Oregon Public Health

Health Consultation

Malden Court Community Orchard
Lents Neighborhood, Portland, OR

October 13, 2015

Oregon Health Authority

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Foreword

The Environmental Health Assessment Program *(EHAP)* within the Oregon Health Authority, Public Health Division prepared this health consultation report with funds from a cooperative agreement with the Agency for Toxic Substances and Disease Registry *(ATSDR)*, U.S. Department of Health and Human Services. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and disease related exposures to toxic substances. This health consultation was prepared in accordance with ATSDR methodology and guidelines. This document has not been reviewed and cleared by ATSDR.

Summary

At the Malden Court Community Orchard *(MCCO)* site, EHAP's purpose is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent people from coming into contact with harmful toxic substances.

The MCCO site is a 0.4 acre unused lot at Southeast 87th Avenue and Malden Court in the Lents neighborhood of Portland, Oregon. It is next to the Springwater Corridor Trail and near several residences. As of 2015, it was covered with dense invasive vegetation. The site has had no formal use during its history and informal uses are not well documented. The lot was acquired by Portland's Bureau of Planning and Sustainability in October 2014, and was later leased to the neighborhood nonprofit Green Lents.

In spring 2015, Green Lents began restoring the site and preparing it for use as a community orchard. Environmental conditions at the site were in question due to some evidence of illegal dumping. Using brownfield funds received by the U.S. Environmental Protection Agency *(EPA)*, Oregon Department of Environmental Quality *(DEQ)* helped prepare the site for sampling and conduct the site investigation. In this health consultation, we state our conclusions about potential health risks at the site, based on the results of these sampling events.

EHAP reached three conclusions in this public health consultation.

Conclusion 1

EHAP concludes coming into contact with the soil on the site of the future Malden Court Community Orchard is not expected to negatively affect people's health. This includes adults *(both visitors and people working in the orchard)* and children on the site.

Basis for decision

In April 2015, soil samples were taken from the entire site. The testing results show levels of all detected chemicals in the soil are too low to affect people who come into contact with it.

Conclusion 2

EHAP concludes consuming fruit from trees and plants from the future Malden Court Community Orchard is not expected to negatively affect people's health. This includes adults and children eating fruit.

Basis for decision

Studies of gardening in urban soils show fruit plants typically do not absorb and accumulate chemicals from contaminated soil. Also, soil sampling at the site showed levels of chemicals in the soil are low.

Conclusion 3

EHAP concludes the asbestos detected during the soil investigation is not expected to affect the health of people who will use the site.

Basis for decision

The asbestos found occurred in only one sample at a low concentration, and Green Lents plans to remove the soil and debris from the area where it was detected.

Next steps

EHAP will work to communicate the findings and recommendations of this report to Green Lents and other MCCO users.

Based on analysis of the available information about the Malden Court Community Orchard, EHAP has does not have any recommendations at this time.

For more information

If you have concerns about the findings of this report, contact the Environmental Health Assessment Program at 971-673-0977 *(Todd Hudson)* or ehap.info@state.or.us. For information about DEQ's work at Malden Court Community Orchard, contact Rebecca Wells-Albers at 503-229-5585 or wells-albers.rebecca@deq.state.or.us.

Purpose and health issues

The Oregon Health Authority, Public Health Division's Environmental Health Assessment Program *(EHAP)* has prepared this health consultation *(HC)* regarding the site of the future Malden Court Community Orchard *(MCCO)*, in Portland, Oregon, at the request of Oregon Department of Environmental Quality *(DEQ)* and Green Lents, a Portland nonprofit neighborhood group. The area of public concern addressed in this document is the content of the soil on the site. This HC addresses the environmental analysis of the soil.

Background

Site description

The MCCO site is a 0.4 acre unused lot at Southeast 87th Avenue and Malden Court in the Lents neighborhood of Portland, Oregon. It is next to the Springwater Corridor Trail and part of the West Lents floodplain of Johnson Creek. The site is surrounded by maintained residential lots and roadways, and is approximately one mile from the neighborhood center of the Lents community. Before Green Lents took interest in the site, the lot was covered with dense invasive vegetation, mostly Himalayan blackberries.

