

APPENDIX C

Model Stormwater Management Guidelines for Ultra-Urban Redevelopment

May 2018

SALMON-SAFE INC.

MODEL STORMWATER MANAGEMENT GUIDELINES FOR ULTRA-URBAN REDEVELOPMENT

MAY 2018

Introduction

Polluted stormwater is the largest threat to the health of the Pacific Northwest's urban watersheds. Pollutants targeted by Salmon-Safe's urban initiative such as heavy metals, petroleum products, pesticide runoff and construction sediment have an adverse impact on the watershed and severely compromise downstream marine health. With the goal of inspiring design that has a positive impact in our watersheds, Salmon-Safe offers stormwater design guidance for ultra-urban areas, which we define as typically those densely developed "downtown" locations mostly covered by structures and pavement. Generally first developed long ago, many such areas are brownfields now undergoing redevelopment, mostly for commercial and residential purposes.

The very extensive impervious surfaces in ultra-urban spaces create a hydrologic environment dominated by surface runoff, with little of the soil infiltration and evapotranspiration predominating in a natural landscape. Vehicle traffic drawn to such areas and the activities occurring there deposit contaminants like heavy metals, oils and other petroleum derivatives, pesticides and fertilizers (nutrients). These pollutants wash off of the surfaces with the stormwater runoff and drain into the piping typically installed to convey water away rapidly. If the piping network is a combined sanitary-storm sewer system, the large stormwater runoff volumes draining from an ultra-urban area exceed the capacity of the wastewater treatment plant at the end of the line in some storms, resulting in releases of untreated, mixed sewage and stormwater to a water body. If the piping network is a separated storm sewer system, the runoff and the pollutants it carries enter a receiving water body without treatment, to the detriment of water quality and the aquatic life there. Although salmon-spawning and rearing streams are rarely present in an ultra-urban location, if they are, the elevated runoff quantity itself is damaging to the downstream habitat that salmon and their food sources rely on and directly to the fish themselves.

Many of the pollutants conveyed by stormwater runoff are toxic to salmon and their invertebrate food sources. The toxicity of heavy metals like copper and zinc to aquatic life has been well studied. However, salmon face many more potentially toxic pollutants in both their freshwater and saltwater life stages. These contaminants include other heavy metals; petroleum products; combustion by-products; and industrial, commercial, and household chemicals. Emerging science from NOAA Fisheries shows that these agents collectively create both lethal and non-lethal impacts, the latter negatively affecting salmon life-sustaining functions to the detriment of their migration, reproduction, feeding, growth and avoidance of predators.



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Despite these challenges, an array of options exists to reduce, or even in the utmost application, eliminate the negative impacts of ultra-urban development stemming from the large quantities of contaminated stormwater runoff potentially generated there. This management category addresses practices to control ultra-urban stormwater runoff to reduce both water quantity and water quality impacts with the following goal.

Goal

Any development or redevelopment project with a footprint that exceeds 5,000 square feet shall use low-impact site planning, design, and operational strategies¹ for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the water quality, rate, volume, and duration of flow.

Objectives

1. Prime objective

Implement low-impact practices, especially runoff retention² practices, addressing both water quantity and water quality control to the maximum extent technically feasible in redeveloping ultra-urban parcels to achieve the stated goal of restoring the predevelopment hydrology. Provide documentation of how the objective will be achieved. If full achievement of the goal is technically infeasible, assemble documentation demonstrating why it is not and proceed to consider Objective 2A and/or 2B, as appropriate to the site.

2. Alternative objectives

Assess if achieving Objective 1 is documented to be technically infeasible.

2A Alternative water quantity control objective when the site discharges to a combined sanitary-storm sewer or a stream—Start with the low-impact practices identified in the assessment pursuant to Objective 1. To the extent that they cannot prevent the generation of stormwater runoff peak flow rates and volumes greater than in the predeveloped condition^{3,4}, implement effective alternative measures to diminish and/or slow the release of runoff to the maximum extent technically feasible, with the minimum objective of reducing the quantity discharged to comply with any applicable water quantity control requirement⁵ and, in any case, below the amount released in the preceding developed condition.⁶

¹ Collectively termed “low-impact practices” in the following points.

