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Options for the Processing and Disposal of Municipal Yard Waste Generated in Apple Maggot Quarantine Areas

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For more information contact:

Amy Clow, Municipal Waste Specialist
Pest Program
Washington State Department of Agriculture
PO Box 42560
Olympia, WA 98504

Matt Kadlec, PhD, DABT
Air Quality Program
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

James Rivard, Central Region Supervisor
Solid Waste Management
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Washington State Department of Ecology – www.ecology.wa.gov

- Headquarters, Olympia 360-407-6000
- Northwest Regional Office, Bellevue 425-649-7000
- Southwest Regional Office, Olympia 360-407-6300
- Central Regional Office, Union Gap 509-575-2490
- Eastern Regional Office, Spokane 509-329-3400

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Options for the Processing and Disposal of Municipal Yard Waste Generated in Apple Maggot Quarantine Areas

Solid Waste Management
Washington State Department of Ecology
Olympia, Washington

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Introduction

In 2018, the Washington State Legislature passed Substitute Senate Bill 6055 which amended RCW 17.24.051 and added a new section to chapter 70.94 RCW. This bill created a pilot program for outdoor burning of residential yard waste in cities or towns located partially inside a quarantine area for apple maggots. The City of Leavenworth pursued outdoor burning as an option through legislation when they lost their ability to transport yard waste to a nearby compost facility located in a pest-free area. The bill requires the Washington State Department of Ecology (Ecology) and the Washington State Department of Agriculture (WSDA) to submit a report to the Legislature by November 1, 2018.

RCW 70.94.6556(2) states, “The department and the department of agriculture are directed to submit to the appropriate policy committees of the legislature no later than November 1, 2018, a report that addresses the available options for the processing and disposal of municipal yard waste generated in areas subject to the apple maggot quarantine, including:

- (a) Techniques that neutralize any apple maggot larvae that may be contained within such yard waste;
- (b) Identification of facilities that are capable of receiving such yard waste;
- (c) Alternatives to outdoor burning, such as composting, chipping, biochar production, and biomass electrical generation; and
- (d) A comparison of the costs of such alternatives.”

This report will address the available options for the processing and disposal of municipal yard waste generated in areas subject to the apple maggot quarantine and includes the following five sections:

1. Techniques that neutralize any apple maggot larvae that may be contained within such yard waste.
2. Identification of facilities that are capable of receiving such yard waste.
3. Alternatives to outdoor burning such as composting, chipping, biochar production, and biomass electrical generation.
4. A comparison of the costs of such alternatives.
5. The public health impacts of burning brush and yard waste.

Background and Risks to the Tree Fruit Industry

The apple maggot (*Rhagoletis pomonella*) is a species of fruit fly which is native to the Northeastern United States and was likely introduced to Washington state as a result of the movement of infested apple fruit (Sansford, Mastro, & Reynolds, 2016). The host plants where the pest can be found include apple, crab apple, native hawthorn, and ornamental hawthorn trees. Other hosts where the apple maggot is occasionally found include cherries, pears, and quince. Female apple maggots puncture the skin of the fruit and lay their eggs under the surface. One female fly has the ability to lay as many as 200 eggs, making the apple maggot a risk to the fruit of its host plant (Sansford, Mastro, & Reynolds, 2016).

As the larvae hatches, it begins to feed and tunnel through the flesh of the fruit. The larvae matures and eventually drops to the ground, where it burrows into the top two inches of soil and overwinters as a pupae. Some pupae can remain in a state of diapause within the soil for at least two years, while others complete development within the same year (Sansford, Mastro, & Reynolds, 2016). The adult flies emerge in early June through September, and begin repeating the reproductive cycle, creating a new generation of flies.

The United States Department of Agriculture (USDA) National Agricultural Statistics Service lists apples as Washington State's top commodity, grossing \$2.389 billion in 2016. The impacts of the apple maggot could have far-reaching effects on the tree fruit industry, including "increased cost of control in commercial premises, particularly apple orchards, costs and losses related to the effects on export markets, as well as environmental impacts arising from increased pesticide use" (Sansford, Mastro, & Reynolds, 2016). Damage caused by apple maggots can lead to a financial loss for the farmer by reducing crop yield. This damage starts when the adult female apple maggot dimples the fruit in order to lay eggs under the skin. As the eggs hatch and the larvae tunnel through the fruit, they leave brown trails in their wake making the fruit unfit for human consumption. This can sometimes cause the fruit to rot and drop prematurely (Sansford, Mastro, & Reynolds, 2016).

It is estimated that over eighty percent of untreated apple trees in Western Washington are infested with apple maggot (Sansford, Mastro, & Reynolds, 2016). To prevent the spread of this pest, the WSDA established quarantines for parts of Washington where the apple maggot is established. Homegrown or foraged fruit cannot be transported outside of these quarantine areas. Apple maggot survey trapping is conducted by WSDA staff each summer to try to determine where populations and infestations are located. Once an apple maggot is detected, a delimiting survey of the area is conducted, and around 5,600 traps are set. This high density trapping is done within a two-mile radius of the catch site. If no other apple maggots are caught, then the area is considered pest-free. However, monitoring surveys are conducted for a minimum of four years within a one-mile radius of the catch site.

When multiple life stages are detected, a meeting of the Apple Maggot Working Group (AMWG) is called. The AMWG includes members from the tree fruit industry, researchers, federal regulators, county extension offices, and WSDA. If the AMWG recommends to the WSDA director that a quarantine of the area is necessary, then a proposed boundary line is drawn based on trapping data, the proximity of apple orchards, and natural geographic boundaries such as mountain ranges. Commercial apple orchards which are located within the quarantine area, cannot transport fruit into the pest-free area without a WSDA issued certificate.

The apple maggot quarantine regulation serves to, “facilitate the movement of commercial fruit to domestic and international markets by providing shippers with one of two types of WSDA documents certifying their fruit is apple maggot free” (Sansford, Mastro, & Reynolds, 2016). Within the pest-free area, around 2 million metric tonnes or 30% of the crop produced, is exported to areas around the world (Sansford, Mastro, & Reynolds, 2016). This large export market is facilitated by the area maintaining its pest-free status.