Site history

The site has had no formal use during its history and informal uses are not well documented. The property has been described as a "nuisance" due to illegal dumping, trespass activities and abandoned automobiles. Multnomah County foreclosed on the property in 1992, and the City of Portland's Bureau of Environmental Services *(BES)* acquired the property for stormwater management. BES determined they could not use the property, and in 2014 transferred it to the city's Bureau of Planning and Sustainability *(BPS)*. In October 2014, BPS leased the lot to the neighborhood nonprofit Green Lents. In April 2015, Green Lents, with assistance from Oregon Department of Environmental Quality *(DEQ)* and funding from the U.S. Environmental Protection Agency *(EPA)*, removed the blackberry thickets – part of the removal process was done with a herd of goats.

Community profile

The Lents neighborhood is in southeast Portland. It is bordered by Southeast Powell Boulevard on the north, the Clackamas County boundary on the south, Southeast 82nd Avenue to the west, and Southeast 112th Avenue on the east. The I-205 freeway cuts through the neighborhood. An urban renewal area was established in Lents in 1998. A renewal area designation steers redevelopment funding into disadvantaged areas of the city.

The Lents neighborhood is within one of several "poverty hotspots" in the east Portland area. This area has a poverty rate of 30%, which is nearly double the county and state rate. *(3)* Lents is an ethnically and racially diverse neighborhood of Portland. The percent of the neighborhood population that is either Latino or non-White is greater than what is found county and statewide. *(2)* Fifty-three percent of housing units are renter-occupied, which is also significantly higher than county and state rates. *(3)* The Lents neighborhood has limited options for residents to buy fresh fruits such as what could be grown at this future orchard site.

Site visits

EHAP visited the future MCCO site twice in the spring of 2015. These visits were made to inspect the current state of the site, tour the site with DEQ and stakeholders, and determine sampling plan specifics.

Discussion

Exposure pathways

In order for a chemical contaminant to harm human health, there must be a way for people to come into contact with the chemical. An "exposure pathway" describes how a chemical moves from its source and comes into physical contact with people. An exposure pathway has five elements:

1. A contaminant source or release;
2. A way for the chemical to move through the environment to a place where people could come into contact with it;
3. A place where people could contact the contaminant;
4. Route of exposure to a contaminant *(breathing it, swallowing it, absorbing it through skin, etc.)*; and
5. A population that comes in contact with the contaminant.

An exposure pathway is "completed" if all five of the elements are known to be in place and occurring. If it is unknown whether one or more of the elements is in place, then it is called a "potential" pathway. If it is known that one of these five elements is not in place, that pathway is "eliminated". *(1)*

Completed exposure pathways

Table 1 describes the completed exposure pathways identified for present and future exposures at the MCCO. Complete exposure pathways would affect people that play or work on the site. Current activities that could put people at risk for exposures include removing nuisance vegetation, trash and other activities meant to prepare the site for planting of orchard plants. Future activities will likely include working on the orchard *(e.g., tending plants, weeding and picking fruit)* or playing on the site. EHAP does not consider past exposure on the site to be a significant issue. The entire site was largely inaccessible in the past due to heavy growth of *(thorn-covered)* blackberry canes that grew several feet high.

Table 1. Completed exposure pathways

Pathway	Time	Source	Media and transport	Point of exposure	Route of exposure	Exposed population
Contact with surface soil on the site	Present and Future	Chemicals in the soil	Surface layer of soil	Areas of the site where people may swallow or touch the soil	Incidentally swallowing or touching soil	People who work or play on the site

Eliminated exposure pathways

Table 2 shows the eliminated exposure pathways identified for the MCCO HC.