² Retention means keeping runoff from flowing off the site on the surface by preventing its generation in the first place, capturing it for a water supply purpose, releasing it via infiltration to the soil or evapotranspiration to the atmosphere, or some combination of these mechanisms.

³ A predeveloped condition is the natural state of the site as it typically would be for the area prior to any modification of vegetation or soil.

⁴ As determined through hydrologic modeling of the previously developed and modified conditions.

⁵ Specified for discharges to combined sewers by the municipal jurisdiction; specified for discharges to Western Washington streams by the Washington Department of Ecology’s Stormwater Management Manual for Western Washington, Minimum Technical Requirement #7.

⁶ As determined through hydrologic modeling of the previously developed and modified conditions.



2B Alternative water quality control objective when the site discharges to a water body or a separate storm sewer leading to a water body—Start with the low-impact practices identified in the assessment pursuant to Objective 1. To the extent that they cannot prevent the generation of stormwater runoff containing pollutants, implement alternative effective measures to reduce contaminants in stormwater to the maximum extent technically feasible, with the minimum objective of complying with the regulatory requirements for water quality control applying to the location.⁷

Plan Elements

1. **Inventory and analysis**—Narrative, mapping, data, and quantitative results that summarize: (1) site land uses and land covers in the redeveloped and preceding developed conditions; (2) results of hydrologic modeling of the undeveloped, previously developed and modified conditions, as the basis for pursuing quantity control objectives; and (3) stormwater drainage sub-basins, conveyance routes, and locations of receiving stormwater drains and natural water bodies in the redeveloped state.
2. **Low-impact practices**—Low-impact practices are systematic methods intended to reduce the quantity of stormwater runoff produced and improve the quality of the remaining runoff by controlling pollutants at their sources, collecting precipitation and putting it to a beneficial use, and utilizing or mimicking the hydrologic functioning of natural vegetation and soil in designing drainage systems.

The following low-impact practices are particularly relevant to ultra-urban sites:

- source control practices
 - ✓ minimizing pollutant introduction by building materials (especially zinc- and copper-bearing) and activities conducted on the site
 - ✓ isolating pollutants from contact with rainfall or runoff by segregating, covering, containing, and/or enclosing pollutant-generating materials, wastes and activities
 - ✓ conserving water to reduce non-stormwater discharges
- constructing vehicle travel ways, sidewalks and uncovered parking lot aisles to the minimum widths necessary, provided that public safety and a walkable environment for pedestrians are not compromised
- harvesting precipitation and putting it to a use such as irrigation, toilet flushing, vehicle or surface washing, or cooling system make-up water
- constructing low-traffic areas with permeable surfaces, such as porous asphalt, open-graded Portland cement concrete, coarse granular materials, concrete or plastic unit pavers, and plastic grid systems (Areas particularly suited for permeable surfaces

⁷In Western Washington, specified by the Washington Department of Ecology's Stormwater Management Manual for Western Washington, Minimum Technical Requirement #6, which is equivalent to the City of Seattle's SMC, Section 22.805.090.B.1.a.



are driveways, walkways and sidewalks, alleys, and overflow or otherwise lightly-used uncovered parking lots not subject to much leaf fall or other deposition.)

- draining runoff from roofs, pavements, other impervious surfaces, and landscaped areas into one or more of the following green stormwater infrastructure (GSI) systems:
 - ✓ bioretention area* (also known as a rain garden)⁸
 - ✓ planter box*, tree pit* (bioretention areas on a relatively small scale)
 - ✓ vegetated swale⁹*
 - ✓ vegetated filter strip*
 - ✓ infiltration trench
 - ✓ green roof

* signifies compost-amended soils as needed to maximize soil storage and infiltration

The following low-impact practices are of limited applicability to ultra-urban sites but may contribute to meeting objectives in some circumstances:

- conserving natural areas including existing trees, other vegetation and soils
- minimizing soil excavation and compaction and vegetation disturbance
- minimizing impervious rooftops and building footprints
- designing drainage paths to increase the time before runoff leaves the site by emphasizing sheet instead of concentrated flow, increasing the number and lengths of flow paths, maximizing non-hardened drainage conveyances and maximizing vegetation in areas that generate and convey runoff

3. **Alternatives**—When on-site low-impact practices alone cannot achieve Objectives 2A and/or 2B, implement one or more of the following strategies to meet at least the minimum water quantity and quality control objectives stated above:

- **For runoff quantity and/or quality control**—
 - ✓ contribute materially to a neighborhood project using low-impact practices and serving the stormwater control needs of multiple properties in the same receiving water drainage basin, with the contribution commensurate with the shortfall in meeting objectives on the site itself.
 - ✓ implement low-impact practices on-site to manage the quantity and quality of stormwater generated in a location off the redevelopment site but in the same receiving water drainage basin, with the scope of the project commensurate with the shortfall in meeting objectives using practices applied to stormwater generated by the site itself.

