

Ecological Landscapes of Calais: A Natural Resource Inventory

Prepared for the Town of
Calais

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Inventory Overview

This inventory of Calais' ecological features was undertaken on behalf of the citizens of Calais, their Conservation and Planning Commissions and the Selectboard, with the intention of developing a more comprehensive understanding of local natural resources relevant to town planning and policy making. The inventory is conceived as a two-phase effort with the first phase initiated in March 2015 to focus on developing more comprehensive wetland mapping and on identifying ecologically significant natural areas, particularly state-significant natural community occurrences. Pending approval of funding, the second phase will begin in March 2016 and will focus on assessing significant habitat blocks and wildlife habitat features along with additional identified needs.

The basic inventory approach consisted of gathering background information from existing sources, including local knowledge, public databases, and maps, integrating that information in a desktop landscape analysis process to map wetlands and identify high priority areas for fieldwork, and conducting new fieldwork to document significant features. Outputs include: an informal kick-off meeting to gather community knowledge and generate interest; a new comprehensive wetland map and datalayer; an expanded knowledge of locations for significant ecological features, including significant natural communities and rare species; this report documenting the project; and a public meeting to share the findings.

In brief, the desktop wetlands assessment resulted in the mapping of 565 wetland and potential wetland units that collectively span almost 10% of the town (includes all lakes and ponds). This effort substantially improved both the accuracy and comprehensiveness of wetland mapping relative to existing state and national wetland maps. Provisional classification of community types for these units resulted in recognition of 26 different wetland and aquatic natural community types, including a number of rare and uncommon types that were subsequently confirmed to be of state significance. Provisional class determinations were also made for the mapped wetland units with a majority being class 2 wetlands.

The landscape analysis process led to identification of many high and medium priority sites for fieldwork, which were ultimately winnowed down to 8 larger areas encompassing nearly half of the individual sites of interest. Conservation Commission members then contacted the relevant landowners to request permission for access. Landowner permission was obtained to visit all or parts of 7 of these macrosites and site visits to these 7 areas subsequently occurred in September and October 2015. These visits resulted in documentation of 16 new state-significant natural community occurrences and numerous new rare plant records. This brings known records from Calais to 22 state-significant natural community occurrences (9 different types) and 27 rare, threatened, or uncommon species (4 vertebrate animals, 5 invertebrate animals, 16 plants, and 2 mosses). These mapped features and their immediate surroundings are some of the most ecologically significant places in Calais, though many additional areas remain to be explored.

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Acknowledgments

An inventory of this scope is the result of many people's contributions, so I would be remiss if I did not thank those who took part. First and foremost, I thank the people of Calais for voting to fund this project and for giving me the opportunity to explore your fascinating landscape and share its ecological treasures with you. Thanks go especially to Stephanie Kaplan and Pam Deandrea who worked over several years (and many grant applications) to fund this project and get it off the ground, as well as to the Selectboard and Planning Commission for supporting this work. Thanks also to the many other Conservation Commission members who provided input to shape this inventory and devoted long hours to the work of contacting landowners for permission to access properties. To the many generous landowners who opened their doors, woods, wetlands, and fields to me and shared knowledge of their own places – without you, little new would have been discovered in this effort. Thanks also to those who attended our kickoff session and shared their knowledge of many interesting features around town. Special thanks in this regard to Eric Sorenson for his prior work identifying many potentially significant features and for his and Everett Marshall's assistance in obtaining existing rare species and significant natural community records from the Vermont Natural Heritage Inventory. Finally, thanks to Dan Currier (CVRPC) for providing GIS-ready landownership data.

Introduction

The Calais Conservation Commission, Planning Commission, Selectboard, and voters recognized the need for a detailed town-wide natural resource inventory to support the achievement of goals laid out in the town plan for natural resource protection and land use planning. This inventory work is intended to provide the critical information base on which to base town planning activities, future policy, and development review. Additionally, this knowledge supports a sense of local identity and recognition of the special attributes of the town.

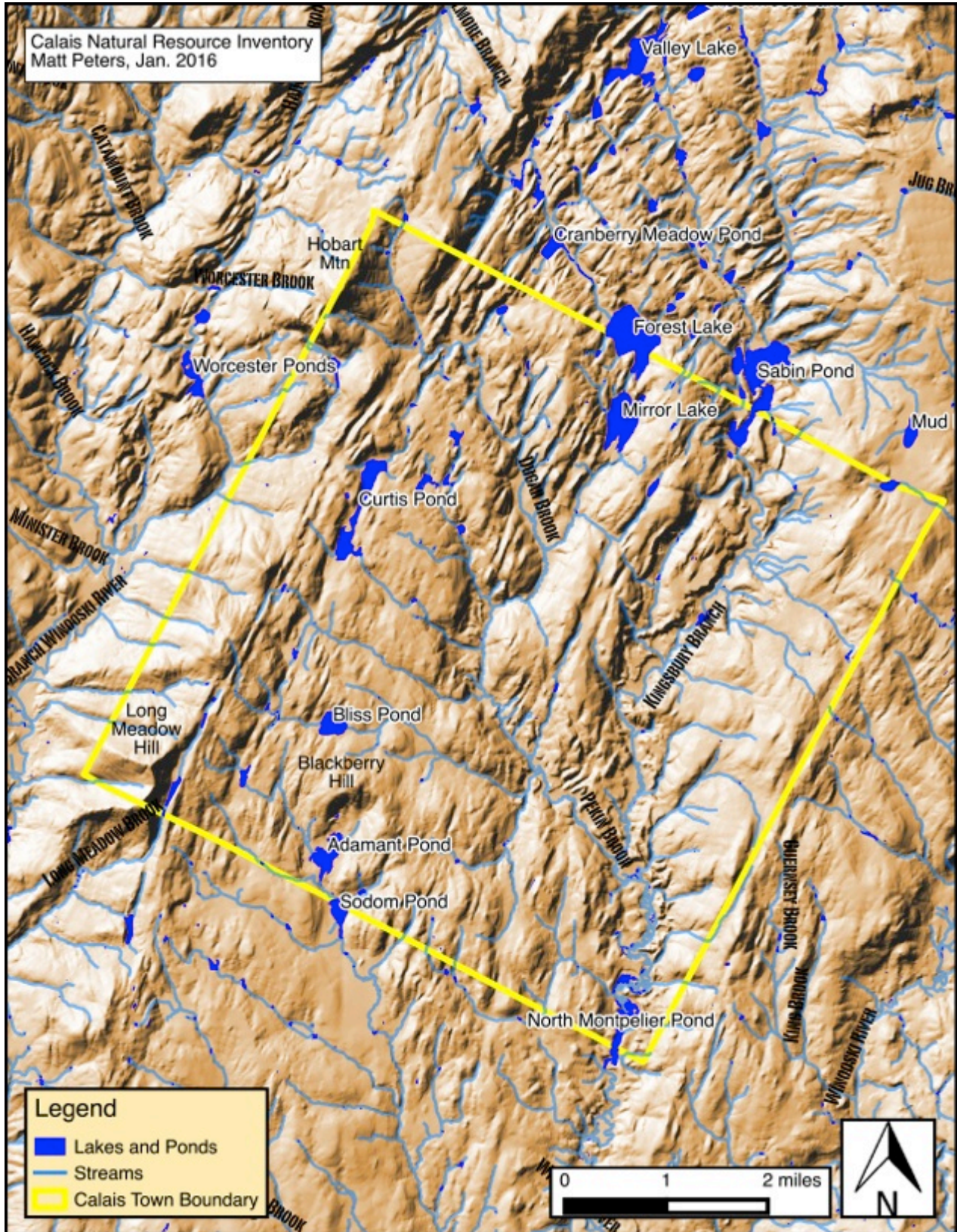
To this end the inventory was initiated in March 2015 as the first phase of a two-phase inventory with three primary components: A) a comprehensive wetlands inventory; B) identification of ecologically significant natural features, with a focus on state-significant natural communities and important habitats for rare species; and C) an assessment of significant wildlife habitat blocks and important wildlife habitat features within the town. Phase 1 consisted of components A and B, and Phase 2, with planned initiation in 2016 pending funding, will focus on component C and any additionally identified needs. This report summarizes the results of phase 1 of the inventory.

Landscape Context and Ecological Setting of Calais

An understanding of Calais' landscape starts with the broad-scale patterns that underlie it. Topographically, Calais tops out at about 2,150 ft on Hobart Mountain along the northwest edge of town, which drains all the way down to just under 700 ft elevation at North Montpelier Pond. Three general topographic regions are apparent: a line of taller, steeper hills forming a ridge along the northwest edge of Calais that culminates in Woodbury Mountain to the north of town; a broad central swath of generally low lying terrain, finely dissected by small ridges and valleys with many streams and wetlands; and a section of broader hills and plateaus east of the Kingsbury Branch. Almost the entire town is within the Kingsbury Branch watershed (including Pekin Brook) and its valley forms both the main artery for water and for people flowing along the Rte 14 corridor. Much of Calais has a distinct northeast-southwest fabric created by the compressive geologic forces that uplifted the Green Mountains. This topographic pattern results in both parallel and perpendicular landscape patterns visible in the network of wetlands and small streams as well as in the Town's road infrastructure and the Town's boundaries.

Calais straddles the boundary between two biophysical regions, the Northern Green Mountains and the Northern Vermont Piedmont; these are regions that share features of climate, geology, topography, soils, natural communities, and, consequently, human history. This regional boundary coincides with one of the main geologic and topographic shifts in Calais and with settlement patterns, with the taller western hills of the Northern Green Mountain region being composed of rocks such as granofels, quartzite, phyllites, and schists, that tend to be harder and result in more acidic, nutrient-limited conditions. This combination of factors has contributed to the limited number of homes and roads in this part of town and the correspondingly largest blocks of intact forests. However, the bulk of Calais is underlain by the upended phyllites and interlacing, crumbly limestone beds of the Waits River Formation. These sporadic limestone beds contribute significantly to the character of Calais' soils and its

Landscape Overview of Calais, Vermont



wetlands. The soft, readily weathered limestone is rich in calcium carbonate that creates locally enriched soils and groundwater of higher dissolved mineral content and pH. These conditions are a primary factor behind the abundance of rich northern hardwood forests and rare enriched wetlands such as fens and calcareous red maple-tamarack swamps. Between these areas of enrichment more resistant phyllite (a schist-like metamorphic rock) forms most of the abundant small ridges and outcrops. In the southwest quadrant of town numerous small areas of granitic pluton are also present. Largest and most notable among these is Blackberry Hill and the terrain around Adamant Pond, which was once home to a collection of small granite quarries whose quarry pit ponds and grout piles are still evident among the regrowing forests.

Small bedrock fins and outcrops are commonplace in Calais, but most of the landscape is cloaked in soil derived from glacial till, the ground-up mixture of rocks, sand, silts, and clays left by the retreat of ice-age glaciers. More well-sorted soils are found along the Kingsbury Branch of the Winooski River and along Pekin Brook. These represent a mix of origins including recent alluvial soil deposits, soils deposited into a glacial lake that once existed in the valley bottom, and, further upstream, glacial outwash deposits of sands and gravels that gave rise to Calais' sand and gravel pits.

Atop this physical landscape the biological and human cultural landscape has enacted many changes in recent history. Like most of Vermont, Calais would have been predominantly forested prior to European settlement and subsequently experienced widespread land clearing for fuel, lumber, and conversion to agricultural uses. Over time intense agricultural use has waned with the resultant return of second growth forests that are the dominant feature of Calais' biological landscape today.

Inventory Methodology

This natural resource inventory used two main methods: landscape analysis and field inventory. The landscape analysis process involves gathering and analyzing existing information from a variety of databases and information sources to identify priority areas for fieldwork. These sources included digital maps, aerial imagery, and databases of wetlands, vernal pools, soils, topography, orthophotography, geology, wildlife habitats, and rare species/natural communities. This information was compiled in a GIS (geographic information system) platform to facilitate analysis and mapping. Local knowledge was also vital to the inventory and was gathered from many community members during an informational session at the outset of the project, as well as thru conversations with landowners. Field inventory efforts were guided by the results of the landscape analysis, but were necessarily constrained to those areas where landowners granted access. In a few areas "windshield surveys" from public roadways were also used. Detailed methods for the wetland mapping and identification of ecologically significant natural features are as follows.

Wetland Mapping Methods

The wetlands inventory developed during this assessment refines and expands upon the existing wetland databases, the National Wetlands Inventory (NWI) and the Vermont Significant Wetlands Inventory (VSWI), to provide more comprehensive and accurate mapping for project planning, development review, and resource protection purposes. Wetland mapping was conducted during April and early May 2015 and was accomplished via desktop analysis of the most recent available color-infrared (CIR) orthophoto imagery and other information, including soils and topographic data. CIR imagery is widely used for wetland mapping due to its superior properties for distinguishing water and variations in infrared reflectance that correlate to different vegetation types, species, and even stress levels within a species (eg. flood stressed vegetation). For the western 2/3 of town leaf-off CIR imagery was available, while the eastern third had only leaf-on CIR imagery available. This likely resulted in somewhat reduced levels of accuracy and resolution in the eastern sector due to the lack of visibility through hardwood tree canopies in leaf-on imagery. Ordinary color imagery in leaf-off condition was used to partially compensate for this situation.

Most mapping was done while viewing imagery at a scale of 1:5,000 with occasional inspection at 1:2,500 or finer as needed. As wetlands were mapped they were assigned one or more provisional natural community types based on professional judgment. Provisional wetland class determinations were also made, as were judgments about potentially significant features. This information can be found in the attribute data for the digital wetland map files (shapefile and kml). ('PRIM_NC' = primary natural community type, 'PROV_NC2', etc. = secondary or alternate natural community type possibilities, 'PROV_CLASS' = provisional wetland class determination.) Natural community type classification generally follows *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont* (Thompson and Sorenson, 2005), except where additional types have been more recently recognized by the Vermont Natural Heritage Inventory, or where additional anthropogenic types (eg. constructed ponds, wet meadows) were needed. Limited road or "windshield" surveys were conducted to augment and verify some wetland mapping and aid in the prioritization process. The resulting wetland boundaries are suitable for planning purposes, including the development of wetland overlays, but are advisory in nature and are not a replacement for onsite field investigations or formal wetland delineations.