It is unlikely people would inhale dust at the site. Dust, such as during a dust storm or when a vehicle drives on a dirt road, consists of particles that are too large to go very deep into the lungs. These larger particles are trapped in mucus that lines the respiratory tract and are carried back up to the throat where they are swallowed. In most cases, the dose of a contaminant from incidental swallowing of soil is much greater than the dose from inhaling it.

It is also unlikely people would inhale asbestos at the site. A single soil sample tested positive for asbestos; this sample came from an area six feet below the soil surface. It is unlikely a person would disturb or come into contact with an area this far beneath the soil surface.

Table 2. Eliminated exposure pathways

Pathway	Time	Source	Media and transport	Point of exposure	Route of exposure	Exposed population
Inhalation of contaminated soil from site	Present and future	Chemicals in the soil	Surface layer of soil	People breathing while on the site	Breathing in airborne dust *(does not occur here)*	Area residents who use the site, both adults and children
Inhalation of asbestos from the site	Present and future	Asbestos in the soil	Area where asbestos was detected *(unable to be transported into the air because it was detected more than six feet underground)*	People breathing while on the site	Breathing in asbestos particles *(there is no known asbestos on the soil surface)*	Area residents who use the site, both adults and children
Eating fruit and plants grown in the soil on the site	Future	Chemicals in the soil	Fruit and plants grown on the site *(soil contaminants do not readily absorb and accumulate in fruits and leaves of plants)*	People eating fruit and plants grown on the site	Ingestion of fruit and plants	Area residents who use the site, both adults and children

Last, it is unlikely people would come into contact with chemicals through eating fruit and plants grown on the site. Studies of gardening in urban soils show fruit plants typically do not absorb and accumulate chemicals from contaminated soil, even when there are extremely high levels of contamination *(4-6)*. Plant tissues such as fruits and leaves don't readily transport and accumulate chemicals.

