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A. Energy Advisory Committee Members

A.1) Northern Middlesex Council of Governments

Greater Lowell Energy Advisory Committee

<u>Name</u>	<u>Title</u>	<u>Affiliation</u>
Walter Alterisio	Selectman	Town of Dunstable
Marshall Arif	Energy Manager	Town of Chelmsford
Joanne Bissetta	Northeast Regional Coordinator	Green Communities Division, DOER
Marc Bouvier	Project Manager	Nobis Engineering
David Braslau	Director	Constellation Energy
Gail Brown	Executive Director	Gr. Lowell Workforce Investment Board
Kathleen Canavan	Member	Westford Green Energy Committee
Patrick Cook	Exec. Dir. of Public Affairs	Middlesex Community College
Gregg Croteau	Executive Director	United Teen Equality Center
Jeremy Downs	Assist. Town Engineer	Town of Westford
Philip Ferreira	Housing and Energy Manager	City of Lowell
David Gendall	Customer & Community Manager	National Grid
Jim Goldenberg	Principal	Cathartes Private Investment
John Langton	Vice President	American Capital Energy
Jay Mason	Member	Lowell Green Building Commission
John Mangiaratti	Asst. Town Manager	Town of Westford
Barbara O'Neil	Executive Director	Career Center of Lowell
Steve Sadwick	Community Development Director	Town of Tewksbury
Stephen Themelis	Selectman	Town of Pepperell
Dave Tibbetts	Executive Director	Merrimack Valley Econ. Dev. Council

A.2) Montachusett Regional Planning Commission Energy Advisory Committee

<u>Name</u>	<u>Affiliation</u>
Al Futterman	Nashua River Watershed Association
Alan Pease	Ashby
Ann Pierce	Mass Development
Charlie Coggins	Leominster Emergency Management
James Wright	Athol Fire
Joanne DiNardo	Leominster Conservation Commission
Joseph Stiso	Mount Wachusett Community College
John Bonazoli	Unitil
Lenny Laakso	Fitchburg DPW
Mark Archambault	Nashua River Watershed Association
Noreen Piazza	Lancaster
Robert Pendrake	National Grid
Sean Hamilton	Sterling Municipal Light
Stan Herriott	Ashburnham Municipal Light
Stephen DiNatale	State Representative
Steve Wallace	Westminster Planner
Trevor Beauregard	Gardner Planning Director
Victor Koivumaki	Lancaster

Kelly Brown
Mike Gary

MA Department of Energy Resources
North Central Workforce Investment Board

B. Meeting Agendas

B.1) Northern Middlesex Council of Governments Greater Lowell Energy Advisory Committee



Northern Middlesex Council of Governments

Greater Lowell Energy Advisory Committee Meeting

December 13, 2012

12:00-1:30 P.M.

NMCOG Conference Room

40 Church Street, Suite 200, Lowell, MA

A Multi-Disciplinary

Regional Planning

Agency Serving:

Billerica

Chelmsford

Dracut

Dunstable

Lowell

Pepperell

Tewksbury

Tyngsborough

Westford

Stephen C. Themelis
Chair

Beverly A. Woods
Executive Director

40 Church Street
Suite 200
Lowell, MA
01852-2686

TEL: (978) 454-8021

FAX: (978) 454-8023

www.nmcog.org

AGENDA

1. **Welcome and Introductions**---Beverly Woods, Executive Director
2. **Energy Advisory Committee – Purpose and Function – Jay Donovan, Assistant Director**
3. **Siting of Renewable Energy Facilities Study – Jay Donovan**
 - Summary of Grant
 - Partnership with MRPC – John Hume, Economic Development Director
 - Outlined Tasks
 - Energy Advisory Committee
 - Sections of the Study
 - Workshops
 - Questions and Answers
4. **Energy Section of the Regional Strategic Plan – Beverly Woods**
5. **Other Energy Initiatives – Jay Donovan**
 - District Local Technical Assistance (DLTA) projects
 - Electric Aggregation
 - EDA Planning Grant – Brownfields and Energy Forums
 - State Grant Opportunities
6. **Next Meeting – March 28, 2013**
7. **Adjournment**



Northern Middlesex Council of Governments

Greater Lowell Energy Advisory Committee Meeting

A Multi-Disciplinary
Regional Planning
Agency Serving:

March 28, 2013
12:00-1:30 P.M.
NMCOG Conference Room
40 Church Street, Suite 200, Lowell, MA

AGENDA

Billerica

Chelmsford

Dracut

Dunstable

Lowell

Pepperell

Tewksbury

Tyngsborough

Westford

Stephen C. Themelis
Chair

Beverly A. Woods
Executive Director

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FAX: (978) 454-8023

www.nmcog.org

1. **Welcome and Approval of Minutes**---Beverly Woods, Executive Director
2. **Siting of Renewable Energy Facilities Study Update** – Jay Donovan, Assistant Director
 - Sections of the Study – Wind Energy Conservation Services, Photovoltaics, Access and Transportation and LEED Certification
 - Workshops – Wind and Solar Siting
3. **Current Energy Initiatives** – Danielle Mucciarone, Energy and Environmental Planner
 - Solarize MA 2013
 - National Grid LED Tariff
4. **Other Energy Initiatives** – Beverly Woods
 - White Paper on Municipal Energy Options
 - Electric Aggregation
5. **Next Meeting – June 27, 2013**
6. **Adjournment**

Greater Lowell Energy Advisory Committee Meeting

June 27, 2013
12:00-1:30 P.M.
NMCOG Conference Room
40 Church Street, Suite 200, Lowell, MA

AGENDA

- 1. Welcome and Approval of Minutes**---Beverly Woods, Executive Director
- 2. Siting of Renewable Energy Facilities Study Update** – Jay Donovan, Assistant Director
 - Sections of the Study – Wind Energy Conservation Services, Photovoltaics, Access and Transportation and LEED Certification
 - Workshops – Solar Siting and Renewable Energy and Historic Preservation
- 3. Current Energy Initiatives** – Danielle Mucciarone, Energy and Environmental Planner
 - Solarize MA 2013
 - National Grid LED Tariff
 - Green Communities
 - Solar II Rebate Program
- 4. Other Energy Initiatives** – Jay Donovan
 - Solar Bylaw and Permitting Project for Westford
 - Electric Aggregation
- 5. Next Meeting – September 26, 2013**
- 6. Adjournment**

Greater Lowell Energy Advisory Committee

September 26, 2013
12:00-1:30pm

**NMCOG Conference Room
40 Church Street, Suite 200, Lowell, MA**

AGENDA

- 1. Welcome and Approval of Minutes - Beverly Woods**
- 2. Siting of Renewable Energy Facilities Update – Jay Donovan**
 - Draft LEED Certification Section – Danielle Mucciarone
 - Draft Wind Energy Section – John Hume and Tom Roufos
- 3. State Energy Sector Partnership Grant Update - Gail Brown, GLWIB**
- 4. Local Energy Initiatives – Danielle Mucciarone**
 - Westford Green Communities Initiative
 - Mass Energy Insight
- 5. Statewide Energy Initiatives – Danielle Mucciarone**
 - LED Street Lighting Regional Procurement
 - Solarize Mass 2013 Round II
 - Owners Agent Technical Assistance Grants
 - Emergency Regulations for RPS Solar Carve-Out
- 6. Next Meeting – December 12, 2013**
- 7. Adjournment**

Greater Lowell Energy Advisory Committee

December 12, 2013

12:00-1:30pm

**NMCOG Conference Room
40 Church Street, Suite 200, Lowell, MA**

AGENDA

- 1. Welcome and Approval of Minutes** – Beverly Woods, Executive Director
- 2. Siting of Renewable Energy Facilities Update** – Jay Donovan, Assistant Director
 - Hydropower Workshop - MRPC
 - Renewable Energy in Historic Buildings Workshop - NMCOG
 - Draft Photovoltaic Section - NMCOG
- 3. Local Energy Initiatives** – Danielle Mucciarone, Energy and Environmental Planner
 - Dunstable Solar Zoning Bylaw
 - Westford Green Communities Initiative
 - Mass Energy Insight
- 4. Statewide Energy Initiatives** – Danielle Mucciarone, Energy and Environmental Planner
 - Grant Opportunities
 - Commonwealth Organics-to-Energy Grant
 - Energy-Saver / Water-Reduction Devices - No-Cost Products Opportunity for State Agencies and Municipalities
 - DOER and MassCEC Grants for Thermal Renewable Energy Projects
 - Renewable Heating and Cooling and District Energy Solicitation
 - DOER Task 3b Report: Analysis of Economic Costs and Benefits of Solar Program
- 5. Next Meeting – March 27, 2014**
- 6. Adjournment**



Northern Middlesex Council of Governments

Greater Lowell Energy Advisory Committee Meeting

April 24, 2014

12:00-1:00 P.M.

NMCOG Conference Room

40 Church Street, Suite 200, Lowell, MA

A Multi-Disciplinary

Regional Planning

Agency Serving:

AGENDA

Billerica

Chelmsford

Dracut

Dunstable

Lowell

Pepperell

Tewksbury

Tyngsborough

Westford

Matthew J. Hanson
Chair

Beverly A. Woods
Executive Director

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FAX: (978) 454-8023

www.nmcog.org

1. **Welcome** ---Beverly Woods, Executive Director
2. **Siting of Renewable Energy Facilities Study Update** – Jay Donovan, Assistant Director
 - Sections of the Study: Wind Energy Conservation Services, Geothermal Energy, Photovoltaics, Hydropower, Biomass, Lands Inventory and Assessment (Access and Transportation) and LEED Certification.
 - Workshops: Renewable Energy and New Construction and Renewable Energy Incentives.
3. **Other Energy Initiatives** – Beverly Woods
 - Westford Green Community designation
 - Pepperell Stretch Code initiative
 - Electric Aggregation
4. ***Greater Lowell CEDS Update for 2010-2013*** – Jay Donovan
5. **Next Meeting – June 27, 2013**
6. **Adjournment**



Northern Middlesex Council of Governments

Greater Lowell Energy Advisory Committee Meeting

A Multi-Disciplinary
Regional Planning
Agency Serving:

June 26, 2014
12:00-2:00 P.M.
NMCOG Conference Room
40 Church Street, Suite 200, Lowell, MA

AGENDA

Billerica
Chelmsford
Dracut
Dunstable
Lowell
Pepperell
Tewksbury
Tyngsborough
Westford

Matthew J. Hanson
Chair

Beverly A. Woods
Executive Director

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1. **Welcome---**Beverly Woods, Executive Director
2. **Siting of Renewable Energy Facilities Study Update** – Jay Donovan, Assistant Director
 - Status of Sections
 - Workshops
 - Final Document
3. **Photovoltaics and LEED Sections** - Danielle Mucciarone, Energy and Environmental Planner
4. **Wind, Geothermal, Hydropower and Biomass Sections** – John Hume and Tom Roufos, MRPC
5. **Manufacturing Lands Inventory and Assessment** – Suzannah Bigolin, Housing and Economic Development Planner
6. **Next Steps-** Jay Donovan
7. **Next Meeting** – August 6, 2014
8. **Adjournment**



Northern Middlesex Council of Governments

Greater Lowell Energy Advisory Committee Meeting

September 25, 2014

12:00-2:00 P.M.

NMCOG Conference Room
40 Church Street, Suite 200, Lowell, MA

A Multi-Disciplinary

Regional Planning

Agency Serving:

Billerica

Chelmsford

Dracut

Dunstable

Lowell

Pepperell

Tewksbury

Tyngsborough

Westford

Matthew J. Hanson
Chair

Beverly A. Woods
Executive Director

40 Church Street
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Lowell, MA
01852-2686

TEL: (978) 454-8021

FAX: (978) 454-8023

www.nmcog.org

AGENDA

1. **Welcome and Approval of Minutes---**Beverly Woods, Executive Director
2. **Siting of Renewable Energy Facilities Study Update** – Jay Donovan, Assistant Director
 - Status of document
 - Final Submission
3. **Draft Siting of Renewable Energy Facilities Study** – Jay Donovan
 - Executive Summary
 - Biomass
 - Geothermal
 - Hydropower
 - Photovoltaic
 - Wind
 - Manufacturing and Labor Force Assessment
 - LEED
 - Final Recommendations
4. **Next Steps: Approval of Document** – Jay Donovan
5. **Future Activities** – Jay Donovan
6. **Next Meeting** – January 2015
7. **Adjournment**

B.2) Montachusett Regional Planning Commission Energy Advisory Committee

(see on following pages)



MONTACHUSETT

REGIONAL PLANNING COMMISSION

R1427 Water Street Fitchburg, Massachusetts 01420
(978) 345-7376 Fax: (978) 348-2490 Email: mrpc@mrpc.org

MONTACHUSETT ENERGY ADVISORY COMMITTEE MEETING SITING OF RENEWABLE ENERGY FACILITIES PLAN

The Montachusett Regional Planning Commission (MRPC) and the Northern Middlesex Council of Governments (NMCOG) were recently awarded \$188,512 in grant funds from the federal Department of Commerce's Economic Development Administration (EDA) to develop a plan for the Siting of Renewable Energy Facilities for the Montachusett Region and the Northern Middlesex Region. Come join us and hear what the project is about and how it could benefit your community!

AGENDA

FRIDAY, OCTOBER 12, 2012

12:30 PM

LUNCH WILL BE PROVIDED!

at

**MONTACHUSETT REGIONAL PLANNING COMMISSION (MRPC) OFFICES
1427R WATER STREET,
FITCHBURG, MA 01420**

- I. Welcome and Introduction
- II. Presentation by MRPC Staff on Scope of Work for New Grant – “Siting of Renewable Energy Facilities”
 - A. Background Information, the Planning Team and the Public Process
 - B. Assessment and Analysis of Wind, Solar, Hydropower, Geothermal, Biomass
 - C. Renewable Energy Manufacturing Lands Inventory and Assessment
- III. Administrative Matters
- IV. Adjournment

RSVP to Linda Parmenter at lparmenter@mrpc.org or (978) 345-7376 x301.

CC: City and Town Clerks: Please post this pursuant to MGL Chapter 30A, Section 11A and ½.



MONTACHUSETT

REGIONAL PLANNING COMMISSION

R1427 Water Street Fitchburg, Massachusetts 01420
(978) 345-7376 Fax: (978) 348-2490 Email: mrpc@mrpc.org

MONTACHUSETT ENERGY ADVISORY COMMITTEE MEETING SITING OF RENEWABLE ENERGY FACILITIES PLAN

The Montachusett Regional Planning Commission (MRPC) and the Northern Middlesex Council of Governments (NMCOG) were awarded grant funds last fall from the federal Department of Commerce's Economic Development Administration (EDA) to develop a plan for the Siting of Renewable Energy Facilities for the Montachusett Region and the Northern Middlesex Region. Come join us for an update of current activities and MRPC Transportation Staff presentation!

AGENDA

FRIDAY, JANUARY 18, 2013

12:30 PM

LUNCH WILL BE PROVIDED!

at

**MONTACHUSETT REGIONAL PLANNING COMMISSION (MRPC) OFFICES
1427R WATER STREET,
FITCHBURG, MA 01420**

- I. Welcome and Introduction
- II. Approval of October 12, 2012 Minutes
- III. Update of Current Activities, Project Timeline, and Lead Responsibilities for MRPC and NMCOG – John Hume, MRPC Planning and Development Director
- IV. Presentation by MRPC Transportation Staff on Renewable Energy Manufacturing Lands Inventory
- V. Administrative Matters
- VI. Adjournment

RSVP to Linda Parmenter at lparmenter@mrpc.org or (978) 345-7376 x301.

CC: City and Town Clerks: Please post this pursuant to MGL Chapter 30A, Section 11A and ½.



MONTACHUSETT

REGIONAL PLANNING COMMISSION

R1427 Water Street Fitchburg, Massachusetts 01420
(978) 345-7376 Fax: (978) 348-2490 Email: mrpc@mrpc.org

MONTACHUSETT ENERGY ADVISORY COMMITTEE MEETING

AGENDA

FRIDAY, FEBRUARY 21ST, 2014

12:30 PM

LIGHT LUNCH WILL BE PROVIDED!

at

MONTACHUSETT REGIONAL PLANNING COMMISSION (MRPC) OFFICES

1427R WATER STREET,

FITCHBURG, MA 01420

- VII. Welcome and Introduction
- VIII. Approval of October 4, 2013 Minutes
- IX. **Hydropower/Biomass.** Brief MRPC staff presentation followed by public discussion/input.
- X. Worcester Polytechnic Institute (WPI) Student Renewable Energy Presentations
 - A. **Implementing Residential Solar Energy in the Montachusett Region.** A team of WPI students will present on promoting economic development in the Montachusett region by enhancing solar adoption. Specific areas in the installation process were evaluated in search of improved methods that could promote a cost savings.
 - B. **Siting Renewable Energy on Brownfields.** WPI students will present a tool created to assist developers with siting renewable energy on brownfields. The siting tool is designed to account for land requirements, available resources, cost, government incentives/programs, permitting and other aspects of brownfield sites considered by developers.
- XI. Administrative Matters
- XII. Adjournment

RSVP to John Hume at jhume@mrpc.org or (978) 345-7376 x302.

CC: City and Town Clerks: Please post this pursuant to MGL Chapter 30A, Section 11A and ½.



MONTACHUSETT

REGIONAL PLANNING COMMISSION

R1427 Water Street Fitchburg, Massachusetts 01420
(978) 345-7376 Fax: (978) 348-2490 Email: mrpc@mrpc.org

MONTACHUSETT ENERGY ADVISORY COMMITTEE MEETING SITING OF RENEWABLE ENERGY FACILITIES PLAN

The Montachusett Regional Planning Commission (MRPC) and the Northern Middlesex Council of Governments (NMCOG) were awarded grant funds last fall from the federal Department of Commerce's Economic Development Administration (EDA) to develop a plan for the Siting of Renewable Energy Facilities for the Montachusett Region and the Northern Middlesex Region. Mount Wachusett Community College and Worcester Polytechnic Institute students will be participating in this project. **Interviews will be held at this meeting with consultants to provide College Student Oversight.**

AGENDA

MONDAY, FEBRUARY 25TH, 2013

1:00 PM

LUNCH WILL BE PROVIDED!

at

MONTACHUSETT REGIONAL PLANNING COMMISSION (MRPC) OFFICES

**1427R WATER STREET,
FITCHBURG, MA 01420**

- I. Welcome and Introduction
- II. Approval of January 18, 2013 Minutes
- III. Interview of Consultant(s) for Siting of Renewable Energy Facilities Plan for College Student Oversight

1:15 p.m. Derren Rosbach
1:45 p.m. Boreal and Alden
2:15 p.m. Energy Advisory Committee Vote to Recommend Hiring to MRPC

IV. Administrative Matters

V. Adjournment

RSVP to Linda Parmenter at lparmenter@mrpc.org or (978) 345-7376 x301.

CC: City and Town Clerks: Please post this pursuant to MGL Chapter 30A, Section 11A and ½.



MONTACHUSETT

REGIONAL PLANNING COMMISSION

R1427 Water Street Fitchburg, Massachusetts 01420
(978) 345-7376 Fax: (978) 348-2490 Email: mrpc@mrpc.org

MONTACHUSETT ENERGY ADVISORY COMMITTEE MEETING

FEATURING A PRESENTATION ON GRANT PROGRAMS BY MASSACHUSETTS EMERGENCY MANAGEMENT AGENCY (MEMA) REPRESENTATIVES

Energy Advisory Committee Members, Police and Fire Departments, Local Officials and anyone else with an interest is invited to meet Representatives of the Massachusetts Emergency Management Agency (MEMA) as they present information about Hazard Mitigation Grant Programs including anything related to generator and /or other back-up power generation sources for critical facilities!

AGENDA

FRIDAY, APRIL 12TH, 2013

12:30 PM

LIGHT LUNCH WILL BE PROVIDED!

at

**MONTACHUSETT REGIONAL PLANNING COMMISSION (MRPC) OFFICES
1427R WATER STREET,
FITCHBURG, MA 01420**

- I. Welcome and Introduction
- II. Approval of January 18, 2013 Minutes AND February 25, 2013 Minutes
- III. Brief Introduction of Consultant hired (Boreal Renewable Energy Development) for Siting of Renewable Energy Facilities Plan for College Student Oversight
- IV. Presentation by Massachusetts Emergency Management Agency (MEMA) representatives Scott Macleod and Sarah White. Presentation will include both MEMA and Federal Emergency Management Agency (FEMA) Grant Programs that are available to communities.
- V. Administrative Matters
- VI. Adjournment

RSVP to Linda Parmenter at lparmenter@mrpc.org or (978) 345-7376 x301.

CC: City and Town Clerks: Please post this pursuant to MGL Chapter 30A, Section 11A and ½.



MONTACHUSETT

REGIONAL PLANNING COMMISSION

R1427 Water Street Fitchburg, Massachusetts 01420
(978) 345-7376 Fax: (978) 348-2490 Email: mrpc@mrpc.org

MONTACHUSETT ENERGY ADVISORY COMMITTEE MEETING

AGENDA

FRIDAY, JULY 19TH, 2013

12:30 PM

LIGHT LUNCH WILL BE PROVIDED!

at

MONTACHUSETT REGIONAL PLANNING COMMISSION (MRPC) OFFICES

1427R WATER STREET,

FITCHBURG, MA 01420

- I. Welcome and Introduction
- II. Approval of April 12, 2013 Minutes
- III. Presentation by MRPC on Wind Energy in the Region. Presentation will include an overview, planning and zoning, and incentives.
- IV. Worcester Polytechnic Institute Faculty Member Professor Michael J. Radzicki, Ph.D. and Boreal Renewable Energy Development present ideas for WPI student activities and the Siting of Renewable Energy Facilities Plan. We need your input so that a final product can assist you!
- V. Administrative Matters
- VI. Adjournment

RSVP to Linda Parmenter at lparmenter@mrpc.org or (978) 345-7376 x301.

CC: City and Town Clerks: Please post this pursuant to MGL Chapter 30A, Section 11A and ½.



MONTACHUSETT
REGIONAL PLANNING COMMISSION
R1427 Water Street Fitchburg, Massachusetts 01420
(978) 345-7376 Fax: (978) 348-2490 Email: mrpc@mrpc.org

MONTACHUSETT ENERGY ADVISORY COMMITTEE MEETING

AGENDA

FRIDAY, AUGUST 8TH, 2014

12:30 PM

at

MONTACHUSETT REGIONAL PLANNING COMMISSION (MRPC) OFFICES

1427R WATER STREET,

FITCHBURG, MA 01420

XIII. Welcome and Introductions

XIV. Siting of Renewable Energy Project

A. Presentation of Final Draft Report.

XV. Administrative Matters

XVI. Adjournment

RSVP to John Hume at jhume@mrpc.org or (978) 345-7376 x302.

CC: City and Town Clerks: Please post this pursuant to MGL Chapter 30A, Section 11A and ½.



MONTACHUSETT
REGIONAL PLANNING COMMISSION
R1427 Water Street Fitchburg, Massachusetts 01420
(978) 345-7376 Fax: (978) 348-2490 Email: mrpc@mrpc.org

MONTACHUSETT ENERGY ADVISORY COMMITTEE MEETING

AGENDA

FRIDAY, OCTOBER 4TH, 2013

12:30 PM

LIGHT LUNCH WILL BE PROVIDED!

at

MONTACHUSETT REGIONAL PLANNING COMMISSION (MRPC) OFFICES
PLEASE NOTE THAT THE MEETING WILL BE HELD AT 840 NORTH MAIN STREET,
LEOMINSTER, MA

- I. Welcome and Introduction
- II. Approval of July 19, 2013 Minutes
- III. Discussion on the potential of Hydropower in the Region. Brief MRPC staff presentation followed by discussion – your input on hydropower is important to the on-going Siting of Renewable Energy Facilities study!
- IV. Worcester Polytechnic Institute (WPI) and Boreal Renewable Energy Development update on WPI student participation and the Siting of Renewable Energy Facilities Plan.
- V. Administrative Matters
- VI. Adjournment

RSVP to Linda Parmenter at lparmenter@mrpc.org or (978) 345-7376 x301.

CC: City and Town Clerks: Please post this pursuant to MGL Chapter 30A, Section 11A and ½.



Solar Energy Siting Workshop

***How can we site solar projects and encourage
economic growth in the region?***



**Tuesday, April 23, 2013
6:00 pm - 7:30 pm**

**Middlesex Community College
Federal Building
50 Kearney Square
Lowell, MA**

Solar Energy Siting Workshop

Middlesex Community College
Federal Building
April 23, 2013
6 – 7:30 P.M.

Agenda

Welcome

Beverly Woods, Executive Director
Northern Middlesex Council of Governments

Project Overview and Introductions

Jay Donovan, Assistant Director
Northern Middlesex Council of Governments

Westford Solar Park

Jim Goldenberg, Co-Founder
Cathartes Investments

Solar Energy Market

John Langton, Vice President
American Capital Energy

Workforce Development Issues

Gail Brown, PMP, Senior Project Manager
Greater Lowell Workforce Investment Board

Questions and Answers

Adjournment



Renewable Energy In Historic Buildings Workshop

***How can we utilize historic buildings to
generate renewable energy?***



United Teen Equality Center, Lowell - Image Courtesy of UTEC

**Monday, November 18, 2013
6:00 pm - 7:30 pm**

**Middlesex Community College
Federal Building
50 Kearney Square
Lowell, MA**

Renewable Energy in Historic Buildings Workshop

Middlesex Community College
Federal Building
November 18, 2013
6 – 7:30 P.M.

Agenda

Welcome

Beverly Woods, Executive Director
Northern Middlesex Council of Governments

Project Overview and Introductions

Jay Donovan, Assistant Director
Northern Middlesex Council of Governments

Lowell's BetterBuildings Program

Tom Heslin, Project Manager
BetterBuildings Lowell - The City of Lowell

Nobis Engineering LEED Project

Ken Koornneef, P.E., Principal
Nobis Engineering

UTEC Platinum LEED Project

Gregg Croteau, Executive Director
United Teen Equality Center (UTEC)

Questions and Answers

Adjournment

Renewable Energy Incentives Workshop

***What energy incentives are available to
businesses in the region?***



Photo Credit: EEA Clean Energy Results Program

**Wednesday, June 11, 2014
6:00 pm - 7:30 pm**

**UMass Lowell Inn and
Conference Center
50 Warren Street
Lowell, MA**

Renewable Energy Incentives Workshop

Agenda

Welcome

Beverly Woods, Executive Director
Northern Middlesex Council of Governments

Project Overview and Introductions

Jay Donovan, Assistant Director
Northern Middlesex Council of Governments

Renewable Energy Financing and Economics

Sean Robertson, Director
Bostonia Partners

MassDevelopment Lending Programs

Rebecca Sullivan, Senior Vice President of Institutional Finance
Massachusetts Development Finance Agency

Renewable Heating and Cooling Alternatives

Bram Claeys, Deputy Director, Renewables Division
Massachusetts Department of Energy Resources (DOER)

Combined Heat and Power (CHP) Incentives

Dinesh Patel, Principal Engineer
National Grid

Thermal Heat Recovery Solutions and Sustainable Gas Efficiency Measures

David Gaudet, Senior Energy Engineer
National Grid

Questions and Answers

Adjournment

B.4) MRPC Workshop Notices

The Montachusett Regional Planning Commission and the Northern Middlesex Council of Governments



A Wind Energy Siting Workshop

Make the world a little greener!

Registration: **Free!**

Includes Light Supper

Tuesday, February 12, 2013

6:00 pm to 8:00 p.m.

840 North Main Street (MART) Leominster, MA

Mount Wachusett Community College

Workshop Topics:

*Collaboration and Public Engagement in Wind Energy Siting – Presentation by
Stacie Smith , Consensus Building Institute*

Wind Energy Bylaw Process – Presentation by Stephen Wallace, Westminster Town Planner

Energy Issues Legislative Update – Presentation by Representative Stephen DiNatale

Open to all who are interested!

Funding provided by:



*Regional Renewable
Energy Facility Siting
Plan*



*Please rsvp to the **Montachusett
Regional Planning Commission***

mrpc@mrpc.org or

(978)345-7376 ext. 301



The Montachusett Regional Planning Commission
and
the Northern Middlesex Council of Governments
Present a



Hydropower Workshop



When: Thursday, November 7th, 2013 at 1:30 PM

Where: Pepperell Town Hall, One Main Street, Conference Room A, Pepperell, MA

Welcome, Introductions, and Legislative Update

- 1:30** Welcome to Pepperell on behalf of the Town and the Northern Middlesex Council of Governments - *Pepperell Town Administrator John Moak*
- 1:35** Workshop Opening and Introductions - *MRPC Chairman Victor Koivumaki*
- 1:40** Legislative Update on Energy Issues – *State Representative Stephen DiNatale*
- 1:50** Open to questions and discussion

Overview of Hydro-Power and the Pepperell Hydro Company

- 2:00** Hydroelectric Power Generation Overview- *Celeste Fay, Project Engineer, Alden Research Laboratory, Inc.*
- 2:15** Overview of Pepperell Hydroelectric Plant- *Davis Hobbs. Principal Pepperell Hydro, LLC*
- 2:30** Open to questions and discussion

Tour of the Pepperell Hydro Company

- 2:45** [Adjourn to Pepperell Hydro Company.](#) This event will include a tour of Pepperell Hydro. Although steel toes will not be required, please remember to wear closed-toe shoes with good bottom grip. In addition, dress properly for outdoor weather and possibly inclement conditions, as some of the tour will be conducted outside.
- 3:00** [Begin Tour of Pepperel Hydro Company](#) lead by Celeste Fay.
- 3:45** Worskhop Adjournment- *MRPC Executive Director Glenn Eaton*

Please RSVP to jhume@mrpc.org by noon Tuesday, November 5, 2013.