Ecologically Significant Natural Features Identification Methods

This portion of the inventory integrated the wetland inventory with landscape analysis and new field inventory effort to identify sites of state-significant natural community occurrences as well as other locally significant features.

Identification of state-significant natural community occurrences is a primary means for locating the most ecologically significant natural features in a landscape. The state Fish and Wildlife Department's Vermont Natural Heritage Inventory (VNHI), developed a set of standards for evaluating specific natural community occurrences to determine if they meet the threshold for state-significance. In brief, these standards involve evaluation of the condition, landscape context (surrounding ~1000ac), and size of a community occurrence against a set of

ranking specifications which, when combined with the rarity status for a given community type, yield an 'Element Occurrence Rank' that determines the significance of the occurrence. See the materials in Appendix 2, produced by the VNHI, for further information relating to state-significance determinations and rarity ranks.

Identifying these features requires fieldwork to document the natural community types, assess their condition and composition, and improve mapping accuracy. Potential sites for fieldwork were identified and prioritized through the landscape analysis process described above. The initial prioritization yielded a total of 57 high priority and 45 medium priority wetlands and 4 high priority and 11 medium priority uplands for a total of 117 high and medium priority sites. This far outstripped the available resources for this phase of the inventory, so further prioritization was conducted to identify clusters of sites that could be visited with maximal efficiency. This resulted in identification of 8 macrosites that collectively encompassed 50 individual high and medium priority sites.

At this point a list of the relevant properties and landowner information for the 8 macrosites was assembled from Grand List information (45 parcels). Conservation Commission members conducted most of the work of contacting landowners for permission to access their properties. Permission was obtained to visit all or parts of 7 of the 8 macrosites, the exception being the Hawkins Pond/ Hawkins Ledge area. In a few instances community occurrences that cross parcel boundaries were mapped onto parcels where permission was not obtained, however such mapping was based strictly on orthophoto interpretation and views obtained from adjacent properties where permission had been received. In no case was a property accessed without permission.

Fieldwork at these sites was conducted during September and October 2015. Site visits consisted of walking the survey area, recording data on the type, quality, and spatial extent of natural community occurrences, important habitat features, vegetation, and wildlife, as well as incidental detection of any rare species present. Data from these site visits were later analyzed to improve relevant mapping and generate this report. Natural community typing, classification, quality and rarity rankings follow established protocols of the VNHI and *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont* (Thompson and Sorenson, 2005). All landowners who granted permission for access also granted permission to share any findings with the VNHI, so, in addition to the reporting provided here, technical descriptions of each state-significant natural community occurrence and rare/uncommon species sighting were prepared and submitted to the VNHI for inclusion in the state natural heritage database.

Wetland Mapping Results

This remote assessment and mapping of Calais' wetlands resulted in the new wetland map in Appendix 1, which displays a substantial increase in the accuracy and comprehensiveness of wetland mapping over existing Vermont Significant Wetlands Inventory (VSWI) maps and National Wetlands Inventory (NWI) maps. During this assessment 565 wetland and potential wetland units were mapped and collectively span 2,380 acres or about 9.6% of the town landbase. This is a substantially greater density and extent than the statewide average of about 4% of the landscape (based on VSWI mapping). For comparison within Calais, the NWI includes just 250 wetland units and the VSWI includes 185 units. (Note that VSWI map units do not distinguish wetland types and thus lump all contiguous parts of a wetland complex into a single map unit, unlike this assessment – the comparable approach with the new wetland map yields 423 non-contiguous wetlands units, thus still a sizeable increase.) While perhaps obvious, it is important to note that this increase in wetland count and mapped area represents an improvement in mapping accuracy and resolution, not an actual increase in the amount of wetland present. Another factor contributing slightly to the increase is the inclusion of all lakes and ponds in this assessment. Overall, the bulk of the newly mapped wetlands are smaller wetlands, a testament to the improved resolution of this mapping effort. While existing VSWI and NWI maps generally captured Calais' larger wetlands, the boundaries were often imprecise and required adjustment for nearly every wetland, thus even for previously mapped wetlands this effort creates an improved map.

The wetland map and corresponding data files include two types of wetland units: wetlands and potential wetlands. The bulk of the mapped features are wetlands, those areas confidently determined to be wholly or mostly wetland based on remote assessment (primarily orthophoto interpretation) and limited fieldwork. A small number (27) of additional areas were mapped as potential wetlands where soils, photo interpretation, and other factors suggested a high likelihood of wetlands occurring, but where they could not be accurately mapped with a high degree of confidence based on remote assessment alone; these areas require further investigation in the field to determine if wetlands exist.

This new wetlands map is now the most accurate wetlands map available for Calais and should be used for planning and development review purposes. However, it is important to note that the map is advisory in nature and that while it is very comprehensive, identifying the vast majority of class 2 wetlands and many class 3 wetlands, no remote assessment can capture every small wetland feature (eg. small vernal pools obscured by conifers); thus it is not a substitute for site specific field evaluations where development activities are proposed. It is, however, a highly accurate guide useful for identifying and planning around the majority of Calais' wetlands. Also note that the limited areas of VSWI mapped wetland outside the wetlands in the new wetlands map may still require attention and clearance with the state Wetlands Program if nearby development is proposed, despite having been judged to be non-wetland in this assessment.

This assessment includes a provisional wetland class determination for each wetland unit. Class 1 (none currently designated in Calais) and 2 wetlands have greater protections than class 3 wetlands under the Vermont Wetland Rules and are generally considered to have greater ecological significance, though all wetlands have beneficial functions in the landscape. The provisional classification field (PROV_CLASS) in the wetland data shows these determinations; however, definitive class determinations for regulatory purposes are made by the Vermont Wetlands Program based on field data. Of the 565 mapped wetland units, 482 appear to be class 2 wetlands and the remaining 83 appear to be class 3. While wetlands captured in the VSWI maps were already classified (VSWI_CLASS data field), a small number of these areas appeared to be inaccurately classified (mostly small, isolated, constructed ponds designated class 2 but appearing to be class 3).

Calais' wetlands represent a diverse assemblage of natural community types, supporting myriad species of plants, animals, and other organisms and contributing a disproportionately large amount of biodiversity to the town, given their limited extent. From this assessment it appears that at least 26 different wetland natural community types are present in Calais. These types are listed in Table 1 along with the number of occurrences (wetland units) of each type, the average and total acreage, and the number of occurrences that were either state significant for the quality of the community occurrence itself and/or have been recorded as hosting rare, threatened, endangered, or uncommon (S3) plants and animals. Full descriptions of most community types can be found in *Woodland, Wetland, Wildland: A Guide to the Natural Communities of Vermont* (Thompson and Sorenson, 2005).

In this assessment the most numerous wetland types in Calais include Vernal Pools (106), constructed ponds (101), Hemlock-Balsam Fir-Black Ash Seepage Swamps (75), and Shallow Emergent Marshes (51). However, in terms of acreage the most common type include natural ponds (607ac.), Alluvial Shrub Swamps (453ac.), Hemlock-Balsam Fir-Black Ash Seepage Swamps (244ac.), Shallow Emergent Marshes (203ac.), Alder Swamps (192ac.), and wet meadows (agricultural or otherwise disturbed)(175ac.). Among the least common types are Silver Maple-Ostrich Fern Floodplain Forest, various types of seepage forests, Red Spruce-Cinnamon Fern Swamp, various types of fens, and other open wetland types. The various types of fens and Calcareous Red Maple-Tamarack Swamps are considered the rarest of the wetland types in Calais, however, they are locally unusually abundant relative to most regions, making them of particular significance and concern. Their abundance is linked to the prevalence of calcareous Waits River Formation bedrock and the resulting enriched groundwater seepage.

This community type assessment is not definitive, since some community types are more readily identified by remote assessment than others, but it provides a valuable overview of the wetland diversity of Calais. Of the 26 community types identified 19 had at least one unit associated with state significant features (rare species and/or the community itself); and a total of about 58 individual wetland units were associated with such features, further emphasizing the importance of protecting wetlands and water bodies to support Calais' natural heritage. These significant community occurrences and species are the focus of the rest of this report.

Table 1. Summary of Wetland Natural Community Types.

Wetland Community Types	Number of occurrences	Average size (ac.)	Total acreage	# with State Significant features*
Pond, natural	24	25.3	606.8	6
Alluvial Shrub Swamp	19	23.8	452.6	10
Hemlock-Balsam Fir-Black Ash Seepage Swamp	75	3.3	244.3	8
Shallow Emergent Marsh	51	4.0	202.9	3
Alder Swamp	38	5.1	192.1	1
Wet Meadow	33	5.3	174.7	4
Pond, constructed	101	0.7	74.1	1
Northern White Cedar Swamp	12	4.9	58.7	3
Intermediate Tall Sedge Fen	7	6.5	45.7	5
Red Maple-Black Ash Seepage Swamp	17	2.5	41.9	2
Poor Fen	5	8.0	40.0	3
Vernal Pool	106	0.3	31.0	1
Hemlock-Hardwood Seepage Forest	7	3.6	25.5	1
Spruce-Fir-Tamarack Swamp	8	3.2	25.3	0
Calcareous Red Maple-Tamarack Swamp	6	4.2	25.0	6
Sweet Gale Shoreline Shrub Swamp	3	8.0	24.0	1
Deep Broadleaf Marsh	8	2.6	20.9	1
Cattail Marsh	4	5.0	19.9	0
Seep	20	0.8	16.2	0
Northern Hardwood Seepage Forest	1	12.7	12.7	0
Open Water	7	1.8	12.5	0
Seepage Forest	2	4.8	9.7	0
Sedge Meadow	6	1.5	9.3	0
Silver Maple-Ostrich Fern Floodplain Forest	1	6.1	6.1	1
Rich Fen	2	2.0	4.1	1
Red Spruce-Cinnamon Fern Swamp	2	2.0	4.0	0
Total	565	4.2	2379.8	58

Ecologically Significant Natural Features

Calais is fortunate in having a wealth of ecologically significant natural features. Such features can be evaluated at a variety of scales from large habitat blocks important for long distance wildlife movement to the detailed locations of individual rare species occurrences. One mid-scale approach to identifying and understanding ecological significance is through the lens of state-significant natural community occurrences. These are discrete areas of a given natural community type that display a high enough quality to be ranked as significant in a state level perspective. This determination weighs the rarity of the community type, the condition or quality of the community itself, the condition of the surrounding landscape context, and the size of the community itself and is guided by protocols developed by the VT Fish and Wildlife Department's Vermont Natural Heritage Inventory. The search for these features was the second focus of this natural resource assessment.

Prior to this inventory 6 state-significant natural community occurrences had been documented in Calais including two Poor Fens, an Intermediate Tall Sedge Fen, a Northern White Cedar Swamp, a Red Maple-Black Ash Seepage Swamp, and an Alluvial Shrub Swamp. Fieldwork undertaken during this assessment resulted in documentation of 16 additional state-significant natural community occurrences, including 6 Calcareous Red Maple-Tamarack Swamps, 4 Hemlock-Balsam Fir-Black Ash Seepage Swamps, 3 Intermediate Fens, a Poor Fen, a Rich Fen, and a Northern Hardwood Talus Woodland. All of these state-significant occurrences are shown in the State-Significant Natural Communities Map (Appendix 1). Most of these community types are rare to uncommon at a landscape level across Vermont. The exception to this is the Hemlock-Balsam Fir-Black Ash Seepage Swamp, which is a fairly common wetland type, in fact, it is the most common forested wetland type in Calais. These four examples, however, are of sufficient size and quality to be state-significant representatives of this more common type.

It is noteworthy that all but one of the state-significant communities identified thus far in Calais are wetlands — there are several explanations for this. First, at a landscape scale wetlands are much less common than uplands, only about 4% of Vermont and 10% of Calais, so wetland community types individually are more likely to be considered rare or uncommon than uplands, and rarity is one of the considerations. Second, many of the rare upland community types are connected to physical landscape features, climatic factors, and other environmental variables that are concentrated in other regions of the state. Conversely, Calais' uplands are dominated by fairly typical and moderate conditions, resulting in the prevalence of more common "matrix" forest types, which require very large acreages in relatively undisturbed condition to be state-significant. Finally, differences among wetland types are often more readily visible in desktop analyses than are differences among upland forest types, making it somewhat easier to identify wetland sites for the necessary fieldwork. This said, other significant upland community occurrences may be as yet unrecognized; likely prospects include large, mature, rich northern hardwood or hemlock forests, various types of cliffs or outcrops, and additional talus woodlands.

The following detailed macrosite descriptions provide summaries of fieldwork at the 7 visited macrosites (see methods section for prioritization process). Following this, brief descriptions of previously documented state-significant sites are given; these were not visited during this inventory since they were already known (except Chickering Bog was briefly visited in conjunction with other features in the surrounding macrosite). In addition to the site descriptions provided here, detailed technical descriptions of significant community occurrences were provided (with landowner permission) to the state Natural Heritage Inventory on their Natural Community Survey Forms.

Chickering Bog Area Macrosite

Location: South of Lightening Ridge Rd., east of Sodom Pond

Information Sources: Matt Peters' site visit on Sept. 24, 2015; VT Fish and Wildlife Department's Natural Heritage Inventory; interview with Nature Conservancy staff.