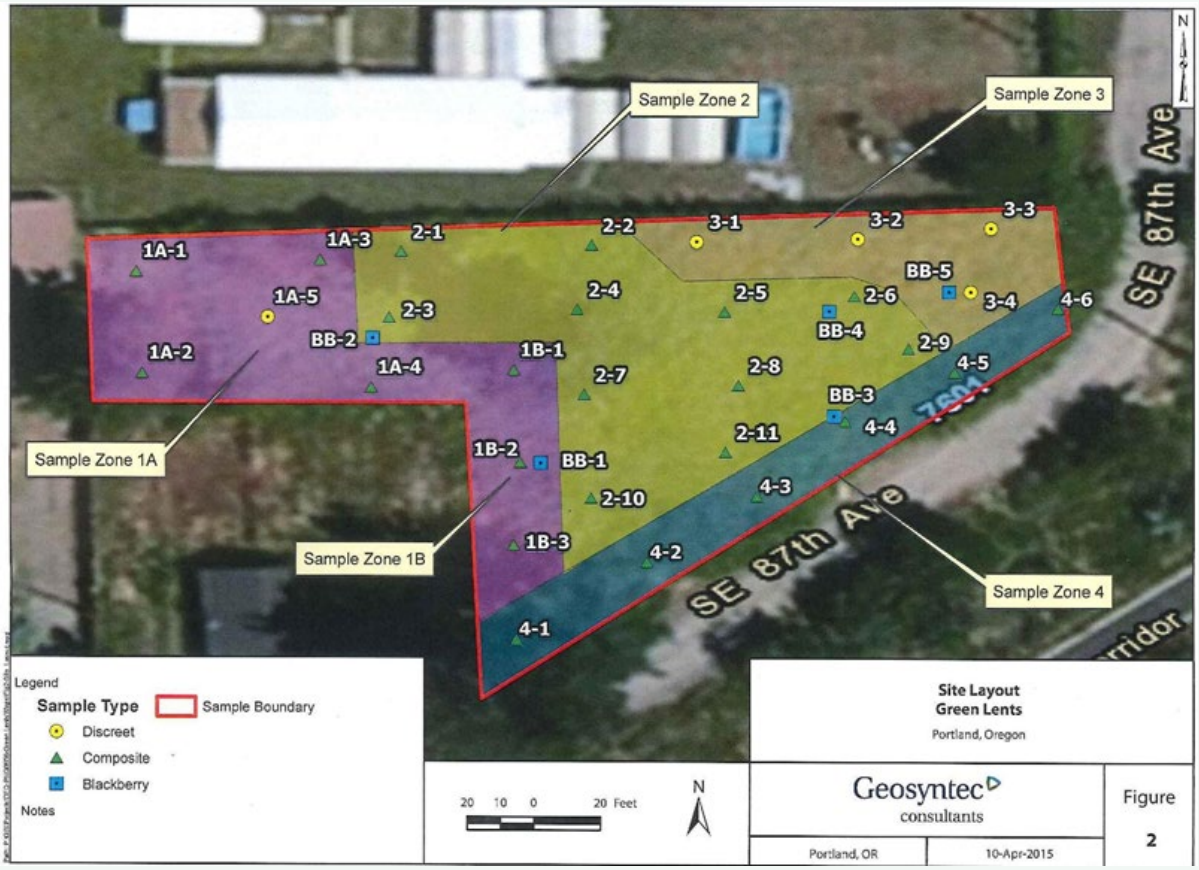
Environmental data

Sample collection and analysis

DEQ and Green Lents decided to sample the site for contamination due to concerns about past undocumented activities on the site, such as illegal dumping. Following the removal of the blackberry plants from the site, DEQ and Geosyntec collected soil samples from 29 different locations on the MCCO site on April 25, 2015, after the blackberry plants were removed *(Figure 1)*.

Figure 1.

Site sampling plan for the lot proposed to be the Malden Court Community Orchard *(Figure courtest of Geosyntec Consultants Inc.)* Note: Sample BB-5, although depicted in this figure, was not taken during the sampling process.



The site was divided into four sample zones *(Figure 1)*. In each zone, individual samples were "composited". A composite sample is when several samples are taken and then combined for analysis to represent the average conditions of a specific area on the site. People working on or being in the orchard are likely to use a large area, rather than sit in a single spot. For example, in Sample Zone 2 *(Figure 1)*, 11 soil samples were taken to be used in one composite analysis. A total of four composite samples *(1A, 1B, 2 and 4)* were analyzed, taken from a total of 24 individual samples.

In Sample Zone 3, four individual samples were taken. These were analyzed separately and not composited as in the other sample zones. Each sample collected from Sample Zone 3 *(locations 3-1 through 3-4)* was also taken at different depths *(e.g., at Sample 3-1, one sample was collected between six and seven feet and another one in the same spot, between nine and ten feet)*. Sample Zone 3 was also the only zone where DEQ and Geosyntec tested the soil for asbestos, because this is where observed conditions *(trash from years of illegal dumping)* suggested asbestos could potentially be present. These conditions were not seen in the other sample zones.

Discrete *(individual)* samples were also collected in certain places on the site where there were conditions such as unexplained dead vegetation or piles of debris. Discrete samples were taken from five locations on the MCCO site *(Figure 1)*.

Samples were analyzed for metals *(including lead and arsenic)*, petroleum hydrocarbons *(from possible gasoline and oil spills)*, and herbicides. See Table 3 for the complete list of contaminants tested. If the first round of analysis samples showed high levels of petroleum hydrocarbons or herbicides, the samples were tested for polycyclic aromatic hydrocarbons *(PAHs)* and polychlorinated biphenyls *(PCBs)*, respectively.

Contaminants of potential concern (COPCs)

Contaminants of potential concern *(COPCs)* are those which, after an initial screening, are included in the next steps of this HC. EHAP identified COPCs by comparing the maximum chemical concentration measured at MCCO to a health-based comparison value *(CV)* for soil. It is important to note that when a COPC is identified, it flags these contaminants for closer evaluation. It does not necessarily mean EHAP expects harmful health effects from exposure to that contaminant.

