

**KING COUNTY DEPARTMENT OF TRANSPORTATION
ROAD SERVICES DIVISION
ROADSIDE WEED CONTROL PROGRAM
MONITORING REPORT
2005**

Submitted by

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Public Health
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EXECUTIVE SUMMARY

Public Health - Seattle & King County (PHSKC) monitored the King County Department of Transportation's Roadside Weed Control Program in 2005. As in past years, six sample sites were monitored in King County. Data patterns have been consistent over the last four years. *Roundup Pro* was detected at low levels. *Oust XP* was detected at lower levels and *Escort XP* at the lowest levels. All levels diminished over time.

One goal of the current PHSKC work is to document that low levels of product application with gradually diminishing persistence are effective. Research papers describe *Roundup Pro* as having "moderate persistence" in soils, as evidenced by the very low concentrations present after several weeks. PHSKC found that the low concentration of application and the low persistence properties has been the pattern for the last four years.

Concentrations may be elevated at some sites independent of King County's application rates. Other influences on the persistence of the herbicides in the environment may be: 1) a history of higher applications in years past; and 2) other applicators such as local parks departments or individuals applying herbicides without the knowledge of King County Road Services Division (Roads). Since 1999 and 2000, King County has reduced roadside spray applications by 86.5 percent by volume. This reduction was accomplished in response to Road's use of the King County Integrated Pest Management (IPM) policies, fishery concerns, and a diversion of staff to noxious weed control.

PHSKC continues to assert that there is minimal risk to public health when herbicides are used sparingly, judiciously, and in a manner consistent with the label requirements and the IPM policy. There are fewer non-detects in 2004 and 2005 because detection limits have been lowered by new laboratory technology. However, the range of the numbers is consistent with the past three years.

The data document conformance with the Tri-County IPM Policy for King County by both its reduced and prudent use of *Oust* and *Roundup*, listed as "Tier II" levels of risk, and *Escort* listed as a "Tier I" level of risk. As in the previous three years, there were no documented cases of misapplication or public health complaints from businesses, other agencies or the public during 2005.

Roads' practices have garnered state wide interest. In 2004, PHSKC participated on a team project with Washington Department of Transportation where we shared Road's approach with a team working to identify practical alternatives for maintenance of vegetation at the pavement edge <http://www.wsdot.wa.gov/maintenance/research.htm>. King County has the only data on roadside spraying in Washington.

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INTRODUCTION

The King County Department of Transportation, Road Services Division (Roads) is responsible for roadside weed control throughout unincorporated King County. One of the significant elements of the weed control program has always been the application of herbicides on the road shoulders. Roadside weed control is implemented according to county policy. In September 1999, the King County executive adopted the Tri-County IPM Model Policy for King County, which incorporates public health risk, safety, and drainage control as key components.

Under a Memorandum of Understanding, Public Health - Seattle & King County (PHSKC) monitors soils and surface waters for herbicide residuals and contamination, and assists in responding to any public complaints or concerns. The PHSKC sampling and testing activities in 2005 were implemented in acknowledgement and consideration of the Tri-County IPM Policy and based on discussions with Roads. This report documents our annual surveillance activities. Since 2002, the monitoring has been done under a quality assurance project plan which triggered a change to a more sensitive chemical analysis and a health and safety plan.

This report discusses any new information found in the 2005 scientific literature research, the observations made on location and the 2005 analytical results. The 2002 research indicated an evolving set of analytical methods, and recommendations for weed control program adjustments. 2005 literature research indicates that the products are effective at lower levels than previously thought and that the analytical methods are effective at detecting lower levels. In 2004, the detection limits were lowered by new technology at the laboratory. Since 2004, the laboratory has used a new LC-MS for the Oust and Escort analysis, thus lowering the reporting limits. Consequently, there are fewer non-detects but the range of the results is comparable to those of 2002 and 2003.

In 2004, Lee Dorigan participated in a project with the Washington Department of Transportation (WDOT) on practical roadside spraying alternatives. WDOT contacted her because they had heard of the program at Roads. With the approval of Roads, PHSKC shared the data of the last three years with the consultant. It is the only available data on roadside spraying in Washington. The project and the meeting minutes are available for viewing on line at <http://www.wsdot.wa.gov/maintenance/vegetation/meeting.htm> . A consultant's report is anticipated by next year. <http://www.wsdot.wa.gov/maintenance/vegetation/research.htm> provides a draft of an 8 state survey of pesticide use in roadside vegetation management.