Ownership: The Nature Conservancy and other privately owned lands

Significant Features:

Natural Communities and other features: Intermediate Tall Sedge Fens*, Calcareous Red Maple-Tamarack Swamps*, Hemlock-Balsam Fir-Black Ash Seepage Swamps*, Seeps, enriched Sedge Meadow, Vernal Pools, upland forests (predominantly hemlock-, red spruce-, and white pine-northern hardwoods). * Indicates occurrences that are State-Significant.

Rare, Threatened, & Endangered Species: dragon's-mouth (*Arethusa bulbosa*), pale sedge (*Carex livida*), water sedge (*Carex aquatilis*), bog-rush (*Cladium mariscoides*), ebony boghaunter – a dragonfly (*Williamsonia fletcheri*), three-ranked Spear-moss (*Calliergon trifarium*, curved-leaved golden moss (*Tomenthypnum falcifolium*), and a historical record for northern adder's-tongue (*Ophioglossum pusillum*).

Uncommon Species: Tuberos Grass-pink (*Calopogon tuberosus* var. *tuberosus*), cyperus-like sedge (*Carex pseudocyperus*), Showy Lady's-slipper (*Cypripedium reginae*), Loesel's Twayblade (*Liparis loeselii*), mountain fly-honeysuckle (*Lonicera villosa*), Rose Pogonia (*Pogonia ophioglossoides*), and the dragonflies: Green-striped Darner (*Aeshna verticalis*), Lilypad Clubtail (*Arigomphus furcifer*), Petite Emerald (*Dorocordulia lepida*), Elfin Skimmer (*Nannothemis bella*).

Site Description:

This site is composed of a series of enriched headwaters swamps and open wetlands nestled among the forested, low relief, north/south oriented ledges near the town boundary with East Montpelier. Enriched groundwater seepage, derived from the interaction of groundwater with calcium-rich bedrock, in this case the limestone beds of the Waits River Formation, is the unifying feature among many of the significant wetland communities here, and is essential to supporting many of the rare species. The matrix of second-growth, primarily mixedwood

forests, mostly hemlock-, red spruce-, and white pine-northern hardwoods, provides a relatively natural context for these important and diverse wetlands.

The namesake “Chickering Bog” is the large (~12ac), centrally located, mostly-open wetland, and has long been known as a peatland of statewide significance and the home of numerous rare plants and animals. This ‘bog’ is technically an Intermediate Tall Sedge Fen with some areas transitional to Rich Fen and cedar swamp; it is among the larger examples of this type in the state and is sustained by slow groundwater seepage rich in calcium and other mineral nutrients. The fen contains a small central pond, not yet filled by naturally accumulating peat deposits, and areas of stunted northern white cedar and larch. A second, smaller fen, known as “East Fen,” is located to the east and is crossed by a VAST trail. This fen, though smaller and somewhat impacted by the trail crossing and adjacent old clearings, is also a significant feature hosting several rare species. Both of these fens are also associated with small Calcareous Red Maple-Tamarack Swamps, a rare type of enriched forested peatland. These swamps have somewhat open, larch (tamarack) dominated canopies, and ground layers that have many species in common with the fens, particularly herbs and shrubs indicative of enriched seepage.

Two moderate sized Hemlock-Balsam Fir-Black Ash Seepage Swamps of significance are also present in the area, one is located to the west of Chickering Bog, the other is east of East Fen and receives the outflow from it. This is a relatively common swamp type in Calais and the region, but the somewhat larger size, good context, and relatively undisturbed condition of these swamps makes them significant. These are also somewhat unusual examples of the type, having relatively strong indications of calcium enrichment and an abundance of white spruce in the canopy, in addition to the more typical dominants. A few other small patches of this community type are also present in the area.

Several vernal pools are present among the ledges, as are various small seeps and a small, enriched sedge meadow. These, together with the state-significant features, create an ecologically important concentration of diverse enriched wetlands in a natural forested context.

A total of 18 uncommon to very rare species have been documented to occur at this site, primarily in association with the unique conditions of the fens, but also in other wetlands and adjacent areas. This is the greatest concentration of such species in Calais and underscores the significance of the site from a biodiversity perspective. These species include 2 state-threatened plants, the dragon’s-mouth orchid and the less dramatically named pale sedge, and 5 other rare or very rare species, including the ebony boghaunter (a dragonfly), water sedge, bog-rush, and a pair of fen mosses. An additional very rare species, the northern adder’s-mouth, a small fern, was documented from the area in 1981, but has not been seen here since then and is thought to be in decline statewide. Ten additional uncommon species are known from the area including 6 plants and 4 dragonflies listed above. Two of these, cyperus-like sedge and mountain fly-honeysuckle, were newly documented during fieldwork for this project, despite the late fall timing of site visits. These discoveries suggest that despite considerable past botanical attention paid to Chickering Bog there may still remain additional rare species to be found in the area.

Management Considerations

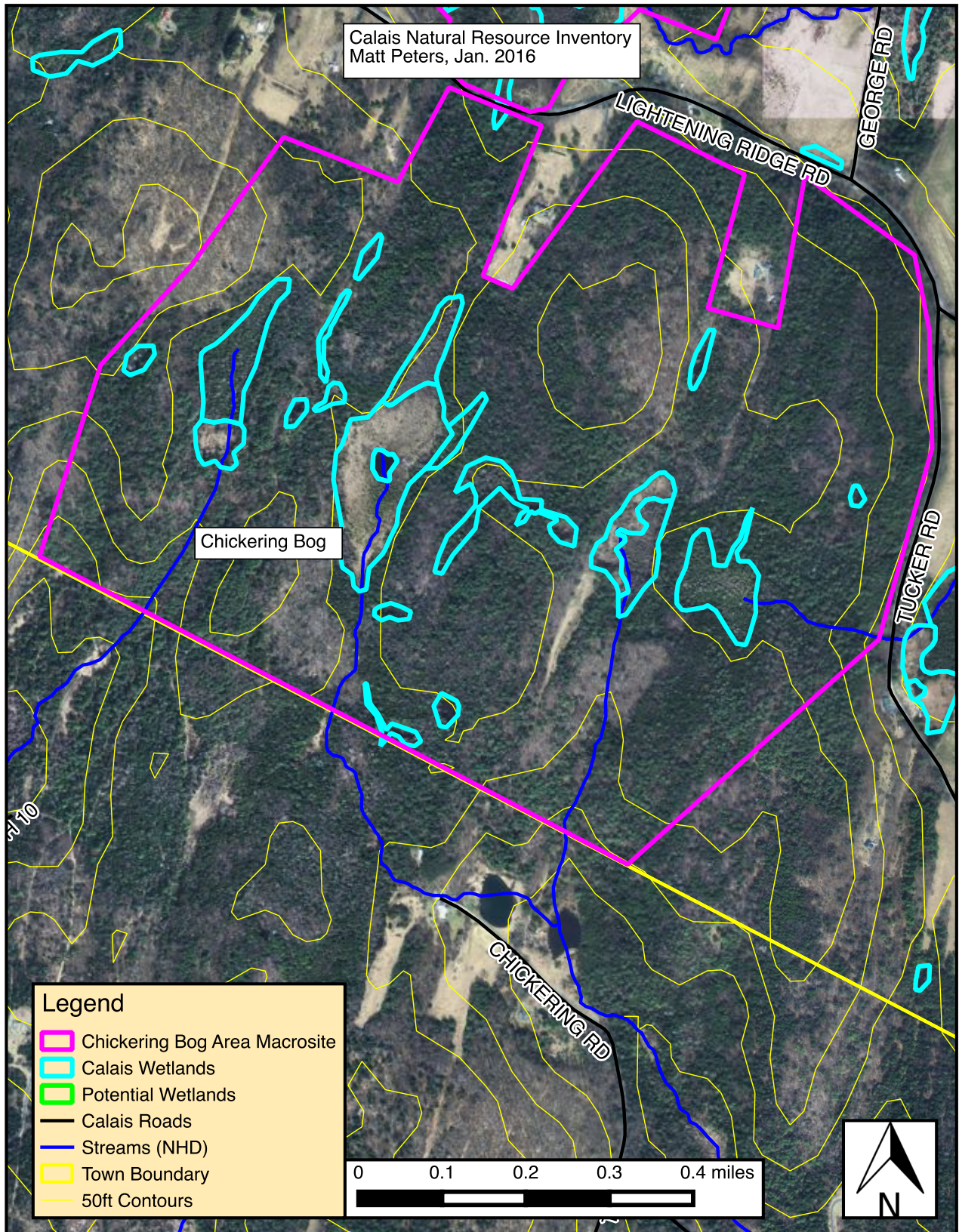
Chickering Bog (and several of the nearby wetlands) is owned by The Nature Conservancy and is publically accessible via a small trail off Lightening Ridge Rd that leads thru private forestland and several other wetlands (including East Fen) to a small boardwalk that projects into the central pond in the fen. This makes this one of the more accessible high quality fens in the state, but also introduces a vulnerability to potential impacts from trampling if off-trail use increases. Conservation of part of this site by TNC is a valuable benefit to the natural heritage of Calais; however, the wetlands at this site are sustained by groundwater seepage making them potentially vulnerable to any disturbances in their watersheds and groundwater source areas. Thus surrounding landowners should be encouraged to minimize activities that might alter patterns or volumes of groundwater or surface water flow. Further protection of these features via conservation easements and other means should be encouraged. Visitors should remain on established trails to minimize and trampling impacts in the wetlands.



*Clockwise
from
top right:
Hemlock-
Balsam
Fir-Black ash
Seepage
Swamp,
3 views of
Chickering
Bog
(Intermediate
Tall Sedge
Fen)*



Chickering Bog Area Macrosite Map



Lightening Ridge North Swamps Macrosite

Location: The headwaters of a small, unnamed tributary to Pekin Brook, north of Lightening Ridge Rd and west of George Rd.

Information Sources: Matt Peters' site visit on Oct. 15, 2015.

Ownership: Privately owned lands

Significant Features:

Natural Communities and other features: Calcareous Red Maple-Tamarack Swamps*, Hemlock-Balsam Fir-Black Ash Seepage Swamps, Seeps, Rich Fen, Shallow Emergent Marsh, Alder Swamp, beaver pond and surrounding upland forests (primarily hemlock- and white pine-northern hardwoods.

* Indicates occurrences that are State-Significant.

Rare, Threatened, & Endangered Species: None known

Uncommon Species: Cypress-like sedge (*Carex pseudocyperus*)

Site Description:

Calcium enriched groundwater seepage is a feature of many of Calais' wetlands and this is particularly true of the headwater swamps of a small unnamed stream north of Lightening Ridge Road. Here two distinct areas of sparsely wooded seepage form tamarack-dominated treed fens best described as Calcareous Red Maple-Tamarack Swamps. Because this community type is rare both swamps are considered state-significant despite their relatively small size and, in one case, somewhat disturbed condition, which shows signs of recovering from past agricultural clearing in places and has likely been somewhat impacted by nearby pond construction. Small herb dominated openings in one of these swamps are akin to Rich Fens, but are too small to map separately. Here the striking white flowers of Grass-of-Parnassus (*Parnassia glauca*) (which is not actually a grass) can be found among many other calciphilic plants. Of the several Calcareous Red Maple-Tamarack Swamps identified in Calais during this inventory these occurrences had the most significant slope leading to variable soil conditions. At the top of the wetland slopes soils are shallow mucky peat about 6" thick over mineral soil, but at the bottom of the slope peat deposits were much more significant at over 4 feet in depth.

Downstream of the upper-most tamarack swamps the stream forms a more defined channel dropping over a bedrock ridge and passing thru a small patch of mixedwood seepage swamp before entering a recently cutover tamarack swamp and marshy meadows surrounding a small beaver pond. These were only viewed from an adjoining parcel. Just below the pond the second of the Calcareous Red Maple-Tamarack Swamps drains into the stream. In the mixedwood forests north of the stream there are several moderate sized, but good condition Hemlock-Balsam Fir-Black Ash Seepage Swamps perched in small depressions without obvious

connections to the larger drainage system. These swamps are home to scattered individuals of the uncommon cypress-like sedge (*Carex pseudocyperus*), which was also found in a number of other similar habitats in town.

