



Wayzata Planning Commission Workshop Meeting Agenda

Monday, September 21, 2015

Community Room,
600 Rice Street East,
Wayzata, Minnesota

- 7:00 p.m.**
- 1. Call to Order and Roll Call**
 - 2. Workshop Items:**
 - a. Approval of the August 17 Planning Commission and City Council Workshop Minutes
 - b. Approval of the August 17 Planning Commission Regular Meeting Minutes
 - c. Tree Preservation Ordinance Discussion
 - d. Alternative Energy Ordinance Discussion
 - 3. Other Items:**
 - a. Review of Development Activities
 - b. Other items
- 9:00 p.m.**
- 4. Adjournment**

NOTES:

¹ Time(s) are estimated and provided for informational purposes only.

² Members of the Planning Commission and some staff may gather at the Wayzata Bar and Grill immediately after the meeting for a purely social event. All members of the public are welcome.

**JOINT WAYZATA PLANNING COMMISSION AND CITY COUNCIL
WORKSHOP MEETING MINUTES
AUGUST 17, 2015**

AGENDA ITEM 1. Call to Order.

Mayor Willcox called the joint workshop meeting to order at 5:30 p.m.

Present at roll call were Commissioners: Gonzalez, Gnos, Ramy, Gruber, and Iverson. Absent and excused were: Commissioners Vanderheyden and Young. Mayor Willcox, Councilmember McCarthy, Councilmember Tyacke, Director of Planning and Building Gadow and Management, City Attorney David Schelzel, Director of Public Service Dave Dudinsky, City Manager Heidi Nelson and Management and Planning Intern Jason Peters were also present.

AGENDA ITEM 2. Joint Planning Commission and City Council Workshop Items:

a. Update on Telecommunications Ordinance and Discussion of Feedback from Telecommunications Vendors

Mr. Gadow stated as part of the Telecommunications Study, the City Council and Planning Commission are updating the City's Telecommunications Ordinance in order to better regulate the location of new cellular towers and other equipment. At the July 21, 2015 meeting, the City Council asked Staff to provide a copy of the working draft of the Telecom Ordinance to each of the four (4) Telecom vendors for their review and comment. Staff and the City Attorney will review any feedback received on the draft ordinance, make any necessary or advisable modifications, and schedule the ordinance for a formal public hearing in September. He clarified Staff has been struggling with if there is a designated preferred site for the telecommunication towers and equipment, how does the City deal with a vendor wanting to place additional equipment outside of this location in terms of zoning and location. He reviewed the proposed process for locating new equipment in the identified locations and the process for locating equipment in other areas of the City. He reviewed the draft Conditional Use Permit process for equipment outside of the designated locations. He clarified Telecom towers and equipment would be allowed with only a permit or license in the designated areas only, but a CUP would be required for other locations in the City.

Councilmember Tyacke stated there have been requests for micro-sites in Wayzata. He asked how the Zoning Ordinances addressed this.

Mr. Gadow stated the City favors micro-sites and there may be an opportunity to use this technology on existing City utility poles. There is some language in the draft ordinance that addresses micro-sites and City utility poles and these would be handled through a license or permit process.

1 Mayor Willcox asked what was unique about the draft Ordinance being presented and other
2 Telecommunication Ordinances for other cities.

3
4 Mr. Gadow stated other cities did not restrict having this equipment located adjacent to
5 residential or City Park areas and Wayzata does not have an industrial park area.

6
7 Councilmember Tyacke asked if the City would involve the telecommunication vendors in the
8 design of the equipment for the macrosite.

9
10 Mr. Gadow stated they would discuss the design with the vendors to ensure it is compatible and
11 would work for their needs but they City has not determined if this would be something the
12 vendors would get final approval on.

13
14 Councilmember McCarthy stated the draft ordinance states vendors should provide a report
15 every 3-years on non-proprietary stealth technology. She stated every 3-years would be too long
16 because this technology is changing quickly and everything is always being redesigned and
17 refocused.

18
19 Mr. Gadow stated Verizon had provided information that there was a recent Federal Law change
20 on what cities can ask for in terms of additional information from an applicant. The City would
21 look into what its ability would be for requesting this type of information.

22
23 Councilmember McCarthy stated they had recently done a service level study and found that not
24 all residents are receiving the same level of service. She asked if they could require a specific
25 level of service from vendors or require an audit from vendors so the City knows what the level
26 of service is.

27
28 Mr. Gadow stated Staff could look into this for the draft and also if the contract language of the
29 City's lease with vendors for the macrosite allows the City to request this information.

30
31 Ms. Valerie Bergman, AT&T, reviewed the key recommendations and changes they would
32 recommend based on other cities ordinances. Section 6.409 had been put together by a work
33 group of constituents, members of the National League of Cities, and other Government
34 organizations. She stated many of the revisions proposed by Verizon are in line with what
35 AT&T would recommend. She clarified for cellular service to work well the macrosite would
36 need to be as high as possible to ensure they are able to provide coverage. She explained the
37 difference between coverage and capacity and in order to accommodate the capacity there may
38 be a need for additional antenna. At this time, AT&T does not have plans for micro-cells at this
39 time. Micro-cells cannot replace a macro-cell location. Micro-cells are designed to work for a
40 defined area where there is high capacity. In order to be effective telecommunication towers do
41 need to be located where people are located. She also stated both homes and businesses are
42 relying on wireless coverage. She stated when putting in towers they consider height and
43 location, in terms if where their customers are.

44
45 Mr. Jason Hall, AT&T, clarified their recommendations were from their Engineering
46 Department, External Affairs, and Legal Department. The draft contains a priority ranking for

1 where towers can go and they would like to see this removed. Their network does not always
2 work solely on public property. There may be other land uses that would work better in order to
3 achieve coverage and capacity. They would recommend a market priority versus a location
4 priority. From a practical stand, requiring ground mounted equipment, equipment placed
5 underground, and only one shelter built for each tower does not work well. Each provider has
6 their own proprietary equipment and they would not like to have this equipment accessible by
7 other providers.

8
9 Commissioner Gonzalez asked what the optimum height of a macrosite tower would be to
10 provide service in Wayzata.

11
12 Mr. Hall stated in a suburban community there is typically a height restriction of 195-feet. The
13 FAA requires a light on the tower if it is over 200-feet. The draft ordinance specifies 150-feet
14 for maximum height and they would request a maximum height of 190-feet.

15
16 Commissioner Iverson asked if AT&T currently had towers located at schools and if there have
17 been vandalism problems.

18
19 Mr. Hall stated AT&T does have towers located at schools. He clarified he is not in operations
20 and cannot speak directly to vandalism but he is not aware of any major problems.

21
22 Commissioner Gruber pointed out AT&T had several strike-outs in the draft ordinance. She
23 asked if they were working with the League of Minnesota Cities on a universal
24 Telecommunications Ordinance.

25
26 Ms. Bergman clarified in response to the new FCC regulations, the work group had prepared a
27 check list and model ordinance. This work group looked how to make this ordinance work at the
28 federal, state, and local levels. AT&T had two (2) attorneys look at the draft ordinance proposed
29 by Wayzata and they provided their input. The attorneys are also willing to work with the City
30 and City Attorney on this ordinance.

31
32 Mr. McMannin, Project Manager for T-Mobile, echoed the concerns of AT&T regarding ground
33 mounted and underground equipment. He stated balloon testing was an outdated means of
34 visualizing the height of equipment. He would request this be removed. He stated the things
35 that drive where they place macro-cells are topography and customer usage, not who owns the
36 land. He would like to see the Ordinance written flexible enough so that it does not have to be
37 rewritten every couple of years. He recommended providing more flexibility on where towers
38 and cells could be located.

39
40 Ms. LeBlanc, Senior Development Manager for T-Mobile, stated where cell towers and
41 equipment are located will determine where the best service areas are. Currently they have
42 equipment that is centrally located but once they are moved to the northwest corner of the City
43 there would be less coverage in the eastern portion of the City. Using small cells would not
44 address this problem because small cells are used to address capacity not to provide additional
45 coverage.

46

1 Commissioner Iverson asked how technology was expected to improve over the next 5-years.
2 She asked how much companies are putting toward researching new equipment and looking for
3 ways to lessen the impact to residents and neighborhoods.

4
5 Ms. LeBlanc stated she would like to see smaller equipment. The lower the frequency the higher
6 the tower needs to be and more users means more capacity, which means more equipment. They
7 are seeing growth in data transmitting. She explained the smaller the antenna, the less coverage
8 it provides so more antennas are needed.

9
10 Mr. Simmon, Senior RF Engineer for T-Mobile, explained they are working on new frequencies
11 and bandwidths but these would require higher antenna to be effective. He explained there
12 would be fewer carriers on a stealth antenna due to its size than a standard antenna.

13
14 Councilmember Tyacke asked if there would be a need for additional towers since they would be
15 moving the macrosite location from the water tower to the school.

16
17 Mr. Simmon stated the maximum height allowed in the Ordinance has changed from 190-feet to
18 150-feet with this change. They would request this be increased to 190-feet to accommodate
19 future demand.

20
21 Ms. LeBlanc stated they would also request the provisions regarding underground equipment be
22 removed from the Ordinance due to safety concerns and potential equipment problems.

23
24 Councilmember McCarthy asked if having the equipment stored underground was just not
25 practical in Minnesota or if it was something that was not preferred by the vendors.

26
27 Mr. Simmons stated underground storage and equipment was not prevalent in Minnesota due to
28 safety concerns.

29
30 Mr. Ron Gunderson, Sprint, stated that one macro-cell at the school would be a reasonable
31 location. He said they may be able to locate something in Minnetonka that would assist in
32 coverage in the eastern portion of Wayzata with this macro-cell relocation. In order to establish
33 a standard of coverage the City may be looking at more antennas than they would want in order
34 to achieve this goal. He asked if the tower went to the Middle School would the City acquire
35 property and the vendors work with the City only or would vendors have to work with the City
36 and the School District.

37
38 Mr. Dudinsky stated the City is working with the School District to finalize an agreement. The
39 intention is that the City would purchase or lease the property and vendors would work with the
40 City.

41
42 Mr. Gunderson stated there are minor issues in Section B for new telecommunications facilities.
43 In Section 2A, he would recommended changing "approved telecommunications equipment" to
44 "previously approved telecommunications equipment".
45

1 Commissioner Iverson asked what safety precautions would be taken at the Middle School
2 location to ensure the kids are safe. The City has expressed concerns about having these
3 facilities in parks but the schools are used more by kids.

4
5 Mr. Gunderson, stated there is an antenna at Central Middle School and they have not had any
6 issues at that location. They also have towers or antenna located at schools in other communities
7 and they have not had any problems with these.

8
9 Mr. Dudinsky stated safety would be reviewed as part of the feasibility study but they are
10 looking at locating this near the highway closer to the edge of the school property.

11
12 Councilmember McCarthy asked if the City was still considering a site near the lift station in the
13 east side of Wayzata for these vendors to utilize if they needed to provide additional coverage in
14 that area.

15
16 Mr. Dudinsky stated the developer has shown some interest in this opportunity. If the Middle
17 School site does not move forward there may be other possibilities.

18
19 Commissioner Gruber stated she liked the idea of locating a site in Minnetonka along the border
20 to meet the needs of both communities.

21
22 Mr. Gunderson stated if the businesses are not interested in working with the vendor then they
23 are not able to put a site there.

24
25 Ms. Amy Dresch, Jacobs Engineering, stated Verizon had previously submitted their comments
26 to the draft ordinance and she would like to comment in regards to site acquisition. The macro-
27 sites include sites such as the water tower and the proposed site at the school. Micro-sites are
28 usually located on utility poles and are shorter. These are meant to address capacity needs not to
29 provide coverage where there was no coverage. You must have a macro-site to support a micro-
30 site. Verizon's coverage in Wayzata has suffered since they lost their equipment at the Anchor
31 Bank site due to redevelopment. She expressed concerns about the ability to place a tower on a
32 parcel adjacent to a residentially zoned parcel. This significantly limits what is available for
33 vendors to use in Wayzata.

34
35 Mr. Gadow clarified the way the ordinance is currently drafted is encompasses wireless
36 telecommunications facilities, which is defined to include both antennas and mono-poles. If the
37 concern is the City is limiting the ability to place antennas then these could be separated out to
38 outline where antennas and associated ground equipment would be allowed.

39
40 Councilmember McCarthy asked if the City would be able to make a distinction between
41 antennas and macro-sites.

42
43 Ms. Dresch clarified a macro-site could be on a tower or rooftop and is the main site with all the
44 standard equipment and typically small cells or micro-sites do not have ground equipment and
45 these are meant to fill in capacity or a service gap.

46

1 Mr. Gadow stated the distinction that would need to be made in the ordinance would be to break
2 out towers versus antennas. It could be specified that towers could not be located adjacent to
3 residential property or parks and allow antennas in commercial areas but not in single-family
4 residential areas. There would have to be some flexibility for ground equipment because in some
5 cases not all of the equipment can be located on the interior of the building. He stated the next
6 steps would be to review the feedback and work with the City Attorney on what changes would
7 be in the best interest of the City. A revised draft ordinance would be prepared and reviewed by
8 the Planning Commission. There will be another opportunity for public comment at a formal
9 public hearing that would be held prior to adoption by the City Council.

10
11 Mayor Willcox stated the City is aware of the urgency to resolve the Telecommunications
12 Ordinance and have something in place so that vendors can begin to look at options for
13 additional macro-cells and antennas.

14
15 The joint meeting of the City Council and Planning Commission ended at 6:58 p.m.

16
17 Respectfully submitted,

18
19 Tina Borg
20 *TimeSaver Off Site Secretarial, Inc.*

**WAYZATA PLANNING COMMISSION MEETING MINUTES
AUGUST 17, 2015**

AGENDA ITEM 3. Regular Planning Commission Business:

Present at roll call were Commissioners: Gonzalez, Gnos, Ramy, Gruber, and Iverson. Absent and excused were: Commissioners Vanderheyden and Young. Director of Planning and Building Gadow and Management, City Attorney David Schelzel, Director of Public Service Dave Dudinsky, City Manager Heidi Nelson and Management and Planning Intern Jason Peters were also present.

a. Approval of July 20th and August 3rd Meeting Minutes

Commissioner Gonzalez stated in the July 20, 2015 minutes, page 5, line 10-11 should be corrected to read “for people to showcase the homes they have renovated and share their experience with renovating their homes and providers with the community.”

Commissioner Gonzalez stated in the August 3, 2015 minutes, on page 3, line 20, change “cars of” to “cars off”.

Commissioner Gruber made a motion, Seconded by Commissioner Gonzalez, to approve the July 20, 2015 and August 3, 2015 meeting minutes as amended. The motion carried unanimously.

b. Review and Adoption of Planning Commission Report and Recommendation on 133 Ridgeview Drive East Variance Application

Commissioner Gnos recused himself from discussion, review and voting for the variance request at his property at 133 Ridgeview Drive East.

Mr. Gadow stated the Applicant has submitted a development application requesting approval to construct a 4-foot by 25-foot long, 100 square-foot, expansion to an existing attached garage at 133 Ridgeview Drive E. The Planning Commission at its August 3 meeting had reviewed this Application and Staff had been directed to prepare a Staff Report and Recommendation for Approval of the Setback Variance request.

Commissioner Gonzalez stated on page 4, Section 4.1.A, insert the word “follow” prior to “all laws”.

Commissioner Gonzalez made a motion, Seconded by Commissioner Ramy, to adopt the Staff Report and Recommendation for Approval of the Setback Variance Request at 133 Ridgeview Drive East. The motion carried 3-ayes (Iverson, Gonzalez and Ramy), 1-Nay (Gruber).

c. Review of Development Activities

1 Mr. Gadow stated the City had received an application for design review of a new 2-story
2 medical office building on Wayzata Boulevard. The City is waiting for additional information to
3 complete the application.

4
5 Mr. Gadow stated he would be leaving the City of Wayzata at the end of August to take a
6 position at another city as city administrator, and until a new Director of Building and Planning
7 is hired, Eric Zweber from WSB Consulting would be working on the City's development
8 applications.

9
10 The Planning Commission and Attorney Schelzel expressed their gratitude to Mr. Gadow for his
11 professionalism, knowledge and expertise, and service to the City of Wayzata.

12
13 **d. Other Items**

14
15 Commissioner Gnos stated the last City Council meeting was discussion on the Downtown
16 Parking Study.

17
18 Commissioner Gruber stated she had missed the last Heritage Preservation Board meeting.

19
20 Vice Chair Iverson stated she would attend the October 6th meeting. She stated the Wise home
21 had been moved successfully.

22
23
24 **AGENDA ITEM 4. Adjournment.**

25
26 There being no further business, Commissioner Gonzalez made a motion, seconded by
27 Commissioner Ramy, to adjourn the meeting. The motion passed unanimously.

28
29 The meeting was adjourned at 7:25 p.m.

30
31 Respectfully submitted,

32
33 Tina Borg
34 *TimeSaver Off Site Secretarial, Inc.*

CITY OF WAYZATA



PLANNING DEPARTMENT

MEMORANDUM

To: Planning Commission
From: Eric Zweber, AICP, Interim City Planner
Date: September 21, 2015
Re: Workshop on Tree Preservation Ordinance

One of Wayzata's goals for 2015 is to prepare and adopt a Tree Preservation Ordinance that protects trees not only during development but also during a homeowner's or business owner's use of their property. Additionally, larger, older trees need to be valued greater than smaller younger trees. The City of Rosemount had those same goals and in 2007 and adopted a Tree Preservation Ordinance that applied to both developers and home/business owners.

On September 8, the Planning Commission reviewed the City of Rosemount ordinance. The reaction was generally favorable and the following courses of action were recommended:

1. Add softwood trees into the definition of a heritage tree. (Section 801.36.02)
2. The Ordinance should apply to everyone. (Section 801.36.03)
3. The warranty for the tree should extend longer. (Section 801.36.14)
4. Provide information on the growth rate of different tree species. (Attachment D)

In addition to the amendment to the Zoning Code, staff also review and revised the existing tree regulations (Chapter 710) and made the following revisions to correlate with the new Zoning Code Section 801.36. The changes are generalized as follows, but the detail is provided in Attachment A:

1. Removed the subdivision purpose. (Replaced with subsection 801.36.01)
2. Removed "preservation plan" definition. (Replaced with subsection 801.36.02)
3. Added Emerald Ash Borer as a nuisance. (710.05)
4. Removed restrictions. (Replaced with Section 801.36)
5. Modified permits (710.5) with reference to 801.36.
6. Removed Standards for Preservation of Trees. (Replaced with Section 801.36)

Please review the proposed changes and provide recommendations for improvements.

Due to the number of Public Hearings scheduled for the October 5 Planning Commission meeting, it is anticipated that the Tree Preservation Ordinance will be reviewed at the October 19 Planning Commission meeting.

Attachments:

Attachment A:	Revised Chapter 710
Attachment B:	Proposed Section 801.36
Attachment C:	Other Communities Ordinances Spreadsheet
Attachment D:	CSU Pamphlet
Attachment E:	USFS Tree Diameter Growth Model
Attachment F:	Trees of Minnesota
Attachment G:	Tree Growth Summary

CHAPTER 710

PLANTING, MAINTENANCE AND REMOVAL OF TREES

710.01. Purpose. The Wayzata City Council has determined the preservation of trees growing on public and private property are necessary to maintain the general welfare of the public and is set forth more fully in Section 710.13 of this Chapter. In order to maintain and enhance the quantity and quality of trees growing within the City, this Chapter is adopted to regulate the planting, maintenance and removal of trees within the City of Wayzata by: (1) Defining the duties and responsibilities of the City Forester as the agent enforcing regulations relating to the planning, planting, maintenance and removal of trees within the City of Wayzata; (2) Providing for the issuing of permits and/or licenses for any maintenance and/or removal of trees within the City of Wayzata; (3) Providing for the pruning and removal of trees on private property that endanger public safety; (4) Providing for standards and specifications of all policy concerning trees on public property; ~~and (5) Providing for standards and specifications of a care protection policy concerning trees in subdivision properties; and (56)~~ (56) Providing for standards and specifications for care protection policy concerning trees within project construction limits.

(Ord. ~~xxxx 614 [5-27-1999]~~)

710.02. Definitions. The following words and terms, when used in this Chapter, shall have the following meanings, unless the context clearly indicates otherwise:

a. "Applicant" shall mean any person applying for any City permit or approval that would result in the construction or improvements on land within the City that contains Significant Trees.

b. "Forester" shall mean that person appointed as City Forester by the Wayzata City Manager.

~~**c.** "Preservation Plan" shall mean a plan which is prepared for a proposed development or redevelopment project by a Minnesota registered surveyor which sets forth the project area, locates proposed improvements and locates all Significant Trees located in the project area. It shall indicate which Significant Trees are to be preserved and which are to be removed as a result of the construction of the project. Significant Trees' diameters, heights (where applicable) and species shall be noted in the Preservation Plan.~~

cd. "Code Enforcement Officer" shall mean the City Manager or designee.

de. "Significant Trees" shall mean healthy trees (as determined by the City Forester) which are six (6) inches in diameter (DBH) for a hardwood deciduous trees, twelve (12) inches DBH or greater than ~~twelveeight (128)~~ (128) feet in height for coniferous trees.

f. "Preservation" shall mean maintaining in its natural condition and location any tree.

g. "DBH" shall mean diameter of trees at breast height. It is that point 4½ feet (54 inches) above the ground at which the diameter of a tree shall be measured.

h. "Drip Line" shall mean the outermost extension of any branches of any tree.

(Ord. ~~xxxx 614 [5-27-1999]~~)

710.03. Duties and Qualifications of the Forester.

a. **Duties.** The Forester, as appointed by the City Manager, for the purposes of this Chapter shall identify diseased and hazardous trees that threaten the health and safety of the public and coordinate all activities of the City relating to the control and prevention of tree diseases. It shall further be the duty of the Forester to identify and describe significant trees in any proposed subdivision or development project and to assist planners, developers, and architects in the development of a tree preservation plan for each construction development project.

b. **Qualifications of the Forester.** The qualifications of the Forester shall be, as a minimum, those qualifications prescribed for certified arborists by the Minnesota Society of Arboriculture or by the Commissioner of Agriculture.

(Ord. 614 [5-27-1999])

710.04. Disease Control Program. It is the intent of the City to conduct a program of plant pest control pursuant to the authority granted by Minn. Stat. §18.022. This Chapter provides full power and authority over all trees, plants and shrubs located within the street rights-of-way, parks and public places of the City; and to trees located on private property that constitute a hazard or threat as described herein; and trees that fall under the tree protection policy as described in Section 710.17 of this Chapter.

(Ord. 614 [5-27-1999])

710.05. Nuisances Declared. The following things hereby are declared to be public nuisances whenever they may be found within the City:

a. Any living or standing elm tree or part thereof infected to any degree with the Dutch Elm disease fungus *Ceratocystis Ulmi* (Buisman) Moreau or which harbors any of the elm bark beetles *Scolytus Multistriatus* (Eichh.) or *Hylurgopinus Rufipes* (Marsh).

b. Any dead elm tree or part thereof, including logs, branches, stumps, firewood or other elm material from which the bark has not been removed or sprayed with an

effective Dutch Elm insecticide, or disposed of in a manner prescribed by the Commissioner of Agriculture.

c. Any living or standing oak tree or part thereof infected to any degree with the Oak Wilt disease fungus *Ceratocystis Fagacearum*.

d. Any infected oak tree or part thereof, including logs, branches, stumps, firewood or other oak material unless all bark material is removed and disposed of in a manner prescribed by the Commissioner of Agriculture.

e. Any ash tree at risk of the Emerald Ash Borer (EAB) as determined by the City Forester.

fe. Any living or standing tree or shrub or part thereof infected to any degree by any organism to be controlled as set forth and described by the Commissioner of Agriculture.

gf. Any dead, dying, decaying or living tree, shrub or parts thereof that interferes with the public use of any public thoroughfare or right-of-way.

It shall be unlawful for any person to permit any public nuisance as defined in this Section to remain on any property owned or controlled by him within the City. Such a nuisance shall be abated in the manner prescribed by this Chapter. Abatement shall be at the discretion of the City Forester in accordance with all State Law and City Code.

(Ord. ~~xxxx 614 [5-27-1999]~~)

710.06. Inspection and Investigation. The City Forester shall inspect all premises and places within the City as often as practicable to determine whether any nuisances as described in this Chapter exist thereon. The Forester shall investigate all reported incidents of diseased trees within the City. The Forester or duly authorized representative(s) may enter upon private premises at any reasonable time for the purpose of carrying out any of the duties assigned under this Chapter. The City Forester shall, upon finding conditions indicating disease infestation, immediately send appropriate specimens or samples to the Commissioner of Agriculture for analysis or take such other steps for diagnosis as may be recommended by the Commissioner. Except as provided in Section 710.08 no action to remove infected trees or wood shall be taken until positive diagnosis of the disease has been made.

(Ord. 614 [5-27-1999])

710.07. Abatement of Nuisances. In abating the nuisances defined in Section 710.05, the Forester shall cause the infected tree or wood to be sprayed, removed, burned or otherwise effectively treated so as to destroy and prevent as fully as possible spread of the disease. Such abatement shall be carried out in accordance with current technical and expert opinions and plans as may be designated by the Commissioner of Agriculture.

(Ord. 614 [5-27-1999])

710.08. Abatement Procedure. Whenever the Forester finds with reasonable certainty that an infestation defined in this Chapter exists in any tree or wood on any public or private property within the City, he shall proceed to abate said nuisance as follows:

- a.** If the Forester finds that the danger of infestation of other trees is not imminent the Forester shall notify in writing the person(s) owning or controlling the property upon which the nuisance is located that the nuisance must be abated within fifteen (15) days from the date of the mailing. If no action to abate the nuisance is taken within this period the Forester then shall make a written report of findings to the City Council. The Council shall take action to abate the nuisance, and it may proceed to recover the costs of such abatement as provided in Section 710.09.
- b.** If the Forester finds that the danger of infestation of other trees is imminent the Forester shall notify in writing the person(s) owning or controlling the property upon which the nuisance is located that the nuisance must be abated within five (5) days from the date of the mailing, and shall report findings to the City Manager. If no action to abate the nuisance is taken within this period the Forester then shall make a written report of actions to the City Council, which may proceed to recover the costs of such abatement as provided in Section 710.09.
- c.** If the Forester finds that the danger of infestation of other trees is imminent the Forester shall notify in writing all persons owning or controlling property upon which is located trees in danger of becoming infested. Within this notice the Forester shall state that action, if any, which should be taken to protect the trees in danger of becoming infested and the period within which such action must be taken. If no such action is taken within this period the Forester then shall take appropriate action to protect these trees as an emergency measure and shall make a written report of this action to the City Council, which may proceed to recover the costs of such action as provided in Section 710.09.

(Ord. 614 [5-27-1999])

710.09. Special Assessment Procedure. Upon receipt of a report from the Forester required by Section 710.08, subsections a. through c., the City Council may pass a resolution to provide for recovering the costs of abatement of a nuisance and/or for recovering the costs of protecting threatened trees by a special assessment procedure. Before such a resolution may be approved the City Manager shall notify all affected property owners by mail that such a procedure is under consideration prior to the meeting thereon. This notice shall state the time and place of the meeting, the abatement action proposed to be taken or already taken, the estimated or actual cost of such abatement and the proposed basis of assessing such cost. At this meeting all affected property owners shall have the right to be heard with reference to the proposed

assessments and assessment procedure. The Council thereafter by resolution may approve such special assessments for the purposes specified herein.

The Forester shall keep a record of all abatement activities and all abatement costs for which special assessments are to be made or may be made, stating the description of the properties involved and the amounts chargeable to each property. On or before October 10th of each year the City Manager shall list the total unpaid charges for such abatement activities against each separate property to which they are attributable under this Chapter. The City Council then may spread the charges or any portion thereof against the property involved as a special assessment for certification to the Hennepin County Auditor and for collection the following year along with current taxes.

(Ord. 614 [5-27-1999])

710.10. Transporting Diseased Wood. It shall be unlawful for any person to transport within the City any diseased wood without first having obtained a permit therefore from the Forester. The Forester may grant such a permit only when the purposes of this Chapter will be served thereby.

(Ord. 614 [5-27-1999])

710.11. Interference Prohibited. It shall be unlawful for any person to prevent, delay or interfere with the Forester or duly authorized representative(s) while they are engaged in the performance of duties imposed by this Chapter.

(Ord. 614 [5-27-1999])

710.12. License Required. No person shall conduct as a business, the cutting, trimming, pruning, removal, spraying or other treatment of trees within the City without first having been issued a license therefore. Refer to Chapter 519, Section .01 of the City Code.

(Ord. 614 [5-27-1999])

710.13. Establishment of Tree Preservation Zone. A tree preservation zone is hereby established and applies to all property within the City of Wayzata in order to aid in the stabilization of soil by the prevention of erosion and sedimentation; reduce storm water runoff and the costs associated therewith and replenish ground water supplies; aid in the removal of carbon dioxide and generation of oxygen in the atmosphere; provide a buffer and screen against noise pollution; provide shade and the significant environmental benefit of counteracting the so-called “heat-island” effect; provide protection against severe weather; aid in the control of drainage and restoration of denuded soil subsequent to construction or grading; protect and increase property values; conserve and enhance the City’s physical and aesthetic environment; provide a haven for birds, animals and flora to thrive; and generally protect and enhance the quality of life and the general welfare of the City.

(Ord. 614 [5-27-1999])

710.14. Application. A tree preservation zone shall be applied to and superimposed upon all property contained herein existing or amended by the text and map of the Wayzata Zoning Ordinance. The regulations and requirements imposed by the Tree Preservation Zone shall be in addition to flood plain, shoreland and wetland regulations and requirements, and will all jointly apply to the property. If a conflict is created by the joint application of zones, the more restrictive requirements shall apply.

(Ord. 614 [5-27-1999])

~~**710.15. Restrictions.** Within the Tree Preservation Zone, it shall be unlawful for any person or groups of persons to remove from privately owned land any tree or trees in excess of thirty-two (32) inches diameter at breast height (DBH) per acre (43,560 square feet) in any twelve (12) month period without having first obtained a valid tree removal permit from the City. The removal rate for parcels which are less than one (1) acre or more than one (1) acre shall be mathematically proportionate (subject, however, to the maximum density of thirty-two (32) inches diameter (DBH) for each acre). For example, up to sixteen (16) inches may be removed from a parcel which is one-half (1/2) acre in size without a permit or up to sixty-four (64) inches (but only up to thirty-two (32) inches) diameter at breast height (DBH) for each acre) may be removed from a parcel which is two (2) acres in size without a permit. The removal of dead, diseased or hazardous trees from privately owned land shall not require a tree removal permit.~~

~~(Ord. 614 [5-27-1999])~~

710.156. Permit.

a. Any person with due authority desiring a permit to remove a tree shall submit a tree preservation plan in accordance with City Code Subsection 801.36.05, as provided in Section 710.15 shall submit a written application to the Code Enforcement Officer. The application shall include the following information:

- ~~(1) Name and address of applicant.~~
- ~~(2) Status of the applicant with respect to the land.~~
- ~~(3) Written consent of the owner of the land, if the applicant is not the owner.~~
- ~~(4) Name of the person preparing any map, drawing or diagram submitted with the application.~~
- ~~(5) Location of the property, including a street address or legal description.~~
- ~~(6) Diagram of the parcel of land, specifically designating the area or areas of proposed tree removal and the existing and proposed use of such area.~~

~~(7) — Location of all proposed or existing structures, driveways or other hard surfaces on the site.~~

~~(8) — Location of all trees and identification of size (DBH) and species.~~

~~(9) — Designation of all diseased or damaged trees.~~

~~(10) — Designation of any tree(s) obstructing any roadway, pavement, walkway or utility.~~

~~(11) — Any proposed grade changes that might adversely affect or endanger any tree(s) on the site and plans to protect them.~~

~~(12) — Designation of trees to be removed and trees to be maintained.~~

~~(13) — Purpose of tree removal (construction, driveway, recreation area, patio, building addition etc.).~~

~~(14) — All materials to be planted as replacement trees, indicating size, species and method of planting.~~

~~b. — Upon receipt of the application, the Code Enforcement Officer may visit and inspect the site and adjoining lands. If it is determined that the plan set forth in the application outlined in this Section will minimize the loss of Significant Tree(s) and will destroy no more trees than are necessary to achieve a proposed development or purpose, and will comply with the Standards for Preservation of Trees in New Construction or Redevelopment of Property set forth in Section 710.17.a. and Section 710.17.c., the permit application may be approved. If the Code Enforcement Officer determines otherwise, the application shall be denied.~~

~~c. — The applicant may appeal the Code Enforcement Officer's decision by providing written notice to the City Council, with the City Council's decision to be made by the first City Council meeting to be held on or after 30 days of the written notice to the Council.~~

(Ord. xxxx 614 ~~[5-27-1999]~~)

710.17. — Standards for Preservation of Trees in New Construction or Redevelopment.

