A
NATURAL COMMUNITY INVENTORY
of the
CITY OF MONTPELIER, VERMONT

Brett Engstrom and John DeLeo

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Table of Contents

Executive Summary 3

Introduction 4

Methods 5

Ranking 6

Results 7

Biophyscial Regions Context 12

Descriptions of Natural Community Types 14

Recommended Biodiversity Conservation Areas 20

References 24

List of Tables

Table 1. Natural community types and variants 9

Table 2. Natural community map summary statistics 10

Table 3. Rare and uncommon plants found in Montpelier 12

Table 4. Recommended biodiversity conservation areas 22

List of Figures

Figure 1. Percentage of Montpelier in natural community types (pie chart) 11

Figure 2. Map of Montpelier in biophysical regions context 13

Figure 3. Map of recommended biodiversity conservation areas 21

List of Appendices

Appendix A: Natural Community Map

EXECUTIVE SUMMARY

This report contains the results of a natural community inventory of the City of Montpelier (City). The inventory, executed from 2006-2007, includes as its primary product a natural community map for the entire City. This map is in digital format as a shapefile created in the ArcGIS environment. Each polygon is attributed with descriptive and ranking information, as well as information on size, condition, and whether the site was visited. A natural community is "an interacting assemblage of organisms, their physical environment, and the natural processes that affect them" (*Wetland, Woodland, Wildland*). Natural communities occur in a wide range of sizes, from a tenth-acre seep, to a thousand-acre northern hardwood forest. The mapping process includes information from many sources, including aerial photographs, soil maps, geology maps, maps from former inventories, plus field surveys. It is important to realize that this natural community map is not a land cover map: areas that are currently hayfields are not mapped as grasslands, but are mapped as the forested community types that would naturally occur if the areas had not been cleared for agriculture.

Summary findings from this natural community inventory are listed below.

- The City of Montpelier was mapped using 44 natural community and other landscape categories which can be broken down into **21 natural community types,** 12 natural community variants, 5 potential natural community types and variants, and 8 other landscape units, such as water bodies, generic wetlands, and developed lands.
- Two **matrix forest types** – Northern Hardwood Forest and Hemlock-Northern Hardwood Forest – account for about 60% of the City, while developed lands occupy 20%.
- **Natural community types of secondary importance** in terms of areal proportion of the City include Semi-rich Northern Hardwood Forest (5%), Hemlock Forest (2.4%), and Rich Northern Hardwood Forest (1.2%).
- **Floodplain** occupies 6% (403 acres) of the City. Approximately 64% of this floodplain is developed and 24% undeveloped (fields, open areas). Only 12% remains as degraded forest fragments.
- The City has many **small wetlands**, especially Vernal Pools, Seeps, Hemlock Swamps, Sloping Seepage Forests, Alder Swamps, and rare, but unclassified, fenny wetlands.
- There are only a few **state-ranked rare and uncommon natural community** types found in the City. Rare types include Sugar Maple-Ostrich Fern Floodplain Forest, Hemlock Swamp, and River Cobble Shore. Only the two occurrences of Hemlock Swamp are considered state-significant.
- There are **many natural community types that are ranked as rare at the municipal level**, such as Mesic Red Oak-Northern Hardwood Forest, Northern Hardwood Talus Woodland, Sugar Maple-Ostrich Fern Floodplain Forest, Hemlock Swamp, Vernal Pool, and fenny wetland. A **ranking methodology** for determining ecological, or biodiversity **significance, on the municipal level** was developed as part of this project.
- Several **rare** to **uncommon plants** were documented in the City, including a sedge (*Carex argyrantha*), narrow-leaved glade fern, tall millet-grass, and other sedges (*Carex* spp.). Several native plants that are likely rare in the City were observed.
- **Seventeen areas are recommended for biodiversity conservation**. These "biodiversity conservation areas" are based on the presence of two or more natural community occurrences that are significant on the municipal level, and other considerations.

INTRODUCTION

This report explains the methods and summarizes the results of a natural community inventory of the City of Montpelier (City). A map of the natural communities of the City is the primary product of this inventory, and accompanies this report as a 36 by 36-inch map, and in digital format as a polygon shapefile created in ArcGIS and as a JPEG file. This report also includes descriptions of the natural community types as they occur in the City, and recommendations for areas of biodiversity conservation.

As defined in *Wetland, Woodland, Wildland*[*], a natural community is "an interacting assemblage of organisms, their physical environment, and the natural processes that affect them" (p.2). Natural communities, including both uplands and wetlands (but excluding aquatic communities), are very useful in describing ecological units of landscapes. They range in size from matrix scale (thousands of acres), such as northern hardwood forest, to small scale (a few acres or less), such as seep. Though similar to habitats, natural communities stand own their own, without reference to a particular species or suite of species. For example, a seep is a natural community that provides habitat for various salamanders and wetland plants. But a seep has its own ecological definition, which includes a much wider range of biota, plus its physical environment, such as slope, soil, and hydrology. Because they depict areas with differing ecological characteristics, natural community maps are useful for conservation, both as an educational tool and as means of geographically displaying areas of biodiversity significance.

This mapping project for the Montpelier Conservation Commission was funded through a Municipal Planning Grant from the Vermont Agency of Commerce and Community Development. This inventory would not have been possible without the willingness of many landowners to allow access to their properties. A special note of appreciation goes to Kris Hammer and Geoff Beyer of the Montpelier Conservation Commission who devoted a large amount of time and effort into making this project happen, and seeing it through.

Brett Engstrom is an independent ecologist/botanist of Marshfield, Vermont. Over the last 18 years he has worked on numerous ecological inventories throughout Vermont, in northern New Hampshire, and at scattered locations across New England and New York. These inventories include describing and mapping upland and wetland natural communities, as well as documenting rare, threatened, and endangered plants. Recent natural community inventories where mapping was done at a landscape scale include the Berlin Pond watershed, West Mountain Wildlife Management Area, and the Nulhegan Basin Division of the Silvio Conte National Fish & Wildlife Refuge. Clients include the Vermont Fish and Wildlife Department's Nongame and Natural Heritage Program, Vermont Military Department, New Hampshire Natural Heritage Bureau, U.S. Fish and Wildlife Service, NatureServe, The Nature Conservancy, The Conservation Fund, town conservation commissions, and private individuals and groups.

John De Leo is a Full Professor tenured faculty at Lyndon State College, one of the Vermont State Colleges. He is currently the Coordinator of the Recreation Resource Mapping concentration within the Department of Recreation Resource and Ski Resort Management. He also coordinates all GIS and GPS technology at Lyndon State College and is currently serving on

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[*] *Wetland, Woodland, and Wildland*: *A Guide to the Natural Communities of Vermont*. Elizabeth Thompson and Eric Sorenson, 2000, The Nature Conservancy and the Vermont Department of Fish and Wildlife.

the Vermont Center for Geographic Information (VCGI) Board of Directors and the Technical Advisory Board. Within the last several years he has coordinated GIS activity on several projects including Community Planning for the town of Danville and parcel mapping for the Towns of Troy and Jay. He was directly involved with the coordination of the ecological inventory for the West Mountain Wildlife Management Area and Nulhegan Basin Division of the Silvio Conte National Fish & Wildlife Refuge.

Frontispiece photo was taken by Brett Engstrom from North Street looking west across the North Branch Valley.

METHODS

The methods used for Montpelier's natural communities map largely follow those used for The Berlin Pond Natural Community Mapping Project that the authors did for the Capital Area Land Trust in 2004-2005. The natural community map was created in three phases: 1) landscape analysis/preliminary mapping, 2) ground-truthing and refining map units, and 3) final map polygon digitizing. Guidelines used for this natural community mapping project generally follow those found in the unpublished State document "Proposed Steps for Mapping and Ranking Natural Communities on State Land," September 12, 2000 Draft, by Eric Sorenson and Laura Cadmus. Natural community names used in the Montpelier natural community map are primarily those described in *Wetland, Woodland, Wildland*. Several new types and variants were used in the map and are described in this report.