BACKGROUND INFORMATION

The herbicides sampled for this report were:

- 1) Glyphosate (*Roundup Pro*) Tri-County IPM Policy – Tier II herbicide,
- 2) Sulfometuron (*Oust XP*) Tri-County IPM Policy – Tier II herbicide, and
- 3) Metsulfuron-methyl (*Escort XP*) Tri-County IPM Policy – Tier I herbicide.

All of the listed herbicides were used at all of the sample site locations. In 2003, Road Services Division switched from Roundup to Roundup Pro, Oust to Oust XP and from Escort to Escort XP. However, there were changes were not in the active ingredients or substantially in the ratio of active ingredients to inert ingredients. Any changes in the inert ingredients are trade secrets. The new

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formulations provide improved solubility and suspendability with less dust.

Glyphosate (trade names *Accord*, *Roundup Pro* or *Rodeo*) is an organic solid of odorless white crystals. (Aminomethyl) phosphonic acid (AMPA) is the primary degradation product of glyphosate. It is used primarily as a post-emergent herbicide to control grasses, herbaceous plants including deep-rooted perennial weed, brush, some broadleaf trees and shrubs, and some conifers. It works by inhibiting production of an enzyme that is essential to the formation of key amino acids in plants. Optimal control of most perennial weeds occurs when the treatment is applied at late growth stages. Rainfall or irrigation occurring within six hours may reduce its effectiveness. Glyphosate may not provide residual weed control. It should be applied at a rate sufficient to wet the targeted vegetation without causing pooling or runoff.

Glyphosate has very low toxicity in mammals. The chemical is poorly absorbed from the digestive tract and is largely excreted unchanged by mammals. Potential absorption through the skin is very low. The acute oral toxicity for glyphosate in mammals is in United States Environmental Protection Agency's (EPA) category IV, the lowest. Glyphosate shows no significant potential to accumulate in animal tissue; however, it may cause skin and eye irritation. The herbicide is "slightly toxic" to aquatic invertebrates and "moderately toxic" to fish according to EPA. Glyphosate is not expected to result in adverse effect to earthworms and honeybees. To date, the animal research on glyphosate indicates no significant reproductive, teratogenic, mutagenic, or carcinogenic effects.

Roundup Pro contains 44.5% water, 41% isopropylamine salt of glyphosate, and 14.5% surfactant. One potential concern with Roundup is the surfactant called polyoxyethyleneamine (POEA). It is listed as inert and accounts for almost 15 percent of Roundup's total volume. POEA is three times more toxic than glyphosate. It is unclear if POEA is in Roundup Pro.

Sulfometuron methyl (trade name *Oust XP*) is a broad-spectrum sulfonyleurea class herbicide used to control annual and perennial grasses and broadleaf weeds on non-crop land. It may be used in both pre-emergence and post-emergence applications. The best results are obtained if the application is made before or during the early stages of vegetation growth. This herbicide works by blocking cell division in the active growing regions of stems and roots. *Oust XP* should be used during seasons where rainfall occurs because moisture is required to move it into the root zone before vegetation becomes well established. The herbicide does not bind strongly to soil and is practically insoluble in water. *Oust XP* is applied in suspension. Its half-life in soil is approximately one month but it remains longer in soil with a cool temperature, low moisture or alkaline pH. Groundwater contamination is rare. Surface waters may be contaminated if *Oust XP* is applied to areas where runoff is likely to occur. Field study data indicates that a majority of the parent compound stays within the top three inches of soil.

Sulfometuron methyl has very low toxicity in mammals. The compound did not accumulate in rats. Sulfometuron methyl is readily absorbed through the gastrointestinal tract of human and animals and is rapidly broken down and removed from the body. However, overexposure of the skin may cause irritation with or without a rash. Eye contact may cause irritation, tearing or blurring of vision. The acute oral toxicity for *Oust XP* in birds is very low. The herbicide is even less toxic to freshwater fish. Few chronic toxic effects from exposure to sulfometuron methyl have been seen in test animals using comparatively high dosages over an extended period of time. Sulfometuron also has not shown

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any significant reproductive, teratogenic, mutagenic, or carcinogenic effects in test animals. *Oust XP* contains 25% unknown inert ingredients.

Metsulfuron methyl (trade names *Ally*, *Allie*, *Gropper* or *Escort XP*) is a residual sulfonylurea compound used as a selective pre- and post-emergence herbicide for broadleaf weeds and some annual grasses. It is a systemic compound with foliar and soils activity and it works rapidly after the plant takes it up. This herbicide inhibits cell division in the shoots and roots of the plant, and it is biologically active at low use rates. Plants rapidly take up metsulfuron-methyl at the roots and on foliage. The chemical is translocated throughout the plant, but is not persistent. Soil microorganisms break it down to lower molecular weight compounds under anaerobic conditions. Metsulfuron degrades in water within 1 to 8 days when exposed to artificial sunlight. However, it is soluble in water, so it leaches and has the potential to contaminate ground water at very low concentrations.

