A PROPOSAL TO USE HERBICIDE TO MANAGE THE KNOTWEED INFESTATION IN THE CEDAR RIVER MUNICIPAL WATERSHED

SEATTLE PUBLIC UTILITIES

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OVERVIEW

Seattle Public Utilities (SPU) has a policy that was enacted in 1989 to not use herbicides in the Cedar River Municipal Watershed. The intent was to stop broadcast spraying of herbicide to control vegetation along forest roads, a typical forest management technique at that time. This was prior to the widespread recognition of the damage that certain non-native invasive plants can do to ecosystems and water quality. Since that time, many invasive species have become major ecological threats in our region, and some of these cannot practically be controlled by physical means.

Knotweed is one such widespread species, and it poses the greatest risk of any invasive plant in the watershed. Able to reproduce from tiny root fragments and occasionally from seed, it takes over habitats near water, completely displacing native species, degrading habitat of salmon and other species, and potentially degrading water quality by destabilizing streambanks and causing increased sediment in the streams. Knotweed is an aggressive, invasive plant that spreads rapidly downstream by flowing water and is extremely difficult and expensive to control by physical means alone. As a consequence, many organizations and land managers, including The Nature Conservancy, the Cascade Land Conservancy, and 17 counties, including King County, have been using a relatively safe herbicide to successfully control this weed immediately adjacent to streams, lakes, and wetlands. These agencies, along with many other landowners, have recognized that the risk to the environment posed by invasive species is far greater than the risk posed by responsible use of the herbicide.

SPU, King County, and the Cascade Land Conservancy are spending large amounts of money in attempts to control this destructive plant along the Cedar River below Landsburg, and upstream control is essential to the success of efforts to control it downstream. This proposal is to allow the use of an herbicide to control some infestations of knotweed in the municipal watershed in a manner that will (1) not pose a public health risk, (2) have a net ecological benefit, and (3) cost only about $30,000 over five years, compared to about $500,000 for physical means of control.

The City of Tacoma, with an unfiltered water supply, engages in spot application of herbicides for control of a variety of weeds near their water supply source, following a protocol approved by Washington Department of Health (WDOH). Water quality tests have never detected any herbicide in their water supply. Limited amounts of herbicide have been used in the South Fork Tolt Watershed to control hawkweed, with the knowledge of WDOH. Use of herbicide in the

Cedar will require an ordinance change and a minor modification of the Cedar River Watershed Habitat Conservation Plan (HCP).

BACKGROUND

SPU focuses on being effective stewards of the municipal watershed lands and resources it owns or controls. Maintaining healthy forests, wetlands, streams, and lakes in the municipal watersheds that supply Seattle-area residents with drinking water is a priority for SPU. It is these healthy ecosystems that provide the abundant and high quality drinking water on which the citizens of this region depend. Protecting water quality for human use also protects resources used by other species. Lands of the Cedar River Municipal Watershed are managed under the HCP, which requires that SPU promote and protect native diversity of plants and animals.

However, because the Cedar is experiencing increased infestation of non-native invasive plant species and currently lacks effective means to manage some of these species, SPU is proposing to use an herbicide treatment as part of its integrated pest management (IPM) for what is considered one of the most threatening and destructive invasive species, knotweed (*Polygonum* x *bohemica, P. cuspidata,* and *P. sachalinense*). After extensive review of the literature, we have come to the conclusion that the risk posed by knotweed is much greater than the risk posed by responsible application of a small amount of a certain herbicide. This document summarizes the proposed herbicide application and the associated rationale.

WHAT INVASIVE PLANT SPECIES IS BEING TARGETED AND WHY?

Non-native invasive species are organisms introduced deliberately or unintentionally outside their natural habitats where they have the ability to establish, invade, and locally eliminate native species, and dominate their new environments. They pose serious challenges to the conservation and sustainable use of global, regional, and local biodiversity, with significant undesirable impacts on the goods and services provided by ecosystems. Their management costs include not only costs of prevention, control, and mitigation, but also the direct and indirect costs associated with the adverse impacts on ecological services such as the production of clean, abundant water and the maintenance of habitat for salmon and other fish and wildlife.