At present, there has never been an apple maggot found in a commercial apple in Washington State. If an apple maggot was ever found in a commercial apple, this would have substantial negative impacts on domestic and international trade, as well as the Washington State apple industry. Commercial orchards located in areas where apple maggot is established must be sprayed and treated regularly for the pest. This can be costly and must be timed correctly to be effective (Sansford, Mastro, & Reynolds, 2016). These orchards are also required to go through the apple maggot certification process in order to transport fruit into the pest-free area.

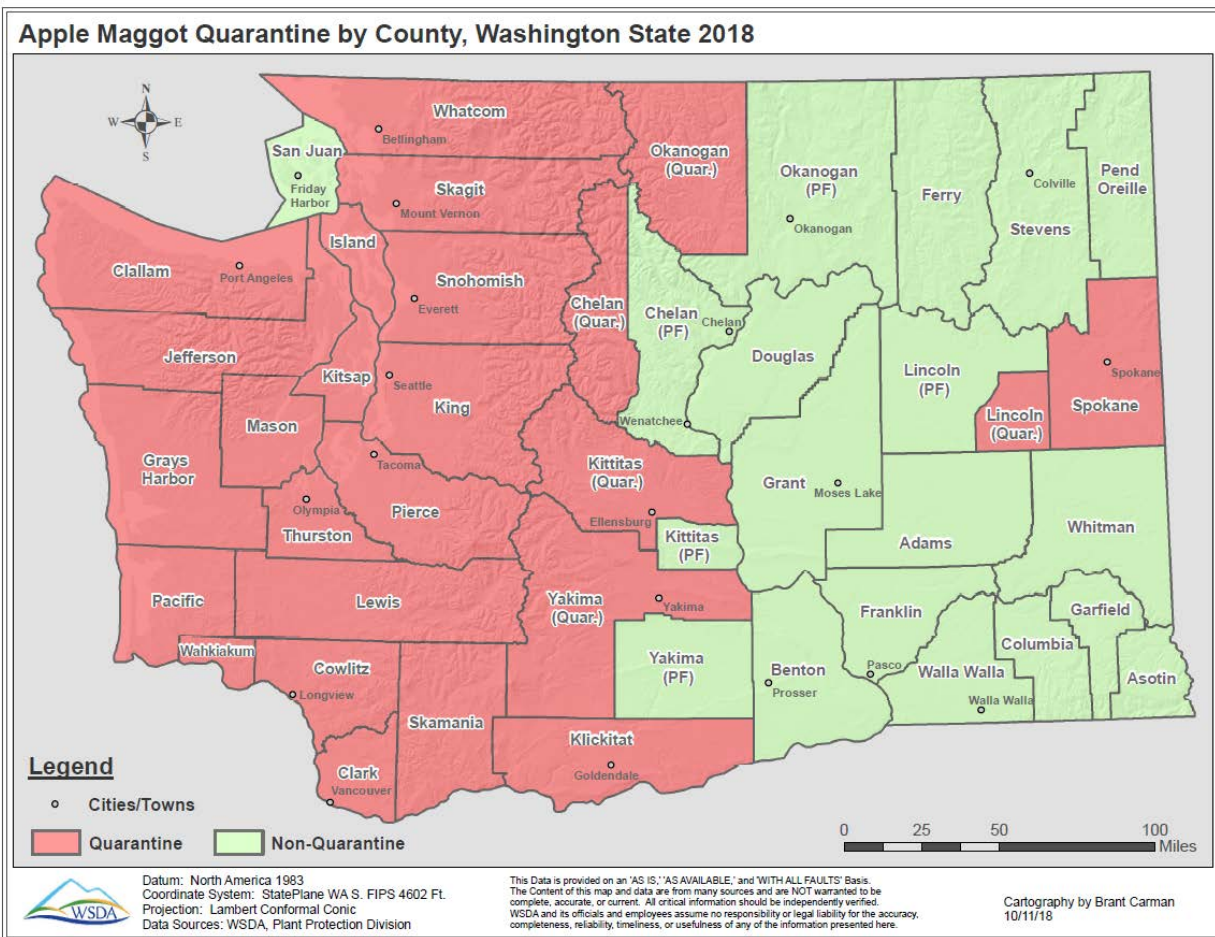


Figure 1: Statewide Apple Maggot Quarantine Map by County

In February of 2015, WSDA issued an emergency rule to Chapter 16-470 WAC. This rule added municipal solid waste and municipal green waste to the list of commodities regulated under the apple maggot quarantine. It also established a special permit to allow for the transportation and

disposition of these commodities from a quarantine area to a pest-free area. This spurred WSDA to commission a report, *Pest Risk Analysis (PRA) for Apple Maggot (Rhagoletis pomonella) Moving on Municipal Green Waste (MGW) into the Pest-free Area (PFA) of the State of Washington*, in May of 2016. The analysis determined that “the overall risk of entry of *R. pomonella* on MGW from the quarantine area to the PFA is assessed as likely to occur with low uncertainty” (Sansford, Mastro, & Reynolds, 2016).

As stated in WAC 173-350-100, municipal solid waste includes “unsegregated garbage, refuse and similar solid waste material discarded from residential, commercial, institutional and industrial sources and community activities, including residue after recyclables have been separated.” Municipal green waste, as defined in WAC 16-470-101(3), includes yard debris, organic feedstocks, organic materials, and agricultural wastes. Both municipal solid waste and municipal green waste are prohibited from being transported from the quarantine area into the pest-free area without a WSDA special permit.

Techniques that Neutralize any Apple Maggot Larvae that may be Contained within Yard Waste

The larvae and the pupae are the life stages of the apple maggot that pose the greatest risk of transfer to the pest-free area. The WSDA's pest risk analysis found evidence that heat treatment either in a laboratory or through composting can result in a 100% mortality rate of apple maggot pupae (Sansford, Mastro, & Reynolds, 2016). The effectiveness of the heat treatment is determined by the temperature and length of time the pest is exposed to the heat. The warmer the temperature, the less time that is required to neutralize the pest.