Phase 1 involved assembling digital map layers and other background inventory information on the City, including National Wetlands Inventory maps, bedrock geologic maps, surficial geologic maps, soils maps, digital orthophoto quads, other digital photo imagery, stereo pairs of the best aerial photographs available, topographic maps (old and recent), previous inventory information (various City reports, Fish and Wildlife Department's Nongame & Natural Heritage Program). References, both electronic and hardcopy resources, are listed in the final section of this report. Several people familiar with the City's natural features were interviewed, including Geoff Beyer, Stephan Syz, Nona Estrin, Charles Johnson, Brian Slopey, and Kris Hammer. They provided information on natural communities at various sites in the City. From this information, preliminary natural community polygons were drawn on acetate sheets overlaying 1962 black and white aerial photographs, scale 1:18,000. These photos with acetate covers were then scanned and georeferenced in GIS and became a preliminary natural community map reference layer. At the same time, 1942 black & white aerial photographs were scanned and georeferenced for determining land use history of the City's landscape. Both sets of photographs are described in References.

Phase 2 included field work that took place on 27 days (many partial days) between July 31 and November 16, 2006, when natural community data was collected at 30 sites. Field observations were recorded in field books and GPS waypoints were taken to geographically document observation points. Additional information was gathered on rare plants.

In Phase 3, the final natural community map was created by onscreen digitizing polygons in ArcMap (ArcGIS 9.2) using the 1996 digital orthophotos as background and GPS waypoints as reference points. Other digital images and map layers were used to help determine natural community boundaries. Polygons were cleaned using ArcGIS tools to produce a final shapefile

of natural community polygons (Montp_NC_06_CL_GP). Attribute data was filled in for each polygon, including fields for polygon ID, natural community name, natural community codes, area (acres and square meters), state rankings (S_Rank, S_EO_R) and significance, municipal rankings (M_Rank, M_EO_R) and significance, ranking notes, description, condition, additional notes (Add_Notes), and even more notes (Notes_2)

RANKING

Ranking of a particular natural community occurrence is a way to rate the unit for its ecological, or biodiversity, significance. Ranking was done at both the state and municipal levels for this inventory. Ranking quickly becomes a complex process, as is described in the following ranking methods. Even though the rankings used in this inventory follow defined methods, they should be viewed as provisional. This is because the accuracy of a ranking relies on the amount of time spent on the ground assessing a given natural community occurrence. Field time for this inventory was limited, hence the provisional qualifier for ranking.

A natural community occurrence is an "element occurrence", or EO, by the Vermont Department of Fish and Wildlife's Nongame and Natural Heritage Program (Heritage Program). It refers to the natural community at a particular location, and to a polygon on the natural community map. Two types of ranking are used to determine significance at the state level: natural community type rank (State or S-rank) and EO rank. S-ranks for all natural communities in Vermont are published in *Wetland, Woodland, Wildland*, and can be found on the Department of Fish and Wildlife's website. S-ranks basically describe the rarity of a natural community type in Vermont. They range from S1 (extremely rare and vulnerable) to S5 (common, widespread). EO ranks on the state level are determined using Heritage Program ranking guidelines, which takes into account an occurrence's condition, landscape context, and size. EO ranks range from A (excellent) to D (poor). An X rank denotes an extirpated occurrence.

Municipal ranking methods were newly created for this inventory. They may represent the first municipal ranking methodology devised for any municipality in Vermont. As a first attempt, they are provisional and need more testing. These rankings parallel state rankings in most respects. Like state ranks, municipal ranks (M-rank) refer to a type's rarity within the City. Using statistics derived from the natural community map, the ranks basically fall into four categories:

<u>Municipal (M) Ranks</u>
M1 = 1-5 occurrences
M2 = 6-10 occurrences
M3 = 11-20 occurrences
M4 = 21+ occurrences and matrix forest types

Municipal EO ranks also parallel state EO ranks, except that size is not used as a significant factor. They are described below.

<u>Municipal (M) Element Occurrence (EO) Ranks</u>
A = **Good condition**, i.e. lacking artificial disturbance, invasive species, etc., and, for forests, better than average maturity. **Well-buffered** landscape context.

B = **Average condition**, i.e. with some artificial disturbance, but species composition mostly natural, and, for forests, average maturity. **Well-buffered to fair** landscape context.
C = **Altered condition** and composition in **fair** landscape context
D = **Poor condition** and heavily altered composition in **poor** landscape context

Significance at the municipal level parallel state level significance determinations in that the significance is a function of both rarity (M-rank) and municipal EO rank. For **M1 and M2** natural community types, all EOs with A, B, or C element occurrence ranks, and even some D-ranked occurrences if highly threatened, are considered of municipal significance. For **M3 and M4** natural community types, all EOs with A or B element occurrence ranks are significant on the municipal level.

Both state and municipal level ranks, EO ranks, and their significance, are given for each occurrence (polygon) on the Montpelier natural community map. EOs (polygons on the map) of the same type within close proximity to one another (within one-quarter to one-half mile) are considered as one EO for both state and municipal ranking purposes. Unclassified (UC) natural community types, i.e. not found in *Wetland, Woodland, Wildland*, generic landscape mapping units (developed floodplain, undeveloped floodplain, developed uplands, water, etc.), and potential natural community types are not ranked at the state level, nor at the municipal level for the latter two categories. Unclassified types are given provisional municipal ranks and significance. This is denoted by question marks after the ranks/significance.

As rough as they may be, all these rankings are an attempt to assign a biodiversity value to natural community occurrences based on their ecological condition and characteristics. They also helped determine the recommended areas important for biodiversity conservation which appear later in this report.

RESULTS

The primary product of this project is a map of natural communities of the City created as a shapefile of natural community polygons named **Montp_NC_06_CL_GP**, created 4/9/2007 and last modified 5/1/2007. The database file accompanying the shapefile contains attributes of the polygons, including natural community names, codes, area, state and municipal rankings (ranks, EO-ranks), state and municipal significances, and natural community descriptions, conditions, and notes. The final, cleaned, polygon shapefile and accompanying GIS files needed to display the natural community shapefile, as well as other shapefiles created for this inventory, including those for waypoints and a potential sites to visit map, as well as scanned aerial photos images, are provided on a CD that accompanies this report. Digital layers from other sources used for the project, and layers created for this project, are listed at the end of the References section. The digital Natural Community Map, along with a 36 x 36 inch printed map, accompany this report as Appendix A.

The City of Montpelier was mapped using 44 natural community and other landscape categories (Table 1). These units can be broken down into 21 natural community types, 12 natural community variants (variants of types, including one variant that has no standard type present), 5 potential natural community types and variants (where believed to occur, but could not determine without field visit), and 8 other landscape units, including water bodies (rivers and ponds), generic wetlands, developed and undeveloped (fields) floodplain, and developed uplands. Table

1 is arranged according to natural community type code (NC_Type), which is related directly to the natural community order found in *Wetland, Woodland, Wildland*. One natural community variant name has been changed for convenience: Sugar Maple-White Ash-Jack-in-the-Pulpit Northern Hardwood Forest variant found in the Vermont classification is replaced by "Semi-rich Northern Hardwood Forest" in this inventory. Descriptions of the natural community types found in the City are found on page 13.

A summary of the natural community (and other units) occurrences (polygons on the map) is shown in Table 2. A total of 439 polygons occur on the map, ranging in size from 0.01 acre for Vernal Pool and Riverside Outcrop (ignoring a 0.00 sliver of Northern Hardwood Forest) to 500 acres for Hemlock-Northern Hardwood Forest. The importance of the different natural communities in terms of size (percent of City, or 6,610 acres) is shown in Figure 1. While reading Table 2 and examining the figure, it is important to point out that not all of the lands typed as forest natural communities are forested. The forest map units include both actual forests and potential forests based on landscape position and soils. The two matrix forest types, Northern Hardwood Forest and Hemlock-Northern Hardwood Forest, comprise well over one-half (60%) of Montpelier's landscape, while developed floodplain and uplands take up about one-fifth of the City. At about 5%, Semi-rich Northern Hardwood Forest is the fourth largest type (natural community and other), and the next largest several units, including Hemlock Forest, water (river), floodplain (undeveloped), and Rich Northern Hardwood Forest, are all less than 3% each. At 2%, the river is a surprisingly significant proportion Montpelier's landscape, especially when compared to individual wetland types. Excluding the river, wetlands comprise about 5% of the City. While these small types are relatively insignificant in acreage, they provide a disproportionally high concentration of the ecological (in terms of natural community types) and biological diversity in the City.

Excluding the river, the floodplain units form 6.09% of the City. The floodplain boundaries were taken largely from FEMA's 100-year statistical flood area map, with some modifications based on photo interpretation and field observations. Of all the floodplain land types, the developed portion is 64%, the undeveloped (fields, open areas) 24%, and Sugar Maple-Ostrich Fern Floodplain Forest 12%.

