past beaver activity near a legacy dam or stream crossing structure located a short distance upstream from Liberty Crossing Drive. Wood debris jamming within this reach has resulted in some minor bank erosion and channel braiding.

Despite the plunge pool downstream from the Major Pope Avenue culvert and minor bank erosion associated with the channel evulsion and debris jamming, this reach is assigned a “stable” geomorphic condition rating due to lack of apparent negative influences on overall geomorphic condition. Streamside vegetation is likely a significant factor in channel stability along this reach.

4.2 MERRICONEAG STREAM

This section presents observations and assigned ratings for the two study reaches along Merriconeag Stream between Beaver Pond Road and the confluence of Merriconeag Stream with Mare Brook.

4.2.1 Reach 11: Beaver Pond Road to Purinton Road

Merriconeag Stream flows from riprap fill at Beaver Pond Road and is fed by numerous spring seeps and small rivulets draining from the adjacent landscape. Merriconeag stream flows through an alluvial floodplain of sufficient width to alleviate flood flows. Despite historical beaver activity and a relatively young riparian forest structure, Merriconeag Stream displays a stable channel form.

Merriconeag Stream flows into Picnic Pond approximately .25-mile upstream from Purinton Road. Picnic Pond is formed by Picnic Pond Dam and serves as a depositional area for sediment transported from the upper Merriconeag Stream watershed. Downstream from Picnic Pond Dam, non-indigenous riprap, boulder and coarse gravel material are evidence of anthropogenic alteration of Merriconeag Stream upstream from Purinton Road.

The overall geomorphic condition of Merriconeag Stream between Beaver Pond Road and Purinton Road is “stable”; however, failure or removal of Picnic Pond Dam could alter this rating.

4.2.2 Reach 12: Purinton to confluence with Mare Brook

Merriconeag Stream has been anthropogenically straightened for a few hundred feet downstream from Purinton Road, likely in an effort to improve conveyance through the culverts at Purinton Road. Channelization within this reach has resulted in loss of floodplain connectivity in this area as well as widening of the channel, with a net result of both minor erosion of channel banks and aggradation of coarse-grained material within the channel. Debris jamming near the downstream terminus of the straightened reach appears to reset channel sediment transport processes. The apparent age of streamside trees is indicative of a stable channel from here to the confluence with Mare Brook.

Despite the condition of the channelized-reach of Merriconeag Stream downstream from Purinton Road, the overall geomorphic condition of Merriconeag Stream between Purinton Road and the confluence with Mare Brook is “stable”.

4.3 MARE BROOK TIDAL REACH

The tidal reach of Mare Brook downstream (seaward) from Liberty Crossing was assessed based on a review of aerial photographs. Planform characteristics of this reach indicate that tidal hydraulic conditions are the primary factor that influences the geomorphic conditions of this reach. This reach of Mare Brook exhibits significant meandering and the channel width progressively increases moving seaward. It is expected that the latter characteristics results from the increasing size of the tidal prism—and increased hydraulic conveyance—moving seaward.

Review of aerial photographs indicate that there has been little anthropogenic encroachment into this reach of Mare Brook, and the assigned geomorphic rating is “stable”.

5.0 SUMMARY AND DISCUSSION

This section presents a summary of the stream reaches, major stressors, and overall reach geomorphic condition stability ratings.

5.1 SUMMARY

The following abbreviations (in parenthesis) were used for stressors in Tables 3 and 4 below.

Stressor (Abbreviation)

- Excess Sediment Supply (ESS)
- Stream Channel Alteration (SCA)
- Stream Crossing (SC)
- Debris Jam (DJ)

Table 3: Identified Stressors and Geomorphic Rating by Reach on Mare Brook

Reach	Description	Stressors	Rating
Reach 1	Baribeau Drive to Barrows Street	ESS, SCA, SC, DJ	Unstable
Reach 2	Barrows Street to MacMillan Drive	SC	Moderately Unstable
Reach 3	MacMillan Drive to Maine Street	ESS, SCA, SC, DJ	Moderately Unstable
Reach 4	Maine Street to Meadowbrook Road	SCA, SC	Moderately Unstable / Stable
Reach 5	Meadowbrook Road to State Route 123 (Harpswell Road)	SCA, SC, DJ	Moderately Unstable / Unstable
Reach 6	State Route 123 (Harpswell Road) to Security Road	SC	Stable
Reach 7	Security Road to Samuel Adams Drive	SCA, SC	Stable
Reach 8	Samuel Adams Drive to Brunswick Executive Airport	SCA	Stable
Reach 9	Brunswick Executive Airport to Major Pope Avenue	ESS, SCA, SC	Unstable
Reach 10	Major Pope Avenue to Liberty Crossing	SC, DJ	Stable

Table 4: Identified Stressors and Geomorphic Rating by Reach on Merriconeag Stream

Reach	Description	Stressors	Rating
Reach 11	Beaver Pond Road to Purinton Road	SC	Stable
Reach 12	Purinton Road to confluence with Mare Brook	SCA, SC, DJ	Stable

5.2 DISCUSSION

Excessive sediment loading, stream channel alteration, and stream crossings all are major stressors to the geomorphic condition in Mare Brook and Merriconeag Stream. Debris jams are also a stressor, though the effects caused by debris jams tend to be more localized.

6.0 REFERENCES

Rosgen, D. 2006. *Watershed Assessment and River Stability and Sediment Supply*. Wildland Hydrology. Fort Collins, Colorado.