Metsulfuron has very low toxicity in mammals. Systemic poisoning by sulfonylurea based compounds is unlikely, unless large quantities have been ingested. No accounts of poisoning by metsulfuron-methyl have been documented. The chemical is broken down quickly and eliminated from the body, however it may cause eye and skin irritation in humans. In tests with radiolabeled metsulfuron-methyl, the excretion half-lives of the herbicide ranged from nine to sixteen hours, and twenty-three to twenty-nine hours for rats administered low and high doses, respectively. There was no bioaccumulation in fish. Metsulfuron-methyl has very low toxicity for aquatic organisms and less for avian organisms. To date, the animal research on metsulfuron-methyl indicates no significant reproductive, teratogenic, mutagenic or carcinogenic effects. *Escort XP* contains 40% unknown inert ingredients.

The King County Department of Transportation, Road Services Division uses its newer application technology, the Norstar Injection System. The system contains three separate chemical tanks and a single water tank that are all connected to a computerized control, which is linked, in turn, to a radar ground speed system. The herbicides are strategically applied either individually or combined while the vehicle is under way. The spray swath is adjustable from two to twenty-seven feet. Water is applied at fifty gallons per acre, *Escort XP* at 1.0 ounce per acre, *Oust XP* at approximately 4.8 ounces per acre, and *Roundup Pro* at about 16.0 ounces per acre. This system has the advantage of using *Oust XP*, *Escort XP*, and/or *Roundup Pro* only when ground vegetation requires it (rather than the historical practice of mixing of 1,000 gallons of product with water in advance). This micro-managed adjustability has resulted in an application of less herbicide. Record keeping has also improved with use of the on-vehicle computer that tracks square yards of spray per chemical.

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LITERATURE REVIEW

A literature search was conducted in 2005 using Internet sites of: the EPA - Office of Prevention, Pesticides and Environmental Health; Federal Department of Health and Human Services - Agency for Toxic Substances Disease Registry and U.S. Department of Agriculture, Forest Service. Two useful documents are a Forest Service monograph on glyphosate and an EPA risk assessment document. They may be accessed from the following websites:

<http://www.fs.fed.us/r6/siskiyou/planning/knapweed/glyphosate.pdf#xml=http>.

<http://www.epa.gov/oppfead1/endanger/effects/glyphosate-analysis.pdf>

Additionally, more accurate and precise analytical methodologies are continuing to evolve. Pacific Agricultural Laboratory is current on the most accurate and widely accepted methods. In 2005 there were no significant new cautions, alerts or information detrimental to public health or the environment that would call for a reduction or removal of the use of *Roundup Pro*, *Oust XP* or *Escort XP* specifically. However one article published in 2005 notes potential endocrine and toxic effects of glyphosate in combination with the adjuvants used in some *Roundup* formulations to cell lines exposed at levels similar to agricultural dilutions.

PROCEDURES

Full soil sample sets were taken from six locations and water samples were taken from three locations in unincorporated King County in two sampling events. In the first event, two sets of samples were taken. The first set was taken before application and the second set was taken directly after application. In the second event one set of samples was taken several months after the first weeks of the rain season. For the second event, care was taken to select a location close to the first event location and where there was the least vegetation. The samples were analyzed for the presence of *Oust XP*, *Escort XP*, *Roundup Pro* and AMPA, a residual of *Roundup Pro*.

The locations of the 2004 and 2003 sample sites in unincorporated King County were as follows:

1. 12800 164th Avenue SE, Renton, 98059 ([new] near entrance to Briarwood Market)
2. SE May Valley Rd by SE 128 Way, Issaquah, 98027
3. 247th Place SE near Mirrormont Place SE, Issaquah, 98027
4. 284th SE between SE 472nd and SE 474th Streets, Enumclaw, 98022
5. SE Lake Holm Road near 141st Place SE, Auburn, 98092
6. Skyway area, near 7108 South 132nd, King County 98178

A map of the King County area with the sites noted is in addendum 1. This map is followed by detail overview maps of each site. This study was designed to monitor the presence, persistence and any movement to water of the herbicides used for weed control along King County roadside shoulders. Quality assurance project plan and field sampling plans, detailing all procedures were revised. Copies of these plans were submitted to staff at roads to be reviewed. The second data set, taken after spraying, can also be used to provide information about application rates.