**Funding provided to the Montachusett Regional Planning Commission and the Northern Middlesex Council of Governments through grant funds from the U.S. Department of Commerce, Federal Economic Development Administration.*

The Montachusett Regional Planning Commission (MRPC) and the
Northern Middlesex Council of Governments (NMCOG) present

New Construction and Renewable Energy



Registration: Free!
Includes Light Supper

Thursday, April 10, 2014
6:00 to 8:00 pm
Vicksburg Square
Conference Room,
33 Andrews Parkway,
Devens, MA

Workshop Topics:

- *Net Zero Energy Housing – Presentation by Carter Scott, Transformations, Inc.*
- *Roof Mounted Solar – Presentation by Jonathan Abe, Blacksmith Solar*
- *Design, Engineering, and Implementation of Renewable Energy for New Construction, Steven J. Strong, President, Solar Design Associates, LLC, Harvard, MA*

Open to all who are interested!

Funding provided by:

EDA
U.S. ECONOMIC DEVELOPMENT ADMINISTRATION

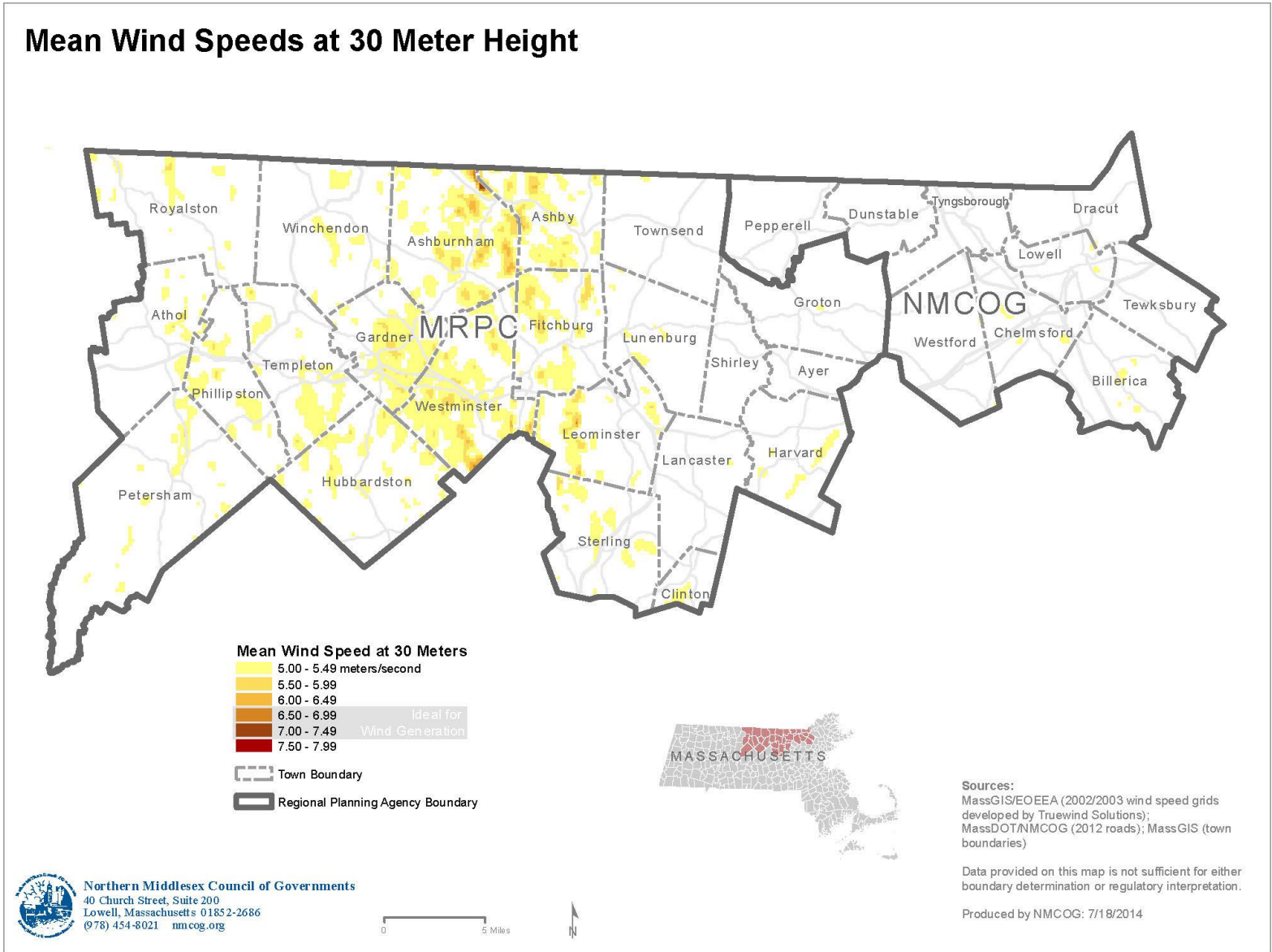
*Regional Renewable
Energy Facility
Siting Plan*



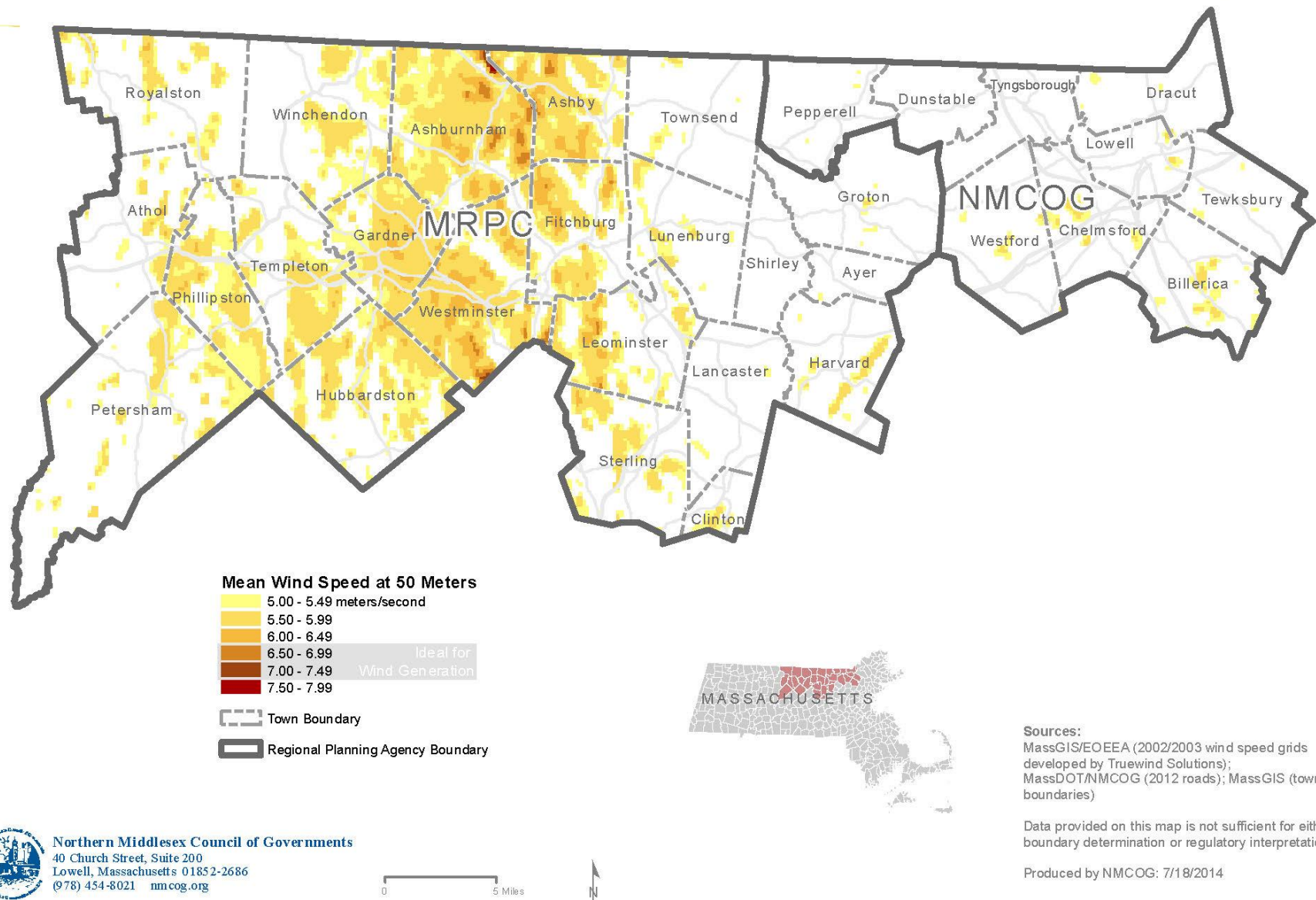
Please rsvp to the Montachusett
Regional Planning Commission
mrpc@mrpc.org or
(978)345-7376 ext. 301
by **April 7** Seating is limited.