Appendix A SURVEY IMPLEMENTATION PLAN: GEOMORPHIC ASSESSMENT OF MARE BROOK

Survey Implementation Plan: Geomorphic Assessment of Mare Brook

Geomorphic Assessment Component of Mare Brook Watershed Assessment and Community Engagement Project

Prepared for:
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Prepared by:
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August 15, 2016

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1.0 INTRODUCTION

This Survey Implementation Plan (SIP) was prepared by Stantec Consulting Services Inc. (Stantec) as part of a reconnaissance-level assessment (RLA) of geomorphic conditions along Mare Brook and Merriconeag Stream from their headwaters to tidewater at Harpswell Cove in Brunswick, Maine. FB Environmental is contracted to the Town of Brunswick, Maine (Town), to perform the Project. Stantec is performing the RLA as a subcontractor to FB Environmental Associates (FB Environmental) as part of the Mare Brook Watershed Assessment and Community Engagement Project (Project).

1.1 PROJECT AND TASK ORGANIZATION

This section presents information on project and task organization. Stantec is a subcontractor to FB Environmental; as such, Stantec will provide reports and information to FB Environmental and FB Environmental will coordinate with external entities.

1.1.1 Stantec Roles and Responsibilities

Stantec will implement its internal review process in accordance with Stantec's Project Management Framework (PM Framework). The PM Framework is a component of Stantec's ISO 9001 Quality Management System.

- David Huntress, P.E. of Stantec will serve as the Technical Lead for implementation of work described in this SIP.
- Michael Chelminski, P.E. of Stantec will perform Stantec's internal Quality Review.
- Bryan Emerson of Stantec will perform Stantec's internal Independent Review.

Stantec will document the internal review process and provide this documentation in deliverables to FB Environmental.

1.1.2 FB Environmental Roles and Responsibilities

Stantec will provide deliverables to FB Environmental. FB Environmental will coordinate with external entities, including the Town and others. FB Environmental will identify the distribution list for materials prepared by Stantec and distribute the materials accordingly.

2.0 RECONNAISSANCE-LEVEL ASSESSMENT OF GEOMORPHIC CONDITIONS

2.1 SURVEY PURPOSE

The purpose of this survey is to perform a reconnaissance-level assessment (RLA) of geomorphic conditions of the study reaches of Mare Brook and Merriconeag Stream in Brunswick, Maine. Purpose of this RLA is to identify sediment sources and channel stability problems linked to specific processes influenced by land and river management activities;

2.2 SAFETY

Stantec will perform work conducted as part of this assessment in accordance with our Health and Safety Program.

2.3 ASSESSMENT AREA

The assessment area is the reach of Mare Brook from Baribeau Drive to tidewater and the reach of Merriconeag Stream from Beaver Pond Road to its confluence with Mare Brook. The assessment will include identification of sub-reaches defined by natural (e.g., apparent changes in physical characteristics) and anthropogenic features, such as stream crossings (e.g., culverts) and dams.

2.4 SITE ACCESS

FB Environmental will obtain permissions for access to other areas identified by Stantec as necessary to perform the survey, including access to the reach of Mare Brook and Merriconeag Stream in the former Brunswick Naval Air Station (BNAS).

2.5 ASSESSMENT AND REPORTING

2.5.1 Schedule

Stantec will coordinate with FB Environmental for scheduling of the field assessment. The identified schedule is to perform the field work and submit draft deliverable prior to July 31, 2016.

2.5.2 Reconnaissance-Level Assessment of Geomorphic Conditions Methodology

The RLA of geomorphic conditions will be based on observed conditions, such as dominant stream substrate size classification, areas of stream bank erosion, areas of stream bed aggradation/degradation, and the location of major debris jams/dams affecting sediment transport processes, stormwater outfalls, and stream crossings. Locations of relevant features will be collected using a Wide Area Augmentation System-enabled Global Positioning System (GPS) receiver. The RLA will use RLA methodology outlined in *Watershed Assessment of River Stability and Sediment Supply* (Rosgen 2006).

The geomorphic assessment of stream crossings will be performed using the methodology described in the *Maine Stream Crossing Survey Manual* prepared by the U.S. Fish and Wildlife Service Gulf of Maine Coastal Program (May 2012). Stream crossing survey forms will be prepared and representative photographs will be taken as part of the field assessment.

The field survey will be performed in accordance with methods described in Abbot (2012), and a "Stream Crossing Survey" form from Abbott (2012) will be filled out for each evaluated stream crossing. A copy of the Stream Crossing Survey form is included in Appendix A.

Digital photographs will be taken at each evaluated stream feature, including stream crossings.