^{8,9}Preferably with an open bottom for the fullest infiltration, but with a liner and underdrain if the opportunity for deep infiltration is highly limited or prohibited for some specific reason, e.g., bedrock or seasonal high-water table near the surface, very restrictive soil (e.g., clay, silty clay) that cannot be adequately amended to permit effective infiltration, non-remediable contamination below ground in the percolating water pathway.



- **For runoff quantity control**—install a vault or tank¹⁰ to store water for delayed release after storms to help avoid combined sewer overflows or high flows damaging to a stream.
- **For runoff quality control**—install an advanced engineered treatment system suitable for an ultra-urban site.¹¹

Considerations for Salmon-Safe Certification

Fulfilling the stormwater component of the Salmon-Safe certification process requires submission of documentation of how Objective 1 will be achieved based on the inventory and analysis conducted for the site. On the other hand, if Objective 1 has been judged to be unachievable, pursuing certification requires documentation establishing the technical infeasibility of doing so. Relevant documentation includes, but is not necessarily limited to, site data, calculations, modeling results, and qualitative reasoning. If achieving Objective 1 is demonstrably technically infeasible, the certification process then requires similar documentation of how Objectives 2A and/or 2B, as appropriate to the site, will be achieved.

Prepared for Salmon-Safe Inc. by Dr. Richard Horner, et. al.

¹⁰ While useful for runoff quantity control, passive vaults and tanks provide very little water quality benefit.

¹¹ The most effective candidate treatment systems now available are chitosan-enhanced sand filtration and advanced media filtration coupled with ion exchange and/or carbon adsorption. Basic sand filtration is another option suitable to an ultra-urban site but is less effective than the more advanced alternatives.





Salmon-Safe Inc.

Report of the Science Team Regarding Salmon-Safe Certification of the City of Shoreline, Washington

REFERENCES

Salmon-Safe Urban Standards

Overview: <https://salmonsafe.org/certification/urban-development/>

Requirements: <https://salmonsafe.org/wp-content/uploads/2018/03/Urban-Standards-Version-2.0-May-2018-2MB.pdf>

Pre-condition 1: General Standard A.1

- (1) **R** Development is not in violation of national, state, or local environmental laws or associated administrative rules or requirements, as determined by a regulatory agency in an enforcement action.

Pre-condition 2: Appendix F of the Urban Standards
(see following page)

APPENDIX F: Model Construction-Phase Stormwater Management Program

Contractor Accreditation

Salmon-Safe provides an accreditation program (AP) for General Contractors that provides guidance for construction management. Accredited contractors have been pre-certified to adhere to the following guidelines and can streamline documentation and certification processes. Contact Salmon-Safe for a list of accredited contractors and to find out more about the accreditation process.

Construction Phase Stormwater Management

Erosion and Sediment Transport

Manage the construction site to avoid, or minimize to the greatest extent operationally feasible, the release of sediments from the site through the use of the following measures:

- i. As the top priority, emphasize construction management BMPs, such as:
 - Maintain existing vegetation cover, if it exists, to the greatest extent technically feasible.
 - Perform ground-disturbing work in the season with the smaller risk of erosion and work off disturbed ground in the higher risk season.
 - Limit ground disturbance to the amount that can be effectively controlled temporarily in the event of rain.
 - Use natural depressions and plan excavations to drain runoff internally and isolate areas of potential sediment and other pollutant generation from draining off the site, so long as safe in large storms.
 - Schedule and coordinate rough grading, finish grading and erosion control applications to be completed in the shortest possible time overall and with the shortest possible lag between these work activities.
- ii. Stabilize with a cover appropriate to the site conditions, season and future work plans; for example:
 - Rapidly stabilize disturbed areas that could drain off the site and will not be worked again, with permanent vegetation supplemented with highly effective temporary erosion control measures until at least 90 percent vegetative soil cover is achieved.
 - Rapidly stabilize disturbed areas that could drain off the site and will not be worked again for more than three days, with highly effective temporary erosion control measures.
 - If 0.1 inch of rain or more is predicted with a probability of 40 percent or greater, before the rain falls, stabilize or isolate disturbed areas that could drain off the site, and that are being actively worked or will be



within three days, with measures that will prevent or minimize to the greatest extent technically feasible the transport of sediment off the property.