~~a. — Owners, Contractors, Developers, Builders and Applicants shall exert their best good faith efforts, as outlined in the Development Agreement, to avoid damage to or the destruction of Significant Trees when designing, locating or grading for and building improvements. This requirement shall be set forth in any development agreement and construction contracts entered into regarding the project.~~

~~b. — The applicant shall submit a Preservation Plan if improvements are to be constructed on property containing Significant Trees. The Preservation Plan shall be submitted along with all other materials required for the permit. The Preservation Plan shall be officially filed when the Code Enforcement Officer has received and examined the application and determined that all required information has been submitted and that the application is complete. Following the determination of “completeness,” the Preservation Plan shall be approved or denied by the Code Enforcement Officer within ten (10) business days unless the Preservation Plan is being submitted in conjunction with a land use application, in which case the City of Wayzata shall approve or deny the application within sixty (60) days from the date of its official submission unless notice of an extension is provided by the City or a time waiver is granted by the applicant.~~

~~c. — The Code Enforcement Officer’s review of the Preservation Plan shall be based upon the following criteria:~~

~~(1) — The applicant’s legal right to use the property.~~

~~(2) — The Preservation Plan minimizes the loss of Significant Trees and will destroy no more trees than are necessary to achieve a proposed development or purpose.~~

~~(3) — The ease with which the applicant can alter or revise a proposed improvement to accommodate existing trees.~~

~~(4) — The density of trees in the area and the effect of tree removal on property values of the neighborhood and on other existing vegetation.~~

~~(5) — Impact upon the urban and natural environment including:~~

~~(a) — Whether tree removal would substantially alter the water table or affect the stabilization of ground and surface water.~~

~~(b) — Whether tree removal would create susceptibility to erosion and siltation.~~

~~(c) — Whether tree removal would cause substantial damage to the existing biological and ecological systems.~~

~~(d) — Whether tree removal would affect noise pollution by increasing source noise levels to such a degree that a public nuisance may be anticipated or a violation of noise control ordinances will occur.~~

~~(e) — Whether tree removal will affect air quality by significantly affecting the natural cleansing of the atmosphere by vegetation.~~

~~(f) — Whether tree removal will affect wildlife habitat by significantly reducing the habitat available for wildlife existence and reproduction or causing the migration of wildlife from adjacent or associated ecosystems.~~

~~(g) — Whether tree removal will increase the possibility of tree disease, wind damage and the loss of windbreak effect.~~

~~(6) — The heightened desirability of preserving tree cover in densely developed or densely populated areas.~~

~~(7) — The need for visual screening in transitional areas or relief from glare, blight, commercial or industrial ugliness or any other visual affront.~~

~~(8) — Whether the removal of the tree(s) is for the purpose of thinning a heavily wooded area where seventy-five (75) percent of the trees will still remain.~~

~~d. — If it is determined that the Preservation Plan complies with the criteria as set forth in part c. above, the Preservation Plan may be approved. If the Code Enforcement Officer determines otherwise, the Preservation Plan shall be denied.~~

~~e. — The applicant may appeal the Code Enforcement Officer's decision by providing written notice to the City Council, with the City Council's decision to be made by the first City Council meeting to be held on or after 30 days of the written notice to the Council.~~

~~f. — If a Preservation Plan is approved, a copy of that approved Preservation Plan shall be attached to any issued permit and a copy shall be retained at City offices.~~

~~g. — Prior to commencing construction of the improvements, applicant must implement some form of barricade such as snow fence or plastic fence, which is easily visible to a height of three feet (36") above ground to protect all trees to be preserved under the Preservation Plan. The barricade must incorporate 100% plus ten (10) feet of the tree(s) at the drip line or area to be preserved. No equipment or materials may be stored, parked, driven, moved or deposited within the area to be preserved. The positive protective measure such as fencing shall not be removed until all phases of construction have been completed and removal of protective measure has been approved by the Forester.~~

~~h. — Upon completion of grading and all construction, the Forester or Designee shall inspect the construction site for damage to trees that were to be preserved under the Preservation Plan. A report "Damage Report" shall be submitted to the Applicant as to any trees required to be preserved under the Preservation Plan which have been destroyed or severely damaged because of the grading or construction activity.~~

~~i. — If the damage report identifies destroyed or severely damaged trees which were required to be preserved under the Preservation Plan, the applicant will be required to pay to the City of Wayzata the sum of two hundred (200) dollars per diameter inch or such greater amount as may be determined by the City Council for each such destroyed or damaged tree. Alternately, the City Council may, at its discretion, agree to tree replanting equaling the total caliper inches lost, species and quality, in lieu of a fine, or in conjunction with a reduced fine. Any such agreement shall specify the replacement tree(s) species and diameter. Applicant shall have the right to appeal the damage, report conclusions and resulting fine or replanting requirements in the same manner as set forth in part e. above.~~

~~j. — A certificate of occupancy shall not be issued until a final inspection of the property by the Code Enforcement Officer demonstrates compliance with the Preservation Plan and until such time as all levied fines have been paid or Security, subject to approval of the City Manager, has been posted by the applicant to secure performance. The Code Enforcement Officer may postpone the final inspection of the property if the Code Enforcement Officer determines that seasonal conditions prevent the determination of whether or not there has been compliance with the Preservation Plan. If the applicant appeals pursuant to part i. above, a Certificate of Occupancy may be issued prior to completion of the appeals process, so long as Security is posted.~~

~~k. — A tree will not be deemed to have been damaged under part h. above where the City verifies the applicant implements positive measures such as fencing, or other City approved methods, during the entire period of grading and construction and where there is no evidence of physical damage to the trees, including their root structure.~~

~~l. — The applicant's responsibility for the loss of trees on site subject to a Preservation Plan shall cease once the site grading and construction have been completed, the preservation has been verified, or any penalty fees have been paid or approved, replacement trees have been planted, and their growth has been well established for two (2) growing seasons. All monies collected pursuant to this Chapter shall be placed in the plant maintenance fund.~~

~~(Ord. 614 [5-27-1999])~~

710.168. Intentional or Deliberate Damage. It shall be unlawful for any person(s) to intentionally damage, destroy or adversely alter any living tree, deciduous or coniferous, on private land within the limits of the City of Wayzata any tree or trees in excess of thirty-two (32) inches diameter at breast height (DBH) per acre (43,560 square feet) in any twelve (12) month period without first having obtained a tree removal permit from the City as set forth in Section 710.156 of this Chapter. The removal rate for parcels which are less than one (1) acre or more than one (1) acre shall be mathematically proportionate (subject, however, to the maximum

density of thirty-two (32) inches diameter (DBH) for each acre.) This shall pertain to manual, mechanical, chemical, abiotic or biotic (fire, water, insects or inoculation) methods of any kind. Minn. Stat. §561.04 strictly prohibits intentional damage to trees on public property in any form and provides that whoever willfully and without lawful authority injures any tree, timber or shrub on City property is liable for treble the amount of damages which may be assessed therefore.

(Ord. ~~xxxx 627 [2-6-2001]~~)

710.179. Violation. Unless expressly provided otherwise, it shall be a misdemeanor for any person to violate any provision of the City Code including this Chapter, any rule or regulation adopted in pursuance of any such provision, or any order lawfully enforcing the City Code or this Chapter. The term "misdemeanor" shall be as defined in Minn. Stat. §609.02, Subd. 3.

It shall also be a misdemeanor for any person to attempt to commit a misdemeanor or to cause, aid, assist, counsel or advise another to commit misdemeanor. Any person who commits a misdemeanor, upon conviction, shall be subject to the penalties therefore established by State Statute. Unless expressly provided otherwise, each act in violation of the City Code, including this Chapter, shall constitute a separate offense, and each and every day that such a violation occurs or continues shall constitute a separate offense.

(Ord. ~~xxxx 627 [2-6-2001]~~)

710.1820. Severability. It is hereby declared to be the intention of the City Council that the sections, paragraphs, sentences, clauses and phrases of the City Code, including this Chapter are severable, and if any phrase, clause, sentence, paragraph, or section of the City Code, including this Chapter, shall be declared unconstitutional, invalid or unenforceable, such unconstitutionality, invalidity, or unenforceability shall not affect any of the remaining phrases, clauses, sentences, paragraphs and sections of the City Code, including this Chapter.

(Ord. ~~xxxx 627 [2-6-2001]~~)

(7-21-81 Code; Chapter repealed and replaced by Ord. 574 [2-21-1995]; Ord. 588 [2-27-1997]; Chapter repealed and replaced by Ord. 614 [5-27-1999]; Ord. xxx [xx-xx-2015])

CITY OF WAYZATA
ZONING ORDINANCE
CHAPTER 801
SECTION 36
TREE PRESERVATION

SECTION 36:

- 801.36.01: Purpose**
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801.36.01 PURPOSE:

The city council finds it is in the best interest of the city to protect, preserve, and enhance the natural environment of the community and to encourage a resourceful and prudent approach to the development and alteration of wooded areas. In the interest of achieving these objectives, the city has established the comprehensive tree preservation regulations herein to promote the furtherance of the following:

- A. Protection and preservation of the environment and natural beauty of the city;
- B. Assurance of orderly development within wooded areas to minimize tree and habitat loss;
- C. Evaluation of the impacts to trees and wooded areas resulting from development;
- D. Establishment of minimal standards for tree preservation and the mitigation of environmental impacts resulting from tree removal;
- E. Provision of incentives for creative land use and environmentally compatible site design which preserves trees and minimizes tree removal and clear cutting during development; and
- F. Enforcement of tree preservation standards to promote and protect the public health, safety and welfare of the community.

801.36.02: DEFINITIONS:

For purposes of this section , the following definitions shall apply:

Canopy Of Tree: The horizontal extension of a tree's branches and foliage in all directions from its trunk and upper layer of green crown.

City Forester: shall mean that person appointed as City Forester by the Wayzata City Manager.

Coniferous Tree: A woody plant bearing seeds and cones oftentimes, but not always, retaining foliage throughout the year.

Construction Area: Any area in which movement of earth, alteration in topography, soil compaction, disruption of vegetation, change in soil chemistry, or any other change in the natural character of the land occurs as a result of site preparation, grading, building construction or any other construction activity.

Deciduous Tree: A woody plant which has a defined crown, and which loses leaves annually.

Developer: Any person or entity who undertakes to improve a parcel of land, by platting for the purposes of establishing two (2) or more dwelling units, or grading which requires a grading

permit.

Diameter Of Coniferous Tree: Every two feet (2') in height of a coniferous tree is equivalent to one caliper inch of diameter.

Diameter Of Deciduous Tree: The length of a straight line measured in caliper inches through the trunk of a tree at four and one-half feet (4.5') above the ground.

Drip Line Or Root Zone Of A Tree: An imaginary vertical line which extends from the outermost branches of a canopy to the ground.

Forester: A person holding at least a Bachelor's Degree in Forestry from an accredited four (4) year college of forestry.

Hardwood Deciduous Tree: Includes ironwood, catalpa, oak, maple (hard), walnut, ash, hickory, birch, black cherry, hackberry, locust and basswood.

Healthy Tree: Average or better condition and vigor for area as may be determined by the forester or City Forester.

Heritage Tree: A healthy deciduous tree measuring equal to or greater than twenty seven inches (27") in diameter or a healthy coniferous evergreen tree greater than fifty feet (50') in height.

Landscape Architect: A person licensed by the state of Minnesota as a landscape architect.

New Development: A piece of property that is being platted for the purpose of establishing urban residential use with two (2) or more dwelling units or is being improved by grading which requires a grading permit. This definition does not apply to public street/utility projects.

Nurseryman: A person licensed by the state of Minnesota as a nurseryman.

Property Owner: The owner of a buildable property who is constructing or expanding a dwelling or a business on that property.

Significant Tree: A healthy deciduous hardwood tree measuring a minimum of six (6) caliper inches in diameter, a healthy softwood deciduous tree measuring a minimum of twelve (12) caliper inches, or a healthy coniferous tree measuring a minimum of twelve feet (12') in height.

Softwood Deciduous Tree: Includes cottonwood, poplars/aspen, box elder, willow, silver maple and elm.

Tree Preservation Zone: As described in Section 710.13 of the City Code.

801.36.03: APPLICATION:

The provisions of this Section shall to the entire Tree Preservation Zone.

801.36.04: PROCESS:

A. For Developers: Unless otherwise determined by the city council, the following process for preserving trees shall be required from the developer:

1. Prepare a tree preservation plan which shall be incorporated on the grading plan.
2. Implement the tree preservation plan prior to and during site development.
3. Submit a performance of financial guarantee for compliance with the approved tree preservation plan.
4. Comply with the city's tree replacement procedure.

The tree preservation plan shall be submitted with preliminary plat plans or as part of the application for a grading permit. The tree preservation plan must be certified by a forester, landscape architect, or nurseryman retained by the developer.

The plat and grading plans will not be approved by the city without an approved tree preservation plan. In the case of plats, the tree preservation plan will b approved by the city council. In the case of grading permit applications, the tree preservation plan will be approved by City Forester. This decision may be appealed directly to the board of appeal and adjustments.

B. For Home And Business Owners: The following process for preserving trees shall be required from the home and business owner:

1. Identify the significant trees and heritage trees on the property.
2. Identify the significant trees and/or heritage trees removed due to grading or construction.
3. Identify the protection measures used to protect the preserved trees during grading or construction.
4. Comply with the city's tree replacement procedure.

The tree preservation plan shall be submitted before any healthy tree is removed. The tree preservation plan may be prepared by the property owner. The tree preservation plan will

be approved by the City Forester. This decision may be appealed directly to the board of appeal and adjustments.

801.36.05: TREE PRESERVATION PLAN:

The developer shall be responsible for implementing the tree preservation plan prior to and during site grading and plan development. The property owner shall be responsible for implementing the tree replacement procedure prior to any healthy tree removal. The tree preservation plan will be reviewed by the City Forester and any other relevant city staff to assess the best overall design for the project taking into account heritage and significant trees and ways to enhance the efforts of the developer to mitigate corresponding damage. The developer is encouraged to meet with staff prior to submission of the preliminary plat application or prior to application for the grading permit, whichever is sooner, to determine the placement of buildings, parking, driveways, streets, storage and other physical features which result in the fewest significant trees being destroyed or damaged. The tree preservation plan shall include the following items:

- A. The name(s) and address(es) of property owners and/or developers.
- B. Delineation of the buildings, structures, or impervious surfaces situated thereon or contemplated to be built thereon.
- C. Delineation of all areas to be graded and limits of land disturbance.
- D. Size, species, and location of all heritage and significant trees located within the area to be platted or the parcel of record.
- E. Identification of all heritage and significant trees on all individual lots. (The developer shall be required to submit a list of all lot and block numbers identifying those lots.)
- F. Measures to protect heritage and significant trees.
- G. Identification of all heritage and significant trees proposed to be removed within the construction area, including the contouring of all areas to be clear cut.
- H. Size, species, and location of all replacement trees to be planted on the property in accordance with the tree replacement schedule.
- I. Signature of the person preparing the plan and statement which includes acknowledgment of the fact the trees to be used as replacements are appropriate species with respect to survival of the replacement trees.

801.36.06: MANDATORY PROTECTION:

Measures to protect heritage and significant trees shall include:

- A. Installation of snow fencing, silt fence, or polyethylene laminate safety netting placed at the drip line of significant trees to be preserved.
- B. Identification of any oak trees requiring pruning between April 15 and July 1; any oak trees so pruned shall be required to have any cut areas sealed with an appropriate tree wound sealant.

801.36.07: DISCRETIONARY PROTECTION:

Measures to preserve or protect significant trees, which may be required by the city, include, but are not limited to:

- A. Installation of retaining walls or tree wells to preserve trees by eliminating the filling or cutting of soil within drip zones.
- B. Placement of utilities in common trenches outside of the drip line of significant trees, or use of tunneled installation.
- C. Prevention of change in soil chemistry due to concrete washout and leakage or spillage of toxic materials, such as fuels or paints.
- D. Use of tree root aeration, fertilization, and/or irrigation systems.
- E. Transplanting of significant trees into a protected area for later moving into permanent sites within the construction area.
- F. Safety pruning.

801.36.08: TREE REMOVAL:

- A. Heritage Trees: Heritage trees are unique trees to Wayzata due to their size and age. All possible measures will be taken to preserve these trees. Heritage trees removal may occur only when there is not a practical alternative, such as infrastructure of a regional nature. There is a zero percent (0%) removal threshold on heritage trees, meaning every caliper inch of heritage tree removed will require replacement in accordance with the standards within subsection 801.36.09.
- B. Significant Tree Removal For Developments: Although the applicant must retain the maximum amount of woodland possible, the city recognizes that a certain amount of significant trees and tree cover removal is an inevitable consequence of the urban development process. Therefore, twenty five percent (25%) of the existing caliper inches of trees can be removed during development without obligation of replacement. Any removal beyond twenty five percent (25%) will require replacement in accordance with the standards within subsection 801.36.09.

- C. Significant Tree Removal For Home And Business Owners: The majority of tree removal occurs during the grading and installation of infrastructure during subdivision. The city recognizes that additional tree removal may occur after subdivision to construct new houses or business, or the expansion of existing homes or business, but to a lesser degree than the original subdivision. Therefore, ten percent (10%) of the existing caliper inches of trees can be removed during home or business construction without obligation of replacement. Any removal beyond ten percent (10%) will require replacement in accordance with the standards within subsection 801.36.09..
- D. Trees Exempt From Replacement: The following types of trees do not need to be included as part of the tally of tree removals:
1. Dead, diseased, or dying trees; or
 2. Trees that are transplanted from the site to another appropriate area within the city; or
 3. Trees that were planted as part of a commercial business such as a tree farm or nursery; or
 4. Any tree needed to be removed to construct or maintain infrastructure of a regional nature, including but not limited to:
 - a. Collector or arterial roads as defined by the City Transportation Plan.
 - b. Regional recreational trails.
 - c. Stormwater infrastructure serving a regional drainage area.
 - d. Installation or maintenance of trunk utility infrastructure as described in the Comprehensive Sewer or Water Plans.

801.36.09: TREE REPLACEMENT FORMULA:

Replacement of removed or disturbed trees in excess of the percentage allowed by this subsection shall be according to the following guidelines:

- A. For development which exceeds the percentage of allowable removal of significant trees, all significant trees shall be replaced at the ratio of one-half (0.5) caliper inch per one (1) caliper inch removed.
- B. For each heritage tree removed by the developer, all heritage trees shall be replaced at the ratio of one (1) caliper inch per one (1) caliper inch removed.

801.36.10: SIZE, TYPES AND DIVERSIFICATION OF REPLACEMENT TREES:

Replacement trees shall be of a similar species to those that are removed, but also shall be a minimum of twenty five percent (25%) conifers and twenty five percent (25%) deciduous hardwoods. Required heritage tree replacement must be of the same species as the heritage tree removed. Replacement trees must be no less than the following sizes:

- A. Deciduous trees shall be no less than three (3) caliper inches; and
- B. Coniferous trees shall be no less than six feet (6') high.

801.36.11: ACCEPTABLE TREE REPLACEMENT SPECIES:

The following list of trees are acceptable for tree replacement species. The city may, at its discretion, approve additional species if circumstances such as soil conditions, hydrology, topography, or recent tree diseases warrant.

Black cherry
Cedar
Fir
Hickory
Linden
Maple (except silver maples)
Oak
Pine
Spruce
Walnut

801.36.12: OTHER REPLACEMENT TREE REQUIREMENTS:

Choice of replacement trees species and location of the trees should also be contingent on the following information:

- A. Soil Composition: Comparisons should be made between soil conditions and the ecology of the proposed species to make sure they are compatible.
- B. Spatial Requirements: The potential height and crown spread of the proposed replacement trees should be known. Usually, half of the adult tree crown diameter is the amount of distance a tree should be planted from any aboveground objects.
- C. Diseases And Insect Problems: Appropriate replacement choices shall also consider insect and disease problems that may be common with particular species in the part of the state in which the city of Rosemount is located.

801.36.13: FEE-IN-LIEU OF TREE REPLACEMENT OR REPLACEMENT TREES PLANTED IN PUBLIC AREAS:

The city recognizes that there may be instances where the total amount of tree replacement required cannot occur on site. In those instances, the city may, at its option, accept a fee-in-lieu of tree placement or allow the planting of replacement trees in public areas. Tree replacement is encouraged to happen on site as much as possible and fee in lieu-of-tree replacement should be used only when replacement cannot occur on site. The fee-in-lieu of tree replacement will be determined annually by the city council through the city fee schedule.

801.36.14: FINANCIAL GUARANTEE:

The city shall, at its option, withhold occupancy certification or require cash, a letter of credit or a bond satisfactory to the city in the amount of one hundred ten percent (110%) of the value of the landscaping, securing the full performance of tree preservation plan and the tree replacement schedule. The amount of the security shall be determined by the fee-in-lieu of tree replacement. The financial guarantee shall be held to guarantee a three (3) year survival of the replacement trees planted. The financial guarantee shall be release on the following schedule:

- A. Installation of a healthy tree:
50% of the financial guarantee for that tree shall be released.
- B. First year inspection determining the installed tree is still healthy:
15% of the financial guarantee for that tree shall be released.
- C. Second year inspection determining the installed tree is still healthy:
15% of the financial guarantee for that tree shall be released.
- D. Third year inspection determining the installed tree is still healthy:
20% of the financial guarantee for that tree shall be released.

	Edina	Minnetonka	Oakdale	Plymouth	Rosemount
Name	Tree Protection	Tree Protection	Trees	Tree Preservation	Tree Preservation
Code Number	Ch 10, Division 3	300.28 Section 19	Chapter 22	Section 530	11-6-3 E
Definition of Heritage Tree/High Priority	None, uses Protected Trees See below	High Priority = Deciduous = ≥ 15 in. dbh, except ash, box elders, elm species, poplar species, willow, silver maple, black locust, amur maple, fruit tree species, mulberry, & norway maple Group of Deciduous = ≥ 8 in. dbh that provide buffer or screening as defined Conifers = ≥ 20 ft. in height, except Colorado spruce that is not in a buffer Group of Conifers = ≥ 15 ft. in height that provide buffer or screening as defined dbh measured at 4.5 ft.	None, uses Significant Tree See below	None, uses Significant Tree See below	Heritage Tree = Hardwood = ≥ 27 caliper in. Softwood = Not Included Conifers = ≥ 50 ft. in height diameters measured at 4.5 ft.
Definition of Significant Tree /Protected	Protected Tree = Deciduous = 8 in. dbh, except box elders, poplar, willow, silver maple, black locust, fruit tree species, & mulberry. Conifers = ≥ 20 ft. in height dbh measured at 4.6 ft.	Protected Tree = in woodland, high priority, or significant Significant = Deciduous = ≥ 8 in. dbh Conifers = ≥ 15 ft. in height	Significant Tree = Hardwood = ≥ 8 in. in diameter Softwood = ≥ 12 in. in diameter Conifers = ≥ 12 ft. in height diameter measured at 54 in. above ground	Significant Tree = Deciduous ≥ 8 in. in diameter Conifers = 4 in. in diameter diameter measured at 54 in. above ground	Significant Tree = Hardwood = between 6 caliper in. & 27 caliper in. Softwood = ≥ 12 caliper in. Conifers = ≥ 12 ft. in height
Definition of Non-Significant Trees/Removable	Any tree not defined as protected OR invasive species defined by MNDNR Protected trees within 10 ft. radius of building pad, deck or patio of new or remodeled home within 5 ft. radius of driveways & parking area within 10 ft. radius of installation of public infrastructure improvement	Not defined but = Hardwood = < 8 in. in dbh Conifers = < 15 ft. in height and not in woodland area	Not defined but = Hardwood = < 8 in. in diameter Softwood = < 12 in. in diameter Conifers = < 12 ft. in height and not in woodland area	Not defined but = Deciduous = < 8 in. in diameter Conifers = < 4 in. in diameter	Hardwood = < 6 caliper in. Softwood = < 12 caliper in. Conifers = < 12 ft. in height

Who approves the tree preservation plan?	City Forester	Silent, City Authority	City Staff & Staff can add up to 5% for practical hardships w/o variance from Council	Staff Review = City Forester City Council approves plan as part of prelim plat Zoning Admin can amend Approval = City Council	City Council = for subdivisions, design reviews, conditional use permits City Staff = New homes or additions not requiring design review or grading permits
Does the ordinance apply to property without development or construction?	Yes	Yes	Yes, New Development, New Building Construction, or grading	No	Applies during construction or grading Does not apply to homeowners if no construction or grading occurs
Does the ordinance apply to subdivision of land?	Yes	Yes	Yes	Yes	Yes
Does the ordinance apply to redevelopment?	Yes	Yes	Yes	No, if lot lines remain unchanged	Yes
Does the ordinance apply to remodeling and additions?	Yes	Yes	Yes	No	Yes
contain a look back clause?	Yes, 1 year	No	No	No	No
Is a tree inventory required?	Yes	Yes	Yes, as a part of preservation plan	Yes, as a part of preservation plan	Yes
Are woodlands included in the ordinance?	No	Yes, defines floodplain forest lowland hardwood forest maple basswood forest mesic oak forest oak woodland brushland tamarack swamp willow swap	Yes, significant woodlands = ≥ 500 sq. ft. of Deciduouss b/w 4 in. and 12 in. in diameter OR Coniferss b/w 4 ft. and 12 ft. in height	No	Not called out separately from the individual trees within a stand of woods that would be inventoried
Is there a tree removal threshold before mitigation is required?	No, but refer to mitigate rate below	Can be removed within 10 ft. of driveways, parking areas & assessorly structures w/o mitigation Can be removed within 20 ft of existing home w/o mitigation	Developments = Up to 25% can be removed with addional 5% adminstratively Building = 20% but possbility of the above 25% + 5% & and additoinal 5% adminsitratively for total of 55%	Development in Residential Districts = up to 50% of total in. of Significant Trees Development in Non-Residential = 75% of total in. of Significant Trees Mixed Use Districts 50% of total in. of significant trees on a solely residential lot & up to 75% of significant trees on remainder of site	Heritage Trees = No Significant Trees = 25% for Developers 10% for Homeowners

What is the mitigation rate or method?	Protected Tree = 1 for 1 per protected tree removed	Significant trees = replace with each w/ 2 in. dbh tree High Priority Deciduous = 1 in. / 1 in. removed High Priority Conifer = 1 foot / 1 foot removed	Schedule A (B&C rarely if ever used per Oakdale City Forester) Hardwood deciduous 8 in. – 20 in. diameter = replaced with 1 Deciduous not less than 3 in. in diameter Hardwood deciduous > 20 in. diameter = replaced with 2 Deciduous not less than 3 in. in diameter Softwood deciduous 12 in. – 24 in. diameter = replaced with 1 Deciduous not less than 3 in. in diameter Softwood deciduous > 24" diameter = replaced with 2 Deciduous not less than 3 in. in diameter Conifers – 12 ft. – 24 ft. high = replaced with 1 Conifers not less than 10 ft. in height Conifers – 24ft or higher = replaced with 2 Conifers not less than 10 ft. in height	1.25 in. / in. removed beyond threshold	Significant Trees = .5 in. / 1 in. of significant trees removed Heritage Trees = 1 in. / 1 in. of heritage trees removed
Is there a warranty/surety required on mitigation trees?	No	Yes, mitigation trees must be replaced if died or severely declined in 2nd growing season following installation AND City may require an escrow deposit	Yes, must restore or replace any mitigation tree, 1 year after the date that the last one was planted Bond, LOC, cash, or escrow Developer = \$1,000 per lot with at least 1 significant tree, plus 125% of estimated cost to furnish and plant Builder \$1,000	Yes, escrow or letter of credit minimum = \$1000 25% of total in. shown as preserved within 15 ft. of disturbance zone X \$125 per in, + 100% of in. required by reforestation plan, (if applicable) X \$125 per in.	No, financial security required to ensure trees are installed & alive when installed. No, additional security required to ensure they stay alive.
Is there a Payment in Lieu of Replacement Trees Option?	No	No	No	Yes	Yes, payment in lieu or replacement trees in public areas determined by annual city fee schedule
Is there a fine for failure to comply?	No	\$500 / in. or ft. removed, not to exceed \$5000 for each tree or shrub	No	No	No

Growth Rates of Common Tree Species in Westminster, Colorado

By Keith Wood



Introduction

This study updates a previous project and publication from 2000 in which tree-growth rates were analyzed on public property in Westminster, Colo. Eight years of diameter growth data were collected in 2000 and updated in early 2008 to obtain 16 years of growth data on the same trees. Growth rates for trees typically are classified based on individual observation or experience. This study, based on trees originally inventoried in late 1992 and early 1993, attempts to measure tree diameter growth rates to more accurately reflect what can be expected of trees growing in this area.

Growth rate numbers are intended to provide average figures of diameter growth in 18 tree types that were studied and averaged over a 16-year study period. The numbers reported are averages, so a typical tree of the types studied will grow at the expected rates over 16 years.



Figure 1: A tree workshop taught by the Colorado State Forest Service. Photo: CSFS

Methods

Prior to the 2009 growing season, many of the same trees measured for this study in 1992 and 2000 were located and re-measured on Westminster public properties, including maintained parks, city facilities, streetscapes, medians and other miscellaneous properties. Sample sizes typically decreased for each of the tree types studied due to tree removal that occurred for various reasons, especially construction-related activities. Numbers for each tree that was revisited were updated from the original values collected in 1992. In most cases, diameter numbers were collected at diameter at breast height (dbh = 4.5 feet above ground).

Trees with diameters ranging from 3 inches to 12 inches in 1992-1993 were again used in this analysis. Many of these same trees were measured in 2009 to determine growth rates over the 16 growing seasons. Diameters were measured with either a diameter tape or Biltmore stick and measured as whole numbers on the inch. Diameters less than ½-inch were rounded to the lower whole number, whereas diameter measurements more than ½-inch were rounded to the next highest whole number.

In late 1992 and early 1993, shade and evergreen trees in the 3-inch to 12-inch diameter class, and ornamental trees in the 3-inch to 7-inch diameter class, which are in the “growth” stage of their development, were measured. Most trees in the study were planted at 2-inch to 2.5-inch caliper diameters prior to 1992

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and were fully established by 1992. Severely stressed trees, or trees rated in poor or very poor condition classes, were not used in the study. Trees used in the study were predominantly classified in the fair to good condition categories, thus estimating how much a typical tree type can be expected to grow, once established, over a 16-year period in a mostly irrigated, clay soil type in the Westminster area.



Figure 2: *Catalpa* trees (*Catalpa speciosa*) have the third highest growth rate in the study area. Photo: CSFS

Sample sizes (N) varied based on tree type; low sample sizes (N = less than 10 trees) were removed from the study, unless trees were spread over several growing sites in the area (e.g. catalpa and white fir).

Results

Eleven shade tree types were evaluated at the end of the 16-year growing period (Table 1). Cottonwood, a tree with a reputation for fast growth, exhibited the highest average diameter expansion over the period. Silver maples exhibited the next highest growth rate in the shade tree category. It should be noted that many ‘Autumn Blaze’ maples, a silver and red maple hybrid, were planted on many landscapes in Westminster around the end of the last century. Observations indicate that they establish quickly and initial growth rate is fast, as it is in silver maples; however, many have developed a “delayed” chlorosis. As a result, growth appears to be slowing and the trees need nutrient supplements to maintain their vigor. Only nine catalpas were monitored over the 16 years, but they showed the third highest growth rate among the shade tree types. Of the remaining shade trees, varieties of white oak, mainly bur, swamp white and English, showed the next fastest growth rate. Typically, oaks are regarded as slow-growing trees, but this study has consistently found that white oak varieties can grow at a moderate rate in this area.