Among the numerous invasive species present in the Cedar, knotweed is considered to be the most threatening due to its rapid growth, ability to quickly displace native vegetation, and alter soil and water chemistry. Specifically, knotweed is suspected or known to:

- reduce the amount and diversity of native streamside vegetation through both competition and secreted chemicals that are toxic to other plants;
- alter the quality, quantity, timing, and chemistry of leaf inputs into streams, thereby reducing the food available for aquatic insects; fewer insects means less food for fish;
- change the soil nutrients and alter soil nutrient cycling, affecting the growth and development of native plant species and insects living in the soil;

- decrease the density and diversity of plant-eating insects – essentially no native insects feed on knotweed; fewer insects means less food for fish, birds, and small mammals;
- destabilize streambanks, changing the patterns and amounts of streamside erosion and sediment input into streams, decreasing habitat quality for fish and other aquatic animals;
- provide no food or nesting habitat for native birds and mammals;
- modify the microclimate, making the area inhospitable to many native wildlife species, including reducing amphibian foraging success.

Once knotweed becomes established, it forms large stands that eliminate all native vegetation, are persistent, and are extremely difficult to eradicate. It can reproduce from tiny root or stem fragments, which are readily transported by water. If unchecked, stands continue to expand and provide propagules that exacerbate infestations downstream.

<u>WHAT IS THE EXTENT OF THE PROBLEM IN THE WATERSHED?</u>

The current infestation in the Cedar has been mapped to total about 15 acres—widely distributed in the lower Watershed, but also in the upper Watershed (Map 1). Fortunately, we do not have large infestations along the Cedar River. Most patches are concentrated along roads, old townsites, in wetlands, and a limited number in riparian zones of small streams.

The Division's past and current attempts at controlling knotweed have included only non-chemical methods on about 4.5 acres, including covering with geotextile fabric and some very limited hand pulling and excavation. We have targeted all the small knotweed patches and all patches considered to pose the highest ecological risk, i.e., patches in riparian areas, wetlands, near high quality forest and other wildlife habitat. Remaining patches are large and concentrated around Cedar Falls, the Education Center, the Masonry Dam, and the old Taylor Townsite. While none of these patches are adjacent to a river, they do pose a substantial risk of being inadvertently spread into riparian areas via wildlife or people working in the watershed. Plus, there is the remote chance that a small proportion of the seed may be viable and spread by either wind or wildlife.

Although covering with fabric appears to be effective, it is extremely costly and labor-intensive and must be maintained throughout the growing season for a minimum of five years. Covering patches is effective on smaller knotweed patches, but becomes logistically untenable on large patches. Large mammals such as elk, deer, bear, and cougar rip it up, and wind displaces it even when it is held down by numerous large rocks. Staking it down is problematic because the knotweed finds the holes and grows through them. Plus the animals have no problem dislodging the fabric from the stakes.

Other physical methods of control, such as hand pulling or cutting to starve the roots, require continual and intensive effort over many years. If this level of effort is not maintained, this method has proven to be ineffective. While these techniques may work on very small patches that are easily accessible, they are logistically impossible on large remote patches. Mowing and excavating the plant roots, either by hand or with heavy equipment, has been tried and only serves to spread the infestation.

Of the 15 acres, only about one acre is on land that drains into the Cedar River. The remainder is located in areas that drain either to the Snoqualmie River or Issaquah Creek.

WHAT ARE OTHER ORGANIZATIONS DOING TO CONTROL KNOTWEED?

The Washington Toxics Coalition, generally advocating non-chemical control of invasive plants, has the following statement in its Weed Management brochure, available on its website: "Although non-chemical control tactics are favored, it may sometimes be necessary to resort to chemical herbicides when the problem involves aggressive perennial weeds or labor is not available for other control methods." That conclusion has also been reached by most land managers regarding the control of knotweed.

The King County Noxious Weed Control Program started treating knotweed along the Cedar River below Landsburg (the municipal water intake) in 2008, funded by grants. SPU contributed ongoing physical treatment of knotweed in the municipal watershed as in-kind support. In addition, SPU treated knotweed on parcels it acquired in the lower Cedar River for HCP habitat protection, and is planning to re-treat these parcels and additional parcels that are acquired in 2009. Recently grant funding was obtained for 2010 and beyond, so SPU will expand its knotweed control efforts in the lower Cedar River to complement the King County's efforts. All of this treatment in the lower Cedar uses an herbicide. Experts from the King County Noxious Weed program have found that imazapyr is the most effective and safe herbicide for treating knotweed, resulting in the highest mortality and using the smallest amount of chemical.