Samples were submitted for analysis at the end of each sampling day to OnSite Laboratory in Redmond for shipment to Pacific Agricultural Laboratory in Portland, Oregon. Data reports are included in addendum 2 and were submitted earlier by electronic mail.

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DATA / SITE OBSERVATION AND ANALYSIS

The following section includes the information collected at each of the six test sites. Levels not detected by the laboratory analysis are noted as ND.

LOCATION #1 12800 164th Avenue, Renton 98059

Sample timing/date	Media	Glyphosate Roundup	AMPA degeneration byproduct	Sufometruronmethyl Oust	Metsulfuronmethyl Escort
		mg/kg (ppm)	mg/kg (ppm)	ug/kg (ppb)	ug/kg (ppb)
Pre spray	1-2" soil	0.031	0.031	ND	ND
June 8, 2005	2-4" soil	0.14	0.030	ND	ND
	water - ug/kg (ppb)	ND	ND	ND	ND
Post spray	1-2" soil	0.24	063	69	12
June 8, 2005	2-4" soil	0.032	0.072	2.3	ND
	water - ug/kg (ppb)	ND	ND	0.15	ND
After late rains	1-2" soil	0.029	0.017	3.8	ND
October 5, 2005	2-4" soil	ND	ND	1.4	ND
	water - ug/kg (ppb)	ND	ND	0.11	0.013
	water - ug/kg (ppb)	ND	ND	0.12	0.012

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LOCATION #2 SE May Valley Rd by SE 128 Way, Issaquah, 98027

Sample timing/date	Media	Glyphosate Roundup	AMPA degeneration byproduct	Sufometruron-methyl Oust	Metsulfuron-methyl Escort
		mg/kg (ppm)	mg/kg (ppm)	ug/kg (ppb)	ug/kg (ppb)
Pre spray	1-2" soil	0.071	0.14	ND	ND
June 8, 2005	2-4" soil	0.13	0.40	0.49	ND
	water - ug/kg (ppb)	ND	ND	0.19	ND
Post spray	1-2" soil	0.25	0.50	30	2.3
June 8, 2005	2-4" soil	0.11	0.34	1.3	ND
	water - ug/kg (ppb)	3100	ND	530	150
After late rains	1-2" soil	0.13	0.41	160	17
October 5, 2005	2-4" soil	0.025	0.072	36	ND

LOCATION #3 247th Place SE and Mirrormont Place SE, Issaquah, 98027

Sample timing/date	Media	Glyphosate Roundup	AMPA degeneration byproduct	Sufometruron-methyl Oust	Metsulfuron-methyl Escort
		mg/kg (ppm)	mg/kg (ppm)	ug/kg (ppb)	ug/kg (ppb)
Pre spray	1-2" soil	0.78	0.73	5.3	ND
June 8, 2005	2-4" soil	0.12	0.42	0.67	ND
Post spray	1-2" soil	0.11	0.21	3.9	ND
June 8, 2005	2-4" soil	ND	ND	ND	ND
After late rains	1-2" soil	0.056	0.15	4.1	ND
October 5, 2005	2-4" soil	0.074	0.40	1.5	ND

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LOCATION #4 284th SE between SE 472nd and SE 474th Streets, Enumclaw, 98022

Sample timing/date	Media	Glyphosate Roundup	AMPA degeneration byproduct	Sufometruron-methyl Oust	Metsulforon-methyl Escort
		mg/kg (ppm)	mg/kg (ppm)	ug/kg (ppb)	ug/kg (ppb)
Pre spray	1-2" soil	0.043	0.078	2.3	ND
June 8, 2005	2-4" soil	ND	ND	ND	ND
	water - ug/kg (ppb)	ND	ND	ND	ND
Post spray	1-2" soil	0.018	0.0092	5.5	ND
June 8, 2005	2-4" soil	ND	ND	ND	ND
	water - ug/kg (ppb)	ND	ND	ND	ND
After late rains	1-2" soil	0.088	0.86	7.3	ND
October 5, 2005	2-4" soil	0.056	0.39	1.7	ND
	water - ug/kg (ppb)	ND	ND	ND	ND

LOCATION #5 14100 SE Lake Holm Rd

Sample timing/date	Media	Glyphosate Roundup	AMPA degeneration byproduct	Sufometruron-methyl Oust	Metsulforon-methyl Escort
		mg/kg (ppm)	mg/kg (ppm)	ug/kg (ppb)	ug/kg (ppb)
Pre spray	1-2" soil	0.062	0.12	1.8	ND
June 8, 2005	2-4" soil	0.10	0.54	1.5	ND
Post spray	1-2" soil	0.90	0.25	580	64
June 8, 2005	2-4" soil	0.085	0.11	4.1	ND
After late rains	1-2" soil	0.42	0.95	2.1	0.87
October 5, 2005	2-4" soil	0.13	0.24	0.87	ND