Next on the list of shade tree types are the lindens (mostly ‘Greenspire’ littleleaf and ‘Redmond’

American linden), varieties of green and white ash (mostly ‘Marshall Seedless’, ‘Patmore’, ‘Summit’ and ‘Autumn Purple’) and red oaks. Red oaks in the Westminster area don’t seem to perform as well as the white oak group, which most likely is due to their reduced ability to thrive in higher pH soils. Honeylocust and Norway maple varieties continue to grow more slowly in this study, but nevertheless have become very desirable shade trees over time. The hackberry and red maple varieties round out the shade trees covered in this study. Hackberry is notoriously slow to establish after transplanting and battles the insect-caused nipple gall most of its life, but it is a nice shade tree if given time. Red maple, often a favorite among homeowners and landscape designers, performs poorly in the Westminster area, often becoming chlorotic and suffering much die-back due to soil and hardness problems.

Blue spruce leads the way in growth rate for the evergreen species (Table 2). The growth rate of the blue spruce often surprises those who plant it, so this tree should be given plenty of room to mature over time. Austrian and ponderosa pine also grow fast for conifers once established. The Austrian seems to tolerate transplantation and withstands heavy soil types and urban conditions slightly better than the native ponderosa. It should be noted that an abundance of mountain pine beetle (MPB) attacks have moved into urban areas, due in large part to the vast numbers of beetles that are impacting native lodgepole pine forests in the area. MPB seems to favor Scotch pine in urban settings, although ponderosa pine



Figure 3: The hawthorn tree (*Crataegus spp's*) ranked the slowest growing in the study. Photo: CSFS

also are frequently attacked. Thus far, the Austrian pine has shown good resistance to MPB attacks. Rounding out the conifers studied, white fir and piñon grew significantly slower over the 16-year period.

Leading the growth rate charge in the ornamental group is the invasive Russian-olive. Many communities, including Westminster, have started Russian-olive control programs and its subsequent listing on the noxious weed list in Colorado has prevented it from being available for planting. The crabapple varieties studied show the next highest growth rate among the ornamental trees on the list, and hawthorn varieties round out the trees analyzed in this study.

Discussion

Based on the results of this 16-year study, a growth rate gradient of tree types is proposed in Tables 4 and 5 and Figure 5. This is open to debate and further analysis, but results from this ongoing study reveal these tree types fit along the described gradient in the Westminster, Colo., area.

The study conducted here applies only to a limited area of the Front Range of Colorado, which typically is characterized by a semi-arid climate, poor soil and a poor overall environment for growing trees. Most trees in this study, and those that are planted in the Westminster area, are not native to the high plains ecosystem. It can be challenging to establish and grow healthy trees in this area; however, with proper species selection, handling, planting and care, many trees can grow to their full potential. Equating growth rates with vigor also can be misleading, as some of the slower-growing tree types on this list can be the most adaptable to the area. Hawthorn, hackberry and honeylocust are good examples.

Homeowners and landscape designers should look locally for information on trees that do well in this difficult environment. Relying on nursery catalogs and information on tree performances from other areas of the country can be misleading and result in monocultures of non-adaptable species. Some tree species have been given a slow growth reputation they may not deserve, and often are passed over at planting time. Adding these species to our plant palette, and mixing them with many of the hardy, slow-growing species will increase the success of our projects and promote species diversity in this area.



(Top) Figure 4: Green ash (*Fraxinus pennsylvanica*). Photo: CSFS (Left) Figure 5: Honeylocust (*Gleditsia triacanthos*) is a slower-growing tree, but can be adaptable. Photo: Tom DeGomez, University of Arizona, bugwood.org

Growth Rate Analysis 1992-2008

Shade Trees

Species	Growth Rate (average dbh inches per year)	Growth Rate (average dbh inches per 16-year period)	Sample Size (N = number of trees)
Cottonwood	0.64	10.2	271
Silver maple	0.49	7.8	42
Catalpa	0.44	7.0	9
White oak	0.43	6.9	31
Linden	0.43	6.8	104
Ash	0.42	6.7	270
Red oak	0.40	6.3	54
Honeylocust	0.37	5.9	216
Norway maple	0.33	5.3	80
Hackberry	0.32	5.2	34
Red maple	0.30	4.8	14

Table 1: Growth rate of shade trees and number of trees sampled.

Evergreen Trees

Species	Growth Rate (average dbh inches per year)	Growth Rate (average dbh inches per 16-year period)	Sample Size (N = number of trees)
Blue spruce	0.47	7.6	133
Austrian/ ponderosa pine	0.43	6.9	503
White fir	0.37	5.9	11
Piñon	0.23	3.7	19

Table 2: Growth rate of evergreen trees and number of trees sampled.

Ornamental Trees

Species	Growth Rate (average dbh inches per year)	Growth Rate (average dbh inches per 16-year period)	Sample Size (N = number of trees)
Russian-olive	0.40	6.4	43
Crabapple	0.39	6.2	100
Hawthorn	0.17	2.7	41

Table 3: Growth rate of ornamental trees and number of trees sampled.

Overall Ratings

Species	Growth Rate (average dbh inches per year)	Growth Rate (average dbh inches per 16-year period)	Sample Size (N = number of trees)
Cottonwood	0.64	10.2	271
Silver maple	0.49	7.8	42
Blue spruce	0.47	7.6	133
Catalpa	0.44	7.0	9
White oak	0.43	6.9	31
Austrian/ ponderosa pine	0.43	6.9	503
Linden	0.43	6.8	104
Ash	0.42	6.7	270
Russian-olive	0.40	6.4	43
Red oak	0.40	6.3	54
Crabapple	0.39	6.2	100
Honeylocust	0.37	5.9	216
White fir	0.37	5.9	11
Norway maple	0.33	5.3	80
Hackberry	0.32	5.2	34
Red maple	0.30	4.8	14
Piñon	0.23	3.7	19
Hawthorn	0.17	2.7	41

Table 4: Growth rate of all species and number of trees sampled.



Figure 6: Blue spruce (*Picea pungens*). Photo: CSFS



Figure 7: Red maple (*Acer rubrum*). Photo: John Ruter, University of Georgia, bugwood.org

Growth Rate Over 16 Years by Tree Species

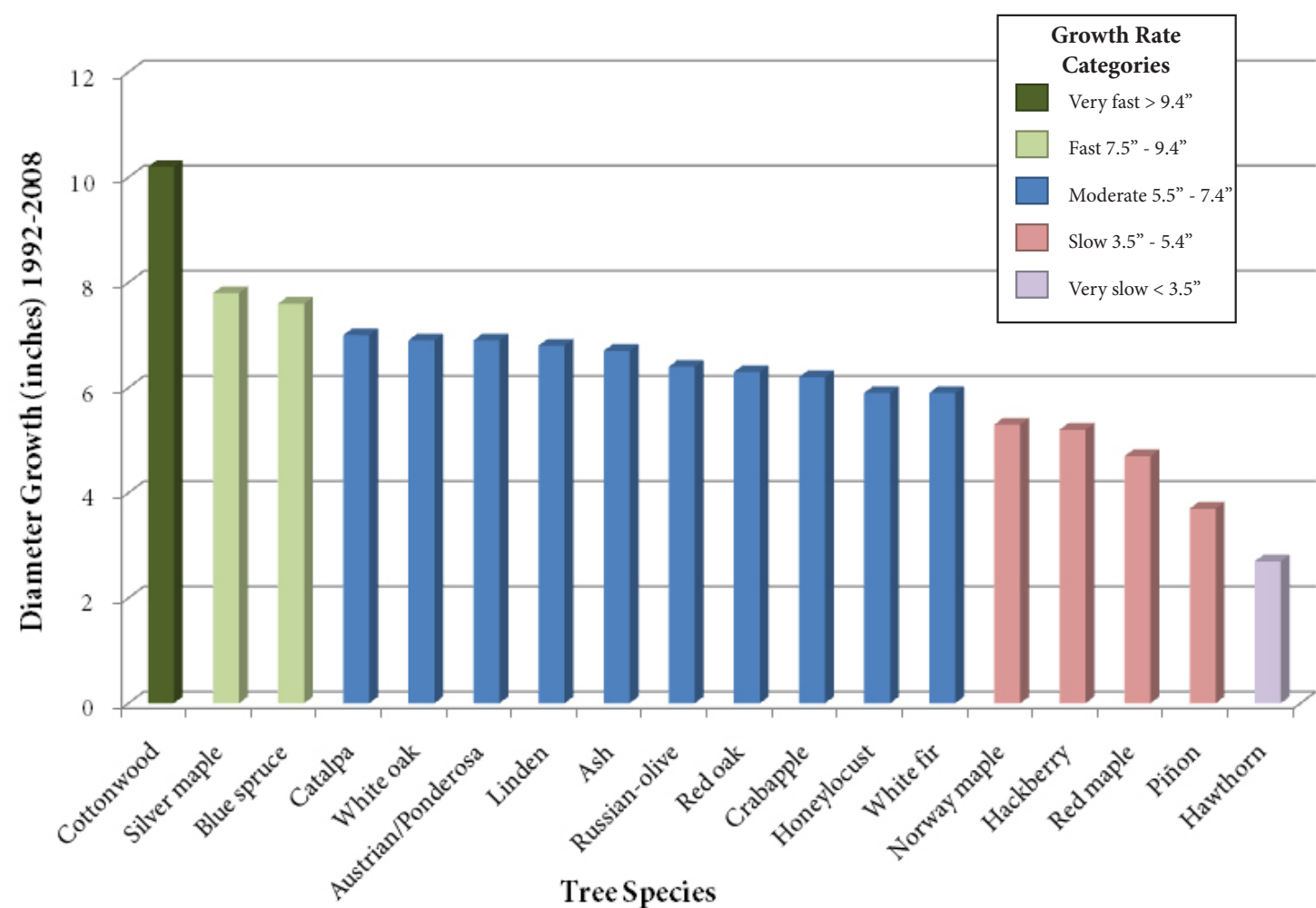


Figure 8: Growth rates (inches in diameter) of tree species over 16 years.

Growth Rate Categories

Very Fast > 9.4"	Fast 7.5" - 9.4"	Moderate 5.5" - 7.4"	Slow 3.5" - 5.4"	Very slow < 3.5"
Cottonwood	Silver maple	Catalpa	Norway maple	Hawthorn
	Blue spruce	White oak	Hackberry	
		Austrian/ ponderosa pine	Red maple	
		Linden	Piñon	
		Ash		
		Russian-olive		
		Red oak		
		Crabapple		
		Honeylocust		
		White fir		

Table 5: Growth rate categories (diameter in inches per 16 years).



United States
Department of
Agriculture

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Northeastern Forest
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Research Paper NE-649



Individual-Tree Diameter Growth Model for the Northeastern United States

Richard M. Teck
Donald E. Hilt



Abstract

Describes a species-specific, distance-independent individual-tree diameter growth model for the Northeastern United States. Diameter growth is predicted in two steps using a two parameter, sigmoidal growth function modified by a one parameter exponential decay function with species-specific coefficients. Coefficients are presented for 28 species groups. The model accounts for variability in annual diameter growth due to species, tree size, site quality, and the tree's competitive position within the stand. Model performance is evaluated using the mean predicted error and the root mean square error. Results are presented for the calibration data and an independent validation data set. The model has been incorporated into NE-TWIGS, a computerized forest growth model for the Northeastern United States.

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Introduction

The ability to predict forest stand development accurately over time is essential for forest planning, and a forest growth simulation system that can predict stand development is a desirable forest management tool. Resource managers in the Northeastern United States need forest growth and yield models to: (1) forecast large-scale regional projections of timber resources, (2) evaluate silvicultural prescriptions, and (3) perform economic analyses of multiresource management alternatives.

More than 30 forest cover types are found in the Northeast. The heterogeneous condition of the forests in this region, defined by the large variation in species composition, stand structure, and site quality, can be traced through several centuries of continuous land use change and a variety of harvesting practices. An individual-tree model is well suited for predicting growth under these diverse conditions.

Some of the earlier individual-tree, distance-independent modeling efforts concentrated on even-aged stand structures with single species. Many of these earlier efforts were limited to linear models, since scientific statistical software packages containing nonlinear regression programs were unavailable. The linear model developed by Lemon and Schumacher (1962), for example, predicted diameter growth in the ponderosa pine forest type as a function of stand competition, site quality, tree size, and age.

More recent modeling endeavors have focused on utilizing nonlinear models for predicting the growth of individual trees in mixed-species heterogeneous forest stands. Many biological processes such as population growth and survival can best be described by nonlinear functions. The response function can often be confined within a specified minimum and maximum range, an advantage when one is concerned with the biological feasibility of the prediction.

The mathematical equations developed by Hahn and Leary (1979) predicted the potential diameter growth of individual trees in the Lake States as a function of diameter, site quality, and crown ratio. Holdaway (1984) modified those predicted growth rates to account for inter-tree competition. More recently, Shifley (1987) developed a 9-parameter function for predicting the growth of 22 species groups in the Central States.

Expanding on the concepts formulated by these researchers, we have attempted to extend the geographic range of these models. However, the model we have developed, although similar in concept to those described above, contains fewer parameters. Nonlinear models with few parameters are easier to recalibrate to local conditions.

Species-specific, individual-tree, distance-independent, diameter growth models have been previously developed for the northern New England states (Hilt et al. 1987a, Hilt et al. 1987b, Hilt and Teck 1987). The models performed

satisfactorily. Our objective here is to calibrate the model coefficients to other species groups and a much larger geographic area in the Northeast. Model parameters were calibrated with Northeastern Forest Experiment Station's Forest Inventory and Analysis (FIA) data for 28 species groups in 14 Northeastern states: Connecticut, Delaware, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, and West Virginia.

Data

Individual-tree measurements collected by the FIA unit were used in developing the model. More than 4,400 1/5-acre permanent plots measured throughout the 14 Northeastern States were used in this study. Data were collected in the 1960's, 1970's, and 1980's. Only one remeasurement period was available for each state except Maine, which was remeasured twice. The remeasurement period averaged 12 years.

The data covered a wide range of age, site, and stocking conditions. Basal area per acre ranged from 30 to 255 ft²/acre. Site index (base age 50 years), recorded on each 1/5-acre plot for the dominant species, ranged from 30 to 90. Site-index conversion equations were used to assign the appropriate site index to each tree depending on its species. Quadratic mean stand diameter ranged from 5 to 13 inches, indicating a wide range in the age of the stands sampled.

Information recorded for each tree (more than 5 inches d.b.h.) included species, initial diameter, diameter at the end of the remeasurement period, and a status code indicating whether the tree was alive or dead.

Most of the major species had a sufficient number of observations to be modeled independently. Less prevalent species had fewer observations and were grouped with other species exhibiting similar silvical characteristics into one of 28 species groups (Table 1).

Every fourth plot was systematically removed from the data base and was set aside for model validation. The calibration data set contains 51,757 observations (Table 2). The validation data set contains 16,748 observations (Table 3).

The data summarized in Table 2 are a subset of a much larger initial data base. Eliminated from the calibration set data were those plots where catastrophic mortality (more than 70 percent of initial basal area) and/or excessive cutting (residual basal area less than 30 percent of initial conditions) occurred between remeasurements. These plots were eliminated because we were unable to determine when the events occurred. Without knowing the timing of such events, it is impossible to determine how long the initial stand conditions existed. Since the independent variables in the model are based on initial stand conditions, it was necessary to remove the plots from the data base.

Table 1.—28 species groups and associated species codes used for analysis

Species group	Species	USDA Code ^a	Species group	Species	USDA Code ^a
American beech	American beech	531	Other hardwoods	Sourwood	711
Balsam fir	Balsam fir	012		Paulownia	712
Black cherry	Black cherry	762		Sycamore	731
Black oak	Black oak	837		Willow oak	831
	Cherrybark oak	813		Black locust	901
Chestnut oak	Chestnut oak	832		Black willow	922
	Swamp chestnut oak	825		Sassafras	931
	Swamp white oak	804		Mountain ash	935
Eastern hemlock	Eastern hemlock	261		Basswood	950
Hickory	Bitternut hickory	402		Elm	970
	Pignut hickory	403	Other pines	Jack pine	105
	Shagbark hickory	407		Shortleaf pine	110
	Mockernut hickory	409		Table mountain pine	123
Loblolly pine	Loblolly pine	131		Pitch pine	126
Noncommercial	Boxelder	313		Pond pine	128
	Striped maple	315		Scotch pine	130
	Mountain maple	319	Paper birch	Paper birch	375
	Serviceberry	355	Quaking aspen	Quaking aspen	746
	American hornbeam	391		Balsam poplar	741
	Catalpa	450		Eastern cottonwood	742
	Eastern redbud	471		Bigtooth aspen	743
	Flowering dogwood	491	Red maple	Red maple	316
	Hawthorn	500	Red pine	Red pine	125
	Eastern hophornbeam	701	Red spruce	Red spruce	097
	Plum cherry	760		Norway spruce	091
	Pin cherry	761		Black spruce	095
N. red oak	N. red oak	833	Scarlet oak	Scarlet oak	806
	Southern red oak	812		Pin oak	831
N. white-cedar	N. white-cedar	241	Tamarack	Tamarack	071
	Atlantic white-cedar	043	Virginia pine	Virginia pine	132
	Eastern redcedar	068	White ash	White ash	541
Other hardwoods	Buckeye	330		Black ash	543
	Yellow buckeye	332		Green ash	544
	Gray birch	379		Blue ash	546
	Hackberry	462	White oak	White oak	802
	Common persimmon	521		Bur oak	823
	Honeylocust	552		Post oak	835
	American holly	591	White pine	White pine	129
	Butternut	601	White spruce	White spruce	094
	Black walnut	602	Yellow birch	Yellow birch	371
	Magnolia	650		Sweet birch	372
	Sweetbay	653		River birch	373
	Apple sp	660	Yellow-poplar	Yellow-poplar	621
	Water tupelo	691		Sweetgum	611
	Blackgum	693		Cucumbertree	651

^aStandard species codes used by the USDA Forest Service, Forest Inventory and Analysis Unit.

Table 2.—Individual-tree and plot characteristics of the calibration data set

Species group	No. of plots	No. of trees	Site index ^a			Plot TPA ^b			Plot basal area			DBH			BAL ^c			Measurement Interval		
			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
									<i>Ft²/acre</i>			<i>Inches</i>			<i>Ft²/acre</i>			<i>Years</i>		
American beech	587	2,511	32	57	90	40	230	661	32	102	220	5.0	9.2	35.6	4	67	220	4	12	18
Balsam fir	633	4,456	30	50	82	82	327	705	40	116	238	5.0	7.0	18.4	3	76	224	4	11	17
Black cherry	253	812	39	68	90	42	283	621	32	106	210	5.0	8.7	26.1	3	67	195	6	12	17
Black oak	199	664	37	64	90	62	212	571	32	85	163	5.0	10.1	24.8	3	46	151	9	12	17
Chestnut oak	172	821	30	58	90	25	222	506	31	95	192	5.0	9.6	30.4	3	63	180	9	12	18
Eastern hemlock	471	3,431	30	50	83	50	309	806	32	131	255	5.0	9.0	29.2	3	82	255	4	12	18
Hickory	261	1,013	35	60	88	25	231	806	32	92	255	5.0	8.6	22.9	4	66	242	9	12	17
Loblolly pine	41	430	49	70	90	90	221	351	36	87	123	5.0	9.3	24.7	4	55	114	9	10	15
Noncommercial	175	422	30	52	78	58	238	581	32	101	214	5.0	6.6	16.5	5	86	214	7	12	17
N. red oak	478	2,093	30	60	88	52	246	806	30	98	255	5.0	9.9	59.1	3	54	177	7	12	17
N. white-cedar	302	2,804	30	42	70	92	355	716	38	130	234	5.0	8.6	28.0	3	73	224	4	11	17
Other hardwoods	557	2,123	30	64	90	38	246	806	31	96	255	5.0	8.3	32.5	4	68	255	4	11	17
Other pines	62	341	30	47	86	68	201	488	36	79	147	5.0	9.0	17.9	3	47	147	7	13	17
Paper birch	486	1,830	30	55	80	90	290	705	37	103	228	5.0	7.9	23.0	2	61	193	4	11	16
Quaking aspen	298	1,328	36	61	90	75	293	806	32	95	255	5.0	8.1	33.6	3	48	178	7	12	17
Red maple	1,225	6,591	30	58	90	40	278	806	30	108	255	5.0	8.4	33.8	3	71	233	4	12	18
Red pine	31	91	31	68	90	111	259	546	39	100	228	5.0	9.3	18.3	3	51	155	10	12	16
Red spruce	697	4,968	30	46	81	50	332	716	32	118	234	5.0	8.1	25.4	2	68	228	4	11	17
Scarlet oak	133	476	37	59	90	70	206	473	32	76	155	5.0	9.1	23.8	4	46	137	9	13	16
Sugar maple	736	4,237	30	59	90	40	259	661	30	113	237	5.0	9.4	39.3	3	75	219	4	12	18
Tamarack	51	238	30	48	69	105	354	705	36	102	207	5.0	7.5	14.3	2	51	156	6	11	15
Virginia pine	53	664	41	63	87	70	263	385	34	87	144	5.0	8.1	16.4	3	55	144	9	11	15
White ash	454	1,393	32	64	90	38	285	806	30	110	255	5.0	8.7	27.3	3	73	248	4	12	17
White oak	345	1,321	31	59	88	25	229	806	31	90	255	5.0	9.5	37.9	3	58	195	9	12	17
White pine	411	2,914	31	65	90	45	262	690	36	120	238	5.0	10.4	43.3	3	64	201	4	12	18
White spruce	149	481	30	49	80	80	331	645	41	119	238	5.0	8.4	22.3	3	63	197	6	11	15
Yellow birch	746	2,562	30	58	90	45	263	806	32	112	255	5.0	9.3	33.8	3	72	242	4	11	18
Yellow-poplar	182	742	38	69	90	25	180	401	30	94	219	5.0	10.7	32.8	4	62	181	9	11	16
Total		51,757																		

^aTotal height (in feet) at age 50.

^bNumber of trees per acre.

^cBasal area of trees larger than or equal to subject tree.

Table 3.—Individual-tree and plot characteristics of the validation data set

Species group	No. of plots	No. of trees	Site index ^a			Plot TPA ^b			Plot basal area			DBH			BAL ^c			Measurement Interval		
			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
									<i>Ft²/acre</i>			<i>Inches</i>			<i>Ft²/acre</i>			<i>Years</i>		
American beech	189	771	35	57	86	42	249	645	32	110	200	5.0	9.2	28.8	4	73	200	4	12	17
Balsam fir	211	1,546	30	51	74	70	328	659	40	116	240	5.0	7.0	17.6	3	76	200	4	11	15
Black cherry	70	230	40	70	90	85	273	536	30	106	202	5.0	8.9	23.7	4	68	187	8	12	17
Black oak	77	298	33	61	86	25	211	476	32	92	187	5.0	11.0	41.0	3	51	174	10	12	16
Chestnut oak	59	461	30	56	80	80	265	618	33	105	225	5.0	9.1	26.5	3	70	196	9	11	18
Eastern hemlock	152	1,176	30	50	80	70	319	721	35	128	240	5.0	8.9	27.1	2	79	237	4	12	17
Hickory	102	378	35	62	84	60	234	436	33	87	200	5.0	8.1	28.1	5	66	167	9	12	17
Loblolly pine	19	181	30	53	77	100	200	290	32	92	127	5.0	9.6	20.2	5	63	127	9	10	15
Noncommercial	52	119	30	53	77	80	221	413	36	98	176	5.0	6.9	13.1	6	84	174	8	12	16
N. red oak	162	651	30	60	89	25	262	618	32	105	225	5.0	10.0	31.3	3	58	206	6	12	18
N. white-cedar	91	941	30	43	66	79	375	659	34	143	258	5.0	8.7	23.2	3	82	225	5	11	16
Other hardwoods	205	652	30	61	90	45	224	645	30	94	225	5.0	8.5	25.8	4	70	209	4	12	17
Other pines	10	54	30	57	82	78	275	371	40	98	115	5.0	9.3	17.6	4	59	115	10	13	16
Paper birch	153	518	34	55	86	55	295	658	34	101	200	5.0	8.0	20.7	3	58	178	4	11	16
Quaking aspen	84	367	32	62	84	58	304	659	30	98	238	5.0	7.9	18.7	3	50	196	6	12	17
Red maple	390	2,195	30	58	86	40	293	802	30	110	242	5.0	8.4	31.6	3	71	242	4	12	17
Red pine	9	60	34	65	80	102	400	618	49	135	187	5.1	9.2	17.8	4	54	135	7	12	14
Red spruce	240	1,686	30	47	72	70	352	802	34	123	258	5.0	8.0	21.5	3	71	242	4	11	16
Scarlet oak	50	154	33	58	86	25	235	468	34	84	165	5.0	9.6	22.0	3	49	123	9	12	15
Sugar maple	235	1,318	31	60	86	40	247	721	35	109	232	5.0	9.6	37.2	4	71	232	6	12	17
Tamarack	13	85	35	58	75	120	428	541	49	121	162	5.2	8.0	13.1	4	59	150	10	11	13
Virginia pine	19	128	37	64	90	108	214	363	35	88	124	5.0	9.2	15.9	5	56	116	9	11	15
White ash	138	389	36	65	90	42	252	558	32	102	225	5.0	8.8	26.7	4	69	197	6	12	16
White oak	122	499	30	58	83	45	225	618	32	94	193	5.0	9.6	32.4	4	61	193	9	12	16
White pine	121	730	34	63	90	70	275	802	42	119	242	5.0	10.1	39.1	3	65	211	4	12	17
White spruce	52	162	30	51	69	80	315	659	34	115	238	5.0	8.0	16.7	3	64	200	5	11	15
Yellow birch	262	817	32	57	86	55	236	563	34	104	258	5.0	9.7	28.0	4	66	228	6	12	17
Yellow-poplar	59	182	42	69	94	42	156	351	31	78	150	5.0	10.4	28.1	4	57	158	9	11	16
Total		16,478																		

^aTotal height (in feet) at age 50.^bNumber of trees per acre.^cBasal area of trees larger than or equal to subject tree.

Methods

Here we first review the development of the species-specific, individual-tree, distance-independent, diameter growth model previously developed by Hilt and others (1987a). Species-specific coefficients for the model are then calibrated for each of the 28 species groups.

Predicted periodic mean annual diameter growth is modeled using a two-step approach. In the first step, potential periodic mean annual basal area growth is modeled as a function of d.b.h. and site index. The potential basal area growth is then reduced for each tree based on the tree's competitive position within the stand. Basal-area growth is then converted to diameter growth.

Many predictor variables were evaluated for inclusion in our model. Plot variables included site index (SI), basal area per acre, trees per acre, quadratic mean stand diameter (QMD), and stand density. Individual-tree variables included basal area and diameter.

Plots of periodic mean annual diameter-growth over diameter for a given site index and stand density revealed a positive correlation between tree diameter and diameter growth. Additional data analysis also revealed a positive correlation between site index and diameter growth.

Diverse land management practices have resulted in stands with tremendous variation in diameter distributions. The normal bell-shaped diameter distribution associated with even-aged stands, and the reverse J-shaped diameter distribution associated with uneven-aged stands are more the exception than the rule. High frequencies of bimodal, trimodal, and uniform diameter distributions in the plot data owe their existence to a multitude of harvesting practices in the second and third generation forests prevalent in the Northeast.

This diversity of stand conditions negated any correlation associated with diameter growth and mean stand diameter (Hilt et al. 1987a). Furthermore, the elimination of mean stand diameter as a predictor variable reduced the effectiveness of stand basal area for predicting growth. Together, these variables can be used to identify relative stand density. However, basal area alone is an unreliable indicator of relative stand density. One hundred square feet of basal area per acre may represent 100 percent stocking in a stand with a small QMD, but only 60 percent stocking in a stand with a larger QMD.

Since the growth rate of a tree is influenced by its relative position (competitive status) within the stand, we calculated several competition indices including: the ratio of d.b.h. to QMD, ratio of tree basal area to plot basal area, and the number of standard deviations a tree's diameter is from plot QMD. The competition index exhibiting the highest correlation with diameter growth was basal area per acre larger than the subject tree (BAL). BAL has been used as a competition indicator in both the PROGNOSIS growth

model (Wykoff et al. 1982) and the Central States TWIGS growth model (Shifley 1987).

The data for each species group were then separated into d.b.h. $\times$ BAL $\times$ SI cells. The upper and lower boundaries of each cell were selected so that there were approximately equal numbers of trees within each cell. The mean value for each of the three predictor variables and the mean annual periodic individual-tree basal area growth rate within each cell were used in the preliminary analysis to select the model form. Cell means were used to reduce the total number of observations so that various nonlinear model forms could be examined more efficiently.

Numerous model forms and combinations of independent variables were examined (Hilt et al. 1987a). Only the final model selected for application is reported here.

Potential Growth

Individual trees for a given species were sorted in descending order according to their mean annual periodic basal-area growth rates in each d.b.h. $\times$ site index class. The top 10 percent of the fastest growers in each class were then used to develop the potential growth function. A modified Chapman-Richards (Richards 1959) sigmoidal growth function was used to predict the potential growth for a given site and tree size:

$$\text{POTBAG} = b_1 \text{SI}(1.0 - \exp(-b_2 \text{DBH10})) \quad (1)$$

where POTBAG is the potential basal-area growth for an individual tree, DBH10 is the average d.b.h. of the top 10 percent of the fastest growers, SI is the species specific site index, and b_1 and b_2 are species specific parameters estimated using weighted nonlinear regression. An investigation of the error structure revealed homogeneity among cell variances in relation to d.b.h. and site index. Each observation was weighted by cell frequency (the number of trees in each cell).

The fitted values for b_1 and b_2 are shown in Table 4, and the resulting equation is plotted in Figure 1 for sugar maple. Potential basal-area growth for sugar maple is then compared with several major species groups in Figure 2. Corresponding potential individual-tree diameter growth rates are plotted in Figure 3.

Modifier Function

Graphic analysis of the cell means revealed that individual-tree basal-area growth rates for all trees in a given initial d.b.h. $\times$ SI class declined in a negative exponential manner as BAL increased. This trend suggests the following model for a given d.b.h. $\times$ SI class:

$$\text{BAG} = \text{POTBAG}(\exp(-b_3(\text{BAL}))) \quad (2)$$

The intercept term, POTBAG, is the potential basal-area growth estimated from equation (1) for each DBH $\times$ site

Table 4.—Individual-tree basal-area growth coefficients^a

Species group	Potential		Modifier	Variance	
	b ₁	b ₂	b ₃	c ₁	c ₂
American beech	0.0006911	0.0730441	0.013029	0.0000138	0.0060925
Balsam fir	.0008829	.0602785	.012785	.0000082	.0046624
Black cherry	.0007929	.1568904	.016537	.0000304	.0089725
Black oak	.0008550	.0957964	.020843	.0000131	.0029118
Chestnut oak	.0008238	.0790660	.013762	.0000181	.0147197
Eastern hemlock	.0008737	.0940538	.009149	.0000136	.0098005
Hickory	.0007993	.0779654	.015963	.0000184	.0311543
Loblolly pine	.0009252	.1134195	.017300	.0000209	.0174766
Noncommercial	.0003604	.0328767	.011620	.0000164	.0112692
N. red oak	.0008920	.0979702	.018024	.0000200	.0031519
N. white-cedar	.0009050	.0517297	.012329	.0000056	.0049320
Other hardwoods	.0009567	.1038458	.020653	.0000160	.0027012
Other pines	.0006634	.1083470	.016835	.0000034	.0128994
Paper birch	.0009766	.0832328	.023978	.0000059	.0014599
Quaking aspen	.0011885	.0920050	.016877	.0000140	.0030131
Red maple	.0007906	.0651982	.016191	.0000173	.0031921
Red pine	.0009252	.1134195	.017300	.0000221	.0282408
Red spruce	.0008236	.0549439	.011942	.0000084	.0048774
Scarlet oak	.0008769	.0866621	.018560	.0000159	.0092161
Sugar maple	.0007439	.0706905	.016240	.0000147	.0037588
Tamarack	.0009933	.0816995	.018831	.0000077	.0042517
Virginia pine	.0006634	.1083470	.016835	.0000093	.0042225
White ash	.0008992	.0925395	.015004	.0000264	.0116584
White oak	.0007417	.0867535	.014235	.0000119	.0070636
White pine	.0011303	.0934796	.015496	.0000255	.0028304
White spruce	.0008721	.0578650	.013427	.0000155	.0173732
Yellow birch	.0006668	.0768212	.019046	.0000125	.0080770
Yellow-poplar	.0008815	.1419212	.019904	.0000429	.0090635

^aBAG = POTBAG (exp(-b₃(BAL))) where: POTBAG = b₁SI(1.0 - exp(-b₂DBH))

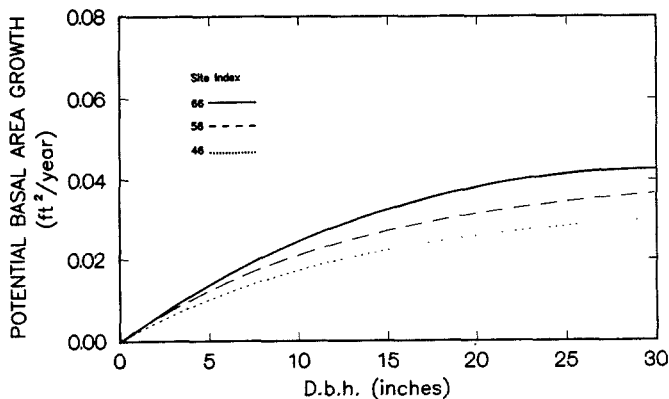


Figure 1.—Effect of site index on the predicted potential basal-area growth rates for sugar maple.