Control of knotweed is not currently legally required by King County because it is so widespread. However, because of their intense control efforts in the Green River Watershed, in February, 2009, King County announced that knotweed control will be mandatory on the banks of the upper and middle Green River and its tributaries. Mandatory control may be required along other King County rivers in the future. The Cedar River in particular will likely have mandatory control once all the downstream patches are eliminated. Snohomish County requires all landowners to control knotweed anywhere within the county and herbicide is a recommended treatment.

Because of the scale of spread of knotweed and the extreme difficulty of control by physical means, The Nature Conservancy (TNC) has used herbicides as its primary means of control along rivers and near wetlands for many years. TNC recently switched to imazapyr as its primary herbicide. Kitsap County is also using herbicides to control knotweed on Bainbridge Island, calling the plant "a cancer on our land." Many cities (including Port Townsend) and sixteen other counties in Washington also use herbicide to control knotweed, most in riparian zones. The Washington Department of Ecology, in its Integrated Pest Management Profile for knotweed states: "Except for small patches that might be controlled non-chemically, any management of the species will likely require some herbicide use." (WDOE 2007)

The City of Tacoma, with an unfiltered water supply, engages in spot application of herbicides for control of certain weeds, following a protocol approved by Washington Department of Health, which involves sampling in any nearby water bodies.

<u>WHAT ARE THE COSTS OF CONTROL BY DIFERENT METHODS?</u>

SPU Watershed Services Division staff used data from past experience with physical control (installing and maintaining fabric) and estimates from other agencies using herbicides to compare the cost of controlling the untreated area of infestation. King County has found that a single treatment with the herbicide imazapyr kills about 95% of the plants in large infestations and 100% of the plants in small patches. Although multiple herbicide applications have been used by other landowners, repeated herbicide treatments for knotweed are not always effective. For this cost estimate, staff assumed a single herbicide application with the use of limited covering to treat the few residual plants not killed by the herbicide, and also assumed that it was logistically possible to cover and maintain fabric on very large patches (which in fact is not possible). The results of the cost analysis, completed in 2008 when the total untreated area was mapped to be 9.75 acres, as well as an analysis of ecological risks, are summarized in the following table.

Results of Analysis of Controlling 9.75 acres[1] of Knotweed by Covering or Herbicide

Method	5-year Cost	Ecological Risk from Knotweed	Ecological Risk from Treatment[2]	Notes
Covering only	$506,000	Low	Low	Very difficult to keep fabric in place as a result of animals and wind. Impossible to maintain fabric on large patches >4,000 ft2
Herbicide & covering[3]	$31,000	Low	Low	$9,00 for herbicide application, $22,000 for covering residual plants for 5 years
No treatment	$0[4]	Very high	Low	Plants would spread from these areas

1 *Currently mapped infestation is 10 acres*
2 *Includes public health risk*
3 *Recommended*
4 *Short-term. Long-term costs would be higher, if impacts of remaining knotweed are considered.*

The cost of treating these additional areas are not included in the current budget for invasive plant control, although the relatively small cost of treatment by herbicide could easily be absorbed into the current program. The cost estimate for covering only is simply for comparative purposes because of the logistical impossibility of using this option. The option of taking no action was ruled out, as these areas could then be sources for knotweed that would undermine efforts by SPU and King County to control the plant in downstream areas, ultimately increasing the cost of control and/or resulting in substantial negative ecological impacts. All treated sites will be replanted to native trees and shrubs. Planting costs were assumed to be covered under HCP restoration project funding and are not included here.

WHAT IS THE PROPOSED HERBICIDE AND HOW WILL IT BE APPLIED?

The proposed herbicide application would be an application of 1% solution of imazapyr (trade name: Habitat®, formulated and approved for use in and near water) with 1% surfactant (Agri-dex®, approved for aquatic use), applied strictly according to label instructions. This includes restrictions such as not applying during rain or wind or when any rain is predicted for the next several days. Imazapyr is a non-selective herbicide used for the control of a broad range of weeds including terrestrial annual and perennial grasses and broadleaved herbs, woody species, and riparian and emergent aquatic species. This combination of Habitat® and Agri-dex® is currently being used by the King County Noxious Weed Control Program in and around streams and water bodies, including along the Cedar River downstream of Landsburg.

The herbicide solution would be hand-applied to knotweed foliage using low-volume backpack sprayers with a non-toxic dye such as Hi-Light Blue Liquid that allows the applicator to see exactly where they have sprayed. This decreases the possibility of over-spraying an area. Experience has shown that the stem injection method typically uses about five times the amount of herbicide as does foliar spraying, with no greater knotweed mortality rates. The advantage of using stem injection is lower mortality to adjacent native plants. However, in the watershed the primary native plant species adjacent to the large knotweed patches is salmonberry. This is a common and robust native species that can easily be replanted. So we recommend using selective foliar spray to minimize the amount of herbicide used.