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LOCATION #6 Skyway area, near 7108 South 132nd, Seattle, 98178

Sample timing/date	Media	Glyphosate Roundup	AMPA degeneration byproduct	Sufometruron-methyl Oust	Metsulforon-methyl Escort
		mg/kg (ppm)	mg/kg (ppm)	ug/kg (ppb)	ug/kg (ppb)
Pre spray	1-2" soil	0.068	0.33	7.4	ND
June 8, 2005	2-4" soil	0.024	0.11	9.8	2.3
	water - ug/kg (ppb)	ND	ND	ND	ND
Post spray	1-2" soil	0.83	0.31	310	47
June 8, 2005	2-4" soil	0.011	0.049	6.8	ND
	water - ug/kg (ppb)	46	ND	23	ND
After late rains	1-2" soil	0.86	0.75	0.79	ND
October 5, 2005	2-4" soil	0.038	0.13	ND	ND
	water - ug/kg (ppb)	16	13	0,0081	ND

The first round of sampling for pre and post spray media had smaller volumes collected than the second round samples after seasonal rains started.

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DISCUSSION and DATA ANALYSIS

The table contains averages of each year's samples for each type of sample taken. Non detected levels were assigned a zero value.

Pre spray averages					
1-2" soil		Glyphosate Roundup	AMPA degeneration byproduct	Sufometruron-methyl Oust	Metsulforon-methyl Escort
2005		0.2048	0.2796	3.3600	ND
2004		0.5478	0.9760	56.8000	0.0466
2003		0.1292	0.4583	0.0046	0.0016
2002		0.5650	0.6500	0.0265	0.0060
2-4" soil					
2005		0.1300	0.2833	0.2067	0.3833
2004		0.1092	0.3100	11.8140	0.6200
2003		0.0527	0.2882	0.0034	0.0000
2002		0.1490	0.1600	0.0027	ND
Water					
2005		0.0000	0.0000	0.1900	ND
2004		0.7667	6.6666	ND	ND
2003		4.6667	0.0000	0.0800	0.0000
2002		ND	ND	ND	ND
Post spray averages					
1-2" soil		Glyphosate Roundup	AMPA degeneration byproduct	Sufometruron-methyl Oust	Metsulforon-methyl Escort
2005		0.3913	64.2792	166.4000	20.8833
2004		0.9758	0.3373	586.1900	7.0740
2003		2.9755	2.0900	0.6887	0.0194
2002		3.4680	0.8190	0.3366	0.0150
2-4" soil					
2005		0.0480	0.0795	5.4500	ND
2004		1.5250	0.3963	557.1400	3.0200
2003		0.1817	0.5157	0.0150	0.0022
2002		0.5340	0.2680	0.1227	0.0017
Water					
2005		786.5000	0.0000	138.2875	37.5000
2004		8.5050	0.0100	5.3333	2.5000
2003		125.0000	8.1667	8.6000	1.1267
2002		ND	ND	ND	ND

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Post rain averages					
1-2" soil		Glyphosate Roundup	AMPA degeneration byproduct	Sufometruron-methyl Oust	Metsulforon-methyl Escort
2005		0.2638	0.5228	29.6817	2.9783
2004		0.6550	0.8020	101.1166	0.2000
2003		0.4363	0.6333	0.0063	0.0020
2002		0.6000	0.4400	0.0305	0.0000
2-4" soil					
2005		0.0538	0.2053	6.9117	ND
2004		0.2315	0.3594	21.4830	0.3300
2003		0.1315	0.4468	0.0015	0.0008
2002		0.1650	0.3600	0.0250	0.0008
Water					
2005		4.0000	3.2500	0.0595	0.0063
2004		ND	ND	0.0400	ND
2003		ND	ND	ND	ND
2002		ND	ND	ND	ND

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The following patterns are noted. The water is showing two general patterns. As detection levels decrease, it becomes evident that there is herbicide in the water before spraying. Additionally, random herbicide hits occasionally come through the roadside ditches. They can be differentiated from county application by timing and ratios that are different from those used by the county

The soils patterns are consistent. Before spraying the soil returns to levels that are similar each year for each of the three analytes. Averages for the three herbicides remained in soils at levels similar to previous two years. After application levels are greatly higher than pre-spray levels in 2005 because of the exceptional level of the site number two water post spray sample. After 15 weeks soil sample levels had all dropped dramatically. All results in the post rain season are well below EPA maximum contaminate levels (MCL) for water. The drinking water MCL for glyphosate is 700 ppb. There is no MCL for sulfometuron-methyl or metsulfuron-methyl. However, *Escort XP* had the lowest levels of any of the herbicides.