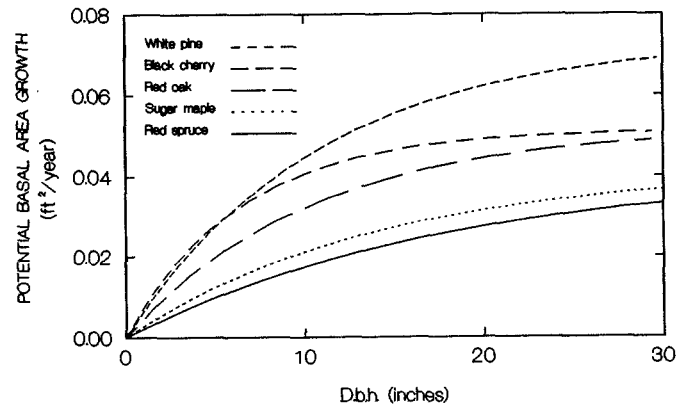


Figure 2.—Predicted potential basal-area growth rates for several important species groups (species specific site index equivalent to SI = 50 for red spruce).

index class. The equation is forced through the potential growth when BAL equals zero.

A two-stage modeling procedure was used to estimate b_3 . First, an estimate of b_3 was determined by fitting equation (2) for each d.b.h. $\times$ SI class. An investigation of the error structure revealed that within-cell variances were correlated with d.b.h. and BAL. The following model was then fitted for each species to describe the error structure:

$$\text{VARBAG} = c_1 \text{DBH}(\exp(-c_2(\text{BAL}))) \quad (3)$$

where VARBAG is the variance of the individual-tree basal-area growth rates. Each observation was weighted by the number of observations in the cell divided by VARBAG. Equation (2) was then refit to the weighted observations. The estimated b_3 's were plotted over d.b.h. and site index to see if they could be modeled as a function of these two variables. No trends were identified. The mean value of b_3 was used as the final estimate for each species group. Fitted values for b_3 , c_1 and c_2 are presented in Table 4. Predicted individual-tree basal-area growth rates for sugar maple are shown in Figure 4 for a range of d.b.h. and BAL values. Corresponding diameter growth rates are presented in Figure 5.

Individual-tree basal-area growth rates are easily calculated using equations (1) and (2). First, compute the potential basal-area growth rate (POTBAG) using equation (1) and the values for b_1 and b_2 from Table 4. Then using the value for b_3 from Table 4, solve equation (2) to determine the individual-tree basal-area growth rate (BAG). Individual-tree basal-area growth rates can then be converted to diameter growth rates (DGROW) using the following conversion formula:

$$\text{DGROW} = \{[0.00545415(\text{DBH})^2 + \text{BAG}] / 0.00545415\}^{.5} - \text{DBH} \quad (4)$$

Predicted potential diameter growth rates for sugar maple are plotted using a three-dimensional response function in Figure 6. Predicted diameter growth rates are presented in Figure 7 for sugar maple site index 56 for a range of diameters and BAL.

Results

To determine how well the model predicts individual-tree growth, we compared observed and predicted periodic annual basal-area growth and periodic annual diameter growth for each observation in the data base. Observed periodic mean annual diameter growth ranged from a low of 0.064 for the noncommercial species group to a high of 0.159 for white pine. The mean annual diameter growth prediction error (i.e. predicted minus observed growth), based on all 51,757 observations, was -0.013 inches. This is an 11.5 percent underprediction of individual-tree annual diameter growth.

Observed and predicted mean annual periodic basal-area growth rates and diameter growth rates and their associated mean predicted errors are presented by species group in Table 5. The largest discrepancy between actual and

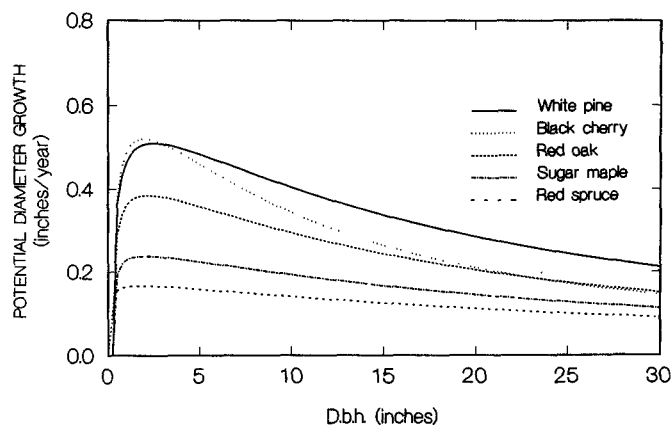


Figure 3.—Predicted potential diameter growth rates for several important species groups (species specific site index equivalent to SI = 50 for red spruce).

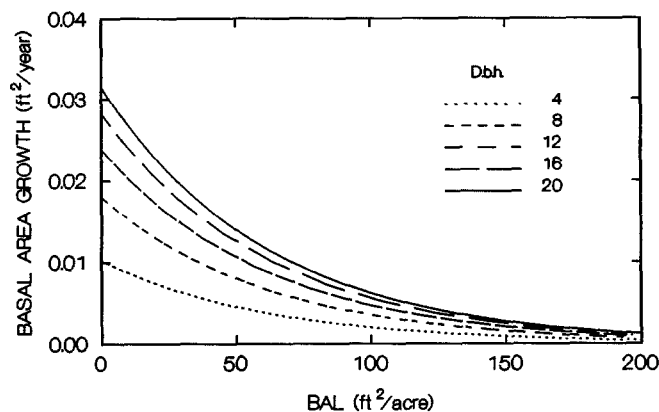


Figure 4.—Predicted basal-area growth rates for sugar maple (SI = 56).

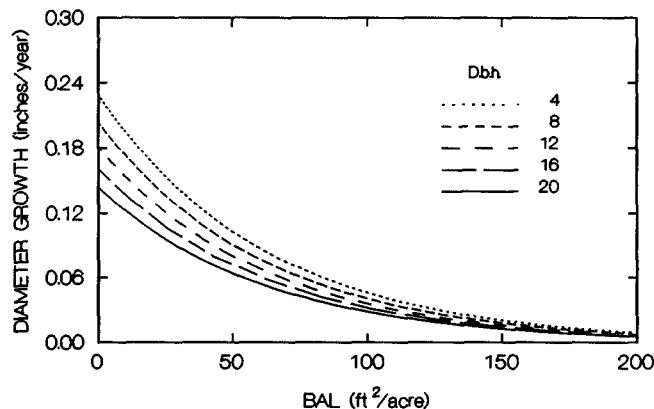


Figure 5.—Predicted diameter growth rates for sugar maple (SI = 56).

predicted individual-tree diameter growth was for quaking aspen. The model overpredicted the mean annual individual-tree diameter growth by 0.062 inches. The model overpredicts annual diameter growth for 16 species groups, and underpredicts annual diameter growth for 12 species groups. The predicted mean annual diameter growth error is within 0.02 inches for 16 of the 28 species groups.

The same evaluation statistics were computed for the validation data (Table 6). The mean annual diameter growth prediction error, based on all 16,748 observations is -0.013 inches. This is an 11.6 percent underprediction of individual-tree annual diameter growth. The model overpredicts annual diameter growth for 12 species groups, and underpredicts annual diameter growth for 16 species groups.

Discussion

Although some of the variability in annual basal-area growth within and among species groups can be explained by the stand and tree variables contained within this model, much of the variability is due to other factors such as the spatial variation of weather, and micro-site conditions.

No simulation model predicting changes to a biological system will ever perfectly represent the system being modeled so long as the environmental conditions within which that system resides continue to change. However, we still need to be concerned with how well the model predicts

change relative to alternative models.

At the present time, this model is the only regionally calibrated, species-specific, individual-tree, distance-independent, diameter growth model for mixed-species, multi-aged forest stands in the 14-state Northeastern Region. Other models that have been calibrated for specific forest types within sub-regions of the Northeast are available. Preliminary evaluations comparing this model to some of the locally developed models (U.S. Dept. of Agric. 1990) show promising results regarding model accuracy and precision.

Potential model users should understand that predicted growth rates for a given species are indicative of the average growth rate for that species throughout the region. Growth rates for a given stand may vary considerably from the regional average due to local edaphic conditions. However, for many species, site index accounts for this variation.

The model form has several inherent constraints that should provide biologically reasonable estimates of diameter growth when extrapolated beyond the range of the calibration data base: (1) The growth of an individual tree cannot exceed its potential growth—it equals the potential growth only when BAL = 0; (2) individual-tree basal-area growth rates for a given d.b.h. and site index decrease as BAL increases; and (3) as BAL increases, individual-tree basal-area growth rates for a given d.b.h. and site index

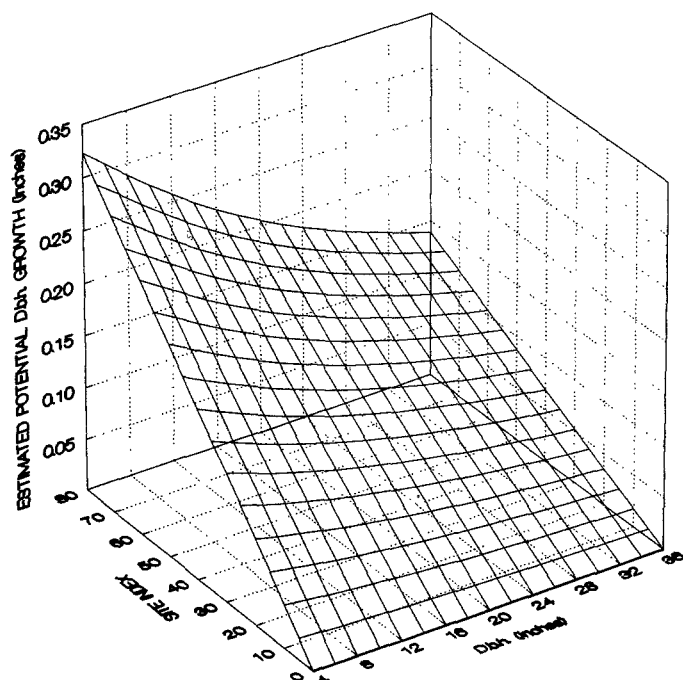


Figure 6.—Predicted potential diameter growth (in inches) for sugar maple.

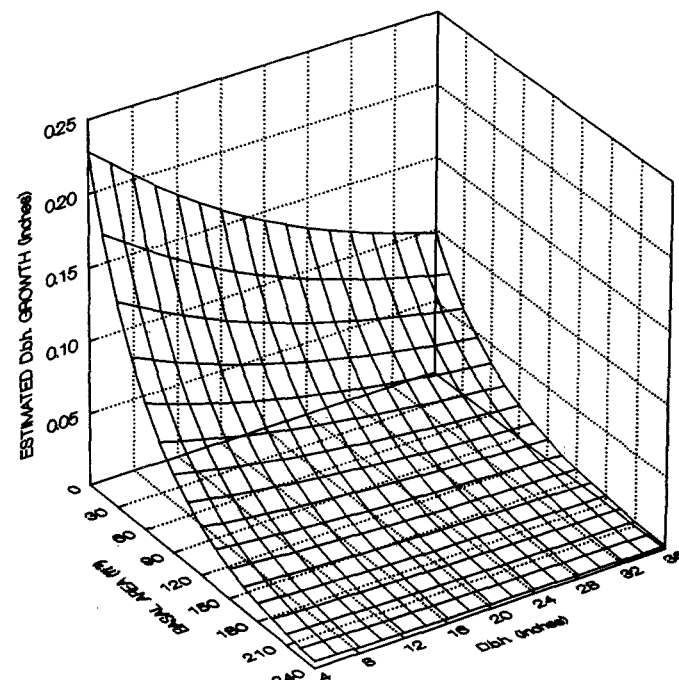


Figure 7.—Predicted diameter growth (in inches) for sugar maple (SI = 56).

Table 5.—Comparison of observed and predicted annual growth rates for calibration data base

Species group	No. of trees	Basal-area growth			Diameter growth		
		Mean observed growth	Mean predicted error	Root mean square error	Mean observed growth	Mean ^a predicted error	Root ^b mean square error
		----- Ft ² /tree -----			----- Inch/tree -----		
American beech	2,511	0.0127	-0.0034	0.010	0.113	-0.026	0.080
Balsam fir	4,456	.0082	- .0016	.006	.095	- .013	.066
Black cherry	812	.0164	- .0007	.014	.145	.016	.112
Black oak	664	.0178	- .0026	.013	.140	- .007	.090
Chestnut oak	821	.0128	- .0010	.010	.107	.001	.065
Eastern hemlock	3,431	.0125	.0007	.009	.110	.017	.073
Hickory	1,013	.0103	- .0005	.007	.097	.000	.065
Loblolly pine	430	.0138	.0051	.012	.122	.055	.103
Noncommercial	422	.0053	- .0038	.008	.064	- .043	.077
N. red oak	2,093	.0197	- .0050	.015	.155	- .025	.097
N. white-cedar	2,804	.0075	- .0009	.007	.075	- .010	.068
Other hardwoods	2,123	.0113	.0003	.012	.107	.011	.101
Other pines	341	.0076	.0022	.008	.071	.024	.068
Paper birch	1,830	.0076	.0007	.008	.081	.009	.076
Quaking aspen	1,328	.0149	.0045	.013	.146	.062	.125
Red maple	6,591	.0120	- .0043	.011	.113	.035	.089
Red pine	91	.0154	.0057	.013	.138	.060	.117
Red spruce	4,968	.0093	- .0023	.008	.093	- .019	.069
Scarlet oak	476	.0157	- .0022	.010	.136	- .005	.082
Sugar maple	4,237	.0144	- .0062	.012	.122	- .049	.091
Tamarack	238	.0089	.0017	.009	.095	.022	.080
Virginia pine	664	.0117	- .0005	.008	.116	.002	.076
White ash	1,393	.0156	- .0028	.011	.140	.014	.093
White oak	1,321	.0132	- .0009	.010	.106	.006	.071
White pine	2,914	.0213	- .0008	.016	.159	.013	.112
White spruce	481	.0117	- .0034	.009	.114	- .030	.083
Yellow birch	2,562	.0113	- .0045	.011	.102	- .041	.084
Yellow-poplar	742	.0284	- .0112	.026	.201	- .060	.155
All	51,757	.0125	- .0022	.011	.113	- .013	.086

^aPredicted minus observed growth. Negative values signify underprediction.

^bRoot mean square error = $[\sum(y_i - \hat{y}_i)^2/n]^{0.5}$

asymptotically approach zero.

This diameter growth model has been incorporated into NE-TWIGS, an individual-tree growth projection system for mixed-species forests of the Northeastern United States (Hilt and Teck 1989, Teck 1990). Computerized forest

growth projection systems like NE-TWIGS, will allow researchers to quantitatively evaluate stand response to alternative silvicultural treatments. Treatment response comparisons can then be used for developing recommended management guidelines for Northeastern forest stands.

Table 6.—Comparison of observed and predicted annual growth rates for validation data base

Species group	No. of trees	Basal-area growth			Diameter growth		
		Mean observed growth	Mean predicted error	Root mean square error	Mean observed growth	Mean ^a predicted error	Root ^b mean square error
		----- Ft ² /tree -----			----- Inch/tree -----		
American beech	771	0.0118	−0.0031	0.009	0.106	−0.024	0.076
Balsam fir	1,546	.0084	− .0017	.007	.097	− .014	.068
Black cherry	230	.0178	− .0014	.014	.165	.001	.117
Black oak	298	.0203	− .0062	.017	.142	− .029	.084
Chestnut oak	461	.0105	.0000	.007	.094	.006	.061
Eastern hemlock	1,176	.0128	.0007	.009	.115	.018	.076
Hickory	378	.0107	− .0012	.007	.104	− .004	.062
Loblolly pine	181	.0133	.0039	.014	.118	.037	.106
Noncommercial	119	.0051	− .0034	.006	.060	− .039	.062
N. red oak	651	.0199	− .0050	.014	.154	− .027	.094
N. white-cedar	941	.0074	− .0009	.007	.073	− .010	.061
Other hardwoods	652	.0121	− .0010	.012	.111	− .002	.098
Other pines	54	.0070	.0040	.007	.060	.038	.056
Paper birch	518	.0077	.0014	.009	.082	.013	.081
Quaking aspen	367	.0162	.0032	.012	.160	.055	.127
Red maple	2,195	.0117	− .0039	.010	.112	− .033	.087
Red pine	60	.0155	.0025	.011	.136	.033	.094
Red spruce	1,686	.0089	− .0021	.007	.092	− .018	.072
Scarlet oak	154	.0165	− .0025	.011	.133	− .009	.076
Sugar maple	1,318	.0145	− .0058	.013	.120	− .043	.090
Tamarack	85	.0103	.0013	.008	.103	.016	.074
Virginia pine	128	.0150	− .0031	.010	.136	− .023	.087
White ash	389	.0156	− .0017	.011	.136	.000	.090
White oak	499	.0127	− .0014	.009	.104	.001	.065
White pine	730	.0198	− .0003	.014	.152	.020	.109
White spruce	162	.0138	− .0054	.010	.137	− .048	.095
Yellow birch	817	.0128	− .0051	.012	.112	− .046	.094
Yellow-poplar	182	.0264	− .0074	.023	.188	− .032	.146
All	16,748	.0124	− .0022	.010	.112	− .013	.085

^aPredicted minus observed growth. Negative values signify underprediction.

^bRoot mean square error = $[\sum(y_i - \hat{y}_i)^2/n]^{0.5}$

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Teck, Richard M.; Hilt, Donald E. 1991. **Individual tree-diameter growth model for the Northeastern United States**. Res. Pap. NE-649. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 11 p.

Describes a distance-independent individual-tree diameter growth model for the Northeastern United States. Diameter growth is predicted in two steps using a two parameter, sigmoidal growth function modified by a one parameter exponential decay function with species-specific coefficients. Coefficients are presented for 28 species groups. The model accounts for variability in annual diameter growth due to species, tree size, site quality, and the tree's competitive position within the stand. Model performance is evaluated using the mean predicted error and the root mean square error. Results are presented for the calibration data and an independent validation data set. The model has been incorporated into NE-TWIGS, a computerized forest growth model for the Northeastern United States.

Keywords: NE-TWIGS; diameter growth prediction; computer simulation; basal-area growth

Headquarters of the Northeastern Forest Experiment Station is in Radnor, Pennsylvania. Field laboratories are maintained at:

Amherst, Massachusetts, in cooperation with the University of Massachusetts

Burlington, Vermont, in cooperation with the University of Vermont

Delaware, Ohio

Durham, New Hampshire, in cooperation with the University of New Hampshire

Hamden, Connecticut, in cooperation with Yale University

Morgantown, West Virginia, in cooperation with West Virginia University

Orono, Maine, in cooperation with the University of Maine

Parsons, West Virginia

Princeton, West Virginia

Syracuse, New York, in cooperation with the State University of New York, College of Environmental Sciences and Forestry at Syracuse University

University Park, Pennsylvania, in cooperation with The Pennsylvania State University

Warren, Pennsylvania

Persons of any race, color, national origin, sex, age, religion, or with any handicapping condition are welcome to use and enjoy all facilities, programs, and services of the USDA. Discrimination in any form is strictly against agency policy, and should be reported to the Secretary of Agriculture, Washington, DC 20250.

Trees of Minnesota

Eastern White Pine

Location: New England, Lake, Mid-Atlantic and South Atlantic States (In Minnesota, white pine is prominent throughout the northern, central and eastern parts of the state.)

Wood Properties: fine, uniform texture; straight grain; light; soft; low in shock resistance and strength; easily kiln-dried

Uses: lumber; patterns for castings; doors; furniture; knotty paneling; shade and map rollers

Full Size: 80-100 feet in height, up to 2-3.5 feet in diameter, maximum 220 feet in height and 6 feet in diameter



Red (Norway) Pine

(Minnesota State Tree)

Location: Southeastern Canada, Lake States and Northeastern U.S. (In Minnesota, Norway pine can be found in many parts of northern and northeastern regions of the state.)

Wood Properties: moderately uneven grain; light; hard and strong

Uses: timber for heavy and general construction

Full Size: 70-80 feet in height, 2-3 feet in diameter



Balsam Fir

Location: Northeastern U.S., Lake States; Canada. (In Minnesota, balsam fir can be found in the northern part of the state and a few scattered locations in the southeastern corner.)

Wood Properties: medium texture; moderately uneven to even grain; weak, soft and brittle

Uses: lightweight construction lumber; pulpwood; packing cases; especially important as Christmas trees

Full Size: 40-60 feet in height, 12-18 inches in diameter, small to medium-size tree



Northern White Cedar

Location: Maine, Lake States.

(In Minnesota, white cedar are native to the northern part of the state.)

Wood Properties: light; soft; weak; low in shock resistance; easily worked; highly decay resistant; fragrant; leaves are scale-like and flattened

Uses: poles; cross ties; lumber; posts; decorative fencing

Full Size: 40-50 feet in height, 12-24 inches in diameter; medium-size tree



Black Spruce

Location: Found mainly in the northern and northeastern parts of Minnesota, as far south as northern Anoka County.

Wood Properties: Yellowish-white; light; soft; medium strong

Uses: Used more extensively for paper pulp than any other tree. Also used extensively for Christmas trees.

Full Size: 25-65 feet in height; 6-12 inches in diameter; small to medium-size tree; Black Spruce is the most important pulpwood species in Canada and is also commercially important in the Lake States, especially Minnesota



Jack Pine

Location: Canada, Northeastern U.S. and Lake States. (In Minnesota, jack pine are found in abundance in north central and northeastern regions of the state.)

Wood Properties: coarse texture; moderately light and soft; moderately low in bending strength; low in shock resistance

Uses: pulpwood; construction; boxes; crates; posts; mine timbers; railway ties and fuel

Full Size: 55-65 feet in height, up to 8-12 inches in diameter



White Spruce

Location: Found extensively in northern Minnesota.

Wood Properties: Light; strong; soft; straight-grained; yellowish-white in color

Uses: Mainly used in the manufacture of paper. Also used in general construction — airplanes, furniture parts, canoe paddles and sounding boards for musical instruments

Full Size: 60-70 feet in height; 18-24 inches in diameter; maximum 184 feet, 4 feet in diameter



Paper (White) Birch

Location: Northern North America.

(In Minnesota, paper birch are abundant throughout the state except in the southwest.)

Wood Properties: fine and uniform in texture; lower strength and weight in comparison with other birches

Uses: pulpwood; veneer; craft products; furniture; cabinets

Full Size: 50-70 feet in height, 12-24 inches in diameter; maximum 120 feet in height and 6 feet in diameter



Eastern Larch (Tamarack)

Location: Lake States.

(In Minnesota, tamarack can be found mainly in swamps in the northeastern part of the state.)

Wood Properties: course texture; strongest softwood in North America; intermediate in other mechanical properties

Uses: pulpwood; framing; tanks; pallets; cross ties; mine timbers; fuel; fenceposts; poles

Full Size: 50-75 feet in height, 14-20 inches in diameter; small to medium-size tree, maximum 100 feet in height and 4 feet in diameter.



Basswood

Location: Lake, Central and Mid-Atlantic States.

(In Minnesota, basswood is common throughout the state except in the extreme northeastern part.)

Wood Properties: fine, even texture; straight grain; high shrinkage in drying, but rarely in use; easily worked

Uses: carving; Venetian blinds; molding; piano keys; patterns; sash and door frames

Full Size: 70-80 feet in height, 2-3 feet in diameter



Black Ash

Location: Lake States.

(In Minnesota, black ash is plentiful throughout the state except in the western half. Most abundant in cold, moist locations and along banks of streams.)

Wood Properties: similar to white ash but lighter, softer and weaker

Uses: barrels; furniture; shipping

Full Size: 40-70 feet in height, 1-2 feet in diameter



Trembling (Quaking) Aspen

Location: Northeastern U.S., Rockies, Lake States. (In Minnesota, aspen are found in sandy or rich soils that are moist. It is common except in southwestern and northeastern parts of the state.)

Wood Properties: fine, uniform texture; straight grain; light; soft; low in strength; easily worked; at least 500 organisms from deer and beaver to insects, fungi and viruses feed upon Quaking Aspen

Uses: one of the most used species in Minnesota; used for lumber pallets; crates; pulpwood; particleboard

Full Size: 50-60 feet in height, 10-20 inches in diameter



Yellow Birch

Location: Northeastern U.S. and Lake States. (In Minnesota, yellow birch are found in the northern half of the state where cool, moist conditions prevail.)

Wood Properties: fine texture; heavy; strong; hard; shock resistant; papery bark

Uses: furniture; veneer; crates; wooden ware; interior finish; doors

Full Size: 60-70 feet in height, 2-2.5 feet in diameter; maximum 114 feet by 4.5 feet



Red Maple

Location: In Minnesota, red maple can be found throughout the eastern half of the state.

Wood Properties: Also called soft maple, this wood is light brown in color and is characterized as heavy, close-grained and weak

Uses: Red maple has little commercial value. It is sometimes used to make inexpensive furniture and other woodenware, and for fuel.

Full Size: 50-70 feet in height; 12-24 inches to 2 feet in diameter; maximum 116 feet in height and 6 feet in diameter



American Elm

Location: Common throughout Minnesota, more abundant on rich bottom lands in southern half of the state. Commonly found along water sources.

Wood Properties: light brown; heavy; hard; strong; difficult to split

Uses: boats; furniture; veneer for baskets and crates

Full Size: 80-100 feet in height, 2-4 feet in diameter



Sugar (Hard) Maple

Location: Lake and New England States. (In Minnesota, hard maple trees grow in cool, rich locations in the eastern half of the state.)

Wood Properties: fine uniform texture; straight, wavy or curly grain; heavy; strong; stiff; hard; shock resistant

Uses: lumber; veneer; cross ties; flooring; furniture; wooden ware; novelties; syrup and sugar

Full Size: 60-80 feet in height, 2 feet in diameter; maximum 135 feet in height and 7 feet in diameter



Black Walnut

Location: Central States. In Minnesota, black walnut trees grow on rich bottom lands and moist, fertile hillsides in the southern part of the state.)

Wood Properties: normally straight grain; heavy; hard; strong; stiff; good shock resistance; stable in use; easily worked; most highly valued of North American hardwoods

Uses: furniture; architectural wood-work; decorative panels; gunstocks; cabinets; interior finish

Full Size: 70-90 feet in height, 2-3 feet in diameter, medium size tree, may reach maximum height of 150 feet and diameter of 8 feet



Big Tooth Aspen

Location: Rich, sandy soils that are moist; common throughout Minnesota except in southwestern and northeastern parts of the state.

Wood Properties: fine, uniform texture; straight grain; light; soft; low in strength; easily worked

Uses: raw material for the pulp and paper, hardboard, wafer board and oriented strand board industries. Also used for wooden match sticks.

Full Size: 60-70 feet in height; 12-24 inches in diameter; fast growing, short lived



NOTE: A wood sample for this type of tree is not included in your Wood Kit. Its properties and appearance are very similar to the Trembling (Quaking) Aspen, which is included.

Northern Red Oak

Location: Eastern half of U.S. except for Gulf and South Atlantic States. (In Minnesota, red oak can be found throughout the state, but it is most common in the rich soil of southern, central and south-eastern regions.)

Wood Properties: coarse, uneven texture; straight grain; heavy

Uses: lumber; cross ties; veneer; flooring; cabinetry; furniture

Full Size: 60-80 feet in height, 2-3 feet in diameter, maximum 160 feet in height and 8 feet in diameter



S

White Oak

Location: South, South Atlantic and Central States. (In Minnesota, white oak are abundant in the southeastern part of the state as far north as the Twin Cities.)

Wood Properties: straight grain; strong; heavy; highly durable and decay resistant; impenetrable to liquids

Uses: furniture; lumber; cross ties; barrels; fenceposts; veneer; mine timbers; planking and bent parts for boats

Full Size: 80-100 feet in height, 3-4 feet in diameter; maximum 150 feet in height, 9 feet in diameter



U

Balsam Poplar

Location: Found throughout the northern part of Minnesota along streams and edges of swamps or in other cool locations.

Wood Properties: Heavy when green, light when dry; soft, not very strong; close grained; light brown.

Uses: Pulp, boxes, packing cases and rough lumber.

Full Size: 60-80 feet in height; 12-24 inches in diameter; fast growing, medium-size tree



T

Eastern Cottonwood

Location: Southern and Central States. (In Minnesota, cottonwood can be found in the southern half of the state.)

Wood Properties: fine, uniform texture; straight grain; moderately stiff and soft; moderately low in strength and shock resistance

Uses: boxes; crates; pallets; veneer; pulpwood; excelsior; fuel

Full Size: 80-100 feet in height, 3-4 feet in diameter; maximum 175 feet in height and 12 feet in diameter



V

NOTE: A wood sample for this type of tree is not included in your Wood Kit. Its properties and appearance are very similar to the Trembling (Quaking) Aspen, which is included.

Trees of Minnesota	Full Size Height (feet)	Full Size Diameter (feet)
American Elm	80 - 100	2 - 4
Balsam Fir	40 - 60	1 - 1.5
Balsam Poplar	60 - 80	1 - 2
Basswood	70 - 80	2 - 3
Big Tooth Aspen	60 - 70	1 - 2
Black Ash	40 - 70	1 - 2
Black Spruce	25 - 65	.5 - 1
Black Walnut	70 - 90	2 - 3
Eastern Cottonwood	80 - 100	3 - 4
Eastern Larch (Tamarack)	50 - 75	1.2 - 1.67
Eastern White Pine	80 - 100	2 - 3.5
Jack Pine	55 - 65	.67 - 1
Northern Red Oak	60 - 80	2 - 3
Northern White Cedar	40 - 50	1 - 2
Paper (White Birch)	50 - 70	1 - 2
Red (Norway) Pine	70 - 80	2 - 3
Red Maple	50 - 70	1 - 2
Sugar (Hard) Maple	60 - 80	2
Trembling (Quaking) Aspen)	50 - 60	.83 - 1.67
White Oak	80 - 100	3 - 4
White Spruce	60 - 70	1.5 - 2
Yellow Birch	60 - 70	2 - 2.5

Overall Ratings

Species	Growth Rate (average dbh inches per year)	Growth Rate (average dbh inches per 16-year period)	Sample Size (N = number of trees)
Cottonwood	0.64	10.2	271
Silver maple	0.49	7.8	42
Blue spruce	0.47	7.6	133
Catalpa	0.44	7.0	9
White oak	0.43	6.9	31
Austrian/ ponderosa pine	0.43	6.9	503
Linden	0.43	6.8	104
Ash	0.42	6.7	270
Russian-olive	0.40	6.4	43
Red oak	0.40	6.3	54
Crabapple	0.39	6.2	100
Honeylocust	0.37	5.9	216
White fir	0.37	5.9	11
Norway maple	0.33	5.3	80
Hackberry	0.32	5.2	34
Red maple	0.30	4.8	14
Piñon	0.23	3.7	19
Hawthorn	0.17	2.7	41

Table 4: Growth rate of all species and number of trees sampled.