All chemicals were below ATSDR CVs, and were not considered in further analysis *(Table 3)*. Since none of the maximum concentrations exceeded their respective CVs, no COPCs were identified in soil samples taken from the MCCO site. Because no soil concentrations are above their CVs, health effects from exposure *(both long term and short term)* are not expected.

Table 3. Results of 2015 soil tests at MCCO site

Class	Chemical	Maximum value	Comparison value	Comparison value source
Hydrocarbons	Gasoline range	ND	82¤	EPA RSL, noncarcinogenic, child
	Diesel range	32	96¤	EPA RSL, noncarcinogenic, child
	Oil range	170	2500¤	EPA RSL, noncarcinogenic, child
Metals	Mercury *(elemental)*	0.12	9.4¤	EPA RSL, noncarcinogenic, child
	Arsenic	6.4	15	Child EMEG, chronic
	Barium	530	10000	Child EMEG, chronic
	Cadmium	0.89	5	Child EMEG, chronic
	Chromium *(hexavalent)*	24	45	Child EMEG, chronic
	Lead	120	NA	No CV for lead
	Selenium	1.7	250	Child EMEG, chronic
	Silver	0.51	390	EPA RSL, noncarcinogenic, child
Herbicides	2,4-D	ND	690	EPA RSL, noncarcinogenic, child
	Dalapon	ND	1800	EPA RSL, noncarcinogenic, child
	2,4-DB	ND	490	EPA RSL, noncarcinogenic, child
	Dicamba	ND	1800	EPA RSL, noncarcinogenic, child
	Dichloroprop	ND	700*	EPA RSL, noncarcinogenic, child
	Dinoseb	ND	62	EPA RSL, noncarcinogenic, child
	MCPA	ND	31	EPA RSL, noncarcinogenic, child
	MCPP	ND	62	EPA RSL, noncarcinogenic, child
	2,4,5-T	ND	620	EPA RSL, noncarcinogenic, child
	2,4,5-TP *(Silvex)*	ND	490	EPA RSL, noncarcinogenic, child

All data was obtained from ESC Lab Sciences and Oregon Department of Environmental Quality.

Abbreviations: NA=not available; ATSDR= Agency for Toxic Substances and Disease Registry; EPA=Environmental Protection Agency; CV=comparison value; ND = chemical not detected above its detection limit; 2,4-D=2,4-dichlorophenoxyacetic acid; 2,4-DB=4-*(2,4-dichlorophenoxy)*butyric acid; MCPA=2-methyl-r-chlorophenoxyacetic acid; MCPP=meta-chlorophenylpiperazine; 2,4,5-T=2,4,5-trichlorophenoxyacetic acid; 2,4,5-TP=2,4,5-trichlorophenoxypropionic acid; RSL=regional screening level; EMEG=Environmental Health Evaluation Guide; RMEG=Reference Dose Media Evaluation Guide

Analytical data qualifiers: < = Chemical was below the laboratory's method detection limit.

* = CV for 2,4-D used as surrogate
¤ = The following comparison values were used for petroleum hydrocarbons: Gasoline range = total petroleum hydrocarbons aromatic low; Diesel range = total petroleum hydrocarbons aliphatic medium; Oil range = total petroleum hydrocarbons aromatic high *(Source: EPA Regional Screening Levels)*

Asbestos

Asbestos is a different contaminant than the chemicals listed in Table 3. It doesn't have comparison values for when it is found in soil. Asbestos is a special form of naturally occurring minerals that consists of long, thin fibers. It isn't absorbed into soil particles like chemicals such as lead or petroleum. Because asbestos fibers can be very small *(smaller than soil particles)*, they have the potential to become airborne and inhaled. It has a number of mostly historical uses that include insulation, fireproofing material and roof/floor tiles.