The 2005 monitoring data, coupled with the reduction in roadside spray application, demonstrates the King County Roads Service Division's basic ongoing adherence to the goals and objectives previously established in the *King County Integrated Vegetative Management Plan* and to the Tri-County IPM Policy for King County.

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RECOMMENDATIONS

1. King County Department of Transportation, Road Services Division staff continue with their responsible and successful methods of reducing herbicide use and minimizing herbicide dosage when applied.
2. PHSKC monitoring personnel will continue to review information, to update and to follow the quality assurance project and sampling plans annually.
3. PHSKC and King County Road Services Division will continue to use the new Tri-County IPM Policy for King County as a guideline for monitoring the King County roadside weed control.

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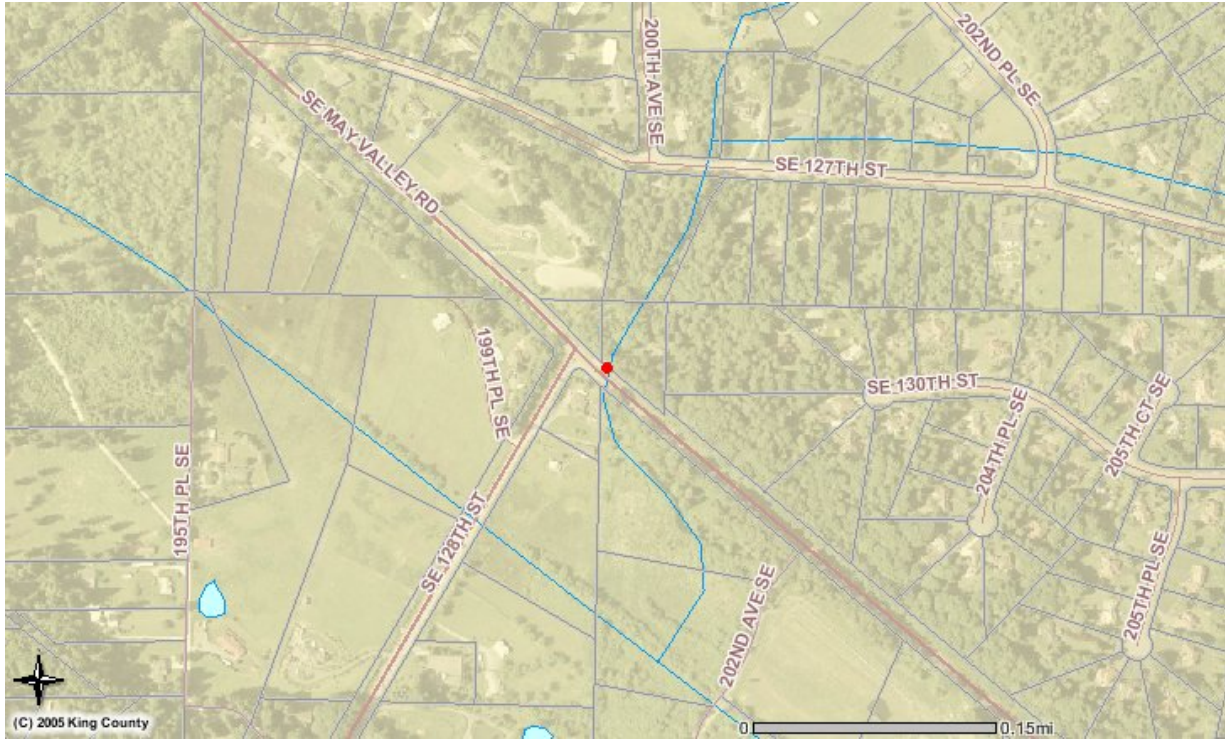
Differential Effects of Glyphosate and Roundup on Human Placental Cells and Aromatase, S. Richard et al, Environmental Health Perspectives, Vol 113 num 6, June, 2005)