Growth Rate Over 16 Years by Tree Species

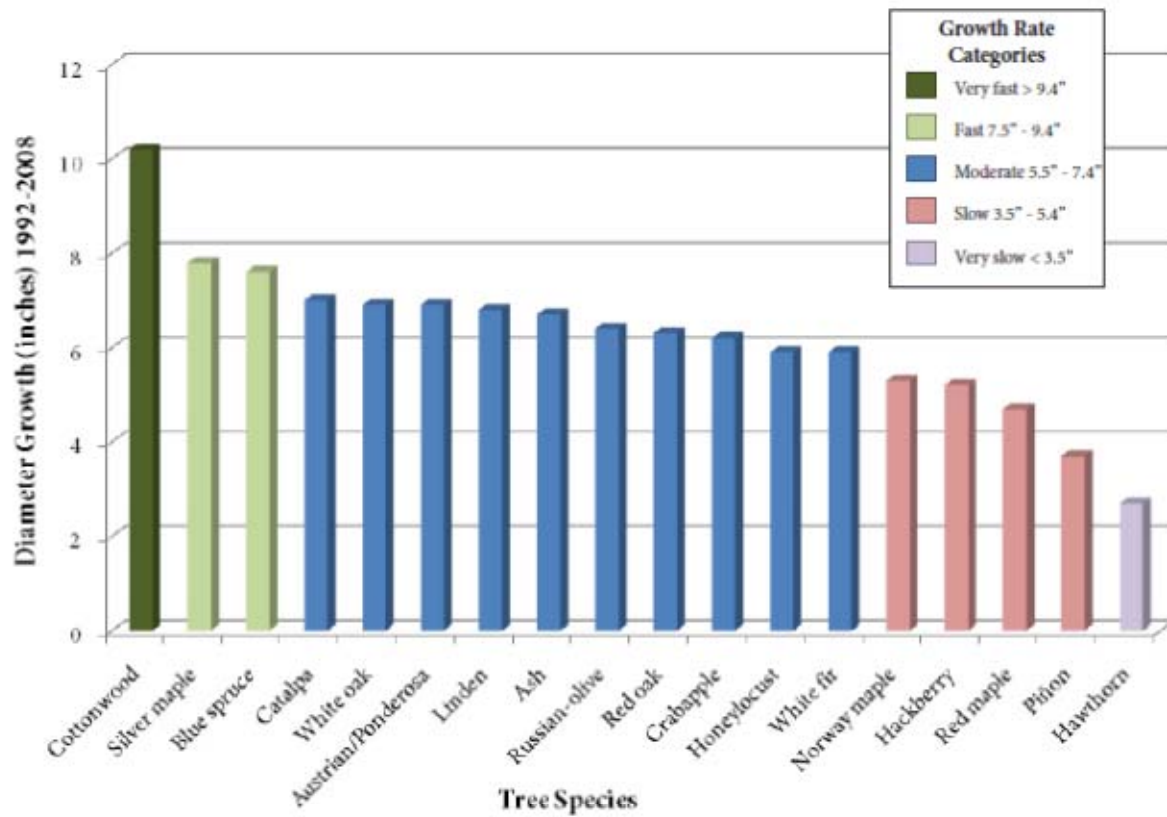


Figure 8: Growth rates (inches in diameter) of tree species over 16 years.

CITY OF WAYZATA



PLANNING DEPARTMENT

MEMORANDUM

To: Planning Commission
From: Jason Peters, Management and Planning Intern
Date: September 21st, 2015
Re: Workshop on Alternative Energy Ordinance

On July 16th, 2015, the Planning Commission was presented several examples of local alternative energy ordinances (Woodbury, Maplewood, Delano, Ramsey, Watertown) and a power point presentation regarding the three types of energy conversion systems most commonly addressed in local ordinances. These systems include: Solar Systems: Geothermal Systems: and Wind Energy Conversation Systems.

Based on the discussion from the July 16th, 2015, the Commission seemed generally comfortable with the ideas of addressing alternative energy, but would like to see additional examples of local ordinances. Included please find Alternative Energy Ordinances from the following Minnesota Cities:

1. Coon Rapids
2. Delano
3. Excelsior
4. Maple Grove
5. Maplewood
6. Orono
7. Ramsey
8. Watertown
9. Woodbury

In particular the purpose of this workshop session is to discuss the more complex issue of how to address Wind Energy Conversion Systems in any proposed draft ordinance.

Attachments:

Attachment A: Power Point Presentation from 01/16/2015
Attachment B: Above referenced Alternative Energy Ordinances
Attachment C: Multi-city Overview of Wind Energy Conversion Systems

Alternative Energy Ordinance

Systems Addressed

Geothermal Energy (GSHPS)

Solar Energy (SES)

Wind Energy (WECS)

Alternative Energy Ordinance

Regional Examples

Delano (wind only)

Excelsior (wind only)

Maplewood (comprehensive)

Orono (comprehensive)

Ramsey (comprehensive)

Woodbury (comprehensive)

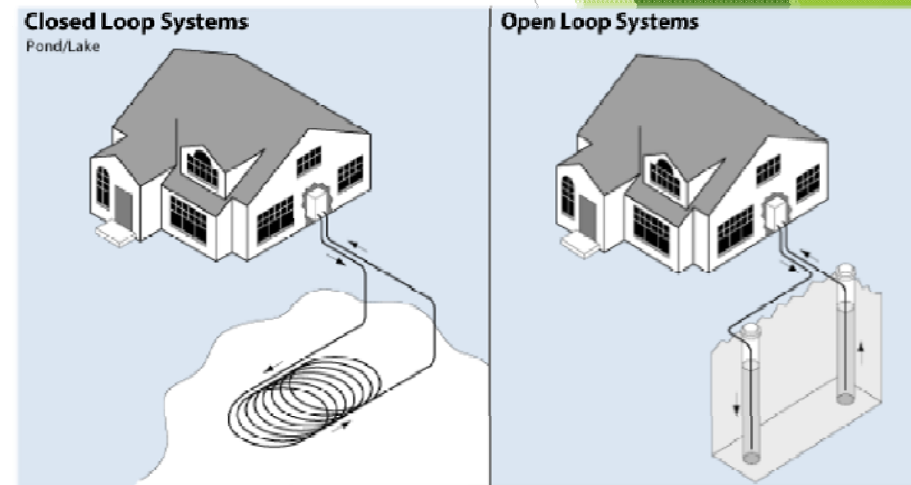
Alternative Energy Ordinance

Geothermal Energy Themes

Building Permits Required

Allowed in all Zoning Districts

Closed Loop Most Commonly Allowed



Alternative Energy Ordinance

Solar Energy Themes

Building Permits Required

Allowed in all Zoning Districts

Roof Mounted vs. Ground

Maximum Height and Ground Coverage



Alternative Energy Ordinance

Wind Energy Themes

Building Permits and/or CUP Required

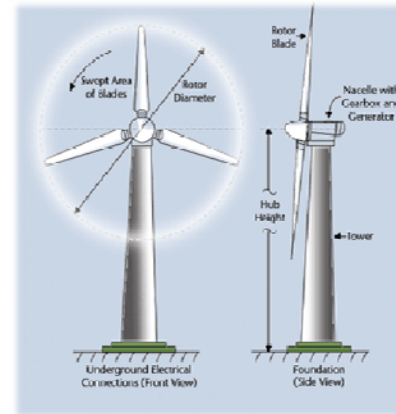
Allowed in Specific Zones

Limited to One

Different Standards for Large and Small Systems

Maximum Heights for Hubs and Blades

Require Manufacturer Warranty and/or Maintenance Agreement



COON RAPIDS

CHAPTER 11-1600 - ALTERNATIVE ENERGY SOURCES AND SYSTEMS

11-1601 - Wind Energy Conversion Systems.

11-1601.1 Purpose. Regulations governing wind energy systems are established to encourage opportunities for the generation of renewable wind energy in appropriate locations, while ensuring compatibility with surrounding land uses, promoting the safe, efficient and effective use of wind energy conversion systems, and protecting the public health, safety and welfare.

11-1601.2 Permitting Process.

- (1) Wind Energy Systems are only allowed as an accessory structure or use.
- (2) All Wind Energy Systems require a Building Permit. In addition to the general application information required as part of the Building Permit, the applicant must submit the following:
 - (a) Scaled schematic drawings and photographic perspectives showing the structure and placement of the Wind Energy System.
 - (b) A survey showing all structures, property lines, easements, power lines and setbacks to property lines.
 - (c) A written certification from a licensed structural engineer that the structure has the structural integrity to carry the weight, wind loads and vibration of the Wind Energy System.
 - (d) An analysis from a licensed engineer showing how the Wind Energy System must be designed, constructed and operated in compliance with applicable federal, state and local laws, codes, standards and ordinances.
 - (e) A written certification from a licensed engineer confirming that the Wind Energy System is designed to not cause electrical, radio frequency, television and other communication signal interference.
 - (f) Utility Notification: No grid-intertie Wind Energy System shall be permitted until evidence has been given to the Inspections Department that the owner has submitted notification to the utility company of the customer's intent to install an interconnected customer-owned generator. Off-grid systems are exempt from this requirement.

11-1601.3 Performance Standards. All Wind Energy Systems are subject to the following performance standards:

- (1) All Districts.
 - (a) No more than one Wind Energy System is permitted on any one lot without a conditional use permit.
 - (b) Wind Energy Systems must not be located in any drainage or utility easement.
 - (c) Wind Energy Systems must be equipped with both a manual and automatic braking device capable of stopping the System's operation in high winds.
 - (d) No climbing apparatus can be located within 12 feet of the ground.
 - (e) Ground mounted towers must be of a monopole design; guy wires are prohibited.
 - (f) Wind Energy Systems must be an unobtrusive color and finish such as off white or grey and a matte or similar dull finish.

- (g) All ground mounted Wind Energy Systems must be setback from all property lines at least 1.1 times the total height of the Wind Energy System.
 - (h) For ground mounted systems, the minimum distance between the ground and the vertical length of any extensions such as the rotor blades must be 15 feet.
 - (i) Building mounted Wind Energy Systems must not exceed a total height of 15 feet and access controlled by a locked and secured door.
 - (j) The structure upon which a proposed Wind Energy System is to be mounted must have the structural integrity to carry the weight, wind loads and vibrations of the Wind Energy System.
 - (k) The total rated capacity of a Wind Energy System must not exceed 50 kilowatts.
 - (l) Noise. Wind Energy Systems must comply with the noise standards contained in Chapter 11-1206.1.
 - (m) Lighting. Wind Energy Systems must not be illuminated by artificial means, except where specifically required by the Federal Aviation Administration or other state or local regulations.
 - (n) Signage. Advertising or identification of any kind on Wind Energy Systems is prohibited, except for applicable warning and equipment information signage.
 - (o) Maintenance. All Wind Energy Systems must be kept in good repair and free from rust, damaged supports, framework or other components.
 - (p) Electrical Wires. All electrical wires associated with a ground mounted Wind Energy System must be located within the tower and underground.
 - (q) Abandoned or Unused Towers. All abandoned or unused Wind Energy Systems must be removed within 12 months of the cessation of operations unless an extension is approved by the Director. If an extension is not approved, such Wind Energy System will be deemed a nuisance and the city may act to abate such nuisance pursuant to Chapter 8-1100. After removal, the owner or operator must restore the site to its original or an improved condition.
- (2) Residential Districts and Uses.
 - (a) Building and ground mounted Wind Energy Systems may be allowed as a conditional use, subject to the provisions of chapters 11-304.3 and 11-305.
 - (b) The maximum total height of a ground mounted Wind Energy System is 60 feet.
 - (3) Industrial District and Uses.
 - (a) Building mounted Wind Energy Systems are allowed as a permitted accessory use.
 - (b) Ground mounted Wind Energy Systems may be allowed as a conditional use, subject to the provisions of chapters 11-304.3 and 11-305.
 - (c) The maximum total height of a ground mounted Wind Energy System is 100 feet.
 - (4) Commercial and Office Districts and Uses.
 - (a) Building mounted Wind Energy Systems are allowed as a permitted accessory use.
 - (b) Ground mounted Wind Energy Systems may be allowed as a conditional use, subject to the provisions of chapters 11-304.3 and 11-305.
 - (c) The maximum total height of a ground mounted Wind Energy System is 60 feet.
 - (5) Overlay and Special Districts. Building and ground mounted Wind Energy Systems are prohibited in all Overlay and Special Districts.

11-1602 - Solar Energy Systems.

11-1602.1 Purpose. Regulations governing solar energy systems are established to encourage opportunities for the generation of renewable solar energy in appropriate locations, while ensuring compatibility with surrounding land uses, promoting the safe, efficient and effective use of solar energy conversion systems, and protecting the public health, safety and welfare.

11-1602.2 Permitting Process.

- (1) Solar Energy Systems are only allowed as an accessory structure or use.
- (2) All Solar Energy Systems require a Building Permit. In addition to the general application information required as part of the Building Permit, the applicant must submit the following:
 - (a) A scaled horizontal and vertical (elevation) drawings. The drawings must show the location of the system on the building, or on the property for a ground-mount system, including all structures, property lines, easements, power lines and setbacks to property lines.
 - (b) Pitched-roof-mounted Systems: For all roof-mounted systems, other than a flat roof, the elevation drawings shall show the highest finished slope of the solar collector and the slope of the finished roof surface on which it is mounted.
 - (c) Flat-roof-mounted Systems: For flat-roof applications a drawing shall be submitted showing the distance to the roof edge and any parapets on the building and shall identify the height of the building on the street frontage side, the shortest distance of the system from the street frontage edge of the building, and the highest finished height of the solar collector above the finished surface of the roof.
 - (d) A written certification from a licensed structural engineer that the structure has the structural integrity to carry the weight, wind loads of the Solar Energy Systems.
 - (e) An analysis from a licensed engineer showing how the Solar Energy Systems must be designed, constructed and operated in compliance with applicable federal, state and local laws, codes, standards and ordinances.
 - (f) Utility Notification: No grid-intertie photovoltaic system shall be permitted until evidence has been given to the Inspections Department that the owner has submitted notification to the utility company of the customer's intent to install an interconnected customer-owned generator. Off-grid systems are exempt from this requirement.

11-1602.3 Performance Standards. All Solar Energy Systems are subject to the following performance standards:

- (1) Certification. Solar energy systems shall be certified by Underwriters Laboratories, Inc. and the National Renewable Energy Laboratory, the Solar Rating and Certification Corporation or other body as determined by the Building Official. The City reserves the right to deny a building permit for proposed Solar Energy Systems deemed to have inadequate certification.
- (2) Aesthetics. All Solar Energy Systems shall be designed to blend into the architecture of the building or be screened from routine view from public rights-of-way other than alleys. The color of the Solar Energy Systems is not required to be consistent with other roofing materials. Reflection angles from collector surfaces shall be oriented away from neighboring windows when possible.
 - (a) Building Integrated Photovoltaic Systems—Building integrated photovoltaic systems shall be allowed regardless of whether the system is visible from the public right-of-way, provided the building component in which the system is integrated meets all required setbacks for the district in which the building is located.

- (b) Solar Energy Systems with Mounting Devices—Solar Energy Systems using roof mounting devices or ground-mount Solar Energy Systems shall not be restricted if the system is not visible from the closest edge of a public right-of-way other than an alley. Roof mounted systems that are visible from the nearest edge of the right-of-way shall not have the highest finished pitch more than five percent steeper than the roof pitch on which the system is mounted, and shall be no higher than 12 inches above the roof.
- (c) Coverage—Roof or building mounted Solar Energy Systems, excluding integrated systems, shall not cover more than 80 percent of the south facing or flat roof upon which the panels are mounted, and shall be setback from the roof edge by a minimum of one foot. The surface area of a pole or ground mounted system shall not exceed half the footprint of the principal structure.
- (3) Feeder lines. The electrical collection system shall be placed underground within the interior of each parcel. The collection system may be placed overhead near substations or points of interconnection to the electric grid.
- (4) Easements. Solar energy systems shall not encroach on public drainage, utility, roadway or trail easements.
- (5) Setbacks. Ground-mounted Solar Energy Systems including any appurtenant equipment must meet the accessory structure setback requirement and placement limitations for the district in which it is installed. Roof-mounted systems shall not extend beyond the exterior perimeter of the building on which the system is mounted. Exterior piping for hot water systems shall be allowed to extend beyond the perimeter of the building on a side yard exposure.
- (6) Height. Roof-mounted solar energy systems shall comply with the maximum height requirements in the applicable zoning district. Ground-mounted solar energy systems shall not exceed 15 feet in height when oriented at maximum tilt.
- (7) Commercial. All Solar Energy Systems shall be limited to the purpose of on-site energy production, except that any additional energy produced above the total onsite demand may be sold to the operator's regular electrical service provider in accordance with any agreement provided by the same.
- (8) Abandoned or Unused Systems. All abandoned or unused Solar Energy Systems must be removed within 12 months of the cessation of operations unless an extension is approved by the Director. If an extension is not approved, such Solar Energy Systems will be deemed a nuisance and the city may act to abate such nuisance pursuant to Chapter 8-1100. After removal, the owner or operator must restore the site to its original or an improved condition.

11-1602.4 Administrative Variance. Where the standards in Sections 11-1602.3(2), (5) and (6) cannot be met without diminishing, as defined below, the minimum reasonable performance of the Solar Energy Systems, an administrative variance may be sought from the Director. An administrative variance shall be granted if the administrative variance standards are met.

- (1) Minimum Performance Design Standards—The following design thresholds are necessary for efficient operation of an Solar Energy System.
 - (a) Fixed Mount Solar Energy Systems—Solar Energy Systems must be mounted to face with 45 degrees of south (180 degrees azimuth).
 - (b) Solar Electric (photovoltaic) systems must have a pitch that is within 20 degrees of latitude, a pitch of between 20 and 65 degrees.
 - (c) Solar Hot Water Systems—Solar collectors need to be mounted at a pitch between 40 and 60 degrees.
- (2) Standards for an Administrative Variance—A variance shall be granted if the applicant demonstrates that the following safety, performance and aesthetic conditions are met.
 - (a) Safety Conditions—All applicable health and safety standards are met.

- (b) Ground Mounted Systems—Pole mounted or ground mounted Solar Energy Systems must be set back from the property line by one foot and shall not encroach on public drainage, utility, roadway or trail easements.
- (c) Aesthetic Conditions—The Solar Energy Systems must be designed to blend into the architecture of the building or be screened from routine view from public rights-of-way other than alleys to the maximum extent possible while still allowing the system to be mounted for efficient performance.

([Ord. No. 2121, § 2, 5-20-14](#))

CITY OF DELANO
COUNTY OF WRIGHT
STATE OF MINNESOTA

ORDINANCE NO. 0-10-02

AN ORDINANCE AMENDING SECTION 51.01 (DEFINITIONS) AND ADDING
SUBDIVISION O TO SECTION 51.03 (GENERAL PROVISIONS) OF THE ZONING
ORDINANCE RELATING TO WIND ENERGY CONVERSION SYSTEMS (WECS)

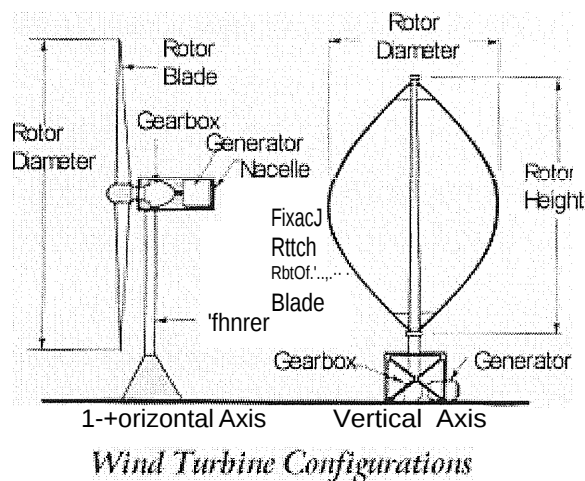
Section 1. Section 51.01, Subd. 8.2 of the Delano Zoning Ordinance is hereby amended to read as follows:

Wind Energy Conversion Systems (WECS) Related:

1. Accessory System: a system designed as a secondary use to existing buildings or facilities, wherein the energy generated is used primarily for on-site consumption.
2. Horizontal Axis Wind Turbine: a wind turbine design in which the rotor shaft is parallel to the ground and the blades are perpendicular to the ground.
3. Hub: the center of a wind generator rotor, which holds the blades in place and attaches to the shaft.
4. Hub Height: the distance measured from natural grade to the center of the turbine hub.
5. Monopole Tower: a tower constructed of tapered tubes that fit together symmetrically and are stacked one section on top of another and bolted to a concrete foundation without support cables.
6. Residential Wind Turbine: a roof-mounted wind turbine of 10 kilowatt (kW) generating capacity or less.
7. Small Wind Turbine: a wind turbine of 100 kilowatt (kW) generating capacity or less.
8. Total Height: the highest point above natural grade reached by a rotor tip or any other part of a wind turbine.
9. Tower: a vertical structure that supports a wind turbine.
10. Utility Wind Turbine: a wind turbine of more than 100 kW nameplate generating capacity.

11. Vertical Axis Wind Turbine: a type of wind turbine where the main rotor shaft runs vertically.
12. Wind Conversion Energy System (WECS): an electrical generating facility that consists of a wind turbine, feeder line, and/or other associated controls and may include a tower.
13. Wind Turbine: any piece of electrical generating equipment that converts the kinetic energy of blowing wind into electrical energy through the use of airfoils or similar devices to capture the wind.

Figure 3- Wind Turbine Configuration



Section 2. Section 51.03, Subd. O of the Delano Zoning Ordinance is hereby added to read as follows:

Subd. O. Wind Energy Conversion Systems (WECS)

1. Purpose and Intent.
 - a. The intent of this Section is to establish standards and procedures by which the installation and operation of wind energy conversion systems and small wind energy conversion systems shall be governed within the City. The city finds that it is in the public interest to encourage alternative energy systems that have a positive impact on energy production and conservation while not having an adverse impact on the community.
 - b. Objectives.
 - 1) To create a livable community where development incorporates sustainable design elements such as resource and energy conservation and use of renewable energy.

- 2) To protect and enhance air quality, limit the effects of climate change and decrease use of fossil fuels.
- 3) To encourage alternative energy development in locations where the technology is viable and environmental, economic and social impacts can be mitigated.
- 4) To control potential nuisances and hazards created with the placement of WECS.

2. Zoning Districts.

- a. Utility Wind Turbines shall be allowed as an accessory conditional use in the 1-1 and 1-2 Districts.
- b. Small Wind Turbines shall be allowed as an accessory conditional use in all zoning districts.
- c. Residential Wind Turbines shall be allowed as an accessory administrative use in all residential districts.

3. Number. No more than one WECS is allowed per parcel.

4. Declaration of Conditions. In addition to the provisions of this Section, the City Council may impose such conditions on the granting of WECS conditional use permit as may be necessary to carry out the purpose and provisions of this Section and to maintain compatibility.

5. Application Information. All applications for a WECS conditional use permit or administrative permit shall be accompanied by a detailed plans and specifications including, but not limited to, the following information:

a. Site Plan showing:

- 1) Lot lines and dimensions.
- 2) Location and height of all buildings, structures, above ground utilities, and trees on the lot, including both existing and proposed structures and guy wires anchors.
- 3) Locations and height of all adjacent buildings, structures, above ground utilities and trees located within three hundred (350) feet of the exterior boundaries of the property in question.
- 4) Existing and proposed setbacks of all structures located on the property in question.

- b. Scaled drawings accurately depicting the proposed location of the WECS and its relationship to structures on adjacent lots.
 - c. WECS specifications including manufacturer and model, rotor diameter, power generation capabilities, engineering analysis and certification of the tower and data pertaining to the tower's safety and stability.
 - d. Soil analysis documentation from the manufacturer or a registered soil or geotechnical engineer that the site's soil conditions meet minimum standards as specified by the manufacturer.
6. Compliance with State Building Code.
- a. Standard drawings of the structural components of the wind energy conversion system and support structures, including base and footings shall be provided along with the engineering data and calculations to demonstrate compliance with the structural design provisions of the State Building Code especially with regards to wind and icing loads. Drawings and engineering calculations shall be certified by a registered structural engineer.
 - b. Roof-mounted WECS shall include detailed plans illustrating roof construction, mounting techniques and wind load capacity.
7. Compliance with National Electrical Code. WECS electrical equipment and connections shall be designed and installed in adherence to the National Electrical Code as adopted by the City.
8. Manufacturer Warranty. The applicant shall provide documentation or other evidence from the dealer or manufacturer that the WECS has been successfully operated in atmospheric conditions similar to the conditions within the City. The WECS shall be warranted against any system failures reasonably expected in severe weather operation conditions.
9. Design Standards.
- a. Height: The permitted maximum height of a WECS shall be determined based on the type of system proposed. In determining the height of the WECS, the total height of the system shall be included.
 - 1) Utility Wind Turbines:
 - a) A ratio of one and one half (1.5) feet of the distance to the closest property line to one (1) foot of the height of the system between the base of WECS and the nearest property line.
 - b) A maximum system height of three hundred (300) feet.

- c) The height of a WECS must also comply with FAA Regulation Part 77 "Objects Affecting Navigable Air Space" and/or MnDOT Rule 14, MCAR 1.3015 "Criteria for Determining Obstruction to Air Navigation."

2) Small Wind Turbines:

- a) A ratio of one and one half (1.5) feet of the distance to the closest property line to one (1) foot of the height of the system between the base of WECS and the nearest property line.
- b) A maximum system height of one hundred fifty (150) feet.

3) Residential Wind Turbines:

- a) A maximum height of twenty (20) feet above the roofline of the principal structure.
- b. Setbacks: All WECS shall be set back a distance equal to no less than one and one half (1.5) times the total height of the structure between the base of the WECS and the nearest property line, above ground utility, road right-of-way, or existing building on the same lot.
- c. Rotor Clearance: Blade-arcs created by the WECS shall have a minimum of thirty (30) feet of clearance over any structure or tree within a three hundred (300) foot radius. Residential Wind Turbines are exempt from this requirement.
- d. Rotor Design: The blade design and materials are to be designed and constructed to ensure safe operation in an urban/rural area.
- e. Rotor Safety: Each WECS shall be equipped with both a manual and automatic braking device capable of stopping WECS operation in high wind or in conditions of imbalance.
- f. Lightning Protection: Each WECS shall be grounded to protect against natural lightning strikes in conformance with the National Electrical Code as adopted by the City.
- g. Appearance, Color and Finish. The wind turbine and tower shall remain painted and finished the color or finish that was originally applied by the manufacturer, unless otherwise approved as part of the conditional use permit.
- h. Tower Access: To prevent unauthorized climbing, WECS towers must comply with one of the following provisions:

- 1) Tower climbing apparatus shall not be located within twelve (12) feet of the ground.
 - 2) A locked anti-climb device shall be installed on the tower.
 - 3) Tower capable of being climbed shall be enclosed by a locked, protective fence at least eight (8) feet high.
- i. Signs: WECS shall have one sign, not to exceed two (2) square feet at the base of the tower and said sign shall contain the following information:
 - 1) Warning high voltage.
 - 2) Manufacturer's name.
 - 3) Emergency phone number.
 - 4) Emergency shutdown procedures.
 - j. Lightning: WECS shall not have affixed or attached any lights, reflectors, flashers or any other illumination, except for illumination devices required by the FAA or other State or Federal agency.
 - k. Electromagnetic Interference: WECS shall be designed and constructed so as not to cause interference with radios, televisions or other electronic devices. Electromagnetic interference, as measured at the property line, shall be less than or equal to pre-existing conditions.
 - l. Noise Emissions: Noises emanating from the operation of WECS shall be in compliance with and regulated by the State of Minnesota Pollution Control Standards, Minnesota Regulations NPC 1 and 2, as amended.
 - m. Utility Company Interconnection: No WECS shall be interconnected with the local electrical utility company until the utility company and the City Utility Manager have review and approved such proposal. The Utility Manager and the applicant shall negotiate interconnection fees for any excess power generated. The interconnection of the WECS with the utility company shall adhere to the National Electrical Code as adopted by the City. All connecting power lines shall be buried underground.
 - n. Shadow Flicker. A shadow flicker analysis shall be required for all Utility Wind Turbines. This analysis must demonstrate that shadow flicker shall not fall on, or in, any existing residential structure. Shadow flicker expected to fall on a roadway or portion of a residentially zoned property may be acceptable if the flicker does not exceed thirty (30) hours per year; and the flicker will fall more than one hundred (100) feet from an existing residence; or the traffic volumes are less than five hundred (500) vehicles per day (ADT). The shadow flicker model shall:

- 1) Map and describe the topography, existing residences and location of their windows, locations of other structures, wind speeds and directions, existing vegetation and roadways within a one thousand (1,000) foot radius of the proposed WECS. The model shall represent the most probable scenarios of wind constancy, sunshine constancy, wind directions and speed.
 - 2) Calculate the locations of shadow flicker caused by the proposed WECS and the expected durations of the flicker in these locations, calculate the total number of hours per year of flicker at all locations.
 - 3) Identify problem areas where shadow flicker will interfere with existing or future residences and roadways and describe proposed mitigation measures including, but not limited to, a change in siting of the WECS, a change in the operation of the WECS, or grading and landscaping mitigation measures.
10. Ornamental Wind Devices. Ornamental wind devices that are not a WECS shall be exempt from the provisions of this Section and shall conform to other applicable provisions of this Chapter and the City Code.
 11. Building Permit Required. A building permit shall be required for the installation of a WECS in the City.
 12. Inspection. The City hereby reserves the right upon issuing any WECS conditional use permit or administrative permit to inspect the premises on which the WECS is located. Utility Wind Turbines shall be inspected annually by a certified installer or registered structural engineer. Small Wind Turbines and Residential Wind Turbines shall be inspected biannually by a certified installer or a registered structural engineer. Proof of inspection shall be submitted to the City as requested. If a WECS is not maintained in operational condition and poses a potential safety hazard, the owner shall upon written notice from the City, take expeditious action to correct the situation.
 13. Abandonment. Any WECS or tower which is not used for six (6) successive months shall be deemed abandoned and shall be dismantled and removed from the property at the expense of the property owner.

Section 3. Effective Date. This ordinance shall be in full force and effect immediately following its passage and publication.

ADOPTED by the Mayor and City Council of Delano, Minnesota this 4th day of hlebruary 2010.



Joe McDonald, Mayor

ATTEST:



Marlene E. Kittock, Clerk/Treasurer
/

Motion By: Larry Bartels
Seconded By: Betsy Stolfa

McDonald: Aye
Schrupp: Aye
Hotchkiss: Abstain
Bartels: Aye
Stolfa: Aye

Excelsior

Appendix E Zoning, Article 28, Wind Energy Conversion Systems (WECS)

ARTICLE 28. - WIND ENERGY CONVERSION SYSTEMS (WECS)

Sec. 28-1. - Purpose.

Sec. 28-2. - Application.

Sec. 28-3. - Code compliance.

Sec. 28-4. - Manufacturing warranty.

Sec. 28-5. - Design standards.

Sec. 28-6. - Ornamental wind devices.

Sec. 28-7. - Inspection.

Sec. 28-8. - Abandonment.

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ARTICLE 28. - WIND ENERGY CONVERSION SYSTEMS (WECS)

Sec. 28-1. - Purpose.

The purpose of this article is to establish standards and procedures by which the installation and operation of wind energy conversion systems (WECS) shall be governed within the city.

Sec. 28-2. - Application.

(a)

Interim use. Wind energy conversion systems may be allowed as an interim use, subject to the regulations and requirements of this article, provided the property upon which the system is to be located is zoned commercial or public and is constructed and maintained on any parcel of at least two and one-half acres in size.

(b)

Declaration of conditions. The planning commission may recommend and the city council may impose such conditions on the granting of a WECS interim use permit as may be necessary to carry out the purpose and provisions of this article.

(c)

Site plan drawing. All applications for a WECS interim use permit shall be accompanied by a detailed site plan drawn to scale and dimensioned, displaying the information as specified in article 9 of this Appendix E and the following:

(1)

Location and height of all buildings, structures, above-ground utilities and trees on the lot, including both existing and proposed structures and guy wire anchors.

(2)

Location and height of all adjacent buildings, structures, above-ground utilities and trees located within 350 feet of the exterior boundaries of the property in question.

(3)

Sketch elevation drawing of the premises accurately depicting the proposed WECS and its relationship to structures on the subject site and adjacent lots.

Sec. 28-3. - Code compliance.

(a)

Compliance with state building code. Standard drawings of the structural components of the wind energy conversion system and support structures, including base and footings shall be provided along with engineering data and calculations to demonstrate compliance with the structural design provisions of the state building code. Drawings and engineering calculations shall be certified by a Minnesota licensed engineer.

(b)

Compliance with National Electrical Code. WECS electrical equipment and connections shall be designed and installed in adherence to the National Electrical Code as adopted by the city.

Sec. 28-4. - Manufacturing warranty.