There are only a few state-ranked rare and uncommon natural community types found in the City (Table 1). Rare types (only S2) include Sugar Maple-Ostrich Fern Floodplain Forest, Hemlock Swamp, and River Cobble Shore, and uncommon (S3) types include Northern Hardwood Talus Woodland, Northern White Cedar Sloping Seepage Forest (a variant), Vernal Pool, and River Sand or Gravel Shore. Of all these S2 and S3 types, however, only two occurrences of Hemlock Swamp are considered state-significant (for locations refer to the attribute table accompanying the natural community map shapefile) . The Vernal Pools might be state significant, but could not be evaluated for their use for breeding by vernal pool obligates since visited in the autumn.

In contrast to the state level, there are many natural community types that are ranked as rare (M1 and M2) at the municipal level. These include three upland types (Mesic Red Oak-Northern Hardwood Forest, Northern Hardwood Talus Woodland, Riverside Outcrop), and many wetland types, such as Sugar Maple-Ostrich Fern Floodplain Forest, Red Maple-Black Ash Swamp, Hemlock Swamp, Vernal Pool, Shallow Emergent Marsh and variants, Sedge Meadow, River Cobble Shore, Alluvial Shrub Swamp, and fenny wetland. Many of the occurrences of these natural community types are rated as significant on the municipal level because of their rarity, even though the condition of many of these occurrences are poor. Refer to attribute table

Table 1. Natural community types and variants, plus other generic landscape units, and their state (S_Rank) and municipal (M_Rank). Natural community **types** are shown in bold. "UC" stands for unclassified. Potential type and uncertain rankings are followed by question marks.

NC_Name	NC_Type	NC_var	S_Rank	M_Rank
UPLANDS				
Northern Hardwood Forest	**8**	**8a**	**S5**	**M4**
Semi-rich Northern Hardwood Forest (variant)	8	8c	S5	M4
Rich Northern Hardwood Forest	**9**	**9**	**S4**	**M3**
potential rich northern hardwood forest	9?	9?	S4?	M3?
Mesic Red Oak-Northern Hardwood Forest	**10**	**10**	**S4**	**M1**
Hemlock Forest	**11**	**11**	**S4**	**M3**
Hemlock-Red Spruce Forest (variant)	11	11a	S4	M3
Hemlock-Northern Hardwood Forest	**12**	**12**	**S4**	**M4**
Hemlock-White Pine-Northern Hardwood Forest (variant)	12	12a	S4	M4
Northern Hardwood Talus Woodland	**13**	**13**	**S3**	**M1**
Riverside Outcrop	**26**	**26**	**S4**	**M1**
WETLANDS				
Sugar Maple-Ostrich Fern Floodplain Forest	**43**	**43**	**S2**	**M1**
Red Maple-Black Ash Swamp	**45**	**45**	**S4**	**M1**
Northern White Cedar Sloping Seepage Forest (variant)	51	51a	S3	M1
potential northern white cedar sloping seepage forest	51?	51a?	S3?	M1?
potential northern white cedar swamp	51?	51?	S3?	M1?
Hemlock Swamp	**54**	**54**	**S2**	**M1**
Hemlock-Hardwood Swamp (variant)	54	54a	S2	M1
potential hemlock-hardwood swamp	54?	54a?	S2?	M1?
Seep	**55**	**55**	**S4**	**M4**
Semi-alluvial Seep (variant)	55	55a	UC	M4
Vernal Pool	**56**	**56**	**S3**	**M1**
Shallow Emergent Marsh	**64**	**64**	**S4**	**M2**
Beaver Meadow (variant)	64	64a	S4	M2
Oxbow Marsh (variant)	64	64b	S4	M1
Beaver Pond & Meadow (variant)	64	64ac	S4	M2
Sedge Meadow	**65**	**65**	**S4**	**M1**
River Sand or Gravel Shore	**72**	**72**	**S3**	**M3**
River Cobble Shore	**73**	**73**	**S2**	**M1**
Alluvial Shrub Swamp	**77**	**77**	**S4**	**M2**
Alder Swamp	**78**	**78**	**S5**	**M3**
Sloping Seepage Forest	**90**	**90**	**UC**	**M3?**
Northern Hardwood Seepage Forest (variant)	90	90a	UC	M3?
Hemlock Seepage Forest (variant)	90	90b	UC	M3?
Mixed Sloping Seepage Forest (variant)	90	90ab	UC	M3?
fenny wetland	**91**	**91**	**UC**	**M1**
OTHER				
wetland - swale	98	98sw		
wetland - small drainage	98	98sd		
wetland - perched basin	98	98pb		
water - river	99	99r		
water - artificial pond	99	99ap		
floodplain - developed	fp	fp-d		
floodplain - undeveloped	fp	fp-u		
developed uplands, artificial fill, etc	0	0		

Table 2. Montpelier natural community map summary arranged in descending order by acres.

Natural Community & Other Unit Names	# Polys	Min. Size (Acres)	Max. Size (Acres)	Ave. Size (Acres)	Total Acres	Percent of City
Northern Hardwood Forest	26	0.00	407.29	88.37	2297.51	34.76
Hemlock-Northern Hardwood Forest	28	0.24	500.04	59.80	1674.49	25.33
developed uplands, artificial fill, etc	15	4.09	307.83	74.41	1116.11	16.89
Semi-rich Northern Hardwood Forest	20	0.15	185.06	16.44	328.86	4.98
floodplain - developed	10	1.28	79.36	25.82	258.19	3.91
Hemlock Forest	17	0.75	22.17	9.26	157.45	2.38
water - river	4	2.87	89.42	33.41	133.63	2.02
floodplain - undeveloped	16	0.16	14.73	5.93	94.94	1.44
Rich Northern Hardwood Forest	20	0.24	24.00	4.11	82.19	1.24
wetland - small drainage	40	0.09	9.32	1.52	60.77	0.92
Sugar Maple-Ostrich Fern Floodplain Forest	14	0.27	15.26	3.52	49.24	0.74
Mesic Red Oak-Northern Hardwood Forest	4	2.15	23.45	12.16	48.63	0.74
Mixed Sloping Seepage Forest	12	0.25	7.76	3.31	39.70	0.60
potential rich northern hardwood forest	11	0.83	10.45	3.51	38.64	0.58
potential n. white cedar sloping seepage forest	4	0.29	26.53	8.30	33.19	0.50
Northern White Cedar Sloping Seepage Forest	5	0.45	10.12	6.55	32.75	0.50
Northern Hardwood Seepage Forest	9	0.14	8.23	1.66	14.93	0.23
Hemlock-White Pine-Northern Hardwood Forest	2	3.59	11.32	7.46	14.91	0.23
Alder Swamp	15	0.16	4.66	0.99	14.91	0.23
Sloping Seepage Forest	4	0.45	10.90	3.69	14.78	0.22
Shallow Emergent Marsh	16	0.10	4.06	0.86	13.69	0.21
water - artificial pond	18	0.04	8.43	0.65	11.69	0.18
potential hemlock-hardwood swamp	4	0.28	7.86	2.60	10.40	0.16
Beaver Meadow	2	1.34	8.84	5.09	10.19	0.15
Hemlock-Red Spruce Forest	1	9.42	9.42	9.42	9.42	0.14
Seep	31	0.02	1.91	0.26	8.14	0.12
potential northern white cedar swamp	2	1.13	6.08	3.61	7.21	0.11
wetland - swale	15	0.06	1.21	0.45	6.73	0.10
Red Maple-Black Ash Swamp	2	1.29	3.63	2.46	4.93	0.07
Semi-alluvial Seep	6	0.06	2.86	0.68	4.10	0.06
wetland - perched basin	5	0.08	2.16	0.73	3.63	0.05
River Sand or Gravel Shore	19	0.05	0.60	0.19	3.57	0.05
Sedge Meadow	3	0.05	2.07	0.88	2.64	0.04
Alluvial Shrub Swamp	8	0.14	0.48	0.27	2.14	0.03
fenny wetland	4	0.10	0.74	0.37	1.50	0.02
Hemlock-Hardwood Swamp	6	0.08	0.52	0.24	1.45	0.02
Hemlock Swamp	4	0.17	0.62	0.33	1.31	0.02
Northern Hardwood Talus Woodland	3	0.15	0.37	0.23	0.68	0.01
Hemlock Seepage Forest	2	0.23	0.27	0.25	0.49	0.01
Oxbow Marsh	1	0.34	0.34	0.34	0.34	0.01
Vernal Pool	6	0.01	0.10	0.04	0.24	0.00
River Cobble Shore	2	0.03	0.18	0.11	0.21	0.00
Riverside Outcrop	3	0.01	0.04	0.03	0.08	0.00
TOTALS	**439**	**<0.01**	**500.04**	**15.06**	**6610.61**	**100.01**