With composting, it can sometimes be difficult to expose all of the pupae to the higher temperatures. Mechanical processing of the waste prior to composting will alleviate this issue by facilitating more even and rapid heating. The reason for this is, "the more surface area available, the easier it is for microorganisms to work, because activity occurs at the interface of particle surfaces and air. Microorganisms are able to digest more, generate more heat, and multiply faster with smaller pieces of material" (Sansford, Mastro, & Reynolds, 2016). However, it is important not to powder the material or make the particles too small, because this will impede the movement of air through the pile.

WAC 16-470-124(2) outlines the Special Permit requirements for neutralizing the apple maggot in order to transport green waste from a quarantine area to a pest-free area. These requirements are based off of the findings of the pest risk analysis. The three main requirements are processing, heat treatment, and sanitation. These requirements as defined in WAC 16-470-124(2) are discussed in detail below.

Processing

Municipal green waste from the quarantine area is mechanically ground or shredded within the quarantine area to a particle size small enough to aid in heat exposure but large enough to produce a feedstock suitable for compost.

Mechanical processing of municipal green waste is required, because it allows for more uniform heat distribution throughout the treatment process. Chippers and grinders are commonly used for this. Chippers are generally used for processing woody material that is harder, whereas grinders are used on a greater variety of materials both hard and soft (Sansford, Mastro, & Reynolds, 2016). Grinders are also able to handle a larger volume of material at one time. Mechanical processing of municipal green waste may not reduce the viability of the pest, but it will aid in the heat treatment process.

Heat Treatments

Option 1. Thermophilic Phase of Composting

The entire quantity of municipal green waste that has been mechanically ground or shredded is composted in the quarantine area and during the composting process is exposed to either:

- Temperature of at least 55°C (131°F) for a continuous period of two weeks or,

- Temperature of at least 65°C (149°F) over a continuous period of one week or,
- In the case of enclosed compost facilities, at least 60°C (140°F) for one week. A minimum number of turnings may be required to ensure that the whole mass is exposed to this temperature. Moisture content should be a minimum of 40%.

Option 2. Direct Heat Treatment

The entire quantity of municipal green waste that has been mechanically ground or shredded is exposed to 74°C (165°F) for 4 hours, 80°C (176°F) for 2 hours or 90°C (194°F) for 1 hour using wet heat.

Any type of heat treatment used must be applied to municipal green waste that has first been processed. This allows for a more even distribution of heat, therefore exposing all of the waste to the treatment. It is important to note, “In the composting process, material takes time to heat up and the period needed for all the waste to heat to lethal temperatures will vary. This partly depends upon ambient temperatures so will vary with the time of year (Sansford, Mastro, & Reynolds, 2016).” The pest risk analysis mentions that, if apple maggot is present in whole apples which are being composted, then it is likely that more time will be required to kill the pest. It goes on to state that “uniform heating throughout the mass of waste at the requisite time x temperature would be required to achieve 100% mortality of the pest (Sansford, Mastro, & Reynolds, 2016).”

There are alternative options for neutralizing the pest available. However, these options have not yet been tested and validated. Some of these options include: vacuum steam, vapor heat, dry heat, non-ionizing radiation, irradiation, fumigation, and vacuum fumigation (Sansford, Mastro, & Reynolds, 2016). Finished compost (WAC 173-350) is not a regulated commodity under the apple maggot quarantine. The transport of fully composted material is unrestricted under the quarantine rule.

Sanitation

Trailers must be thoroughly washed within the quarantine area prior to transporting municipal green waste that has been processed and treated into or through the pest-free area. Sanitation of trailers transporting waste into the pest-free area will ensure they are free of any pests before being moved into the pest-free area.

Any organization wishing to transport municipal green waste from a quarantine area to a pest-free area must apply for a WSDA special permit (WAC 16-470-124). WSDA grants these special permits on a case-by-case basis. To receive a special permit, an organization must meet the guidelines for municipal green waste described above. Additionally, the organization must go through a validation process for the proposed heat treatment method as a precondition of the issuance of the special permit. An impartial third party would conduct the validation by reviewing and testing the effectiveness of the heat treatments at the treatment site located in the quarantine area. The validation step includes data collection on temperature and moisture over a specified time and spatial design.

After WSDA issues a special permit, WSDA staff will deploy apple maggot traps around the facility and conduct inspections by recording moisture and temperatures of the municipal green

waste at regular intervals throughout the year. A fee of \$125 is charged for issuing a special permit. These permits are effective for 1 – 5 years. To learn more about applying for a special permit, click [here](#) or visit <https://agr.wa.gov/PlantsInsects/InsectPests/AppleMaggot>.

Facilities Capable of Receiving Yard Waste Generated in Areas Subject to the Apple Maggot Quarantine

Any facility in Washington State that is receiving yard waste originating from an apple maggot quarantine area must either be located within a quarantine area, or must hold a special permit for the transport of municipal green waste from an apple maggot quarantine area to a pest-free area. This requirement is irrespective of whether the yard waste is being disposed in a landfill or treated at a compost facility. To date, no company or agency has received a special permit to transport green waste from the apple maggot quarantine area to the pest-free area.

The [Statewide Apple Maggot Quarantine Map by County \(Figure 1\)](#) illustrates that all of Washington State west of the Cascades is designated as apple maggot quarantine area. [Table 1](#) lists the facilities within the vicinity of the City of Leavenworth that are available to receive green waste from areas quarantined for apple maggot. [Figure 2](#) shows a map of facilities within a reasonable distance of Leavenworth that are able to take green waste in the quarantine area. [Table 2](#) is a list of all the compost facilities in Washington State.