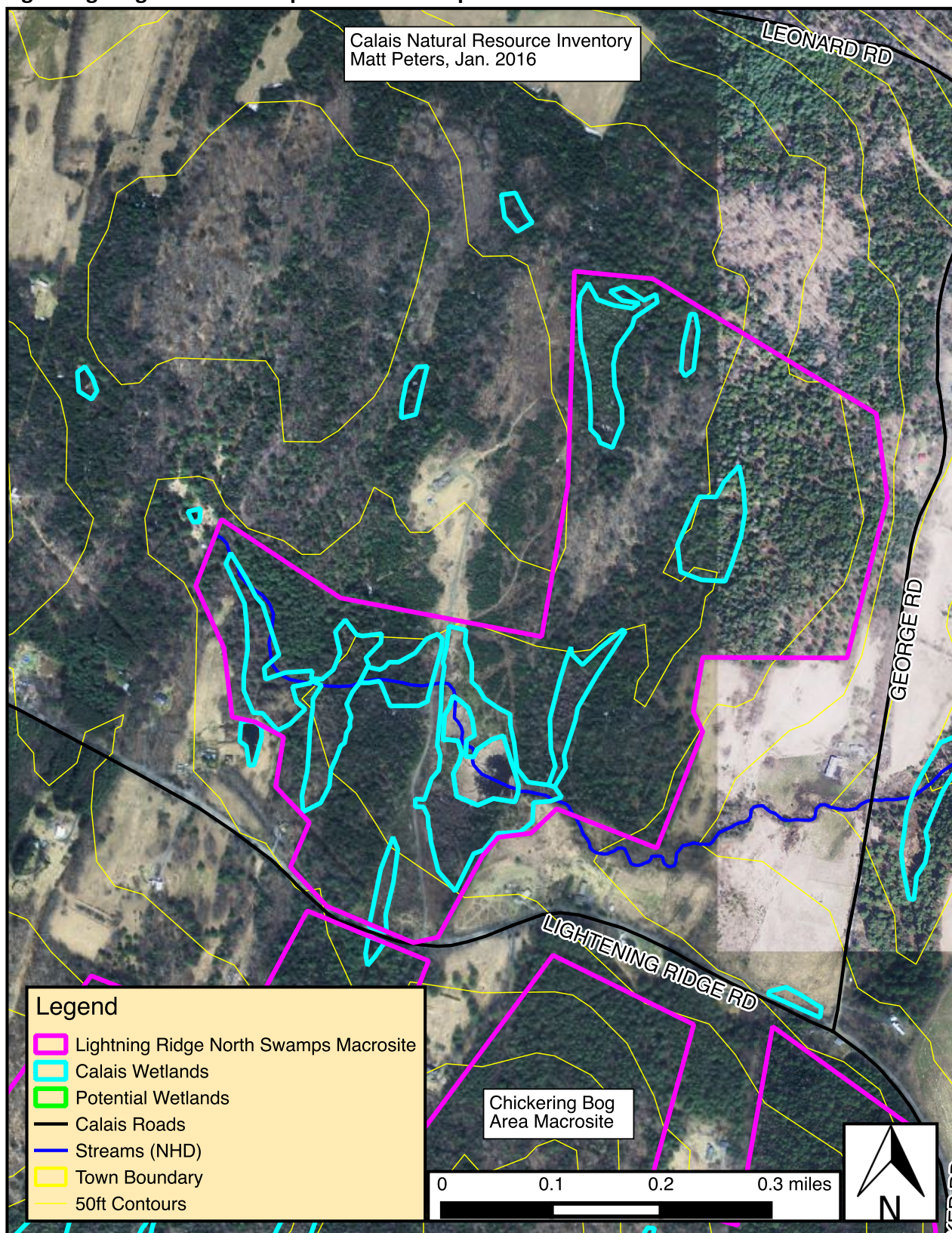
Management Considerations

These wetlands should be protected from any further encroachment into their buffer zones and, due to saturated ground conditions, forest management activities within them are discouraged. If any such activities do occur they should happen only under thoroughly frozen ground conditions and should retain significant canopy cover. The state-significant swamps at the west end of this site are in recovery from past agricultural clearing of the area, likely for pasture; this recovery should be allowed to proceed. Since the character of these swamps is strongly determined by their hydrology and the enriched groundwater seepage they receive, care should be taken to avoid further impacts to these processes. Small constructed ponds are present at the periphery of this area in two places and may have impacted these wetlands in the past, any modification or maintenance of these ponds should be undertaken with appropriate care to avoid impacts to the downslope wetlands. It is also recommended that fully forested buffers be allowed to develop around these wetlands in the few places they are presently lacking.



Calcareous Red Maple-Tamarack Swamp north of the brook showing tamarack canopy and diverse herb layer.

Lightning Ridge North Swamps Macrosite Map



Blackberry Hill/Adamant Pond Area Macrosite

Location: Blackberry Hill and around Adamant Pond just northwest of Adamant village.

Information Sources: Matt Peters' site visit on Oct. 8, 2015.

Ownership: Privately owned lands

Significant Features:

Natural Communities and other features: Cattail Marshes, Sweet Gale Shoreline Shrub Swamps, Hemlock-Balsam Fir-Black Ash Seepage Swamp*, Alder Swamps, constructed and semi-natural ponds, Northern Hardwood Talus Woodland*, Red Oak-Northern Hardwood Forest and surrounding upland forests (primarily northern hardwoods, hemlock- and white pine-northern hardwoods).

* Indicates occurrences that are State-Significant.

Rare, Threatened, & Endangered Species: water sedge (*Carex aquatilis*), American Ginseng (*Panax quinquefolius*)

Uncommon Species: Cypress-like sedge (*Carex pseudocyperus*)

Site Description:

This diverse site spans Adamant Pond, its associated wetlands, a nearby forested swamp, and Blackberry Hill to the north of the pond. Blackberry Hill is unique in town because, unlike most of Calais, it is composed of granitic bedrock. The core of the hill is the largest mapped area of granite in town with smaller pockets clustered nearby. This relatively small area of granite was historically quarried for a short time resulting in numerous remnant quarry pit ponds and grout piles (the large blocks of waste rock) near the west and north shores of Adamant Pond. The hard granite, relatively resistant to glacial erosion, also resulted in a steep, rocky south-facing slope that led to the formation of locally unusual forests. These warmer south slopes are home to a small area of Red Oak-Northern Hardwood Forest, perhaps the only such area of naturally occurring oak in town. Adjacent to this oak forest the ground surface is littered with large, rounded, naturally occurring boulders, creating the setting for a small area of Northern Hardwood Talus Woodland. This community type is uncommon, occurring only in steep, extremely rocky areas, and this example appears to be state-significant, though its full extent could not be determined due to lack of access. This is a stable talus setting, so soil formation among the rocks has been extensive, leading to a fairly closed forest canopy, rather than an open woodland, composed of relatively large and mature white ash, sugar and red maple, with a few basswood and butternut. The rocky ground with more light availability encourages a dense shrub layer of mountain maple, elderberry and others, and the well-drained slope results in nutrients accumulating downslope, supporting wild ginger (*Asarum canadense*), maidenhair fern (*Adiantum pedatum*) and other plants of somewhat enriched habitats. Below this talus forest area old quarry pits and grout piles are disappearing into the regrowing forest.

At the base of the slopes lies Adamant Pond with its extensive fringe of wetland meadows, cattail marshes and shrub swamps. These were not visited extensively, but a brief visit to one distinctive area revealed a patch of Sweet Gale Shoreline Shrub Swamp with a healthy colony of the rare plant water sedge (*Carex aquatilis*). According to local histories, Adamant Pond has fluctuated significantly in its water levels, sometimes existing as a shallow pond, other times draining to leave only wet meadows that were historically hayed – a feat hard to imagine in its present pond configuration. Outflow from the pond is affected by both human control structures and beaver activity.

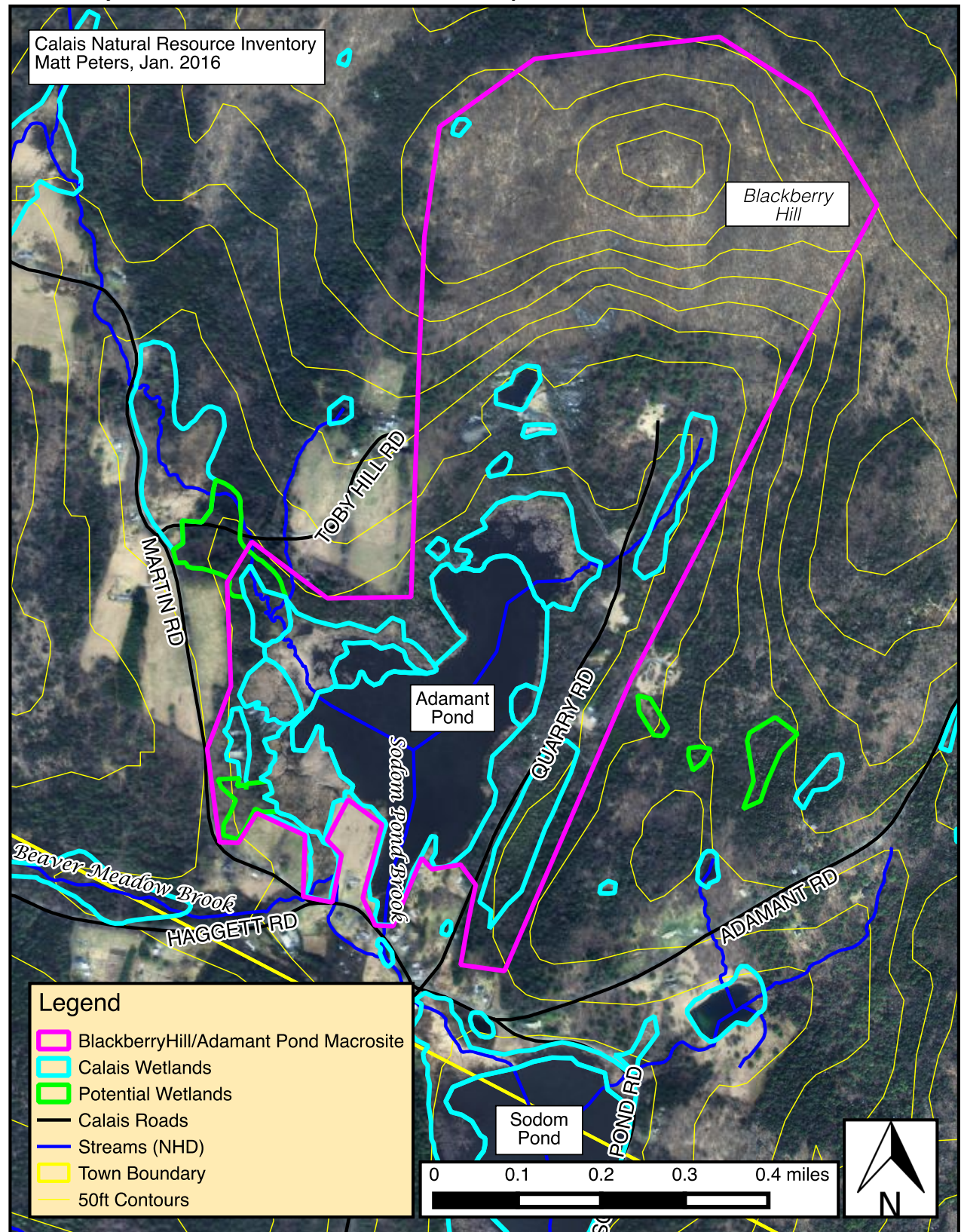
Just east of the pond lies a nearly 6 acre forested swamp along Quarry Road. This is a good example of the Hemlock-Balsam Fir-Black Ash Seepage Swamps that are so common in Calais, though this example is just large enough and in good enough condition to be considered state-significant. Here an unusually diverse and mixed canopy of fir, black ash, red spruce, red maple, yellow birch, elm and larch grows atop deep saturated peat deposits with slowly flowing enriched seepage waters. Like many of the other swamps of this type that were visited, this one is home to scattered individuals of the uncommon cypress-like sedge (*Carex pseudocyperus*).

Management Considerations

The wetlands at this site should be protected from any further encroachment into their buffer zones, and, where lacking, forested buffers should ideally be allowed to redevelop around Adamant Pond. Continued manipulation of water levels in Adamant Pond may be required to mitigate potential threats to roads and other infrastructure; however active manipulation should be avoided to the extent possible. Where beavers create concerns, beaver baffles may offer a possible solution to recurrent water level issues. The forests on Blackberry Hill, including the state-significant talus woodland area and the locally unusual red oak-northern hardwood forest are relatively mature and in good condition. Any forest management activities here should ideally occur under the guidance of a trained forester and should strive to maintain relatively mature stand conditions that will perpetuate the high quality of these locally and state-significant features.



Blackberry Hill/Adamant Pond Area Macrosite Map



Long Meadow Brook Area Macrosite

Location: Long Meadow Brook drainage and adjacent east flanks of Long Meadow Hill and Hersey Hill in the southwest corner of town.

Information Sources: Matt Peters' site visit on Oct. 12, 2015, conversations with owners.

Ownership: Privately owned lands

Significant Features:

Natural Communities and other features: Intermediate Tall Sedge Fen*, Calcareous Red Maple-Tamarack Swamp*, Rich Fen*, undeveloped natural ponds, Red Maple-Black Ash Seepage Swamp, Hemlock-Balsam Fir-Black Ash Seepage Swamps, Shallow Emergent Marshes, Vernal Pools, Alder Swamps, Seeps, small enriched outcrops, upland forests including mature Sugar Maple-White Ash-Jack-in-the-Pulpit Northern Hardwoods, Hemlock-, Red Spruce-Northern Hardwoods and more typical Northern Hardwoods.

* Indicates occurrences that are State-Significant.

Rare, Threatened, & Endangered Species: water sedge (*Carex aquatilis*)

Uncommon Species: none found

Site Description:

The Long Meadow Brook drainage is perhaps one of the more seldom-seen corners of Calais, nestled at the eastern foot of Long Meadow and Hersey Hills in a long straight crease that drains gently to the southwest. This setting is ideal for beaver activity and the result has been an extensive series of diverse beaver influenced wetlands and ponds rather than a well-defined brook. These include at least three small, undeveloped ponds, a state-significant Intermediate Tall Sedge Fen, and numerous areas of Shallow Emergent Marsh, Alder Swamp, hardwood and mixedwood seepage swamps. This long wetland corridor in a fairly undisturbed setting certainly has great significance for wildlife as well as supporting a diverse array of plants. The intermediate fen is of particular interest as a large (~11ac), high quality example of a rare community type. This is Calais' second largest fen, just slightly smaller than the well-known Chickering Bog (actually a fen), and the two are similar in many aspects of composition. However, this fen is very open, with few stunted trees, it borders a larger pond formed by beaver activity rather than a natural basin, and thus is more subject to changing water levels and is laced by many, narrow, deep channels. Overall, this fen also appears to be somewhat less enriched than Chickering Bog with a less diverse array of highly calciphilic plants, though it does support a robust population of the rare water sedge (*Carex aquatilis*). The southern portion of this fen has large colonies of leatherleaf suggesting it may slowly be transforming into a poor fen over time.