C. Wind Energy

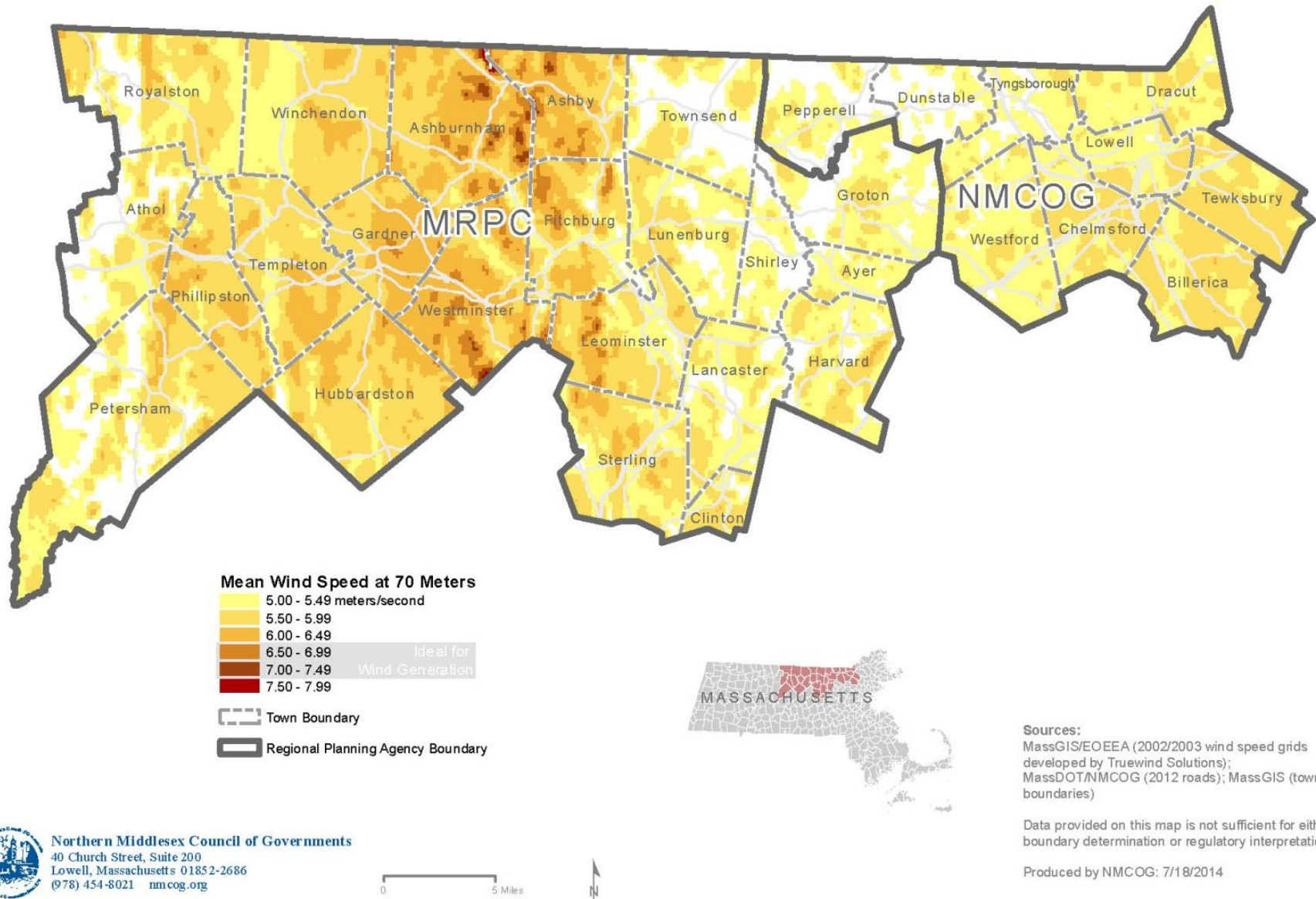
C.1) Wind Energy Maps



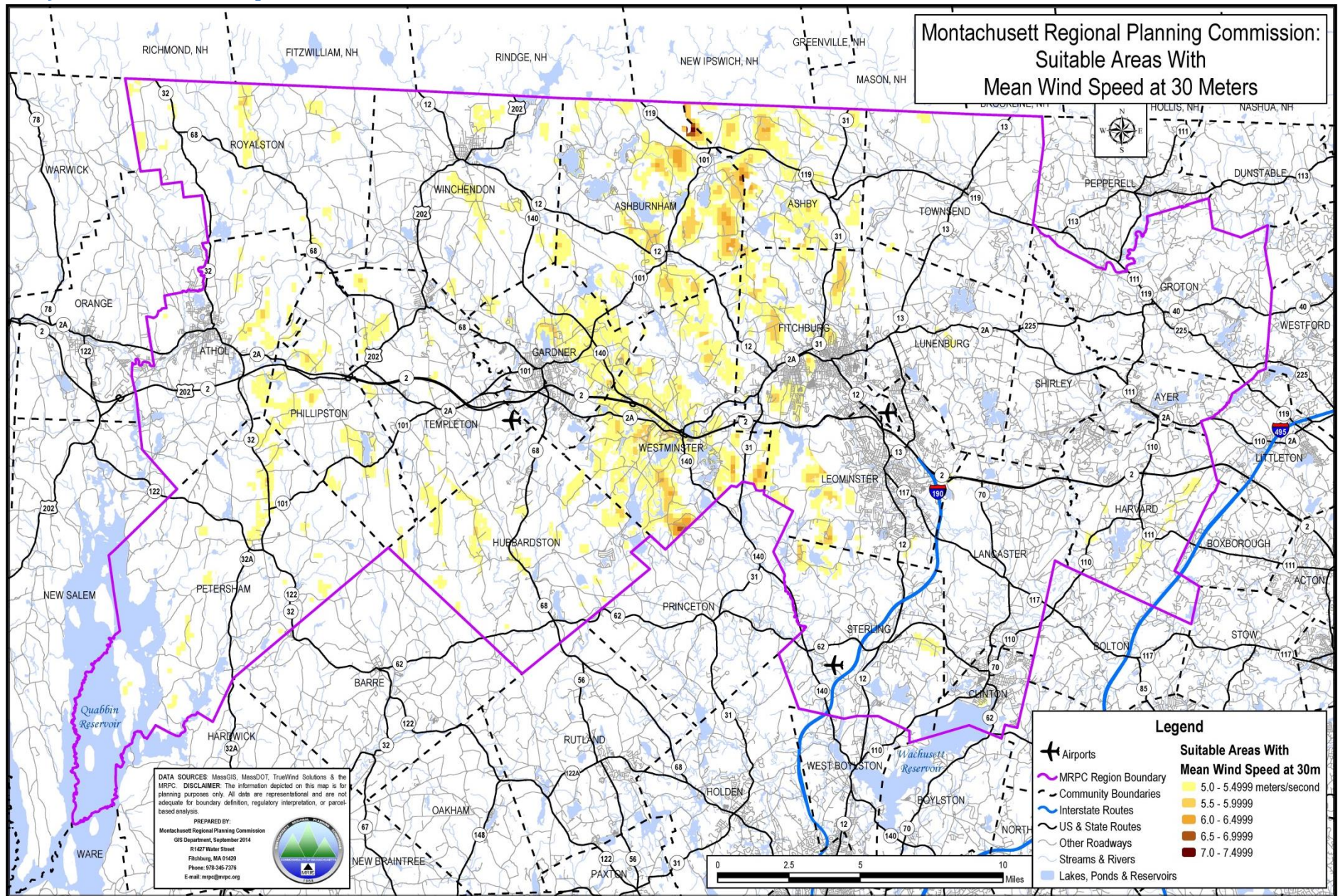
Mean Wind Speeds at 50 Meter Height

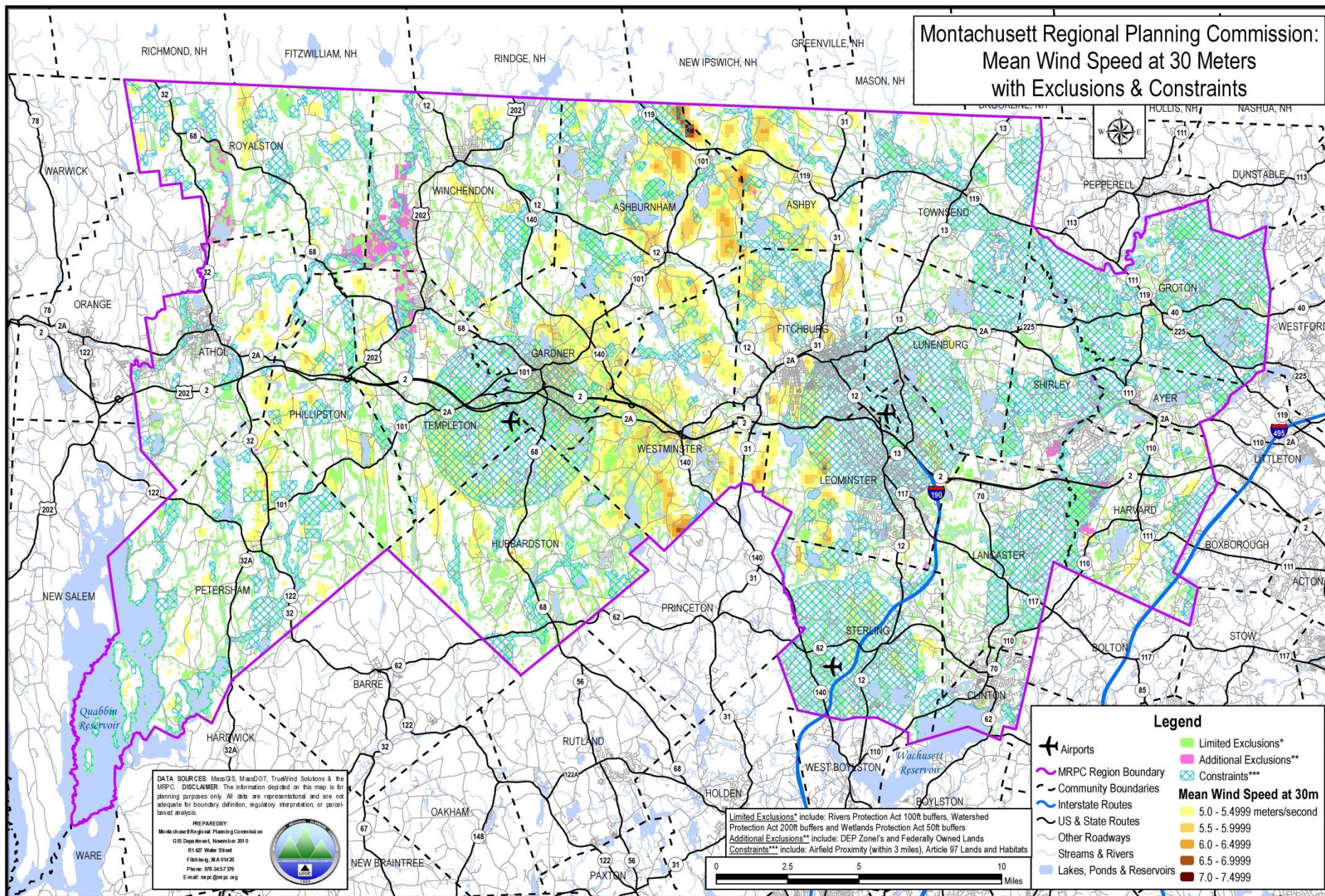


Mean Wind Speeds at 70 Meter Height

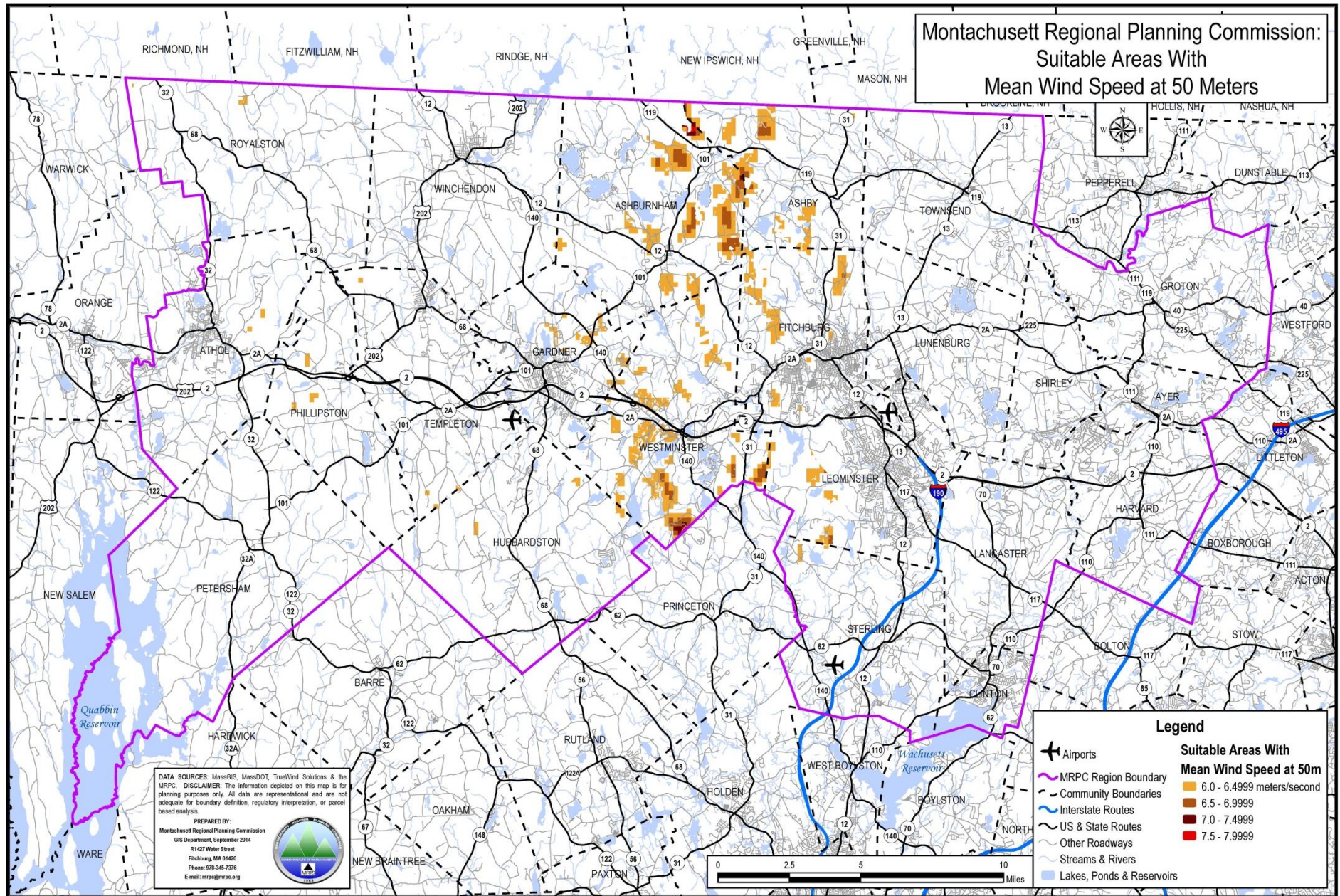


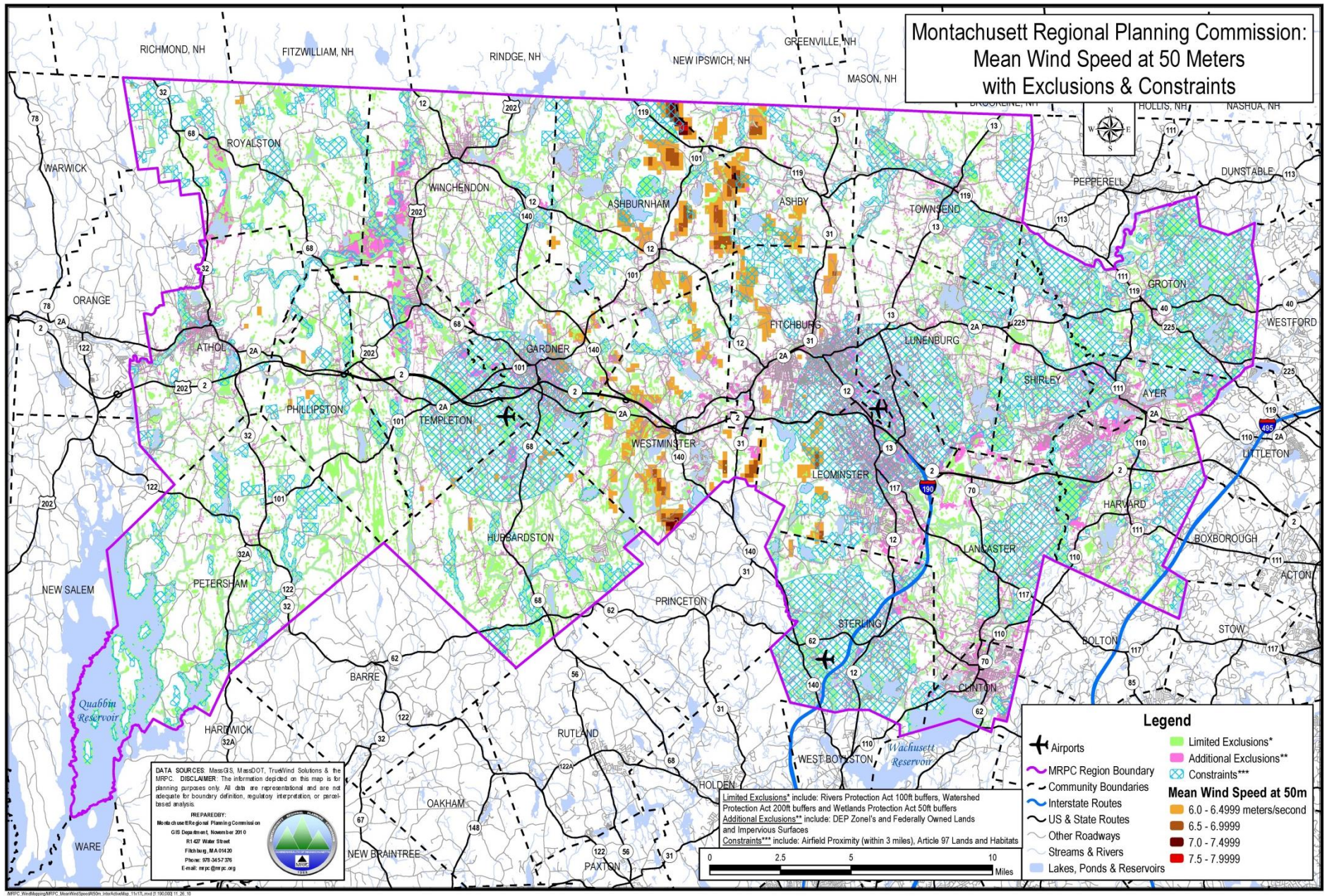
C.1.a) MRPC 30m Wind Maps



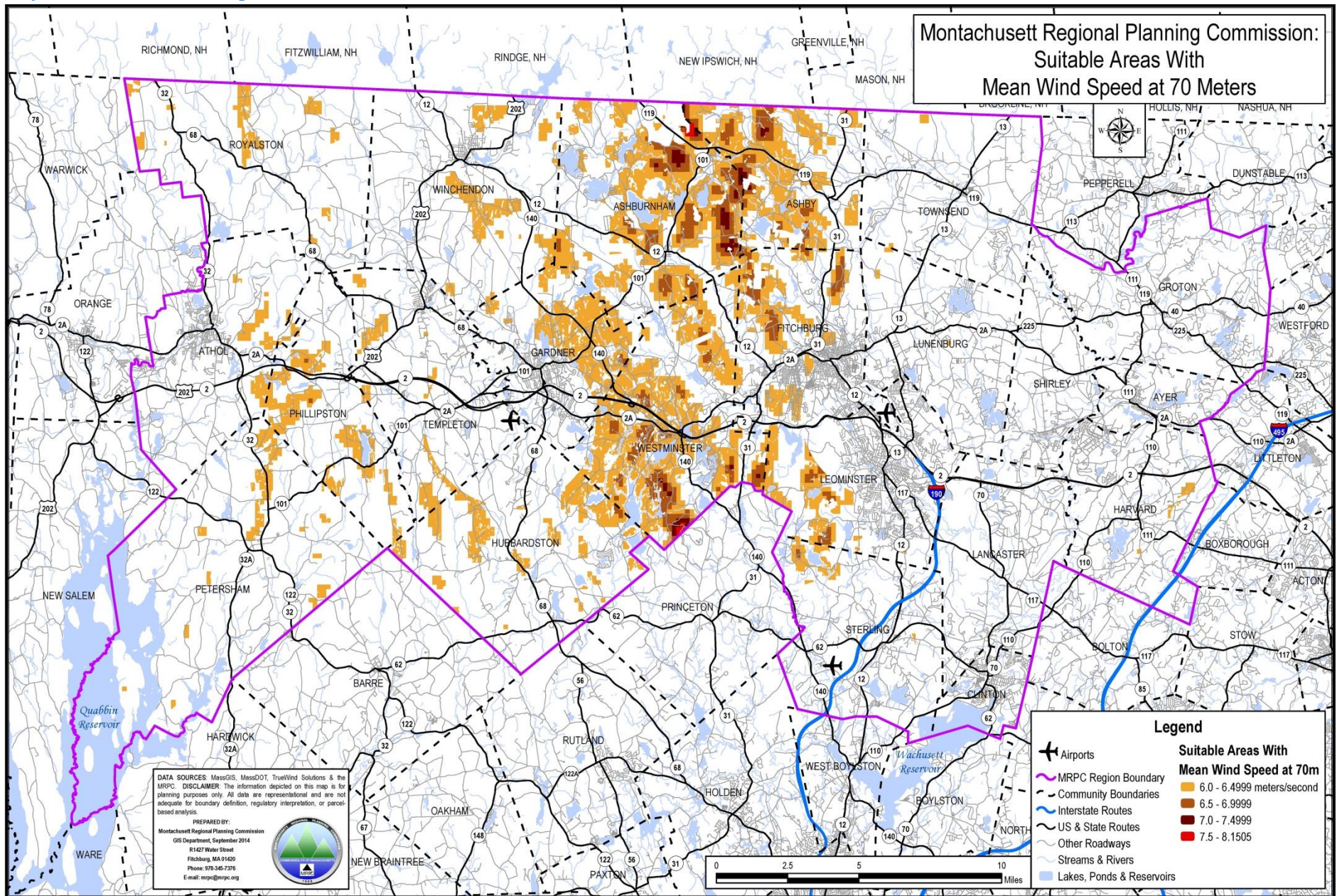


C.1.b) MRPC 50m Wind Maps

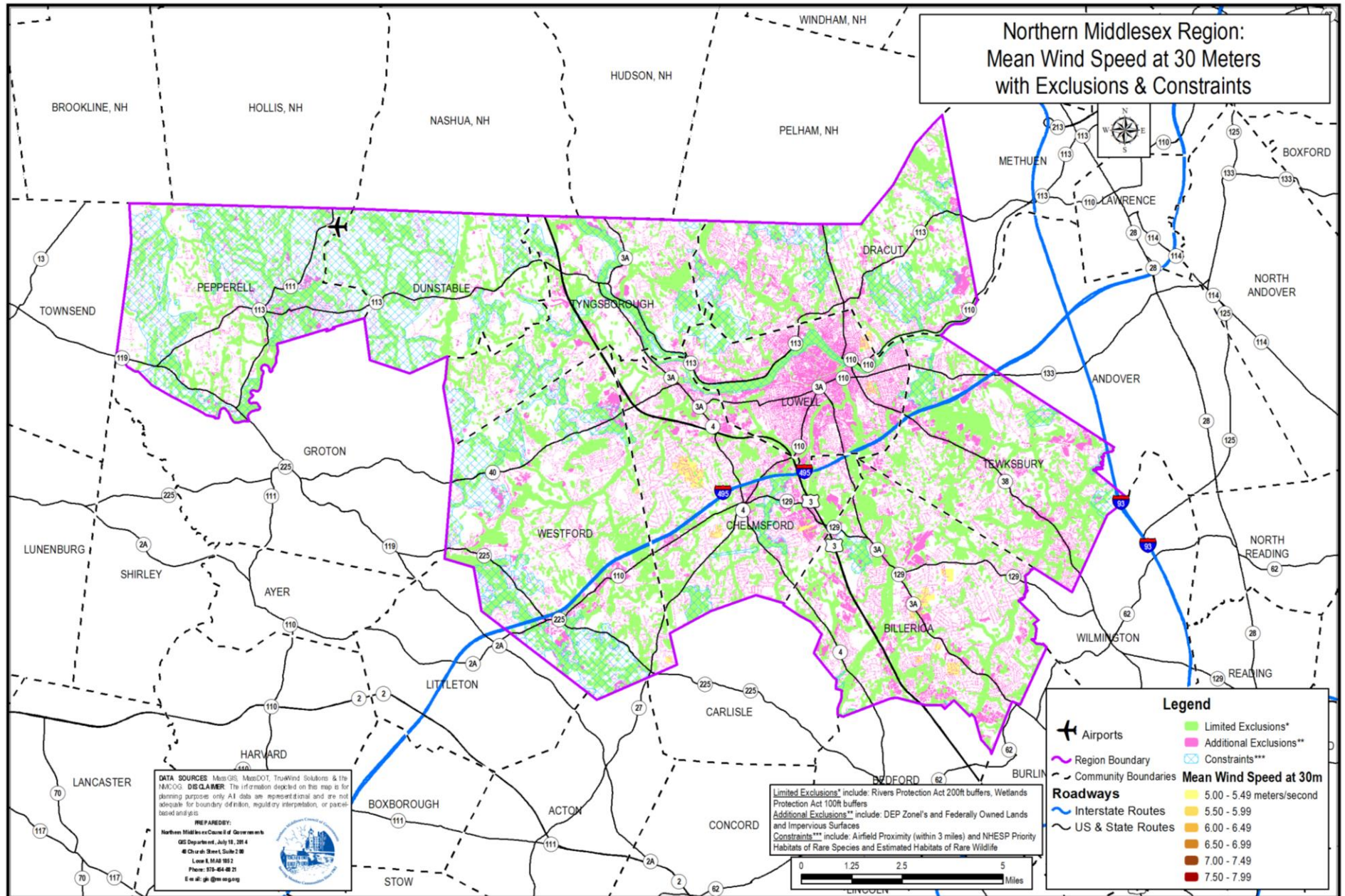




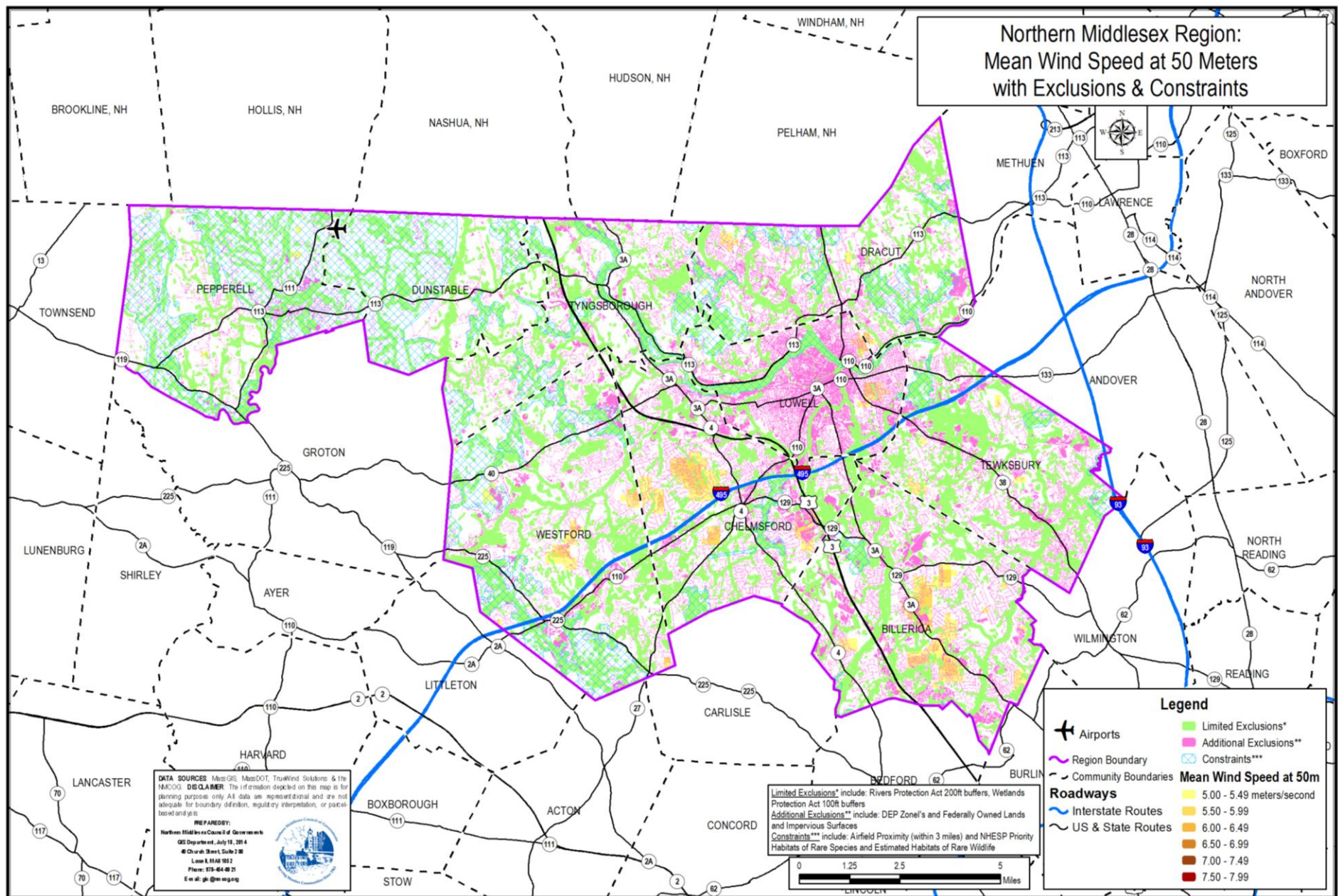
C.1.c) MRPC 70m Wind Maps



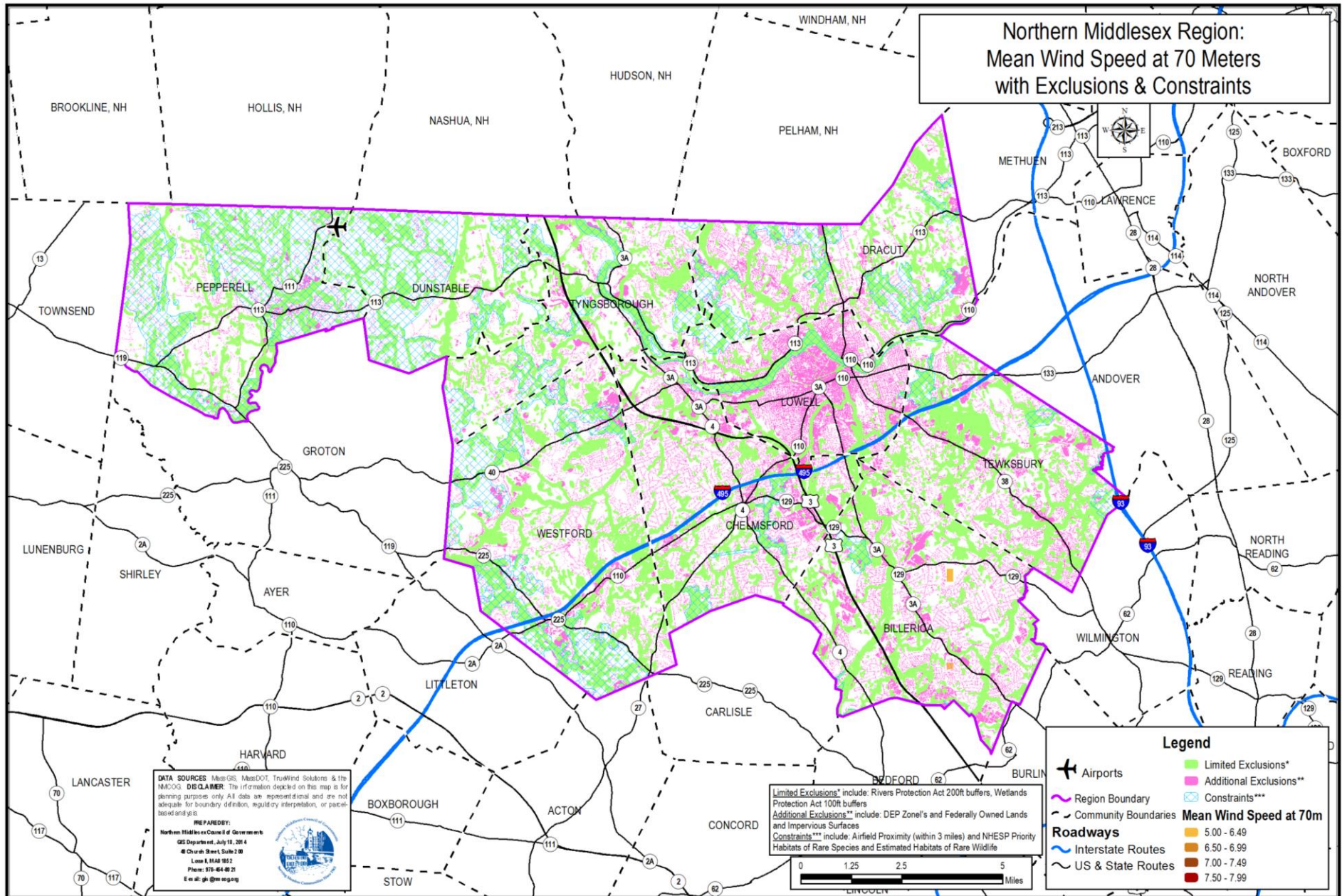
C.1.d) NMC0G 30m Wind Map



C.1.e) NMCOG 50m Wind Map

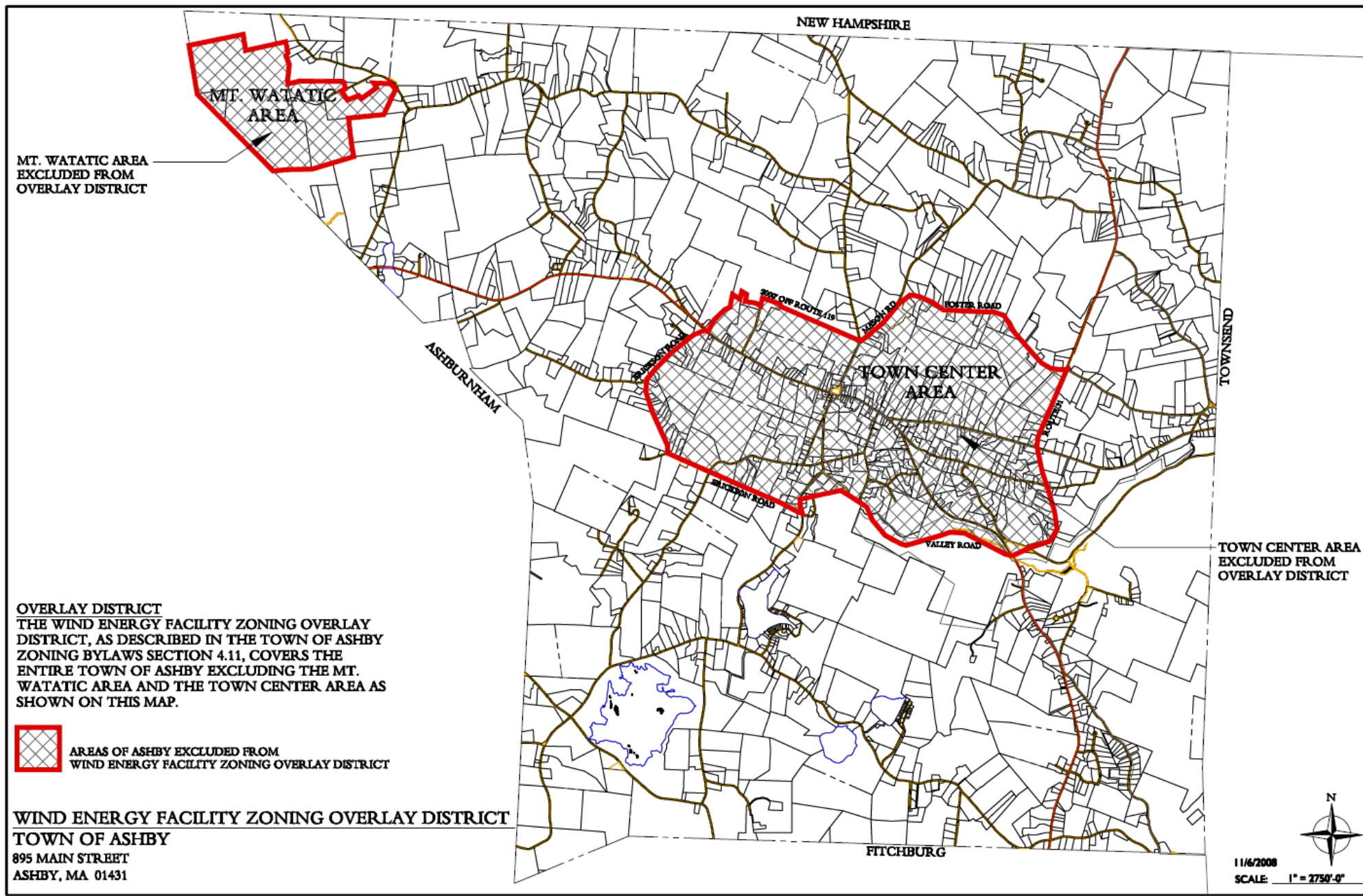


C.1.f) NMCOG 70m Wind Map



C.2) Ashby Wind Energy Facility Zoning Overlay District

<http://www.ci.ashby.ma.us/document/planbd/Wind%20Energy%20Facility%20Zoning%20Overlay%20District%20Map.pdf>



C.3) Sample Bylaw: Townsend

§ 145-87. Wind Energy Systems

A. Purpose. The purpose of this bylaw is to minimize the impacts of wind turbines on the character of neighborhoods, property values, scenic, historic, and environmental resources of the Town and to protect health and safety while allowing wind energy.

(1) Applicability

This section applies to all utility-scale, on-site wind facilities, and Small Wind Energy Systems, proposed to be constructed after the effective date of this section. This section also includes building integrated wind systems, and physical modifications to existing wind facilities that materially alter the type, configuration, location or size of such facilities or other equipment.

B. Definitions.

Utility-Scale Wind Facility: A commercial wind facility, where the primary use of the facility is electrical generation to be sold to the wholesale electricity markets.

On-Site Wind Facility: A wind project, which is located at a commercial, industrial, agricultural, institutional, or public facility that will generate electricity on-site.

Small Wind Energy System (SWES): All equipment, machinery and structures utilized in connection with the conversion of kinetic energy of wind into electrical power including storage, electrical collection and supply equipment, transformers, service and access roads, and one or more wind turbines, which will have a height not to exceed 80 feet.

Large Wind Energy System (LWES): All equipment, machinery and structures utilized in connection with the conversion of kinetic energy of wind into electrical power including storage, electrical collection and supply equipment, transformers, service and access roads, and one or more wind turbines, which will have a height greater than 80 feet.

Height/Maximum Tip Height: The height of a wind turbine measured from natural grade to the tip of the rotor blade at its highest point, or blade-tip height.

Rated Nameplate Capacity: The maximum rated output of electric power production equipment. This output is typically specified by the manufacturer with a nameplate on the equipment.

Special Permit Granting Authority (SPGA): The Special Permit Granting Authority shall be the Planning Board for the issuance of special permits to construct and operate wind facilities.

Substantial Evidence: Such evidence as a reasonable mind might accept as adequate to support a conclusion.

Wind Energy Facility: All of the equipment, machinery and structures together utilized to convert wind to electricity including developer-owned electrical equipment, storage, collection and supply equipment, service and access roads, and one or more wind turbines.

Wind Monitoring or Meteorological Tower: A temporary tower equipped with devices to measure wind speeds and direction, used to determine how much wind power a site can be expected to generate.

Wind turbine: A device that converts kinetic wind energy into rotational energy that drives an electrical generator. A wind turbine typically consists of a tower, nacelle body, and a rotor with two or more blades.

Building Permit: A Building Permit is a required approval of a project by the Building Commissioner which is consistent with the local, state and federal building codes. In addition, the permit must meet the criteria set forth under the local zoning bylaws regarding Small Wind Energy Systems.

Agriculture: “Farming” or “agriculture” shall include farming in all of its branches and the cultivation and tillage of the soil, dairying, the production, cultivation, growing and harvesting of any agricultural, aqua cultural, floricultural or horticultural commodities, the growing and harvesting of forest products upon forest land, the raising of livestock including horses, the keeping of horses as a commercial enterprise, the keeping and raising of poultry, swine, cattle and other domesticated animals used for food purposes, bees, fur-bearing animals, and any forestry or lumbering operations, performed by a farmer, who is hereby defined as one engaged in agriculture or farming as herein defined, or on a farm as an incident to or in conjunction with such farming operations, including preparations for market, delivery to storage or to market or to carriers for transportation to market.

C. General Requirements for all Wind Energy Facilities

(1) Exemptions

Wind turbines constructed, reconstructed, or renovated for the primary purpose of commercial agriculture shall be considered a structure pursuant to MGL, c. 40A, §3 and, therefore, shall be exempt from this by-law.

(2) Compliance with Laws, Ordinances and Regulations

The construction and operation of all such proposed wind energy facilities shall be consistent with all applicable local, state and federal requirements, including but not limited to all applicable safety, construction, environmental, electrical, communications and aviation requirements.

(3) Fees.

(a) The Planning Board will normally require fees to cover the costs of outside consultants, to be deposited in advance with the Town, in accordance with the provisions of MGL c. 44, § 53G. Such fees will be deposited in a separate account, and any amounts remaining in said account after the completion of the associated project will be refunded to the applicant or successor, in accordance with these rules and said state law. When the expense of such consultants exceeds the currently available funds in the 53G account, the applicant is required to provide such additional and appropriate funds within 14 days of notification by the Board of the required amount. Additional fee requirements as outlined in §175-26 of the Planning Board Rules and Regulations may apply.

(b) The application for a Building Permit for a Small Wind Energy System must be accompanied by the fee required for a Building Permit for a Permitted Accessory Use.

(4) Proof of Liability Insurance

The applicant shall be required to provide evidence of liability insurance in an amount, and for a duration, sufficient to cover loss or damage to persons and property occasioned by the failure of the facility. Insurance in a reasonable amount determined and approved by the owner’s insurance company shall be in force prior to construction. Annual proof of said insurance shall be filed with the Town Clerk.

(5) Site Control

At the time of application for a Special or Building Permit, the applicant shall submit documentation of actual or prospective control of the project site sufficient to allow for installation and use of the proposed facility. Documentation shall also include proof of control over setback areas and access roads, if required. Control shall mean the legal authority to prevent the use or construction of any structure for human habitation, or inconsistent or interfering use, within the setback areas.

(6) Utility Notification

No site plan for the installation of a wind energy facility shall be approved until evidence has been given that the electric utility company that operates the electrical grid where the facility is to be located has been informed of the customer's intent to install an interconnected customer-owned generator, and copies of site plans showing the proposed location have been submitted to the utility for review. No installation of a wind energy facility should commence and no interconnection shall take place until an Interconnection Agreement pursuant to applicable tariff and consistent with the requirements for other generation has been executed with the utility. Off-grid systems shall be exempt from this requirement, unless they are proposed to be located within setback distance from the sideline of an existing utility Right of Way (ROW).

D. Small Wind Energy System Requirements

(1) Building Permit

No Small Wind Energy System (SWES) shall be erected, constructed, installed or modified as provided in this section without first obtaining a Building Permit. All such wind energy systems shall be constructed and operated in a manner that, where economically feasible, will minimize adverse visual, safety and environmental impacts. The construction of a small wind facility shall be permitted in any zoning district, except a designated Historic District, subject to the issuance of a Permit and provided that the use complies with all requirements set forth in sections F, G and H set forth herein.

(2) Application Process & Requirements

The Building Permit application shall be accompanied by deliverables including the following:

(a) A plot plan showing:

- i.** Property lines and physical dimensions of the subject property within 500 feet of the wind turbine from the proposed tower location;
- ii.** Location, dimensions, and types of existing major structures on the property;
- iii.** Location of the proposed wind system tower, foundations, guy anchors and associated equipment;
- iv.** The right-of-way of any public road that is contiguous with the property;
- v.** Location of all existing above ground or overhead gas or electric infrastructure, including Critical Electric Infrastructure, and utility rights of way (ROW) and easements, whether fully cleared of vegetation or only partially cleared, within 500 feet of the site parcel;
- vi.** Location and approximate height of tree cover;

vii. Wetland resource areas within 100 feet of the proposed area;

viii. Rivers, streams or brooks within 200 feet of the proposed area.

(b) Wind system specifications, including manufacturer and model, rotor diameter, tower height, tower type (freestanding or guyed).

(c) One or three line electrical diagram detailing wind turbine, associated components, and electrical interconnection methods, with all NEC compliant disconnects and overcurrent devices.

(d) Name, address, phone number and signature of the applicant, as well as all co- applicants or property owners, if any.

(e) The name, contact information and signature of any agents representing the applicant.

(f) A plan for maintenance of the small wind energy facility.

E. Large Wind Energy System (LWES) Requirements

(1) Special Permit

No large wind turbine or tower may be erected, constructed, installed or modified without first obtaining a Special Permit from the Special Permit Granting Authority (SPGA). The SPGA under this bylaw shall be the Planning Board. A LWES may be permitted in any zoning district, provided that the use is maintained and complies with all requirements set forth herein and any conditions ascribed to any specific project. No Special Permit shall be granted unless the SPGA determines that all such wind energy systems shall be constructed and operated in a manner that minimizes adverse visual, safety, and environmental impacts.

(2) General

All plans and maps shall be prepared, stamped and signed by a professional engineer licensed to practice in Massachusetts.

(3) Waivers

(a) The Planning Board may waive strict adherence to sections of this bylaw if it finds that the safety and well-being of the public will not be adversely affected by such a waiver. For each waiver granted, the Planning Board will make a written record indicating that the proposed tower meets the purpose of this bylaw.

(b) All requests for waivers shall be made in writing on a separate sheet (or sheets) of paper and be attached to the Site Plan Review Special Permit Application and be presented at the time of the initial application.

(c) Requests for waivers shall indicate the section number and the reason the applicant needs the waiver along with any documentation to support the request.

(d) The Planning Board will grant requests for waivers only upon a four-fifths majority vote. Each request shall be voted on separately. The applicant shall have the right to withdraw the request at

any time prior to the actual vote. Once a request for a waiver is withdrawn it may not be presented again for a period of one year.

(e) Requests for more than three waivers, including, in the case of an amendment or renewal, any waivers previously granted for the existing or any predecessor permits, will indicate to the Planning Board the following:

- i. The site is inadequate for the proposed use, or
- ii. The site plan is incomplete.

(4) Application Requirements. A Site Plan Review Special Permit Application and plans shall be filed under the provision set forth in Zoning Bylaw Section 145-65 C. Plans shall have the following minimum requirements:

- (a) Site boundaries and access road;
- (b) Tower location, including guy wires, if any, tower height and blade length;
- (c) Setbacks from property boundaries;
- (d) Buildings within 500 feet of the proposed tower;
- (e) Abutters;
- (f) View lines from the middle of each abutter's property line, including a view from each street shown, beginning at true North and continuing clockwise;
- (g) Topography;
- (h) Fencing and landscaping;
- (i) Areas to be cleared of vegetation and trees;
- (j) Historic sites;
- (k) Wetland resource areas within 100 feet of the proposed area;
- (l) Rivers, streams or brooks within 200 feet of the proposed area;
- (m) Habitats for endangered species;
- (n) A locus map showing lot dimensions and all abutting street locations;
- (o) Name, address, phone number and signature of the applicant, as well as all co- applicants or property owners, if any;
- (p) The name, contact information and signature of any agents representing the applicant; and
- (q) A maintenance plan for the wind energy facility.

(r) Reports shall:

- i.** Describe the wind turbine, tower and the technical, economic and practical reasons for the tower design, and the need for the tower at the proposed location.
- ii.** The applicant shall demonstrate to the satisfaction of the Planning Board that the location of the wind turbine and tower is adequate and that the size and height is the minimum necessary for the purpose.
- iii.** Other feasible sites, including existing sites, if any
- iv.** Demonstrate that the wind turbine and tower complies with these regulations and all applicable standards of the federal and state governments.
- v.** Provide the specifications of the wind turbine and tower.

(5) Notification

Permits for Large Wind Energy Systems (LWES) shall be granted in accordance with the procedure for notice hearings, decisions and appeals set forth in Townsend Zoning Bylaw § 145-65 and MGL c. 40A, §§ 9 and 11. All additional abutters within one half mile are also to be notified of the hearings.

(6) Decision

Decisions may be issued in accordance with §145-65.

(7) Lapse

Permits granted hereunder shall lapse within one year if substantial progress has not been made unless satisfactory reasons have been proven to the SPGA.

(8) Modifications

A substantial modification to approved plans will apply if:

- (a)** The applicant requests the terms of the Special Permit be altered, or,
- (b)** The applicant requests adding equipment, alters the height or location and /or exterior appearance of the original design, or
- (c)** SPGA initiates modification if good cause is shown.

Modifications shall be granted in accordance with the procedure for notice hearings, decisions and appeals set forth in Townsend Zoning Bylaw § 145-65, and MGL c. 40A, §§ 9 and 11.

(9) Renewals

Existing Special Permits under this bylaw shall not require re-submission unless there has been a substantive change in the information or conditions reviewed for the existing Special Permits, and provided further that a complete application for renewal of the permit is submitted prior to the expiration of the existing permit.

(10) Term of Special Permit

A Special Permit issued for a wind facility shall be valid 20 years, unless extended or renewed. The time period may be extended or the permit renewed by the SPGA upon satisfactory operation of the facility. Request for renewal must be submitted at least 180 days prior to expiration of the Special Permit. Submitting a renewal request shall allow for continued operation of the facility until the SPGA

acts. At the end of that period (including extensions and renewals), the wind facility shall be removed as required by this section.

F. Design Standards

(1) Appearance, Color and Finish

Color and appearance shall comply with Federal Aviation Administration (FAA) safety requirements. Colors and surface treatment of the installation shall minimize visual disruption, for example, by painting non-reflective muted colors darker against land, lighter colors against sky, without graphics or other decoration. However, visible, reflective, colored objects, such as flags, reflectors, or tape shall be placed on the anchor points of guy wires and along the guy wires up to a height of 10 feet from the ground.