2.5.3 Reporting

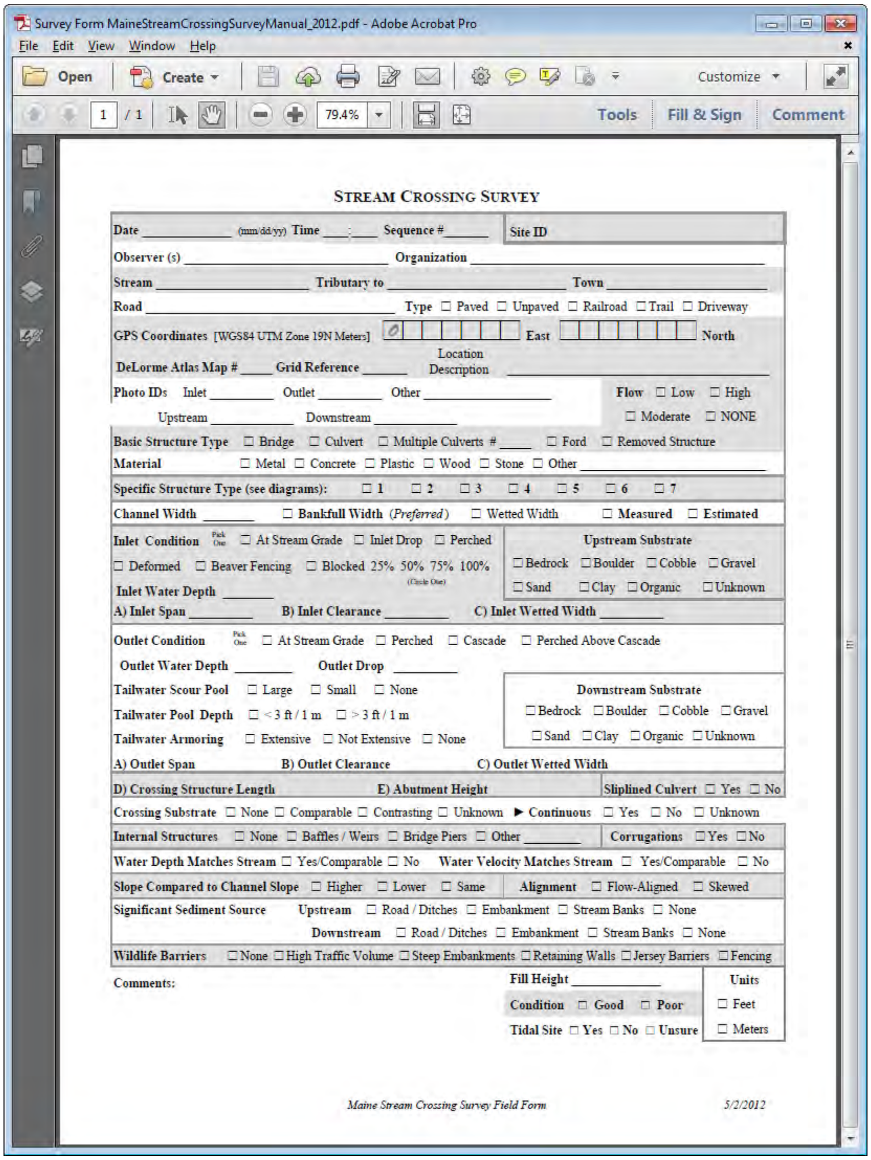
Stantec will prepare draft and final reports based on information obtained as part of the field assessment. The draft report will include a brief narrative summary of the methods and results of the habitat assessments, including figures showing the locations of identified resources. Representative photographs will also be included. The draft report will be provided to FB Environmental in editable format (i.e., Microsoft Word). The final report will be provided in Adobe PDF file format. Additional deliverables will include photographs of each site.

3.0 REFERENCES

Abbott, A. 2012. *Maine Stream Crossing Survey Manual*. Gulf of Maine Coastal Program, U.S. Fish and Wildlife Service, Falmouth, Maine, USA. May.

Rosgen, D. 2006. *Watershed Assessment of River Stability and Sediment Supply (WARSSS)*. Wildland Hydrology.

Appendix A STREAM CROSSING SURVEY FORM



STREAM CROSSING SURVEY

Date ________ (mm/dd/yy) Time ___:___ Sequence # ______ Site ID

Observer (s) ____________ Organization ____________

Stream ____________ Tributary to ____________ Town ____________

Road ____________ Type ☐ Paved ☐ Unpaved ☐ Railroad ☐ Trail ☐ Driveway

GPS Coordinates [WGS84 UTM Zone 19N Meters] East North

DeLorme Atlas Map # ____ Grid Reference ____ Location Description ____________

Photo IDs Inlet ______ Outlet ______ Other ______ Flow ☐ Low ☐ High

Upstream ______ Downstream ______ ☐ Moderate ☐ NONE

Basic Structure Type ☐ Bridge ☐ Culvert ☐ Multiple Culverts # ____ ☐ Ford ☐ Removed Structure

Material ☐ Metal ☐ Concrete ☐ Plastic ☐ Wood ☐ Stone ☐ Other ____________

Specific Structure Type (see diagrams): ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

Channel Width ______ ☐ Bankfull Width *(Preferred)* ☐ Wetted Width ☐ Measured ☐ Estimated

Inlet Condition (Pick One) ☐ At Stream Grade ☐ Inlet Drop ☐ Perched

☐ Deformed ☐ Beaver Fencing ☐ Blocked 25% 50% 75% 100% (Circle One)

Inlet Water Depth ______

Upstream Substrate: ☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ Clay ☐ Organic ☐ Unknown

A) Inlet Span ______ B) Inlet Clearance ______ C) Inlet Wetted Width ______

Outlet Condition (Pick One) ☐ At Stream Grade ☐ Perched ☐ Cascade ☐ Perched Above Cascade

Outlet Water Depth ______ Outlet Drop ______

Tailwater Scour Pool ☐ Large ☐ Small ☐ None

Tailwater Pool Depth ☐ < 3 ft / 1 m ☐ > 3 ft / 1 m

Tailwater Armoring ☐ Extensive ☐ Not Extensive ☐ None

Downstream Substrate: ☐ Bedrock ☐ Boulder ☐ Cobble ☐ Gravel ☐ Sand ☐ Clay ☐ Organic ☐ Unknown