ADDENDUM 1
Maps

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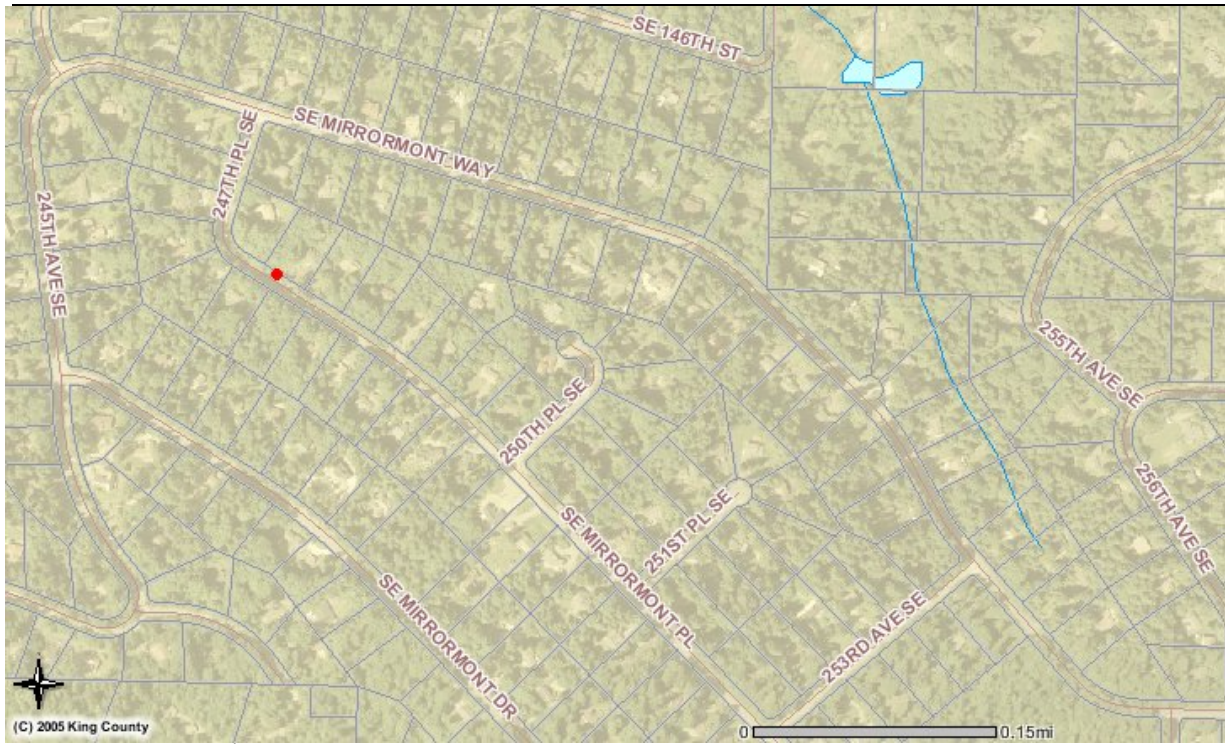


Location # 1: 12800 164th Avenue SE, Renton 98059



Location #2: SE May Valley Rd by SE 128 Way, Issaquah, 98027

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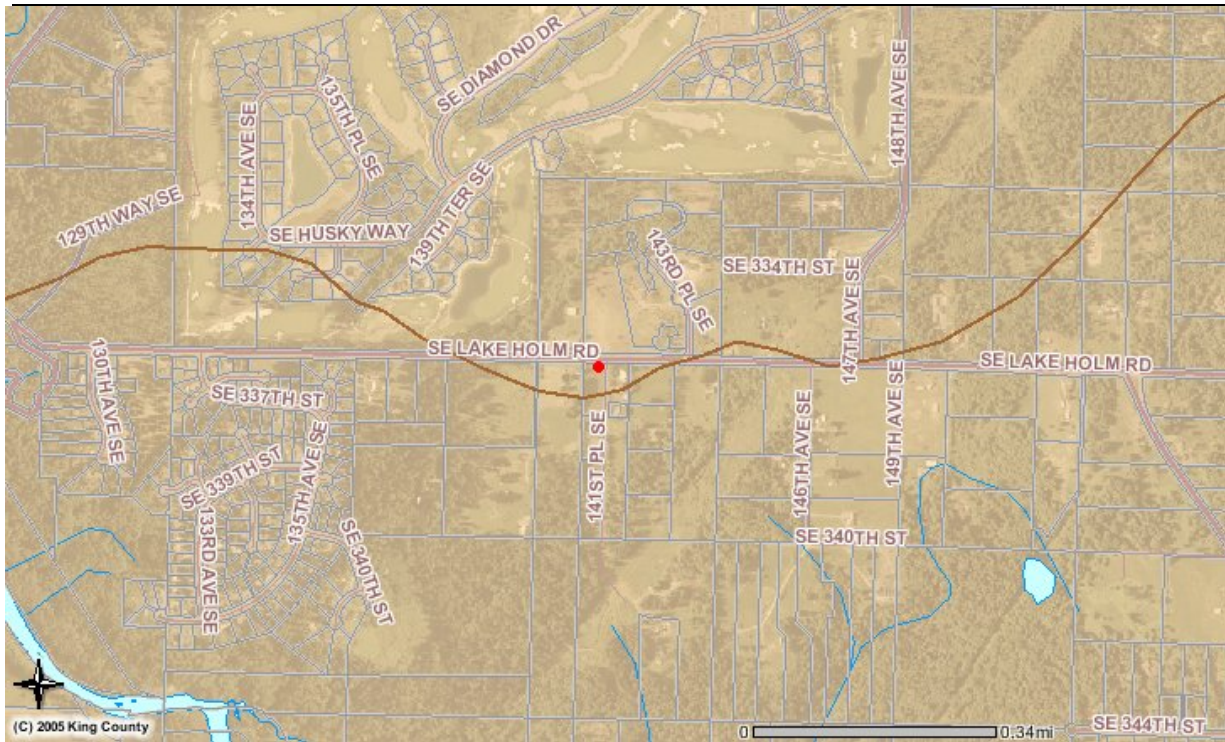