(2) Lighting

Wind turbines shall be lighted only if required by the FAA. Lighting of other parts of the wind energy facility, such as appurtenant structures, shall be limited to that required for safety and operational purposes, and shall be reasonably shielded from abutting properties. Except as required by the FAA, lighting of the wind energy facility shall be directed downward and shall incorporate full cut-off fixtures to reduce light pollution.

(3) Signage

Signs on wind energy facilities shall comply with the Town's sign by-law. The following signs shall be required:

- (a) Those necessary to identify the owner, provide a 24-hour emergency contact phone number, and warn of any danger;
- (b) Educational signs providing information about the facility and the benefits of renewable energy.

Wind turbines shall not be used for displaying any advertising except for reasonable identification of the manufacturer or operator of the wind energy facility.

(4) Utility Connections

Reasonable efforts, as determined by the SPGA, shall be made to place all developer-owned utility connections from the wind energy facility underground, depending on appropriate soil conditions, shape, and topography of the site and any requirements of the utility provider. Utility owned electrical equipment required for utility interconnections may be above ground, if required by the utility provider.

(5) Appurtenant Structures

All appurtenant structures to wind energy facilities shall be subject to applicable regulations concerning the bulk and height of structures, lot area, setbacks, open space, parking and building coverage requirements. All such appurtenant structures, including but not limited to, equipment shelters, storage facilities, transformers, and substations, shall be architecturally compatible with each other and contained within the turbine tower whenever technically and economically feasible. Whenever reasonable, structures shall be shaded from view by vegetation and/or located in an underground vault and joined or clustered to avoid adverse visual impacts.

(6) Height

(a) For a Large Wind Energy System (LWES) the maximum height shall be determined by the Planning Board and/or according to manufacturer recommendation, not to exceed FAA Regulations.

G. Safety and Environmental Standards

(1) Emergency Services

The applicant shall provide a copy of the project summary, electrical schematic, and site plan to the police and fire departments, and/or the local emergency services entity designated by the local government, as well as the local electrical utility company. Upon request the applicant shall cooperate with local emergency services in developing an emergency response plan. All means of disconnecting the wind energy facility shall be clearly marked. The applicant or facility owner shall identify a responsible person for public inquiries or complaints throughout the life of the project.

(2) Unauthorized Access

Wind energy facilities shall be designed to prevent unauthorized access. For instance, the towers of wind turbines shall be designed and installed so that step bolts or other climbing features are not readily accessible to the public and are not installed below the level of 8 feet above the ground. Electrical equipment shall be locked where possible.

(3) Setbacks

(a) A SWES and LWES may not be sited within:

1. A distance equal to one and one-half (1.5) times the maximum tip height (MTH) of the wind turbine from buildings, critical infrastructure—including Critical Electric Infrastructure and above-ground natural gas distribution infrastructure—or private or public ways that are not part of the wind energy facility;

2. A distance equal to three (3.0) times the maximum tip height (MTH) of the turbine from the nearest existing residential or commercial structure; or

3. A distance equal to one and one-half (1.5) times the maximum tip height (MTH) of the turbine from the nearest property line, and private or public way.

(b) The Permit Granting Authority may increase setbacks to satisfy the intent of the bylaw herein, and require appropriate setbacks to help mitigate potential impacts.

(4) Shadow/Flicker

Wind energy facilities shall be sited in a manner that minimizes shadowing or flicker impacts. The applicant has the burden of proving that this effect will not have adverse impact on neighboring or adjacent uses.

(5) Sound

The wind facility and associated equipment shall conform with the provisions of the Department of Environmental Protection's Division of Air Quality Noise Regulations (310 CMR 7.10), unless the Department and the Permit Granting Authority agree that those provisions shall not be applicable. A source of sound will be considered to be violating these regulations if the source:

(a) Increases the broadband sound level by more than 10 dB(A) above ambient, or

(b) Produces a pure tone condition when an octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.

These criteria are measured both at the property line and at the nearest inhabited structure. Ambient is defined as the background A-weighted sound level that is exceeded 90% of the time measured during operating hours. The ambient may also be established by other means with consent from DEP. An analysis prepared by a qualified engineer shall be presented to demonstrate compliance with these noise standards, if required by the Permit Granting Authority.

The Permit Granting Authority, in consultation with the DEP, shall determine whether such violations shall be measured at the property line or at the nearest inhabited residence.

(6) Land Clearing, Soil Erosion and Habitat Impacts

Clearing of natural vegetation shall be limited to that which is necessary for the construction, operation and maintenance of the wind energy facility or otherwise prescribed by applicable laws, regulations, and bylaws, and subject to existing easements, restrictions and conditions of record.

H. Monitoring and Maintenance

(1) Wind Energy Facility Conditions

(a) The applicant shall maintain the wind energy facility in good condition. Maintenance shall include, but not be limited to, painting, structural repairs, emergency braking (stopping) and integrity of security measures. Site access shall be maintained to a level acceptable to the local Fire Chief and Emergency Medical Services. The project owner shall be responsible to maintain any access road(s), unless accepted as a public way, and the cost of maintaining the wind energy facility to the level and standard of this bylaw as well as remain in compliance with all applicable conditions.

(b) If a LWES or SWES is designated a safety hazard by the Zoning Enforcement Officer, the owner shall correct the hazard or remove the WES within ninety (90) days.

I. Abandonment or Decommissioning

(1) Removal Requirements

Any wind energy facility which has reached the end of its useful life or has been abandoned shall be removed. The owner/operator shall physically remove the facility no more than 150 days after the date of discontinued operations. The applicant shall notify the SPGA by certified mail of the proposed date of discontinued operations and plans for removal. Decommissioning shall consist of:

(a) Physical removal of all wind turbines, structures, equipment, security barriers and transmission lines from the site;

(b) Disposal of all solid and hazardous waste in accordance with local, state, and federal waste disposal regulations;

(c) Stabilization or re-vegetation of the site as necessary to minimize erosion. The SPGA may allow the owner to leave landscaping or designated below-grade foundations in order to minimize erosion and disruption to vegetation.

(2) Abandonment

Absent notice of a proposed date of decommissioning or written note of extenuating circumstances, the wind energy facility shall be considered abandoned when the facility fails to operate for more than two years without the written consent of the SPGA. If the applicant fails to remove the facility in accordance with the requirements of this section within 150 days of abandonment or the proposed date of decommissioning, the town may enter the property and physically remove the facility at the owner's expense.

(3) Financial Surety

(a) Surety for Removal

Applicants for utility-scale large wind energy facilities shall provide a form of surety, either through escrow account, bond or otherwise, to cover the cost of removal or failure to maintain, in the event the town must maintain or remove the facility and remediate the landscape, in an amount and form determined to be reasonable by the SPGA, but in no event to exceed more than 125 percent of the cost of removal and compliance with the additional requirements set forth herein, or as determined by a peer review engineer. Such surety will not be required for municipally or state-owned facilities. The applicant shall submit a fully inclusive estimate of the costs associated with removal, prepared by a qualified engineer. The amount shall include a mechanism for calculating increased removal costs due to inflation.

(b) Surety for Maintenance

An initial bond shall be posted for a LWES unless they are used solely for commercial agricultural use pursuant to MGL, c. 40A, §3. Such bond shall cover maintenance and construction costs. An annual maintenance bond shall be posted for the access road (if applicable), site (if applicable) and tower(s) in an amount to be approved by the SPGA.

(c) Failure to post an approved bond and/or provide proof of insurance shall be grounds to revoke the special permit.

C.4) Sample Bylaw: Town of Westminster

§ 205-39.3. Wind energy facilities.

[Added ATM 5-5-2012 by Art. 44]

A. Purpose. The purpose of this section is to:

- (1) Provide a permitting process for wind energy facilities so they may be utilized in a cost effective, efficient and timely manner to reduce the consumption of utility-supplied electricity;
- (2) Integrate these facilities in the community in a manner that does not disrupt the character of existing neighborhoods and minimizes their impacts on nearby property values and on the scenic, historic, and environmental resources of the Town; and
- (3) Protect health and safety of the community, while allowing wind energy technologies to be utilized for citizens' general welfare.

B. Applicability.

- (1) This section applies to small wind energy facilities no greater than 750 kilowatts per hour of rated nameplate capacity in total that are proposed to be constructed after the effective date of this section.
- (2) For residential wind energy facilities, this section applies to facilities of no greater than 15 kilowatts per hour of measured capacity in total. With the exception of a net metering agreement between the owner of a residential wind energy facility and a utility company, residential wind facilities shall provide electricity only to the lot they are placed on. Experimental wind turbines shall not be tied into the utility electric grid.

C. Definitions.

A-WEIGHTED SOUND LEVEL (DBA)

A measure of overall sound pressure level designed to reflect the response of the human ear, which does not respond equally to all frequencies. It is used to describe sound in a manner representative of the human ear's response. It reduces the effects of the low frequencies with respect to the frequencies centered around 1,000 Hz. The resultant sound level is said to be A-weighted and the units are dBA.

C-WEIGHTED SOUND LEVEL (DBC)

Similar in concept to the A-weighted sound level (dBA), but C-weighting does not de-emphasize the frequencies below 1,000 Hz as A-weighting does. It is used for measurements that must include the contribution of low frequencies in a single number representing the entire frequency spectrum. Sound level meters have a C-weighting network for measuring C-weighted sound levels (dBC) meeting the characteristics and weighting specified in ANSI S1.43-1997 Specifications for Integrating Averaging Sound Level Meters for Type 1 instruments.

DAYTIME SOUND

The ambient sound level heard during the daytime between the hours of 7:00 a.m. and 7:00 p.m.

EXPERIMENTAL WIND FACILITY

A wind turbine and associated equipment that is used for experimental, demonstration, educational and/or research purposes that does not have a rated nameplate and is not connected to the electrical grid. Experimental wind facilities that are not anchored to an existing structure shall be considered temporary structures for the purposes of this bylaw.

FALL ZONE

An area surrounding the wind turbine into which the turbine and/or turbine components might fall due to inclement weather, poor maintenance, faulty construction methods, or any other condition causing turbine failure that shall remain unobstructed and confined within the property lines of the primary parcel where the turbine is located at, the purpose being that if the turbine should fall or otherwise become damaged, the falling structure will be confined to the primary parcel and will not fall onto dwellings, accessory buildings, and will not intrude onto a neighboring property. The fall zone area shall be the circumference of the area around the turbine equal to the height of the turbine as measured from the bottom of the base of the tower to the tip of the wind turbine blade at its highest point.

HEIGHT

The height of a wind turbine measured from natural grade to the tip of the rotor blade at its highest point, or blade tip height.

HERTZ

Frequency of sound expressed by cycles per second.

LOW FREQUENCY SOUND (LFN)

Refers to sounds with energy in the lower frequency range of 20 to 200 Hz. LFN is deemed to be excessive when the difference between a C-weighted sound pressure level and an A-weighted sound pressure level is greater than 20 decibels at any measurement point outside or inside a sound sensitive receptor.

MEASURED CAPACITY

The maximum rated output of electric power production equipment. This output is typically measured by mathematical extrapolation of mean wind over voltage multiplied by resistance or test meters connected to the equipment.

NIGHT TIME SOUND

The ambient sound level heard during the nighttime between the hours of 7:00 p.m. and 7:00 a.m.

QUALIFIED INDEPENDENT ACOUSTICAL CONSULTANT

Qualifications for persons conducting baseline and other measurements and reviews related to a small wind energy facility application or for enforcement action against operational wind facilities include demonstration of competence in the specialty of sound testing and full membership in the Institute of Sound Control Engineers.

RATED NAMEPLATE CAPACITY

The maximum rated output of electric power production equipment. This output is typically specified by the manufacturer with a "nameplate" on the equipment.

RESIDENTIAL WIND ENERGY FACILITIES

All equipment, machinery and structures utilized in connection with the conversion of wind to electricity. This includes, but is not limited to, storage, electrical collection and supply equipment, transformers, service and access roads, and one or more wind turbines, which have a measured capacity of 15 kW or less.

SENSITIVE RECEPTOR

Places or structures intended for human habitation, whether occupied or not, public parks, institutional uses (places of public assembly, churches, schools, health care facilities), state and federal wildlife areas, recreation areas used by the public.

SHADOW FLICKER

A repeating cycle of changing light intensity that occurs when shadows caused by the rotating blades of a wind turbine pass over an object or across a window.

[Added STM 11-29-2012 by Art. 17]

SMALL WIND ENERGY FACILITIES

All equipment, machinery and structures utilized in connection with the conversion of wind to electricity. This includes, but is not limited to, storage, electrical collection and supply equipment, transformers, service and access roads, and one or more wind turbines, which have a rated nameplate capacity of 750 kW or less.

SPECIAL PERMIT

A permit provided by the special permit granting authority for small wind energy facilities.

SPECIAL PERMIT GRANTING AUTHORITY

The special permit granting authority shall be the Planning Board, for the issuance of special permits to construct and operate small wind energy facilities.

WIND MONITORING OR METEOROLOGICAL TOWER (MET TOWERS)

A temporary tower equipped with devices to measure wind speeds and direction, used to determine how much wind power a site can be expected to generate.

WIND TURBINE

A device that converts kinetic wind energy into rotational energy that drives an electrical generator. A wind turbine typically consists of a tower, nacelle body, and a rotor with two or more blades.

D. General siting standards. Note moved to bylaw from regulations.

(1) Height.

(a) Residential wind energy facilities shall be no higher than 35 feet above the current grade of the land to the tip of the wind turbine blade or 10 feet above the building structure which it is mounted to, including the tip of the wind turbine blade.

(b) Small wind energy facilities shall be no higher than 225 feet above the current grade of the land, as measured from the bottom of the base of the tower to the tip of the wind turbine blade at its highest point.

(c) The Planning Board may allow for a height up to 300 feet if all of the following conditions are met:

[1] The applicant demonstrating by substantial evidence that a greater height reflects industry standards for a similar sited wind facility;

[2] Demonstration that a greater height is necessary for the facility to be technically and financially feasible, to prevent financial hardship to the applicant; and

[3] The facility satisfies all other criteria for the granting of a special permit and site plan approval.

(2) Setbacks.

(a) Small wind facilities shall be set back a distance at least three times the total height of the wind turbine (as measured from the bottom of the base of the tower to the tip of the wind turbine blade at its highest point) from all inhabited structures, overhead utility lines, public roads or rights-of-way and property boundaries, provided that no setback shall be required from a building or buildings which are on the same parcel and which are served by the wind energy facility. The SPGA may reduce the minimum setback distance if written permission is granted by the entity with care and control over the affected asset.

(b) Residential wind facilities shall be set back a distance equal to the total height of the wind turbine plus 25 feet from all inhabited structures, overhead utility lines, public roads or rights-of-way and property boundaries, provided that no setback shall be required from a building or buildings which are on the same parcel and which are served by the wind energy facility. No wind energy facility shall be erected within the front yard setback restriction of any residentially zoned parcel.

E. Maintenance and removal. Note: moved to bylaw from regulations.

(1) Maintenance. The owner shall maintain the wind energy facility conversion system in good condition. Maintenance shall include, but not be limited to, painting, structural repairs, and security measures.

(2) Abandonment or decommissioning. Any wind energy facility conversion system which has reached the end of its useful life or has been abandoned shall be removed. A wind energy facility conversion system shall be considered abandoned when it fails to operate continuously for one year (excluding periods of shutdown for the purpose of flicker control) and the turbine owner has not notified the SPGA of the need to temporarily suspend operation for a period of time lasting past one year.

(3) Removal plan. The applicant shall submit a detailed plan for the removal of the wind facility and restoration of the site to its preexisting condition upon abandonment or decommissioning. The removal plan shall be prepared by a qualified professional and include a detailed estimate of the anticipated removal and site restoration costs that includes a mechanism to account for inflation. Upon a notice of abandonment issued by the Building Commissioner, the wind energy system owner will have 30 days to provide sufficient evidence that the system has not been abandoned.

F. Temporary wind monitoring towers (met towers). Wind monitoring or meteorological towers shall be permitted in all zoning districts subject to issuance of a building permit for a temporary structure and shall be limited to 18 months after construction has commenced.

G. Approved wind turbines. Small wind turbines must be approved under an emerging technology program such as the California Energy Commission, International Electrotechnical Commission, or any other small wind certification program recognized by the American Wind Energy Association (AWEA) or the U.S. Department of Energy.

H. Special permit criteria for small wind energy facilities.

(1) Special permits shall be granted by the SPGA only upon its written determination that the proposed use or structure(s) shall not cause substantial detriment to the neighborhood, or the Town, taking into account the characteristics of the site and the proposal in relation to the site. In addition to any specific factors that may be set forth elsewhere in this bylaw and its associated regulations, such determination shall include consideration of each of the following:

(a) Social, economic, or community needs which are severed by the proposal;

(b) Traffic flow and safety, including parking and loading;

(c) Adequacy of utilities and other public services;

(d) Neighborhood character;

(e) Impacts on the natural environment; and

(f) Potential fiscal impact, including impact on Town services, tax base and property values.

(2) The SPGA's determination for each of the six criteria shall be set forth in the special permit decision as findings of fact.

I. Expiration and renewal.

(1) Special permits and/or building permits issued pursuant to this bylaw shall expire if:

(a) The wind energy system is not installed and functioning within 24 months from the date the permit is issued; or

(b) The wind energy system is abandoned (failure to continuously operate for one year, excluding periods of shutdown for the purpose of flicker control), and the owner has not notified the SPGA of the need to temporarily suspend operation.

(2) Special permits for small wind energy facilities shall automatically expire after five years from the date of SPGA approval. Current owners wishing to renew the special permit must seek approval from the SPGA before the use is allowed to continue.

J. Regulations. The SPGA may periodically adopt or amend rules and regulations for the implementation of this section by majority vote for the purpose of setting forth performance standards for sound levels and shadow flicker, as well as requirements for sureties and insurance for small wind energy facilities.

K. Severability. The provisions of this bylaw are severable, and the invalidity of any section, subdivision, paragraph, or other part of this bylaw shall not affect the validity or effectiveness of the remainder of the bylaw.

C.5) Links to additional Wind Energy Bylaws

State of Massachusetts Department of Energy Resources Conditional Use Bylaw

<http://www.mass.gov/eea/docs/doer/gca/wind-not-by-right-bylaw-june13-2011.pdf>

State of Massachusetts Department of Energy Resources As of Right Bylaw

<http://www.mass.gov/eea/docs/doer/gca/as-of-right-wind-bylaw-june-2011.pdf>

Ashby

<http://www.ci.ashby.ma.us/document/Zoning%20Bylaw090502.pdf>

Ashburnham

http://www.ashburnham-ma.gov/Pages/AshburnhamMA_WebDocs/ZoningBy-LawwithCover5-2-09.pdf

Athol

http://www.athol-ma.gov/egov/docs/1357907472_661712.pdf

Fitchburg

<http://www.fitchburgma.gov/zoningord.pdf>

Gardner

http://www.gardner-ma.gov/Pages/GardnerMA_BComm/Planning/zoningord04032012.pdf

Groton

<http://ecode360.com/13711604>

Leominster

<http://www.leominster-ma.gov/pdf/zoning-09/new-sections-revised.pdf>

Lowell

<http://www.lowellma.gov/depts/dpd/permitting/zoning/zoning-ordinance/130612%20Lowell%20Zoning%20Ordinance.pdf>

Pepperell

<http://www.pepperell-mass.com/planning/zonebylaw/Zoning%20Bylaw%205.7.12.pdf>

Sterling

http://www.sterling-ma.gov/Pages/SterlingMA_Clerk/forms/protective.pdf

Winchendon

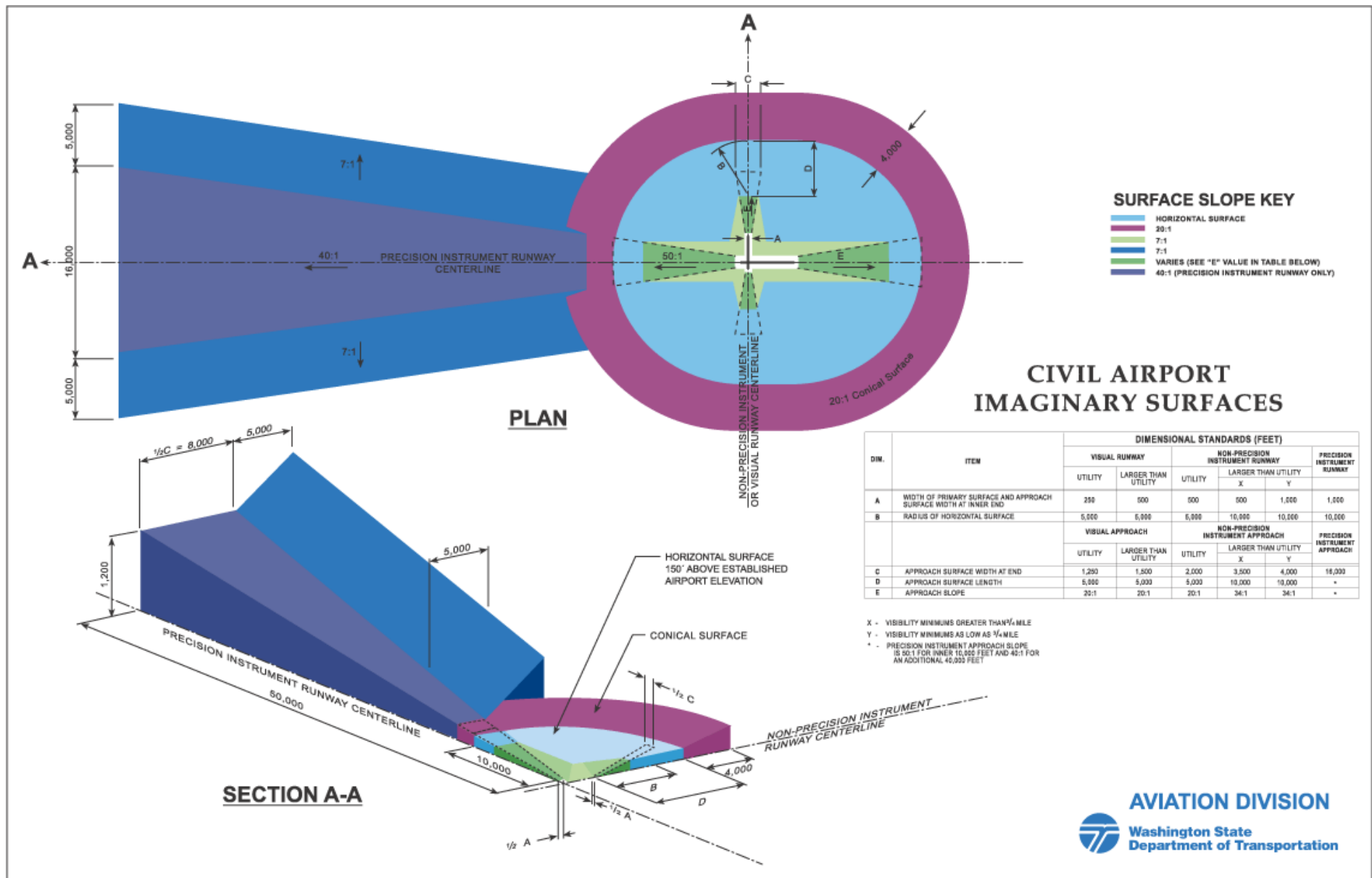
http://www.townofwinchendon.com/Pages/WinchendonMA_BComm/ZBA/Zoning_Bylaw_accepted_5.21.12.pdf

C.6) FAA Lighting Law

Due to the size of this document, a link has been provided below.

http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC%2070%207460-1K.pdf

C.7) Image depicting Invisible surfaces surrounding an Airport



<http://www.wsdot.wa.gov/aviation/Planning/CivAPImagSurfBig.htm>

C.8) Table of laws and Regulating Authorities

http://www.umass.edu/windenergy/publications/published/communityWindFactSheets/RERL_Fact_Sheet_7_Permittin g.pdf



Community-owned wind turbine, at the high school in Hull, MA.

Agencies

That may have Jurisdiction in Community-Scale Wind Projects

The following regulations may apply to a community wind power project at a given site. The order in which permits are issued is typically Local, State, then Federal. Links to most of the forms are included below (in the on-line version of this document).

Local

Regulation / Permit	Authority	Comments
Zoning permit	Town Zoning Board	Some towns have height or setback restrictions that may require a variance.
Special local permit or variance	Town Zoning Board	Needed if zoning bylaws do not yet include wind power projects.
Building permits	Building Inspector	
Board Approval	Planning Board	
<u>Order of Conditions (OOC)</u>	Town Conservation Commission (CC)	This permit is required if wetlands will be altered in any way. The permit application is called a <u>Notice of Intent</u> and is also sent the Mass. Dept. of Environmental Protection. See also Notice of Intent below in State section. If an area of less than 5000 sq. ft. of wetland is altered, then the OOC also serves as the project's Section 401 Water Quality Certificate. If the CC has never dealt with issues related to wind turbines, they may need extra time for education.

State

Regulation / Permit	Authority	Comments	More Information
<u>MEPA Determination: Environmental Notification Form (ENF) or Expanded ENF*</u>	<u>Mass. Executive Office of Environmental Affairs (EOEA)</u>	Must be filed if more than 25 acres of land will be directly altered or other thresholds met. A thorough treatment of this form is recommended.	www.state.ma.us/envir/mepa/index.htm 617-626-1020
MEPA Review: Environmental Impact Report (EIR)	<u>Mass. Executive Office of Environmental Affairs (EOEA)</u>	Unlikely to apply to community-scale projects. Based on the review of the ENF by the Secretary of Environmental Affairs. Automatically required if more than 50 acres of land will be directly altered or other thresholds met.	www.state.ma.us/envir/mepa/index.htm 617-626-1020
<u>Notice of Intent (NOI)</u>	<u>Mass. Department of Environmental Protection (DEP)</u>	Same form as with the local Conservation Commission.	All wetlands forms: http://www.mass.gov/dep/water/approvals/wvfforms.htm 800-462-0444
<u>Notice of Intent (NOI)</u> (same as above)	<u>Mass. Natural Heritage and Endangered Species Program</u>	Same form as for the local CC and state DEP. Required if project falls within an "Estimated Habitat" of rare wildlife. Avoid disturbing threatened species.	http://www.mass.gov/dfwele/dfw/nhep/nhevyro.htm 508-792-7270 ext. 200

Continued on next page...

* The Secretary of Environmental Affairs recommends that proponents of a wind project include and distribute all relevant supporting supplemental information with the ENF form, even if the proponent does not formally choose an "Expanded ENF" option for MEPA review.

Renewable Energy Research Laboratory, University of Massachusetts at Amherst

State, continued

Regulation / Permit	Authority	Comments	More Information
Conservation and Management Permit	Mass. Natural Heritage and Endangered Species Program	Required if there is any "take" of a state endangered species.	By town: www.state.ma.us/dfwele/dfs/nhesp/nhtown.htm 508-792-7270 ext. 200
General Access Permits	Mass. Dept. of Highways	Needed if road alterations to state roads are required.	617-973-7800
Wide Load Permits	Mass. Dept. of Highways	Possibly needed for transportation of turbine components, construction materials and equipment.	http://www.mhd.state.ma.us/default.asp?pgid=content/permits&sid=about 617-973-7800
Project Notification Form	Mass. Historical Commission	Describe the project and any impact on historic or archaeological properties.	www.state.ma.us/sec/mhc/mhcidx.htm 617-727-8470
Noise control policy (310 CMR 7.10)	Mass. Department of Environmental Protection (DEP)	The policy discourages a broad-band noise level in excess of 10 dB(A) above ambient, or pure tone noise.	www.airandnoise.com/MA310CMR710.html 800-462-0444
EOEA Article 97 Policy Mass. General Law Chapter 61	Mass. Executive Office of Environmental Affairs (EOEA)	These govern use of protected land. Compliance with these pieces of legislation is not part of any specific permit, but is necessary for a successful ENF or EIR process. These may be applicable if the project requires access/easements over protected parkland or agricultural land.	www.state.ma.us/envir/mepa-fourthlevel/pages/article97policy.htm www.state.ma.us/legis/laws/mgl/gl-61-toc.htm
Massachusetts Clean Waters Act: Section 401 Water Quality Certificate	Mass. Department of Environmental Protection (DEP)	If less than 5000 sq. ft. of wetland is altered, the OOC serves this purpose.	www.mass.gov/dep/bwp/www/files/314cmr9.htm
NEPOOL Interconnection System Impact Study	ISO New England and the owner of transmission lines at point of interconnection	The impact of the new generating capacity on the existing grid is studied. The Facility Study then determines what, if any, additional electrical components are required for the transmission system.	ISO-New England's information on new or modified interconnections
	Energy Facility Siting Board (EFSB)	The EFSB is primarily concerned with plants of 100 MW or more, but may have jurisdiction over a community wind project if a new transmission line is: - over 1 mile long, or - over 69 kilovolts	www.state.ma.us/dpu/siting/handbook.htm EFSB: 617-305-3525
Review of Development of Regional Impact (DRI). Town Referral & Application	Cape Cod Commission on Cape Cod Martha's Vineyard Commission in Duke's County	For Cape Cod and Martha's Vineyard only. Most community wind projects will not require a DRI review. Applies if the project meets or exceeds any of the DRI thresholds . If applicable, precedes local permitting.	http://www.capecodcommission.org/regulatory/DRIbrochure.pdf Commission: 508-362-3828
Request for Airspace Review	Mass. Aeronautics Commission (MAC)	While not a permit per se, the MAC should be notified of projects over 200' tall. This process is similar to the federal Part 77 review discussed below.	617-973-8881

Continued on next page...