During analysis of samples taken at MCCO, DEQ and Geosyntec collected four individual samples from Sample Zone 3 *(3-1, 3-2, 3-3 and 3-4)* and had them analyzed for the presence of asbestos. The sample at location 3-3 confirmed the presence of asbestos at a depth of six to seven feet below the surface. The asbestos found is believed to be the result of asbestos-containing materials dumped and buried there many years ago *(e.g., floor/ceiling tiles, pipe insulation and wallboard)*. There was no asbestos detected on the soil surface, and DEQ and Geosyntec confirmed asbestos containing materials were not seen anywhere else on the site.

EHAP eliminated asbestos as an exposure pathway for the following reasons:

- Only one sample showed the presence of asbestos, and the percentage of asbestos in the sample *(0.25%)* was well below the threshold for it to be considered asbestos-containing material *(ACM)* ;
- The asbestos was detected at a significant depth below the soil surface *(greater than six feet)*, making it unlikely that asbestos will be disturbed into the air where it can be breathed; and
- Green Lents plans to remove the soil in Sample Zone 3 before the orchard is built.

Table 4. Summary of asbestos sampling at the MCCO site

Sample	Depth (feet)	Asbestos Present?	Percent Asbestos
3-1	6–7*	No	NA
3-2	6–7	No	NA
3-3	6–7	Yes	0.25%
3-4	1	No	NA

* = This indicates the sample was taken from this depth range.
NA = Not applicable

Lead

Studies have not shown a risk-free level of exposure to lead in children. Therefore, EHAP does not compare concentrations of lead to a CV. In urban environments, lead is frequently found above background concentrations due to historical uses of lead-based paint or pesticides, and leaded gasoline. It also occurs naturally in the soil.

EHAP evaluated the maximum concentration of lead *(120 mg/kg)* in the soil samples by using the Integrated Exposure Uptake Biokinetic Model for Lead in Children *(IEUBK)*. This model predicts blood lead levels in young children up to seven years of age, based on the lead concentration in a given soil sample. The Center for Disease Control and Prevention *(CDC)* has a defined reference value for blood lead levels. For children, it is defined as being greater than or equal to 5 micrograms per deciliter of blood *(µg/dl)*. This reference value is based on the 97.5 percentile of child blood lead concentrations measured in the National Health and Nutrition Examination Survey *(NHANES)*. NHANES is a survey-based research program conducted by the federal government to assess the health status of adults and children in the United States. Studies have not shown a risk-free level of exposure to lead in children and 5 µg/dl is considered the level at which action should be taken to find and remove the source of lead exposure.

Normally, EHAP uses the 95th upper confidence limit *(UCL)*, a statistical calculation of all samples from a site, to estimate the exposure point concentration *(EPC)*. Using a simple average can lead to uncertainty, such as a person being in the area of a site where soil concentrations of lead are much higher than the average value. Calculating a UCL requires a minimum of 12 individual samples. At the MCCO, there were too few composite sample values, and they could not be combined with discrete samples to calculate a UCL.

Since a UCL could not be calculated, EHAP chose to use the maximum value of lead *(120 mg/kg)* found on the future MCCO site. The IEUBK model predicted a child's blood lead level would range from 1.4 to 2.5 ·g/dL if they were exposed to the amount of lead in the soil at the MCCO on a daily basis for one year. This range is slightly above the average blood lead level of 1.3 ·g/dL that NHANES reported in children of a similar age range *(CDC, 2013)*. It is likely actual exposure would be much lower since the IEUBK's model predictions are based on a daily, one-year-long, residential exposure scenario. Also, this model considers effects on young children, who are the most sensitive to lead contamination. Adolescent children and adults are less likely to come into contact and be affected by lead.

Fruit consumption

EHAP considers exposure to contaminants through the consumption of fruit and plants at MCCO to be an eliminated exposure pathway, because fruiting plants do not transport or accumulate the chemicals tested in Table 3. It is especially unlikely for people to be exposed to chemicals through eating fruit at the MCCO site because the levels of chemicals tested were low or not detected.