Only Washington-State certified pesticide applicators and those under their direct supervision will be allowed to apply the chemicals. They will all work under supervision of Watershed Services Division staff, who will also be state certified. A one-pass application would be made over the entire dispersed 10 acres of infestation between early August and mid-September during the pre-bud stage, which has been demonstrated to be the most effective growth stage for herbicide application. An estimated 12.3 gallons of tank mix per acre would be applied (which is approximately the middle of the recommended application rate of 5 to 20 gallons per acre). This would be a total of 1.23 gallons of imazapyr (equals 2.46 pounds of the acid equivalent of the active ingredient) and 1.23 gallons of Agri-dex® applied over the entire 10 dispersed acres of knotweed infestation, or 0.123 gallons per acre (equals 0.246 pound of acid equivalent per acre).

Only 1.2 acres of untreated knotweed are located on land that drains into the Cedar River. So a total of 0.148 gallons of imazapyr (equal to 0.3 pounds of acid equivalent) would be used on knotweed patches on land that drains into the Cedar River.

Most of the application will be applied in terrestrial environments and will not require any specific permit. All proposed treatment sites are several miles from the municipal water intake at Landsburg. A small percentage of the application is anticipated to occur in a riparian area in the Issaquah Creek watershed and may require coverage under an Aquatic Pesticide General Permit from the Washington State Department of Ecology. This area does not drain into water that reaches the Cedar River and the municipal water intake at Landsburg. None of the application will occur in water.

More details about the herbicide and surfactant and their safety can be found in Attachment 1.

HOW WILL THE TREATMENT BE MONITORED?

The Invasive Species Program Manager for SPU's three major watersheds (a wildlife biologist and watershed ecologist with extensive training and experience) will personally conduct compliance monitoring during all herbicide application. She will be on site throughout application to ensure that:

- herbicide is only applied during dry calm weather
- chemicals are properly mixed
- spray is properly applied
- there is minimal or no spray of adjacent native vegetation
- safety precautions, including personal protective equipment, for the applicators are followed
- chemicals are properly stored
- all paperwork required by the Washington Department of Ecology is complete and accurate

She will also personally collect all water samples for water quality testing (see below). Within one week of the treatment she and one other staff person will monitor all treated sites for any incidental wildlife mortality, searching especially for amphibians. Because imazapyr has such low toxicity (see below) and virtually no native animals use large monocultures of knotweed as habitat, the changes of finding any animal mortality is remote.

After application, all sites treated with herbicide will be monitored by Invasive Species Program staff for knotweed and adjacent vegetation response. All treated sites will be visited once during the fall after application, then every two months during the first growing season following treatment. Any mortality of adjacent vegetation and any knotweed re-growth will be measured and mapped using GPS. If a large amount of knotweed re-growth is observed, then the treatment will be reviewed and evaluated. Experts will be consulted in order to discover what went wrong.

All treated sites will be monitored at least three times a year for a minimum of five years to ensure that any re-growth is found early and treated immediately. All treated sites will be replanted with native trees and shrubs, and these plantings will be monitored at the same time. If necessary, we will periodically plant additional native species to ensure that the habitat is restored to a functioning native system.

A report documenting the application, initial monitoring results, and water quality testing results will be completed within six months of the treatment. An annual monitoring report documenting all findings, including maps and data, will be completed by December 31 each year. All reports will be placed on the City of Seattle HCP website, so will be available to the public for review.

ARE THESE CHEMICALS SAFE?

Imazapyr inhibits an enzyme only found in plants and is classified as a Category III (low toxicity) herbicide by the US Environmental Protection Agency. Imazapyr has relatively low toxicity to mammals, showing low toxicity if individuals get residues on their skin, and very low toxicity if it is eaten or inhaled. It is practically non-toxic to slightly toxic to fish and practically non-toxic to birds. Some formulations of imazapyr can cause severe eye irritation if it gets directly into a workers eye. Although this has not been reported for Habitat®, safety precautions, including personal protective equipment such as goggles, will be required for all applicators and the applications will be monitored to ensure worker safety.