- iii. As backup for cases where all of the above measures are used to the greatest extent technically feasible but sediments still could be released from the site, consider the need for sediment collection systems including, but not limited to, conventional settling ponds and advanced sediment collection devices such as polymer-assisted sedimentation and advanced sand filtration.
- iv. Specify emergency stabilization and/or runoff collection procedures (e.g., using temporary depressions) for areas of active work when rain is forecast.
- v. If runoff can enter storm drains, use a perimeter control strategy as a backup where some soil exposure will still occur, even with the best possible erosion control (the above measures) or when there is a discharge to a sensitive water body.
- vi. Specify flow control BMPs to prevent or minimize to the greatest extent technically feasible the following:
 - Flow of relatively clean off site water over bare soil or potentially contaminated areas;
 - Flow of relatively clean intercepted groundwater over bare soil or potentially contaminated areas;
 - High velocities of flow over relatively steep and/or long slopes, in excess of what erosion control coverings can withstand; and
 - Erosion of channels by concentrated flows either by using channel lining, velocity control, or both.
- vii. Minimize the number of construction entrances. Specify stabilization of construction entrance and exit areas, provision of a nearby tire and chassis wash for dirty vehicles leaving the site with a wash water sediment trap, and a sweeping plan.
- viii. Specify construction road stabilization.
- ix. Specify wind erosion control.
- x. Manage the construction site to avoid the release of pollutants other than sediments by preventing contact between rainfall or runoff and potentially polluting construction materials, processes, wastes, and vehicle and equipment fluids by such measures as enclosures, covers, and containments, as well as berming to direct runoff.
 - Construction vehicles larger than pick-up trucks parked for more than two days shall be located so that any fluid leaks cannot contaminate stormwater runoff. The best way of preventing contamination is to park in a location that cannot drain into any stormwater conveyance leaving



the site. If a selected location could drain away, it should be modified by slightly recessing the parking spots to prevent draining out. An alternative if such a location cannot be found, is to place leakage collection trays under the vehicles. Any vehicle observed to be leaking any significant quantity of a fluid should be repaired immediately.



Condition 4: Standard U.1.1

Standard U.1.1: Existing site improvements related to stormwater management have been inventoried.

Performance Requirements

- i. Information on existing stormwater infrastructure, if any, has been collected from record drawings, site mapping, or field visits. This includes locations of stormwater conveyance channels, pipes, catch basins, outlets and low-impact development stormwater facilities. **E**
- ii. Existing improvements contributing to stormwater runoff, including impervious and semi-pervious (e.g. gravel or pavers) surfaces, are mapped. **E**
- iii. Site topography has been mapped and a drainage area assessment conducted. This information shows major stormwater catchments and locations of receiving stormwater drains or streams, if present.¹ **E**
- iv. Areas suitable for low impact development stormwater facilities based in part on soil infiltration capacity (U.1.5.1) have been mapped. **E**

¹An existing site stormwater management plan, if updated and available, is generally sufficient to meet performance requirements U.1.1 (i-iii), and can be provided to the Evaluation Team as a substitute for these requirements.