A) Outlet Span ______ B) Outlet Clearance ______ C) Outlet Wetted Width ______

D) Crossing Structure Length ______ E) Abutment Height ______ Sliplined Culvert ☐ Yes ☐ No

Crossing Substrate ☐ None ☐ Comparable ☐ Contrasting ☐ Unknown ► Continuous ☐ Yes ☐ No ☐ Unknown

Internal Structures ☐ None ☐ Baffles / Weirs ☐ Bridge Piers ☐ Other ______ Corrugations ☐ Yes ☐ No

Water Depth Matches Stream ☐ Yes/Comparable ☐ No Water Velocity Matches Stream ☐ Yes/Comparable ☐ No

Slope Compared to Channel Slope ☐ Higher ☐ Lower ☐ Same Alignment ☐ Flow-Aligned ☐ Skewed

Significant Sediment Source Upstream ☐ Road / Ditches ☐ Embankment ☐ Stream Banks ☐ None

Downstream ☐ Road / Ditches ☐ Embankment ☐ Stream Banks ☐ None

Wildlife Barriers ☐ None ☐ High Traffic Volume ☐ Steep Embankments ☐ Retaining Walls ☐ Jersey Barriers ☐ Fencing

Comments:

Fill Height ______ Units ☐ Feet ☐ Meters

Condition ☐ Good ☐ Poor

Tidal Site ☐ Yes ☐ No ☐ Unsure

Maine Stream Crossing Survey Field Form 5/2/2012

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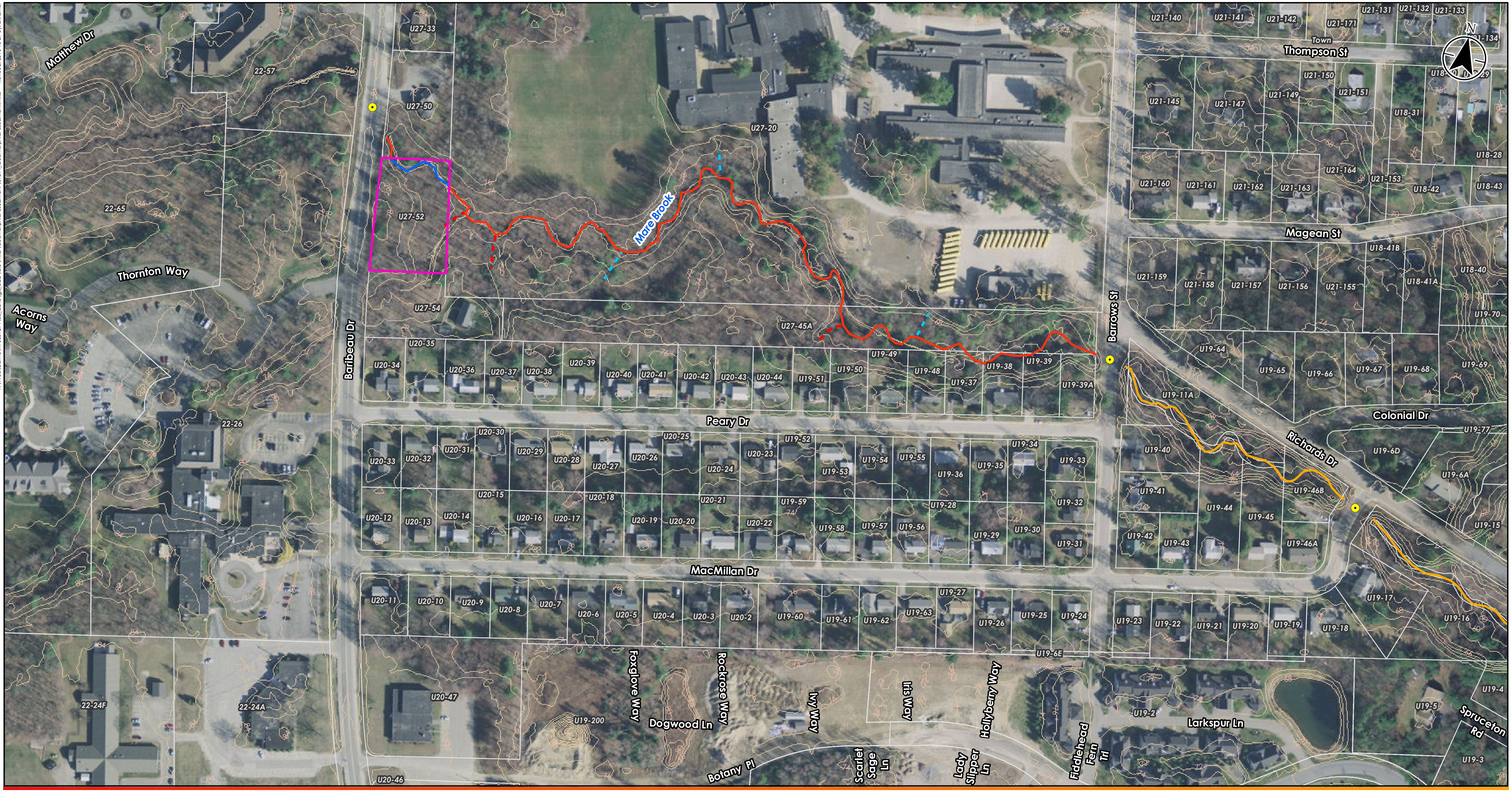
Appendix B GEOMORPHIC ASSESSMENT FIGURES