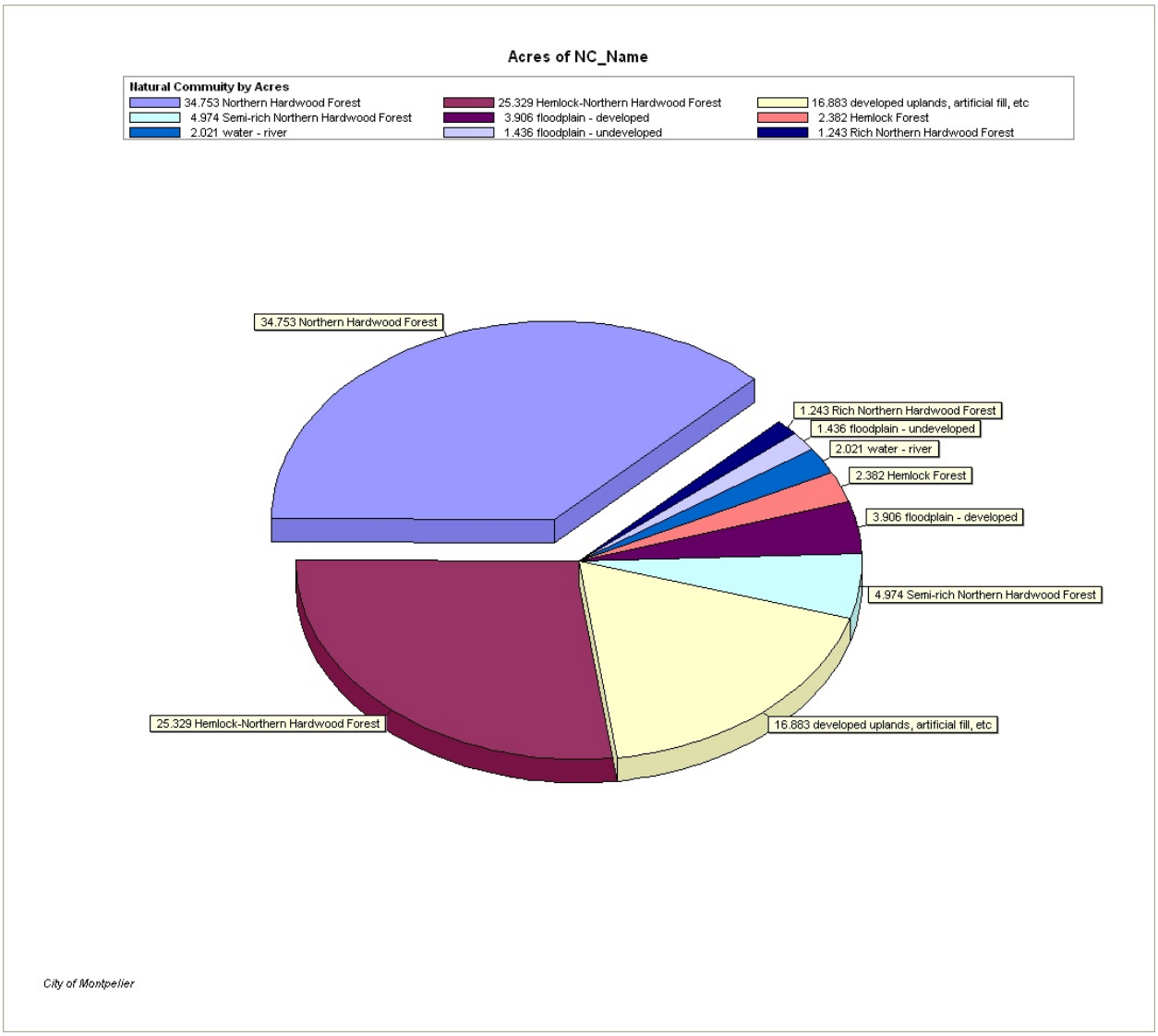

Figure 1. Percentage of City of Montpelier's total area (6611 acres) in natural community types and other mapping units.

accompanying the natural community map shapefile for locations and information on the significance of these occurrences. There is also more discussion on significant occurrences in the recommendations section of this report.

One state-level rare and several uncommon plants were observed in the City during this natural community inventory (Table 3). The only rare plant discovered was found in dry, rocky habitat in Red Oak-Northern Hardwood Forest in the west part of the City. All the uncommon flowering plants are associated with Rich Northern Hardwood Forest, while the uncommon moss occurred in one of the fenny wetlands. With the exception of the narrow-leaved glade fern, which was documented in the Arrowwood Environmental's *Natural Resources Inventory: Phase II* report in 2003, these are additions to the flora of the City. Data documenting the rare sedge will be sent to the Heritage Program.

Table 3. Rare and uncommon plants found in Montpelier during this inventory

Plant Species	**S-Rank**	**# Occurrences**	**EO-Rank(s)**	**State Signif.**
sedge (*Carex argyrantha*)	S2	1	CD	yes
narrow-leaved glade fern (*Diplazium pycnocarpon*)	S3	1	C	no
wild millet (*Milium effusum*)	S3	3	C , CD, CD	no
sedge (*Carex backii*)	S3	2	CD	no
sedge (*Carex laxiculmis*).	S3	2	CD	no
a moss (*Tomenthypnum nitens*)	S3	1	unknown	no

In addition to these state-ranked species listed above, several plants noted during the inventory, which are likely to be rare in the City, include American pennyroyal (*Hedeoma pulegioides*), Wiegand's wild-rye (*Elymus wiegandii*), tall brome (*Bromus latiglumis*), bottlebrush grass (*Elymus hystrix*), Goldie's fern (*Dryopteris goldiana*), slippery elm (*Ulmus rubra*), and leatherwood (*Dirca palustris*). The American pennyroyal is associated with the Red Oak-Northern Hardwood Forest, and the Wiegand's wild-rye, tall brome, and slippery elm are associated with Sugar Maple-Ostrich Fern Floodplain Forest. The remainder of the species, plus the slippery elm, are found in Rich Northern Hardwood Forest. While restricted to Rich Northern Hardwood Forest sites, wild leek (*Allium tricoccum*) was found to be more widespread in the City than formerly believed. More field work is necessary to fully understand the significance of these species in the City.

BIOPHYSICAL REGIONS CONTEXT

Montpelier sits directly on the boundary between the Northern Vermont Piedmont and Northern Green Mountains biophysical region (Figure 2). The biophysical regions of Vermont, shown in full in *Wetland, Woodland, Wildland*, were created in 1997 by Phil Girton and David Capen for the Vermont EcoMapping Roundtable. While a distinct line on the map, in reality the boundary is a gradual transition from the Green Mountains, with higher elevations, more rugged topography, and colder conditions, to the Northern Vermont Piedmont, where lower elevations,