Renewable Energy Research Laboratory, University of Massachusetts at Amherst



Community-owned wind turbine, in Moorhead, MN

Renewable Energy Research Laboratory

University of Massachusetts at Amherst



160 Governors Drive
Amherst, MA 01003
413-545-4359
rerl@ecs.umass.edu
www.ceere.org/rerl/



MASSACHUSETTS
TECHNOLOGY
COLLABORATIVE
RENEWABLE ENERGY TRUST
Mass. Technology Collaborative
Mass. Renewable Energy Trust
75 North Drive
Westborough, MA 01581
508-870-0312
www.mtpe.org/RenewableEnergy/index.htm

Agencies with Jurisdiction, continued

Federal

Regulation / Permit	Authority	Comments	More Information
Notice of Proposed Construction or Alteration, 7640-1 "Part 77" review	Federal Aviation Administration (FAA)	This form is submitted for all structures at least 200' above ground-level, or within a few miles of an airport (the distance depending on the type of airport). All wind turbines with tip-heights over 200' will need lighting. MassPort (Massachusetts Port Authority) may also be involved if an airport is nearby.	http://forms.faa.gov/forms/faa7460-1.pdf FAA New England: (781) 238-7520
The following federal laws may also be applicable to community-scale wind projects under certain circumstances:			
Habitat Conservation Plan & Incidental Take Permit	US Fish and Wildlife Service	Needed if any federally listed endangered or threatened species will be harmed.	endangered.fws.gov/permits/index.html 603-223-2541
Migratory Bird Treaty	US Fish and Wildlife Service	Forbids the "take" of migratory birds.	603-223-2541
National Pollution Discharge Elimination System (NPDES); Storm Water Notice of Intent	US Environmental Protection Agency (EPA)	Needed if waste water is to be generated during construction, or ground water to be affected. Note that unlike most forms of electricity generation, wind turbines do not use water for power production.	efpub.epa.gov/npdes/ 202-564-9545
Section 401 and Section 404 of the federal Clean Water Act	U.S. Army Corps of Engineers	Most community-scale wind projects will not fall under this regulation. These would apply if fill were discharged into wetlands.	



For More Information

Mass. Executive Office of Environmental Affairs:
Mass. Environmental Protection Act: www.state.ma.us/envir/mcpa/index.htm and Renewable Energy & Distributed Generation Guidebook http://www.mass.gov/Eoca/docs/doer/pub_info/guidebook.pdf

Examples of state permitting & precedents:

- Hoosac Wind Project Permitting: www.hoosacwind.com/etc6.html

- Hoosac ENF certificate (EOEA # 13143), December 2003: <http://www.mass.gov/envir/mcpa/downloads/13143enfpdfversion.pdf>
- Princeton Municipal Project ENF certificate (EOEA #13229), April 2004: www.state.ma.us/envir/mcpa/pdffiles/certificates/13229pdfversion.pdf

For the on-line version of this Fact Sheet with the complete set of links, see www.ceere.org/rerl/about_wind/

C.9) Table Comparing Zoning Laws

Provision	State Energy Department Model Conditional Use	State Energy Department Model As-Of-Right	Ashburnham
Small Scale Bylaws/Zoning	X	-	X
Large Scale Bylaws/Zoning	X	X	X
Definitions Section	X	X	X
Generalized Law	X	-	-
Definition of Small Scale/Residential Max	100 kW	-	60 kW
Permitting Authority Residential Scale	Building Inspector	-	Building Inspector, Planning board if Special Permit needed
Permitting Authority Utility scale	Special Permit Granting Authority as defined in individual town bylaws	Building Inspector, Zoning Board	Planning Board
Number allowed per parcel Small/Residential	-	-	-
Number allowed per parcel Utility	-	-	-
Setback Distance Small/Residential Scale (ft.)	1.5x Height from property line, 3x height from residential/commercial structure	-	1x blade tip height and 5 from property line*
Setback Distance Utility Scale (ft.)	1.5x Height from property line, 3x height from residential/commercial structure	1.5x Height from property line, 3x height from residential/commercial structure	1x blade tip height and 100 from property line*
Height Small/Residential Scale (ft.)	250*	-	160 above grade or 10 above rooftop*
Height Utility Scale (ft.)	450*	450	400 above grade or 10 above rooftop*
Term of Special Building Permit Utility Scale	48 Months	-	-
Term of Special Building Permit Small/Residential	48 Months	-	-
Term of Special Permit Utility Scale	Abandonment	-	25 Years
Term of Special Permit Small/Residential	Abandonment	-	25 Years
Abandonment Small/Residential	1 Year	-	30 days
Abandonment Utility	1 Year	1 Year	150 days
Liability Insurance Required	X	X	X
Shadow/Flicker Utility Scale	X	X	X
Shadow/Flicker Small/Residential Scale	X	-	-
Noise Utility Scale	X	X	X
Noise Small/Residential Scale	X	-	-
Visual Representation	X	-	X
Security Bond/Financial Surety	125% Cost of Removal	125% Cost of Removal	125% Cost of Removal
Zoning District Restrictions	X	X	X

KEY

X = Section exists in Law

- = Section Does Not Exist in Law

* Waiver Available

Provision	Groton	Leominster	Lowell	Pepperell
Small Scale Bylaws/Zoning	X	X	X	X
Large Scale Bylaws/Zoning	X	-	X	-
Definitions Section	-	-	X	X
Generalized Law	-	-	-	-
Definition of Small Scale/Residential Max	-	60 kW	100 ft. Overall Height	60 kW
Permitting Authority Residential Scale	Building Commissioner	Director of Inspections	Building Commissioner & Planning Board	Attached to building: Building Inspector Free standing: Planning board and Building Inspector
Permitting Authority Utility scale	Planning Board	-	Building Commissioner & Planning Board	-
Number allowed per parcel Small/Residential	2	-	-	-
Number allowed per parcel Utility	-	-	-	-
Setback Distance Small/Residential Scale (ft.)	1.5x height	Height plus 5 from property line	75% height from property line, overall height from buildings	Freestanding only: distance equal to height, no fall zone to cross property line
Setback Distance Utility Scale (ft.)	Height plus 25*	-	75% height from property line, 120% overall height from buildings	-
Height Small/Residential Scale (ft.)	65	-	125	Attached to building: no higher than 35 overall height including building. Free standing: 140
Height Utility Scale (ft.)	Set by Planning Board	-	300	-
Term of Special Building Permit Utility Scale	-	-	-	-
Term of Special Building Permit Small/Residential	-	-	-	-
Term of Special Permit Utility Scale	25 Years	-	-	-
Term of Special Permit Small/Residential	-	-	-	-
Abandonment Small/Residential	-	-	12 Months	One Year
Abandonment Utility	1 Year	-	12 Months	-
Liability Insurance Required	X	-	X	X
Shadow/Flicker Utility Scale	X	-	X	-
Shadow/Flicker Small/Residential Scale	-	-	X	X
Noise Utility Scale	X	-	X	-
Noise Small/Residential Scale	X	-	X	X
Visual Representation	X	-	X	-
Security Bond/Financial Surety	Amount determined by PB	-	125% Cost of Removal	-
Zoning District Restrictions	X	X	X	-

KEY

X = Section exists in Law

- = Section Does Not Exist in Law

* Waiver Available

Provision	Sterling	Templeton	Westminster	Winchendon
Small Scale Bylaws/Zoning	X	X	X	X
Large Scale Bylaws/Zoning	-	X	-	X
Definitions Section	X	X	X	X
Generalized Law	-	X	-	-
Definition of Small Scale/Residential Max	10 kW	10kW	750 kWh/15 kWh	10 kW
Permitting Authority Residential Scale	Planning Board	Planning Board	Planning Board	Planning Board
Permitting Authority Utility scale	-	Planning Board	-	Planning Board
Number allowed per parcel Small/Residential	1	1*	-	1*
Number allowed per parcel Utility	-	1*	-	1*
Setback Distance Small/Residential Scale (ft.)	Height plus 100. 10,000 from Sterling Airport runway	Engineered Fallzone plus 10*	3x Height/height plus 25	Engineered fall zone plus 10*
Setback Distance Utility Scale (ft.)	-	Engineered Fallzone plus 10*	-	Engineered fall zone plus 11*
Height Small/Residential Scale (ft.)	100, wivable to no more than 130	150*	225 with a waiver for 300. Residential is 35, minimum underblade of 10	150*
Height Utility Scale (ft.)	-	300*	-	300*
Term of Special Building Permit Utility Scale	-	-	-	-
Term of Special Building Permit Small/Residential	-	-	24 Months	-
Term of Special Permit Utility Scale	-	-	-	-
Term of Special Permit Small/Residential	-	-	5 Years	-
Abandonment Small/Residential	2 Years	2 Years	1 Year	2 Years
Abandonment Utility	-	2 Years	-	2 Years
Liability Insurance Required	-	X	-	X
Shadow/Flicker Utility Scale	-	X	-	X
Shadow/Flicker Small/Residential Scale	X	X	X	X
Noise Utility Scale	-	X	-	X
Noise Small/Residential Scale	X	X	X	X
Visual Representation	-	-	-	-
Security Bond/Financial Surety	Amount Determined by PB	-	-	-
Zoning District Restrictions	X	X	-	X

KEY

X = Section exists in Law

- = Section Does Not Exist in Law

* Waiver Available

C.10) Wind Power Decision Tree

http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB4QFjAA&url=http%3A%2F%2Fwww.epa.gov%2Foswer%2Fdocs%2Fwind_decision_tree.pdf&ei=gCUjVPSBOYGnyATio4FY&usg=AFQjCNGLmVcmOdumHmQJjrVKxXL48lw-pQ&sig2=UiAyALog6ltEYtm5GmeHtw&bvm=bv.76180860,d.aWw

D. Photovoltaic Power

D.1) Number of Solar Installations per Community in the Montachusett Region

Municipality	Agricultural	College/ University	Commercial	Industrial	Mixed-Use	Municipal	Religious	Residential	Retail	School (k-12)	State Agency	Utility	Other	Total
Ashburnham	0	0	0	0	0	5	0	13	0	0	0	1	0	19
Ashby	0	0	1	0	0	0	0	17	0	0	0	0	0	18
Athol	1	0	0	0	0	0	0	12	0	0	0	0	0	13
Ayer	0	0	0	2	0	0	0	15	0	0	0	0	0	17
Clinton	0	0	1	0	0	0	0	12	0	0	0	0	0	13
Fitchburg	0	3	1	2	0	2	0	47	0	0	0	0	0	55
Gardner	0	0	0	1	0	1	0	18	0	0	0	0	1	21
Groton	0	0	1	0	0	0	0	8	0	0	0	0	0	9
Harvard	1	0	0	0	0	1	0	85	0	0	0	0	1	88
Hubbardston	0	0	1	1	0	1	0	14	0	0	0	0	1	18
Lancaster	0	0	0	0	1	3	0	20	0	0	1	0	0	25
Leominster	0	0	4	1	0	0	0	47	0	0	0	0	0	52
Lunenburg	0	0	0	0	0	2	0	43	1	1	0	0	2	49
Petersham	0	0	0	0	0	0	0	7	0	0	0	0	1	8
Phillipston	0	0	1	0	0	0	0	7	0	0	0	0	0	8
Royalston	0	0	0	0	0	0	0	13	0	0	0	0	0	13
Shirley	0	0	1	0	0	1	0	25	0	0	1	2	0	30
Sterling	0	0	2	1	0	1	0	11	0	0	0	1	0	16
Templeton	0	0	0	0	0	1	0	2	0	0	0	0	0	3
Townsend	1	0	0	0	0	1	1	38	0	0	0	0	0	41
Westminster	0	0	1	1	0	0	0	26	0	0	0	0	0	28
Winchendon	0	0	0	1	0	0	0	13	0	0	0	0	0	14
Total	3	3	14	10	1	19	1	493	1	1	2	4	6	558

Source: DOER SREC Database July 9, 2014, Massachusetts ARRA Database, DOER

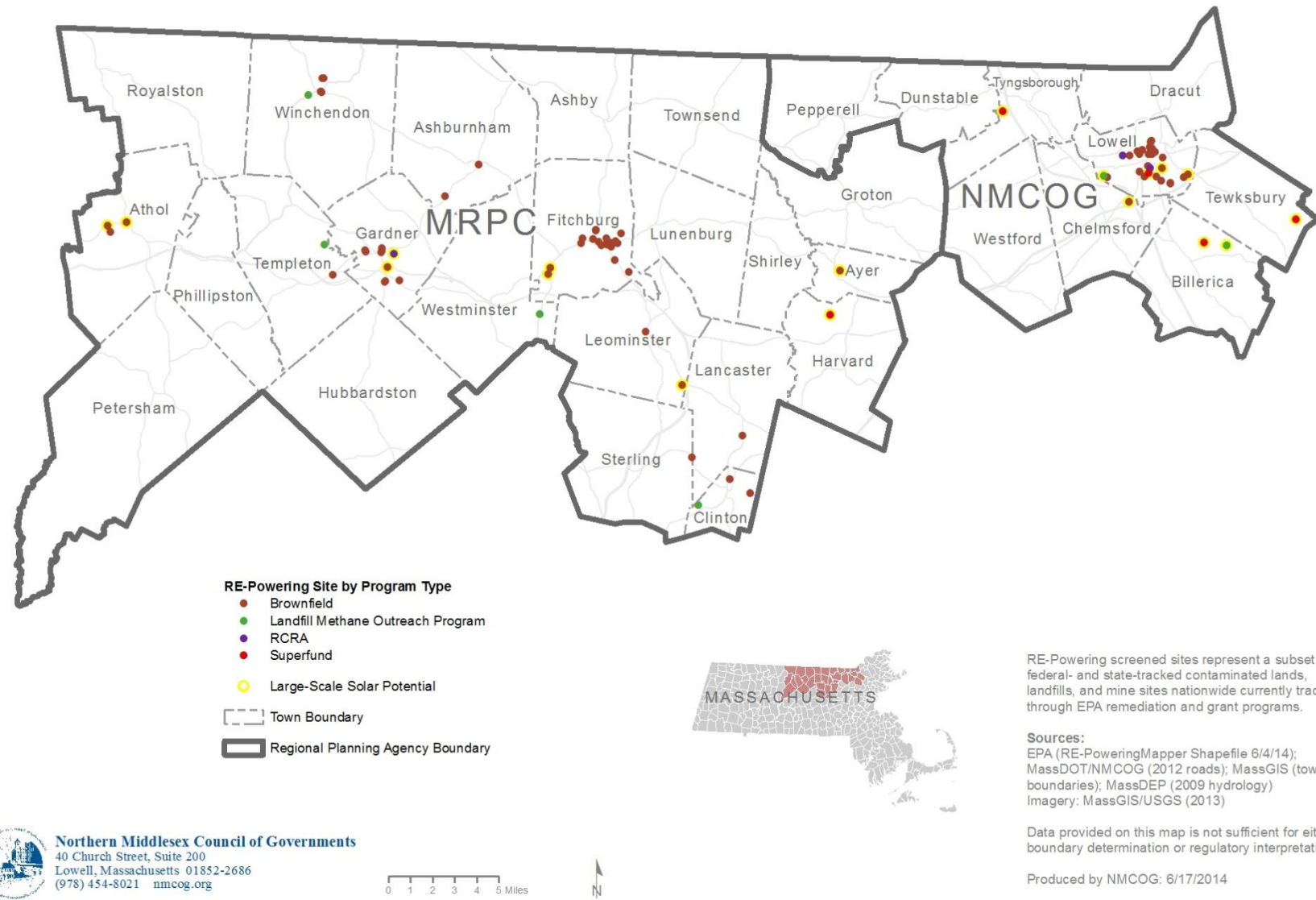
D. 2) Number of kW of Solar Power Produced by Community in the Montachusett Region

Municipality	Agricultural	College/ University	Commercial	Industrial	Mixed-Use	Municipal	Religious	Residential	Retail	School (k-12)	State Agency	Utility	Other	Total
Ashburnham	0	0	0	0	0	81	0	104	0	0	0	3,981	0	4,167
Ashby	0	0	14	0	0	0	0	129	0	0	0	0	0	143
Athol	3,494	0	0	0	0	0	0	63	0	0	0	0	0	3,557
Ayer	0	0	0	129	0	0	0	82	0	0	0	0	0	210
Clinton	0	0	15	0	0	0	0	86	0	0	0	0	0	100
Fitchburg	0	178	840	557	0	185	0	295	0	0	0	0	0	2,055
Gardner	0	0	0	445	0	2,500	0	121	0	0	0	0	986	4,052
Groton	0	0	7	0	0	0	0	70	0	0	0	0	0	77
Harvard	220	0	0	0	0	6	0	539	0	0	0	0	294	1,059
Hubbardston	0	0	3	3,154	0	2,540	0	104	0	0	0	0	830	6,631
Lancaster	0	0	0	0	6,000	4,532	0	128	0	0	29	0	0	10,689
Leominster	0	0	416	124	0	0	0	297	0	0	0	0	0	836
Lunenburg	0	0	0	0	0	1,302	0	276	352	106	0	0	5,395	7,430
Petersham	0	0	0	0	0	0	0	40	0	0	0	0	2	42
Phillipston	0	0	10	0	0	0	0	42	0	0	0	0	0	52
Royalston	0	0	0	0	0	0	0	92	0	0	0	0	0	92
Shirley	0	0	93	0	0	206	0	149	0	0	210	6,623	0	7,280
Sterling	0	0	50	1,169	0	2	0	83	0	0	0	2,392	0	3,697
Templeton	0	0	0	0	0	7	0	22	0	0	0	0	0	29
Townsend	5	0	0	0	0	40	29	276	0	0	0	0	0	351
Westminster	0	0	549	788	0	0	0	176	0	0	0	0	0	1,513
Winchendon	0	0	0	2,310	0	0	0	82	0	0	0	0	0	2,392
Total	3,719	178	1,996	8,676	6,000	11,402	29	3,255	352	106	239	12,996	7,507	56,454

Source: DOER SREC Database July 9, 2014, Massachusetts ARRA Database, DOER

D.3) Photovoltaic EPA Map

EPA-Tracked Sites with Solar Energy Potential



D.4) Siting Renewable Energy on Brownfields

Please contact the MRPC for instructions on viewing this document.

D.5) MRPC Drafted Royalston Photovoltaic By-Law

Large-Scale Ground-Mounted Solar Photovoltaic Installations

1. Purpose and Applicability

The purpose of this bylaw is to promote the creation of new large-scale ground-mounted solar photovoltaic installations by providing standards for the placement, design, construction, operation, monitoring, modification and removal of such installations that address public safety, minimize impacts on scenic, natural and historic resources and to provide adequate financial assurance for the eventual decommissioning of such installations. The provisions set forth in this section shall apply to the construction, operation, and/or repair of large-scale ground-mounted solar photovoltaic installations.

This section applies to large-scale ground-mounted solar photovoltaic installations proposed to be constructed after the effective date of this section. This section also pertains to physical modifications that materially alter the type, configuration, or size of these installations or related equipment.

2. Definitions

Large-Scale Ground-Mounted Solar Photovoltaic Installation: A solar photovoltaic system that is structurally mounted on the ground and is not roof-mounted, and has a minimum nameplate capacity of 10 kW DC.

On-Site Solar Photovoltaic Installation: A solar photovoltaic installation that is constructed at a location where other uses of the underlying property occur.

Rated Nameplate Capacity: The maximum rated output of electric power production of the Photovoltaic system in Direct Current (DC).

Solar Photovoltaic Array: an arrangement of solar photovoltaic panels.

3. Use Standards

Large-Scale Ground-Mounted Solar Photovoltaic Installations are hereby allowed by right in Solar Overlay District located on Assessors Map 11 parcel 39 and allowed by Special Permit in the Residential (R) and the Residential/Agricultural (RA) Districts.

4. General Standards

A. **Permit Granting Authority**

It is hereby established under this bylaw that the Planning Board will be the permit granting authority under this section.

B. **Site Plan Review and Special Permit Requirements**

Ground-mounted large scale solar photovoltaic installations with 10 kW or larger of rated nameplate capacity shall undergo either Site Plan Review or Special Permit review process contingent on the location of proposed project prior to construction, installation or modification as provided in this section. Projects that are subject to the Site Plan Review provision of this bylaw shall be acted upon by the Planning Board within 180 days from the time of the initial approved application submittal.

(1) General

All plans and maps shall be prepared, stamped and signed by a Professional Engineer licensed to practice in Massachusetts.

(2) Required Documents

Pursuant to the special permit or site plan review process, the project proponent shall provide the following documents:

- (a) A site plan showing:
 - i. Property lines and physical features, including roads, for the project site;
 - ii. Proposed changes to the landscape of the site, grading, vegetation clearing and planting, exterior lighting, screening vegetation or structures;
 - iii. Drawings of the solar photovoltaic installation signed by a Professional Engineer licensed to practice in the Commonwealth of Massachusetts showing the proposed layout of the system and any potential shading from nearby structures
 - iv. One or three line electrical diagram detailing the solar photovoltaic installation, associated components, and electrical interconnection methods, with all National Electrical Code compliant disconnects and overcurrent devices;
 - v. Documentation of the major system components to be used, including the PV panels, mounting system, and inverter;
 - vi. Name, address, and contact information for proposed system installer;
 - vii. Name, address, phone number and signature of the project proponent, as well as all co-proponents or property owners, if any;
 - viii. The name, contact information and signature of any agents representing the project proponent; and
- (b) Documentation of actual or prospective access and control of the project site;
- (c) An operation and maintenance plan (see also Section 12);
- (d) Zoning district designation for the parcel(s) of land comprising the project site (submission of a copy of a zoning map with the parcel(s) identified is suitable for this purpose);
- (e) Proof of liability insurance; and
- (f) Description of financial surety that satisfies Section 16.

(3) Waiver

The Planning Board may waive documentary requirements as it deems appropriate.

5. Compliance with Laws, Bylaws and Regulations

The construction and operation of all large scale solar photovoltaic installations shall be consistent with all applicable local, state and federal requirements, including but not limited to all applicable safety, construction, electrical, and communications requirements. All buildings and fixtures forming part of a solar photovoltaic installation shall be constructed in accordance with the State Building Code.

6. Utility Notification

No large-scale ground-mounted solar photovoltaic installation shall be constructed until written evidence has been given to the Planning Board and a Utility Company has been informed and has an agreement in hand, of the solar photovoltaic installation owner or operator's intent to install an interconnected customer-owned generator. Off-grid systems shall be exempt from this requirement.

7. Building Permit

No large scale solar photovoltaic installation shall be constructed, installed or modified as provided in this section without first obtaining a building permit.

8. Fees

At the time of an application submittal an Administration Fee will be required.

A Review Fee will be determined by the Planning Board before the Public Hearing by acquiring an estimate from the peer review engineer and other professionals as appointed by the Planning Board to review the project.

9. Design Standards

A. Dimension and Density Requirements

Large Scale Solar Energy Systems shall comply with all standards within Intensity Requirements section of the Zoning Bylaw.

B. Lighting

Lighting of solar photovoltaic installations shall be consistent any state and federal law. Lighting of other parts of the installation, such as appurtenant structures, shall be limited to that required for safety and operational purposes, and shall be reasonably shielded from abutting properties. Where feasible, lighting of the solar photovoltaic installation shall be directed downward and shall incorporate full cut-off fixtures to reduce light pollution.

B. Signage

Solar photovoltaic installations shall not be used for displaying any advertising except for reasonable identification of the manufacturer or operator of the solar photovoltaic installation.

C. Screening/ Buffer Requirement

If permitted by special permit in residential districts, within (50) feet of the project parameter a vegetated buffer is required that will screen the view of the large-scale ground-mounted solar photovoltaic installation so as to sufficiently block the view of the project from all dwellings abutting the property. In all other districts where site plan approval is given, the project shall have a vegetated buffer that will screen the view of the Large-scale Ground-mounted Solar Photovoltaic Installation from (50) feet of the project parameter of any abutting residential premises.

Plants shall be placed in casual mixed groupings of varying length and width and shall screen a minimum of seventy percent (70%) of the linear frontage. Plantings shall be a mix of evergreen and deciduous species, shall include at least three (3) species each of evergreen and deciduous trees and deciduous shrubs, and be planted at varying spacing from a minimum of three (3) feet to a maximum of fifteen (15) feet.

D. Utility Connections

Reasonable efforts, as determined by the Planning Board, shall be made to place all utility connections from the solar photovoltaic installation underground, depending on appropriate soil conditions, shape, and topography of the site and any requirements of the utility provider. Electrical transformers for utility interconnections may be above ground if required by the utility provider.

10. Safety, Emergency Services and Environmental Standards

A. Emergency Services

The large scale solar photovoltaic installation owner or operator shall provide a copy of the project summary, electrical schematic, and site plan to the fire chief. Upon request the owner or operator shall cooperate with local emergency services in developing an emergency response plan. All means of shutting down the solar photovoltaic installation shall be clearly marked. The owner or operator shall identify a responsible person for public inquiries throughout the life of the installation.

B. Land Clearing, Soil Erosion and Habitat Impacts

Clearing of natural vegetation shall be limited to what is necessary for the construction, operation and maintenance of the large – scale ground-mounted solar photovoltaic installation. . The applicant will implement Best Management Practices (BMPs) to help manage stormwater per the Zoning Bylaw requirements for Low Impact Development.

11. Accessory Buildings

All appurtenant structures to large- scale ground-mounted solar photovoltaic installations shall be subject to reasonable regulations concerning the bulk and height of structures, lot area, setbacks, open space, parking and building coverage requirements. All such appurtenant structures, including but not limited to, equipment shelters, storage facilities, transformers, and substations, shall be architecturally compatible with each other. Whenever reasonable, structures should be shaded from view by vegetation and/or joined or clustered to avoid adverse visual impacts.

12. Operation and Maintenance Plans

- A. The project proponent shall submit a plan for the operation and maintenance of the installation, which shall include measures for maintaining safe access to the installation, storm water controls, as well as general procedures for operational maintenance of the installation.
- B. The large - scale ground-mounted solar photovoltaic installation owner or operator shall maintain the facility in good condition. Maintenance shall include, but not be limited to, painting, structural repairs, and integrity of security measures. Site access shall be maintained to a level acceptable to the local Fire Chief and Emergency Medical Services. The owner or operator shall be responsible for the cost of maintaining the solar photovoltaic installation and any access road(s), unless accepted as a public way.

14. Modifications

- A. All material modifications to a Solar Energy Collection System installation made after approval of the site plan shall require a modification of the approval.
- B. The Planning Board shall review each site plan at intervals of not less than five years and may, after public notice and hearing, modify the approved plan to insure the public safety and compliance with the town bylaws and regulations.

15. Abandonment

Absent notice of a proposed date of decommissioning or written notice of extenuating circumstances, the solar photovoltaic installation shall be considered abandoned when it fails to operate for more than one year without the written consent of the Planning Board. The Utility Company shall have the right of first refusal as to whether they will choose to assume responsibly for the solar operation. If the Utility Company chooses to forgo the operation and the owner or operator of the large- scale ground-mounted solar photovoltaic installation fails to remove the installation in accordance with the requirements of this section within 150 days

of abandonment or the proposed date of decommissioning, the town may enter the property and physically remove the installation.

16. Financial Surety

Proponents of large-scale ground-mounted solar photovoltaic projects shall provide a form of surety through the Planning Board. The form of surety that is acceptable to the Planning Board will cover the cost of removal in the event the town must remove the installation and remediate the landscape, in an amount and form determined to be reasonable by the Planning Board, but in no event to exceed more than 125 percent of the cost of removal and compliance with the additional requirements set forth herein, as determined by the project proponent. Such surety will not be required for municipally- or state-owned facilities. The project proponent shall submit a fully inclusive estimate of the costs associated with removal, prepared by a qualified engineer. The amount shall include a mechanism for calculating increased removal costs due to inflation.

17. Severability

If any section or provision of this bylaw is found by a court of competent jurisdiction to be invalid, such invalidity shall not affect the validity of any other section or provision of this Bylaw.