Applicant shall provide documentation or other evidence from the dealer or manufacturer that the WECS has been successfully operated in atmospheric conditions similar to the conditions within Excelsior. The WECS shall be warranted against any system failures reasonably expected in severe weather operation conditions.

Sec. 28-5. - Design standards.

(a)

Heights. The permitted maximum height of a WECS shall be determined in one of two ways. In determining the height of the WECS the total height of the system shall be included. System height shall be measured from the base of the tower to the highest possible extension of the rotor.

(1)

A ratio of one foot to one foot between the distance of the closest property line to the base of the WECS to the height of the system.

(2)

A maximum system height of 175 feet.

The shortest height of the two above mentioned methods shall be used in determining the maximum allowable height of a WECS system. The height of a WECS must also comply with FAA regulation part 77 "Objects Affecting Navigable Air Space" and/or MNDOT Rule 14, MCAR 1.3015 "Criteria for Determining Obstruction to Air Navigation".

(b)

Setbacks. No part of a WECS (including guy wire anchors) shall be located within or above any required front, side or rear yard setback. WECS towers shall be setback from the closest property line one foot for every one foot of system height. WECS shall not be located within 30 feet of an above ground utility line.

(c)

Rotor size. All WECS rotors shall not have rotor diameters greater than 26 feet.

(d)

Rotor clearance. Blade arcs created by the WECS shall have a minimum of 30 feet of clearance over any structure or tree within a 200-foot radius.

(e)

Rotor safety. Each WECS shall be equipped with both a manual and automatic braking device capable of stopping the WECS operation in high winds (40 mph or greater).

(f)

Lightning protection. Each WECS shall be grounded to protect against natural lightning strikes in conformance with the National Electrical Code as adopted by the city.

(g)

Tower access. To prevent unauthorized climbing, WECS towers must comply with one of the following provisions:

(1)

Tower climbing apparatus shall not be located within 12 feet of the ground.

(2)

A locked anti-climb device shall be installed on the tower.

(3)

Towers capable of being climbed shall be enclosed by a locked, protective fence at least six feet high.

(h)

Signs. WECS shall have one sign, not to exceed two square feet, posted at the base of the tower and said sign shall contain the following information.

(1)

Warning high voltage.

(2)

Manufacturer's name.

(3)

Emergency phone number.

(4)

Emergency shutdown procedures.

(i)

Lighting. WECS shall not have affixed or attached any lights, reflectors, flasher or any other illumination, except for illumination devices required by FAA regulations part 77 "Objects Affecting Navigable Air Space" and FAA Advisory circular 70/7460-1F, September 1978 "Obstruction Marking and Lighting".

(j)

Electromagnetic interference. WECS shall be designed and constructed so as not to cause radio and television interference.

(k)

Noise emission. Noises emanating from the operation of WECS shall be in compliance with and regulated by the State of Minnesota Pollution Control Standards, Minnesota Regulations NPC 1 and 2, as amended.

(l)

Utility company interconnection. No WECS shall be interconnected with a local electrical utility company until the utility company has reviewed and commented upon it. The interconnection of the WECS with the utility company shall adhere to the National Electrical Code as adopted by the city.

Sec. 28-6. - Ornamental wind devices.

Ornamental wind devices that are not a WECS shall be exempt from the provisions of this article and shall conform to other applicable provisions of this Appendix E.

Sec. 28-7. - Inspection.

The city hereby reserves the right upon issuing any WECS interim use permit to inspect the premises on which the WECS is located. If a WECS is not maintained in operational condition and poses a potential safety hazard, the owner shall take expeditious action to correct the situation.

Sec. 28-8. - Abandonment.

Any WECS or tower which is not used for six successive months shall be deemed abandoned and shall be dismantled and removed from the property at the expense of the property owner.

MAPLE GROVE

Sec. 36-833. - Geothermal, solar, and wind energy conversion systems.

(a) Geothermal system.

- (1) Permitted accessory use in all zoning districts on the condition it meets the requirements of this section and other provisions of the Code.
- (2) Coils and piping may not cross lot lines without recorded easement from the effected property.
- (3) Upon determination by the city that encroachment of coils and piping into drainage and utility easements does not interfere with the city's use of the easement, coils and piping may cross into drainage and utility easements with the city's written permission subject to conditions determined by the city.
- (4) Systems that are proposed under wetland types 1 and 2 shall require approval from the city engineering department in addition to any other permits required for by any other governmental entity. System shall not be allowed under wetland types 3 through 7, or in any Minnesota Department of Natural Resources protected waters.
- (5) Systems shall meet Minnesota Department of Health Standards (Minnesota Rules chapter 47-25, part 18.31 and part 70.50 (2009) and any amendments thereto).

(b) Photovoltaic system and solar thermal system.

(1) Nonresidential zoning districts.

- a. Permitted accessory use if on a building or in rear yard. Must be screened from adjacent lots pursuant to subsection 36-817(b).
- b. Conditional use if in front or side yard.

(2) Residential zoning districts.

- a. Permitted accessory use if on a building (both principal and accessory buildings) or in a rear yard. Must be screened from adjacent lots pursuant to subsection 36-817(b). Panels on buildings shall not hang over edge of roof.
- b. Not permitted in front or side yards.
- c. For lots subject the shoreland district:
 - i. Not allowed within the 75-foot shoreland setback if not on a building;
 - ii. Panels on boat lifts under two square feet in size shall be a permitted use;
 - iii. Panels on boat lifts greater than two square feet in size shall be a conditional use and, in addition to the reviews and approvals required, shall be subject to the review and recommendation of the city lake quality commission.

(3) Requirements for all zoning districts.

- a. Solar thermal piping shall match roof or solar collector color.

(c) Wind energy conversion systems.

(1) Residential zoning districts.

- a. Conditional use permit required for any wind energy conversion systems, which conditions shall include, but are not limited to the following:
 - i. For lots under two acres in size wind energy conversion systems must be attached to a building.

- ii. For lots over two acres and under 20 acres in size wind energy conversion systems must be attached to a building or to a monopole in the rear yard that is under 100 feet in height.
- iii. For lots 20 acres and over, wind energy conversion systems must be attached to a building or to a monopole that may be over 100 feet in height.
- iv. Lot line setbacks shall be equal to maximum turbine blade height. If over 100 feet in height the setback shall be as follows: for each foot over 100, add an additional 0.5 feet to the setback from residentially zoned lot line (example, a 150-foot tall tower would need to be setback 175 feet from the lot line). In addition to the above, any towers on a lot subject to the shoreland district shall not be allowed within the 75-foot shoreland setback.

(2) Nonresidential zoning districts.

- a. Permitted accessory use if under 100 feet in height.
- b. Conditional use if over 100 feet in height and/or more than one pole mounted on a lot.
- c. Lot line setbacks shall be equal to maximum turbine blade height. If over 100 feet in height the setback shall be as follows: for each foot over 100, add an additional 0.5 feet to the setback from residentially zoned lot line (example, a 150-foot tall tower would need to be setback 175 feet from the lot line). In addition to the above, any towers on a lot subject to the shoreland district shall not be allowed within the 75-foot shoreland setback.
- d. No limit on the number of roof mounted turbines.

(3) For all zoning districts.

- a. Free standing towers shall be of monopole design.
- b. All wind energy conversion systems shall be equipped with an automatic overspeed control device as part of the design.
- c. Restriction on sound level at lot line (55 dba) or shall comply with the state pollution control agency's noise pollution control section (NPC 1 and NPC 2), as amended, whichever is most restrictive.
- d. Minimum blade clearance to ground of 30 feet for pole mounted horizontal turbines.
- e. Setbacks along public land may be waived or reduced at the discretion of public body in ownership of said land, subject to the review and approval of the city council.
- f. All applicable provisions of chapter 8 of this Code, including, but not limited to, the applicable provisions of the state building codes therein adopted, shall be complied with, in addition to those requirements set out in this article and chapter 36.
- g. Prior to the issuance of a permit, the applicant shall provide, among other things, to the city documentation or other evidence from the dealer or manufacturer that the wind energy conversion system has been successfully operated in atmospheric conditions and is warranted against any systems failures under reasonably expected severe weather operating conditions as established by the director of fire and building inspection services. The applicant shall also provide, among other things, to the city documentation that the tower structure for the system has received a professional engineer's certification.
- h. Wind energy conversion system tower foundations shall be designed to resist two times the wind uplift calculated pursuant to the Uniform Building Code as adopted by the city and shall have a professional engineer's certification.
- i. No wind energy conversion system tower shall be constructed within 20 feet laterally of an overhead electrical power line (excluding secondary electrical service lines or service drops). The setback from underground electric distribution lines shall be at least five feet.

- j. No wind energy conversion system or support tower of any kind shall be erected anywhere within the city without first making an application for and obtaining from the city a permit therefor which shall not be granted unless all requirements of this article are met and the proposed use will not be harmful to the public health, welfare and safety.
 - k. Wind energy conversion systems and towers shall be adequately grounded, as determined by the city engineer, for protection against a direct strike by lightning and shall comply, as to electrical wiring and connections, with all applicable federal regulations, state statutes, regulations, and standards, as well as city codes.
 - l. For all wind energy conversion system towers, effective measures shall be taken to prevent public interference and to place the tower in a substantially nonclimbable condition. Effective measures include removal of climbing rungs or ladders from the bottom eight feet of the tower. The intention shall be to prevent climbing of the tower by unauthorized persons.
 - m. Except for illumination devices required by FAA regulations and residential lighting in compliance with city codes, no wind energy conversion system or tower shall have affixed or attached to it in any way any sign (does not include equipment labels), banner, or placard of any kind, except for one sign, not to exceed two square feet, which displays suitable warning of danger to unauthorized persons, the system's manufacturer, and emergency shut-down procedures.
 - n. All wind energy conversion systems shall comply with all applicable Federal Communications Commission regulations, as amended
 - o. All wind energy conversion systems shall comply with all applicable Federal Aviation Administration regulations, as amended.
 - p. The interface of a wind energy conversion system with the consumer's electric service shall be pursuant to all applicable federal and state regulations. The city encourages the owner to notify his local electric utility company in advance and requests that both parties regulate their activities in a cooperative manner.
 - q. Any wind system or tower which is not used for 12 successive months, commencing after January 27, 1982, shall be deemed abandoned and shall be removed as abandoned lot pursuant to the procedures set forth in chapter 14, article II, division 3, or in the Uniform Building Code as adopted by the city in chapter 8, article II.
- (d) General conditions.
- (1) All conditional use permits required by this section shall be subject to and shall comply with the requirements of code chapter 36, article II, division 4 and all other applicable local, state and federal rules and regulations.
 - (2) System shall be constructed and maintained pursuant to all applicable local, state and federal regulations.
 - (3) No system shall be erected anywhere within the city without first making an application for and obtaining from the city a permit therefor which shall not be granted unless all requirements of this article are met and the proposed use will not be harmful to the public health, welfare and safety.
 - (4) Unless specifically stated otherwise in this section, all systems shall be subject to applicable front, rear and side yard setbacks.

(Ord. No. 09-11, 2, 10-5-2009)

Maplewood

ARTICLE VIII. - RENEWABLE ENERGY SYSTEMS Added

DIVISION 1. - GENERALLY Added

Sec. 18-301. - Scope. Added

This article applies to the regulations of on-site renewable energy systems within the City of Maplewood, Ramsey County, Minnesota. The article focuses on wind turbines, solar systems, and geothermal ground-source heat pumps which are located on the site for which the generation of energy will be used, with excess energy distributed into the electrical grid.

(Ord. No. 914, § 1, 10-10-2011)

Sec. 18-302. - Purpose and intent. Added

It is the goal of the city to provide a sustainable quality of life for the city's residents, making careful and effective use of available natural resources to maintain and enhance this quality of life. Cities are enabled to regulate land use under Minn. Stats. §§ 394 and 462 for the purpose of "promoting the health, safety, morals, and general welfare of the community."

As part of this regulatory power, Maplewood believes it is in the public interest to encourage renewable energy systems that have a positive impact in energy conservation, with limited adverse impact on the community. While Maplewood strongly encourages increased energy conservation and improved energy efficiency, the city also finds that increased use of appropriate renewable energy systems will be an important part of improving urban sustainability.

The renewable energy regulations are intended to supplement existing zoning ordinances and land use practices, and ensure these systems are appropriately designed, sited and installed. These regulations are in place to balance the need to improve energy sustainability through increased use of renewable energy systems with concerns for preservation of public health, welfare, and safety, as well as environmental quality, visual and aesthetic values, and existing neighborhood social and ecological stability. With these regulations, Maplewood is concerned that renewable energy systems, particularly wind energy systems, be designed to minimize the negative impacts on bird and bat species which are vulnerable to mortality from these energy gathering machines.

(Ord. No. 914, § 2, 10-10-2011)

Secs. 18-303—18-320. - Reserved. Added

DIVISION 2. - WIND ENERGY Added

Sec. 18-321. - Wind energy sources and systems. Added

(a)

Definitions, wind energy sources and systems. The following words, terms and phrases, when used in this division, shall have the meaning provided herein, except where the context clearly indicates otherwise:

Feeder line means any power line that carries electrical power from one or more wind turbines or individual transformers associated with an individual wind turbine to the point of interconnection with the electric power grid. In the case of interconnection with the high-voltage transmission systems, the point of interconnection shall be the substation serving the WECS.

Ground-mounted WECS means freestanding WECS mounted to the ground with footings or other apparatus.

Large WECS means a WECS of equal to or greater than 100kW in total nameplate generating capacity. The energy must be used on site with excess energy distributed into the electrical grid. Large WECS are limited to 125 feet in height.

Property line means the boundary line of the area over which the entity applying for WECS permit has legal control for the purposes of installation of a WECS. This control may be attained through fee title ownership, easement, or other appropriate contractual relationship between the project developer and land owner.

Roof-mounted WECS means a WECS utilizing a turbine mounted to the roof of a structure.

Significant tree means any tree defined as a significant tree in the city's tree preservation ordinance.

Small WECS means a WECS of less than 100kW in total nameplate generating capacity. The energy must be used on site with excess energy distributed into the electrical grid. Small WECS are limited to 60 feet in height.

Tower means vertical structures that support the electrical generator, rotor, and blades, or the meteorological equipment.

Tower height means the total height of the WECS, including tower, rotor, and blade to its highest point of travel.

Turbine cut-in speed means the lowest wind speed at which turbines generate power to the utility system.

Wind energy means kinetic energy present in wind motion that can be converted into electrical energy.

WECS means a wind energy conversion system which is an electrical generating facility comprised of one or more wind turbines and accessory facilities, including, but not limited to, power lines, transformers, substations and metrological towers that operate by converting the kinetic energy of wind into electrical energy. The energy must be used on site with excess energy distributed into the electrical grid.

Wind energy system means an electrical generating facility that consists of a wind turbine associated controls and may include a tower.

Wind turbine means a wind turbine is any piece of electrical generating equipment that converts the kinetic energy of blowing wind into electrical energy through the use of airfoils or similar devices to capture the wind.

(Ord. No. 914, § 3.a., 10-10-2011)

Sec. 18-322. - WECS districts. Added

(a)

Large WECS districts.

(1)

Ground- and roof-mounted large WECS shall be allowed with approval of a conditional use permit as outlined in subsection (d) (conditional use permit procedure) in the following zoning districts and land use designations:

a.

In all properties located in commercial zoning districts (heavy manufacturing, light manufacturing, business commercial, business commercial modified, limited business commercial, commercial office, neighborhood commercial, shopping center).

b.

In all properties located in multiple dwelling residential zoning districts (multiple dwelling residential and multiple dwelling residential townhouse) for purposes of shared WECS energy production among the residential dwelling units.

c.

In all properties approved as a planned unit development for purposes of shared WECS energy production among the businesses/organizations, residential dwelling units, or adjoining businesses/organizations/residential dwelling units.

d.

In all properties guided as government or institutional in the city's land use designations of the comprehensive plan.

(2)

Ground- and roof-mounted large WECS shall be prohibited in all properties guided as park or open space in the city's land use designations of the comprehensive plan.

(b)

Small WECS districts.

(1)

Roof-mounted small WECS shall be deemed permissible in all zoning districts.

(2)

Ground-mounted small WECS shall be deemed an accessory structure, permissible in the following zoning districts and land use designations:

a.

In all properties located in commercial zoning districts (heavy manufacturing, light manufacturing, business commercial, business commercial modified, limited business commercial, commercial office, neighborhood commercial, shopping center).

b.

In all properties located in multiple dwelling residential zoning districts (multiple dwelling residential and multiple dwelling residential townhouse) for purposes of shared WECS energy production among the residential dwelling units.

c.

In all properties approved as a planned unit development for purposes of shared WECS energy production among the businesses/organizations, residential dwelling units, or adjoining businesses/organizations/residential dwelling units.

d.

In all properties guided as government or institutional in the city's land use designations of the comprehensive plan.

e.

In all properties guided as park in the city's land use designations of the comprehensive plan.

(3)

Ground-mounted small WECS shall be deemed an accessory structure, permissible in double or single dwelling residential zoning districts if the following neighborhood consent requirements are met:

Written consent of 100 percent of the owners or occupants of privately- or publicly-owned real estate that are located adjacent (i.e., sharing property lines) on the outer boundaries of the premises for which the permit is being requested, or in the alternative, proof that the applicant's property lines are 150 feet or more from any house.

Where an adjacent property consists of a multiple dwelling or multi-tenant property, the applicant need obtain only the written consent of the owner or manager, or other person in charge of the building. Such written consent shall be required on the initial application and as often thereafter as the officer deems necessary.

(Ord. No. 914, § 3.b., 10-10-2011)

Sec. 18-323. - Placement and design. Added

(a)

Ground-mounted WECS.

(1)

Height.

a.

Large WECS shall have a total height, including tower and blade to its highest point of travel, of no more than 125 feet.

b.

Small WECS shall have a total height, including tower and blade to its highest point of travel, of no more than 60 feet.

(2)

Placement.

a.

Large WECS shall be located as follows:

1.

Shall not be located between a principal structure and a public street, unless the city determines that such a location would lessen the visibility of the large WECS or would lessen the negative impacts of such a WECS on nearby properties.

2.

Have a minimum setback distance from the base of the monopole of one times the height from any property line, electric substation, transmission line, or other WECS. In addition, the setback distance must be increased by 25 feet from any property that is zoned or planned for residential.

3.

Have a minimum setback distance from the base of the monopole of one and one-half times the height from any public right-of-way, occupied structure, or public use area.

4.

Have a minimum setback distance from the base of the monopole of 600 feet from any property guided as park or open space in the city's land use designations of the comprehensive plan.

5.

Have a minimum setback distance from the base of the monopole of one-fourth mile or 1,320 feet from any bluff.

b.

Small WECS shall be located:

1.

Shall not be located between a principal structure and a public street, unless the city determines that such a location would lessen the visibility of the small WECS or would lessen the negative impacts of such a WECS on nearby properties.

2.

Have a minimum setback distance from the base of the monopole of one times the height from any property line, public right-of-way, electric substation, transmission line, or other WECS.

(3)

Number.

a.

Large WECS. One large WECS shall be allowed on a single lot of one to five acre(s). All other larger parcels will be limited to one large WECS per five acres of land area.

b.

Small WECS. One small WECS shall be allowed on a single lot up to one acre in size. All other larger parcels will be allowed one small WECS per five acres of land area.

(4)

Design.

a.

Tower configuration. All ground mounted WECS shall:

1.

Be installed with a tubular, monopole-type tower.

2.

Have no guyed wires attached to the tower or other components.

3.

Have no ladder, step bolts, rungs, or other features used for tower access to extend within eight feet of the ground. Lattice-style towers shall have a protective barrier to prevent unauthorized access to the lower eight feet of the tower.

b.

Signs. A WECS operator is required to provide a single posting, not to exceed four square feet, at the base of a WECS prohibiting trespassing, warning of high voltage, and providing the emergency contact information for the operator.

(b)

Roof-mounted WECS.

(1)

Height.

a.

Large roof-mounted WECS:

1.

Total height of not more than 25 feet, measured from the top of the roof to the blade tip at its highest point of travel.

b.

Small roof-mounted WECS:

1.

Total height of not more than 25 feet, measured from the top of the roof to the blade tip at its highest point of travel.

2.

Residential installation. In addition to the 25-foot height restriction for the small roof-mounted WECS, the height of the WECS and the structure on which it is attached must not exceed the maximum height allowed in the residential zoning district for which it is installed.

(2)

Placement. Roof-mounted WECS must be erected above the roof of a building or structure. The mounts associated with the WECS may extend onto the side of the building or structure.

(3)

Number.

a.

Large roof-mounted WECS. The maximum number of large roof-mounted WECS shall be approved through the conditional use permit process.

b.

Small roof-mounted WECS. No more than three roof-mounted small WECS shall be installed on any rooftop.

(Ord. No. 914, § 3.c., 10-10-2011)

Sec. 18-324. - Conditional use permit procedure. Added

Procedures for granting conditional use permits from this division are as follows:

(1)

The city council may approve conditional use permit requirements in this division.

(2)

Before the city council acts on a conditional use permit, the environmental and natural resources commission and the planning commission will make a recommendation to the city council.

(3)

In reviewing the conditional use permit the environmental and natural resources commission, planning commission, and city council will follow the requirements for conditional use permit approvals as outlined in article V (conditional use permits).

(Ord. No. 914, § 3.d., 10-10-2011)

Sec. 18-235. - General standards. Added

(a)

The following provisions will apply to all WECS erected under the provisions of this division:

(1)

Noise: Have a maximum noise production rating of 55 dB 50 dBA and shall conform to this standard under normal operating conditions as measured at any property line.

(2)

Over-speed controls: Shall be equipped with manual and automatic over-speed controls to limit the blade rotation within design specifications.

(3)

Lighting: Have no installed or accessory lighting, unless required by federal or state regulations.

(4)

Intent to install: Prior to the installation or erection of a WECS, the operator must provide evidence showing their regular electrical service provider has been informed of the customer's intent to install an interconnected, customer-owned generator. Off-grid systems shall be exempt from this requirement.

(5)

Signs: The placement of all other signs, postings, or advertisements shall be prohibited on the units. This restriction shall not apply to manufacturer identification, unit model numbers, and similar production labels.

(6)

Commercial installations: All WECS shall be limited to the purpose of on-site energy production, except that any additional energy produced above the total on-site demand may be sold to the operator's regular electrical service provider in accordance with any agreement provided by the same or applicable legislation.

(7)

Feeder lines: Any lines accompanying a WECS, other than those contained within the WECS's tower or those attached to on-site structures by leads, shall be buried within the interior of the subject parcel, unless there are existing lines in the area which the lines accompanying a WECS can be attached.

(8)

Clearance: Rotor blades or airfoils must maintain at least 20 feet of clearance between their lowest point and the ground.

(9)

Blade design: The blade design and materials must be engineered to insure safe operation in an urban area.

(10)

Energy storage: Batteries or other energy storage devices shall be designed consistent with the Minnesota Electric Code and Minnesota Fire Code.

(b)

In addition to the provisions outlined in subsection 18-321(e)(1) above, the following provisions will apply to large WECS erected under the provisions of this division:

(1)

Color. Turbine paint color and high levels of ultraviolet and infrared components of paint could have an impact on the attraction of insect species to the structure, which may attract birds and bats and cause bird and bat mortality. As such, turbine paint color may be approved as part of the

conditional use permit process and must be shown to reduce the negative impacts to birds and bats and be a non-obtrusive color so not to cause negative visual impacts to surrounding properties.

(2)

Warnings. A sign or signs shall be posted on the tower, transformer and substation warning of high voltage. Signs with emergency contact information shall also be posted on the turbine or at another suitable point.

(3)

Environmental standards. The applicant shall provide the following information in the conditional use permit application. The information will be evaluated in meeting the criteria of a conditional use permit for purposes of minimizing impacts on the environment:

a.

Natural heritage review by the Minnesota Department of Natural Resources.

b.

Lands guided as park or open space in the city's land use designation of the comprehensive plan that are located within one mile of the project.

c.

Conservation easements and other officially protected natural areas within a quarter mile of the project.

d.

Shoreland, Mississippi critical area, greenways, wetland buffers, wildlife corridors and habitat complexes.

e.

All significant trees impacted by the project.

f.

A plan for turbine cut-in speed strategies where feasible in order to reduce bird and bat deaths. Studies have shown that bird and bat fatalities would be significantly reduced by changing turbine cut-in speed and reducing operational hours during low wind periods, evening hours (one-half hour before sunset to one-half hour after sunrise only in spring, summer, and early fall), and migration times in spring and fall.

(c)

In addition to the provisions outlined in subsection 18-321(e)(1) above, the following provisions will apply to small WECS erected under the provisions of this division:

(1)

Color. Turbine paint color must be a nonobtrusive color so not to cause negative visual impacts to surrounding properties.

(Ord. No. 914, § 3.e., 10-10-2011)

Sec. 18-326. - Abandonment. Added

A WECS that is allowed to remain in a nonfunctional or inoperative state for a period of 12 consecutive months, and which is not brought in operation within the time specified by the city after notification to the owner or operator of the WECS, shall be presumed abandoned and may be declared a public nuisance subject to removal at the expense of the operator.

(Ord. No. 914, § 3.f., 10-10-2011)

Secs. 18-327—18-350. - Reserved. Added

DIVISION 3. - SOLAR ENERGY Added

Sec. 18-351. - Solar energy sources and systems. Added

(a)

Definitions, solar energy sources and systems. The following words, terms and phrases, when used in this section, shall have the meaning provided herein, except where the context clearly indicates otherwise:

Building-integrated solar system means an active solar system that is an integral part of a principal or accessory building, rather than a separate mechanical device, replacing or substituting for an architectural or structural component of the building. Building-integrated systems include, but are not limited to, photovoltaic or hot water solar systems that are contained within roofing materials, windows, skylights, and awnings.

Ground-mounted panels means freestanding solar panels mounted to the ground by use of stabilizers or similar apparatus.

Photovoltaic system means an active solar energy system that converts solar energy directly into electricity.

Roof- or building-mounted SES means solar energy system (panels) that are mounted to the roof or building using brackets, stands or other apparatus.

Roof pitch means the final exterior slope of a building roof calculated by the rise over the run, typically, but not exclusively, expressed in twelfths such as 3/12, 9/12, 12/12.

Solar access means a view of the sun, from any point on the collector surface that is not obscured by any vegetation, building, or object located on parcels of land other than the parcel upon which the solar collector is located, between the hours of 9:00 a.m. and 3:00 p.m. standard time on any day of the year.

Solar collector means a device, structure or a part of a device or structure for which the primary purpose is to transform solar radiant energy into thermal, mechanical, chemical, or electrical energy.

Solar energy means radiant energy received from the sun that can be collected in the form of heat or light by a solar collector.

Solar energy system (SES) means an active solar energy system that collects or stores solar energy and transforms solar energy into another form of energy or transfers heat from a collector to another medium using mechanical, electrical, or chemical means.

Solar hot water system means a system that includes a solar collector and a heat exchanger that heats or preheats water for building heating systems or other hot water needs, including residential domestic hot water and hot water for commercial processes.

(Ord. No. 914, § 4.a., 10-10-2011)

Sec. 18-352. - Districts. Added

Solar energy systems (SES) shall be allowed as an accessory use in all zoning districts.

(Ord. No. 914, § 4.b., 10-10-2011)

Sec. 18-353. - Placement and design. Added

(a)

Height.

(1)

Roof or building mounted SES shall not exceed the maximum allowed height in any zoning district. For purposes for height measurement, solar systems other than building-integrated solar systems shall be considered to be mechanical devices and are restricted consistent with other building-mounted mechanical devices.

(2)

Ground-mounted SES shall not exceed the height of an allowed accessory structure within the zoning district when oriented at maximum tilt.

(b)

Placement.

(1)

Ground-mounted SES must meet the accessory structure setback for the zoning district in which it is installed.

(2)

Roof or building-mounted SES. The collector surface and mounting devices for roof or building mounted SES shall not extend beyond the required setbacks of the building on which the system is mounted.

(c)

Coverage. Ground-mounted SES may not exceed the area restrictions placed on accessory structures within the subject zoning district.

(d)

Visibility.

(1)

SES shall be designed to blend into the architecture of the building or be screened from routine view from public rights-of-way other than alleys. The color of the solar collector is not required to be consistent with other roofing materials.

(2)

Building-integrated solar systems shall be allowed regardless of visibility, provided the building component in which the system is integrated meets all required setback, land use or performance standards for the zoning district in which the building is located.

(3)

Ground-mounted SES shall be screened from view to the extent possible without reducing their efficiency. Screening may include walls, fences, or landscaping.

(Ord. No. 914, § 4.c., 10-10-2011)

Sec. 18-354. - General standards. Added

(a)

Notification. Prior to the installation or erection of a SES, the operator must provide evidence showing their regular electrical service provider has been informed of the customer's intent to install an interconnected, customer-owned SES. Off-grid systems shall be exempt from this requirement.

(b)

Feeder lines. Any lines accompanying a SES, other than those attached to on-site structures by leads, shall be buried within the interior of the subject parcel, unless there are existing lines in the area which the lines accompanying an SES can be attached.

(c)

Commercial. All SES shall be limited to the purpose of on-site energy production, except that any additional energy produced above the total onsite demand may be sold to the operator's regular electrical service provider in accordance with any agreement provided by the same or applicable legislation.

(d)

Restrictions on SES limited. No homeowners' agreement, covenant, common interest community, or other contract between multiple property owners within a subdivision of Maplewood shall restrict or limit solar systems to a greater extent than Maplewood's renewable energy ordinance.

(e)

Maplewood encourages solar access to be protected in all new subdivisions and allows for existing solar to be protected consistent with Minnesota Statutes. Any solar easements filed must be consistent with Minn. Stats. ch. 500, § 30

(Ord. No. 914, § 4.d., 10-10-2011)

Sec. 18-355. - Abandonment. Added

An SES that is allowed to remain in a nonfunctional or inoperative state for a period of 12 consecutive months, and which is not brought in operation within the time specified by the city, shall be presumed abandoned and may be declared a public nuisance subject to removal at the expense of the operator.

(Ord. No. 914, § 4.e., 10-10-2011)

Secs. 18-356—18-400. - Reserved. Added

DIVISION 4. - GEOTHERMAL ENERGY Added

Sec. 18-401. - Geothermal energy sources and systems. Added

(a)

Definitions, geothermal energy sources and systems. The following words, terms and phrases, when used in this section, shall have the meaning provided herein, except where the context clearly indicates otherwise:

Closed loop ground source heat pump system means a system that circulates a heat transfer fluid, typically food-grade antifreeze, through pipes or coils buried beneath the land surface or anchored to the bottom in a body of water.

Geothermal energy means renewable energy generated from the interior of the earth and used to produce energy for heating buildings or serving building commercial or industrial processes.

Ground source heat pump system (GSHPS) means a system that uses the relatively constant temperature of the earth or a body of water to provide heating in the winter and cooling in the summer. System components include closed loops of pipe, coils or plates; a fluid that absorbs and transfers heat; and a heat pump unit that processes heat for use or disperses heat for cooling; and an air distribution system. The energy must be used on site.

Heat transfer fluid means a non-toxic and food-grade fluid such as potable water, aqueous solutions of propylene glycol not to exceed 20 percent by weight or aqueous solutions of potassium acetate not to exceed two percent by weight.

Stormwater pond means ponds created for stormwater treatment. A stormwater pond shall not include wetlands created to mitigate the loss of other wetlands.

(Ord. No. 914, § 5.a., 10-10-2011)

Sec. 18-402. - Districts. Added

Ground source heat pump systems (GSHPS) shall be deemed an accessory structure, permissible in all zoning districts.

(Ord. No. 914, § 5.b., 10-10-2011)

Sec. 18-403. - Placement and design. Added

(a)

Placement.

(1)

All components of GSHPS including pumps, borings and loops shall be set back at least five feet from interior and rear lot lines.

(2)

Easements. All components of GSHPS shall not encroach on easements.

(3)

GSHPS are prohibited in surface waters, except for stormwater ponds where they are permitted.

(b)

Design.

(1)

Only closed-loop GSHPS utilizing Minnesota Department of Health approved heat transfer fluids are permitted.

(2)

Screening. Ground source heat pumps are considered mechanical equipment and subject to the requirements of the city's zoning ordinance.

(Ord. No. 914, § 5.c., 10-10-2011)

Sec. 18-404. - General standards. Added

Noise. GSHPS shall comply with Minnesota Pollution Control Agency standards outlined in Minnesota Rules Chapter 7030.