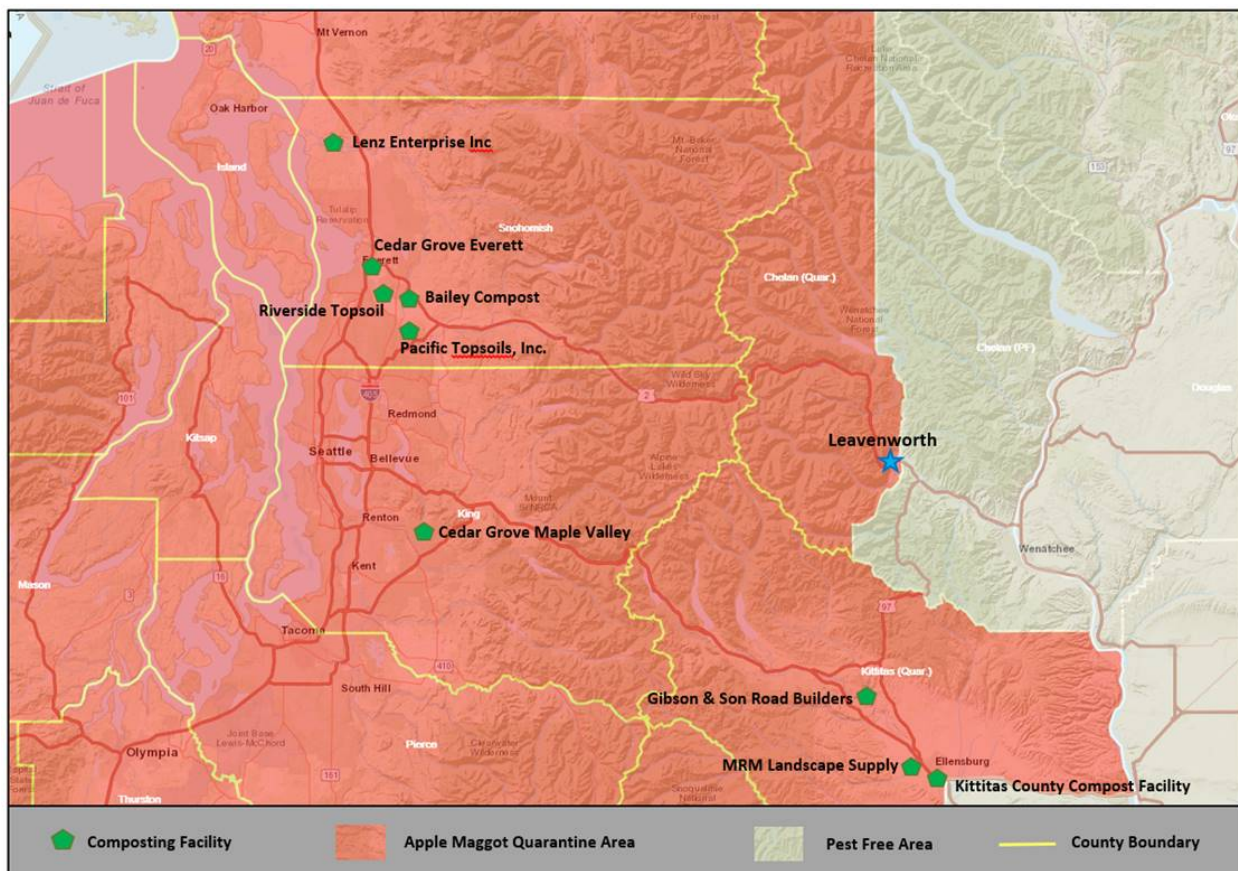


Figure 2: Map of Known Organic Waste Processing Facilities near Leavenworth in the Apple Quarantine Area

Table 1: List of Facilities Available to take Green Waste near Leavenworth

Facility	Address	City	Materials Accepted	Price	Website
Gibson & Son Road Building	1221 Thorp Hwy S	Ellensburg	Woody debris including topsoil	Varies	http://www.gibsonandsonroadbuilding.com/
Kittitas County Compost Facility	1001 Industrial Way	Ellensburg	Yard waste	\$37.86 per ton plus refuse tax	https://www.co.kittitas.wa.us/solid-waste/transfer-stations.aspx
MRM Construction & Landscape Supply	1180 Umptanum Rd	Ellensburg	All types of green waste, including topsoil	If hauled to site \$8 a cubic yard	http://mrmtopsoil.com/index.html

Table 2: List of all Composting Facilities in Washington State

Compost Facilities	Address	City
North Mason Fiber Co.	431 NE Log Yard RD	Belfair
Dykstra Farm	19111 Gear Road	Burlington
Centralia Composting	1223 Woodland Avenue	Centralia
Shorts Family Farm	1594 Center Road	Chimacum
Dirt Hugger LLC	111 E Rockland Rd	Dallesport
Columbia Compost	109 Eager Road	Dayton
Kittitas County Compost Facility	1001 Industrial Way	Ellensburg
MRM Construction & Landscape Supply	1180 Umptanum Rd	Ellensburg
Cedar Grove Composting, Inc.	3620 36th Place NE	Everett
Full Circle Natural Products Inc.	5429 Lowell-Larimer Rd	Everett
Lowell Farm	5429 Lowell-Larimer Rd	Everett
Pierce County (Purdy) Composting Facility	14515 54th Ave	Gig Harbor
WSDOT Goldendale Compost Facility	1261 Scalehouse Rd	Goldendale
Steerco/Sawdust Supply	7409 South 202nd	Kent
Olympic Organics LLC	7890 NE Ecology Rd	Kingston
Midnight's Farm	3042 Center Road	Lopez Island
Green Earth Technology	774 Meadowlark Road	Lynden
Cedar Grove Composting Co. Maple Valley	17825 Cedar Grove Road SE	Maple Valley
Skagit Soils Inc	13260 Ball Road	Mount Vernon
Mailliard's Landing Nursery	3068 N Oak Harbor Rd	Oak Harbor
Wildwood Farm	2326 N Happy Valley Rd	Oak Harbor
City of Port Angeles Compost Facility	3501 West 18th Street	Port Angeles
WSU Compost Facility	Dairy Rd WSU Pullman	Pullman
LRI Compost Factory	17926 Meridian St E	Puyallup