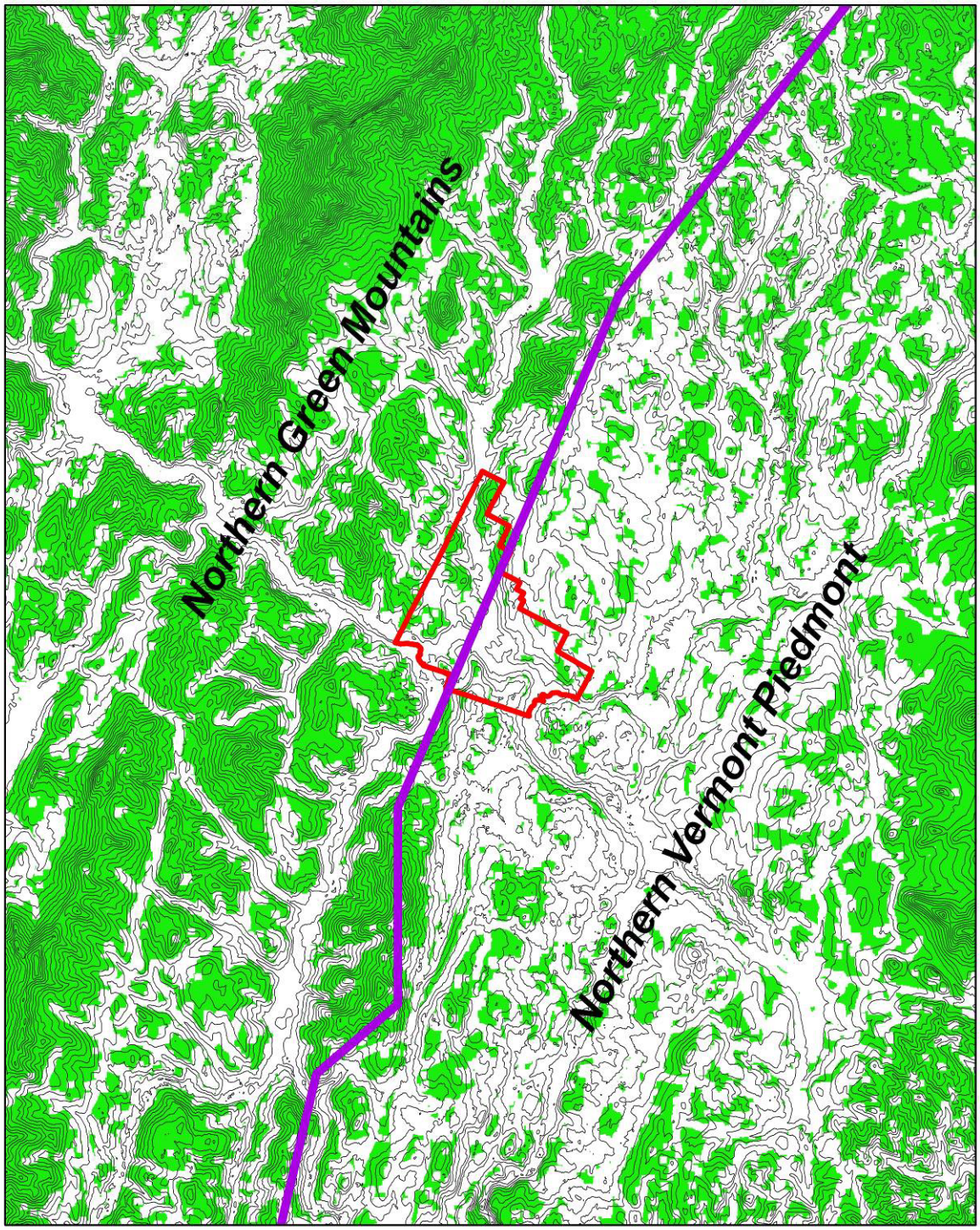

Figure 2. Map of Montpelier in biophysical regions and core habitat context.

gentler topography, and milder climate conditions occur. Given it's generally low elevations and hill/valley landscape, the City has closer affinities to the Northern Vermont Piedmont than the Northern Green Mountains. However, the biophysical regions boundary shown in Figure 2 does relate to a more distinct bedrock geological boundary. It marks the contact between the older (Ordovician) phyllites of the Moretown Formation and the younger (Silurian-Devonian) Waits River Formation. This might seem esoteric, except that this contact marks a real change in bedrock types, from the non-limy Moretown Formation to the limestone-rich Waits River Formation. Indeed, it is clear that the biophysical regions boundary follows this bedrock contact. The change in bedrock plays out in terms of gross physical setting: more rugged, mountainous terrain of the Moretown Formation versus the gentler, rolling terrain of the Waits River Formation. And, importantly, the change in bedrock leads from more less fertile soils in the Moretown Formation to the richer, more fertile soils of the Waits River Formation.

The presence/absence of natural communities, and plant species, also breaks out along this bedrock contact/biophysical regions boundary. Northern white cedar, along with the Northern White Cedar Swamp natural community type and variants, naturally occurs only on the limy Waits River Formation, and cannot be found (except for some stray individuals) west of the contact/boundary. Likewise, Rich Fens, and fenny wetlands, occur in the Waits River Formation and not in the Moretown Formation/Green Mountains to the west of the contact. Rich Northern Hardwood Forests are scattered throughout the Waits River Formation, yet is rare to the west of this limy Formation. Refer to the Montpelier Natural Community Map (Appendix A) to see these distributions of natural communities relative to the bedrock contact/biophysical regions boundary.

The Waits River/Moretown bedrock formations contact bisects the City, running NNE-SSW, basically paralleling North St. and Northfield St. 0.2 miles west of the streets. The contact almost runs right through the Statehouse.

Figure 2 also shows Montpelier in relation to "core habitat" of the central Vermont region. The green (gray in black & white) areas represent contiguous forest (100 meters from human disturbance) as created by University of Vermont's Spatial Analysis Lab in 2000. Note that the largest core habitats of the City are to the north and are almost connected to much larger core habitats to the north and northwest. The core habitat on the west side of the City – the "West Hill" (north of Green Mount Cemetery) – is connected to a major core habitat unit to the west in Middlesex, which in turn, is nearly connected to a very large core habitat region in the Worchester Mountains. In contrast, the core habitat at the east end of the City has no significant core habitat to connect to going eastwards into the Northern Vermont Piedmont. The small core habitat at "South Hill" (east of Northfield St.) is separated from the core habitats of the Irish Hill-Paine Mountains area by Interstate 89. The City's core habitat context has implications especially for the movement of wildlife.

DESCRIPTIONS OF NATURAL COMMUNITY TYPES

The descriptions of the natural community types found in Montpelier include a summary of each community's extent, distribution, ecological factors, general condition, and some characteristic species. Variants of the types are included in the type descriptions. More detailed information is

found in the attribute table associated with the natural community map shapefile. Natural community type codes (NC_Type in the attribute table) are given in parentheses after the names.

UPLANDS

Northern Hardwood Forest (8)

Including its Semi-rich Northern Hardwood Forest variant, Northern Hardwood Forest type covers close to 40% (2626 acres). While a matrix forest type found throughout the City, significant portions of this hardwood forest type occurs as fields or is in a successional state recovering from past clearing. Some of it is in conifer plantations, or with a supercanopy of white pine with a dense understory of the characteristic sugar maple, beech, birch and white ash saplings. It is the forest type which dominates the moderately fertile upland till soils, and the deep, finer-textured soils in the valley bottoms. The Semi-rich Northern Hardwood Forest variant is a contracted name for Sugar Maple-White Ash-Jack-in-the-Pulpit Northern Hardwood Forest in the Vermont natural community classification. The Semi-rich Northern Hardwood Forest tends to occur in more moist and fertile conditions than typical Northern Hardwood Forest. Hence, it often grows on lower positions of sloped terrain. This widespread and common (S5) natural community is really the forest that defines Vermont.

Rich Northern Hardwood Forest (9)

A total of 82 acres (1.24% of City) of Rich Northern Hardwood Forest was documented during the inventory. It usually occurs in less than 5-acre units, though one 24-acre occurrence was mapped. Most of the occurrences are in the south part of town in association the lime-rich Waits River Formation. A few small units occur in the Moretown Formation, which lacks the limestone, but can have inclusions of other calcium-rich rocks. Most of the Rich Northern Hardwood forest is associated with moderate to steep, concave slopes below outcrops containing some limestone. A couple occurrences are positioned on flattish ground of hill summits, or on very gradual slopes. Sugar maple and white ash characteristically dominate the canopy of this rich forest type, while basswood, butternut, and slippery elm are less common, but good indicator species for the type. Wildflowers indicative of the fertile soils in Rich Northern Hardwood Forest include blue cohosh (*Caulophyllum thalictroides*), wild leek (*Allium tricoccum*), baneberries (*Actaea* spp.), wild ginger (*Asarum canadense*), and several spring ephemerals, especially squirrel corn (*Dicentra canadensis*) and Dutchman's britches (*Dicentra cucullaria*). The rich, or fertile soils, are also very indicative of the natural community. They usually have a relatively thick, humus-rich, topsoil (A horizon). Most of the occurrences visited had rather youthful, even-aged canopies. Weeds, especially the invasive hemp-nettle (*Galeopsis tetrahit*), are a problem in some of the occurrences. Several slopes in the east part of the City mapped as potential Rich Northern Hardwood Forest need to be visited to determine whether rich woods are present. Most of the state-level uncommon plant species, along with several species believed to be rare in the City, are associated with Rich Northern Hardwood Forest. These species are listed in the Results section.