(Ord. No. 914, § 5.d., 10-10-2011)

Sec. 18-405. - Abandonment. Added

A GSHPS that is allowed to remain in a nonfunctional or inoperative state for a period of 12 consecutive months, and which is not brought in operation within the time specified by the city after notification to the owner or operator of the GSHPS, shall be presumed abandoned and may be declared a public nuisance subject to removal at the expense of the operator.

ORDINANCE NO. 142, THIRD SERIES

**CITY OF ORONO HENNEPIN
COUNTY, MINNESOTA**

**AN ORDINANCE AMENDING
ORONO MUNICIPAL ZONING CODE SECTION 78-1379
REGARDING WIND ENERGY CONVERSION SYSTEMS**

THE CITY COUNCIL OF ORONO ORDAINS:

SECTION 1. The following language is hereby deleted and added to Orono Municipal Zoning Code Section 78-1379(c)(4):

(4) *Wind energy conversion systems definitions.*

Horizontal axis wind turbine. A wind turbine design in which the rotor shaft is parallel to the ground and the blades are perpendicular to the ground.

Hub. The center of a wind generator rotor, which holds the blades in place and attaches to the shaft.

Hub height. The distance measured from natural grade to the center of the turbine hub.

Monopole tower. A tower constructed of tapered tubes that fit together symmetrically and are stacked one section on top of another and bolted to a concrete foundation without support cables.

~~*Residential wind turbine.* A wind turbine of 10 kilowatt (kW) nameplate generating capacity or less.~~

Small wind turbine energy conversion system (SWECS). A wind turbine WECS of 100 5000 kW nameplate generating capacity or less.

Total height. The highest point above natural grade reached by a rotor tip or any other part of a wind turbine.

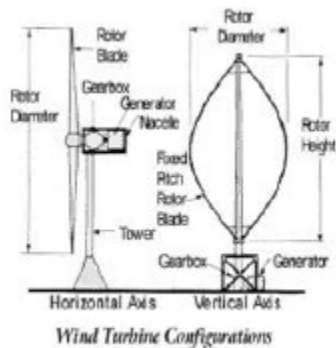
~~*Tower.* A vertical structure that supports a wind turbine.~~

~~*Utility wind turbine.* A wind turbine of more than 100 kW nameplate generating capacity.~~

Vertical axis wind turbine. A type of wind turbine where the main rotor shaft runs vertically.

Wind energy conversion system (WECS). An electrical generating facility that consists of a wind turbine, feeder line(s), associated controls and may include a tower.

Wind turbine. Any piece of electrical generating equipment that converts the kinetic energy of blowing wind into electrical energy through the use of airfoils or similar devices to capture the wind.



SECTION 2. Orono Municipal Zoning Code Section 78-1379(f) is hereby deleted and a new Section 78-1379(f) inserted in its place to read as follows:

“(f) Wind Energy Conversion Systems.”

- (1) *Zoning Districts.* Small Wind Energy Conversion Systems (SWECS) in accordance with the standards in this section are permitted accessory uses on lots at least 10 acres in gross area within the RR-1A and RR-1B Rural Residential zoning districts. SWECS in accordance with the standards in this section are allowed as a conditional use on lots at least 5 acres in gross area and subject to conditional use permit approval in the following Commercial or Industrial Districts: B-1 Retail Sales; B-4 Office and Professional; B-6 Highway Commercial; B-6 PUD; and I Industrial.
- (2) *Standards for SWECS in Residential Zoning Districts.*
 - a. *Number.* No more than one SWECS is permitted per parcel.
 - b. *Height.* In the RR-1A and RR-1B zoning districts, a maximum hub height of 30 feet is allowed as a permitted accessory use.
 - c. *Blade length.* A maximum blade length of 15 feet is permitted.
 - d. *Clearance.* The minimum distance from the ground for the lowest point of a blade or any other moving part shall be 12 feet.
 - e. *Roof mounting.* Roof or wall mounted SWECS are not permitted.
 - f. *Setbacks.* The base of the SWECS tower shall be set back at least 100 feet from all property lines. SWECS shall not be installed in the front yard of any lot or in the side yard of a corner lot adjacent to a public right-of-way. SWECS shall not be located more than 100 feet from the principal structure on the property.
 - g. *Easements.* SWECS shall not encroach on public drainage, utility, roadway or trail easements.
 - h. *Noise.* SWECS shall comply with Minnesota Pollution Control Agency standards outlined in Minnesota Rules Chapter 7030 at all property lines.

- i. *Screening.* SWECS are exempt from the screening requirements for the district in which they are located.
 - j. *Aesthetics.* All portions of the SWECS shall be a nonreflective surface, subject to the approval of the City Administrator or his/her designee. Only monopole towers are permitted. The appearance of the turbine, tower and any other related components shall be maintained throughout the life of the SWECS pursuant to industry standards. Systems shall not be used for displaying any advertising, nor for other uses including but not limited to cell phone antennas, flags, ham radio antennas, etc. No components unnecessary to the operation of the SWECS shall be allowed. Systems shall not be illuminated.
 - k. *Feeder lines.* The electrical collection system shall be placed underground within the interior of each parcel.
 - l. *Vibration.* No wind energy conversion system shall produce vibrations through the ground that are perceptible beyond the property on which it is located.
 - m. *Location.* No SWECS shall be allowed within the Shoreland Overlay District. SWECS shall be setback a distance at least equal to the height of the SWECS from a floodplain, pond or wetland.
- (3) *Standards for SWECS in Commercial and Industrial Zoning Districts.*
- a. *Number.* No more than one SWECS is permitted per parcel.
 - b. *Height.* In commercial and industrial zoning districts, a maximum hub height of 30 feet is allowed.
 - c. *Blade length.* A maximum blade length of 15 feet is permitted.
 - d. *Clearance.* The minimum distance from the ground for the lowest point of a blade or any other moving part shall be 12 feet.
 - e. *Roof mounting.* Roof or wall mounted SWECS are not permitted.
 - f. *Setbacks.* The base of the SWECS tower shall be set back at least 100 feet from all property lines. SWECS shall not be installed in the front yard of any lot or in the side yard of a corner lot adjacent to a public right-of-way. SWECS shall not be located more than 100 feet from the principal structure on the property.
 - g. *Easements.* SWECS shall not encroach on public drainage, utility, roadway or trail easements.
 - h. *Noise.* SWECS shall comply with Minnesota Pollution Control Agency standards outlined in Minnesota Rules Chapter 7030 at all property lines.
 - i. *Screening.* SWECS are exempt from the screening requirements for the district in which they are located.

- j. *Aesthetics.* All portions of the SWECS shall be a nonreflective surface, subject to the approval of the City Administrator or his/her designee. Only monopole towers are permitted. The appearance of the turbine, tower and any other related components shall be maintained throughout the life of the SWECS pursuant to industry standards. Systems shall not be used for displaying any advertising, nor for other uses including but not limited to cell phone antennas, flags, ham radio antennas, etc. No components unnecessary to the operation of the SWECS shall be allowed. Systems shall not be illuminated.
 - k. *Feeder lines.* The electrical collection system shall be placed underground within the interior of each parcel.
 - l. *Vibration.* No SWECS shall produce vibrations through the ground that are humanly perceptible beyond the property on which it is located.
 - m. *Location.* No SWECS shall be allowed within the Shoreland Overlay District. WECS shall be setback a distance equal to the height of the WECS from a floodplain, pond or wetland.
- (4) *Safety.*
- a. *Standards and certification.*
 - 1. *Standards.* SWECS shall meet minimum standards such as International Electrotechnical Commission (IEC) 61400-2 or the American Wind Energy Association's (AWEA) Small Wind Turbine Performance and Safety Standard or other standards as determined by the City Administrator or his/her designee.
 - 2. *Certification.* SWECS shall be certified by Underwriters Laboratories, Inc. and the National Renewable Energy Laboratory, the Small Wind Certification Council or other body as determined by the City Administrator or his/her designee. The city reserves the right to deny a building permit for proposed SWECS deemed to have inadequate certification or testing for operation in a severe winter climate.
 - 3. *Maintenance.* SWECS shall be maintained under an agreement or contract by the manufacturer or other qualified entity. The owner of the SWECS shall once every two years have the SWECS inspected by a licensed qualified professional and submit to the City a report on the status and condition of the SWECS.
 - b. *Utility connection.* All grid connected systems shall have an agreement with the local utility prior to the issuance of a building permit. A visible external disconnect must be provided if required by the utility.
- (5) *Abandonment.* If the SWECS remains nonfunctional or inoperative for a continuous period of one year, the system shall be deemed to be abandoned and shall constitute a public nuisance. The owner shall remove the abandoned system at their expense after a demolition permit has been obtained. Removal includes the entire structure including foundations to below natural grade and transmission equipment.

- (6) *Permits.* A building permit shall be obtained for any SWECS prior to installation.
- (7) *Power Distribution.* The power produced from a SWECS shall only be used for on-site consumption except if connected to the local utility power grid per the provisions of this Section.

SECTION 3. Repeal of Moratorium. The moratorium enacted by the City Council via Interim Ordinance No. 125, Third Series on October 27, 2014 which temporarily prohibited SWECS and established that during the moratorium the City will not process any SWECS applications it receives and directed that City staff shall return such applications to the applicant, is hereby repealed as of the effective date of this Ordinance.

SECTION 4. EFFECTIVE DATE: This ordinance shall take effect immediately upon its passage and publication.

ADOPTED this 13th day of April, 2015 on a vote of 3 ayes and 1 nay by the City Council of Orono, Minnesota.

ATTEST:

Diane Tiegs, City Clerk

Lili Tod McMillan, Mayor

Ordinance published in The Laker and The Pioneer newspapers the week of April 19, 2015.

Ramsey

Chapter 117 Zoning and Subdivisions, Article 2 Zoning, Division 7 Requirements for Miscellaneous Uses

Sec. 117-430. - Alternative energy systems.

- (a) Purpose and intent. The purpose and intent of this section is to establish standards and procedures by which the installation and operation of alternative energy systems shall be governed within the city. The city finds that it is in the public interest to encourage alternative energy systems that have a positive impact on energy production and conservation while not having an adverse impact on the community.
- (b) Wind energy conversion systems (WECS). The following standards are intended to:
- Facilitate the provisions for WECS to the residents and businesses of the city;
 - Minimize adverse visual effects of wind towers, turbines, and generators through careful design and site selection standards;
 - Avoid potential damage to adjacent properties from tower failure through structural standards and setback requirements.
- (1) Location. WECS units shall be allowed by conditional use if listed as a conditional use in the underlying zoning district. Furthermore, WECS units shall not be allowed in the Critical River, Wild and Scenic River, and Shoreland Overlay Districts, except for micro-scale WECS provided that it does not violate the maximum structure height of the overlay district.
- (2) Bulk standards.
- a. General requirements. No part of the WECS, equipment, guyed wires, blades, or braces shall at any time extend across or over any part of the public right-of-way, public street, highway, sidewalk, or recreation trail.
 - b. Setback. All small scale WECS and medium scale WECS units shall maintain a minimum setback of 1.5 times the height of the tower. In addition, WECS units in any R-1, R-2, or R-3 residential district must maintain a minimum setback of 1,000 feet from any principle dwelling unit on adjacent parcels.
 - 1. Setbacks shall be measured from the center of the WECS tower to the nearest property line.
 - c. Height. Height for any WECS shall be restricted by the definition of the WECS as listed in City Code section 117-1, definitions.
 - 1. The city council may increase the height of a small scale WECS up to an overall height of 100 feet if the applicant is able to demonstrate to the satisfaction of the city council that the surrounding topography, structures, vegetation, and other factors make the height limit for a complying WECS impractical.
 - 2. A micro-scale WECS is limited to 25 feet taller than the structure to which it is mounted and can be no taller than the maximum building height of the underlying zoning district. A variance, processed in accordance with section 117-53 (Variance procedures) is required for any micro-scale WECS proposed to be taller than these restrictions.
 - d. Blade clearance. Any WECS blade shall maintain a minimum ground clearance of 30 feet.
 - e. Restricted climbing apparatus. Any WECS tower shall be designed to have removable climbing apparatuses a minimum of 25 feet from the ground. All climbing apparatus within 25 feet of the ground must be removed when not being serviced.

- f. Site location in residential districts. A WECS may only be located in the rear yard in the R-1, R-2, and R-3 residential districts.
 - 1. The city council may approve a WECS in the front yard if the applicant is able to demonstrate setbacks would be unable to be met in the rear yard.
- (3) Design standards. A proposed or modified WECS shall meet the following minimum design standards.
 - a. Tower design. Any WECS shall be of a monopole design unless the city council determines that an alternative design is preferred in cases where structural or design considerations, neighborhood compatibility, or location availability is better suited with an alternate design.
 - b. Architectural design. Any WECS shall be designed to blend into the surrounding environment through the use of color and design, except in instances where the color is dictated by federal or state authorities such as the Federal Aviation Administration.
 - 1. Architectural design standards are subject to final city council approval.
 - 2. The city council may deny a WECS if it determines the design standards are incompatible with the surrounding area.
- (4) Use of city owned land for WECS.
 - a. Priority of users.
 - 1. City of Ramsey;
 - 2. Public safety agencies, including law enforcement, fire, and ambulance services, which are not part of the City of Ramsey and private entities with a public safety agreement with the city;
 - 3. Other governmental agencies, for uses which are not related to public safety; and
 - 4. Entities providing licensed commercial wireless telecommunication services including cellular, personal communication services (PCS), specialized mobilized radio (SMR), enhanced specialized mobilized radio (ESMR), paging, and similar services that are marketed to the general public or wireless telecommunication services.
 - 5. Entities providing alternative energy sources including WECS.
 - b. Minimum requirements.
 - 1. The user must obtain a lease from the city, which shall take the following criteria into consideration:
 - (i) The WECS will not interfere with the purpose for which the city owned property is intended;
 - (ii) The WECS will have no adverse impact on surrounding private property;
 - (iii) The applicant is willing to obtain adequate liability insurance and commit to a lease agreement which includes equitable compensation for the use of public land and other necessary provisions and safeguards. The fees shall be established by the city council after considering comparable rates in other cities, potential expenses, risks to the city, and other appropriate factors;
 - (iv) The WECS will not interfere with other users who have a higher priority as discussed in subsection 117-430(e)(1);
 - (v) Upon reasonable notice, the WECS may be required to be removed at the user's expense;

- (vi) The applicant must reimburse the city for any costs which it incurs because of the presence of the applicant's WECS; and
- 2. The user must obtain all necessary land use approvals, including a conditional use permit from the city.
- c. Special requirements. The use of certain city owned property, such as water tower sites and parks, for a WECS brings with it special concerns due to the unique nature of these sites. The placement of a WECS on these special city owned sites will be allowed only when the following additional requirements are met:
 - 1. Water tower sites. The city's water tower represents a large public investment in water pressure stabilization and peak capacity reserves. Protection of the quality of the city's water supply is of prime importance to the city. As access to the city's water storage system increases, so too increases the potential for contamination of the public water supply. For these reasons, the placement of a WECS on existing or future water tower sites will be allowed only when the city is fully satisfied that the following requirements are met:
 - (i) The applicant's access to the facility will not increase the risks of contamination to the city's water supply;
 - (ii) There is sufficient room on the structure and/or on the grounds to accommodate the applicant's facility;
 - (iii) The presence of the facility will not increase the water tower maintenance costs to the city; and
 - (iv) The presence of the facility will not unreasonably interfere with maintaining the water tower.
 - 2. Parks. The presence of certain WECS represents a potential conflict with the purpose of some city owned parks. A WECS will be considered only in parks after the recommendation of the park and recreation commission and approval of the city council.
- d. Application process. All applicants who wish to locate a WECS on any property must submit to the city administrator, or his/her designee, a completed application and detailed plan that complies with the submittal requirements of the zoning ordinance along with other pertinent information requested by the city.
- e. Termination. The city council may terminate any lease if it determines that any one of the following conditions exist:
 - 1. A potential user with a higher priority cannot find another adequate location and the potential use would be incompatible with the existing use;
 - 2. The WECS unreasonably interferes with other users of a higher priority, including wireless communication, regardless of whether or not this interference was adequately predicted in the technical analysis; or
 - 3. A user violates any of the standards in this policy or the conditions attached to the city's permission.

Before taking action, the city will provide 30 days notice to the user of the intended termination and the reasons for it, and provide an opportunity for the user to address the city council regarding the proposed action. This procedure need not be followed in emergency situations.

- f. Reservation of right. Notwithstanding the above, the city council reserves the right to deny, for any reason, the use of any or all city owned property by any one or all applicants.

- g. Use of revenue. All revenue generated through the lease of city owned property for a WECS shall be made payable to the City of Ramsey and transmitted to the city's department of finance.

Revenue shall be credited as follows:

1. To the specific operating activity using the land upon which the wireless telecommunication towers and antennas are located:
 - (i) To the water utility fund when located on water utility property;
 - (ii) To the park improvement fund if located on park or open space land;
 - (iii) Any revenues not meeting the above criteria shall be applied as general revenues of the general fund.
- (5) Co-location requirements. Whenever possible, the city encourages co-location of wireless telecommunication facilities on a WECS in accordance of section 117-428.
- (6) Tower construction requirements. Any WECS erected, constructed, or located within the city, and all wiring therefore, shall comply with the requirements set forth of chapter 105 of this Code. Towers shall be designed to be properly grounded in the event of a lightning strike.
- (7) WECS Lighting. Towers shall not be illuminated by artificial means and shall not display strobe lights unless such lighting is specifically required by the Federal Aviation Administration or other federal or state authority for a particular tower, or if required by the city council for safety reasons. When incorporated into the approved design of the tower, light fixtures used to illuminate ball fields, parking lots, or similar areas may be attached to the tower.
- (8) Signs and advertising. The use of any portion of a tower for signs other than warning or equipment information signs is prohibited.
- (9) Accessory utility buildings. All utility buildings and structures accessory to a WECS shall be architecturally designed to blend in with the surrounding environment and shall meet the minimum setback requirements of the underlying zoning district. Ground mounted equipment shall be screened from view by suitable vegetation, except where a design of non-vegetative screening better reflects and complements the architectural character of the surrounding neighborhood, as determined by the city council.
- (10) Abandoned or unused WECS or portions of a WECS. Abandoned or unused WECS or portions of a WECS shall be removed as follows:
 - a. All abandoned or unused WECS and associated facilities shall be removed within 12 months of the cessation of operations at the site unless a time extension is approved by the city council. A copy of the relevant portions of a signed lease which requires the applicant to remove the tower and associated facilities upon cessation of operations at the site shall be submitted at the time of application.
 - b. The replacement of portions of a WECS previously removed requires the issuance of a new conditional use permit.
- (11) Interference with public safety telecommunications. No new or existing WECS with co-location of telecommunications antennas shall interfere with public safety telecommunications, in accordance with the rules and regulations of the Federal Communications Commission. Before the introduction of new service or changes in existing service, telecommunication providers shall notify the city at least ten calendar days in advance of such changes and allow the city to monitor interference levels during the testing process.
- (12) Submittal requirements. In addition to the information required elsewhere in this Code, development applications for WECS shall include the following supplemental information:
 - a. A report from a qualified and licensed professional engineer which:

1. Describes the WECS height and design including a cross-section and elevation;
 2. Includes other information necessary to evaluate the request.
- b. Written documentation from the U.S. Fish and Wildlife Service or applicable government agency, documenting that the proposed site will not interfere with migratory bird patterns.
- c. Before the issuance of a building permit, the following supplemental information shall be submitted:
1. Affirmation that the proposed WECS will comply with any applicable regulations administered by the Federal Aviation Administration; and
 2. A report from a qualified and licensed professional engineer which demonstrates the compliance of the WECS with the aforementioned structural and electrical (but not radio frequency) standards.
 - (i) Electrical standards are set by state statute/law and inspected by the state electrical inspector.
 3. Certificate of insurance for the WECS.
- (13) Conditional use permit required. Except as otherwise provided for in this section of the Code, it shall be unlawful for any person, firm, or corporation to erect, construct in place, place or re-erect, or replace any WECS without first making application to the city council and securing a conditional use permit therefore as hereinafter provided. Routine maintenance of the WECS and related structures shall not require the issuance of a conditional use permit.
- (14) Violations. Any person who shall violate any of the provisions of this section shall be guilty of a misdemeanor.
- (15) Existing WECS. Any WECS in existence as of the effective date of the ordinance from which this section derives, which do not conform to or comply with this section of the Code are subject to the following provisions:
- a. The WECS may continue in use for the purpose now used and as now existing but may not be replaced or materially altered without complying in all respects with this section.
 - b. If such WECS are hereafter damaged or destroyed due to any reason or cause whatsoever, the WECS may be repaired and restored to its former use, location, and physical dimensions upon obtaining a building permit therefor, but without otherwise complying with this section, provided, however, that if the cost of repairing the WECS to its former use, physical dimensions, and location would exceed 50 percent of the cost of a new WECS of like kind and quality, then the WECS may not be repaired or restored except in full compliance with this section.
- (c) Solar energy systems. In all districts, solar energy systems shall be permitted as an accessory use in accordance with the standards in this section.
- (1) Exemptions. Passive or building-integrated solar energy systems are exempt from the requirements of this section and shall be regulated as any other building element.
 - (2) Standards.
 - a. Location. Ground-mounted solar energy systems may be permitted in any yard.
 1. In residential districts, the location of ground-mounted solar energy systems shall be in accordance with the accessory building location standards in City Code section 117-349(d)(12).
 - b. Setbacks.
 1. Ground-mounted solar energy systems shall be located on a property such that the distance to the closest property boundary is at least equal to the height of the solar energy system at its maximum designed tilt.

2. Building-mounted solar energy systems shall comply with all building setbacks in the applicable zoning district and shall not extend beyond the perimeter of the building on which the system is mounted unless the mounting system has been explicitly engineered to safely extend beyond the edge.
 3. In residential districts, front, side and rear yard setbacks for ground-mounted solar energy systems shall be in accordance with accessory building setbacks outlined in City Code section 117-111(d).
- c. Height.
1. The height of ground-mounted solar energy systems at maximum designed tilt shall not exceed the distance from the nearest property boundary or the maximum allowable building height for the applicable zoning district, whichever is more restrictive.
 2. Building-mounted solar energy systems shall comply with the maximum allowable building height for the applicable zoning district.
 3. In residential districts, the height of ground-mounted solar energy systems shall be in accordance with accessory building height limitations outlined in City Code section 117-349(d)(6).
- d. Easements. Solar energy systems shall not encroach on public drainage, utility, roadway or trail easements.
- e. Feeder lines. The electrical collection system shall be placed underground within the interior of each property. The collection system may be placed overhead near substations or points of interconnection to the electric grid.
- f. Aesthetics. All solar energy systems shall be designed to blend into the architecture of the building and to minimize glare toward vehicular traffic and adjacent properties to the extent possible without impacting the performance of the system.
- g. Abandonment. If a solar energy system remains non-functional or inoperative for a continuous period of one year, the system shall be deemed to be abandoned and shall constitute a public nuisance. The owner shall remove the abandoned system at their expense after obtaining a demolition permit.
- h. Permits. A permit(s) shall be obtained for any solar energy system in accordance with Minnesota State Building Code prior to installation.
- i. Glare. The panels of ground mounted solar energy systems shall be placed and arranged such that reflected solar radiation or glare shall not be directed onto adjacent buildings, properties or roadways.
1. Prior to the issuance of a permit for a ground mounted solar energy system in a residential district or on a property abutting a residential district, the permit applicant must provide an analysis demonstrating that the ground mounted system will not impact aesthetics of adjacent residential properties due to glare.
- (d) Ground source heat pump systems. In all districts, ground source heat pump systems shall be permitted as an accessory use in accordance with the standards in this section.
- (1) System requirements.
 - a. Only closed loop ground source heat pump systems utilizing heat transfer fluids are permitted. Open loop ground source heat pump systems are not permitted.
 - (2) Setbacks.
 - a. All components of ground source heat pump systems including pumps, borings and loops shall be set back at least five feet from any property boundary.

- b. Above ground equipment associated with the ground source heat pump system shall meet all required setbacks for the applicable zoning district.
 - c. The loop field of a ground source heat pump system shall be no closer than five feet from the water main line.
- (3) Easements. Ground source heat pump systems shall not encroach on any public drainage, utility, roadway or trail easement.
 - (4) Abandonment. If the ground source heat pump system remains non-functional or inoperative for a continuous period of one year, the system shall be deemed to be abandoned and shall constitute a public nuisance. The owner shall remove the abandoned system at their expense, after a demolition permit has been obtained, in accordance with applicable codes.
 - (5) Permits. A permit(s) shall be obtained for any ground source heat pump system in accordance with Minnesota State Building Code prior to installation.

(Ord. No. 14-04, § 2, 5-27-2014)

Editor's note— Ord. No. 14-04, § 2, adopted May 27, 2014, in effect repealed the former § 117-430, and enacted a new § 117-430 as set out herein. The former § 117-430 pertained to wind energy conversion systems (WECS) and derived from Ord. No. 09-12, adopted September 8, 2010.

WATERTOWN

Chapter 61 - ALTERNATIVE ENERGY SYSTEMS

ARTICLE I. - IN GENERAL

Sec. 61-1. - Purpose and intent.

- (a) The purpose of this chapter is to promote the effective and efficient use of energy sources, herein referred to as "alternative energy systems" (AES) to reduce dependency on and consumption of fossil fuels as sources of energy.
- (b) The intent of this chapter is to set forth installation and operation regulations for alternative energy systems by establishing location requirements and circumstances under which the use of alternative energy sources may be implemented without detriment to the public health, safety, and general welfare of the residents of the City of Watertown.

(Ord. No. 351, § 1, 8-9-10)

Sec. 61-2. - Enforcement, violations, remedies, and penalties.

Enforcement of the alternative energy systems ordinance shall be done in accordance with process and procedure established in the City of Watertown Zoning Ordinance.

(Ord. No. 351, § 1, 8-9-10)

Sec. 61-3. - Definitions.

Commercial wind energy conversion system (WECS) means a WECS of equal to or greater than 40kW in total nameplate generating capacity.

Feeder line means a power line that carries electrical power from one or more wind turbines or individual transformers associated with individual wind turbines to the point of interconnection with the electrical power grid, in the case of interconnection with the high voltage transmission systems the point of interconnection shall be the substation servicing the WECS.

Horizontal axis wind turbine (HAWT) means a wind turbine that revolves around an axis which is parallel to the ground.

Meteorological tower means towers erected to measure wind speed and direction plus other data relevant to siting WECS.

Nameplate generator capacity means the maximum capacity of the generator as printed on the nameplate of the generator by the manufacturer.

Non-commercial wind energy conversion system (WECS) means a WECS of less than 40kW in total nameplate generating capacity.

Photovoltaic cell means a singular assembly of materials using the photovoltaic effect to generate electrical energy.

Solar energy systems means solar energy systems, including solar collectors, photovoltaic arrays, storage facilities and distribution components for space heating and cooling and domestic water heating.

Solar panels means a panel consisting of several packaged and interconnected photovoltaic cells.

Rotor diameter means the diameter of the circle described by the moving rotor blades.

Vertical axis wind turbine (VAWT) means a wind turbine which revolves around an axis which is perpendicular to the ground.

WECS total height means the highest point above ground reached by a rotor tip or any other part of the WECS.

WECS tower means a vertical structure that supports an electrical generator, rotor blades, and/or meteorological equipment used in the operation of a WECS.

Wind energy conversion system (WECS) means an electrical generating facility comprised of one or more wind turbines and accessory facilities, included but not limited to: Power lines, transformers, substations and meteorological towers, that operated by converting the kinetic energy of wind into electrical energy. The energy may be used on-site or distributed into the electrical grid.

Wind turbine means any piece of electrical generating equipment that converts the kinetic energy of blowing wind into electrical energy through the use of airfoils or similar devices to capture the wind.

(Ord. No. 351, § 1, 8-9-10)

Sec. 61-4. - Conditional use.

Application for alternative energy systems (AES) shall be reviewed and processed in accordance with the conditional use permit procedures established in division 5 of the Watertown Zoning Ordinance or as otherwise set forth in this chapter. A conditional use permit may be granted by the city council after demonstration by evidence that:

- (1) The establishment, maintenance, or operation of the special use will not be detrimental to or endanger the public health, safety, comfort or general welfare;
- (2) The special use will not be injurious to the use and enjoyment of other property in the immediate vicinity for the purpose already permitted;
- (3) The establishment of the special use will not impede the normal and orderly development and improvement of surrounding property for uses permitted in the district;
- (4) Adequate utilities, access roads, drainage, and necessary facilities have been or will be provided;
- (5) Adequate measures have been or will be taken to provide ingress and egress so designed as to minimize traffic congestion in the public streets;
- (6) The special use shall, in all other respects, conform to the applicable regulations of the district in which it is located.

(Ord. No. 351, § 1, 8-9-10)

ARTICLE II. - WIND ENERGY CONVERSION SYSTEM (WECS)

WECS may be either a horizontal axis wind turbine (HAWT) or a vertical axis wind turbine (VAWT). This chapter is not concerned and is not intended to regulate the design, performance, or cost of the WECS. This chapter is concerned only with the safety and welfare of the residents of the City of Watertown.

Sec. 61-5. - Application procedures.

The following information is required in addition to the information required for a conditional use permit application:

- (1) The application for all WECS shall include the following information:
 - a. The name(s) of project applicant.
 - b. The name(s) of the project owner.
 - c. The legal description and address of the project.
 - d. A description of the project including: number, type, nameplate generating capacity, tower height, rotor diameter, and total height of all wind turbines and means of interconnecting with the electrical grid.
 - e. Property survey, including the location of property lines, wind turbines, electrical wires, interconnection points with the electrical grid, and all related accessory structures. The site layout shall include distances and be drawn to scale.
 - f. Evidence that the applicant can obtain and maintain adequate liability insurance for the WECS and subject property.
 - g. Engineer's certification.
 - h. Documentation of land ownership or legal control of the property.
- (2) The application for commercial WECS shall also include:
 - a. An FAA permit application, if required.
 - b. A decommissioning plan.
 - c. A noise study, prepared by a qualified professional, that demonstrate that except for intermittent episodes, the WECS shall not emit noise in excess of the limits established in Minnesota Rules 7030 governing noise.
 - d. A shadow flicker model that demonstrates that shadow flicker shall not fall on, or in, any existing residential structure. Shadow flicker expected to fall on a roadway or a portion of a residentially zoned property may be acceptable if the flicker does not exceed 30 hours per year; and the flicker will fall more than 100 feet from an existing residence; or the traffic volumes are less than 500 vehicles (ADT). The shadow flicker model shall:
 1. Map and describe with a 1,000 foot radius of the proposed dispersed wind energy system the topography, existing residences and location of their windows, location of other structures, wind speeds and directions, existing vegetation and roadways. The model shall represent the most probable scenarios of wind constancy, sunshine constancy, and wind directions and speed;
 2. Calculate the locations of shadow flicker caused by the proposed project and the expected durations of the flicker at these locations, calculate the total number of hours per year of flicker at all locations.
 3. Identify problem areas where shadow flicker will interfere with existing or future residences and roadways and describe proposed mitigation measures, including, but not limited to, a change in siting of the WECS, a change in the operation of the WECS, or grading or landscaping mitigation measures.

(Ord. No. 351, § 1, 8-9-10)

Sec. 61-6. - Additional submittal requirements.

- (a) Site plan drawing. All applications for WECS conditional use permit shall be accompanied by a detailed site plan drawn to scale and dimensioned, displaying the following information:

- (1) Lot lines and dimensions.
 - (2) Location and height of all buildings, structures, above ground utilities and trees on the lot, including both existing and proposed structures and guy wire anchors.
 - (3) Locations and height of all adjacent buildings, structures, above ground utilities and trees located within 350 feet of the exterior boundaries of the property in question.
 - (4) Existing and proposed setbacks of all structures located on the property in question.
 - (5) Sketch elevation of the premises accurately depicting the proposed WECS and its relationship to structures on adjacent lots.
- (b) The owner shall provide engineered drawings for tower mounted units which are over 30 feet in height, or manufacturers recommended erection or mounting drawings for structure mounted units or towers 30 feet high or less.

(Ord. No. 351, § 1, 8-9-10)

Sec. 61-7. - Horizontal axis wind turbine (HAWT) and vertical axis wind turbine (VAWT).

- (a) Zoning. The construction, erection, and installation of a wind energy conversion systems (WECS) will be conditionally permitted or not permitted based on the generating capacity and land use district as established in table 1 below. The planning commission may recommend and the city council may impose conditions on the granting of the conditional use permit for a WECS as may be necessary to carry out the purpose and provisions of this chapter.