Compost Facilities	Address	City
Overnell Farms Composting Facility	4201 Road P NW	Quincy
Quincy Compost	18655 Rd 9 NW	Quincy
Overnell Farms Composting Facility	4201 Road P NW	Quincy
Silver Springs Organics Composting LLC	13835 Military Road SE	Rainier
Wilcox Farms Inc	40400 Harts Lake Valley Rd S	Roy
Lawrence Farms LLC Compost Facility	13000 Rd D SW	Royal City
Royal Organic Products	17405 Road 13 SW	Royal City
Lawrence Farms LLC Compost Facility	13000 Rd D SW	Royal City
Bailand Farms Yardwaste (Bailey) Compost	12711 Springhetti Road	Snohomish
Riverside Topsoil Inc	7404 Lowell Snohomish Road	Snohomish
Barr-Tech Composting Facility	9117 Kallenberger Rd N	Sprague
Lenz Enterprises Inc	5210 State Route 532	Stanwood
Natural Selection Farms Composting Facility	6800 Emerald Rd	Sunnyside
Sunnyside Dairy	4581 Maple Grove Rd	Sunnyside
Natural Selection Farms Composting Facility	6800 Emerald Rd	Sunnyside
H & H Wood Recyclers	8401 NE 117th Avenue	Vancouver
Sudbury Landfill Compost Facility	414 Landfill Rd	Walla Walla
Boise White Paper LLC	31831 W Hwy 12	Walla Walla
Stemilt World Famous Compost Facility	4471 Stemilt Hill Rd	Wenatchee
Pacific Topsoils – Maltby	8616 219 Street SE	Woodinville

Facility Options for the City of Leavenworth

Options in Western Washington

There are several existing facilities available to receive and treat yard waste from the City of Leavenworth. All compost facilities in Western Washington may receive yard waste from an apple maggot quarantine area without a special permit unless transportation of the waste is through a non-quarantine area. A list of all the compost facilities available in Washington can be found in [Table 2](#).

Long distance transport cost and higher tipping fees in Western Washington make most compost facilities more expensive than the three facilities in Eastern Washington ([Table 1](#)). Ecology did not independently estimate a range of annual disposal costs across various facilities, however the City of Leavenworth was quoted \$85,000 to remove all of its organic material to Western Washington. Historically, the City of Leavenworth paid in the range of \$8,000 to \$12,000 annually to dispose of the city’s organic materials at the Stemilt composting facility outside of Wenatchee in Chelan County.

Options in Eastern Washington

All facility options available to the City of Leavenworth require a special permit either from WSDA or the county where the compost facility is located.

Chelan County

The Stemilt Organic Recycling Center in Wenatchee is operationally efficient at composting organic waste and has nearly ten acres of paved surface. The Stemilt facility previously received organic waste materials from the City of Leavenworth and surrounding areas. With a conditional special permit to move material from the quarantined area to a non-quarantined area granted by WSDA, materials could be taken to Stemilt and be a cost neutral option for the City of Leavenworth. The tipping fee at Stemilt is \$6.00 a cubic yard. However, in June of 2017, WSDA determined that the transport of untreated green waste from Leavenworth to Stemilt was in violation of the apple maggot quarantine rule and an unacceptable risk of transporting apple maggot into the pest-free area. WSDA requested the city suspend all shipments of green waste to Stemilt unless ground or shredded and heat treated prior to shipping.

Regional Options

Gibson & Son Road Building, Kittitas County Solid Waste Compost Facility, and MRM Construction & Landscape Supply facilities are in Kittitas County and within a quarantined area of the state. However, these facilities would require the transport of material from a quarantined zone through a non-quarantined area (Blewett pass) to another quarantined area (Thorp/Ellensburg), which is a violation of the apple maggot quarantine rule. Moving material from the City of Leavenworth and surrounding areas, through a pest-free area to another quarantined zone would require a special permit issued by WSDA. The tipping fee at MRM Construction & Landscape Supply is \$8.00 a cubic yard, which is close to being a cost neutral solution for the city as they were accustomed to paying \$6.00 a cubic yard at Stemilt. The tipping fee at Kittitas County Solid Waste is significantly higher and requires pre-approval by the county government for acceptance of out of county waste. The tipping fee for Gibson & Son depends on job specific factors and is unknown at this time.

Special Permit Requirements

Grinding or shredding and heat treatments of organic waste prior to leaving the quarantine area are the primary mitigation measures required by WSDA for issuing a special permit to allow the transportation of green waste from the quarantine area into the pest-free area. Inspections by WSDA of untreated organic waste have found live apple maggot, even after the waste was transported over 160 miles in a container vehicle. A conditional special permit would be required to establish risk mitigating factors to control the apple maggot that are as effective as the current quarantine rule.

The City of Leavenworth could request a conditional special permit from WSDA to transport untreated organic material to organic waste processing facilities in either Chelan or Kittitas County. For Gibson, Kittitas County Solid Waste, and MRM facilities this would result in the non-stop transport of organic material through a non-quarantined area for 27 miles. Organic waste would then be processed at a facility in a quarantined area consistent with WSDA protocols. Such a special permit request would need to detail at a minimum:

- Demonstrated need and hardship;

- Impacts if a special permit is not granted;
- Unique circumstances including community specifics (regulatory constraints, fire-wise need, public health risk, carbon-foot print reduction);
- A description of the materials that would be transported;
- Who would transport the materials;
- How the materials would be transported;
- When the transport would occur; and
- The mitigation measures that would be taken to reduce the risk of apple maggot escape.

Examples of risk mitigating measures include; using a non-stop route over approximately a 27-mile stretch to another quarantined area of the state, taking only a small quantity of material, using covered transport, and having a limited number of loads. Also providing transport only in cold weather under 32 degrees Fahrenheit between November 15th and February 15th. At these temperatures, the fly form of the apple maggot's lifecycle is dead and the next generation of the pest is in soil and unlikely to be present in the organic waste.

The City of Leavenworth was informed of this option to request a special permit for transport in early 2018. To date, the City of Leavenworth has not sought this option. Moreover, until the city submits a proposal to WSDA and the risk of transporting apple maggot into the pest-free area has been evaluated by the agency, WSDA will not make any prior commitments to issue a special permit under this option.

Burning Brush and Yard Waste – Impacts on Public Health

Open burning of yard waste can harm public health. Smoke from burning leaves, grass, brush, and trees contains many hazardous pollutants, including particulates, carbon monoxide, volatile organic compounds, and nitrogen oxides, which are federally regulated pollutants. A number of chemicals in smoke can cause cancer, such as polychlorinated dibenzodioxins and polycyclic aromatic hydrocarbons. [1]

Yard waste-burning is a large source of airborne particulate matter. In a study conducted in Portland, Ore. [2], open burning of twigs, branches, leaves, and other domestic yard debris was shown to be a major source of fine particulate matter (PM_{2.5}). For example, open burning contributed about 60 µg/m³ to PM_{2.5} levels in springtime, a level nearly twice the federal air quality standard of 35 µg/m³.