Condition 5: Standards U.2.3, U.2.6, U.2.9 and Appendix G of the Urban Standards

Standard U.2.3: Opportunities for stormwater harvest, water reuse and wastewater reclamation under municipal code have been investigated during the site inventory and assessment and are employed to the greatest extent operationally feasible. **E**

Standard U.2.6: Water conservation practices are used during site maintenance. **E**

Performance Requirements

- i. Modern drip irrigation, automated soil moisture sensors and other water-conserving techniques are part of the irrigation plan. Irrigation delivers water based on specific vegetation requirements, rate of infiltration, evapotranspiration and other factors. Temporary irrigation systems are used for landscape vegetation that typically require water only during establishment periods.
- ii. Stormwater reuse and gray water reuse systems, if compatible with code and regulatory requirements and investigated in Standard U.2.3, are used. Water may be reused within building water systems, irrigation or any water use that reduces consumption.
- iii. For existing developments, an analysis is performed to identify and assess opportunities to retrofit existing water systems per the above performance requirements in U.2.6 (i-ii). A report is submitted to Salmon-Safe within one year presenting a plan and schedule for implementing technically feasible water conservation projects.

Standard U.2.9: The appropriate managing authority within the development has adopted a water conservation plan as a short written document and formalizes the existing conservation practices, as detailed in Appendix G (Water Conservation Plan Guidance). **E**

Performance Requirements

- i. The plan lists activities to perform, provides a schedule for activities and identifies responsible parties. Adaptive management triggers actions that respond to changes in performance. The water conservation plan shall include a drought management plan that details how significant reductions will be achieved during a drought.
- ii. This plan as a whole, or its elements therein, have been adopted into the development's guiding documentation that formalizes the appropriate managing authority's responsibility to implement and enforce all aspects of the plan on both private property or common property managed for the public good.

Condition 6: Appendix F of the Urban Standards
(see Pre-condition 2 above)

Condition 9: Salmon-Safe landscape management practices
(see next page, Appendices D & E of the Urban Standards)

APPENDIX D: IPM, Nutrient and Chemical Management Plan Guidance

Salmon depend on clean water free from harmful levels of fertilizers (nutrients), pesticides (herbicides and insecticides, fungicides and other biocides), stormwater runoff pollutants and organic waste. These contaminants can travel long distances in stormwater runoff from an urban development to receiving waters. The principal methods to avoid contamination of salmon-bearing waters are to minimize overall inputs of these contaminants, restrict the type of inputs and develop an acceptable method of application through a comprehensive management program, such as an integrated pest management (IPM) plan. The appropriate managing partner for the urban development shall require that guiding O&M documents for each eligible phase of the project incorporate a Salmon-Safe approved IPM, nutrient and chemical management plan to ensure maintenance of Salmon-Safe practices over time.

IPM Requirements within the Plan

An IPM plan or policies are developed to promote management practices that reduce the impact of, the unnecessary reliance upon, or eliminate the need for hazardous chemicals and pesticides. Hazardous chemicals and pesticide use on the development should not result in contamination of stormwater or streams with amounts of any chemical or pesticide harmful to salmon or aquatic ecosystems. These practices generally include careful monitoring and scouting of insects, weeds and disease; use of non-spray control methods (cultural practices and mechanical controls); use of reduced impact pesticide controls; and/or managing specific sites without the use of chemical or pesticides. In addition to the required elements of an IPM plan outlined in Appendix A, the IPM plan should comply with the following guidelines:

- i. **Type of pesticides**—All use of pesticides within the development, including waterways, waterway buffers and uplands, is limited in an IPM program by the specific policies on the method of use, including application type, rate, frequency, location and amount. Managers and residents use only those pesticides that are on an approved list for the development (see Appendix E). These pesticides will only be used when there is no undue risk of harm to salmon and aquatic ecosystems. This limited use list is established and reviewed on an annual basis by development management to ensure that potential harm to salmon and aquatic ecosystems is minimized.
- ii. **Minimize aquatic impacts from high-hazard pesticides**—The use of any pesticides on the Salmon-Safe Cautionary List of High Risk Pesticides requires written explanation for each pesticide used that details the methods of use, including timing and location that demonstrate that the risk to aquatic systems is negligible (Appendix E: Salmon-Safe High-Hazard Pesticide List).