195601214

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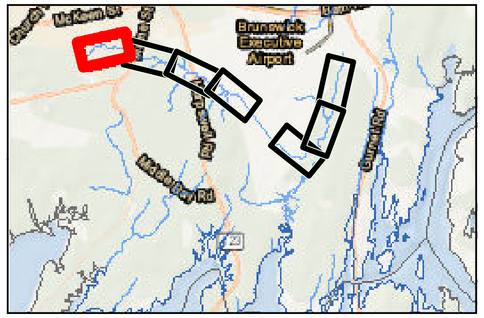
Topsham, ME USA 04086
Phone (207) 729-1199

Prepared by EMK on 2016-10-04
Quality Review by KWH on 2016-10-05
Independent Review by DWH on 2016-10-05

01214_GeomorphicAssessment.mxd



Legend

- Culverts/Dam
- Stream Type
- Moderately Unstable
- Unstable
- Not Classified
- Tributary
- Unstable Tributary
- 2' Contour
- Tax parcels
- No Access Parcel

Data Source

1. Aerial imagery provided by ArcGIS Online World Imagery Mapping Service (2015 NAIP) (http://server.arcgisonline.com/arcgis/services/World_Imagery/MapServer).
2. Town of Brunswick tax parcels provided by FB Environmental.
3. Contour data obtained from the Maine Office of GIS.

Note

1. Stream mapping data was derived from a combination of field located GPS data, aerial photo interpretation, and the National Hydrograph Dataset (NHD) and should be considered approximate.

0 200 Feet
1 inch = 200 feet (At page size of 11"x17")

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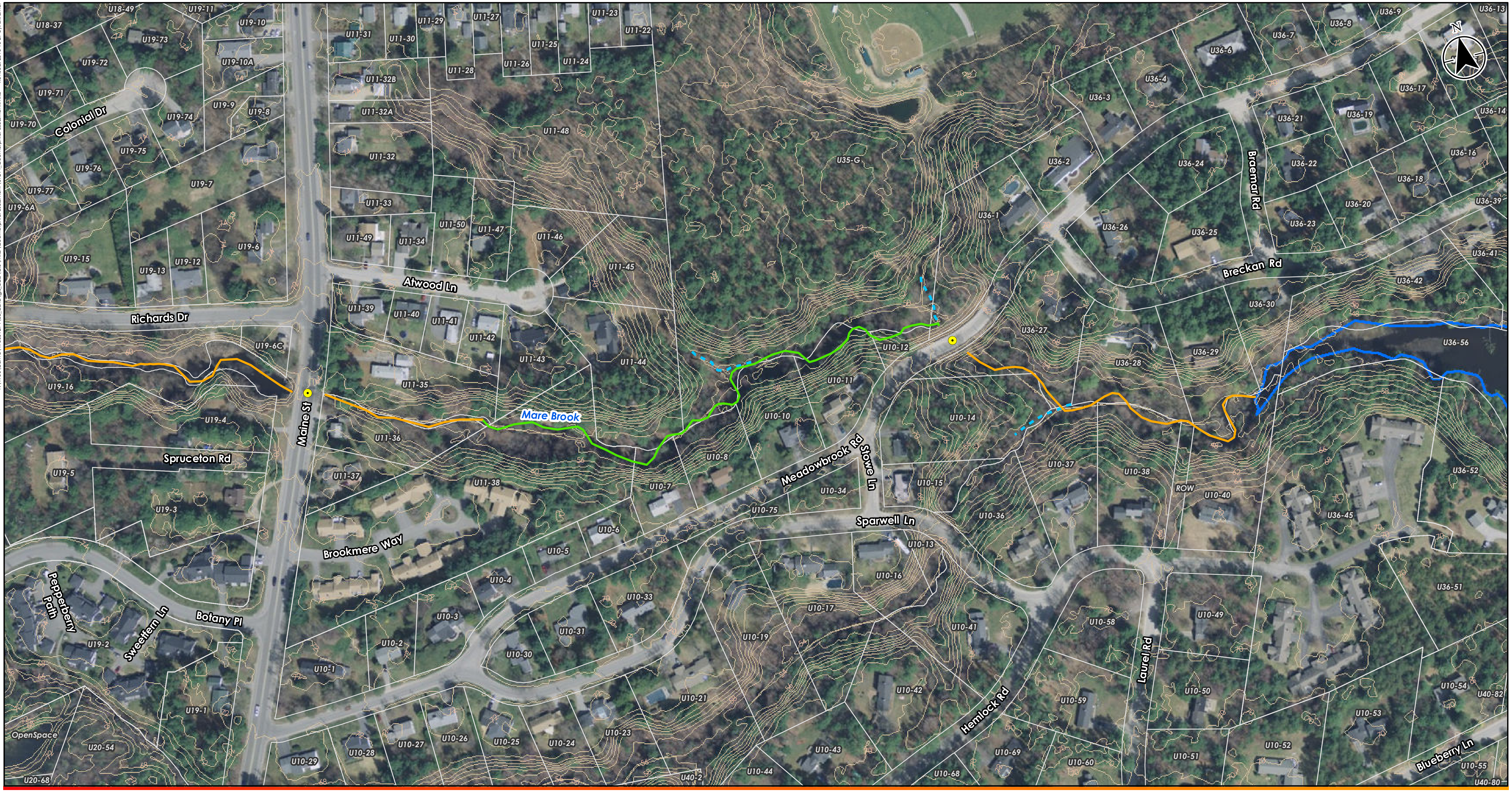
Mare Brook Geomorphic Assessment
Brunswick, Maine