The Washington State 2014 Comprehensive Emission Inventory includes information about PM_{2.5} emissions for Chelan County. It shows that smoke was the leading source of fine particulate matter accounting for over 97% of PM_{2.5} emissions that year (see Figure 3). [3]

¹ Estrellan, CR and Iino F (2010) Toxic emissions from open burning. *Chemosphere*, 80(3):193-207

² Edgerton SA. et al. (1984) Estimates of air pollution from backyard burning. *J. Air Poll. Control Assoc.*, 34(6):661-4

³ The Washington State 2014 Comprehensive Emission Inventory shows that smoke was the leading source of fine particulate matter accounting for over 97% of PM_{2.5} emissions that year. In summer and early fall, sources of smoke are primarily wildfires. In winter and spring, the leading source is wood burning in home heating devices such as fireplaces and woodstoves.

2014 Chelan County PM_{2.5} Emissions

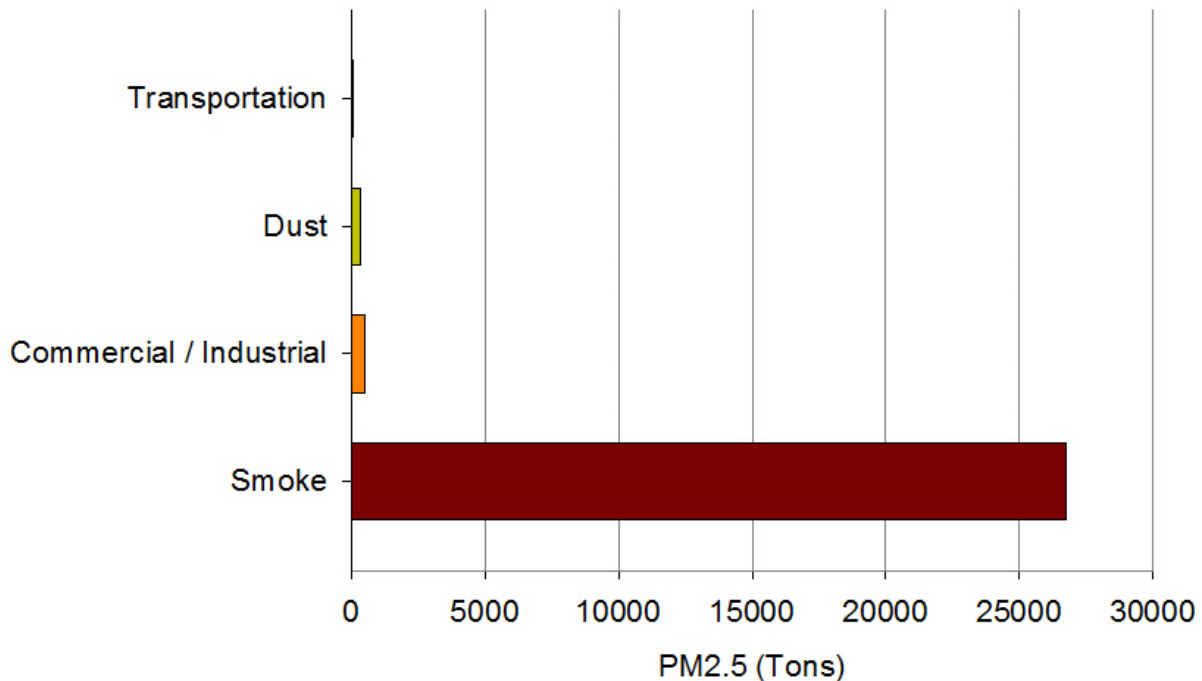


Figure 3: Chelan County PM_{2.5} Emissions in 2014

Ponderosa pine trees are common throughout the Leavenworth area. Smoke from burning Ponderosa wood and needles contains higher amounts of carcinogenic chemicals than occurs when many other tree species are burned. [4] Aside from this, there is little data on chemical constituents of smoke from yard waste. However, much is known about smoke from burning wood in woodstoves and fireplaces, and the pollutants in wood smoke have been shown to be dangerous to human health in many research studies. The high moisture content of grass clippings and fallen leaves reduces combustion temperature, which results in inefficient burning, incomplete combustion, and greater emissions of harmful pollutants. Such increases are likely to make smoke from burning yard waste more dangerous to human health than wood smoke is.

Because of this, yard waste smoke is likely to be particularly harmful to young children, elderly people, and people with pre-existing respiratory or cardiovascular diseases. People with asthma or chronic obstructive pulmonary disease (COPD) are likely to suffer the most. People with other chronic lung diseases, acute respiratory infections or other respiratory conditions are also likely to be at greater than average health risk from smoke.

⁴ Kim YH, et al. 2018. Mutagenicity and lung toxicity of smoldering vs. flaming emissions from various biomass fuels: implications for health effects from wildland fires. *Environ. Health Perspect.*, 126(1):017011

Even people who aren't directly exposed to yard waste smoke outdoors can be affected, because smoke readily infiltrates into air inside homes and businesses. [5]

In order to protect the public from the health impacts of air pollution exposure, EPA sets National Ambient Air Quality Standards (NAAQS) for PM_{2.5} and other pollutants. Areas where PM_{2.5} concentrations repeatedly exceed the NAAQS can be designated nonattainment for PM_{2.5}. Nonattainment areas are subject to a number of federal regulatory requirements designed to reduce unhealthy levels of pollution. The economic impacts of a nonattainment designation can include constraints on new businesses and industrial development, loss of federal highway funding, and pollution control requirements for permitted facilities. These impacts are not only costly for existing businesses but they can also hinder new development and tourism, which can negatively affect a region's economy and job growth. The City of Leavenworth appears frequently on the Department of Ecology's annual map of areas of concern for elevated PM_{2.5} due to exceedances of the state's healthy air goal. When data for wildfire smoke is considered in the analysis, the area has exceeded the federal standard two of the previous eight years. While not currently in imminent danger for nonattainment, smoke from open burning increases the risk of violating the federal standards. It also puts public health at risk, particularly among vulnerable populations including the elderly, children, and those with existing cardiovascular and respiratory conditions near the burn sites. Prevention of nonattainment is an important goal for both public health protection and economic development.