Location #3: 247th Place SE near Mirrormont Place SE, Issaquah, 98027

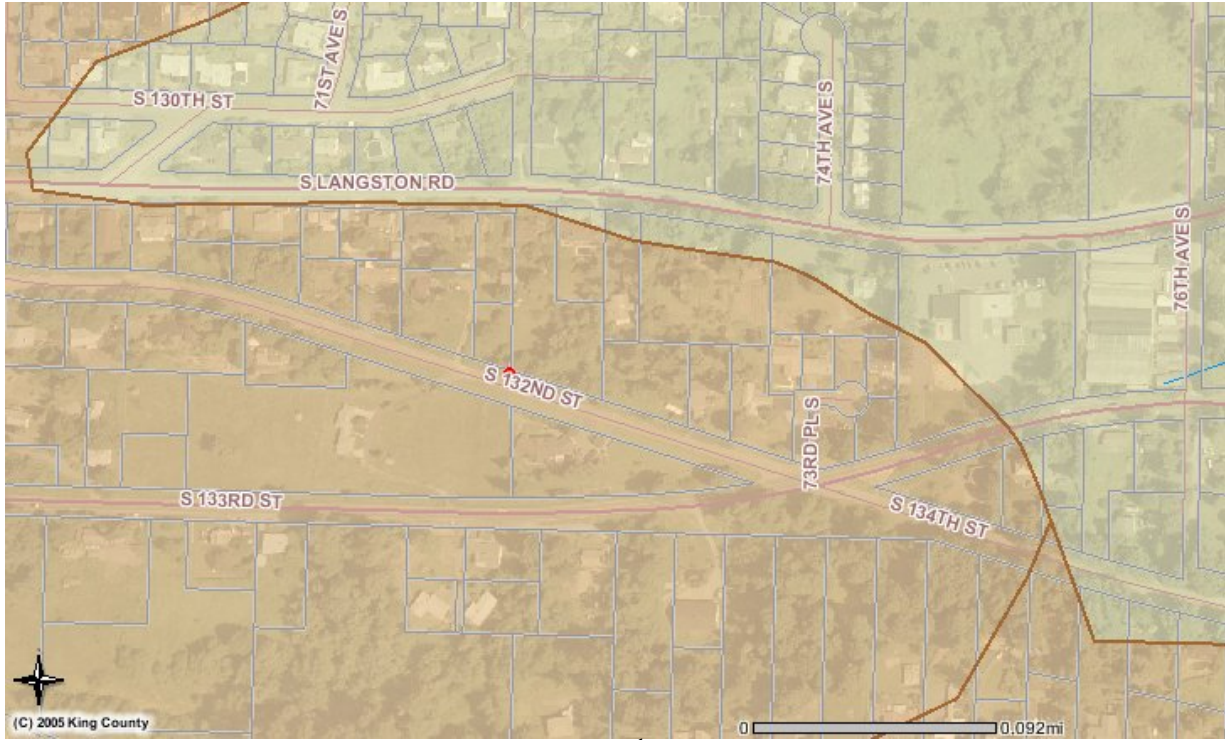


Location #4: 284th SE between SE 472nd and SE 474th Streets, Enumclaw, 98022

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Location #5: SE Lake Holm Road near 141st Place SE, Auburn, 98092



Location #6: Skyway area, near 7108 South 132nd, King County 98178

ADDENDUM 2: Laboratory Reports