- iii. **Restricted use zones**—Pesticide use is specially managed within:
(1) waterways; and (2) adjacent waterway buffer areas. For the purposes of pesticide application, the buffer zone is defined as a corridor of land that is 60 feet in width on each side of a stream or other body of water (no-development buffers may be wider). Measurement of this buffer zone begins at the edge of the water line at the time of application and is measured horizontally as if on a map. Anticipated seasonal or weather-related changes affecting water level will be included in the decision-making process when dealing with buffer zones.
- iv. **Pesticide treatment of trees**—Within riparian buffer zones, pesticides are used only on rare occasion for treating tree pests or diseases. Injection of pesticides within tree tissues or paintbrush application are the only application methods for trees allowed in riparian buffer zones.
- v. **Application equipment**—Within riparian buffers, pesticide application for vegetation other than trees is done by hand and using low-volume, low-pressure, single-wand sprayers, wiping, daubing and painting equipment or injection systems. The methods used minimize fine mists and ensure that the applied materials reach targeted plants or targeted soils surfaces.
- vi. **Pesticide drift**—Great care is taken to ensure that pesticide drift does not reach nearby surface waters by using appropriate equipment and methods. Spray applications are not allowed in the buffer area when wind speed is above 5 mph or wind direction would carry pesticides toward open water. Also, no spraying is done during an inversion.
- vii. **IPM program**—Pesticide applicators, whether employees or contractors, are trained in the IPM plan and implement it fully.
- viii. **Pesticide applicator licensing**—All persons applying pesticides must be currently licensed as private pesticide applicators by the applicable state agency (Department of Agriculture). Licensed personnel must be specifically endorsed for any of the state-defined categories of pest control they undertake, such as aquatic endorsement for all aquatic pest control activities.
- ix. **Chemical and pesticide storage, rinsates and disposal**—The managing partner of the development has rigorous policies in place to ensure that no contamination of stormwater or streams occurs due to the storage, cleaning of equipment or disposal of chemicals and pesticides. These policies are adhered to by maintenance personnel, contractors and residents.
- x. **Pesticide tracking system**—Detailed records are maintained for all pesticide applications on the part of the managing partner, including applications to aquatic areas and buffer zones, consistent with state requirements.
- xi. **Pesticide application timing**—Pesticides are not applied when it is raining (unless otherwise directed by label instructions) or when there is a potential



for transport by runoff to stormwater drains or streams. Decisions regarding scheduling of pesticide applications should account for the expected impacts of anticipated storm events.

Nutrient Management Requirements within the Plan

The potential for nutrient and lime use to contaminate stormwater and streams can be minimized through a program that uses alternative cultural and mechanical practices to maintain soil fertility, uses fertilizers with discretion based on soil fertility and plant needs, uses slow-reacting fertilizers and ensures proper application of fertilizer and lime in terms of amounts and timing. The nutrient management plan should comply with the following guidelines:

- i. **Types of fertilizers**—Fertilizer types are tailored to the existing soil conditions and plant requirements. Slow release, organic fertilizers or compost are generally used. Fertilizers must be selected through a state-approved screening and approval process to ensure the fertilizer does not contain toxic contaminants. If soluble fertilizers are used, the timing and rate of application are carefully considered (see below).
- ii. **Fertilizer application amounts**—In general turf and shrub bed areas, soluble fertilizer rates of application are limited to no more than 0.5 lb N/1,000 square feet with restraints on timing to minimize fertilizer in stormwater runoff.
- iii. **Low fertilizer landscaping**—Plants with low-fertilizer requirements are used for landscaping to the greatest extent technically feasible.
- iv. **Focused use**—Fertilizer is used only on high- and moderate-intensity use areas, such as flower beds, ball fields, golf courses, some turf areas and planting beds, and some plantings associated with construction and restoration projects, if at all. Lime is used to adjust pH to minimize fertilizer use where suitable, in a manner that does not pose impacts to water quality.
- v. **Buffer zone width**—Fertilizer and lime use is highly restricted within a waterway (riparian or wetland) buffer zone.
- vi. **Use within watercourse buffers**—Fertilizer use in buffer zones of waterways is restricted depending on the intensity of application and type of fertilizers. The allowable use of fertilizer also varies depending on whether it is being used for routine maintenance or for restoration and construction projects.
- vii. **Soil testing**—Periodic soil testing is used to determine the need for fertilizer (phosphorus and potassium), compost and lime relative to appropriate benchmarks established by the development managing partner. Testing is conducted a minimum of twice per year and prior to fertilizer application.



- viii. **Soil fertility**—Practices such as on-site mulching of leaf and grass clippings are used to reduce the need for fertilizer.
- ix. **A summary report of annual fertilizer use** is provided that shows a stable or declining trend in synthetic fertilizer use development-wide, taking into account the changes in acreage managed, specific uses and other relevant factors.