The City of Leavenworth conducted a burn under the pilot program authorized by the passage of Substitute Senate Bill 6055 from October 9-11, 2018. The burn, although completed faster than anticipated, did result in a few complaints and elevated monitor readings. The monitor in the town of Leavenworth did not record high levels; however, the mobile monitor located in the neighborhood near the burn site peaked at 138 micrograms per cubic meter, which is approximately 4 times higher than the federal air quality standard. This concentration falls into the Washington Air Quality Advisory (WAQA) category for "Very Unhealthy" air.

⁵ Barn P, et al., (2008) Infiltration of forest fire and residential wood smoke: an evaluation of air cleaner effectiveness. *J. Exposure. Sci. Environ. Epidemiol.* 18(5):503-11.

Alternatives to Outdoor Burning

There are alternatives to outdoor burning including; composting, chipping, biochar production, steam treatment, and biomass electrical generation.

Composting

Composting in the quarantined area is an option, but the City of Leavenworth reports that it is not economically feasible to set up a traditional compost system as they have limited equipment, personnel, and financial resources. One option is to enter into a lease agreement with Green Mountain Technologies, Inc. (GMT), which has a lower cost aerated static pile (ASP) compost system which requires less labor and equipment than a traditional system.

The City of Leavenworth is a small town with a population of about 2,000. The city collects yard waste in the form of organic materials twice a year in the spring and fall. The city does not produce enough organic material to keep a compost facility running year-round. By leasing an ASP composting system from GMT the city would incur less financial costs in terms of equipment and maintenance, as the system is non-permanent and could be brought in once or twice a year. Personnel requirements to run the system are low, as GMT would setup the aeration blower and WebMAC's equipment and piping at the site. GMT would also operate and maintain the entire system remotely via cellular link, reducing any additional labor costs for the city. The city would be responsible for grinding the yard debris and placing it on the pipe, however personnel would be trained by GMT on how to build an ASP pile.

The ASP composting system would likely qualify as a conditionally exempt facility under [WAC 173-350-220](#) (Table 220-A(3)). The ASP system consists of two 250 cubic yard ASP aeration zones which use available feedstock per Table 220-A(3) as referenced above. The feedstock is composted using air for 30-45 days, after which the blower and WebMACS controller are removed. The materials are then cured for 60-90 days. Since this is a moveable system, it allows for potential partnerships between counties or municipalities, who could share the system. After the 30-45 day aeration period is complete, the equipment can then be transported to a neighboring municipality for use.

Costs for leasing a pilot ASP composting system and adding on-site support from GMT are around \$3,750 for the first batch of 500 cubic yards of compost and \$2,950 for each additional batch of 500 cubic yards of compost. In the past, the City of Leavenworth typically paid \$8,000-\$12,000 annually to dispose of green waste. Leasing an ASP composting system falls in line with the city's historic budgeting for green waste at a total cost of around \$9,650 to process 1,500 cubic yards of green waste. The city can save additional funds from leasing the system by selling the resulting compost to residents or using it in place of expensive fertilizers on city parks and greenways.

Chipping

Chipping material and spreading it, or giving the material away in the quarantined area is an option. In the past, some material has been chipped, but the cost to purchase, maintain, and staff a chipper is expensive and the city has limited resources. The City of Leavenworth did request to

borrow a chipper from Chelan County Public Works, but the cost would have been \$600 an hour to borrow the tub grinder, not including site preparation, staffing, mobilization, and land application. Another option is for the city to rent a chipper from a private company. For a six inch chipper, prices range from \$249 - \$280 to rent for a day or \$747 - \$1,060 to rent for a week. For a twelve inch chipper, prices are around \$450 for a day or \$1,995 for a week.

Once chips are made, the City of Leavenworth would need a location to spread the chips. Chelan County did spread some chips within the quarantined boundary on its own property, but the city has struggled to find land to spread chips. It was suggested that the city spread some chips on city park property, but this was not seen as a long-term solution by the City of Leavenworth. Chipping and spreading on large tracts of state or federal land in the quarantined area around the city is a potential solution, however to date a land owner with a large tract of land has not volunteered. Financial assistance is available to the City of Leavenworth through an existing solid waste grant program, but approval of expenditures must go through Chelan County.

Chips could be given away free to residents in the quarantine area. Residents could use the chips on their yards or as mulch in their gardens. Chips could also be used on playgrounds, walking trails or as erosion control. In parts of Europe and Canada wood chips are being used in place of salt and grit on icy roads. Sometimes these chips are treated with magnesium chloride before being applied. This could be a potential option for Leavenworth, however more research is required to evaluate the cost and effectiveness of this use.

Biochar

Biochar production is a possible alternative to burning and is being evaluated based on permitting, logistics, and costs. Biochar is black carbon produced from a biomass source like plant or woody residues. Biochar production could be beneficial because biochar can be used as a soil amendment for agriculture use, which would be an economically beneficial product that could be transported into and used in non-quarantined areas of the state without any transport restrictions.

US Mat, a local company in the area, indicated it is willing to provide assistance if a pilot demonstration of biochar occurs. US Mat is interested in forest health and fire prevention efforts through producing biochar on a large scale, if contracts from the Washington State Department of Natural Resources or the U.S. Forest Service were available. US Mat's location has railroad access and is in a good location for this type of operation. Seed money through a public/private partnership to fund a pilot or any startup costs for US Mat to enter into the biochar producing market would be needed.

Biochar production may trigger Notice of Construction (NOC) air quality permit requirements. Ecology has air quality regulatory jurisdiction within Chelan County. Ecology cannot guarantee approval of an NOC under this alternative. NOCs are evaluated and issued on a unit and location specific basis.