Parallel to the Long Meadow drainage is another smaller series of wetlands that includes two enriched peatlands, a small Rich Fen and the surrounding Calcareous Red Maple-Tamarack

Swamp. Both of these features are state-significant and support a diverse array of species indicative of enriched groundwater seepage. The swamp is rather open with widely scattered tamarack that gives way to the rich fen in a somewhat larger opening. Tall grasses and sedges are abundant, including lake sedge and bluejoint grass, and colorful flowers, such as blueflag iris, bog goldenrod, and turtlehead, abound in their season along with many other less conspicuous plants.

To the west of all these wetlands rise the slopes of Long Meadow Hill (and Hersey Hill to the north), which is Calais' southernmost extension of the long ridge trailing south from Woodbury Mountain, dividing the town from neighboring Worcester. This hill (and the larger ridge) comprise parts of some of the largest intact forest blocks in town, thus providing important wildlife habitat. These slopes are made somewhat inaccessible by the wetlands below and, perhaps as a result, have some relatively mature hardwood forest. This forest is mildly enriched, being dominated by sugar maple with a diverse herbaceous layer. The steep slopes are marked by a few scattered, small outcrops or ledges of limy bedrock.

Management Considerations

The wetlands discussed above are generally in very good condition and should be protected from impacts. Adequate forested buffers should be maintained and hydrologic alterations should be avoided, particularly near the state-significant features. In general, surrounding landowners should be encouraged to minimize activities that might alter patterns or volumes of groundwater or surface water flow, particularly ground disturbance or extensive clearing near any of the wetlands or ponds. Forest management activities around the wetlands should maintain forested buffers and avoid cutting or operating within the wetlands. Such activities would ideally occur in frozen ground conditions. Due to access difficulties for forest management west of the wetlands, some wetland crossings may be necessary. These should occur at the narrowest possible locations and make use of skidder bridges or other temporary structures to avoid rutting, compaction, and other ground disturbance of the wetland soils. Long Meadow Hill Road crosses the northernmost end of the Long Meadow drainage; this is unfortunate in terms of wetland impacts, though the surrounding wetland appears to have adjusted and recovered well. Any road maintenance in this area should strive to minimize further wetland disturbances, especially hydrologic alterations.

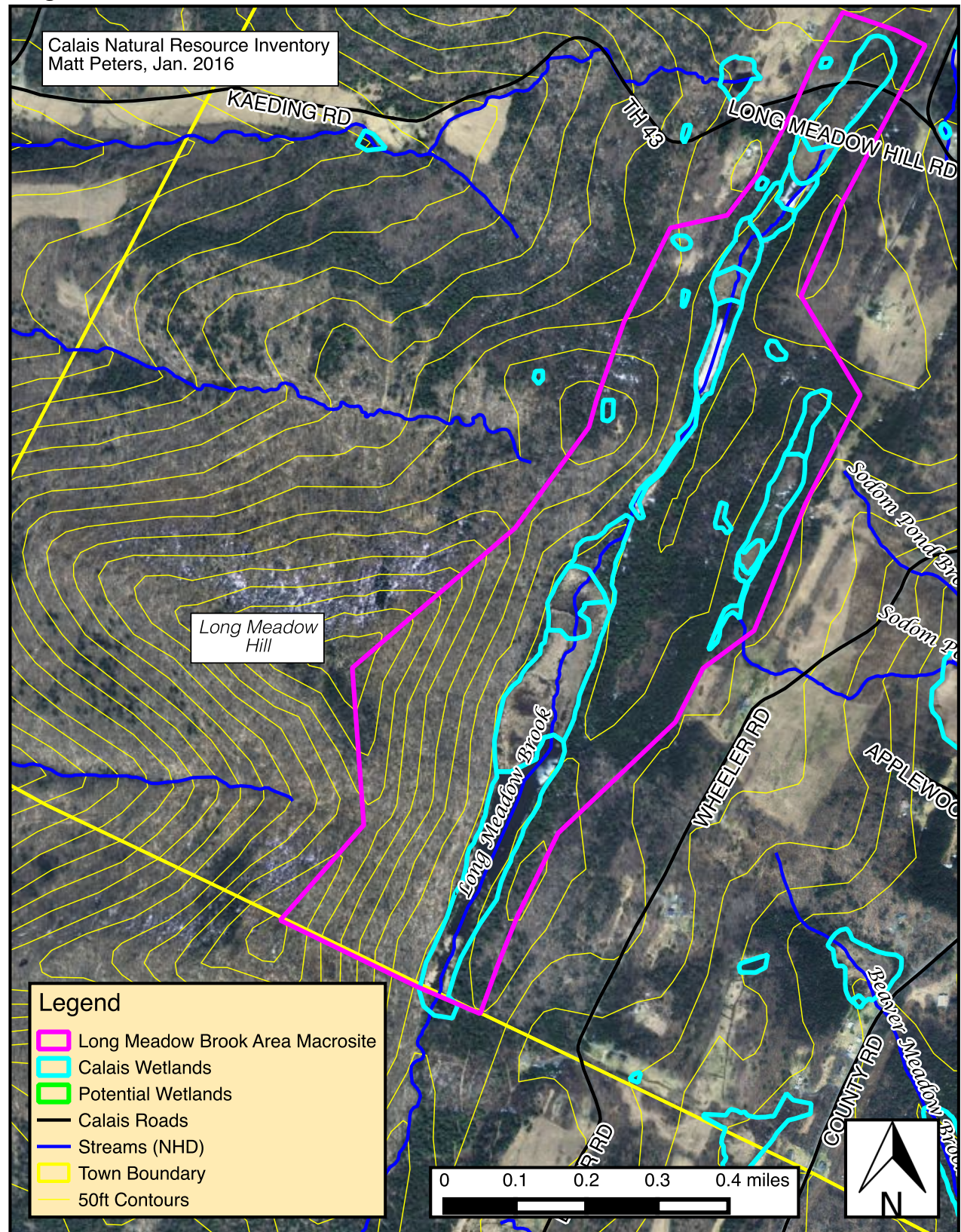


Long Meadow Brook Pond and Intermediate Fen



Calcareous Red Maple-Tamarack Swamp and Rich Fen

Long Meadow Brook Area Macrosite



Three Ponds Macrosite

Location: Area surrounding Wheeler (Wheelock), Tabor, and Watson Ponds, encompassed by West County Rd., Apple Hill Rd., and Dugar Brook Rd.

Information Sources: Matt Peters' site visit on Oct. 13, 2015, VT Fish and Wildlife Department's Natural Heritage Inventory.

Ownership: Privately owned lands

Significant Features:

Natural Communities and other features: Intermediate Tall Sedge Fen*, Poor Fen*, Red Maple-Black Ash Seepage Swamps*, Hemlock-Balsam Fir-Black Ash Seepage Swamps, Vernal Pools, undeveloped natural ponds, Shallow Emergent Marshes, Sweet Gale Shoreline Shrub Swamps, Alder Swamps, upland forests (predominantly Hemlock-, Red Spruce-Northern Hardwoods and Northern Hardwoods as well as a small patch of Rich Northern Hardwoods).

* Indicates occurrences that are State-Significant.

Rare, Threatened, & Endangered Species: water sedge (*Carex aquatilis*), white adder's-mouth (*Malaxis monophyllos* var. *brachypoda*).

Uncommon Species: cyperus-like sedge (*Carex pseudocyperus*), hoary willow (*Salix candida*)

Site Description:

This area features a great abundance of small to moderate-sized wetlands of diverse types perched among low, forested ridges around a collection of three pristine small ponds, Wheeler (AKA Wheelock), Watson, and Tabor, at the headwaters of an unnamed tributary of Pekin Brook. As with most undeveloped ponds these have a special scenic beauty as well as providing great habitat and ecological benefits.

The individual wetlands at this site are too numerous to describe in detail but include at least 7 vernal pools and 10 discrete hardwood and mixedwood seepage swamps, which show significant degrees of mineral enrichment in their seepage waters, no doubt stemming from the underlying calcareous Waits River Formation bedrock. One of these swamps was previously documented to be a state-significant Red Maple-Black Ash Seepage Swamp with a rather stunted, sparse tree canopy including an 8" diameter red spruce that was 109 years old, and a 10" diameter white pine that was 80 years old (when aged in 2000). Another forested swamp in the area appears more cut off from active seepage waters, with drier, more acidic conditions, and is one of the few known Red Spruce-Cinnamon Fern Swamps in Calais.

The interconnected wetlands surrounding Wheeler, Watson, and Tabor Ponds were of particular interest. Beavers are active throughout this area resulting in significant fluctuations in the water levels of at least Wheeler and Tabor Ponds. These changes can be inferred from changes in the extent of shoreline vegetation visible in recent aerial photos. Water levels are

currently fairly high in these ponds and wetlands, converting some previously marshy areas into open water for the time being. At the north end of this chain of ponds a small, but state significant Intermediate Tall Sedge Fen filters seepage waters entering Wheeler Pond. This fen supports a few carnivorous pitcher plants as well as a typical assortment of tall sedges such as hairy-fruited sedge (*Carex lasiocarpa*). On the opposite side of the pond a more extensive state significant Poor Fen exists as an inaccessible complex of boggy islands and floating Sphagnum mats built up on accumulated peat deposits over time. These areas are heavily dominated by the common bog shrub leatherleaf (*Chamaedaphne calyculata*) as well as hairy-fruited sedge in the wetter hollows. Poor fens are typically more acidic and have fewer available nutrients than intermediate fens, apparently indicating that this side of the lake receives less enriched seepage input than the northern arm. Due to unstable conditions and lack of access, this fen was viewed only from the west shore and the south end, where the floating mats meet the shore. The extensive marshy meadows around Tabor Pond and the outlet of Watson Pond shown signs of significant peat accumulation with somewhat acidic conditions and may cycle between fen-like and marshy conditions depending on the level of beaver activity. The current high waters associated with beaver dams has inundated the wetlands, leading to greater nutrient availability and favoring marsh species. Low water levels associated with breached dams and lack of beaver may result in fen species gaining dominance in some areas as indicated by remnant patches of leatherleaf and hairy-fruited sedge.

Several rare and uncommon species were noted or previously documented in the wetlands at this site. They include a single plant of the state-threatened white adder's-mouth orchid, which is also known from one other locale in Calais, the rare water sedge, cyperus-like sedge and hoary willow. All of these species are indicative of or associated with enriched groundwater seepage, which is a significant feature of many of Calais' wetlands.

Management Considerations

These three ponds, undeveloped except for a tiny structure on an island in Watson Pond, are in excellent condition and should be protected from the shoreline development that alters most of Calais' pond shores. Combined with the state significant wetlands, rare species, and many other interesting wetland and upland habitat features, this area as a whole deserves special consideration as one of the habitat and biodiversity highlights of the town. Unfortunately, the ownership is highly fragmented among about 18 different parcels, complicating any attempts at conservation. In general, surrounding landowners should be encouraged to minimize activities that might alter patterns or volumes of groundwater or surface water flow, particularly ground disturbance or extensive clearing near any of the wetlands or ponds. Forest management activities around the wetlands should maintain forested buffers and avoid cutting or operating within the wetlands and would ideally occur in frozen ground conditions.

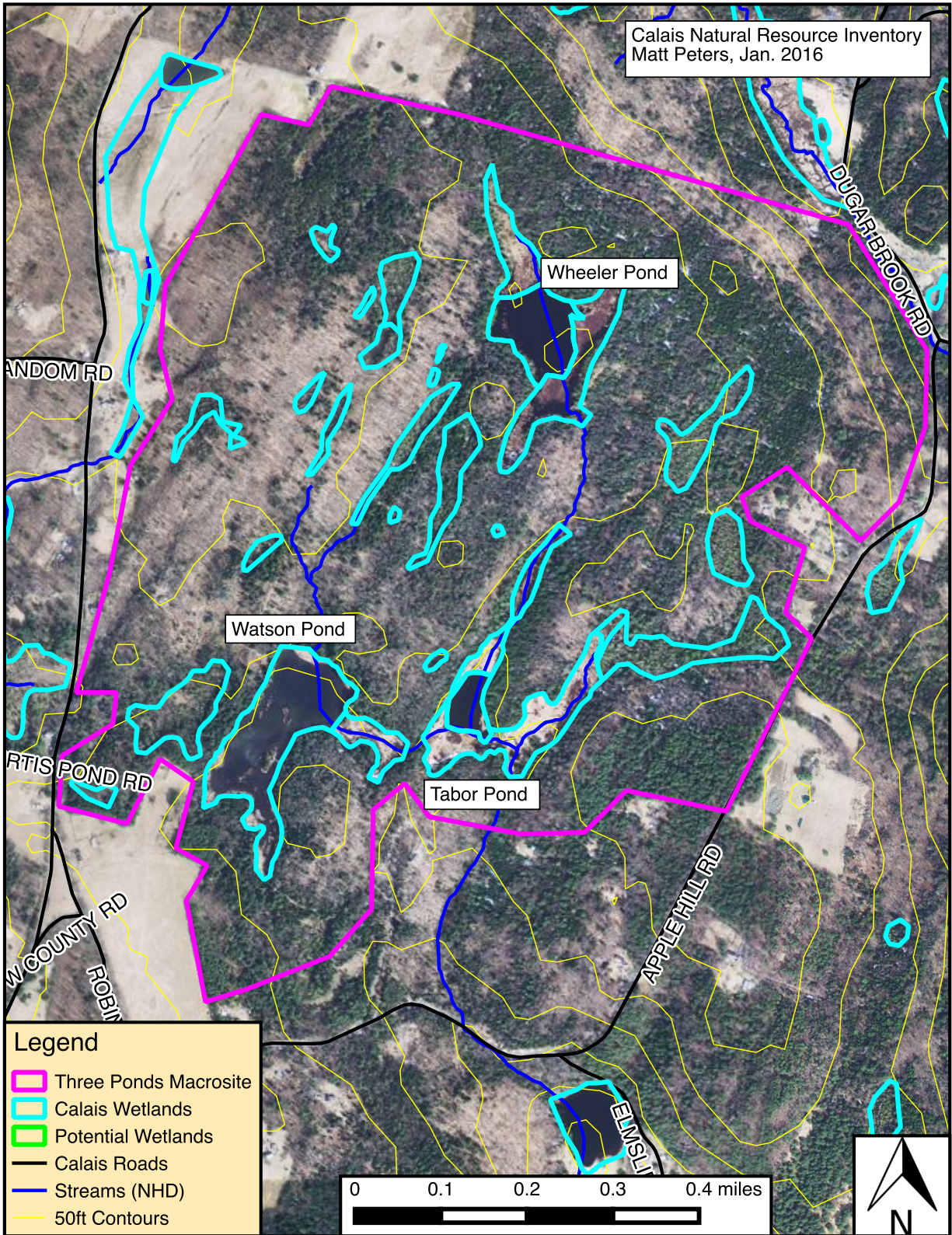


Wheeler (Wheelock) Pond Intermediate Fen (left) and Poor Fen (right background)



Watson Pond

Three Ponds Macrosite Map



Lower Dugar Brook Swamps Macrosite

Location: the lower reaches of Dugar Brook and along Pekin Brook just below the mouth of Dugar Brook, along N. Calais and Dugar Brook Roads.