Other Contaminant Management within the Plan

Other contaminants, such as animal and chemical waste, should not contaminate stormwater or streams leaving the urban development. Recognizing that the managing partner may have a limited ability to control residents, the public and actions of other agencies, the project should comply with the following guidelines:

- i. **Chemical use control**—Eliminate or minimize the use of chemicals commonly used to maintain urban infrastructure that may cause undue risk of harm to salmon and aquatic species. Evaluate various solvents, deicers, sealants, etc., to choose the least toxic or harmful product to aquatic ecosystems without compromising the health, safety and welfare of the human environment.
- ii. **Animal waste control**—The development managing partner fosters management and education policies regarding dog or other domestic animal waste control that are effective in minimizing the contamination of stormwater or streams.
- iii. **Wildlife waste control program (geese, ducks)**—If necessary and the greatest extent technically feasible, a management program is implemented to ensure that duck and goose waste does not contaminate stormwater or streams.



APPENDIX E: Salmon-Safe's List of High Hazard Pesticides

Salmon-Safe Urban High Hazard List of Pesticides (UHHL)

High hazard pesticides are a serious threat to salmon and other aquatic life. Pesticide formulations can also contain other ingredients that are potentially more toxic than the active ingredients, such as non-ionic surfactants. In addition to killing fish, high hazard pesticides at sublethal concentrations can stress juveniles, alter swimming ability, interrupt schooling behavior, cause salmon to seek suboptimal water temperatures, inhibit seaward migration and delay spawning. All of these behavioral changes ultimately affect survival rates.

The table below lists many of the pesticides known to cause problems for salmon and other aquatic life. Use this list to identify pesticides that require special consideration.

Note: This table lists only some of the currently available and commonly used pesticides.

SALMON-SAFE URBAN HIGH HAZARD LIST OF PESTICIDES			
Insecticides / Miticides			
abamectin	chlorpyrifos ^{1,2} (2)	imidacloprid ²	prallethrin ^{1,2}
acetamiprid	cyfluthrin ^{1,2}	indoxacarb ²	spinosad ²
alpha-cypermethrin ¹	cypermethrin ^{1,2}	lamda-cyhalothrin ^{1,2}	spiromesifen ¹
bifenthrin ^{1,2}	deltamethrin ^{1,2}	malathion ^{1,2} (1)	tralomethrin ¹
carbaryl ² (2)	esfenvalerate ^{1,2}	naled ¹ (3)	zeta-cypermethrin ¹
chlorantraniliprole ²	etofenprox ¹	novaluron	
chlorfenapyr ^{1,2}	fipronil ^{1,2}	permethrin ^{1,2}	
Fungicides			
acequinocyl	cyazofamid	folpet	thiram
azoxystrobin ²	cyprodinil	pentachlorophenol (PCP) wood treatment	trifloxystrobin ¹
captan (4)	difenoconazole	propiconazole ²	
chlorothalonil ^{1,2} (4)	fluazinam ¹	pyraclostrobin ^{1,2}	
copper ^{1,2}	fludioxanil ²	thiophanate methyl	
Herbicides			
2,4-D ² (4)	dithiopyr ²	linuron ² (4)	prodiamine
atrazine ²	diuron ² (4)	oxadiazon ²	triclopyr BEE ² (4)
benefin	diquat dibromide ²	oxyfluorfen ²	trifluralin ² (5)
diclofop-methyl	flumioxazin ²	pendimethalin ² (5)	
<p>Very Highly Acutely Toxic and/or Highly Acutely Toxic¹ to fish and/or aquatic invertebrates. Based on EPA's Aquatic Life Benchmarks².</p> <p>Pesticide names followed by a number in parentheses indicates the specific NOAA /NMFS Biological Opinion where it was assessed for jeopardy and/or habitat destruction/modification to endangered salmonids in accordance with the Endangered Species Act (https://www.epa.gov/endangered-species), regarding the 37 pesticides listed in the Washington Toxics Coalition (WTC) court settlement. Completed BiOps listed below³.</p> <p>* Active ingredients being Very Highly Acutely Toxic (LC50 or EC50 <100 ug/L) to BOTH fish and aquatic invertebrates</p> <p>+ Active ingredients determined to generally have very high potential for risk of off target movement through surface runoff, based on the pesticide's adsorption to soil/sediment and it's field dissipation half-life (persistence) http://ccpestmanagement.ucanr.edu/files/237465.pdf</p>			