In a 2004 risk assessment, the US Forest Service found that no adverse effects are likely to occur for a variety of mammals and birds, including herbivores and carnivores, with spraying at any typical application rate (Durkin and Follansbee 2004, Bautista 2005). Studies indicate that imazapyr is rapidly excreted by mammalian systems, with no bioaccumulation (The Nature Conservancy 2004). A peer-reviewed field study found that there were no adverse effects on stream macroinvertebrates at application rates as high as 100 times normal (Fowlkes et al. 2003). Although herbicides, including Habitat®, contain inert ingredients that are considered proprietary, these toxicity tests were performed on the entire formulation, not just the active ingredient.

In toxicity tests on juvenile rainbow trout, Agri-Dex® was found to be much less toxic than other surfactants. It took 271 parts per million (ppm) for an LC50 (the concentration at which 50% of the test subjects died), compared to 6, 17, and 74 ppm for the other commonly used surfactants tested (Smith et al 2004). It would require application directly into a stream and a water depth of less than 5 mm in order to reach the LC50 concentration for trout, a situation that would not occur in the field.

More details about the chemicals and their safety can be found in Attachment 1. The Material Safety Data Sheets for Habitat® and Agri-Dex® are attached (Attachments 2 and 3).

HOW IS IMAZAPYR BROKEN DOWN?

Imazapyr is water soluble and is broken down by sunlight in water with a reported half-life in water as short as two days (The Nature Conservancy 2004), but no longer than five days (Environmental Protection Agency 2006).

The half-life of imazapyr in soils in the field have been has been reported to be as short as 10 days to as long as 17 months in humid temperate climates, depending on soil type and particle size, pH, temperature, moisture content, and organic material content. In soils imazapyr is degraded by microbial metabolism. Because imazapyr is water-soluble, it can move in soil and can potentially enter the ground water. However, amount of movement depends on soil pH. Below pH 5, adsorption capacity of imazapyr increases and its movement in soils is limited (The Nature Conservancy 2004). Most forest soils in western Washington are acidic, with soils under

Douglas-fir generally under pH 6, and under red alder (common in riparian areas) under pH 5 (pers comm. Darlene Zabowski, soil science professor, University of Washington).

HOW CAN SPU BE SURE THAT DRINKING WATER WILL NOT BE AFFECTED?

None of the 1.2 acres of knotweed patches on land that drains into the Cedar River are adjacent to the river or any of its tributaries. The closest location is 250 feet from the river and over 10 miles from the municipal water intake at Landsburg. For terrestrial applications, the chance of imazapyr entering the Cedar River via surface runoff is extremely remote because proper protocols will be followed (i.e., no applications when raining or windy, targeted hand-spray of only knotweed) and because there are no surface channel connecting any of the knotweed patches to the river or any of its tributaries. The lack of surface channels is demonstrated by Lidar maps of the ground surface for the two areas within the Cedar River drainage (Maps 2 and 3). Because of the forest present between the knotweed patches and the Cedar River, no overland sheet flow occurs, even during large storm events.

Only a small amount of chemical (0.148 gallons or less than 2.4 cups, equal to 0.3 pounds of acid equivalent) would be applied within the Cedar River drainage, spread over the 1.2 acres of infestation. The vast majority of this chemical will be absorbed by the knotweed plants, as imazapyr is readily absorbed both by foliage and roots. However, we did a series of calculations assuming an absolute worst case (albeit completely unrealistic) scenario. First, we assumed a huge rainstorm washed all the chemical off the plants and none was absorbed by the roots. This is extremely unlikely because of the precautions we will take by not applying when any rain is predicted for several days. We then assumed the entire 2.4 cups moved into the groundwater. If this happened over the 1.2 acres, there is a very small chance that it could then move into the Cedar River. We continued our worst case scenario and assumed the entire 2.4 cups would flow down the Cedar River to Landsburg and all of it would be diverted simultaneously at Landsburg into the pipe that takes the water to Lake Youngs. In fact, if 2.4 cups flowed through the ground water into the Cedar River, it would happen slowly over time. Once it reached the river, it would be mixed into and diluted by the more than 35 million gallons of water flowing in the 10 miles of the Cedar River between Cedar Falls and Landsburg at the lowest flow time of year. Then at most two-thirds of it would be diverted into the pipe under only the very driest, low flow, and maximum municipal usage conditions.