Information Sources: Matt Peters' site visit on Oct. 16, 2015, VT Fish and Wildlife Department's Natural Heritage Inventory.

Ownership: Privately owned lands

Significant Features:

Natural Communities and other features: Hemlock-Balsam Fir-Black Ash Seepage Swamps*, Seeps, Alluvial Shrub Swamps, Shallow Emergent Marsh, Wet Meadows, Constructed Pond.

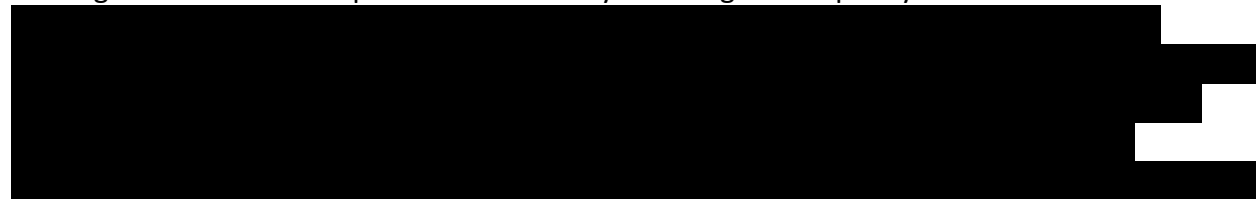
* Indicates occurrences that are State-Significant.

Rare, Threatened, & Endangered Species: None known

Uncommon Species: ---Sensitive species--- redacted

Site Description:

Calais, Woodbury, and other towns in the watershed of the Kingsbury Branch of the Winooski River contain extensive amounts of valley bottom floodplain swamps that, among many attributes, provide important floodwater retention functions to the towns and other downstream communities. One such area is the complex of Alluvial Shrubs Swamps, open marshes, and mixedwood seepage swamps that fill the valley bottoms around the confluence of Dugar Brook with Pekin Brook, extending about a half mile downstream and over three quarters of a mile upstream from this point. The most obvious features of this site include extensive swaths of alder dominated Alluvial Shrub Swamp, readily visible from North Calais Road, that opens in small marshy sedge dominated meadows in slightly lower, wetter areas. These areas are fertile and productive for those plants that can cope with the frequent flooding and saturated soils that make the area inhospitable to tree growth. In addition to slowing downstream movement of floodwaters these riparian wetlands filter runoff and floodwaters, causing sediment to be deposited and thereby reducing water quality concerns downstream.



On the slightly sloping terrain at the edges of the valley bottom further from the stream, several patches of enriched mixedwood seepage swamp have developed. The largest of these is an extensive (~34ac) area of Hemlock-Balsam Fir-Black Ash Seepage Swamp that begins just upstream of the confluence and continues about 0.4 miles upstream with small feeder drainages crossing Dugar Brook Road in two places. This swamp is a state-significant occurrence

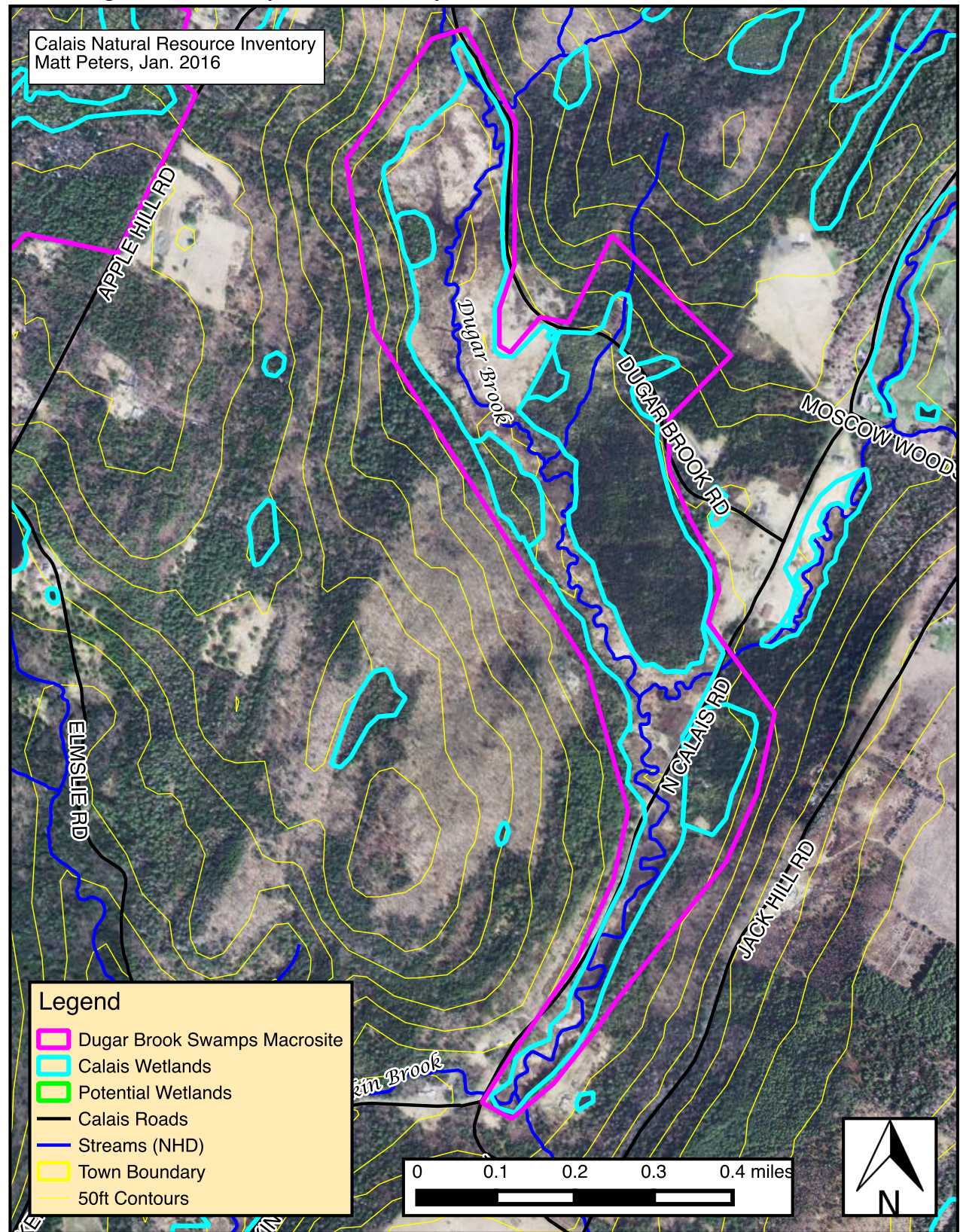
and owing to its valley bottom location with alluvial influences is a somewhat atypical example of this swamp type that more commonly occurs in small headwater basins. This swamp is dominated by a variable mixture of fir, black ash, red spruce, red maple, yellow birch, and a little larch, with hardwoods more abundant in the wettest areas. Numerous areas of groundwater seepage surfacing along the lower valley slopes feed the northeastern edge of this swamp. Closer to the stream, the swamp hydrology shows signs of influence from stream flooding processes and is wetter, probably experiencing prolonged inundation in the spring. Slightly raised areas within the swamp also hold inclusions of drier ground with only marginally wetland conditions that are conducive to better tree growth. These finer details were not mapped due to limited site access and only the north end of the swamp was visited. Three other smaller patches of similar looking swamp are present in the area but were not visited.

Management Considerations

As noted above, these and other riparian wetlands in Calais perform important floodwater retention and water quality enhancement functions as well as providing excellent wildlife habitat in an undisturbed setting. Maintaining the current high quality of these wetlands is important to retaining these functions. The close proximity of town roads with two road crossings and one private driveway crossing are the main impacts to the wetlands – best management practices should be used in the maintenance of these crossings and the adjacent roads to minimize inputs of road related sediments and other pollutants. The bridge crossings are likely undersized for the stream and should be enlarged if replaced. No further encroachments should be allowed into this important stream corridor or the connected wetlands. Due to unsuitable ground conditions forest management activities are discouraged – there is little sizeable timber present regardless. If any such activities do occur they should happen only under thoroughly frozen ground conditions and should retain significant canopy cover. The northwest end of the valley bottom shrub swamps and marshes appears more recently disturbed by agricultural and other clearing activities. This area appears to be reverting to more natural wetland conditions and should be allowed to do so to continue to enhance the functioning of this wetland complex. Finally, a small colony of invasive common reed (*Phragmites australis*) was noted near the road crossing on North Calais Rd. This should be monitored for signs of extensive spreading and should possibly be treated.



Lower Dugar Brook Swamps Macrosite Map



Bayne Comolli Road Swamps Macrosite

Location: North of Bayne Comolli Rd., northwest of Nelson Pond

Information Sources: Matt Peters' site visit on Oct. 19, 2015.

Ownership: Privately owned lands

Significant Features:

Natural Communities and other features: Calcareous Red Maple-Tamarack Swamp*, Hemlock-Balsam Fir-Black Ash Seepage Swamps, Seep, potential Rich and Intermediate Tall Sedge Fens, potential Vernal Pools, a small undeveloped natural pond, upland forests (predominantly hemlock-, red spruce-northern hardwoods and northern hardwoods).

* Indicates occurrences that are State-Significant.

Rare, Threatened, & Endangered Species: None known

Uncommon Species: None known

Site Description:

This macrosite contains a series of enriched headwaters swamps, pools, a pond, and small open wetlands nestled among the forested, low relief hills near the town boundary with Woodbury. The matrix of second-growth, primarily mixedwood forests, mostly hemlock- and red spruce-northern hardwoods with some patches of pure northern hardwoods, provides a relatively natural context for these wetlands, though several are within 100m of residences along Bayne Comolli Road.

Lack of access limited the assessment of some features at this site, but the eastern swamps were visited and proved quite interesting. The largest of the swamps is a state-significant Calcareous Red Maple-Tamarack Swamp that, among the examples visited in Calais, may be the most mature, with a canopy dominated by larger (12-14" diameter) tamarack, some of which have died, creating patchy openings amid standing snags. Scattered white pine and red maple are also present in the canopy and the subcanopy is a more diverse mix of softwoods and hardwoods including both species of enriched seepage swamps, like black ash, and species typical of more acidic, nutrient poor peatlands, such as black spruce. This swamp is one of only a small number of sites in Calais where black spruce occurs. This unusual mix of species is also notable in the shrub and herbaceous layers and may be due in part to the relatively well developed hummock topography of the swamp which allows a divergence in growing conditions between drier, more acidic and nutrient poor hummocks and wetter, ground water influenced, enriched hollows. This swamp has developed woody peat deposits greater than 4 feet deep. To the east are a series of two or three additional swamps interconnected by enriched somewhat fen-like seepages. These swamps also have significant components of tamarack in their canopies and have strong indications of enriched groundwater seepage at their edges, but are otherwise better described as Hemlock-Balsam Fir-Black Ash Seepage

Swamps. These swamps are in good condition with the exception of minor impacts from a few private winter trails that cross the swamps.

No rare or uncommon species were observed at this site, though the late timing of the site visit hindered this aspect of the inventory and earlier visits could still reveal rare species in the likely habitats of these enriched wetlands.