Figure No.
1 of 7

Title
Geomorphic Assessment Results

10/27/2016



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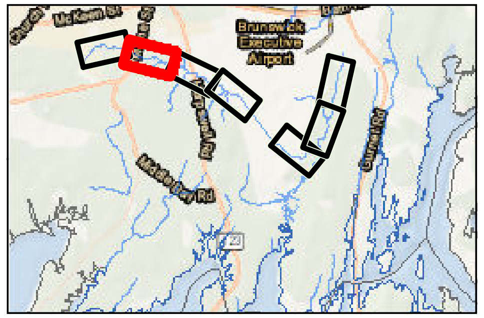

Legend

- Culverts/Dam
- Stream Type
  - Stable
  - Moderately Unstable
  - Tributary
- 2' Contour
- Open Water (approx.)
- Tax parcels

Data Source

1. Aerial imagery provided by ArcGIS Online World Imagery Mapping Service (2015 NAIP) (http://server.arcgisonline.com/arcgis/services/World_Imagery/MapServer).
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Figure No.
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Title
Geomorphic Assessment Results
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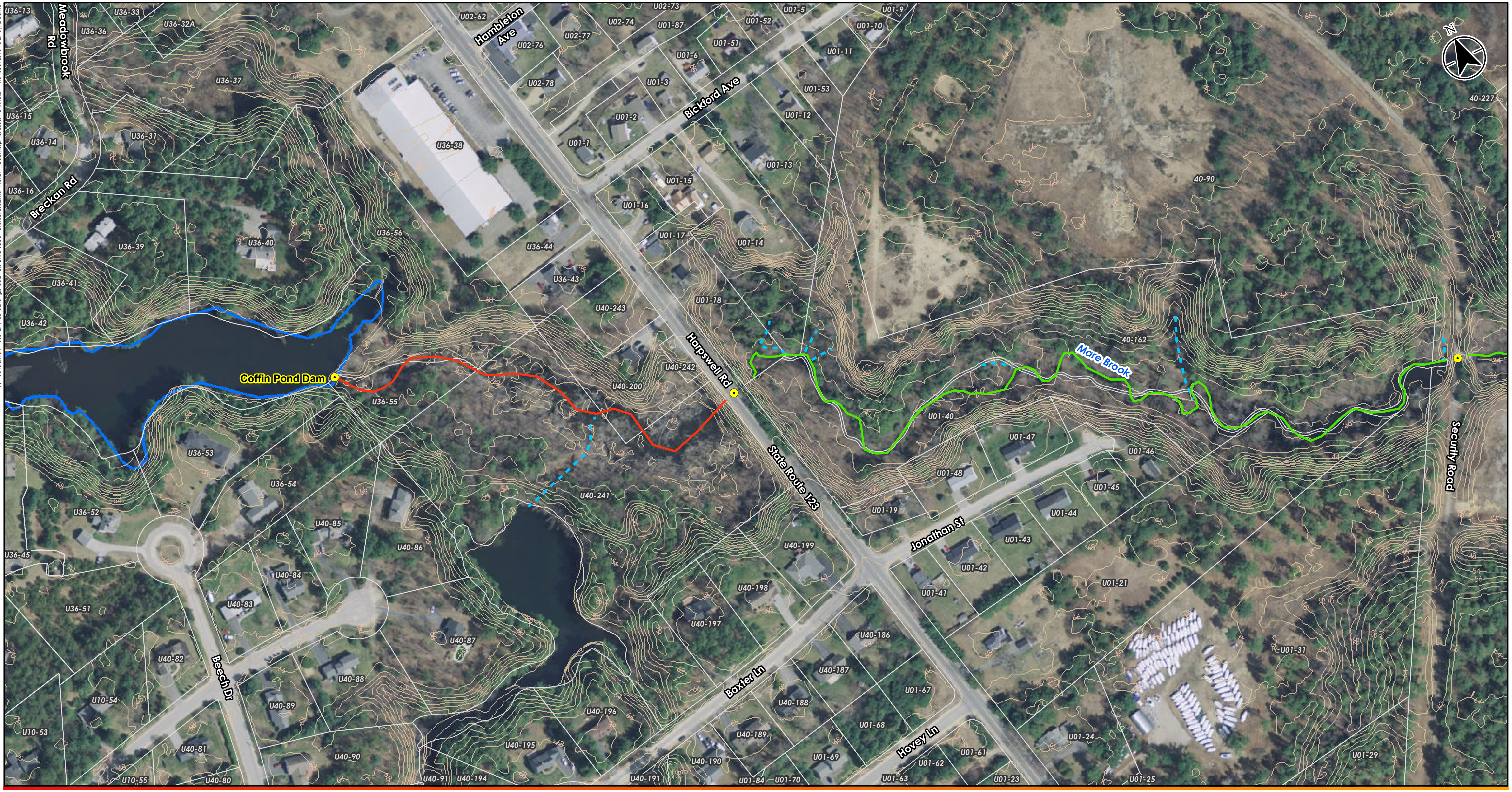

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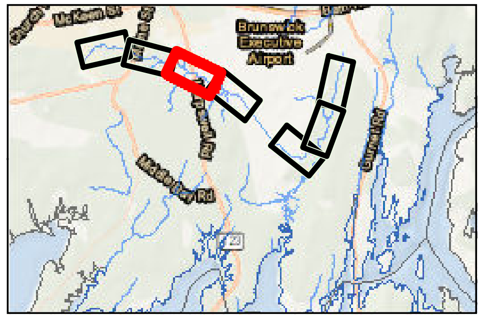