E. Hydropower

E.1) Nashua River – Fitchburg, Leominster, Pepperell

Fitchburg

Discharge, cubic feet per second,												
USGS 01094400 NORTH NASHUA RIVER AT FITCHBURG, MA ¹												
Monthly mean in ft ³ /s (cfs)												
YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	93.2	128.4	220.7	257.4	145.7	187.4	58.7	67.9	45.3	52.8	80.8	113.2
2001	53.0	88.0	223.4	407.8	74.2	130.3	53.8	15.1	17.9	15.1	14.2	35.5
2002	34.0	58.1	102.9	114.5	157.2	88.0	17.8	9.49	10.2	28.8	94.5	147.9
2003	88.4	78.5	287.7	243.2	145.1	130.9	26.6	55.0	49.8	107.7	128.0	223.5
2004	85.1	53.6	127.8	371.0	125.8	48.1	28.8	27.1	80.1	64.7	88.3	232.0
2005	161.4	90.4	169.0	392.2	211.0	139.1	100.0	37.0	14.7	375.9	212.9	226.7
2006	305.9	252.4	107.4	115.6	276.0	323.0	107.6	43.0	46.0	126.2	258.2	106.4
2007	130.1	60.5	190.9	399.8	176.6	80.6	50.7	19.3	17.8	28.5	52.1	58.3
2008	138.0	362.9	337.9	233.7	115.1	42.7	81.5	88.5	147.8	75.3	128.7	335.5
2009	127.1	105.1	225.5	233.9	136.0	191.5	216.2	77.3	29.1	81.4	109.0	172.6
2010	137.5	206.6	727.1	247.2	79.8	43.3	28.8	19.6	8.84	83.2	131.8	154.0
2011	56.3	81.8	493.2	221.0	133.1	85.9	27.0	139.3	218.6	207.0	219.6	247.6
2012	128.0	94.9	132.5	77.6	108.6	75.8	13.9	22.4	16.4	95.4	66.5	102.1
2013	96.6	118.7	189.2	205.8	124.5	253.7	65.8	44.7	17.8			

¹ http://nwis.waterdata.usgs.gov/nwis/nwisman/?site_no=01094400&agency_cd=USGS

Mean of Monthly Discharge	133	137	241	244	144	106	52	47	46	87	118	147
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Leominster

Discharge, cubic feet per second, cfs ²												
USGS 01094500 NORTH NASHUA RIVER NEAR LEOMINSTER, MA												
Monthly mean in ft ³ /s												
YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	151.2	208.2	429.0	518.5	251.8	341.2	97.7	106.0	77.6	79.6	132.1	190.5
2001	100.8	145.4	441.4	718.7	124.9	232.4	107.4	44.5	50.8	37.5	33.7	58.0
2002	52.8	93.7	182.7	210.0	310.0	177.1	44.4	30.2	34.5	60.8	189.1	307.2
2003	186.9	173.0	606.6	495.8	296.4	264.6	69.8	118.5	100.5	196.6	207.8	457.9
2004	172.4	90.2	219.7	870.0	257.4	88.1	62.1	57.1	147.0	103.9	135.6	373.6
2005	341.2	295.5	421.0	721.0	412.0	239.5	170.5	71.5	45.4	625.4	365.6	368.8
2006	485.4	422.0	155.1	165.9	524.0	480.3	169.4	91.5	87.9	199.4	520.0	209.5
2007	248.7	114.5	356.7	728.1	298.1	134.3	96.2	49.5	50.9	65.4	91.0	95.5
2008	234.0	649.8	610.0	392.5	188.5	85.1	143.8	152.1	261.0	143.4	214.1	540.4
2009	216.3	201.7	366.6	347.6	211.4	295.1	433.2	149.4	70.2	118.0	185.3	268.2
2010	215.6	364.4	1,159	390.1	140.6	89.4	71.6	47.3	35.8	101.5	142.3	212.3
2011	102.0	150.0	789.3	420.2	254.1	192.6	70.5	210.0	368.8	388.2	430.8	446.5
2012	233.5	173.9	221.6	144.5	190.8	155.8	44.1	61.3	55.3	165.4	138.0	182.8
2013	175.5	227.0	360.0	344.0	223.8	468.1	141.8	90.9	51.9			
Mean of monthly Discharge	215	230	395	426	248	175	95	82	90	126	180	219

Pepperell

Discharge, cubic feet per second, cfs												
USGS 01096500 NASHUA RIVER AT EAST PEPPERELL, MA ³												
Monthly mean in ft ³ /s												
YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	93.2	128.4	220.7	257.4	145.7	187.4	58.7	67.9	45.3	52.8	80.8	113.2
2001	428.7	526.8	1,168	1,514	857.9	929.9	300.9	354.6	204.6	233.3	397.6	533.9
2002	314.6	405.3	1,331	2,071	357.5	516.1	272.4	131.4	100.6	116.9	94.7	171.4
2003	141.3	264.9	452.5	572.1	820.3	490.5	125.9	69.6	72.9	155.8	464.3	757.5
2004	530.5	463.5	1,318	1,414	807.5	900.9	400.7	512.3	357.2	1,313	620.3	944.7
2005	517.1	282.4	608.2	1,986	859.7	447.2	320.3	371.6	434.4	355.7	386.7	904.5
2006	881.6	782.7	957.9	1,745	1,217	729.3	433.6	215.2	131.3	1,570	937.3	1,026
2007	1,354	1,290	499.9	472.8	1,435	1,465	683.6	375.8	410.1	537.7	1,335	723.5
2008	756.0	305.8	1,010	2,189	878.4	421.6	322.1	225.5	129.3	186.4	241.9	220.2
2009	538.3	1,581	1,772	1,075	556.8	217.4	475.5	590.5	750.3	427.1	557.5	1,465
2010	829.1	699.1	987.0	965.7	688.5	843.5	1,399	679.0	353.9	476.4	609.2	717.4

² http://waterdata.usgs.gov/ma/nwis/nwisman/?site_no=01094500

³ http://waterdata.usgs.gov/ma/nwis/nwisman/?site_no=01096500

2011	603.1	900.5	3,352	2,182	501.3	429.4	228.6	158.7	111.0	301.2	396.8	586.1
2012	383.5	462.7	2,122	1,216	853.5	669.6	360.9	525.6	1,059	1,249	1,286	1,464
2013	880.5	688.5	782.6	482.7	678.6	691.6	222.6	158.8	123.3			
Mean of monthly Discharge	622	680	1,160	1,270	741	518	282	234	249	358	502	629

E.2) Merrimack River – Lowell

Lowell

00060, Discharge, cubic feet per second,												
USGS 01100000 MERRIMACK RIVER BL CONCORD RIVER AT LOWELL, MA ⁴												
Monthly mean in ft ³ /s (Calculation Period: 2000-01-01 -> 2013-09-30)												
YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	6,741	6,228	17,730	23,170	12,660	7,469	3,515	4,627	2,414	2,966	5,314	8,666
2001	4,853	4,813	10,690	26,020	7,375	8,390	2,750	1,541	1,522	1,576	1,792	2,729
2002	2,097	3,592	7,048	12,310	11,920	8,273	2,173	1,067	1,241	2,325	5,879	7,093
2003	5,198	4,304	14,140	20,750	12,010	7,939	2,559	6,723	4,170	7,962	11,980	17,470
2004	7,896	3,984	7,225	22,730	11,930	5,850	3,397	4,406	5,755	3,982	5,196	12,870
2005	10,730	8,688	9,297	26,860	15,800	12,240	6,385	2,259	2,742	25,910	18,450	14,540
2006	18,900	15,640	7,222	7,554	27,810	22,410	9,813	4,035	2,671	7,123	18,580	10,720
2007	11,010	3,849	9,901	29,380	14,680	6,354	3,558	1,824	1,680	3,330	5,571	5,124
2008	9,558	16,780	21,030	26,640	11,910	3,638	6,668	11,490	9,661	8,346	11,010	18,740
2009	9,556	6,830	14,280	19,930	8,757	9,806	15,340	9,846	3,902	6,865	10,260	11,740
2010	9,600	9,669	30,160	23,600	5,670	3,497	1,895	1,442	1,196	6,258	7,714	9,715
2011	5,035	4,586	23,160	22,230	15,130	6,410	2,550	6,189	12,510	15,550	13,210	17,770
2012	9,686	6,767	9,956	6,298	10,730	10,060	1,968	2,710	2,313	4,834	7,909	7,375
2013	5,955	6,764	11,290	14,390	8,069	12,880	11,370	3,930	4,828			
Mean of Monthly Discharge	8,340	7,320	13,800	20,100	12,500	8,940	5,280	4,430	4,040	7,460	9,450	11,100

E.3) Millers River

00060, Discharge, cubic feet per second,												
USGS 01162000 MILLERS RIVER NEAR WINCHENDON, MA												
Monthly mean in ft ³ /s (Calculation Period: 2000-01-01 -> 2013-09-30)												
YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	109.1	151.8	429.4	342.0	207.5	188.3	46.3	109.6	61.8	99.6	105.9	166.7
2001	80.9	98.7	157.3	606.2	77.8	129.8	77.6	19.5	25.9	21.2	17.3	42.6
2002	38.1	91.8	156.1	175.0	181.0	150.9	23.9	10.4	12.3	25.4	99.7	135.2
2003	96.5	70.9	375.6	423.3	218.6	150.1	30.2	92.0	62.4	120.4	233.7	345.5
2004	149.1	67.9	162.2	446.3	173.5	58.3	38.0	55.1	146.9	122.2	109.8	256.4
2005	210.2	211.4	321.5	457.3	242.6	143.3	108.6	39.7	43.0	414.1	281.7	236.3
2006	341.5	276.2	68.0	75.2	237.3	198.8	78.7	29.7	40.8	153.0	272.3	122.6

4

http://waterdata.usgs.gov/ma/nwis/monthly?referred_module=sw&site_no=01100000&por_01100000_2=1267275,0006_0,2,1923-06,2014-04&start_dt=2000-01&end_dt=2014-04&format=html_table&date_format=YYYY-MM-DD&rdp_compression=file&submitted_form=parameter_selection_list

2007	168.8	53.8	178.9	597.8	164.3	64.3	39.8	19.8	18.1	32.0	90.2	118.3
2008	225.8	510.0	425.1	414.7	156.0	103.8	206.0	186.8	193.5	83.2	152.5	457.5
2009	226.8	169.2	285.0	249.0	129.9	221.4	252.4	149.6	48.2	117.5	204.4	174.4
2010	136.9	154.4	921.0	354.0	54.8	28.1	16.2	6.43	6.95	72.0	174.7	147.1
2011	54.3	62.1	570.8	289.2	142.3	110.5	27.9	144.6	252.8	259.7	352.2	377.4
2012	182.5	130.0	114.9	73.2	174.5	118.4	9.34	13.3	20.1	114.2	190.3	131.4
2013	127.4	179.8	212.6	286.4	165.0	303.0	55.2	39.5	56.2			
Mean of Monthly Discharge	153	159	313	342	166	141	72	65	71	126	176	209

E.4) Matrix Comparing Three Licensing Processes⁵

	Integrated Licensing Process (ILP)	Traditional Licensing Process (TLP)	Alternative Licensing Process (ALP)
Consultation w/ Resource Agencies and Indian Tribes	- Integrated	- Paper-driven	- Collaborative
FERC Staff Involvement	- Pre-filing [beginning at filing of Notice of Intent (NOI)] - Early and throughout process	- Post filing (after the application has been filed) - Available for education and guidance	- Pre-filing (beginning at filing the NOI) - Early involvement for National Environmental Policy Act (NEPA) scoping as requested
Deadlines	- Defined deadlines for all participants (including FERC) throughout the process	- Pre-filing: some deadlines for participants - Post-filing: defined deadlines for participants	- Pre-filing: deadlines defined by collaborative group - Post-filing: defined deadlines for participants
Study Plan Development	- Developed through study plan meetings with all stakeholders - Plan approved by FERC	- Developed by applicant based on early stakeholder recommendations - No FERC involvement	- Developed by collaborative group - FERC staff assist as resources allow
Study Dispute Resolution	- Informal dispute resolution available to all participants - Formal dispute resolution available to agencies with mandatory conditioning authority - Three-member panel provides technical recommendation on study dispute - OEP Director opinion	- FERC study dispute resolution available upon request to agencies and affected tribes - Office of Energy Projects (OEP) Director issues advisory opinion	- FERC study dispute resolution available upon request to agencies and affected tribes - OEP Director issues advisory opinion

⁵ <https://www.ferc.gov/industries/hydropower/gen-info/licensing/matrix.asp>

	binding on applicant		
Application	- Preliminary licensing proposal or draft application and final application include Exhibit E (environmental report) with form and contents of an EA	- Draft and final application include Exhibit E	- Draft and final application with applicant-prepared environmental assessment or third-party environmental impact statement
Additional Information Requests	- Available to participants before application filing - No additional information requests after application filing	- Available to participants after filing of application	- Available to participants primarily before application filing - Post-filing requests available but should be limited due to collaborative approach
Timing of Resource Agency Terms and Conditions	- Preliminary terms and conditions filed 60 days after Ready for Environmental Analysis (REA) notice - Modified terms and conditions filed 60 days after comments on draft NEPA document	- Preliminary terms and conditions filed 60 days after REA notice - Schedule for final terms and conditions	- Preliminary terms and conditions filed 60 days after REA notice - Schedule for final terms and conditions

F. Geothermal Power

F.1) Developer's Roadmap Document

Due to document size, the following link will provide access to the document. This document is for use as a guide to navigate federal laws, as it does not include State of Massachusetts laws. This gives further information for developers to analyze sites.

<http://en.openei.org/wiki/RAPID/Roadmap/Geo>

F.2) Ground Source Heat Pump Well Guide

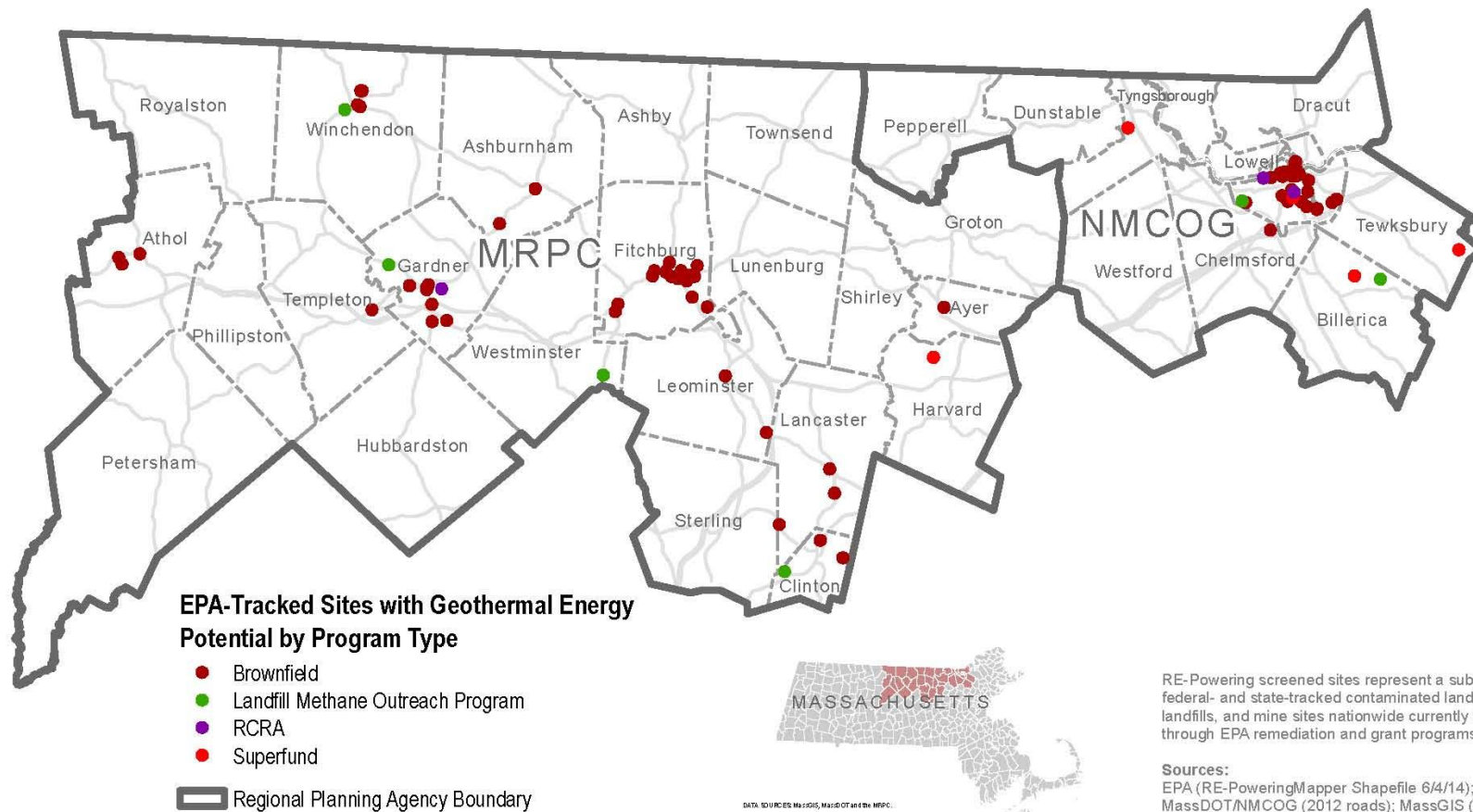
Due to document size, the following link will provide access to the document.

<http://www.mass.gov/eea/docs/dep/water/laws/a-thru-h/gshpguid.doc>

Further information can be found here: <http://www.mass.gov/eea/agencies/massdep/water/reports/geothermal-integration.html>

F.3) EPA Tracked Sites with Geothermal Energy Potential

EPA-Tracked Sites with Geothermal Energy Potential



Northern Middlesex Council of Governments
 40 Church Street, Suite 200
 Lowell, Massachusetts 01852-2686
 (978) 454-8021 nmcog.org

0 5 Miles



DATA SOURCES: MassGIS, MassDOT and the MRPC.
 DISCLAIMER: The information depicted on this map is for planning purposes only. All data are representative and are not adequate for boundary definition, regulatory interpretation, or precise location analysis.
 PREPARED BY:
 Massachusetts Regional Planning Commission
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RE-Powering screened sites represent a subset of federal- and state-tracked contaminated lands, landfills, and mine sites nationwide currently tracked through EPA remediation and grant programs.

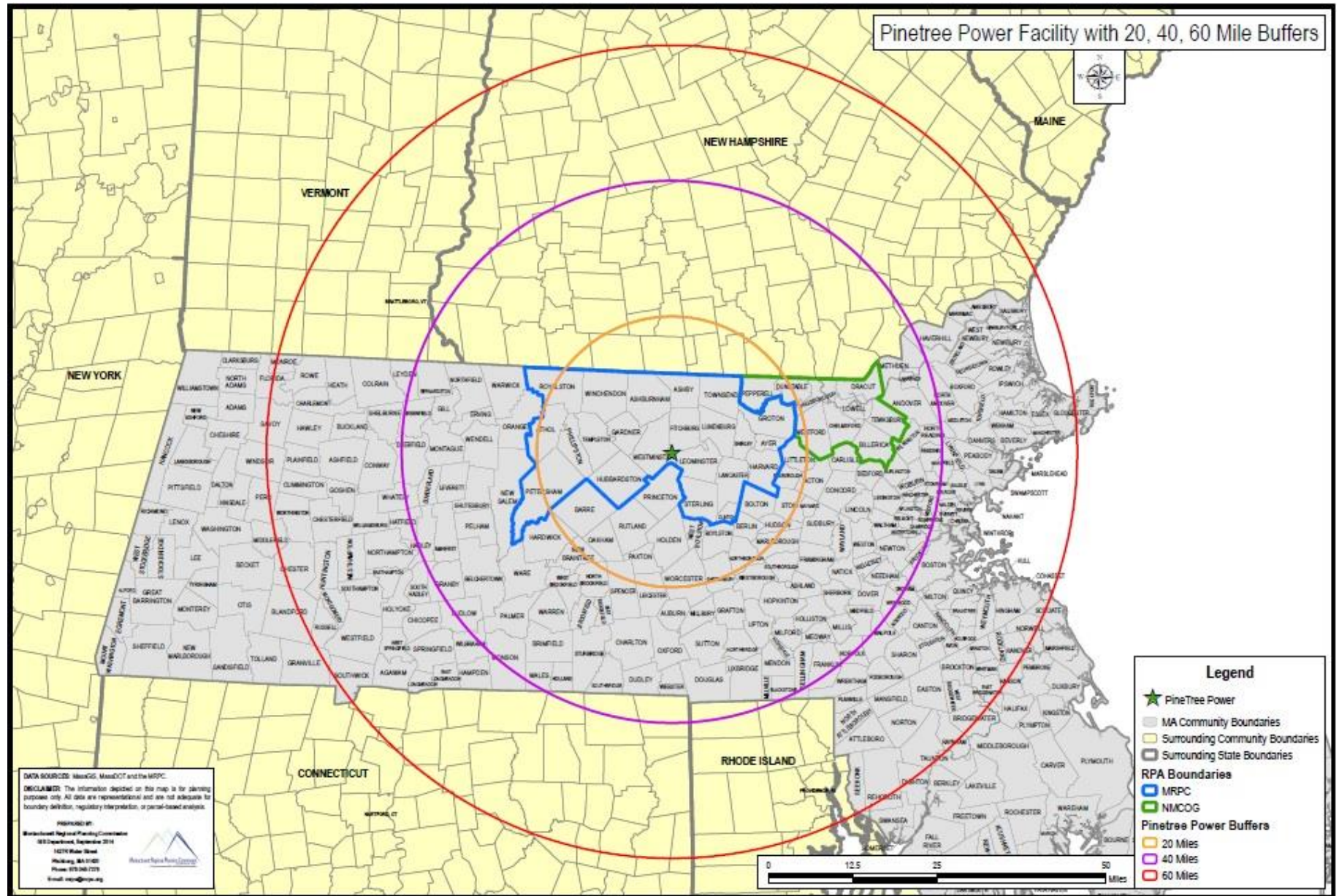
Sources:
 EPA (RE-PoweringMapper Shapefile 6/4/14);
 MassDOT/NMCOG (2012 roads); MassGIS (town boundaries)

Data provided on this map is not sufficient for either boundary determination or regulatory interpretation.

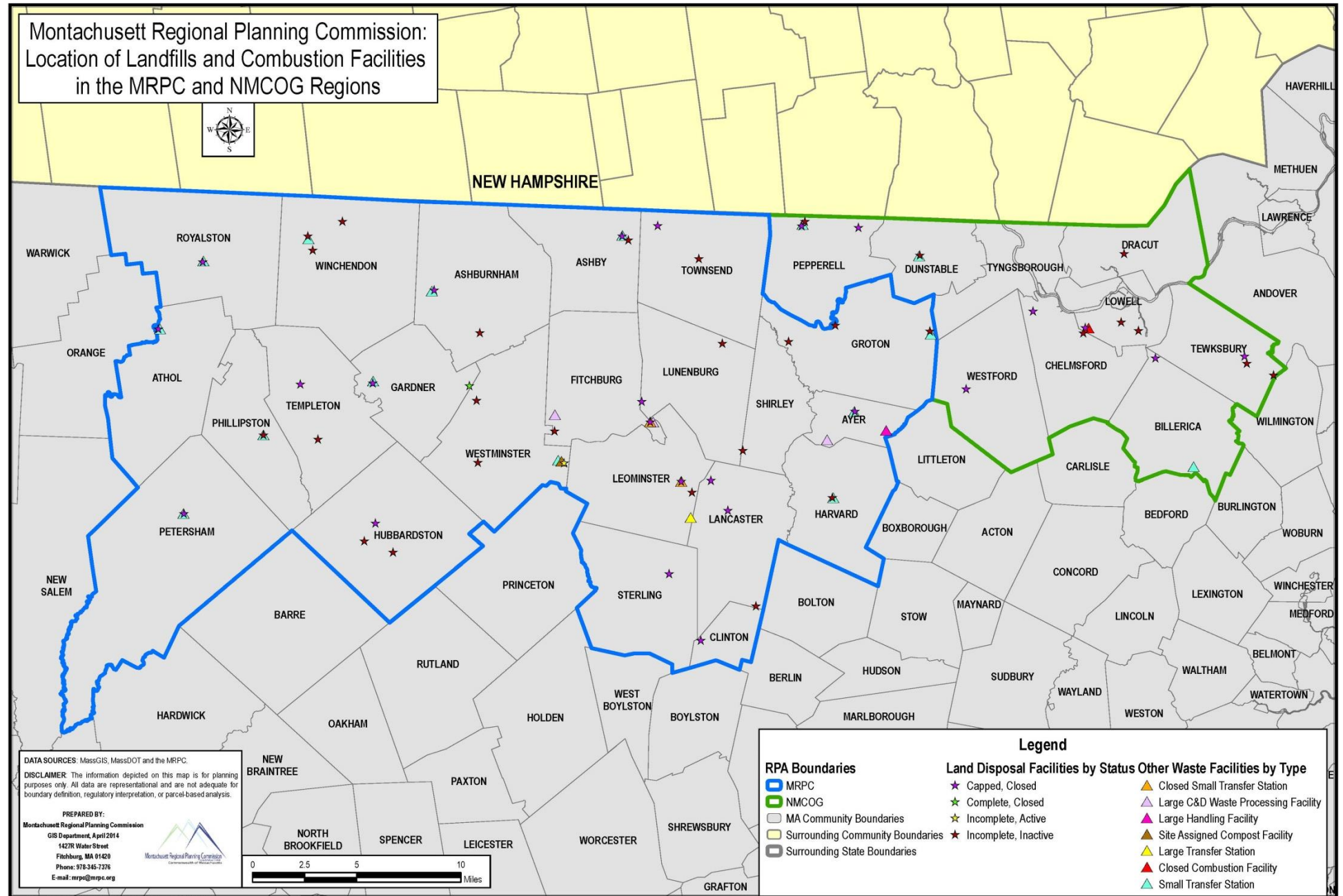
Produced by MRPC: 8/13/2014

G. Biomass Power

G.1) Map of Efficient Fuel Sourcing for Westminster Pinetree Power Plant

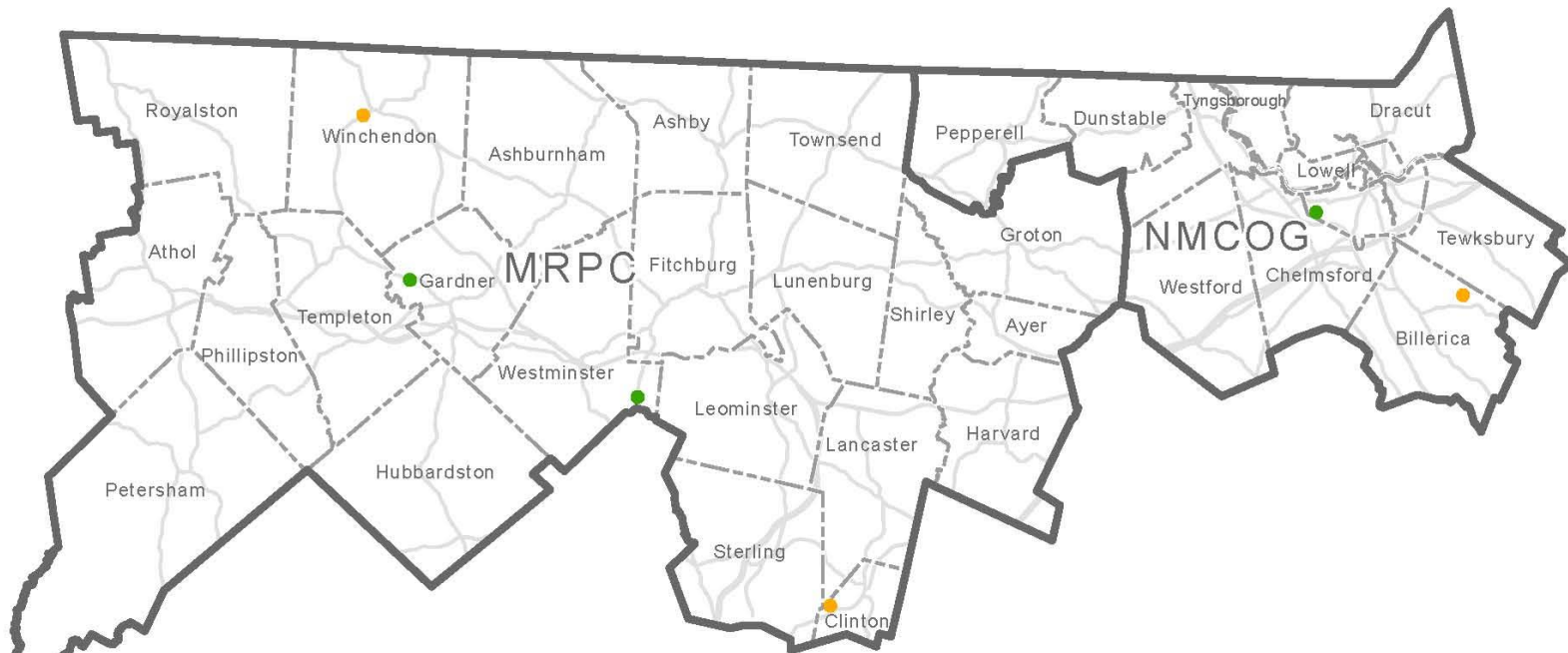


G.2) Map of Landfill Gas Sources



C.3) EPA Tracked Sites for Landfill Gas

EPA-Tracked Sites with Landfill Energy Potential



EPA-Tracked Sites with Landfill Energy by Program Type

- Landfill Methane Outreach Program (Potential)
- Landfill Methane Outreach Program (Operational)

▬ Regional Planning Agency Boundary



DATA SOURCES: MassGIS, MassDOT and the MRPC.
DISCLAIMER: The information depicted on this map is for planning purposes only. All data are representational and are not adequate for boundary definition, regulatory interpretation, or parcel-based analysis.

PREPARED BY:
Massachusetts Regional Planning Commission
615 Department, August 2014
14.270 Water Street
Rutland, MA 01543
Phone: 253-2434-1205
Email: info@mrpc.org



RE-Powering screened sites represent a subset of federal- and state-tracked contaminated lands, landfills, and mine sites nationwide currently tracked through EPA remediation and grant programs.

Sources:
EPA (RE-PoweringMapper Shapefile 6/4/14);
MassDOT/NMCOG (2012 roads); MassGIS (town boundaries)

Data provided on this map is not sufficient for either boundary determination or regulatory interpretation.