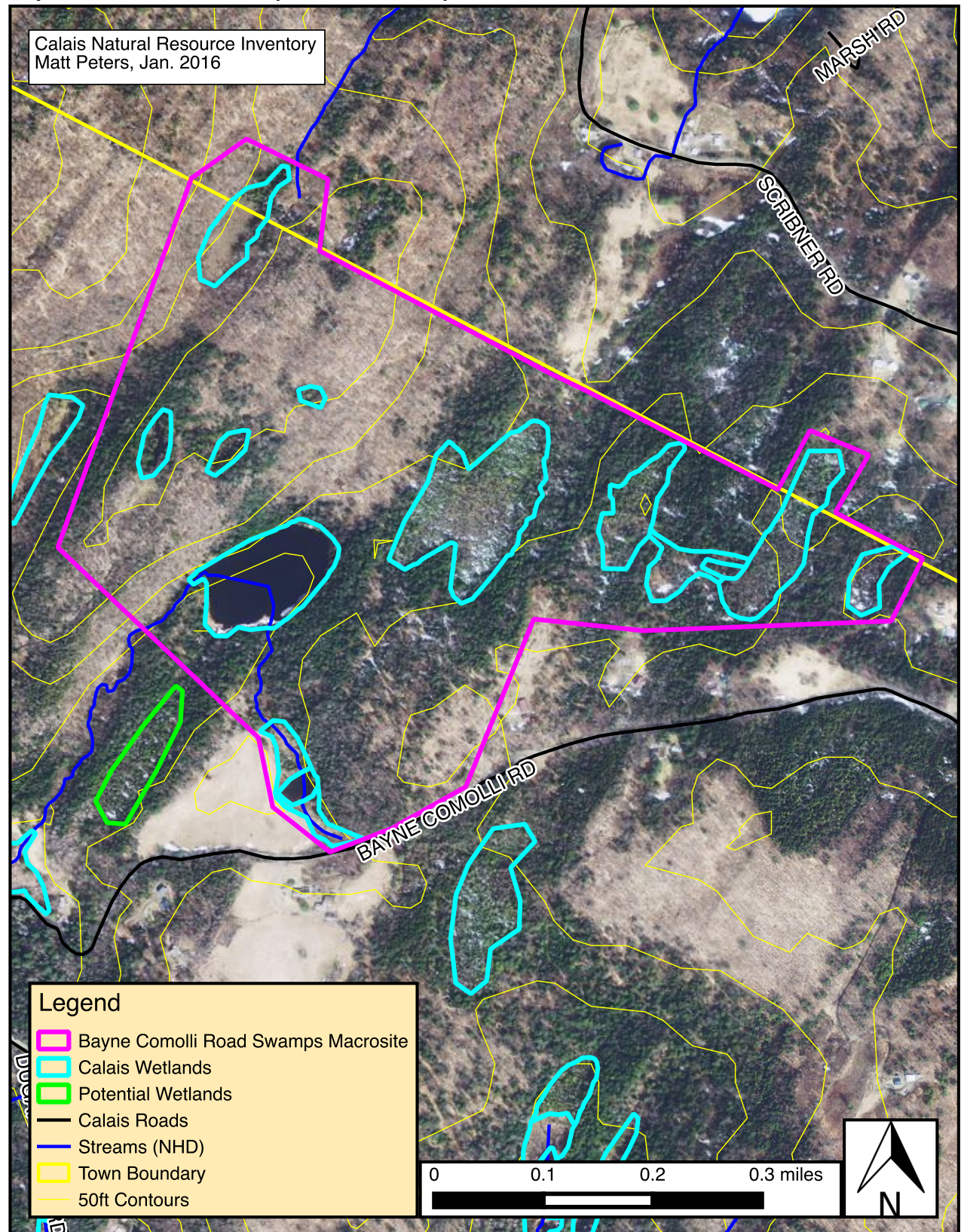
Management Considerations

These swamps are presently in good condition, however, they are sustained by groundwater seepage making them potentially vulnerable to any disturbances in their watersheds and groundwater source areas. Thus surrounding landowners should be encouraged to minimize activities that might alter patterns or volumes of groundwater or surface water flow, particularly nearby ground disturbance or extensive clearing. Existing small trail crossings of some of the swamps have little current impact as their use appears to occur in the winter; motorized use of these trails in unfrozen-ground conditions should be minimized to avoid rutting of the soft peatland soils. Forest management activities around the wetlands should maintain forested buffers and ideally avoid cutting within the wetlands. Finally, lack of access prevented assessment of the pond (Blue Pond), potential vernal pools and fen, but, if access can be obtained, further inventory of the remaining priority features is desirable.



Calcareous Red Maple-Tamarack Swamp

Bayne Comolli Road Swamps Macrosite Map



Previously Documented Significant Natural Communities

Six natural community occurrences in Calais were documented as state-significant prior to this inventory. The following descriptions are based on information from the Vermont Natural Heritage Inventory database rather than new fieldwork.

Chickering Bog – Intermediate Tall Sedge Fen: This fen is described above in the Chickering Bog area Macrosite description.

West County Road Swamp – Red Maple-Black Ash Seepage Swamp: This swamp is described above in the Three Ponds Macrosite description.

Bliss Pond Cedar Swamp – Northern White Cedar Swamp: At about 18 acres this is the largest cedar swamp in Calais and it is conserved within the town forest north of Bliss Pond. This swamp drains via a tributary to Pekin Brook. As the name suggests, this swamp is dominated by a canopy of northern white cedar which average only about 10 inches in diameter but have reported ages of 157 years or more, despite some past logging. This swamp includes two state-threatened plant species. The growth surface has well-developed hummocks and hollows underlain by almost 8ft of well-decomposed black organic muck with woody fragments throughout indicating a forested swamp has occupied the site for thousands of years.

North Montpelier Pond – Alluvial Shrub Swamps: This is a series of patches of relatively intact shrub swamps flanking the Kingsbury Branch of the Winooski River north of North Montpelier Pond in the vicinity of the former Legare farm. These naturally occurring shrub swamps are dominated by alder, with scattered gray dogwood, nannyberry, black ash, Virginia creeper, and non-native honeysuckles. The swamps were likely continuous and more extensive along the river prior to agricultural conversion, but are in good condition and provide [REDACTED] important water quality and flood retention benefits. The mapping of this occurrence is limited but the community is much more widespread along the river, though some areas are in poorer condition due to human disturbance.

Sabin Pond – Poor Fen: This is a tiny (0.3 ac) isolated poor fen that developed in a small basin on a gravelly kame terrace, and is interpreted to have likely arisen from a “kettle hole”, a buried block of glacial ice that melts, leaving a depression that becomes a pond and subsequently filled with about 6-25 feet of peat deposits to become the present fen. This fen is flanked by a gravel pit and open hayfields with only a narrow buffer of forest, but is considered to be in very good condition due to intact upslope hydrology and characteristic composition of stunted black spruce and widespread leatherleaf shrubs overtopping a continuous layer of sphagnum moss with a few dark pools that support salamander breeding.

West Hill Road Fen – Poor Fen: This poor fen is located on the Marshfield town line at the head of a small beaver pond drainage. Little information is available on this fen but it has a strongly hummocky character with Sphagnum mosses abounding and scattered stunted tamaracks. A heron rookery has been reported from the area historically but is apparently no longer active.

Summary of Rare Species Information

Calais' landscape is known to provide important habitat for 27 rare and uncommon plant and animal species, many of which are associated with specific habitat conditions such as the particular nutrient and hydrologic regimes of certain types of wetlands and lakes. Many, but not all, of the known rare species are associated with Calais' wetland and aquatic habitats. It is important to note that records of rare species typically accumulate as a result of knowledgeable people studying particular locales or species, so the information presented here represents only what has been discovered to date and is not a complete inventory of the entire town. It is likely that additional rare species or populations occur but are not yet known. While locating additional rare species was not the main focus of this inventory, surveys led to documentation of 3 new rare and uncommon species previously unknown from Calais, as well as new locations for 3 additional species that were previously known from other sites in town.

Table 2 below provides a summary of Calais' 27 rare and uncommon species, their rarity status, number of known locations, and when they were last seen (or reported to VNHI). A species' rarity status is designated at different geographic scales, global, national, and state by a 1-5 rank, with 1 being the rarest and 5 the least rare. Species that are common globally can be rare at state or national levels and thus be of conservation concern even though the overall species is considered stable or secure. These ranks are explained in greater detail in Appendix 2. Legal threatened or endangered status is different from these numeric rarity ranks in Vermont. Four of Calais' rare species are listed as state-threatened. These include the dragon's mouth (*Arethusa bulbosa*) and white adder's mouth (*Malaxis monophyllos var. brachypoda*) orchids, bog wintergreen (*Pyrola asarifolia*), and pale sedge (*Carex livida*). The latter is one of Vermont's rarest species, with only 1 other known location in the state. Ogden's Pondweed (*Potamogeton ogdenii*) has a small number of locations statewide, but is a globally rare (G1G2) endemic that is only known from a small number of sites in New England, New York, and Ontario, including a pond in Calais; eutrophication from development related runoff and invasive species are primary threats to its survival. Another species, the Northern Adder's-tongue fern (*Ophioglossum pusillum*), has not been seen anywhere in the state since 1986 and was last seen in Calais in 1981. These are just a few of the most significant stories among Calais' rarities; each species has its own story and all are important components of Calais' natural heritage worthy of protection.

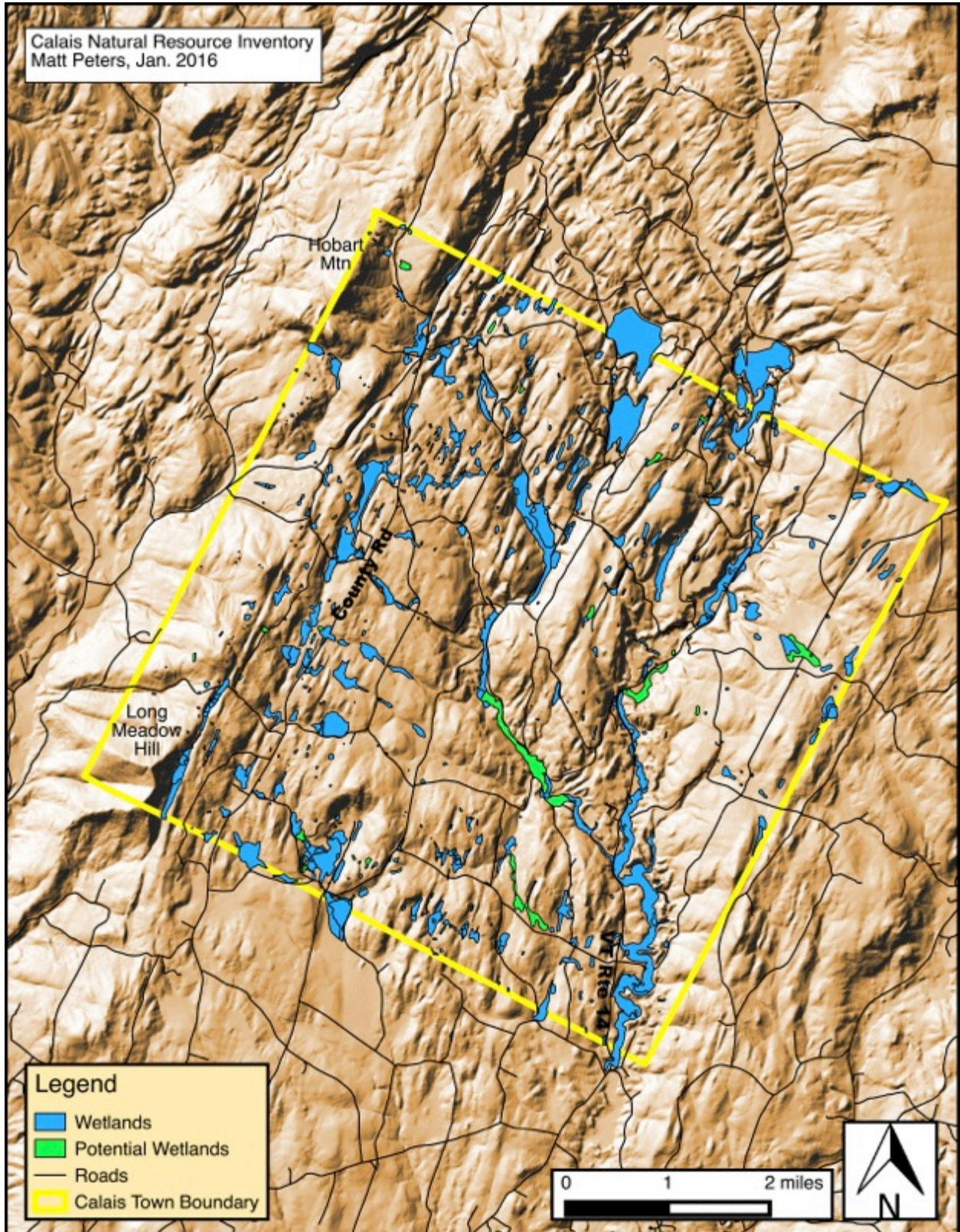
Table 2. Known Rare and Uncommon Plants and Animals of Calais