Legend

- Culverts/Dam
- Stream Type
- Stable
- Unstable
- Tributary
- 2' Contour
- Open Water (approx.)
- Tax parcels

Data Source

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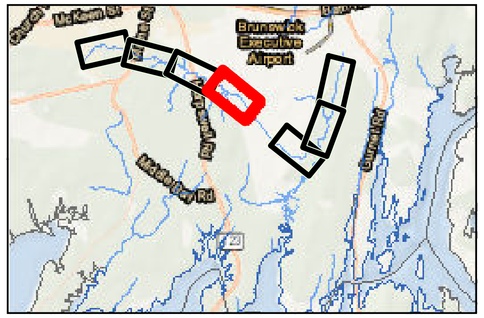

Legend

- Culverts/Dam
- Stream Type
  - Stable
  - Side Channel
  - Tributary
- 2' Contour
- Fence (approx.)
- Tax parcels

Data Source

1. Aerial imagery provided by ArcGIS Online World Imagery Mapping Service (2015 NAIP) (http://server.arcgisonline.com/arcgis/services/World_Imagery/MapServer).
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Title
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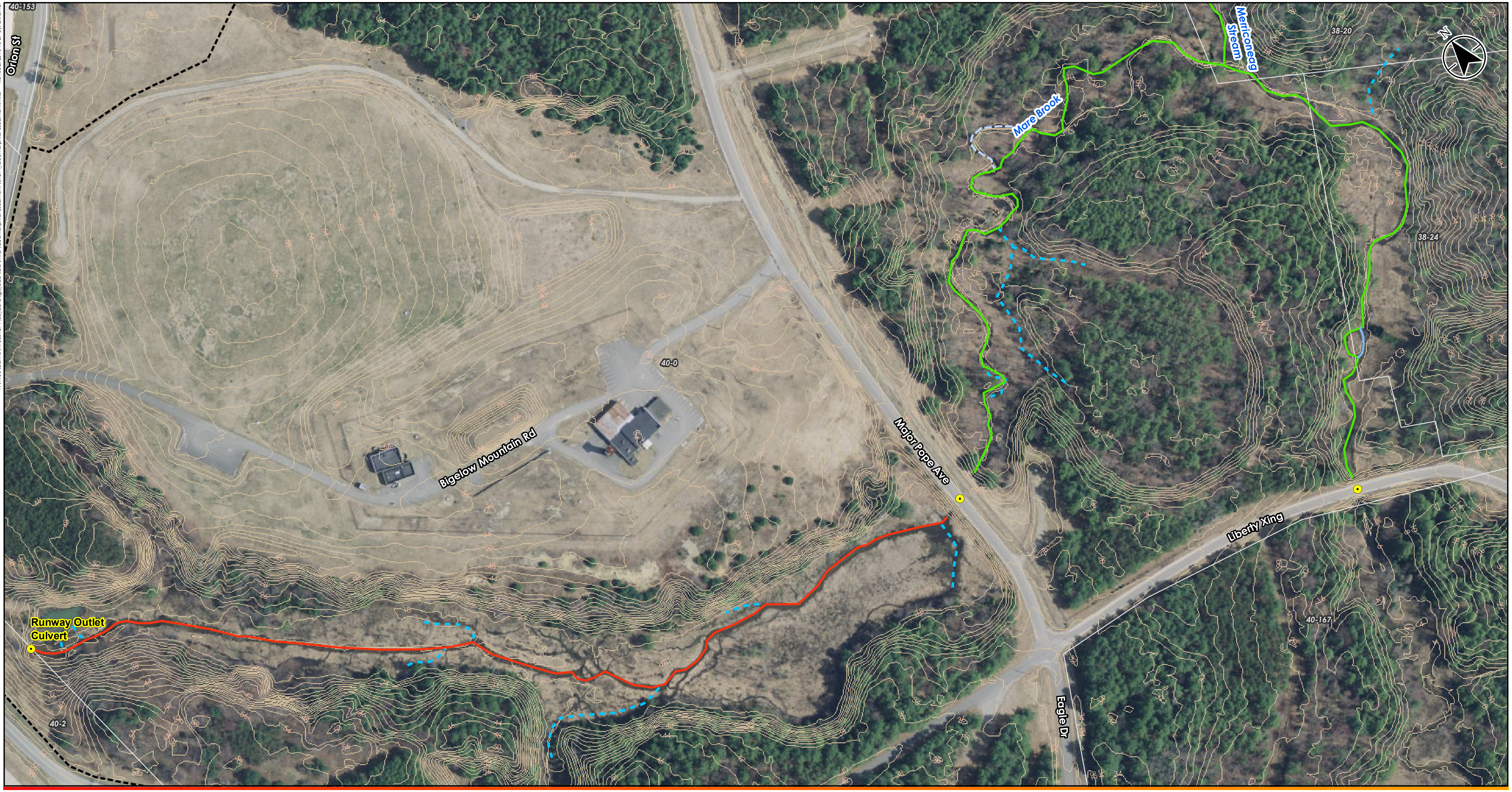

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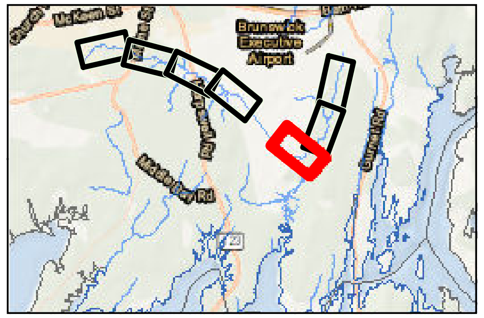