Continuing the worst case scenario, if all 2.4 cups reached Lake Youngs, it would be diluted into the 11 billion gallons of water stored in this open lake, resulting in a concentration of 8 parts per trillion. The imazapyr would be exposed to sunlight both in the river and at Lake Youngs, and would be broken down with a half life of two to five days. The average residence time of water at Lake Youngs before it is transported via pipes to water customers, is over 70 days assuming an average withdrawal rate during the maximum demand months of July and August. In 70 days, the imazapyr would have undergone a minimum of 14 half-lives, during which time the original 2.5 cups would be reduced to 0.0003 cups or 0.014 teaspoon. So even under this highly unlikely worst case scenario, the chance of any detectable chemical being transported to any water customers is extremely minute. Under any likely scenario, the expected concentration after 70 days in Lake Youngs would be far less.

Dr. Allan Felsot, a widely respected and published toxicology expert at the Washington State University Food & Environmental Quality Lab, conducted an assessment of this proposal and prepared a worst case scenario in which the entire amount of herbicide mixture used on all of the knotweed (not just that within the hydrographic boundary) was put directly into Lake Youngs. That would result in a concentration of 26.6 parts per trillion of imazapyr. He assumed no breakdown of the chemical and evaluated the human health risk of this concentration in the drinking water. His data showed that this concentration was at least 600,000 times lower than a benchmark derived from an exposure that is already 100 times less than a dose that was found to cause no adverse effects. Thus the risk from this concentration could not be distinguished from nil.

Water quality samples will be taken at the municipal water intake at Landsburg within 24 hours after treatment, and again at one and two months after application, in case any small amount of chemical happens to reach the ground water. Samples will be sent to the Pacific Agricultural Laboratory in Portland, Oregon for analysis. This laboratory specializes in pesticide residue analysis and is accredited by the Washington State Department of Ecology. The Washington Department of Agriculture conducted water quality monitoring at three riparian sites that were treated with imazapyr using backpack sprayers, the same type of application that will be used. 24 hours after application no imazapyr was detectable in any of the water samples collected (Haubrich 2006; Haubrich and Archbold 2005).

WHAT ABOUT WATERS THAT DON'T DRAIN INTO THE CEDAR RIVER?

For the limited application in riparian areas near water that drains either to Issaquah Creek or the Snoqualmie River, the chance is very small that any amount of concern would enter water because of the small amount of chemical used, the application precautions taken, and the fact that only a very small amount of knotweed is adjacent to water in these areas. The water quality monitoring tests proposed below will provide a check on this assumption.

Water quality samples will be taken within 24 hours after treatment from any water body that is within 50 feet of herbicide application. For any areas that are surface-dry during application, but where water flows during fall or winter (a small site near the Taylor townsite, draining into Issaquah Creek), water samples will be taken within two weeks after surface water appears. If any chemical is detected, a series of samples at increasing distance from the application site will be taken immediately to determine the exact extent of the movement. These samples will be repeated at 2 week intervals until no chemical is detected.

DO OTHER UTILITIES IN OUR REGION USE HERBICIDES?

SPU belongs to a group of six water utilities in the Pacific Northwest called the Pacific Northwest Watersheds Group. An information request was sent to the other five utilities about their use of herbicides. Responses are shown below.

Utility	Use herbicides?	Notes
Portland	No	Little attention to date, but a new staff person hired specifically for invasive plant management is currently looking at using herbicides.
Tacoma	Yes, various	Backpack sprayer or stem injection using agreed protocols with WDOH. Water quality sampling has never revealed any detectable amounts of herbicide in their water supply.
San Francisco	Yes, various	Use herbicides for a large number of invasive species, for cost and effectiveness at the large scale of the problem in their watershed.
Vancouver	No	Not on their radar, but are interested in discussing herbicide use in the future
Victoria	No	Not on their radar, but are interested in discussing herbicide use in the future

While some of the above utilities currently do not use herbicides, the two that do not showed interest in our efforts to change this policy. This probably reflects the growing awareness of the problem with invasive organisms and the cost implications of various control methods.

WHAT PROCESS APPROVALS ARE REQUIRED FOR THIS PROPOSAL?

Existing City Ordinance 114632 ("Cedar River Watershed Secondary Use Policies") prohibits the use of herbicides in the Cedar. Thus, this proposed herbicide application would require a legislative change that must be approved by the Mayor's Office and Seattle City Council. There is a requisite public review and comment period associated with changes in existing ordinances. Prior to taking this proposed policy change to the Mayor's Office and City Council, SPU will seek feedback and concurrence from numerous agencies (including Washington Department of Health, U.S Fish and Wildlife Service, and NOAA Fisheries, among others). The Cedar River HCP may require a Minor Modification to allow this herbicide application. This would likely involve a simple letter of approval from the Services.