Uncertainties

With any determination of risk, there are uncertainties. Some of the uncertainty is related to the health guideline values used to assess toxicity *(comparison values)*. While it's true these values have passed a rigorous multi-agency peer-review process, each individual is unique and individuals vary in their sensitivity to toxic chemicals. To some extent, these uncertainties have been addressed by applying mathematical adjustments that account for variability.

Conclusions

EHAP has reached three conclusions regarding the MCCO site.

1. Coming into contact with the soil on the site of the future MCCO is not expected to negatively affect people's health. This includes adults *(both visitors and people working in the orchard)* and children on the site. In April 2015, soil samples were taken from the entire site. The levels of all chemicals in the soil are too low to affect people who come into contact with it.

2. Consuming fruit from trees and plants from the future MCCO is not expected to negatively affect people's health. This includes adults and children eating fruit. Studies of gardening in urban soils show fruit plants typically do not absorb and accumulate chemicals from contaminated soil. Also, soil sampling at the site showed levels of chemicals in the soil are low.

3. Asbestos detected during the soil investigation is not expected to affect the health of people who will use the site. The asbestos found occurred in only one sample at a low concentration, and Green Lents plans to remove the soil and debris from the area where it was detected.

Recommendations

Based on analysis of the available information about the MCCO, EHAP does not have any recommendations at this time.

Public health action plan

A public health action plan describes the specific actions EHAP will take based on the results of this HC. EHAP will implement this action plan in collaboration with community members, partner agencies and other stakeholders at the future MCCO site.

Public health actions completed

To date, EHAP has taken the following actions:

- In April 2015, EHAP worked with DEQ, Green Lents and Geosyntec Consultants to create a soil sampling plan for the entire site and designed to ensure public health is protected.
- In June 2015, EHAP reviewed the results of the soil sampling from the site.
- In July 2015, EHAP assessed health risks as documented in this health consultation.

Public health actions planned

EHAP will take the following public health actions:

- Release this HC report for interested community members and others; and
- Provide technical assistance and consultation to DEQ and other stakeholders as needed throughout the development of the future MCCO site.

Report preparation

This health consultation for the Malden Court Community Orchard was prepared by the Oregon Environmental Health Assessment Program *(EHAP)* under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry *(ATSDR)*. Editorial review was completed by the cooperative agreement partner.

This report was supported by funds from a cooperative agreement with the Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services. This document has not been reviewed and cleared by ATSDR.

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Glossary

The Agency for Toxic Substances and Disease Registry *(ATSDR)* is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR serves the public by using the best science available to take responsive public health actions and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the EPA, which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used in this document. It is not a complete dictionary of environmental health terms. If you have questions or comments, call CDC's toll-free telephone number, 1-800-CDC-INFO (1-800-232-4636).

Absorption:	How a chemical enters a person's blood after the chemical has been swallowed, has come into contact with the skin, or has been breathed in.
Adverse *(or negative)* health effects:	A change in body function or cell structure that might lead to disease or health problems
ATSDR:	The Agency for Toxic Substances and Disease Registry. ATSDR is a federal health agency in Atlanta, Georgia that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.
Background level:	An average or expected amount of a chemical in a specific environment or amounts of chemicals that occur naturally in a specific environment.
Cancer:	A group of diseases which occur when cells in the body become abnormal and grow, or multiply out of control.
Chronic exposure:	A contact with a substance or chemical that happens over a long period of time. ATSDR considers exposures of more than one year to be chronic.
Completed exposure pathway:	See **Exposure pathway**.
Comparison value (CVs):	Concentrations of substances in air, water, food and soil that are unlikely, upon exposure, to cause adverse health effects. Comparison values are used by health assessors to select which substances and environmental media *(air, water, food and soil)* need additional evaluation while health concerns or effects are investigated.
Concern:	A belief or worry that chemicals in the environment might cause harm to people.
Concentration:	How much or the amount of a substance present in a certain amount of soil, water, air or food.
Contaminant:	See **Environmental contaminant**.
Dermal contact:	A chemical getting onto your skin *(See* **Route of exposure***)*.
DEQ:	Oregon Department of Environmental Quality. A regulatory agency whose job is to protect the quality of Oregon's environment.