Salmon-Safe Urban High Hazard List of Pesticides | List and Table References with Additional Notes

1. US EPA Toxicity Classification	Acute Aquatic LC50 or EC50 (ug/L)
Practically Nontoxic	> 100,000
Slightly Nontoxic	> 10,000; <= 100,000
Moderately Toxic	> 1,000; <= 10,000
Highly Toxic	> =100; <= 1,000
Very Highly Toxic	< 100

These ratings are based on acute toxicity and do not account for chronic and/or possible sub-lethal effects:

- Fish acute toxicity is generally the lowest 96-hour LC50 or EC50 in a standardized test, commonly using rainbow trout, fathead minnow or bluegill.
- Acute invertebrate toxicity values are usually the lowest 48 or 96-hour LC50 or EC50 in a standardized test commonly using midge, scud or daphnia.

2. Both EPA-established acute and chronic aquatic benchmarks are available on the EPA website:

<https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-pesticide-registration>

In addition to inherent toxicity, the overall assessment of the risk of a specific pesticide to aquatic water quality should consider a number of other factors: Pesticide Properties (e.g., water solubility, soil adsorption, half-life), Environmental Properties (e.g., soil makeup, climate) and Management Practices (e.g., application methods, use rate, irrigation, no-till). These properties and their possible interactions are discussed in detail in the following UC publications: <http://anrcatalog.ucanr.edu/pdf/8119.pdf> and <http://ccpestmanagement.ucanr.edu/files/237465.pdf>

The 28 Threatened or Endangered species listed in the Biological Opinions (BiOps) are described as Evolutionarily Significant Units (ESU) and are species, location/habitat and temporally specific. For example, Chinook salmon are assessed as 9 separate ESU's in the BiOps: (1) Chinook salmon (Puget Sound); (2) Chinook salmon (Lower Columbia River); (3) Chinook salmon (Upper Columbia River Spring-run); (4) Chinook salmon (Snake River Fall-run); (5) Chinook salmon (Snake River Spring/Summer-run); (6) Chinook salmon (Upper Willamette River); (7) Chinook salmon (California Coastal); (8) Chinook salmon (Central Valley Spring-run); and (9) Chinook salmon (Sacramento River Winter-run).

Refer to the Biological Opinions for a detailed list and description of each ESU and their geographic range

<http://www.nmfs.noaa.gov/pr/consultation/pesticides.htm>

Refer to the NOAA/NMFS Biological Opinion Schedule on the NOAA Fisheries website

http://www.nmfs.noaa.gov/pr/consultation/pesticide_schedule.htm

Variations and Variance Requests

Urban sites or projects using any of the pesticides indicated as "High Hazard" may be certified only if written documentation is provided that demonstrates a clear need for use of the pesticide, that no safer alternatives exist and that the method of application (such as timing, location and amount used) represents a negligible hazard to water quality and fish habitat. All variances must be approved in advance by Salmon-Safe.

For more information about the variance process, or to request a variance form, please contact Salmon-Safe at info@salmonsafe.org.

Salmon-Safe Urban High Hazard List of Pesticides | May 2018



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Condition 10: Standard U.5.4

Standard U.5.4: Using the analysis conducted in the previous standards, develop site strategies for creation and retention of habitat and landscape patches that provide for food, forage and refuge for a diversity of species, including key indicators of ecosystem health. Such strategies could include:

Performance Requirements

- i. Creation of pollinator pathways of vegetation along roadways and through sites to attract bees, butterflies and other species of interest.
- ii. Usage of street tree, shrub and groundcover species that provide biological diversity and consistent food, forage and refuge for a range of urban species.
- iii. Extension of street planters and larger bulb-outs at corners to maximize street landscape coverage and diversity and incorporation of stormwater facilities to provide intermittent water, mud and nesting materials.
- iv. Reduction of turf areas and strategic integration of large patches of green roof with specific habitat elements into designs, such as woody debris, gravel/cobble and other elements typically not found in urban settings.