Mesic Red Oak- Northern Hardwood Forest (10)

With its characteristic red oak mixed in with sugar maple, beech, white ash, and other northern hardwoods, this forest community type occupies steep, rocky slopes at low elevations with southerly exposures. It is rare in the City, restricted to a very small areas (2-23 acres) on Capitol Hill and in the vicinity of Green Mount Cemetery. While this forest type becomes common in

the Champlain Valley, Montpelier is near the upper reaches of its extent in the Winooski Valley. As a bearer of hard mast, red oak is a very important species for wildlife. Two of the rare/uncommon plants in the City are associated with this natural community type. Both occurrences (4 polygons) are of municipal significance because of the type's rarity in the City.

Hemlock Forest (11)

Hemlock Forest occurs in one to 23-acre units scattered throughout the hills in the north part of the City, plus in the vicinity of National Life. Often it is associated with ravines and convex slopes with shallow soil. While Hemlock Forest is typically low in biological diversity (witness the understory and groundcover nearly devoid of plants), it can be important as deer wintering areas. Only one 10-acre example of the Hemlock-Red Spruce Forest variant of this natural community is mapped in the City. Many of the 18 units (fewer occurrences) of this M3 natural community are in good condition and landscape context, hence considered significant on the municipal level.

Hemlock-Northern Hardwood Forest (12)

Occupying 25% of the City, Hemlock-Northern Hardwood Forest is a matrix forest type second in extent only to Northern Hardwood Forest. It occurs in units ranging from less than one acre to 500 acres, and is most prevalent in the north and west portions of the City. Some of the examples are quite mature and form matrix blocks which are significant for biodiversity conservation on the municipal level. The two areas mapped as the Hemlock-White Pine-Northern Hardwood Forest variant are related to sandy soils. Both of these areas have been mined for sand, hence the natural community extirpated.

Northern Hardwood Talus Woodland (13)

Three very small (<0.5 acre) occurrences of this woodland community are mapped in the City. This community is the bouldery-rocky rubble found below cliffs and ledges. It is a unique ecological setting which supplies den sites for some wildlife, especially porcupine and bobcat. Because of the community's rarity, all three occurrences of this type are significant on the municipal level. More occurrences of talus woodland are likely to be found with more field work in the hills at the north end of the City.

Riverside Outcrop (26)

These unique, upland riverside environments are defined as bedrock outcroppings along rivers. Flooding, ice-scour, and general exposure are ecological processes associated with this community type. The three areas mapped as Riverside Outcrops are tiny, ranging from 0.01-0.04 acres in size. Only one of the three units was surveyed, and it was in very weedy condition. The other two units need survey. Because of its rarity, this natural community type is considered significant on the municipal level.

WETLANDS

Sugar Maple-Ostrich Fern Floodplain Forest (43)

Fourteen examples of this floodplain natural community type are mapped in the City. They are remnants, <1 to 15 acres in size, of a natural community type once occupying several hundred acres in the City. The largest examples are concentrated along the North Branch, while other examples are found along the Winooski River, and one along the Dog River. Though wooded,

these remnants are highly degraded occurrences of the natural community type. Despite its canopy being dominated by non-native box elder (*Acer negundo*) and white willow (*Salix* X *rubens*), these remnants still have characteristic floodplain species, such as ostrich fern (*Matteuccia struthiopteris*), zig-zag goldenrod (*Solidago flexicaulis*), American and slippery elms, basswood, and butternut. Surprisingly, obligate floodplain species, such as Wiegand's wild-rye and tall brome, both uncommon/rare species in Montpelier, can still be found in some of these remnants. These remnants are plagued with invasives, especially Japanese knotweed (*Polygonum cuspidatum*) and goutweed (*Aegopodium podagraria*), as well as many other non-natives. Though dams have altered the flow patterns in Montpelier's rivers, flood waters still deposit silts and sands which define the fertile, alluvial soils of the natural community type. These riverine floodplain forests could be classified as the closely related "Silver Maple-Ostrich Fern Floodplain Forest", as Arrowwood did in their 2003 natural resources inventory. However, the lack of silver maple in the City's floodplain (only a couple were observed along the Winooski), coupled with the author's field observations both up and down the Winooski watershed, suggests that the floodplain forests in the City were likely more of the Sugar Maple-Ostrich Fern type. All of the floodplain forest units are considered significant on the municipal level because of their rarity and threatened status.

Red Maple-Black Ash Swamp (45)

Two of these hardwood swamp type units comprising one 5-acre occurrence are mapped on the hill above Green Mount Cemetery. This occurrence was not visited due to lack of landowner permission to access the site. Development related project information provided the basis for these mapped units. Field surveys are needed to verify their classification and condition.

Northern White Cedar Swamp (51)

No typical Northern White Cedar Swamps were documented in the City, though two potential cedar swamps are mapped in the far eastern reaches of the City. The variant Northern White Cedar Sloping Seepage Forest (51a) does occur in the City in the same far east section. Potential occurrences of this variant are also mapped in this vicinity. The cedar community variant is associated with wet slopes in the portion of the Waits River Formation where the bedrock has a higher concentration of limestone. Northern white cedar is strongly affiliated with limestone in New England. The species', and associated natural communities, distribution in the City follows the bedrock: cedar populations and communities all occur in the Waits River Formation on the east side of City, and are lacking in the west half of the City off the Waits River Formation. Throughout the Waits River Formation east and north of the City cedar and cedar swamps are quite frequent, yet to the west they are non-existent until the Champlain Valley where limestone appears again.

Hemlock Swamp (54)

Several very small (0.08-0.62 acres) Hemlock Swamps, and its Hemlock-Hardwood Swamp variant, are mapped in the City as five occurrences. The are found in small basins perched on hill tops in the northern part of the City. Typically they have muck soils, though some of the degraded examples have a muddy surface soil layer. Though comprising a tiny fraction of the landscape in the City, these swamps, as well as other small wetlands, are very high in biodiversity. The Hemlock Swamps are tentatively rated as state-significant. All of these swamps are significant at the municipal level.

Seep (55)

Seeps by definition are small (usually less than 0.25 acre), discrete natural communities that occur within a matrix upland community. They cannot be mapped remotely. Thirty-one Seeps, plus an additional 6 six Semi-alluvial Seeps (Seep variant), are mapped throughout the City. Many more seeps undoubtedly occur in the City. Several of the better quality examples are rated as significant at the municipal level. Seeps provide a surprisingly high amount of biological diversity in forested systems.

Vernal Pool (56)

Six vernal pools are mapped in the City, three of which are clustered on a flattish hilltop at the north end of the City. These are tiny wetlands, all less than 0.1 acre in size. Typically they are found in shallow basins cradled between bedrock spines on hilltops. They are critical breeding habitat for some invertebrates and amphibians, especially mole salamanders (*Ambystoma* spp.), wood frogs, and spring peepers. Vernal pools must retain water for at least 6-8 weeks to be useful as breeding sites for most amphibians. The pools visited during this inventory had standing water in autumn after heavy rains. They must be assessed during the spring and early summer to determine their significance as breeding habitat for amphibians, which, in turn, is a criteria in determining the significance of Vernal Pools on the state level.

Shallow Emergent Marsh (64)

About 20 Shallow Emergent Marshes, including the Beaver Meadow and Oxbow Marsh variants, are mapped throughout the City for a total of 25 acres. Most of the marshes average about one acre in size, while the large marshes range from 4 to 8 acres. The larger marshes are products of beaver impoundments. Many of the marshes visited in Montpelier are in degraded condition. However, marshes have many functional values for landscapes, from stormwater runoff retention to water quality protection, plus, they are very important for biodiversity. They are critical habitat for numerous species, from invertebrates up to large mammals. Many of the marshes in Montpelier are rated as significant at the municipal level for this reason.

Sedge Meadow (65)

Only three small units of Sedge Meadow totaling 2.5 acres are mapped, though there are likely more sedge meadows in the City. Since they all occur in open areas that were formerly pastures, their status as a “natural” community is held in question.

River Sand or Gravel Shore (72)

These small, river bar features average less than 0.2 acres in size and are scattered along the rivers. Concentrations of these features occur in the vicinities of the confluences of both the Dog River and Stevens Branch with the Winooski mainstem. They can be either mid-channel or shore sand/gravel bars. They shift positions according to changing river currents and migrating channels. Opposing ecological processes of washing and deposition, as well as ice-scour, take place during river highwater events. These natural communities are often open sands/gravels with sparse herbaceous vegetation and scattered shrub willows. Weedy species, both native and non-native, tend to thrive in such open, sandy environments. They are very distinct ecological units which can be important habitat for a variety of invertebrates and plants. Only one of these shore communities was visited during the inventory. More field work needs to be done on this natural community in order to assess their biodiversity significance.