Steam Treatment of Yard and Organic Waste

Professor Gary Chastagner, Washington State University, is testing a steam treatment method to evaluate if the technology will effectively raise the temperature of a chipped organic pile high

enough to neutralize apple maggot larvae. If successful, chipped material could be moved into the non-quarantined area for reuse, composting, or landfill. The steam treatment uses a portable steam generator, which applies steam to the organic material using a soaker hose type method. A tarp is placed over the material which allows it to heat rapidly. Tests of this method have been conducted using a Sioux SF-20 steam generator (790,000 BTU/hour). This system requires kerosene or diesel to power the generator, water and electricity; for a total estimated cost of \$600-\$800 per day to run. This test system is exempt from air quality permitting under WAC 173-400-110(4)(c)(iv) as a new emission unit with combined aggregate heat input of less than 1,000,000 Btu/hr and using #2 fuel oil (diesel). Kerosene fuel would result in the same exemption. Cost and treatment times may vary depending on the amount of material being treated. Modifying this method to use multiple or larger generators may not qualify for the exemption under WAC 173-400-110(4)(c)(iv).

Biomass Electrical Generation

Alliance BioEnergy +, Inc., has created a patented CTS (cellulose to sugar) conversion process which produces biofuels for less than \$1 a gallon. Virtually any cellulose material can be put through the CTS process including agricultural waste, yard waste, and specialty plants. The process can be modular, portable, and scaled to meet the feedstock availability. The CTS conversion process is 100% CO₂ neutral, environmentally friendly, and less expensive than petroleum based products.

Biomass electrical generation production may trigger Notice of Construction (NOC) air quality permit requirements. Ecology has air quality regulatory jurisdiction within Chelan County. Ecology cannot guarantee approval of an NOC under this alternative. NOCs are evaluated and issued on a unit and location specific basis.

More information on the Alliance BioEnergy +, Inc. CTS conversion process can be found by clicking [here](#) or going to https://docs.wixstatic.com/ugd/ccc459_dd8fca4523d84c8aa2c306fb7f3424f1.pdf.

Cost Comparison of the Alternatives to Outdoor Burning

There are many alternatives to outdoor burning that are cost effective. Previously, the tipping fee cost to the City of Leavenworth at Stemilt was \$6.00 a cubic yard. The tipping fee at MRM Construction & Landscape Supply, if the city transported the materials is \$8.00 a cubic yard. MRM is nearly cost neutral and may be a solution for the City of Leavenworth’s organic material. However, a special permit by WSDA would be required to insure procedures are in place that prevent the spread of apple maggots into the pest-free area.

Many alternatives to outdoor burning exist (see Table 3) however cost comparison estimates depend on numerous factors, all of which cannot be captured in this report without an extensive expense of time, financial resources, and customization (wants and desires) decided by the local community. Some of the variable cost factors can at a minimum include: equipment purchasing vs. leasing, employee salary and benefits, site preparation, construction, permitting, and scale. Any organization pursuing an alternative to outdoor burning should consider hiring the services of a private consultant to best advise the organization itself and should not solely rely on this report.

Table 3: Basic Cost Comparison of Alternative Treatments Described in this Report*

<i>Method</i>	<i>Cost</i>	<i>Amount Processed</i>	<i>Included in Cost</i>	<i>Not Included in Cost</i>
Composting	\$3,750 for first batch, \$2,950 for each additional batch	500 cubic yards per batch	5hp ASP blower, WebMACS controller, aeration piping for two zones, set-up and start-up of system, remote monitoring, temperature report, removal of equipment.	Labor, permitting, grinding of material prior to processing
Chipping	Daily rental: 6in \$249-\$280, 12in ~\$450 Weekly rental: 6in \$747-\$1060, 12in ~\$1995	Varies	Chipper	Labor and transport of equipment
Biochar	Unavailable	Unavailable	Unavailable	Unavailable
Steam Treatment	\$600-\$800 per day	Varies	Steam generator (790,000 BTU/hour), kerosene or diesel, water, electricity	Any necessary tarping, piping, and permitting
Biomass Electrical Generation	Unavailable	Unavailable	Unavailable	Unavailable

*Cost comparison estimates in this report are basic high level estimates that may not include all costs associated with a particular alternative treatment method. There are numerous variables that need to be considered to accurately estimate costs and there may be unforeseen expenses. Any organization pursuing an alternative method to open burning is advised to confer with a knowledgeable consultant.

Conclusion

Outdoor burning of yard waste creates negative impacts to human health and, if the resulting emissions contribute to a nonattainment area designation, can have significant economic impacts. The State of Washington has worked hard over the past 25 years to develop alternatives to outdoor burning that improve air quality, protect human health and create organic material that can be land applied to improve soil health and increase crop production. Two of the cities eligible to burn under SSB 6055 are located in areas of concern for elevated levels of fine particulates from wood smoke. More burning could result in violation of the National Ambient Air Quality Standards for fine particulates and will increase health risk for residents of these cities.

SSB 6055 required the Washington State Department of Agriculture and the Department of Ecology to evaluate the effectiveness of burning yard waste in eliminating apple maggots and to identify alternatives for management of yard waste in apple maggot quarantine areas. Many alternatives are available, some may have a significant economic impact or require a regulatory special permit. Grant funding from Ecology may be available to offset the economic impact to the City of Leavenworth. Ecology is available to work with the Legislature and the Department of Agriculture to address the increasing need to manage yard waste from apple maggot quarantine areas in a manner that protects human health and the environment while creating a beneficial material for soil health and crops.

Next Steps

Given the documented health effects of outdoor burning, it is important that the City of Leavenworth find an alternative waste management option for the residential yard waste generated within the city. There are safer, more environmentally accepted alternatives available to the city. Grant funding exists and has historically been available to local governments to manage yard waste other than burning. The Local Solid Waste Financial Assistance Program could be used to provide financial assistance for communities in a similar situation, as funds are available.

State and local agencies should work together to manage waste safely in light of the continued difficult challenges created by apple maggots and prevent new requests to burn yard waste. Both the solid waste regulations, as well as the agricultural regulations governing the prevention of the spread of apple maggot, have special permit procedures that may be evaluated and made available to impacted communities, if the risk of transporting apple maggot into the pest-free area is sufficiently mitigated.

The Department of Ecology and the Washington State Department of Agriculture are available and willing to continue working with the Legislature, local governments, and impacted communities to find viable alternatives for the management of yard waste in quarantine areas.

References

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