Produced by MRPC: 8/13/2014



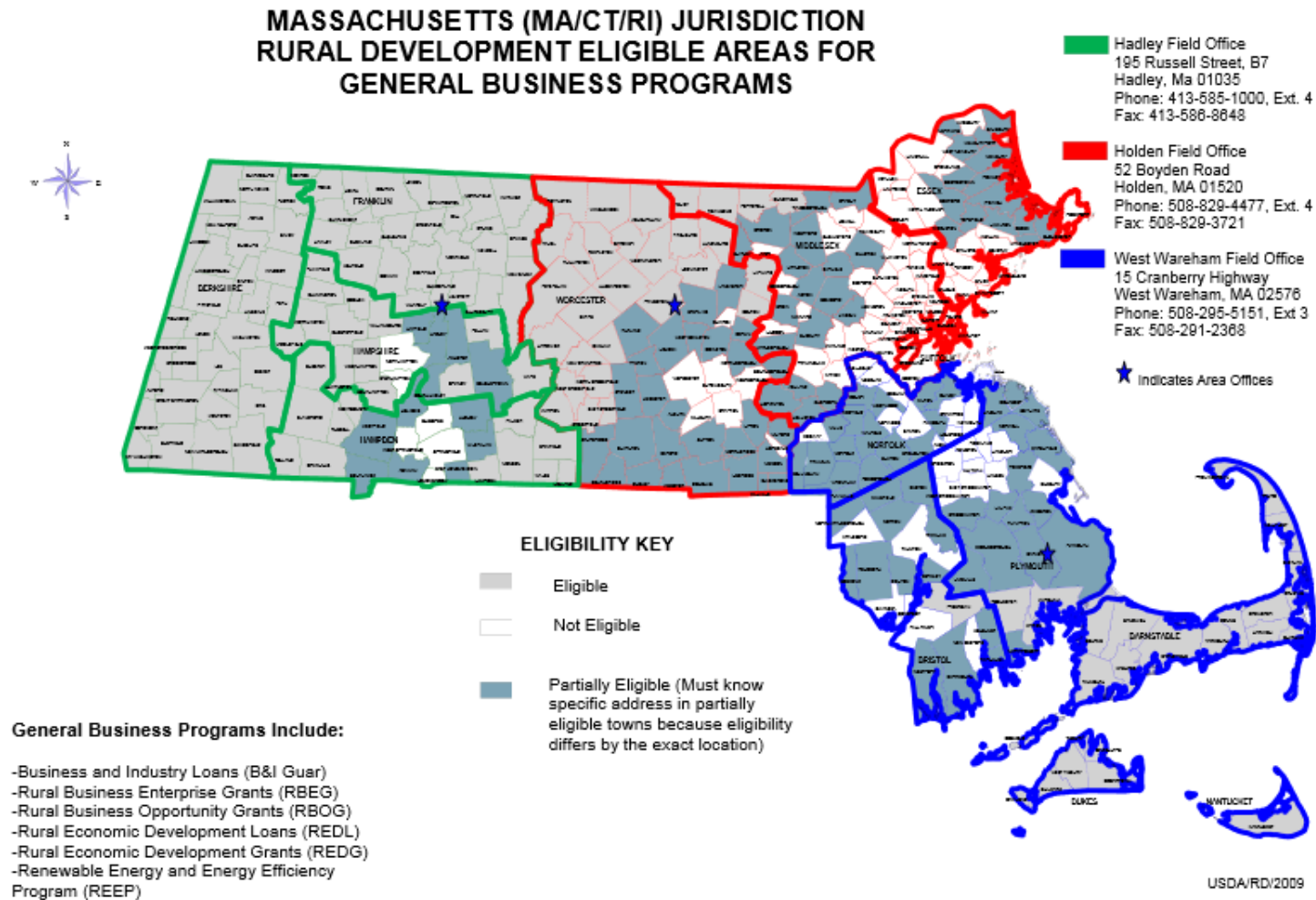
Northern Middlesex Council of Governments
40 Church Street, Suite 200
Lowell, Massachusetts 01852-2686
(978) 454-8021 nmcog.org

0 5 Miles



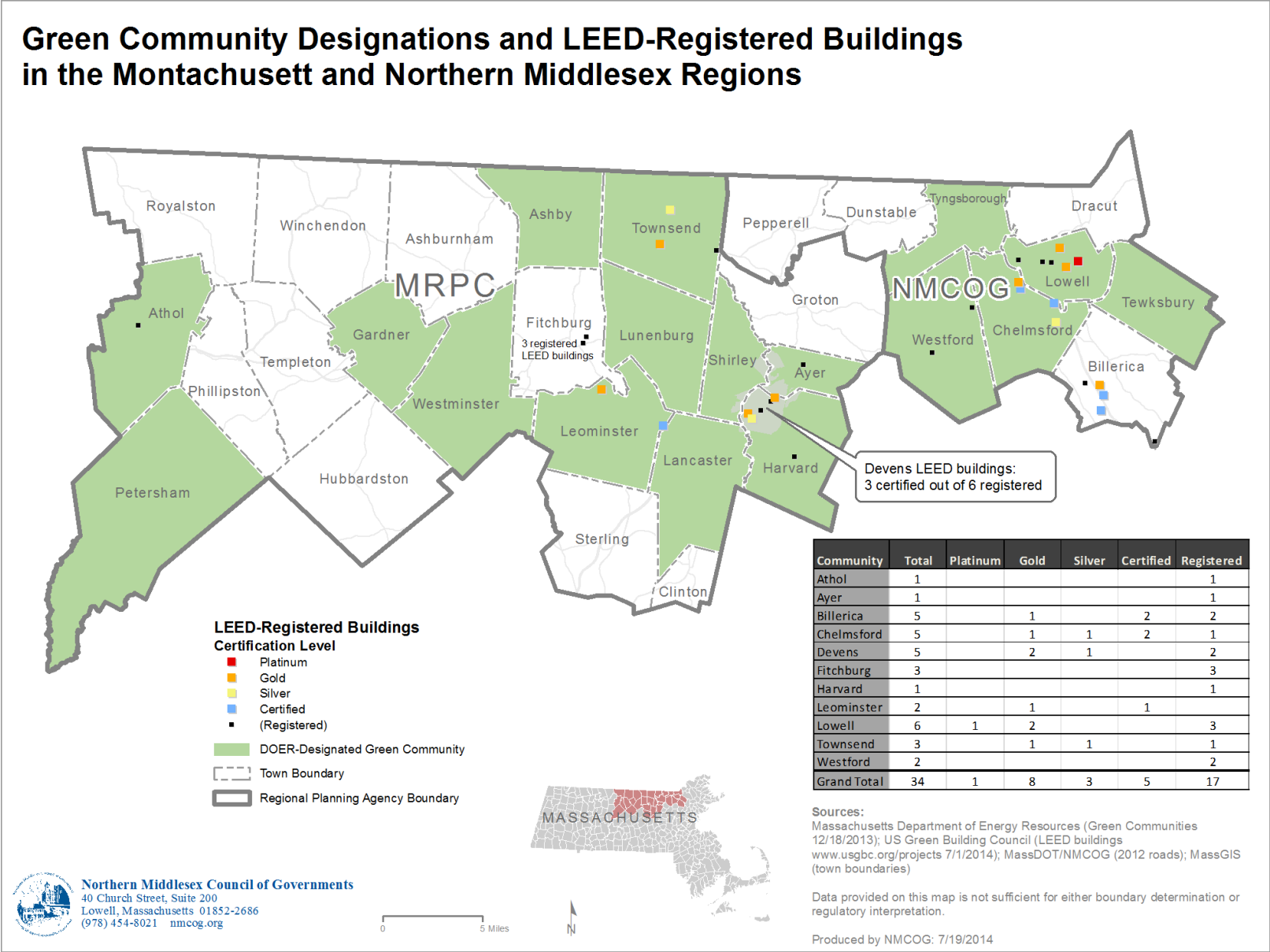
H. Power Generation/Installation Incentives

H.1) REAP Eligibility Map



I. LEED Certification

I.1) Map of LEED Certified Structures and Green Communities



J. Renewable Energy Manufacturing and Labor Force Assessment

J.1) Zoning in the Northern Middlesex Region

Community	Heavy Manufacturing / Manufacturing		Light Manufacturing		Condition/requirement	Laboratory and Research/ Office Park Facilities		Comment
	By right	Special permit	By right	Special permit		By right	Special permit	
Billerica	No	No	I-Industrial	GB-General Business C- Commercial District	Manufacturing shall consist only of products primarily for sale at retail on the premises where manufactured and there shall be no more than 5 full-time employees or their equivalent	No	NB-Neighborhood Business GB-General Business C - Commercial I-Industrial AE-Adult Entertainment	Potentially some renewable energy facilities firms would be categorized as light industry
Chelmsford	No	No	IS – Special Industrial District IA - Limited Industrial District	CB Roadside Commercial District.	-	No	No	-
Dracut	No	Yes – I2	I1 Industrial 1 I2- Industrial 2 If less than 50,000 sqf gfa	Yes if more than 50,000sqft gfa	-	No	No	Renewable energy facilities firms would be categorized as light industry
Dunstable	No	No	No	B-3 Expanded Commercial District	building shall not exceed 36' feet and the minimum area of any tract to be developed shall be 100,000 square feet. No building shall serve to occupy an area larger 25% of the lot size, nor shall any parking area, adequate for the use of the building cover an area greater than 25% of the lot size.	No	No	-

(Continued)

Community	Heavy Manufacturing/ Manufacturing		Light Manufacturing		Condition/Requirement	Laboratory and Research/ Office Park Facilities		Comment
	By Right	Special Permit	By right	Special Permit		By right	Special Permit	
Lowell	No	LI: Light Industry, Manufacturing, & Storage GI: General Industry	LI: Light Industry, Manufacturing, & Storage GI: General Industry	RR - Regional Retail District DMU - Downtown Mixed-Use District HRC High- Rise Commercial District INST Institutional Mixed-Use District OP- Office / Research Park	-	SMU- Suburban Mixed-Use District RR - Regional Retail District DMU- Downtown Mixed-Use District HRC High-Rise Commercial District INST Institutional Mixed-Use District OP- Office / Research Park LI: Light Industry, Manufacturing, & Storage GI: General Industry	TMU UMU	-
Pepperell	I - Industrial	C-Commercial	C-Commercial I- Industrial	No	-	No	No	-
Tewksbury	No	HI -Heavy Industry OR- Office Research zones Manufacturing of large machine parts is prohibited	HI -Heavy Industry OR- Office Research zones	No	Research laboratories, manufacture of equipment, electronics industry, assembling of electrical appliances	No	No	-
Tyngsborough	No	I-1	I-1 (cannot exceed 10,000sqf)	B-4		I-1 (cannot exceed 10,000sqf)	B-4	
Westford	No	No	IH-Industrial Highway IA - Industrial A IB - Industrial B IC - Industrial C ID - Industrial D	No		CH Commercial Highway IH Industrial Highway IA Industrial A IB Industrial B IC Industrial C ID Industrial D		

Note: These zones are mapped in Section 6, which identifies potential available land supply.

J.2) Zoning in the Montachusett region

Community	Heavy Manufacturing / Manufacturing		Light Manufacturing		Condition/requirement	Laboratory and Research/ Office Park Facilities		Comment
	By right	Special permit	By right	Special permit		By right	Special permit	
Harvard	No	No	No	No	-	No	No	-
Lancaster	No	No	GI	LI LI2	All Buildings or Structures be at least 10 feet from a Residential District.	LI and LI2	EZ	Potentially some renewable energy facilities firms would be categorized as light industry
Lunenburg	No	No	No	Yes	All Buildings or Structures be at least 10 feet from a Residential District.		Yes in the Industrial District	
Fitchburg	No	No	LI and I	CBD, NBD and C & A	Min. 65,000 sf w/o sewer Min with sewer: LI- 43,560 sf NBD, CBD, C & A, and I- No minimum MS- Min 15,000 sf	I and MS	CBD, NBD, C& A, and LI	
Wichendon	No	PD	C1 and I	C2 PD	Min lot area: C1- 75,000 sf C2- 20,000 sf I- 43,560 sf PD- 5,000 - 10,000 sf Max coverage: C1 & C2 45%, I none, PD 70%	C1 and I	C2 PD	
Templeton	No	no	no	CIA and CIB	Min 1 acre	no	CIA and CIB	-
Athol	No	G and I	G	existing building- RA, RC, CA, CB, I New Building- I	Min lot area: I- 40,000 sf, G and CB- 10,000 sf, CA none, RA- 8,000 sf, and RC- 44,000 sf Max lot coverage: RA 20 %, RC 15%, CA 50%, CB 30%, G 40%, I 35%	No	in all districts	-
Ayer	No	No	LI and HI	GB	LI at lease 120,000 sf HI at least 30,000 sf 50% building coverage	LI and HI	DB and GB	
Clinton	No	I	I	C	Min. lot size 12,000 sf	I	C	No
Leominster	I, MU1, and MU2	No	I, MU1, and MU1	C	Min. lot area: 5,000 sf	C, I, MU1, and MU2	BB	
Ashby	No	I	No	I	Min. lot size 60,000 sf Max building coverage: 35%	No	I	No
Ashburnham	No	No	LI-A, LI-B, and I		Min lot size: 60,000 sf Max lot coverage: LI-A and LI- B 40%, I 30%	LI-A, LI-B, B, and I	R-A, R-B VC-C, VC-R WSP	
Hubbardston	No	No	No	LI	Min. 100,000 sf Max coverage 50%	No	LI	
Groton	No	No	M-1	No	Min. 40,000 sf	No	B-1	

Community	Heavy Manufacturing / Manufacturing		Light Manufacturing		Condition/requirement	Laboratory and Research/ Office Park Facilities		Comment
	By right	Special permit	By right	Special permit		By right	Special permit	
					max coverage 25%		M-1	
Sterling	No	No	LI	No		No	No	
Townsend	ID	ID	ID	ID	Min. lot 45,000 sf Max. lot coverage 25% special permit required for buildings with a gross floor area greater than 25,000 sf	No	No	
Gardner	No	I-1 and I-2	I-1 and I-2	Comm-1 Comm-2	Comm 1: Min 10,00 sf, 30% coverage Comm 2:Min 30,000 sf, 50% coverage I-2: Min 30,000 sf, 50% coverage I-1: Min. 10,000 sf, 65% coverage	I-1 and I-2	Comm-2	
Phillipston	No	C-I	C-I	No	Min. 40,000 sf Max coverage 40%	C-I	No	

J.3) MRPC Energy Siting Transportation Review

Study Area

The study area consists of all Industrial zoned property that is located within 2½ miles of major transportation routes (major roadways, highways and active freight and rail lines). These areas would be considered ideal for manufacturing. These areas were then broken down into smaller, more detailed, zones. Zones were then given a numerical identifier within each community. The study area was narrowed down further by creating a matrix database of all major roadway routes to and from each industrial zone to the nearest major highway (Route 2 and Interstate 190 and 495). For consistency, these routes were based on directions from Google Maps.

Data Collection

The following data was collected for this study:

Distance to a Major Highway

Distance to a major highway is significant for any type of manufacturing facility. The distance to the highway for all directions (north, south, east and west) was calculated for each industrial zone. The top five locations that were closest to the highway are shown in the table below. The locations that had multiple routes, depending on the direction the trucks might be traveling, were averaged.

Community	Industrial Zone	Average Miles to Major Highway
Lancaster	3	3.00
Leominster	2	3.00
Leominster	9	3.23
Fitchburg	10	3.46
Leominster	10	3.79

Crash data with severity

The MRPC has accident data available from the Massachusetts Department of Transportation (MassDOT). The most recent data, years 2009-2011, were used. All recorded crashes in the study area were calculated through a Geographic Information System (GIS). Each crash was classified by the following severity types:

- Fatal Crash - A crash that results in at least one human fatality.
- Injury - A crash that results in an injury to at least one human. It can be a serious or non-serious injury.
- Non-Injury/Property Damage Only - A crash that does not result in either a fatality or an injury to a human. It involves only damage to the vehicle, or vehicles, involved in the crash or other types of property.

Based on the above information, the Equivalent Property Damage Only (EPDO) method was used to classify locations with high crash severity.

The Equivalent Property Damage Only (EPDO) Method takes into account the total number of crashes at a location and the severity of each crash. This system is currently used by MassDOT in its development of the Top 1000 Crash Locations in the State of Massachusetts.

The EPDO method is a system of ranking intersections in terms of safety. The system is point based with different types of crashes receiving different point values. The scoring is based as follows:

- 1 point for a Property Damage Only Crash or Not Reported/Unknown Severity Crash
- 5 points for an Injury Crash
- 10 points for a Fatal Crash

The formula for determining the EPDO is as follows:

$$\text{EPDO} = (1 \times \text{Number of Property Damage Only Crashes}) + (5 \times \text{Number of Injury Crashes}) + (10 \times \text{Number of Fatal Crashes})$$

The five industrial zones with the lowest EPDO rating are shown below. These scores were determined by averaging the EPDO scores along the routes to the major highways.

Community	Industrial Zone	EPDO Score
Leominster	5	28
Phillipston	3	32
Phillipston	4	37
Shirley	2	41
Phillipston	1	42

Pavement Condition

MRPC, in cooperation with MassDOT, maintains pavement condition data on all Federal Aid eligible miles of roadway in the Montachusett region in what is known as a Pavement Management System (PMS). The Montachusett Pavement Management System is a tool used to provide an ongoing inventory of pavement conditions along this network in the region. The data maintained is utilized when prioritizing projects for federal funding and assessing current and future needs in our infrastructure.

Through our existing Pavement Management Program, we were able to identify the pavement condition of each roadway within the study area. This data was compiled into a table to show which roadways were in need of repairs and which ones were in good condition to accommodate truck traffic.

A Pavement Management System (PMS) is a systematic process that collects and analyzes roadway pavement information for use in selecting cost-effective strategies for providing and maintaining pavements in a serviceable condition. The role of a PMS is to provide an opportunity to improve roadway conditions and to help make cost-effective decisions on maintenance priorities and schedules.

The 5 industrial zones with the best pavement conditions to and from the major highways are shown below. The percentages were calculated based on the average of roadway miles for each industrial zone and the corresponding condition.

Community	Industrial Zone	Pavement Conditions (%)				No Data
		Excellent	Good	Fair	Poor	
Lancaster	3	84%	12%	3%	1%	0%
Leominster	2	84%	12%	3%	1%	0%
Fitchburg	3	81%	1%	18%	0%	0%
Fitchburg	10	68%	23%	2%	6%	0%
Fitchburg	12	65%	1%	17%	18%	0%

Bridge Data

Within the 22 communities of the Montachusett planning area, 359 bridges are identified and rated by MassDOT as part of their inventory system. MassDOT has provided a Bridge Rating Table to the MRPC that includes the town where the bridge is located, the road name the bridge is located on, the bridge identification number, functional classification of the road, year built, historical significance, rebuilt date (if applicable), AASHTO (American Association of State Highway and Transportation Officials) rating, and the deficiency status of each bridge, i.e. structurally deficient or functionally obsolete.

Structurally Deficient bridges are the main concern in terms of repair priorities. A Structurally Deficient bridge is not necessarily unsafe but is deteriorated to a point where it must be closely monitored and inspected or repaired. A bridge that is *Functionally Obsolete* is also not necessarily unsafe but may not have adequate lane widths, shoulder widths, or vertical clearances to serve current traffic demand.

In order to maintain an efficient movement of goods and people, a responsive and adequately funded bridge maintenance system is essential. Bridge closings and weight restrictions alter traffic patterns by forcing vehicles to find alternate routes frequently leading through residential streets. The result is

increased congestion and pollution, potential loss of business, the potential for more accidents and failure of the emergency planning process.

Structurally Deficient and Functionally Obsolete bridges were identified that lie within the study area. The Industrial zones that have road network access without bridges identified as Structurally Deficient or Functionally Obsolete are shown below.

Community	Industrial Zone
Fitchburg	3
Fitchburg	4
Fitchburg	6 E
Fitchburg	7 W
Fitchburg	8
Community	Industrial Zone
Fitchburg	9
Fitchburg	10
Fitchburg	11
Fitchburg	12
Gardner	5
Gardner	6
Gardner	7 W
Gardner	9
Gardner	10
Lancaster	2
Lancaster	3
Leominster	1
Leominster	2

Leominster	3
Leominster	4
Leominster	5
Leominster	6
Leominster	11
Phillipston	1
Phillipston	2
Phillipston	3
Phillipston	4
Phillipston	5
Shirley	1 E
Shirley	2
Shirley	3
Shirley	4
Shirley	5
Shirley	6 W
Sterling	1
Sterling	2
Sterling	3
Sterling	4
Sterling	5
Westminster	2
Westminster	3
Westminster	4

Westminster	5
Westminster	6

*Zones with a letter (W, E, S, N) represent the direction that one would travel to access the highway. (ex. traveling to Route 2 westbound would be “W”)

Goods Movement Survey data

In 2012, the MRPC sent out surveys to each community asking for feedback regarding problems or concerns on their roadways, rail systems or airports that are either caused by or inhibit the movement of goods. Some responses included high truck traffic on residential streets, inadequate areas for trucks to load/unload, bridge clearance and weight restrictions, and lack of climbing lanes. Comments that can be attributed to a particular industrial zone are listed below.

Community	Industrial Zone	Goods Movement Comment
Fitchburg	7	Area where trucks need extra space to pull over & let traffic pass
Lancaster	2	Heavy truck use
Leominster	1S	High crash location
Phillipston	3	Culvert weight limits
Shirley	1	More guard rails needed
Shirley	3	Concerns regarding Dunkin Donuts
Shirley	4	Increased traffic from Devens Village Square
Shirley	5	Trucks loading/unloading
Shirley	6	Increased traffic from Devens Village Square
Sterling	2	Trucks loading/unloading along Main St
Sterling	3	Trucks loading/unloading along Main St
Sterling	4	High crash Location
Sterling	5	High crash location

Industrial Parks

Currently open and operating Industrial parks within the region were identified and located on community maps. Since established industrial parks are more likely to have the infrastructure in place

to support an energy manufacturing site, these locations may represent a higher importance to potential users. The sites with industrial parks are listed below.

Community	Industrial Zone	Ind. Park
Ayer	1	Y
Ayer	7	Y
Fitchburg	1	Y
Fitchburg	10	Y
Fitchburg	7	Y
Gardner	1	Y
Gardner	4	Y
Gardner	6	Y
Gardner	10	Y
Lancaster	3	Y
Leominster	2	Y
Leominster	3	Y
Leominster	5	Y
Leominster	6	Y
Leominster	1	Y
Sterling	4	Y

Recommendations or Conclusions

In conclusion, the Transportation element of this document has many components. Depending on the company or organization seeking the manufacturing site, the search criteria may vary. It would not be viable to assume what the top locations would be in this instance. Because of this, the data was prioritized for each data set so that those involved can make their own judgments based on which criteria are most important to fit their particular needs.

J.4) NMCOG Energy Siting Transportation Review

Introduction

The study area consists of all industrial zoned area within the Northern Middlesex Region and all major roadways leading to these zones. In this section, the roadway network will be identified and any hindrances to transportation related access around these industrial zones will be outlined. Map 1 provides the overview, showing locations of industrial zones, the existing transportation roadway and rail network, high crash locations throughout the network, and functionally obsolete and structurally deficient bridges.

Major Roadways

Limited Access Highways

The NMCOG region is served by three (3) limited access highways that carry people and goods to and from locations within the region as well as outside of the region. These include I-495, I-93, and US Route 3. Map 1 shows that the majority of industrial zones in the region buffer these three limited access highways as the industry relies on mobility.

Interstate 495 is a six lane highway running in a north south direction for nearly 14 miles in the Northern Middlesex Region. Outside of the region, the circumferential roadway begins in southeast Massachusetts and ends in northeast Massachusetts connecting to the major roadways serving the Metro Boston area including I-90, I-95, and I-93. Average daily traffic volumes along I-495 in the region range from 97,000 to 123,000 vehicles per day and the posted speed limit is 65 mph.

A short segment of **Interstate 93** runs through the Town of Tewksbury in the Northern Middlesex region. I-93 runs in a north-south direction connecting Boston to New Hampshire in the North and I-95 just south of the City. In the Northern Middlesex region, the roadway is six lanes in with the highway adding a lane in each direction just south of the Tewksbury/Andover Town line. Daily volumes average 161,175 vehicles per day.

In the Northern Middlesex region, **U.S. Route 3 North** is generally a six lane limited access highway running in a north-south direction approximately 15 miles from the New Hampshire state border to the Bedford Town Line. Route 3 sees traffic volumes ranging from 90,000 to 120,000 vehicles per day.

Arterials/Collectors

Below the limited access highways in the hierarchy of functional class lay the arterial and collector classes. These roadways carry people and goods to/from the limited access highways to/from the industrial zones laid out in Map 1. Examples of arterials include State numbered routes such as Route 113 in Dracut providing industrial zone access to/from I-93 in Methuen, or Route 111 in Pepperell providing industrial zone access to/from Route 3 in Nashua NH.

Rail Network

In addition to the highway network, the Northern Middlesex Region is served by freight railroad lines providing access to industrial zones. The region is directly served by Pan Am Railways to move materials through the region to final destination points. The area serves as a major connection for freight movement by rail between New Hampshire and Massachusetts. Map 1 provides an overview of the active rail lines running through the region. These include the Stony Brook Freight Main Line (Ayer to North Chelmsford), the NH Route Branch (North Chelmsford to Lowell), the Lowell Branch (Bleachery to Lowell Junction), and the Northern Main Line (North Chelmsford to NH State Line).

Safety Analysis

The goal of the safety analysis is to identify high crash locations along roadways leading to located industrial zones within the region. The identification of high crash locations is based on a three-year study period (2009-2011), in order to reduce annual variations that can be created by construction, road closures, or variable factors involving reporting frequency on the part of local police departments. The crash data analyzed has been provided by the Massachusetts Department of Transportation (MassDOT). The Massachusetts Registry of Motor Vehicles (RMV) receives all crashes from local and state police departments. From there, the RMV builds a database of crashes throughout the state. Once this database is complete, MassDOT receives the data where it is mapped using Geographic Information Systems (GIS) methodologies. Once the GIS work is complete, the data is provided to NMCOG. Once this database is made available, the process of locating the various intersections associated with the crash data points can be completed. NMCOG flags intersections that experience 15 or more crashes in a three-year period as candidate locations for a list of high crash locations. A more detailed review of each record associated with each candidate intersection is then performed to determine the top crash intersections in the region.

The ranking system is based on the Equivalent Property Damage Only (EPDO) method. Each crash is assigned a numeric value based on the reported severity of the crash. Using the EPDO ranking system, property damage only crashes are assigned one (1) point, injury crashes are assigned five (5) points, and fatal crashes are assigned ten (10) points. The points assigned to each crash at a given location are then added to determine the intersection's EPDO value.

On **Map 1**, the latest top 100 high crash list was inserted to identify any safety concerns along roadways leading to industrial zones. For example, many industrial zones in Lowell are located along the south side of the Merrimack River near bridges. At the intersections on either side of any Merrimack River bridge, safety is usually a concern with high crash locations located at river crossing intersections. The latest top 110 high crash intersection list is included in the following table.