ATTACHMENT 1. DETAILS ABOUT THE CHEMICALS AND THEIR SAFETY

Obviously, herbicides are not safe for the targeted plants, which they are designed to kill. Information on the human health and environmental risks associated with imazapyr and other chemicals is available on the Internet and in the scientific literature and is summarized below. This herbicide and other chemicals are tested and registered for use by the Environmental Protection Agency (EPA) to assure unintended harm to human and ecosystem health will not occur. In addition, most states regulate herbicide use, primarily to assure their safe application, storage, and disposal.

Imazapyr Mode of Action

The proposed herbicide application is a one-time application of 1% solution of the isopropylamine salt of imazapyr (trade name Habitat®) with 1% surfactant (Agri-dex®), applied strictly according to label instructions. Imazapyr is absorbed quickly through plant tissue and can be taken up by roots. It is moved readily within the plant to the growing meristematic tissues, where it inhibits the enzyme acetohydroxy acid synthase (AHAS), also known as acetolactate synthase (ALS) (The Nature Conservancy 2004). ALS catalyzes the production of three essential amino acids required for protein synthesis and cell growth in the plant. The rate of plant death usually is slow (several weeks) and is likely related to the amount of stored amino acids available to the plant. Only plants have ALS and produce these three amino acids, therefore, imazapyr is of low toxicity to animals (including birds, mammals, fish, and insects) (Durkin and Follansbee 2004, Bautista 2005).

Imazapyr is degraded slowly in soils primarily by microbial metabolism. It will undergo rapid photodegradation (breakdown by sunlight) in water, but there is little to no photodegradation of imazapyr in soil, and it is not readily degraded by other chemical processes. Imazapyr does not bind strongly with soil particles, and depending on soil pH, can be neutral or negatively charged. When negatively charged, imazapyr remains available in the environment for continued uptake by the target species until it is degraded by soil microbes.

In water imazapyr initially photodegrades rapidly to two primary products, "CL 119060", and "CL9140" (7-hydorxyfurol[3,4-b]pyridine-5(7H) and 2,3-pyridinedicarboxylic acid). According to the manufacturers, CL119060 is biologically oxidized to CL 9140, and eventually mineralizes to carbon dioxide (CO_2) following the cleavage of the pyridine ring structure. Both imazapyr degradation products rapidly degrade, with half lives less than or equal to 3 days (Mangels and Ritter 2000).

Imazapyr Toxicity Studies

Imazapyr is classified as a Category III (low toxicity) herbicide by the EPA. Imazapyr has relatively low toxicity to mammals, showing low toxicity if individuals get residues on their skin, and very low toxicity if it is eaten or inhaled. Some formulations (for instance, inert ingredients in some imazapyr formulations such as Chopper® and Stalker®) can cause severe, irreversible eye damage. This has not been reported for the Habitat® formulation, however. The chemical formulation shows no mutagenic or potential for developmental malformations (The Nature Conservancy 2004).

Studies indicate imazapyr is excreted rapidly in urine and feces by mammalian systems. Residues of imazapyr did not accumulate in the liver, kidney, muscle, fat, or blood (Miller 1991). It is practically non-toxic to slightly toxic to fish, practically non-toxic to birds, and has low toxicity to algae. In a 2005 study, the US Forest Service found that no adverse effects should occur to a variety of mammals and birds with spraying at any typical application rate (Durkin and Follansbee 2004, Bautista 2005). The study evaluated both acute (single) and chronic (extending over the average species lifetime) exposures. Test animals included small mammals such as mice, small insectivorous mammals, both large and small herbivorous mammals, medium carnivorous mammals, fish-eating birds, herbivorous birds, predatory birds, and insectivorous birds. All of these toxicology tests were performed using the entire formulation, including the inert ingredients.

A peer-reviewed field study found that there were no adverse effects on benthic macroinvertebrates (including invertebrate biomass, community composition, and deformities) at rates as high as 100 times normal applications (Fowlkes et al. 2003). Another peer-reviewed study tested the embryos of zebra fish, an extremely sensitive in vivo test that reveals the effects of endocrine system dysfunction (Stehr et al. 2009). They found an "absence of toxicity at relatively high exposure concentrations".