Dose:	The amount of a substance to which a person may be exposed, usually on a daily basis. Dose is often explained as "amount of substance(s) per body weight per day."
Duration:	The amount of time *(days, months, years)* that a person is exposed to a chemical.
Environmental contaminant:	A substance *(chemical)* that gets into a system *(person, animal or the environment)* in amounts higher than the **background level**, or what would be expected.
Environmental media:	Usually refers to the air, water and soil in which chemicals of interest are found. Sometimes refers to the plants and animals eaten by humans. **Environmental media** is the second part of an **exposure pathway**.
U.S. Environmental Protection Agency (EPA):	The federal agency that develops and enforces environmental laws to protect the environment and the public's health.
Exposure:	Coming into contact with a chemical substance. *(For the three ways people can come in contact with substances, see* **Route of exposure***.)*
Exposure assessment:	The process of finding the ways people come in contact with chemicals, how often and how long they come in contact with chemicals, and the amounts of chemicals they come in contact.
Exposure pathway:	A description of the way that a chemical moves from its source *(where it began)* to where and how people can come into contact with *(or get exposed to)* the chemical. ATSDR defines an exposure pathway as having five parts: 1. Source of contamination; 2. Environmental media and transport mechanism; 3. Point of exposure; 4. Route of exposure; and 5. Receptor population. When all five parts of an exposure pathway are present, it is called a **completed exposure pathway**. Each of these five terms is defined in this Glossary.
Frequency:	How often a person is exposed to a chemical over time; for example, every day, once a week or twice a month.

Hazardous waste:	Substances released or thrown away into the environment which, under certain conditions, could be harmful to people who come into contact with them.
Health effect:	ATSDR deals only with **adverse health effects** *(see definition in this Glossary)*.
Ingestion:	Swallowing something, as in eating or drinking. It is a way a chemical can enter your body *(See **Route of exposure**)*.
Inhalation:	Breathing. It is a way a chemical can enter your body *(See **Route of exposure**)*.
kg:	Kilogram or 1000 grams. Usually used here as part of the dose unit mg/kg/day meaning mg *(contaminant)*/kg *(body weight)*/day.
µg:	Microgram or 1 millionth of 1 gram. Usually used here as part of the concentration of contaminants in water *(µg/Liter)*.
mg:	Milligram or 1 thousandth of 1 gram. Usually used here as in a concentration of contaminant in soil mg contaminant/kg soil or as in the dose unit mg/kg/day meaning mg *(contaminant)*/kg *(body weight)*/day.
Point of exposure:	The place where someone can come into contact with a contaminated environmental medium *(air, water, food or soil)*. Some examples include the area of a playground with contaminated dirt, a contaminated spring used for drinking water or the backyard area where someone might breathe contaminated air.
Population:	A group of people living in a certain area or the number of people in a certain area.
Route of exposure:	The way a chemical can get into a person's body. There are three exposure routes: – Breathing *(also called inhalation)*; – Eating or drinking *(also called ingestion)*; and – Getting something on the skin *(also called dermal contact)*.
Safety factor:	Also called **uncertainty factor**. When scientists don't have enough information to decide if an exposure will cause harm to people, they use "safety factors" and formulas in place of the information that is not known. These factors and formulas can help determine the amount of a chemical that is not likely to cause harm to people.

Source *(of contamination)*:	The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank or drum. Contaminant source is the first part of an **exposure pathway**.
Toxic:	Harmful. Any substance or chemical can be toxic at a certain dose *(amount)*. The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.
Tumor:	Abnormal growth of tissue or cells that have formed a lump or mass.

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