2009-2011 Northern Middlesex Region Top Crash Locations –At grade intersections

Rank 2009-2011	Intersection	Community	Total Crashes 2009-2011	PDO Crashes 2009-2011	Injury Crashes 2009- 2011	Fatal Crashes 2009-2011	EPDO 2009- 2011
1	VFW Highway/Varnum Ave at School St/Mammoth Rd	Lowell	146	113	33	0	278
2	VFW Highway at Bridge St	Lowell	119	83	36	0	263
3	Wood St at Middlesex St	Lowell	116	91	25	0	216
4	VFW Highway at Aiken St	Lowell	64	40	24	0	160
5	Appleton St/Church St at Central St	Lowell	66	45	21	0	150
6	Rte 3A (Thorndike St) at Highland St	Lowell	61	41	20	0	141
7	School St at Pawtucket St	Lowell	51	34	16	1	124
7	Rte 38 (Nesmith St) at Rte 133 (Andover St)	Lowell	60	44	16	0	124
9	Rte 3A (Westford St) at Wilder St	Lowell	59	44	15	0	119
9	Rte 110 (Chelmsford St) at Plain St/Powell St	Lowell	55	39	16	0	119
11	Rte 38 (Main St) at Shawsheen St	Tewksbury	54	41	13	0	106
11	Wood St at Rte 113 (Pawtucket Blvd)	Lowell	50	36	14	0	106
13	Father Morrisette Boulevard at Cabot St	Lowell	37	20	17	0	105
14	School St at Branch St	Lowell	44	29	15	0	104
15	Dutton St at Fletcher St	Lowell	50	37	13	0	102
16	VFW Highway at Riverside St	Lowell	35	19	16	0	99
17	Bridge St at French St	Lowell	53	43	10	0	93
18	Salem St at South St	Tewksbury	55	46	9	0	91
19	Pawtucket St at Fletcher St	Lowell	43	32	11	0	87
20	Rte 113 (Riverside St) at University Ave	Lowell	41	30	11	0	85
21	Rte 110 (Littleton Rd) at Boston Rd	Westford	67	64	3	0	79
22	Middlesex St at Stevens St	Lowell	22	8	14	0	78
23	Lakeview Ave at Aiken St	Lowell	33	22	11	0	77
23	Rte 38 (Bridge St) at Rte 113 (Arlington St)	Dracut	29	17	12	0	77
25	Church St at Lawrence St	Lowell	36	26	10	0	76

Rank 2009-2011	Intersection	Community	Total Crashes 2009-2011	PDO Crashes 2009-2011	Injury Crashes 2009- 2011	Fatal Crashes 2009-2011	EPDO 2009- 2011
26	Broadway at Wilder St	Lowell	23	10	13	0	75
27	Broadway at Fletcher St	Lowell	38	29	9	0	74
27	Andover St at High St	Lowell	46	39	7	0	74
29	Rte 3A (Westford St) at School St	Lowell	34	25	9	0	70
30	Rte 3A (Princeton St) at Wood St	Lowell	37	29	8	0	69
31	Rte 113 (Kendall Rd) at Rte 3A (Middlesex Rd)	Tyngsborough	36	28	8	0	68
32	Lakeview Ave at Mammoth Rd	Dracut	27	17	10	0	67
33	Mammoth Rd at Fourth Ave	Lowell	30	21	9	0	66
34	Gorham St at Elm St/Highland St	Lowell	37	30	7	0	65
35	Rte 110 (Chelmsford St) at Stevens St/Industrial Ave	Lowell	27	18	9	0	63
35	VFW Highway at University Ave	Lowell	35	28	7	0	63
37	Rte 38 (Bridge St) at Third St	Lowell	26	17	9	0	62
37	Rte 129 (Salem Rd) at Gray St	Billerica	22	12	10	0	62
39	Rte 38 (Rogers St) at Boylston St	Lowell	37	31	6	0	61
40	Central St at Market St	Lowell	35	29	6	0	59
41	Rte 3A (Boston Rd) at Shawsheen Rd	Billerica	22	13	9	0	58
42	Middlesex St at Baldwin St	Lowell	25	17	8	0	57
42	Andover Rd/Shawsheen St at Whipple Rd	Billerica/ Tewksbury	29	22	7	0	57
42	Broadway at Walker St	Lowell	25	17	8	0	57
42	Plain St at Manufacturers St	Lowell	37	32	5	0	57
46	Broadway at School St	Lowell	28	21	7	0	56
46	Rte 3A (Boston Rd) at Wyman/Webb Brook Rd	Billerica	32	26	6	0	56
46	Route 113 (Riverside St) at Sparks St	Lowell	24	16	8	0	56
46	Middlesex St at Wilder St	Lowell	28	21	7	0	56
50	Rte 133 (Andover St) at Clark Rd	Lowell	19	10	9	0	55

Rank 2009-2011	Intersection	Communi ty	Total Crashes 2009-2011	PDO Crashes 2009-2011	Injury Crashes 2009- 2011	Fatal Crashes 2009-2011	EPDO 2009- 2011
51	Rte 3A (Boston Rd) at Bridge Street	Billerica	22	14	8	0	54
51	Dutton St at Broadway St	Lowell	30	24	6	0	54
51	East St at Livingston St	Tewksbury	21	14	6	1	54
54	Westford St at Stedman St	Lowell	21	13	8	0	53
54	Rte 40 (Groton Rd) at Dunstable Rd	Westford	29	23	6	0	53
56	Rte 3A (Gorham St) at Moore/Dix St	Lowell	32	27	5	0	52
56	Route 38 (Main St) at Pleasant St	Tewksbury	28	22	6	0	52
56	Rte 4 (North Rd) at Rte 3A (Princeton St)	Chelmsford	24	17	7	0	52
56	Drum Hill Rd at Parkhurst Rd	Chelmsford	28	22	6	0	52
56	Middlesex St at School St	Lowell	24	17	7	0	52
61	Rte 3A (Frost Rd) at Rte 113 (Pawtucket Blvd)	Tyngsborough	23	16	7	0	51
61	Rte 38 (Nesmith St) at Stackpole St	Lowell	23	16	7	0	51
61	Rte 129 (Salem Rd) at Pond St	Billerica	23	16	7	0	51
64	Rte 38 (Main St) at Astle St/Pike St/Veranda Ave	Tewksbury	34	30	4	0	50
65	Middlesex St at Pawtucket St	Lowell	15	8	6	1	48
65	Rte 38 (Rogers St) at Douglas Rd/Phoenix Ave	Lowell	24	18	6	0	48
67	Rte 38 (Bridge St) at W. Sixth St	Lowell	27	22	5	0	47
67	Westford St at Technology Dr	Lowell	19	12	7	0	47
67	Wood St at Westford St	Lowell	23	17	6	0	47
67	Rte 3A (Boston Rd) at Charnstaffe Ln	Billerica	23	17	6	0	47
71	Rte 3A (Boston Rd) at Cook St	Billerica	18	11	7	0	46
72	Pawtucket St at Wilder St	Lowell	17	10	7	0	45
73	Rte 113 (Pleasant St) at Lakeview Ave	Dracut	24	19	5	0	44
73	Bridge St/Prescott St at Merrimack St (Kearney Square)	Lowell	24	19	5	0	44
73	Andover St at Concord St	Lowell	24	19	5	0	44
73	Route 113 (Main Street) at Mill/Canal Streets	Pepperell	24	19	5	0	44

Rank 2009-2011	Intersection	Communi ty	Total Crashes 2009-2011	PDO Crashes 2009-2011	Injury Crashes 2009- 2011	Fatal Crashes 2009-2011	EPDO 2009- 2011
77	Central St at Middlesex St/Green St	Lowell	23	18	5	0	43
77	Pawtucket St at Mt Vernon St	Lowell	19	13	6	0	43
77	Rte 3A (Thorndike St) at Gallagher Terminal	Lowell	23	18	5	0	43
80	Gorham St at Union St	Lowell	22	17	5	0	42
80	Route 38 (Main St) at South St	Tewksbury	22	17	5	0	42
80	Rte 3A (Thorndike St) at YMCA Dr/Hale St	Lowell	30	27	3	0	42
83	Pawtucket St at Merrimack St	Lowell	21	16	5	0	41
83	Broadway at Mt. Vernon St	Lowell	17	11	6	0	41
83	Father Morrisette Boulevard at Aiken St	Lowell	21	16	5	0	41
86	School St at Rock St	Lowell	20	15	5	0	40
86	Rte 38 (Nesmith St) at East Merrimack	Lowell	24	20	4	0	40
86	Pine St at Stevens St	Lowell	12	5	7	0	40
86	Rte 113 (Pawtucket Blvd) at Varnum Ave	Lowell	20	15	5	0	40
86	Rte 3A (Boston Rd) at Rte 129 (Chelmsford Rd)	Billerica	16	10	6	0	40
86	Aiken St at Perkins St	Lowell	20	15	5	0	40
92	Lakeview Ave at Parker Ave	Dracut	15	9	6	0	39
92	Rte 110 (Chelmsford St) at Lincoln St	Lowell	19	14	5	0	39
92	Mammoth Rd at Second Ave	Lowell	19	14	5	0	39
95	Gorham St at Appleton St	Lowell	22	18	4	0	38
95	East Merrimack St at High St	Lowell	30	28	2	0	38
95	Rte 4 (Nashua Rd) at Rangeway Rd	Billerica	10	3	7	0	38
95	Merrimack St at Central St	Lowell	18	13	5	0	38
99	Rte 110 (Chelmsford St)/Rte 4 (Boston Rd) at Rte 129 (Billerica Rd)	Chelmsford	21	17	4	0	37
99	Central St at Warren St	Lowell	21	17	4	0	37
99	Pawtucket St at Wannalancit St	Lowell	17	12	5	0	37
99	Rte 119 (South St) at Shirley St	Pepperell	9	2	7	0	37
99	Rte 3A (Boston Rd) at Cummings Rd	Billerica	21	17	4	0	37
100	Rte 110 (Chelmsford St) at Rte 3A (Westford St)	Lowell	24	21	3	0	36
100	Appleton St at South St	Lowell	16	11	5	0	36
100	Route 113 (Main Street) at Park/Elm Streets	Pepperell	20	16	4	0	36
100	Rte 110 (Chelmsford St) at Parker St	Lowell	20	16	4	0	36

Bridges in the Northern Middlesex Region

The map provides an inventory of functionally obsolete and structurally deficient State maintained bridges in the Northern Middlesex region. These locations are included to present possible barriers for freight movement to and from industrial zones in the region. Weight restrictions and clearance restrictions posted for bridges may cause larger vehicles to have to detour from the most direct and efficient path to and from their destination. Poorly designed bridges or structurally unsound bridges are considered barriers to highway freight movement. MassDOT uses inspection and rating standards developed by the American Association of State highway and Transportation Officials (AASHTO) to evaluate all bridges in Massachusetts based on their condition. Of the two hundred and ninety (290) bridges in the region, fifty one (51) have been classified as functionally obsolete or structurally deficient. Sixteen bridges have been identified as having weight restrictions, while fourteen (14) have some sort of clearance restriction.

Structurally Deficient Bridges

A structurally deficient classification indicates a deterioration of significant bridge elements, which may require a restriction in the load capacity of the bridge. It does not mean that the bridge is unsafe, but that repairs should be made before conditions deteriorate further. Fifteen (15) bridges in the region are classified as structurally deficient. Of those bridges, five (5) currently have weight restrictions associated with them. These include:

1. Main Street over the Salmon Brook in Dunstable - (Reconstruction scheduled for 2014)
2. Mill Street over the Shawsheen River in Tewksbury (Reconstruction scheduled for 2014)
3. Market Street over the Western Canal in Lowell (Reconstruction scheduled for 2015)
4. Lawrence Street over the Concord River in Lowell
5. VFW Highway over Beaver Brook in Lowell (Reconstruction scheduled for 2015)

Currently no structurally deficient bridges are listed as having clearance restrictions for height.

Functionally Obsolete Bridges

A functionally obsolete classification indicates that the bridge is still structurally sound, but does not meet current design standards for the level of traffic on the bridge. Thirty six (36) roadway bridges in the region are classified as functionally obsolete. Of those bridges, four (4) currently have weight restrictions. These include:

1. Route 129 (Salem Road) over the Shawsheen River in Tewksbury
2. Faulkner Street over the Concord River in Billerica
3. Route 3A (Boston Road) over the Shawsheen River in Billerica
4. Wood Street over the Merrimack River in Lowell (Rourke Bridge)

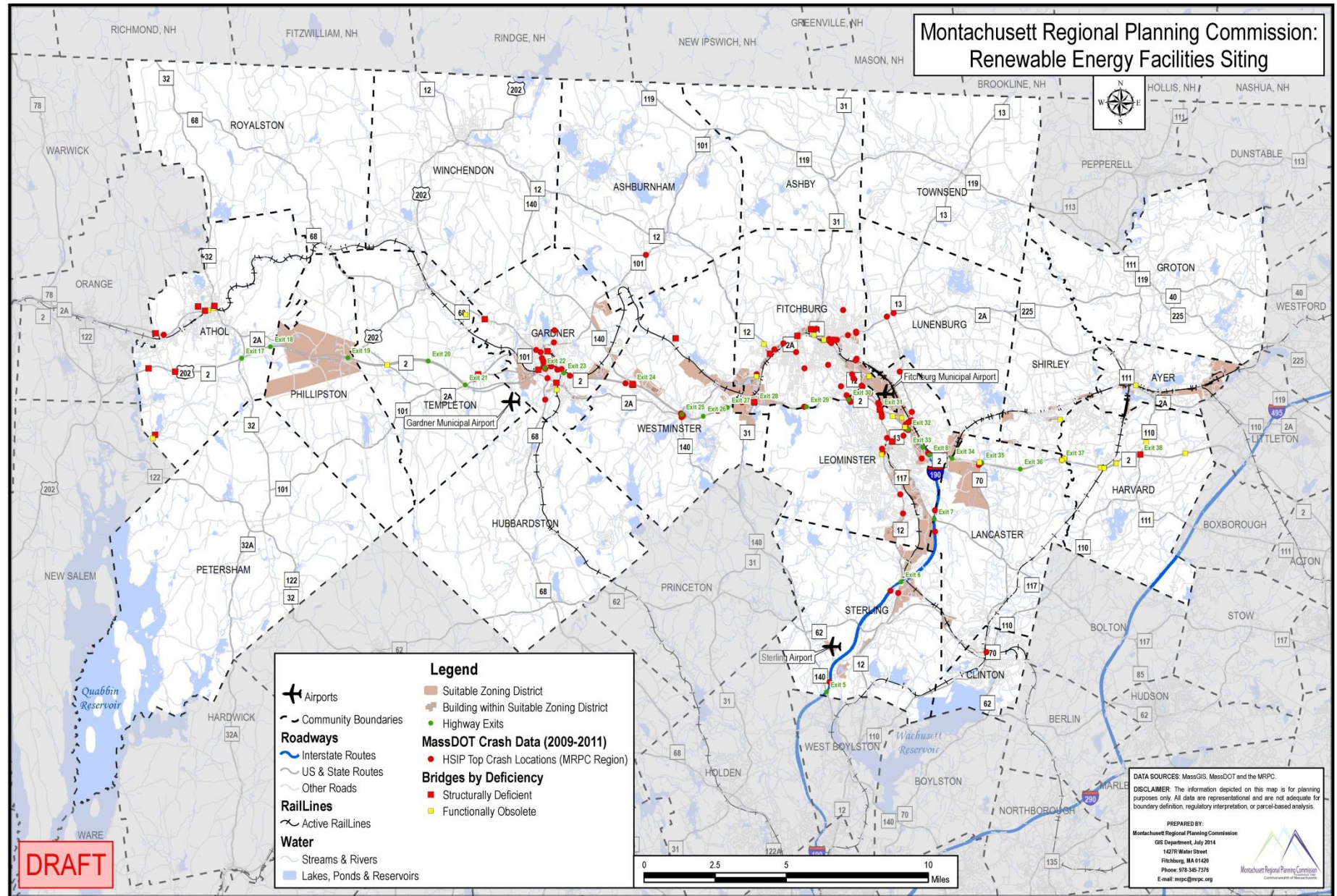
Currently, two (2) functionally obsolete bridges have clearance restrictions. These include:

1. Lowell Connector NB over the I-495 Ramps in Chelmsford
2. I-495 NB over Tadmuck Rd in Westford

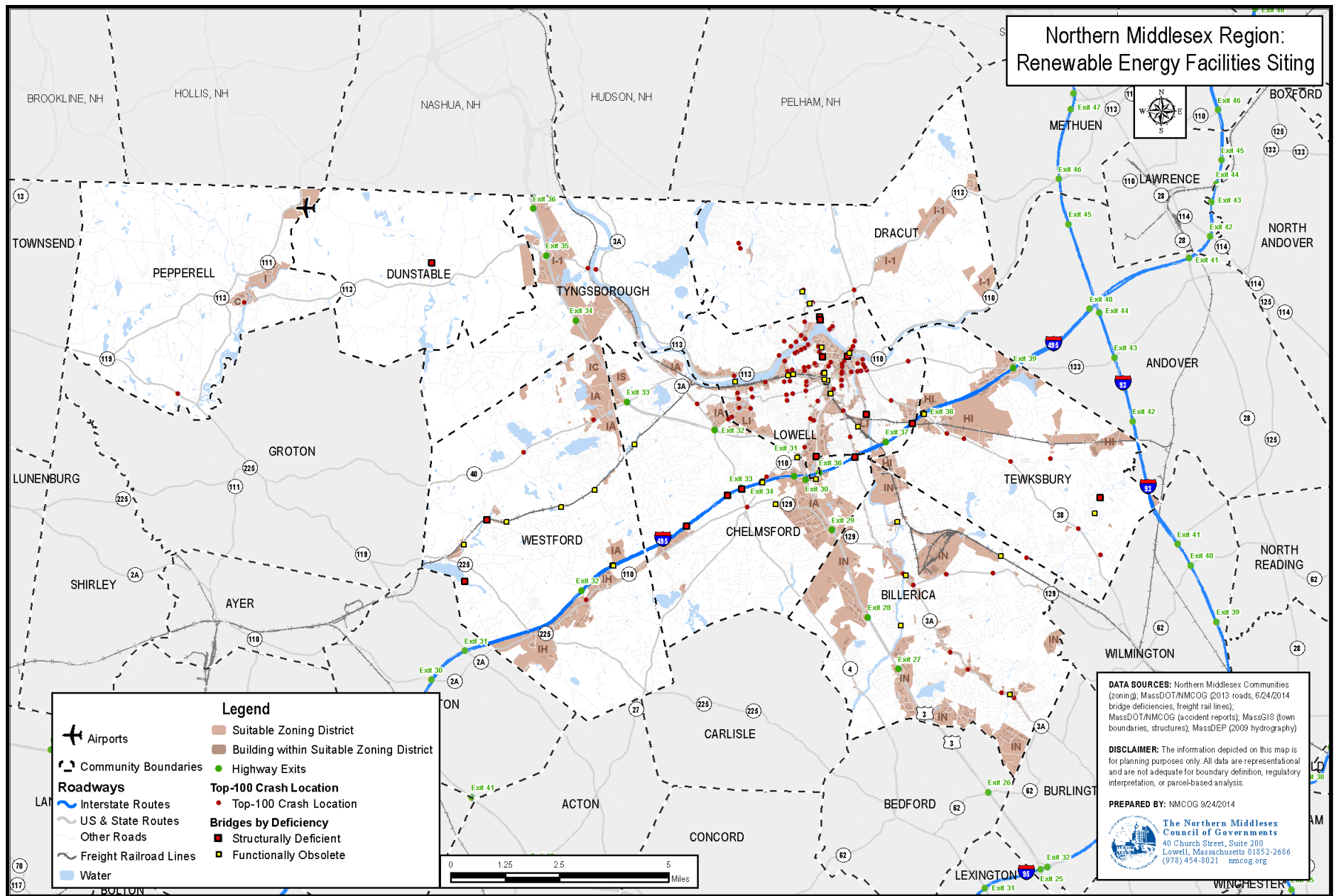
J.5) Land Use Maps

See Following pages

J.5.a) MRPC Land Use Map



J.5.b) NMCOG Land Use Map



J.6) Renewable Energy workforce development and training programs

Institution	Address	Course/Program
		Career/Technical High School
Greater Lowell Technical High School Tyngsboro, MA	HVACR	Graduates of this program have a wide variety of career options. Through the Wheels of Learning Curriculum, they are trained in the theory, design, installation, and repair of domestic and commercial air conditioning, refrigeration, heating, and ventilation equipment
	Green Technology	Renewable energy and green technology education provides students with an opportunity to learn about natural resources and how they are converted to energy such as solar energy and other alternative power sources
Shawsheen Valley Regional Technical High School Billerica, MA	HVAC	The HVAC-Refrigeration program ensures that students are skilled in the operation, design, installation, troubleshooting, and repair of air conditioning, refrigeration, heating, and ventilation equipment. The curriculum includes both off-site and shop learning opportunities with real-world applications.
Leominster High/Center for Technical Education	HVAC	The HVAC program is intended to teach the student all aspects of the industry, starting from electric controls, thermostats, relays, motors, and moving to central air conditioning, commercial refrigeration, and central heating.
Montachusett Regional Vocational Technical High School 1050 Westminster Street,	Renewable Energy Center	Using its new Renewable Energy Center Montachusett Regional Vocational Technical High School, is offering training in Green Technology/Clean Energy programs offered through the Continuing Education Department. Programs include Solar Installer 101, Beginning/Advanced

Fitchburg, MA**Insulation Installer, and Infrared Technology****Vocational****Community Teamwork,
Inc.****YouthBuild of Greater
Lowell**

YouthBuild provides education and employment training to prepare youth for careers in construction and healthcare. YouthBuild Lowell provides trainings for green construction and weatherization techniques integrated into construction trainings.

17 Kirk St. Lowell, MA**Apprenticeship, Continuing Ed./Professional Dev.****Mount Wachusett
Community College
Gardner, MA****Certified Indoor Air
Quality Manager**

The Certified Indoor Air Quality Manager (CIAQM) program is designed to help you diagnose indoor environmental problems in your building, correct those problems, and prevent them from ever happening again. The program gives you practical steps to establish an IAQ Management Plan for your facility that will help you collect, log and resolve air quality complaints.

Certificate Programs**UMass Lowell****Energy Conversion
Certificate**

Energy conversion is a discipline that spans across three departments: Electrical, Mechanical, and Chemical and Nuclear Engineering. Interest is rising for practical applications in the housing industry to supply houses with clean sources of energy to meet electrical supply needs, as well as for space heating/cooling. All renewable energy sources will be considered (e.g. wind energy and photovoltaics). Information about batteries, battery charging stations, battery chargers, and energy conversion devices (such as rectifiers, inverters, choppers, controllers) is presented as related to the development of low emission

**883 Broadway Street,:
Lowell, MA**

vehicles.

UMass Lowell

**Renewable Energy
Engineering Certificate**

This certificate provides engineers and scientists with rigorous but practical grounding in the fundamentals of renewable energy systems for design, research, development, and manufacture. The certificate is part of a long-standing interdisciplinary graduate degree program in renewable energy engineering with experienced faculty. The courses address topics ranging from green building technology (basic insulation and efficiency, passive solar heating and cooling, daylighting, solar hot water) to photovoltaic and wind systems, solar electrolyzers and fuel cells to stochastic process modeling of irradiation.

**Mount Wachusett
Community College
(Devens)**

**Energy Management
Certificate**

This program will help students gain skills needed to work in energy services industries. Students learn how to develop and implement energy conservation and efficiency projects, programs, and policies that reduce operating costs and the impact on the environment. Courses will focus on a variety of content areas such as energy auditing, renewable energy, building performance, and sustainability.

**Mount Wachusett
Community College
(Devens)**

**Manufacturing Career
Preparation Certificate**

Information required

**Middlesex Community
College**

**Energy Utilities
Technology Certificate**

The Energy Utility Technology Certificate is a nine-month program designed to prepare students for entry-level positions in the utility industry. The program includes courses that give students an introduction to the energy utility industry; knowledge of direct and alternating current circuits; generation, transmission and distribution of electricity; industrial safety; and computer

applications.

Undergraduate

UMass Lowell	Energy Engineering Minor	The College of Engineering at UMass Lowell offers a Minor in Energy Engineering for undergraduate students pursuing a bachelors degree.
Mount Wachusett Community College (Devens)	Energy Management Degree	This program will help students gain skills needed to work in energy services industries. Students learn how to develop and implement energy conservation and efficiency projects, programs, and policies that reduce operating costs and the impact on the environment. Courses will focus on a variety of content areas such as energy auditing, renewable energy, building performance, and sustainability.
Fitchburg State University	Energy Management Technology Concentration	<p>Energy courses have always been the core requirement for all the concentrations within the Industrial Technology program. Over the years, the Industrial Technology Department has been reviewing the employment trends as it relates to energy concentration. As a result of making it more comprehensive and compatible with other department concentrations, the department utilized a new grouping of existing and new courses to refocus into Energy Management Technology Concentration.</p> <p>In addition to courses in their concentration, all Industrial Technology students receive a well-rounded technical core of classes in Energy Systems, Energy Conservation and Principles, Energy Efficiency, technical drawing, technical analysis, computers in industrial technology, chemistry, physics and the evolution of industrial technology.</p>

Graduate

UMass Lowell	Doctoral Degree Programs in Energy	The objective of UMass Lowell's doctoral program in energy engineering is to prepare engineers for leadership positions in industry, academia, and
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Engineering	government to provide society with sustainable energy systems. Presently there are two areas of concentration: renewable (solar) and nuclear.
Master of Science Degree Program in Energy Engineering	The UMass Lowell graduate program in Energy Engineering offers professional training at the master's degree level designed to prepare the student to perform state-of-the-art work on energy systems. There are two options: Renewable (Solar) Engineering, and Nuclear Engineering.

Source: Massachusetts Clean Energy Careers Training and Education Directory, <http://ma.cleanenergyeducation.org/>

J.7 Potential Careers in Renewable Energy

J.7.a) Careers in Solar Energy

CAREERS IN SOLAR ENERGY⁶	
Scientific Research	Median Annual Wages (2010)
Physicists	\$106,370
Material scientists	\$84,720
Chemists	\$68,320
Engineers	
Computer software developers, applications	\$96,230
Chemical engineers	\$92,820
Electrical engineers	\$92,070
Materials engineers	\$86,380
Industrial engineers	\$83,620
Mechanical engineers	\$78,910
Electrical and electronics engineering technicians	\$51,060
Manufacturing	
Industrial production managers	\$97,330
Electrical and electronics repairers, commercial and industrial equipment	\$47,480
Glaziers	\$36,640
Semiconductor processors	\$32,880
Coating, painting, and spraying machine setters, operators, and tenders	\$32,520
Computer-controlled machine tool operators, metal and plastic	\$31,470
Welders, cutters, solderers, and brazers	\$27,590
Electrical and electronic equipment assemblers	\$27,500
Development	
Atmospheric and space scientists	\$87,780
Environmental scientists and specialists, including health	\$61,700
Real estate brokers	\$54,910
Construction	
Construction managers	\$83,170
Civil engineers	\$74,620
Welders, cutters, solderers, and brazers	\$45,990
Structural iron and steel workers	\$44,890

⁶ Hamilton, James. Careers in Solar Power, Bureau of Labor Statistics; http://www.bls.gov/green/solar_power/

Operating engineers and other construction equipment operators	\$43,240
Construction laborers	\$29,600
Electric Power Generation	
Electrical and electronics repairers, powerhouse, substation, and relay	\$66,230
Plumbers, pipefitters, and steamfitters	\$66,080
Power plant operators	\$64,270
Electricians	\$59,020
Pump operators, except wellhead pumpers	\$58,740
CAREERS IN SOLAR ENERGY⁷	
Scientific Research	Median Annual Wages (2010)
Other	
Roofers, plumbers, pipefitters, and steamfitters	\$50,550
The Occupational Employment Statistics data is available at www.bls.gov/oes . The data includes neither benefits nor overtime. The wages are a national average and vary by employer and location.	

⁷ Hamilton, James. Careers in Solar Power, Bureau of Labor Statistics; http://www.bls.gov/green/solar_power/

J.7.b) Careers in Water Conservation/Hydro Energy

CAREERS IN WATER CONSERVATION/HYDRO ENERGY⁸	
Scientific Research	Median Annual Wages (2012)
Hydrologists	\$75,530
Chemists	\$71,770
Microbiologists	\$66,260
Environmental scientists and specialists, including health	\$63,570
Conservation scientists	\$61,100
Engineering	
Mining and geological engineers, including mining safety engineers	\$84,320
Environmental engineers	\$80,890
Civil engineers	\$79,340
Industrial engineers, including health and safety	\$78,690
Agricultural engineers	\$74,000
Planning	
Operations research analysts	\$72,100
Urban and regional planners	\$65,230
Landscape architects	\$64,180
Public relations specialists	\$54,170
Construction	
Construction managers	\$82,790
Plumbers, pipefitters, and steamfitters	\$49,140
Construction equipment operators	\$40,980
Pipelayers	\$36,180
Septic tank servicers and sewer pipe cleaners	\$34,020
Construction laborers	\$29,990
Agricultural and maintenance	
Farmers, ranchers, and other agricultural managers	\$69,300
Agricultural equipment operators	\$25,860
Landscaping and grounds keeping workers	\$23,570
Farmworkers and laborers, crop, nursery, and greenhouse	\$18,670
Operations occupations	
Pump operators, except wellhead pumpers	\$44,610

⁸ Hamilton, James. Careers in Water Conservation, Bureau of Labor Statistics; www.bls.gov/green/water_conservation/water_conservation.pdf

Water and wastewater treatment plant and system operators	\$42,760
<p>**The Occupational Employment Statistics data is available at www.bls.gov/oes. The data includes neither benefits nor overtime. The wages are a national average and vary by employer and location.**</p>	

J.7.c) Careers in Geothermal Energy

CAREERS IN GEOTHERMAL ENERGY⁹	
Scientific Research	Median Annual Wages (2010)
Environmental Scientists and specialists, including health	\$87,160
Geoscientists, except hydrologists and geographers	\$77,460
Hydrologist	\$75,680
Zoologists and wildlife biologists	\$57,420
Engineering	
Electronics engineers, except computer	\$90,790
Civil engineers	\$84,950
Electrical engineers	\$84,730
Mechanical engineers	\$82,230
Environmental engineers	\$79,530
Drilling Occupations	
Rotary drill operators, oil and gas	\$51,310
Derrick operators, oil and gas	\$45,220
Roustabouts, oil and gas	\$32,980
Construction	
Construction managers	\$95,630
Plumbers, pipefitters, and steamfitters	\$68,800
Electricians	\$60,310
Carpenters	\$58,000
Operating engineers and other construction equipment operators	\$57,630
Construction laborers	\$43,480
Plant Operators	
Power plant operators	\$66,340
The Occupational Employment Statistics data is available at www.bls.gov/oes . The data includes neither benefits nor overtime. The wages are a national average and vary by employer and location.	

⁹ Liming, Drew. Careers in Geothermal Energy, Bureau of Labor Statistics; http://www.bls.gov/green/geothermal_energy/geothermal_energy.htm

J.7.d) Careers in Wind Energy

CAREERS IN WIND ENERGY¹⁰	
Scientific Research	Median Annual Wages (2010)
Atmospheric and space scientists	\$84,710
Geoscientists, except hydrologists and geographers	\$81,220
Environmental scientists and specialists, including health	\$61,010
Zoologist and wildlife biologists	\$56,500
Engineering	
Aerospace engineers	\$94,780
Engineers, all other	\$89,560
Electronics engineers, except computer	\$89,310
Materials engineers	\$83,190
Electrical engineers	\$83,119
Environmental engineers	\$77,040
Mechanical engineers	\$77,020
Civil engineers	\$76,590
Industrial engineers	\$75,110
Health and safety engineers, except mining safety engineers and inspectors	\$74,080
Engineering technicians, except drafters	\$50,130
General Manufacturing	
Industrial production managers	\$87,120
Machinists	\$41,480
Inspectors, testers, sorters, samplers, and weighers	\$37,500
Welders, cutters, solderers, and brazers	\$35,920
Computer-controlled machine tool operators, metal and plastic	\$34,790
Team assemblers	\$29,320
Project Development Jobs	
Land acquisition and asset management	\$74,010
Logisticians	\$65,950
Construction	
Electricians	\$49,800
Crane and tower operators	\$47,170
Operating engineers and other construction equipment operators	\$39,530

¹⁰ Hamilton, James and Liming, Drew. Careers in Wind Energy, Bureau of Labor Statistics; http://www.bls.gov/green/wind_energy/

Construction laborers	\$29,110
The Occupational Employment Statistics data is available at www.bls.gov/oes . The data includes neither benefits nor overtime. The wages are a national average and vary by employer and location.	

J.7.e) Careers in Biofuels

CAREERS IN BIOFUELS ¹¹	
Scientific Research	Median Annual Wages (2011)
Chemists	\$75,550
Biochemists and biophysicists	\$63,530
Soil and plant scientists	\$58,940
Microbiologists	\$57,350
Chemical technicians	\$49,920
Engineering	
Chemical engineers	\$96,870
Civil engineers	\$96,370
Environmental engineers	\$89,070
Mechanical engineers	\$88,320
Electrical engineers	\$85,350
Industrial engineers	\$79,530
Agricultural engineers	\$74,630
Construction	
Construction managers	\$101,970
Operating engineers and other construction equipment operators	\$33,440
Construction laborers	\$29,730
Agriculture	

¹¹ Richards, Emily. Careers in Biofuels, Bureau of Labor Statistics; http://www.bls.gov/green/wind_energy/

Farmers, ranchers, and other agricultural managers	\$52,180
Agricultural equipment operators	\$21,340
Farmworkers and laborers, crop, nursery, and greenhouse	\$19,130
Plant Operators	
Industrial production managers	\$99,770
Industrial machinery mechanics	\$54,380
Chemical equipment operators and tenders	\$49,060
Sales	
Wholesale and manufacturing sales representatives, technical and scientific products	\$83,100
Buyers and purchasing agents, farm products	\$51,380
The Occupational Employment Statistics data is available at www.bls.gov/oes . The data includes neither benefits nor overtime. The wages are a national average and vary by employer and location.	