TABLE 1

Zoning District	Non-Commercial WECS	Commercial WECS	Meteorological Tower
C-1, C-2, C-3	Not Permitted	Not Permitted	Not Permitted
I-1, PUD-BP	Conditionally Permitted	Conditionally Permitted	Conditionally Permitted
A-1	Conditionally Permitted	Not Permitted	Conditionally Permitted
R-1, R-2	Conditionally Permitted	Not Permitted	Conditionally Permitted
R-3, R-4	Not Permitted	Not Permitted	Not Permitted
P-1, P-2	Conditionally Permitted	Conditionally Permitted	Conditionally Permitted
PUD-FH	Conditionally Permitted	Not Permitted	Conditionally Permitted
PUD-RP, PUD-TV, PUD-G	Not Permitted	Not Permitted	Not Permitted

(b) Setbacks.

- (1) All required setbacks shall be measured from the center of the base.
- (2) No part of a WECS shall be located within or above any required front, side, or rear yard setback.
- (3) Ground mounted WECS towers shall adhere to the setbacks established in table 2 below. Setbacks for rooftop-mounted WECS shall be consistent with the underlying zoning district in which in the WECS will be sited.

TABLE 2

	Non-Commercial WECS	Commercial WECS	Meteorological Towers
Property Lines	1.1 times the total height	1.1 times the total height	1.1 times the total height
Neighboring Structures	Setback to property lines of 1.1 times the total height	750 feet	Guyed towers: The fall zone, as certified by a professional engineer +10 feet Non-guyed towers: 1.1 times the total height
Road right-of-way and other right-of-ways (railroads, power lines, etc.)	Guyed towers: the fall zone, as certified by a professional engineer +10 feet; Non-guyed towers: 1.1 times the total height	1.1 times the height	
Other existing WECS	NA	600 feet	600 feet
Wetlands, USFW, Types III, IV, and V	NA	600 feet	600 feet

(c) Requirements and Standards.

- (1) Total height. Ground mounted WECS shall have a total height of less than 150 feet, as measured from the base of the tower to the peak of the highest turbine blade. The pole cannot exceed 120 feet in height, as measured from the base to the hub of the tower, not including the turbine portion of the tower. A HAWT or VAWT that is mounted to the roof of a residence shall not exceed a height of five feet above the highest roof ridge of a residence.

- (2) Tower configuration. All wind turbines, which are part of a commercial WECS, shall be installed with tubular, monopole type tower and shall be self-supporting and shall not use guy wires or chains.
- (3) Scale. There shall be no more than one WECS per parcel and such parcel shall be large enough to accommodate the required setbacks as determined in table 2. A principal structure must be located on the parcel where the WECS is proposed.
- (4) Color and finish. Towers shall be painted a non-contrasting color consistent with the surrounding area such as pale gray or white or another non-obtrusive color. Finishes shall be matt or non-reflective. The applicant shall demonstrate through project site planning and proposed mitigation that the WECS visual impacts will be minimized to the extent possible for surrounding neighbors and the community. This may include buffering, turbine design, or appearance, or site selection.
- (5) Lighting. No tower shall have affixed or attached lights, reflectors, flashers, or any other illumination, except for any devices required by the FAA.
- (6) Engineering certification. For all WECS, the manufacture's engineer or another qualified engineer shall certify that the turbine, foundation and tower design of the WECS is within accepted professional standards, given local soil and climate conditions.
- (7) Rotor clearance. Blade arcs created by the WECS shall have a minimum of 30 feet of clearance over any structure or tree within a 200-foot radius.
- (8) Rotor safety. Each WECS shall be equipped with both a manual and automatic braking device capable of stopping the WECS operation in high winds (40 miles per hour or greater).
- (9) Feeder lines. All communication and feeder lines installed as part of a WECS shall be buried.
- (10) Decommissioning plan. Each commercial WECS shall have a decommissioning plan outlining the anticipated means and cost of removing WECS at the end of their serviceable life or upon becoming a discontinued use. The cost estimates shall be made by a competent party; such as a professional engineer, a contractor capable of decommissioning or a person with suitable expertise or experience with decommissioning. The plan shall also identify the financial resources that will be available to pay for the decommissioning and removal of the WECS and accessory facilities.
- (11) Noise. All WECS shall comply with Minnesota Rules 7030, as amended, governing noise.
- (12) Complaint resolution. The owner/operator of the WECS shall develop a process to resolve complaints from nearby residents. The process shall use an independent mediator or arbitrator and include a time frame for acting on a complaint. The owner/operator shall make every reasonable effort to resolve any complaint.
- (13) Electrical code and standards. All WECS and accessory equipment and facilities shall comply with the Minnesota State Electrical Code and other applicable standards. The tower shall be grounded and shielded to protect against natural lightning strikes, in conformance with the Minnesota State Electrical Code.
- (14) Uniform Building Code. All WECS shall comply with the Uniform Building Code adopted by the State of Minnesota. Standard drawings of the structural components of the wind energy conversion system and support structures, including base and footings shall be provided along with engineering data and calculations to demonstrate compliance with the structural design provisions of the building code. Drawings and engineering calculations shall be certified by a Minnesota licensed engineer.
- (15) Interference. The WECS shall be filtered, shielded or otherwise designed and constructed so as not to cause electrical, radio frequency, television, and other communication signal interference.
- (16) Shadow flicker. Shadow flicker may not exceed 30 hours per year and shall not fall more than 100 feet from an existing residential property.

- (17) If a WECS is not maintained in operational condition and poses a safety hazard, the owner shall take expeditious action to correct the situation.
- (d) Federal and state code compliance.
- (1) All WECS shall be in compliance with all applicable federal, state, and county regulatory standards including but not limited to the FAA, FCC, EPA, and MPCA.
 - (2) Copies of any permits, applicable regulations, certifications, and inspection reports must be submitted to the city prior to the WECS being put into service.
- (e) Utility company interconnection.
- (1) No WECS shall be interconnected with a local utility company until the utility company has reviewed and commented upon it.
 - (2) The interconnection of the WECS with the utility company shall adhere to the Minnesota State Electrical Code.
- (f) Tower access. All WECS shall be reasonably protected against unauthorized access or climbing of a tower. To prevent unauthorized access or climbing of a tower, the WECS shall comply with at least one of the following provisions:
- (1) Tower climbing apparatus shall not be located within 12 feet of the ground.
 - (2) A locked anti-climb device shall be installed on the tower.
 - (3) The access to the WECS shall be restricted by a six-foot high non-climbable fence with a locking gate. The gate shall remain locked at all times except when providing access to appropriate personnel associated with the WECS.
- (g) Signs. Electric warning signs are required to be posted on the tower, transformer and substation. Signs with emergency contract information shall also be posted on the turbine or at another suitable point. Painted aviation warnings are recommended on meteorological towers less than 200 feet. All signage on site shall comply with the City of Watertown sign ordinance. Additional signs may be required on the basis of individual applications as safety needs dictate.
- (h) Discontinued use or abandonment. A WECS shall be considered abandoned if its use has been discontinued (no energy production) for 12 consecutive months or more unless the owner notifies the city in writing of the situation causing the shutdown of the WECS and the intention to put the WECS back into service when such situation has been corrected. Situations may include but are not limited to the following:
- (1) Difficulty obtaining repair parts.
 - (2) Compliance with interference regulations.
 - (3) Structural repairs.
 - (4) Mandated shut-down from the EPA, FAA, FCC, MPCA, Utility Company, or other entities that may have authority to require shut-down.
- (i) Dismantling. Upon declaration of abandonment, the WECS shall be dismantled and removed within three months by the property owner in accordance with the following:
- (1) A demolition permit is required for the dismantling of any WECS regardless of size, unless otherwise instructed by the city building code inspector.
 - (2) Upon demolition and removal of the WECS, the property shall be restored as close as possible to its condition prior to the construction of the WECS, or to a condition compatible with the function, use, and aesthetics of the property, whichever is more appropriate as determined by the zoning administrator, planning commission, and city council.

(Ord. No. 351, § 1, 8-9-10)

Sec. 61-8. - Temporary meteorological equipment.

- (a) Temporary meteorological equipment located upon a temporary tower used on an interim basis to gather wind and meteorological data to determine feasibility of the WECS shall require the processing of an interim use permit and shall comply with the following standards:
- (1) No more than one such temporary tower shall be permitted on a lot at one time.
 - (2) The tower shall be placed on the property for no longer than 24 months from the date of interim use permit issuance. Any abandoned or obsolete temporary tower shall be removed within 30 days from the cessation of operation at the site.
 - (3) The tower shall be temporary by nature and shall not have permanent foundations. Guy wires may be used as long as the connections to the ground are temporary and the wires are designed to support the wind and ice load of the tower.
 - a. The tower and any related guy wires shall be protected against unauthorized climbing.
 - (4) The tower shall meet the minimum wind and ice load design required by City Code and the Minnesota State Building Code.
 - (5) The tower shall be grounded and shielded to protect against natural lightning strikes, in conformance with the Minnesota State Electrical Code.
 - (6) No tower shall have affixed or attached lights, reflectors, flashers or any other illumination, except for those devices required by the Federal Aviation Administration.

(Ord. No. 351, § 1, 8-9-10)

Secs. 61-9—61-12. - Reserved.

ARTICLE III. - SOLAR ENERGY SYSTEMS AND STRUCTURES

Sec. 61-13. - Solar equipment.

- (a) Solar energy systems are permitted within all zoning districts pursuant to the regulations of this chapter. Any equipment or device that utilizes, operates or supplies energy derived from the sun shall meet the following standards:
- (1) The equipment or device must meet all setback requirements for principal structures in the zoning district where located.
 - (2) The equipment or device may extend up to five feet above the roof surface on which they are installed, even if this exceeds the maximum height limit in the district in which it is located.
 - (3) The equipment or device must be designed and constructed in compliance with all applicable building and electrical codes.
 - (4) The equipment or device must be in compliance with all state and federal regulations regarding co-generation of energy.
 - (5) All solar arrays or panels shall be installed or positioned so as not to cause any glare or reflective sunlight onto neighboring properties or structures, or obstruct views.
 - (6) The zoning administrator may require compliance with any other conditions, restrictions or limitations deemed reasonably necessary to protect the residential character of the neighborhood.

- (7) A solar energy system or structure which, when installed, cannot prevent abutting properties from being developed in conformance with all applicable codes and regulations.
- (8) Design guidelines in section 61-16 have been provided to help owners think about appropriate locations and methods for installing a solar energy system. The location of detached solar arrays should consider visibility from adjacent properties, which shall be reduced to the extent possible while still maintaining solar access.

(Ord. No. 351, § 1, 8-9-10)

Sec. 61-14. - Conditional use.

- (a) Free standing solar energy systems, free standing solar structures, and structurally attached solar panels installed on building projecting vertically more than 12 inches above the roof shall be permitted by conditional use in all districts; provided, that the systems and/or structures is in compliance with minimum setbacks of the underlying zoning district and such structure or system meets the requirements of section 61-13
- (b) Solar panels structurally attached to the principal structure not exceeding more than 12 inches from the roof shall be a permitted accessory use in all districts and subject to administrative review and approval as part of the building permit process and shall meet the requirements of section 61-13. In addition, structurally attached solar panels installed on a building with a sloped roof shall not project vertically above the peak of the roof.

(Ord. No. 351, § 1, 8-9-10)

Sec. 61-15. - Application procedures.

The application for all solar energy systems and structures shall include the following information:

- (1) The names of project applicant.
- (2) The name of the project owner.
- (3) The legal description and address of the project.
- (4) A description of the project including: Property survey with location of the solar panel system indicated on the plans including roof plan, elevation and mounting details for panel installation. The site layout shall include distances and be drawn to scale. For ground mounted solar systems, provide dimensions from existing structure on lot to solar unit edge. Provide details of solar unit's maximum height from grade and overall size of panel array.
- (5) Documentation of land ownership or legal control of the property.
- (6) Solar applications located in a multi-family zoning district (R-2, R-3, R-4) will require a homeowner's association or management approval letter with plan submittal, if applicable.
- (7) A decommissioning plan shall be submitted outlining the anticipated means and cost of removing the solar equipment at the end of their serviceable life.

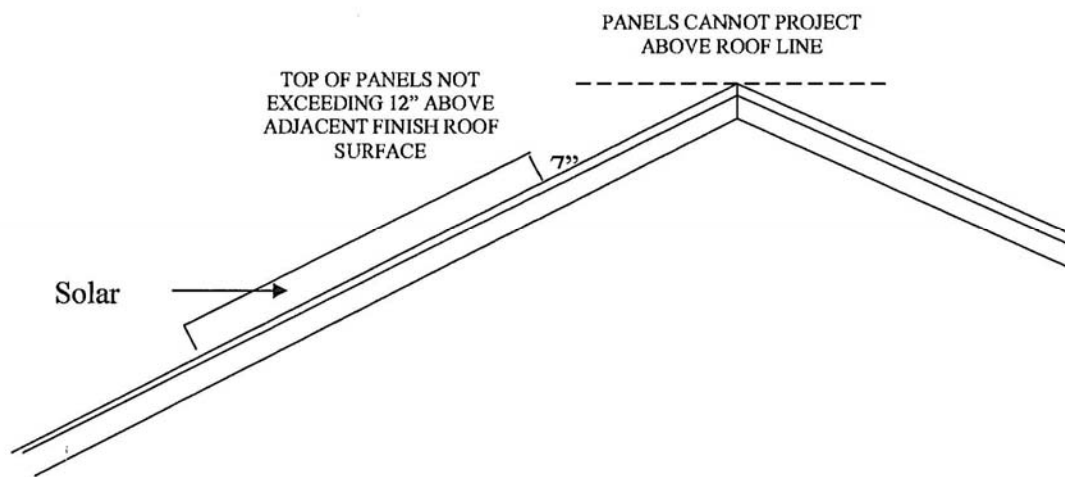
(Ord. No. 351, § 1, 8-9-10)

Sec. 61-16. - Solar panel placement design guidelines.

- (a) The following guidelines are to be used in the design and placement of solar panels (photovoltaic and solar thermal systems) on pitched and flat roofs of single-family and multi-family dwellings for

the purpose of compatible design. With foresight and planning, a solar system can be effectively integrated into the design of new and existing roofs.

- (1) Solar panels should be low profile and parallel with the plane of the pitched roof.
- (2) Panels should not project above the roof ridge line.
- (3) Set solar panels and solar devices back from the edge of a flat roof to minimize visibility. Panels and devices may be set at a pitch and elevated, if not highly visible from public streets.
- (4) Select solar panels, solar devices, mechanical equipment and mounting structures with non-reflective finishes such as an anodized finish. Color of panel frames and support structures should be neutral and compatible with the roof surface color.
- (5) Placement of panels should be uniform. Consider the panels as part of the overall roof configuration. Match the slope and proportions of the array with the shape and proportions of the roof.



- (b) For free standing/ground mounted systems and structures, the following guidelines are to be used in the design and placement.
 - (1) Location: Location shall be in the rear or side yard.
 - (2) Setback: The system, structure, and support apparatus shall be within the building setback as determined by the underlying zoning district.
 - (3) Maximum height: The maximum height shall be six feet.

(Ord. No. 351, § 1, 8-9-10)

Woodbury

Chapter 24 Zoning, Article 6 Supplemental Performance Standards, Division 5 Alternative Energy System.

DIVISION 5. - ALTERNATIVE ENERGY SYSTEMS

Sec. 24-401. - Scope.

This division applies to alternative energy systems in all zoning districts.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Sec. 24-402. - Purpose and intent.

It is the goal of the city council, as expressed in the comprehensive plan, to provide a sustainable quality of life for the city's residents, making careful and effective use of available natural, human and economic resources and ensuring that resources exist to maintain and enhance the quality of life for future residents. In accordance with that goal, the city finds that it is in the public interest to encourage alternative energy systems that have a positive impact on energy production and conservation while not having an adverse impact on the community. Therefore, the purposes of this division include:

- (a) To promote rather than restrict development of alternative energy sources by removing regulatory barriers and creating a clear regulatory path for approving alternative energy systems.
- (b) To create a livable community where development incorporates sustainable design elements such as resource and energy conservation and use of renewable energy.
- (c) To protect and enhance air quality, limit the effects of climate change and decrease use of fossil fuels.
- (d) To encourage alternative energy development in locations where the technology is viable and environmental, economic and social impacts can be mitigated.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Sec. 24-403. - Definitions.

The words, terms and phrases, when used in this division, shall have the meanings ascribed to them in section 24-4.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Sec. 24-404. - Ground source heat pump systems.

- (a) Zoning districts. Ground source heat pump systems in accordance with the standards in this section are allowed as a permitted accessory use in all zoning districts.
- (b) Standards.
 - (1) System requirements.

- a. Only closed loop ground source heat pump systems utilizing heat transfer fluids as defined in section 24-403 are permitted. Open loop ground source heat pump systems are not permitted.
 - b. Ground source heat pump systems in public waters may be permitted as an interim conditional use in accordance with section 24-407 subject to approval from the Minnesota Department of Natural Resources and subject to written consent of all property owners and/or approval by an association in accordance with its adopted bylaws.
 - c. Ground source heat pump systems in water bodies owned or managed by the City of Woodbury are not permitted.
- (2) Setbacks.
- a. All components of ground source heat pump systems including pumps, borings and loops shall be set back at least five feet from interior side lot lines and at least ten feet from rear lot lines.
 - b. Above-ground equipment associated with ground source heat pumps shall not be installed in the front yard of any lot or the side yard of a corner lot adjacent to a public right-of-way and shall meet all required setbacks for the applicable zoning district.
- (3) Easements. Ground source heat pump systems shall not encroach on public drainage, utility roadway or trail easements.
- (4) Noise. Ground source heat pump systems shall comply with Minnesota Pollution Control Agency standards outlined in Minnesota Rules Chapter 7030.
- (5) Screening. Ground source heat pumps are considered mechanical equipment and subject to the requirements of section 24-235(d)(9).
- (6) Deviations. Any deviation from the required standards of this division may be permitted through an interim conditional use permit in accordance with section 24-407
- (d) Safety. Ground source heat pumps shall be certified by Underwriters Laboratories, Inc. and meet the requirements of the State Building Code.
- (e) Abandonment. If the ground source heat pump system remains nonfunctional or inoperative for a continuous period of one year, the system shall be deemed to be abandoned and shall constitute a public nuisance. The owner shall remove the abandoned system at their expense after a demolition permit has been obtained in accordance with the following:
- (1) The heat pump and any external mechanical equipment shall be removed.
 - (2) Pipes or coils below the land surface shall be filled with grout to displace the heat transfer fluid. The heat transfer fluid shall be captured and disposed of in accordance with applicable regulations. The top of the pipe, coil or boring shall be uncovered and grouted.
 - (3) Lake ground source heat pump systems shall be completely removed from the bottom of the body of water.
- (f) Permits. A building permit and interim conditional use permit, if required, shall be obtained for any ground source heat pump system prior to installation. Borings for vertical systems are subject to approval from the Minnesota Department of Public Health.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Sec. 24-405. - Wind energy systems.

- (a) Zoning districts. Residential wind turbines in accordance with the standards in this section are permitted accessory uses on lots at least three acres in size in the R-1, urban reserve, and the R-2, rural estate; on lots at least 20 acres in size in the R-4, urban residential zoning districts; and on lots

at least one and one-half acres in size in the B-2, general business, and the I-1, light industrial provided the lot does not abut a residential zoning district. Wind energy systems are not permitted in any other zoning districts.

(b) Standards.

- (1) Number. No more than one wind energy system is permitted per parcel.
- (2) Height. In the R-1, urban reserve, zoning district, a maximum hub height of 60 feet is allowed as a permitted accessory use; additional height, up to 120 feet in total height, may be permitted as an interim conditional use in accordance with section 24-407. In the R-2, rural estate, R-4, urban residential, B-2, general business, and I-1, light industrial zoning districts, a maximum hub height of 45 feet is allowed as a permitted accessory use. Additional height, up to 75 feet in total height, may be permitted as an interim conditional use in accordance with section 24-407
- (3) Blade length. A maximum blade length of 15 feet is permitted.
- (4) Roof mounting. Roof mounted wind turbines are not permitted.
- (5) Setbacks. The base of the wind turbine tower shall be set back from all property lines a distance equal to the hub height. Wind energy systems shall not be installed in the front yard of any lot or in the side yard of a corner lot adjacent to a public right-of-way.
- (6) Easements. Wind energy systems shall not encroach on public drainage, utility roadway or trail easements.
- (7) Noise. Wind energy systems shall comply with Minnesota Pollution Control Agency standards outlined in Minnesota Rules Chapter 7030 at all property lines.
- (8) Screening. Wind energy systems are exempt from the requirements of section 24-235(d)(9).
- (9) Aesthetics. All portions of the wind energy system shall be a nonreflective, non-obtrusive color, subject to the approval of the community development director. Only monopole towers are permitted. The appearance of the turbine, tower and any other related components shall be maintained throughout the life of the wind energy system pursuant to industry standards. Systems shall not be used for displaying any advertising. Systems shall not be illuminated.
- (10) Feeder lines. The electrical collection system shall be placed underground within the interior of each parcel. The collection system may be placed overhead near substations or points of interconnection to the electric grid.
- (11) Deviations. Any deviation from the required standards of this division may be permitted through an interim conditional use permit in accordance with section 24-407

(d) Safety.

- (1) Standards and certification.
 - a. Standards. Wind energy systems shall meet minimum standards such as International Electrotechnical Commission (IEC) 61400-2 or the American Wind Energy Association's (AWEA) Small Wind Turbine Performance and Safety Standard or other standards as determined by the community development director.
 - b. Certification. Wind energy systems shall be certified by Underwriters Laboratories, Inc. and the National Renewable Energy Laboratory, the Small Wind Certification Council or other body as determined by the community development director. The city reserves the right to deny a building permit for proposed wind energy systems deemed to have inadequate certification or testing for operation in a severe winter climate.
 - c. Maintenance. Wind energy systems shall be maintained under an agreement or contract by the manufacturer or other qualified entity.

- (2) Utility connection. All grid connected systems shall have an agreement with the local utility prior to the issuance of a building permit. A visible external disconnect must be provided if required by the utility.
- (e) Abandonment. If the wind energy system remains nonfunctional or inoperative for a continuous period of one year, the system shall be deemed to be abandoned and shall constitute a public nuisance. The owner shall remove the abandoned system at their expense after a demolition permit has been obtained. Removal includes the entire structure including foundations to below natural grade and transmission equipment.
- (f) Permits. A building permit and interim conditional use permit, if required, shall be obtained for any wind energy system prior to installation.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Sec. 24-406. - Solar energy systems.

- (a) Zoning districts. Solar energy systems in accordance with the standards in this section are allowed as a permitted accessory use in all zoning districts.
- (b) Standards.
 - (1) Exemption. Passive or building-integrated solar energy systems are exempt from the requirements of this section and shall be regulated as any other building element.
 - (2) Minimum lot size. In the R-4, urban residential zoning district, a minimum lot size of 8,000 square feet is required for ground-mounted solar energy systems.
 - (3) Height. Roof-mounted solar energy systems shall comply with the maximum height requirements in the applicable zoning district. Ground-mounted solar energy systems shall not exceed 15 feet in height.
 - (4) Location. In residential zoning districts, ground-mounted solar energy systems are limited to the rear yard. In nonresidential zoning districts, ground-mounted solar energy systems may be permitted in the front yard of any lot or the side yards on corner lots but shall not encroach in the minimum 20-foot landscaped area adjacent to public rights-of-way.
 - (5) Setbacks. Ground-mounted solar energy systems including any appurtenant equipment shall be set back a minimum of 15 feet from all property lines and a minimum of 30 feet from all dwellings located on adjacent lots. Roof-mounted systems shall comply with all building setbacks in the applicable zoning district and shall not extend beyond the exterior perimeter of the building on which the system is mounted.
 - (6) Roof mounting. Roof-mounted solar collectors shall be flush mounted on pitched roofs. Solar collectors may be bracket mounted on flat roofs.
 - (7) Easements. Solar energy systems shall not encroach on public drainage, utility roadway or trail easements.
 - (8) Screening. Solar energy systems shall be screened from view to the extent possible without reducing their efficiency, but are exempt from the strict requirements of section 24-235(d)(9). Screening may include walls, fences or landscaping.
 - (9) Maximum area. In the R-4, urban residential, zoning district, ground-mounted solar energy systems shall be limited to a maximum area of 200 square feet. In other residential zoning districts, ground-mounted solar energy systems shall be limited to a maximum area consistent with the accessory structure limitations in section 24-281(b) or no more than 25 percent of the rear yard, whichever is less.

- (10) Aesthetics. All solar energy systems shall use colors that blend with the color of the roof or other structure. Reflection angles from collector surfaces shall be oriented away from neighboring windows. Where necessary, screening may be required to address glare.
 - (11) Feeder lines. The electrical collection system shall be placed underground within the interior of each parcel. The collection system may be placed overhead near substations or points of interconnection to the electric grid.
 - (12) Deviations. Any deviation from the required standards of this division may be permitted through an interim conditional use permit in accordance with section 24-407
- (d) Safety.
- (1) Standards and certification.
 - a. Standards. Solar energy systems shall meet the minimum standards outlined by the International Electrotechnical Commission (IEC), the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE), ASTM International, British Standards Institution (BSI), International Electrotechnical Commission (IEC), International Organization for Standardization (ISO), Underwriter's Laboratory (UL), the Solar Rating and Certification Corporation (SRCC) or other standards as determined by the community development director.
 - b. Certification. Solar energy systems shall be certified by Underwriters Laboratories, Inc. and the National Renewable Energy Laboratory, the Solar Rating and Certification Corporation or other body as determined by the community development director. The city reserves the right to deny a building permit for proposed solar energy systems deemed to have inadequate certification.
 - (2) Utility connection. All grid connected systems shall have an agreement with the local utility prior to the issuance of a building permit. A visible external disconnect must be provided if required by the utility.
- (e) Abandonment. If the solar energy system remains nonfunctional or inoperative for a continuous period of one year, the system shall be deemed to be abandoned and shall constitute a public nuisance. The owner shall remove the abandoned system at their expense after a demolition permit has been obtained. Removal includes the entire structure including transmission equipment.
- (f) Permits. A building permit and interim conditional use permit, if required, shall be obtained for any solar energy system prior to installation.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Sec. 24-407. - Interim conditional use permit.

Deviations to the standards in this division may be permitted as an interim conditional use in accordance with section 24-45. In granting an interim conditional use permit, the city council shall consider the criteria in sections 24-43 and 24-45 and the following additional criteria unique to alternative energy systems:

- (a) That the deviation is required to allow for the improved operation of the alternative energy system;
- (b) That the alternative energy system has a net energy gain;
- (c) That the alternative energy system does not adversely affect solar access to adjacent properties;
- (d) That the alternative energy system complies with all other engineering, building, safety and fire regulations; and

- (e) That the alternative energy system is found to not have any adverse impacts on the area, including the health, safety and general welfare of occupants of neighboring properties and users of public rights-of-way.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Sec. 24-408. - Interpretation.

In interpreting this division and its application, the provisions of these regulations shall be held to be the minimum requirements for the protection of public health, safety and general welfare. This division shall be construed broadly to promote the purposes for which it was adopted.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Sec. 24-409. - Conflict.

This division is not intended to interfere with, abrogate or annul any other ordinance, rule or regulation, statute or other provision of law except as provided herein. If any provision of this division imposes restrictions different from any other ordinance, rule or regulation, statute or provision of law, the provision that is more restrictive or imposes high standards shall control.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Sec. 24-410. - Separability.

If any part or provision of this division or its application to any developer or circumstance is judged invalid by any competent jurisdiction, the judgment shall be confined in its operation to the part, provision or application directly involved in the controversy in which the judgment shall be rendered and shall not affect or impair the validity of the remainder of these regulations or the application of them to other developers or circumstances.

(Ord. No. 1863, § 1863.02, 10-24-2012)

Secs. 24-411—24-420. - Reserved.

Alternative Energy	Coon Rapids	Delano	Excelsior	Maple Grove	Maplewood	Orono	Ramsey	Watertown	Woodbury
Ordinance No.	11-1601	51.03 Subd. O	28-1 - 28-8	36-833	18-301 - 18-405	78-1379	117-430	61	24-401 - 24-410
Wind (WECS)?	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
WECS Permits?	Building Permit	Conditional use Building Permit	Interim use permit	A permit	Conditional Use	Building Permit	Conditional use	Conditional use	Building Permit & conditional use
WECS Districts Allowed?	Residential = Building as Assessor Ground as conditional use Industrial & Commercial & Office = Ground as Conditional use Mounted as Assessor Prohibited in Overlay & Special Districts	1-1 & 1-2 = Utility Turbine as accessory conditional use All Districts = Small Wind Turbines as accessory conditional use Residential = Residential Wind Turbines as accessory administrative use	Zoned commercial or Public and is constructed & maintained on any parcel of at least 2.5 acres in size	Conditional use = Residential Non Residential if over 100 ft. in height Accessory use = Nonresidential if under 100 ft. in height	Large WECS District = Ground and Roof in Commercial, Multiple dwelling residential (shared), PUD (shared), government, institutional, Small WECS Districts = Roof mounted in all Ground in Commercial, Multiple dwelling residential, PUD, government, institutional, in park & open space, double or single residential w/ Written consent of 100 % of the owners or occupants of privately	Small allowed in lots at least 10 acres in gross area within RR-1A & RR-1B as accessory use At least 5 acres in gross subject to CUP in Commercial or Industrial: B-1 Retails Sales: B-4 Office & Professional: B-6 Highway Commercial: B-6 PUD & I Industrial No Building or roof mounted allowed in Residential, Commercial or Industrial No SWECS allowed in Shore Overlay	Conditional Use in Underlying zone Not allowed in Critical River, Wild & Scenic River & Shore land Overlay MicroWECS allowed in Shore land Overlay, if it does not violate max structure height	Non Commercial = I-1, PUD-BP, A-1, R-1, R-2, P-1, P-2, PUD-FH Commercial = I-1, PUD-BP, P-1, P-2 Meteorological Tower = I-1, PUD-BP, A-1, R-1, R-2, P-1, P-2, PUD-FH.	Lots at least 3 acres in R-1, Urban Reserve, R-2, Rural Estate Lots at least 20 acres in R-4 & urban residential zoning districts Lots at least 1.5 acres in B-2, general business, & I-1 provided does not abut residential zoning district
# WECS?	1 / lot, w/o conditional use permit	1 / parcel	Doesn't Specify	Nonresidential = No limit on # of roof mounted	Ground Large WECS = 1 on lot of 1 to 5 acres OR larger parcel 1 per 5 acres Small WECS = 1 on lot up to 1 acre OR larger parcel 1 per 5 acres Roof Large = approved through permit process Small = no more than 3	Residential = 1 / parcel Commercial & Industrial =1 / parcel	Doesn't Specify	Doesn't Specify	1 / parcel
Setbacks	All Districts Ground = setback at least 1.1 X total height of WECS	All = 1.5 X total height b/w the base & nearest property line, above ground utility, road right away or existing building on same lot	Must not be within setback for zone 1 ft. for 1 ft. of height Not within 30 ft. of above ground utility	applicable front, rear, and side setbacks	1 X height from any property line, electric substation, transmission, or WECS. Add 25 ft. from any residential property. 1.5 X height from any public right way, occupied structure, or public use are. Min. 600 ft. from any park or open space. 1320 ft. from any bluff. Small = 1 X height from any property line,	100 ft. from all property lines not in front yard or side yard of corner lot adjacent to public right away not more than 100 ft. from principal structure	Small & Medium Scale = 1.5 X height Residential min. of 1000 ft. from any principle dwelling unit on adjacent property	Non Commercial = 1.1 X height to property line, neighboring structures, road right of ways Commercial 1.1 X height to property line 750 ft. neighboring structures 600 ft. from existing WECS & Wetlands, USFW, Types III, IV,& V	1 X hub height
Clearance	All Districts min distance b/w ground & vertical extension of blades must be 15 ft.	Min. of 30 ft. over any structure or tree within 300 ft. radius Residential Exempt	Min. of 30 ft. over any structure or tree within 200 ft. radius	Min. 30 ft.	Min. of 20 ft. b/w lowest point & ground	Min. of 12 ft. lowest point and ground	Min. 30 ft.	Min. of 30 ft. over any structure or tree within 200 ft. radius	Doesn't specify

[illegible]