River Cobble Shore (73)

Only two River Cobble Shores are mapped, and one visited. Both occur in the high-gradient reach of the Winooski River just upstream from the Route 2 bridge at Gallison Hill Road. The one visited is marginally a cobble shore given the amount of sand that has been deposited on it. This particular example has a rather heavy graminoid (especially rushes)-scouring rush (*Equisetum variegatum*)-low willow (*Salix eriocephala*) cover. Like the River Sand or Gravel Shore community, River Cobble Shore has river flood events and ice-scour as driving ecological processes. More field work is needed on this natural community.

Alluvial Shrub Swamp (77)

None of the eight Alluvial Shrub Swamps mapped were visited during the inventory, though several were observed from roads nearby. Most of these alder and willow dominated shrub swamps occur along the North Branch between the bridges of Grout and Haggett roads. The water is quite quick along this reach of the river, so the soil in these units would likely be sand, gravel, and cobble. These examples do not fit the typical low-gradient, meandering, small river environment described in *Wetland, Woodland, Wildland*. All of the mapped Alluvial Shrub Swamps are less than one-half acre in size. More field work is needed to assess their biodiversity significance.

Alder Swamp (78)

Alder Swamps occur as small natural communities averaging about one acre in size. The 15 mapped polygons are scattered throughout the City. Most are associated with brooks; some can be found in swales in valley bottoms and along toe slopes leading down to the valley bottoms. While some of the Montpelier examples have typical muddy, or muck soils, some of the examples clearly receive alluvium from stream flooding. At nearly 10 acres, the largest occurrence is two-thirds of the total acreage for the natural community in the City. This occurrence is located along upper “East Brook”, upstream from Towne Hill Road. This site was not visited.

Sloping Seepage Forest (90)

This is a new natural community that has recently been incorporated in the Vermont natural community classification and will be described in an upcoming revision. In the City, this natural community occurs on gentle to moderate slopes frequently associated with poorly-drained Cabot and very poorly-drained Peacham soils, both of which are considered hydric soils by the Natural Resources Conservation Service. While generally fertile soils, i.e. nonacid and loamy textured, their wetness, and sometimes rockiness, make them unsuitable for agriculture and development, though many are successional from being pastures. Seep natural communities can sometimes be mapped within these seepage forests, though often the seepage points are too diffuse to be mapped. This natural community type is variable in canopy composition, so three variants are used for mapping: Northern Hardwood Seepage Forest (90a), Hemlock Seepage Forest (90b), and Mixed Sloping Seepage Forest (90ab). These seepage forests are not wet enough to exclude sugar maple, yet they are wet enough to support black ash. There are 23 of these seepage forests mapped in the City totaling 55 acres. They range in size from less than one acre to 8 acres. Concentrations of this natural community type occur along North Street and along upper Blanchard Brook. These seepage forest occurrences are believed to be significant for biodiversity conservation on the municipal level, but need more field survey to determine the community’s municipal rank.

Fenny Wetland (91)

These four very small (0.1-0.75 acres), open wetlands are located in pastures and old fields in the eastern limestone (Waits River Formation) district of the City. They may be degraded examples of the Rich Fen natural community type, or perhaps what resides after a Northern White Cedar Swamp has been cleared and grazed for many years. Knowing that Rich Fens occur in the Waits River Formation to the south, east, and northeast of Montpelier, the community type was searched for in the City. Regardless of what they may have been, the fenny wetlands found in the City are unique ecological units that have similarities with Rich Fens. These fenny wetlands all have significant moss cover, including several lime-loving, fen-associated species, such as *Bryum pseudotriquetrum, Philinotis fontana, Tomenthypnum nitens* (uncommon in Vermont), and *Helodium blandowii*. Dorothy Allard, consulting botanist/ecologist of Bakersfield, VT, identified these mosses, and Eric Sorenson, Heritage Program ecologist, supplied the information on their natural community affiliations. Herbs frequently associated with Rich Fens that were observed at these sites include *Carex interior, Carex flava, Carex hystericina*, larch, cattail, red osier dogwood, common and water horsetails, water avens, and common strawberry. All occur on gentle slopes, often associated with slope breaks, i.e. at the slope inflection point where steeper slopes shift to gentle slopes. At least two of the four have shallow, muck soils typical of Rich Fens. At one site, the muck was very wet, appearing as though the site was a groundwater discharge point. The gleyed and mottled silty soil beneath the muck at this fenny wetland had a pH of 7.0. Despite their classification ambiguity, these fenny wetlands are rare in the City and have high biodiversity qualities. Therefore, they are deemed significant on the municipal level.

Other Landscape Units

Other landscape units used for this natural community map include generic wetlands (perched basin, small drainage, and swale), water (artificial pond and river), and floodplain (developed and undeveloped). The generic wetlands occur mostly in fields and are visable on aerial photographs viewed stereoscopically. The small drainages may naturally be Seeps. Undeveloped floodplains refer to fields within the floodplain. They were naturally floodplain forests. See RESULTS section for descriptions of these Other categories with respect to the City as a whole.

RECOMMENDATIONS FOR BIODIVERSITY CONSERVATION AREAS

Seventeen areas, called “biodiversity conservation areas”, are recommended for their importance to the overall biodiversity within the City of Montpelier (Figure 3 and Table 4).
These areas are recommended based on the presence of two or more natural community occurrences of municipal level significance, with the exception of four sites along the Winooski and Dog Rivers where the sites are recommended based on the presence of remnant floodplain forests. Floodplain forests are a special case for biodiversity conservation. They are all in poor condition because of invasives plants and their greatly reduced size due to development and former conversion to agricultural fields. Yet, they still are reservoirs of natural biological diversity, as shown by the discovery of several of the native floodplain species still present at these sites. Also, the natural flood processes of deposition and erosion are still present, which leads to their very unique ecological character. They retain high biodiversity values, as well as educational value, and can be restored. Hence, they are included as biodiversity conservation areas among the larger and much more intact recommended areas up in the hills.