Scientific Name	Common Name	Global Rank	VT Rank	VT T/E	# of Locations	Other Status Lists*	Last Observed
VERTEBRATE ANIMALS							
<i>Ardea herodias</i>	Great Blue Heron	G5	S3S4B		1	SGCN	1983
<i>Gavia immer</i>	Common Loon	G5	S3B		3	RSGCN, SGCN	2011
Sensitive species	Redacted				4	RSGCN, SGCN	2010
<i>Lota lota</i>	Burbot	G5	S3S4		2	RSGCN	1998
INVERTEBRATE ANIMALS							
<i>Aeshna verticalis</i>	Green-striped Darner	G5	S3S4		1	SGCN	1994
<i>Arigomphus furcifer</i>	Lilypad Clubtail	G5	S3S4		1		1994
<i>Dorocordulia lepida</i>	Petite Emerald	G5	S3		1	SGCN	2006
<i>Nannothemis bella</i>	Elfin Skimmer	G4	S3		2		2006
<i>Williamsonia fletcheri</i>	Ebony Boghaunter	G4	S1S2		1	SGCN	2008
VASCULAR PLANTS							
<i>Arethusa bulbosa</i>	Dragon's mouth orchid	G4	S1	T	1	FC, SGCN	2014
<i>Calopogon tuberosus</i> var. <i>tuberosus</i>	Tuberous Grass-pink	G5T5	S3		1		2009
<i>Carex aquatilis</i> ssp. <i>altior</i>	Water Sedge	GNR	S2S3		5		2015
<i>Carex livida</i>	Pale Sedge	G5	S1	T	1	FC, SGCN	2010
<i>Carex pseudocyperus</i>	Cyperus-like sedge	G5	S3		9		2015
<i>Ceratophyllum echinatum</i>	Prickly Hornwort	G4?	S2S3		2	SGCN	2012
<i>Cladium mariscoides</i>	Bog-rush	G5	S2S3		1		2005
<i>Cypripedium reginae</i>	Showy Lady's-slipper	G4	S3		1		2005
<i>Eleocharis intermedia</i>	Matted Spikerush	G5	S3		1		2005
<i>Liparis loeselii</i>	Loesel's Twayblade	G5	S3		2		2015
<i>Lonicera villosa</i>	Mountain fly-honeysuckle	G5	S3		1		2015
<i>Malaxis monophyllos</i> var. <i>brachypoda</i>	White Adder's-mouth	G4Q	S2S3	T	2	FC, SGCN	2004
<i>Myriophyllum alterniflorum</i>	Water Milfoil	G5	S2S3		1	SGCN	1983
<i>Ophioglossum pusillum</i>	Northern Adder's-tongue	G5	S1		1	FC	1981
<i>Panax quinquefolius</i>	American Ginseng	G3G4	S3		2	FC SGCN	2015
<i>Pogonia ophioglossoides</i>	Rose Pogonia	G5	S3		1		1991
<i>Potamogeton bicupulatus</i>	Snail-seed Pondweed	G4	S2		1	SGCN	1983
<i>Potamogeton hillii</i>	Hill's Pondweed	G3	S3		1	FC, SGCN	2005
<i>Potamogeton obtusifolius</i>	Blunt-leaf Pondweed	G5	S3		1		1992
<i>Potamogeton strictifolius</i>	Straight-leaf Pondweed	G5	S2S3		2	SGCN	2007
<i>Potamogeton x ogdenii</i>	Ogden's Pondweed	G1G2	S1		1	FC, SGCN	2010
<i>Pyrola asarifolia</i> ssp. <i>asarifolia</i>	Bog Wintergreen	G5T5	S2	T	2	SGCN	2010
<i>Ranunculus aquatilis</i> var. <i>diffusus</i>	White Water-crowfoot	G5T5	S3		4	SGCN	2005
<i>Rosa nitida</i>	Shining Rose	G5	S2		1	SGCN	2015
<i>Salix candida</i>	Hoary willow	G5	S3		1		2000
<i>Utricularia minor</i>	Lesser Bladderwort	G5	S3		1		2012
NONVASCULAR PLANTS							
<i>Calliergon trifarium</i>	A Moss	G4	S1		1	SGCN	2005
<i>Tomenthypnum falcifolium</i>	A Moss	G3G5	S1		1	SGCN	2005

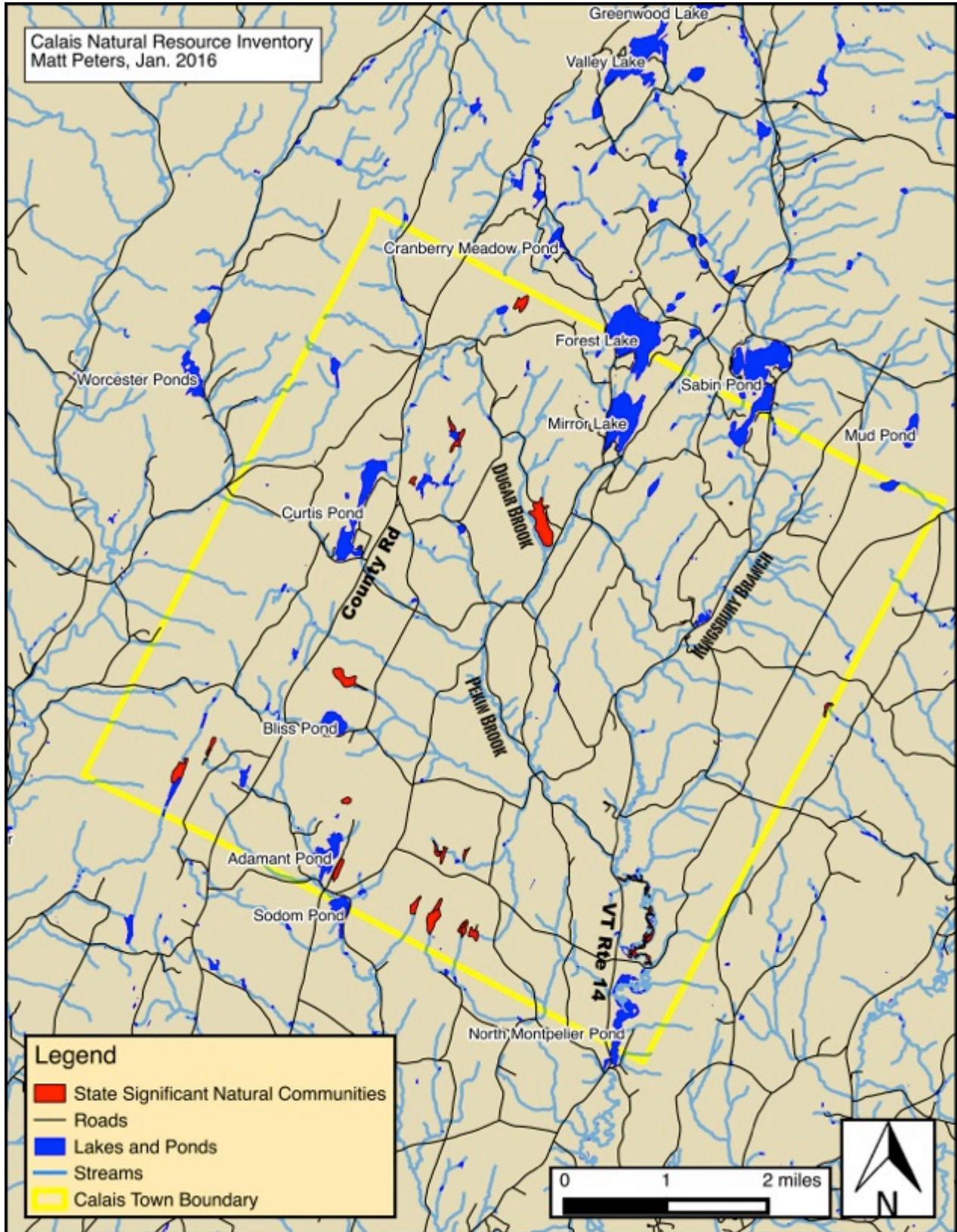
*FC= Flora Conservanda, a New England regional list of vascular plants of conservation concern, developed by the New England Wildflower Society, SGCN= Species of Greatest Conservation Need, a list developed in conjunction with the state's Wildlife Action Plan, whose aim is to prevent species from becoming endangered.

Appendix 1: Maps

Wetlands Map



State-Significant Natural Communities Map



Appendix 2: Natural Heritage Inventory Protocols

Explanation of Legal Status and Information Ranks¹

State Rank and Global Rank - Value that best characterizes the relative rarity (abundance) or endangerment of a native taxon within Vermont's geographic boundary or throughout its range, respectively. Ranks are as follows:

1 - Very rare (Critically imperiled): At very high risk of extinction or extirpation due to extreme rarity (often 5 or fewer populations or occurrences), very steep declines, or other factors

2 - Rare (Imperiled): At high risk of extinction or extirpation due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors

3 - Uncommon (Vulnerable): Moderate risk of extinction/extirpation due to restricted range, relatively few populations or occurrences (often 80 or fewer), recent and widespread declines, or other factors

4 - General, regular, and apparently secure: May be locally uncommon or widely scattered but not uncommon on a statewide basis

5 - Common (Secure): widespread and abundant

H - Possibly extinct/extirpated: Missing; only historical occurrences but potential for rediscovery

X - Presumed extinct/extirpated: Not located despite intensive searches and little likelihood of rediscovery

U - Unrankable: Currently unrankable due to lack of information or due to substantially conflicting information about status or Trends

NR - Not ranked: Not yet assessed

NA - Not applicable. Element is not a suitable target for conservation for one of the following reasons: Hybrid, Exotic Origin, Accidental/Nonregular, Not Confidently Present, No Definable Occurrences

An indicator of uncertainty about the rank, either in the form of a range rank (e.g. S1S3) or a ? qualifier, may follow a numeric rank. For global ranks only, an appended T-rank indicates an infraspecies, and a qualifier after the rank in the form of a Q indicates questionable taxonomy.

State Status - Legal protection under Vermont Endangered Species Law (10 V.S.A. Chap. 123)

E = Endangered: in immediate danger of becoming extirpated in the state

T = Threatened: with high possibility of becoming endangered in the near future

PDL = Proposed for Delisting

PE = Proposed for Endangered Status (not legally protected by 10 V.S.A. Chap. 123)

PT = Proposed for Threatened Status (not legally protected by 10 V.S.A. Chap. 123)

RE = Recommended (by the Endangered Species Committee) for Endangered Status (not legally protected)

RT = Recommended (by the Endangered Species Committee) for Threatened Status (not legally protected)

RDL = Recommended (by the Endangered Species Committee) for Delisting

Federal Status - Legal protection under the federal Endangered Species Act, U.S. Fish & Wildlife Service

LE = Listed Endangered

LT = Listed Threatened

PDL = Proposed for Delisting

C = Candidate for Listing (not legally protected under ESA)

¹ Excerpted from *Rare and Uncommon Native Vascular Plants of Vermont* web-published by the Vermont Natural Heritage Inventory, Vermont Fish & Wildlife Department 15 September 2014.

Guidelines for State-significance
Natural Heritage Inventory
Vermont Fish & Wildlife Department

Initially drafted November 5, 1996, latest revision July 25, 2013

The following guidelines are for determining whether a particular area will be entered into the Vermont Fish & Wildlife Department's Natural Heritage Database as a species or natural community occurrence of statewide conservation significance. They are used in conjunction with the Natural Heritage Network's Element Occurrence Data Standard and Element Occurrence Specifications. These guidelines are primarily intended for staff and others providing Natural Heritage data to the Vermont Natural Heritage Inventory (VNHI)

These guidelines represent VNHI's default position on determining state-significance for a species or natural community Element Occurrence (EO). Any deviation from the guidelines needs to be clearly justified and documented either in these guidelines (see Exceptions Section) or in the Natural Heritage Database.

The terms state-significant and exemplary have been used synonymously in the past to describe important Natural Heritage Element Occurrences. The term exemplary is currently used in the Vermont Wetland Rules (Exemplary Wetland Natural Community, section 5.5) and includes all wetland natural community occurrences that VNHI determines to be state-significant.

Meeting any of the following criteria would constitute state-significance for the purpose of entering an Element Occurrence into the Natural Heritage Database.

PLANT SPECIES

- Presence of any S1, S2, or state-listed (Threatened or Endangered) species;
- Presence of any G3/S3 species (e.g. Ginseng, Hill's Pondweed).

Note that split-rank species default to the lower ranking, e.g. an S2S3 species is treated as S2 and mapped and tracked as an EO.

S3 (but not S3S4) plant species are documented in the Natural Heritage Database with limited observational information but are not considered as state-significant.

ANIMAL SPECIES

- Known or suspected occupied breeding-season habitat for any S1, S2, or state-listed species;
- Known or suspected occupied breeding-season habitat for a G3/S3 species (e.g. West Virginia White);
- Known overwintering concentrations of S1, S2, or state-listed species;
- Known overwintering concentrations of G3/S3 species.

Note that split rank species default to the lower ranking, e.g. an S2S3 species is treated as S2 and mapped and tracked as an EO.

S3 and S3S4 animal species are documented in the Natural Heritage Database with limited observational information but are not considered as state-significant.

NATURAL COMMUNITIES

- Presence of an S1 or S2 natural community type with an EO Rank of A, B, or C;
- Presence of an S3 or S4 natural community type with an EO Rank of A or B;
- Presence of an S5 natural community type with an EO Rank of A.

Note that D-ranked S1 and S2 natural communities, C-ranked S3 and S4 natural communities, and B-ranked S5 natural communities may be tracked in the Natural Heritage Database, and may be considered state-significant, if their EO Rank has been downgraded due to a temporary lowering of their condition for which recovery is expected. Justification must be provided. C-ranked Vernal Pools are tracked regardless

of whether their condition is downgraded and expected to recover because the primary basis for ranking vernal pools is amphibian breeding.

ASSOCIATIONS OF NATURAL COMMUNITIES

A site may be considered state-significant if it contains an association of natural communities for which ecologically intact examples are rare or declining in the state. There are typically strong ecological connections between the natural communities in these associations that relate to specific site characteristics, such as topography, soils, hydrology, or natural disturbance. In these cases, the association of natural communities is the state-significant feature, not necessarily all of the individual natural communities that are components of the association, although at least one component natural community should be state-significant. Examples include the following: Lake Champlain associations of Deep Rush Marsh, Lakeshore Grassland, Lakeside Floodplain Forests, Sand Beach, and Sand Dune, all closely tied to the ecological processes of flooding, wave action, wind, and sand deposition; and associations on calcareous hills of the Champlain Valley, including Mesic Maple-Ash-Hickory-Oak Forest, Dry Oak-Hickory-Hophornbeam Forest, and Temperate Calcareous Outcrop and Cliff, all tied to the warm, dry to mesic calcareous substrate of these hills.

EXCEPTIONS TO THE GUIDELINES

Great Blue Heron: While this species is ranked S3S4B, because of their concentrated nesting and vulnerability to human disturbance, VNHI does track Great Blue Heron rookeries.

Double-crested Cormorant: While this species meets the criteria for S2B it currently is not of conservation concern and is not tracked by VNHI. The species is considered a nuisance and its population in Vermont is being actively controlled. Under current conditions it is expected the population size would return to at least S4 levels if active control activities ceased.

American Eel: Though rare and of conservation concern, there are no definable occurrences to track due to their dispersed distribution while in their juvenile stage here. VNHI tracks observations as Independent Source Features.

Bryophytes: Most bryophyte S-ranks are provisional. VNHI will not track S3 bryophyte species, even as Independent Source Features, until further notice.