Inert Ingredients and Surfactants

Formulations of Habitat® and other herbicides often contain proprietary carriers and other so-called "inert" ingredients that are usually not identified on herbicide labels. Inert compounds are those that are intentionally added to a formulation, but have no herbicidal activity themselves and do not affect the herbicidal activity. Inerts are added to the formulation to facilitate its handling, stability, or mixing. Adjuvants are compounds added to the formulation to improve its performance. They can either enhance the activity of an herbicide's active ingredient (activator adjuvant) or offset any problems associated with its application (special purpose or utility modifiers). Surfactants are one type of adjuvant that makes the herbicide more effective by increasing absorption into the plant, for example.

Inerts and adjuvants, including surfactants, are not under the same registration guidelines as are pesticides. The EPA classifies these compounds into four lists based on the available toxicity information. List 1 contains "inerts of toxicological concern"; List 2 contains "potentially toxic inerts, high priority for testing"; List 3 contains "inerts of unknown toxicity"; and List 4 contains "minimal risk inerts" or "inerts for which EPA has sufficient information to conclude that their current use patterns will not adversely affect public health or the environment." If the compounds are not classified as toxic, then all information on them is considered proprietary and the manufacturer need not disclose their identity.

The identity of inert compounds used in imazapyr formulations is generally confidential, but Syracuse Environmental Research Associates (SERA) reviewed them, using the Freedom of Information Act, for preparation of risk assessments conducted for the US Forest Service (Durkin and Follansbee 2004). They conducted very comprehensive searches of the literature and used peer-reviewed articles from public scientific literature, current U.S. Environmental Protection Agency (EPA) documents available to the public, and Confidential Business

Information to evaluate toxicity and risk from the herbicides analyzed. Their work was summarized in a 2005 US Forest Service document (Bautista 2005). No apparently hazardous materials were identified in the review of the inerts used in Habitat®. The NCAP website (http://www.pesticide.org/FOIA/picloram.html) identifies only glacial acetic acid, an approved food additive, as an inert ingredient. Isopropanolamine is also present, and it is classified as a List 3 inert.

Agri-Dex®

Surfactants are proprietary blends of heavy-range paraffin-based petroleum oil, polyol fatty acid esters, and/or polyethoxylated derivatives thereof. There is scant information on the human health and environmental effects of such surfactants. However, they have been approved by EPA for use in aquatic systems, and no adverse effects from their use on knotweed have been observed or documented. Agri-Dex® is a nonionic blend of surfactants and spray oil. It improves pesticide application by modifying the wetting and deposition characteristics of the spray solution, resulting in a more even and uniform spray deposit on the leaves of the target species.

The 2008 MSDS for Agri-Dex® reports that it is expected to be adsorbed to soil and should be biodegradable. Bioaccumulation is unlikely due to the low water solubility of the product. Animal toxicity data for similar products required very large doses (>2,000 mg/kg) to cause mortality, showed low inhalation toxicity, and were practically non-irritating to skin and eye in tests on rabbits.

The effects of Agri-Dex® on aquatic organisms and garter snakes has not been studied in depth, however, aquatic acute toxicity studies by Washington State University have indicated that Agri-Dex® is practically non-toxic and is less toxic to fish and aquatic invertebrates than R-11®, a commonly used surfactant (Anderson unpubl report). Agri-Dex® was also shown to be less toxic to fish and aquatic invertebrates than R-11® in preliminary lab work conducted by the California Department of Fish and Game Aquatic Toxicology Lab (Anderson unpubl report).

In toxicity tests on rainbow trout performed by the Washington Cooperative Fish and Wildlife Unit at the University of Washington, Agri-Dex® was found to be by far the least toxic surfactant tested (Smith et al. 2004). In laboratory tests it took 271 parts per million (ppm) for an LC50 dose (the concentration at which 50% of the test subjects died), compared to only 6 ppm for R-11, 17 ppm for LI700, and 74 ppm for Hasten (Smith et al 2004). They also studied the relative concentrations of the surfactants in relation to water depths expected in the field. Even at the maximum allowed concentration of Agri-Dex® of 5% (five times that used in knotweed control), a trout stream would have to be sprayed directly and be less than 5 mm (or about ¼ inch) deep in order to reach the LC50 concentration for trout. Clearly trout could never survive in such shallow water, so in practice no mortality would occur.

When asked to approve the use of herbicides for water hyacinth control in California, NOAA-Fisheries offered the biological opinion that the use of Agri-Dex adjuvant would not cause an adverse impact on salmon.

ATTACHMENT 2. MATERIAL SAFETY DATA SHEET FOR IMAZAPYR, HABITAT® FORMULATION

ATTACHMENT 3. MATERIAL SAFETY DATA SHEET FOR AGRI-DEX®, SURFACTANT

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