Legend

- Culverts/Dam
- Stream Type
  - Stable
  - Unstable
  - Side Channel
  - Abandoned Channel
  - Tributary
- 2' Contour
- Fence (approx.)
- Tax parcels

Data Source

1. Aerial imagery provided by ArcGIS Online World Imagery Mapping Service (2015 NAIP) (http://server.arcgisonline.com/arcgis/services/World_Imagery/MapServer).
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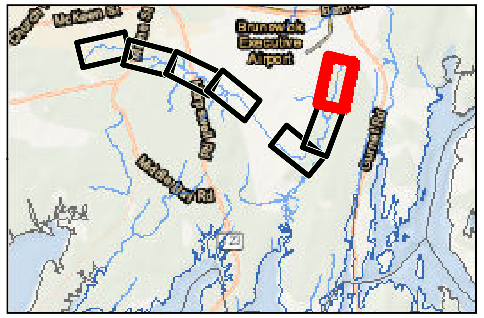

Legend

- Culverts/Dam
- Stream Type
- Stable
- Tributary
- 2' Contour
- Tax parcels

Data Source

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Mare Brook Geomorphic Assessment
Brunswick, Maine

Figure No.
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Title
Geomorphic Assessment Results

10/27/2016

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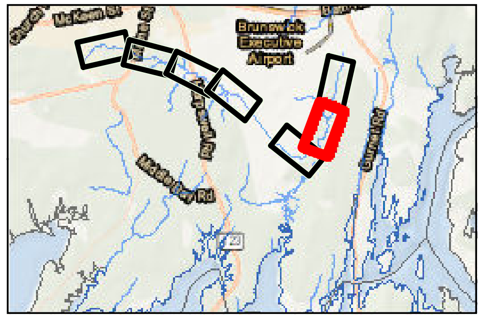

Legend

- Culverts/Dam
- Stream Type
- Stable
- Moderately Unstable
- Abandoned Channel
- Tributary
- 2' Contour
- Open Water (approx.)
- Tax parcels

Data Source

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Mare Brook Geomorphic Assessment
Brunswick, Maine

Figure No.
7 of 7

Title

Geomorphic Assessment Results

10/27/2016

Appendix C REPRESENTATIVE PHOTOGRAPHS

Photo 1. Excess sediment loading from stormwater outfall between Baribeau Drive and Barrows Street. Stantec, August 15, 2016.

Photo 2. Excess sediment loading and wood debris between Baribeau Drive and Barrows Street. Stantec, August 15, 2016

Photo 3. Minor vertical and lateral instability between Barrows Street and MacMillan Drive. Stantec, August 15, 2016.

Photo 4. Minor lateral channel instability between Barrows Street and MacMillan Drive. Stantec, August 15, 2016.

Photo 5. Low-gradient due to perched culvert inlet at Maine Street. Stantec, August 15, 2016.

Photo 6. Backwater created by perched culvert inlet at Maine Street. Stantec, August 15, 2016.

Photo 7. Stream channel alteration downstream from Maine Street. Stantec, August 15, 2016.

Photo 8. Evidence of stream channel alteration (mid-channel stump) downstream from Maine Street, indicative of a channel that was forced to the present location. Stantec, August 15, 2016.

Photo 9. Poor sediment transport capacity upstream from Coffin Pond Dam. Stantec, August 15, 2016.

Photo 10. Debris jams and poor sediment transport downstream from Coffin Pond Dam. Stantec, August 16, 2016.

Photo 11. Stable channel between State Route 123 and Security Road. Stantec, August 16, 2016

Photo 12. Perched inlet condition and debris jamming at Security Road. Stantec, August 16, 2016.

Photo 13. Minor channel lateral migration between Security Road and Samuel Adams Drive. Stantec, August 16, 2016.

Photo 14. Vegetation-controlled channel upstream from Samuel Adams Drive. Stantec, August 16, 2016.

Photo 15. Vegetation-controlled channel between Samuel Adams Drive and Brunswick Executive Airport runway culverts. Stantec, August 16, 2016.

Photo 16. Debris jam (beaver dam) in front of Brunswick Executive Airport runway culvert inlets. Stantec, August 16, 2016.

Photo 17. Excessive sediment loading downstream from Brunswick Executive Airport runway culvert outlets. Stantec, August 16, 2016.

Photo 18. Overly widened, straightened reach between Brunswick Executive Airport runway culverts and Major Pope Avenue. Stantec, August 16, 2016.

Photo 19. Plunge pool downstream from Major Pope Avenue culvert outlet. Stantec, August 17, 2016.

Photo 20. Vegetation-controlled channel downstream from Major Pope Avenue. Stantec, August 17, 2016.

Photo 21. Merriconeag Stream downstream from Beaver Pond Drive. Stantec, August 17, 2016.

Photo 22. Merriconeag Stream backwatered by Picnic Pond Dam. Stantec, August 17, 2016.

Photo 23. Overly-widened, straightened reach of Merriconeag Stream downstream from Purinton Road. Stantec, August 17, 2016.

Photo 24. Merriconeag Stream near confluence with Mare Brook. Stantec, August 17, 2016.

Photo 25. Tidally affected reach of Mare Brook looking downstream from Liberty Crossing culvert. Stantec, August 17, 2016.

Photo 26. Plunge pool downstream from Liberty Crossing culvert (tidally affected). Stantec, August 17, 2016.