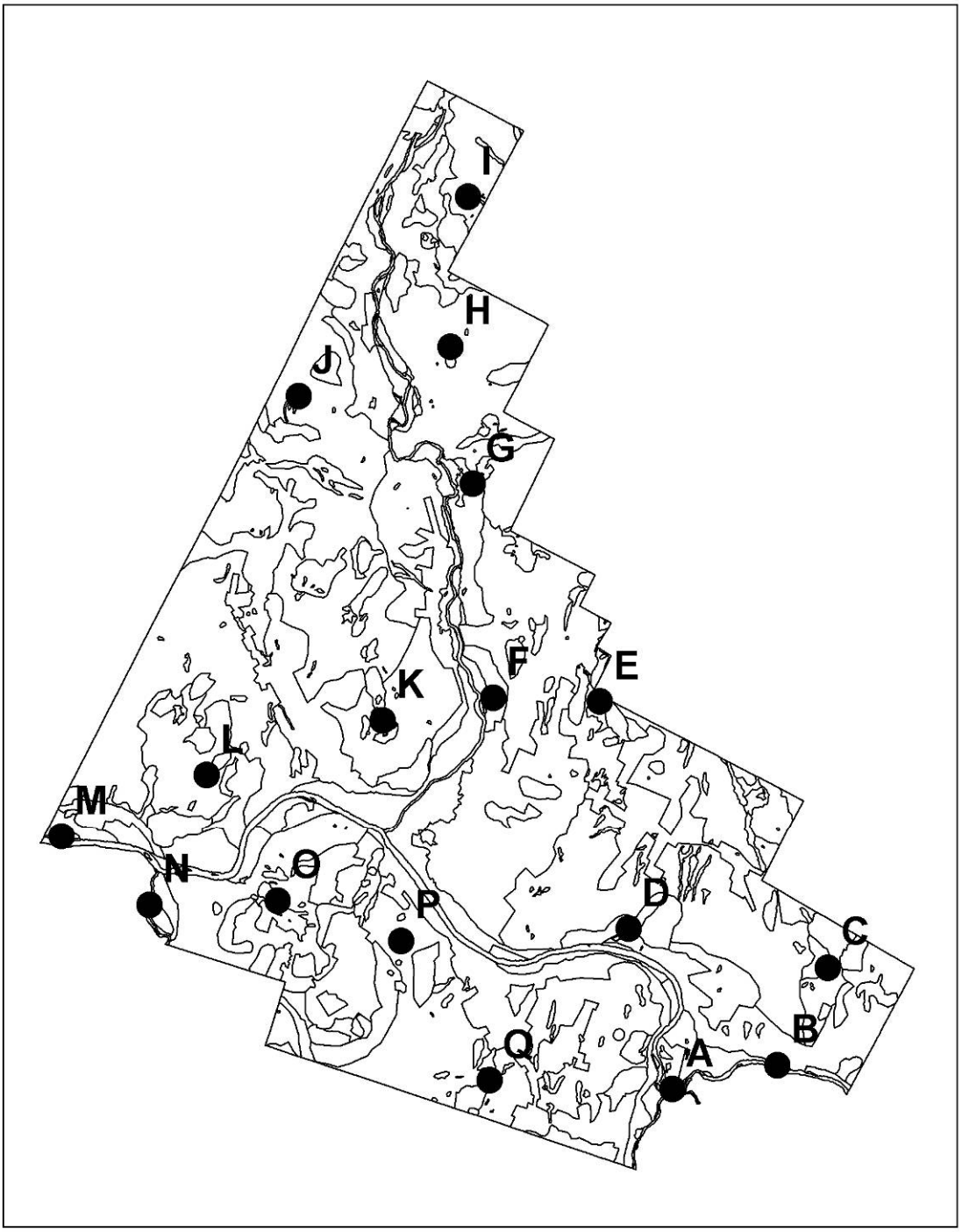

Figure 3. Recommended biodiversity conservation areas in Montpelier. The natural community map polygons are background.

Table 4. Recommended biodiversity conservation areas in the City of Montpelier. Order not arranged in any priority.

Site	Site Name	Location	Significant NC Occurrences
A	Two Rivers	North bank of the Winooski at Dog River confluence	Floodplain, with remnant floodplain forest (Sugar Maple-Ostrich Fern Floodplain Forest)
B	Gallison Hill Road Floodplain	Small floodplain along Winooski S. of Gallison Hill Rd.	Remnant floodplain forest (Sugar Maple-Ostrich Fern Floodplain Forest)
C	East Brook	Vicinity of brook north of Gallison Hill Road	Rich Northern Hardwood Forest, N. White Cedar Sloping Seepage Forest, Hemlock-NHF, brook & ravine
D	Old Country Club Road Slope	Slope N. of Winooski and E. of Barre St. bridge	Rich Northern Hardwood Forest, Hemlock-Northern Hardwood Forest
E	Upper Blanchard Brook	Blanchard Brook vicinity above Towne Hill Rd.	fenny wetlands, Mixed Sloping Seepage Forests, Hemlock-Northern Hardwood Forest, Alder Swamp
F	Lower North Branch Slope	East of North Branch fromHillhead St.to Cummings St.	Northern Hardwood Seepage Forest, Semi-rich Northern Hardwood Forest, floodplain forest (Sugar Maple-Ostrich Fern Floodplain Forest)
G	North Branch River Park	Mostly E. of North Branch N. of Cummings St. bridge	Floodplain (some forest), Seeps, Hemlock-N. Hardwood Forest, Rich &Semi-rich N. Hardwood Forest, Hemlock Forest, Shallow Emergent Marsh,
H	Gould Hill West	W. of Gould Hill Rd.and E. of the North Branch	Hemlock-Northern Hardwood Swamps, Vernal Pool, Hemlock-N. Hardwood Forest, undeveloped floodplain, floodplain forest, Alder Swamp, Seeps
I	North Hill	Hill in N. end of City, SE of Wrightsville Dam	Vernal Pools, Hemlock Swamp, N. Hardwood Talus Woodland, Hemlock Forest, N. Hardwood Forest, Rich N. Hardwood Forest, Alluvial Alder Swamps
J	Boundary Hill	1040' hill summit W. of North Branch and Gould Hill Rd. bridge	Hemlock Swamps, N. Hardwood Talus Woodland, Hemlock Forest, Hemlock-N. Hardwood Forest, Seeps, Sloping Seepage Forest
K	Capitol Hill/Hubbard Park	Hill behind state capitol including Hubbard Park	Red Oak-N. Hardwood Forest, Seeps, Mixed Sloping Seepage Forest, Rich N. Hardwood Forest, Hemlock Forest
L	West Hill	Hill N. of Green Mount Cemetery	Red Oak-N. Hardwood Forest, Hemlock-N. Hardwood Forest, Shallow Emergent Marsh (Beaver Meadow), Red Maple-Black Ash Swamps
M	West Corner Floodplain	N. side of Winooski in far W. corner of City	Floodplain Forest, and undeveloped floodplain
N	Dog River	E. bank of Dog River in City	Floodplain Forest, and undeveloped floodplain
O	Double Hill	Two summited hill W. of Northfield St. (Rt. 12)	Rich N.Hardwood Forest, Hemlock-N. Hardwood Forest, Shallow Emergent Marsh, Hemlock Forest, Seeps
P	South Hill	Hill E. of Northfield St. and W. of Hill St.	Rich Northern Hardwood Forest, Hemlock-N. Hardwood Forest
Q	Fenny Lane	West of Berlin St. near Berlin town line	fenny wetland, Hemlock-N. Hardwood Forest, Rich N. Hardwood Forest

Dots represent the general area where the significant natural community occurrences are located. The attributed GIS natural community map has all the data on the rankings of individual polygons listed as significant occurrences in Table 4.

One major omission in this list and map of biodiversity conservation areas is the rivers themselves. They have distinct aquatic natural communities of very high biodiversity importance. Unfortunately, their inventory was beyond the scope of this project. Refer to Hans Estrin's 1995 "Montpelier Rivers Report" for an overview of the conservation importance of rivers in the City.

These biodiversity conservation areas contain a large percentage of the natural community types found in Montpelier. There is repetition among natural community types occurring at these recommended areas both because their reoccurrence is natural in the landscape, and because it is important to try to conserve multiple examples of community types to insure the persistence of the full diversity of species, and ecological processes and conditions, in a given landscape over the long haul of time.

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Wright, Stephan. 1999. Surficial Geologic Map of the Barre West Quadrangle, Vermont. Vermont Geological Survey Open File Report VG99-6, 3 plates and text, scale 1:24,000.

Digital Layers Used in this Report

1996 digital orthophoto quads
2003 leaf-on true color aerial photographs (rectified)

1963 B&W aerial photos (VT-62-H), scale 1:18,000. Photos used stereoscopically for preliminary map: line 44 #129-133, line 44 #143-147, and line 44 #27-28, flown 4/29/63. Because of overlap in the images, only every other photo was mapped on, as well as scanned and georeferenced.

1942 B&W aerial photos (DCC), scale 1:20,000. Line 1 #61-65 and line 1 #1-44, flown 6/30/42. Because of overlap in the images, only every other photo was scanned and georeferenced.

Montpelier wetlands: Arrowwood shapefile obtained from the City Planning & Community Development

Montpelier generalized upland natural communities: Arrowwood shapefile obtained from the City Planning & Community Development

USGS topographic maps

Soils: attributed polygon shapefile created by NRCS, available from VCGI

National Wetlands Inventory map: attributed polygon shapefile, available from VCGI

Water bodies: attributed polygon and line shapefiles, available from VCGI

City boundary: shapefile obtained from the City Planning & Community Development

Parcels: shapefile obtained from the City Planning & Community Development

Vermont biophysical regions, available from VCGI

Vermont core habitat, available from VCGI

FEMA Statistical 100-year flood area, available from VCGI

Digital Layers Created for this Report

Montp_NC_06 = original natural community polygon shapefile, including polygons extending outside of the City boundaries. Created 10/23/06, last modified 4/9/2007

Montp_NC_06_CL_GP = the final, cleaned natural community polygon shapefile clipped to City boundaries, created 4/9/2007 last modified 5/1/2007. This is the final product of this project. Contains attributed table with polygon ID, natural community name, codes, area (acres and square meters), State rankings (S_Rank, S_EO_R), & significance Municipal rankings (M_Rank, M_EO_R) and significance, ranking notes, Description, Condition, Additional Notes (Add_Notes), and even more notes (Notes_2)

Montp06_allwaypts = Point layer shapefile of all GPS fixes taken for this project.

Sites_Map = polygon shapefile of sites to field visit.. Attributes table includes field of priority for visitation

BioConserv_Areas = point shapefile of biodiversity conservation areas. Attributes include Site, SiteName, Location, Features, and Notes.

Other sources of information

Nongame and Natural Heritage Program