Oregon Department Of Forestry:
Forest Chemical Application Monitoring Program

November 1997

The attached protocol has been developed to test compliance and effectiveness of Best Management Practices (BMP's) in protecting water quality during aerial applications of forest pesticides. This document describes the Oregon Department of Forestry's (ODF's) approach and provides a protocol that can be utilized in other monitoring programs. ODF has coordinated with private landowners, representatives of the environmental community, Oregon State University (OSU) and community water managers in developing the protocol.

Effectiveness and Implementation Questions

Are BMP's protecting riparian vegetation and water quality during forest chemical applications?

Are chemical application BMP's being implemented properly?

Need: Forest pesticides are commonly used to aid in the re-establishment, growth and harvest of conifer species through out Oregon. In 1997 the Board of Forestry revised forest practice rules regarding chemical application. Effectiveness and implementation of these rules in protecting water quality and riparian vegetation needs to be tested.

MONITORING STRATEGY

The chemical application-monitoring program is composed of effectiveness and compliance monitoring. Effectiveness monitoring will consist of water quality and aquatic insect sampling and community water manager coordination. Compliance monitoring will consist of visual observation during the operation, a follow-up vegetation survey, investigation of public complaints, and PARC interagency investigations.

Trained field crews under the supervision of the ODF monitoring coordinator will implement the majority of the monitoring program. Field data collection will take place in the spring and fall. Other forest practices staff, landowners and operators will coordinate on different aspects of the project. Data analyses and reports will be conducted by the ODF monitoring coordinator.

MONITORING FOCUS

ODF is committed to testing the effectiveness and implementation of the forest practice rules in protecting riparian function and water quality during aerial application of pesticides. The program will prioritize monitoring efforts based on past findings, toxicity criteria, chemical use, and regional distribution of chemical applications over the past two years. The program will coordinate with private landowners in situations where the landowner has existing plans to

monitor. ODF will seek additional funding for effectiveness monitoring to augment the current monitoring budget.

Past Findings

Water sampling results: Forest chemical monitoring has taken place in Washington and Oregon over the past 16 years. Results from three different studies indicate that the majority of the 24-hour-average composite samples contained either no detectable residue or less than 1.0 ppb of the applied chemical (Figure 1). From 1980 to 1987, ODF implemented a water-sampling program to assess the effectiveness of the forest practice rules in protecting the waters of the state (Oregon Department of Forestry, Forest Practices Monitoring Program, 1992). A representative subset of total chemical applications was monitored totaling 153 water samples. Of 153 samples analyzed, 86 percent (132 samples) resulted in no detectable chemical residue. A subsequent study was carried out from 1989 to 1990 by ODF to assess herbicide applications again. Of 52 samples analyzed 83 percent (43 samples) resulted in no detectable herbicide.

The Washington Timber Fish and Wildlife Program (TFW) intensively studied six monitoring operations during 1991 (Rashin and Graver, 1993). Of six samples analyzed, 83 percent (5 samples) contained 0.13 to 0.56 ppb of the applied herbicide. Results of these three studies indicate that under most conditions, chemical concentrations greater than 1 ppb are relatively rare as a result of forest operations.

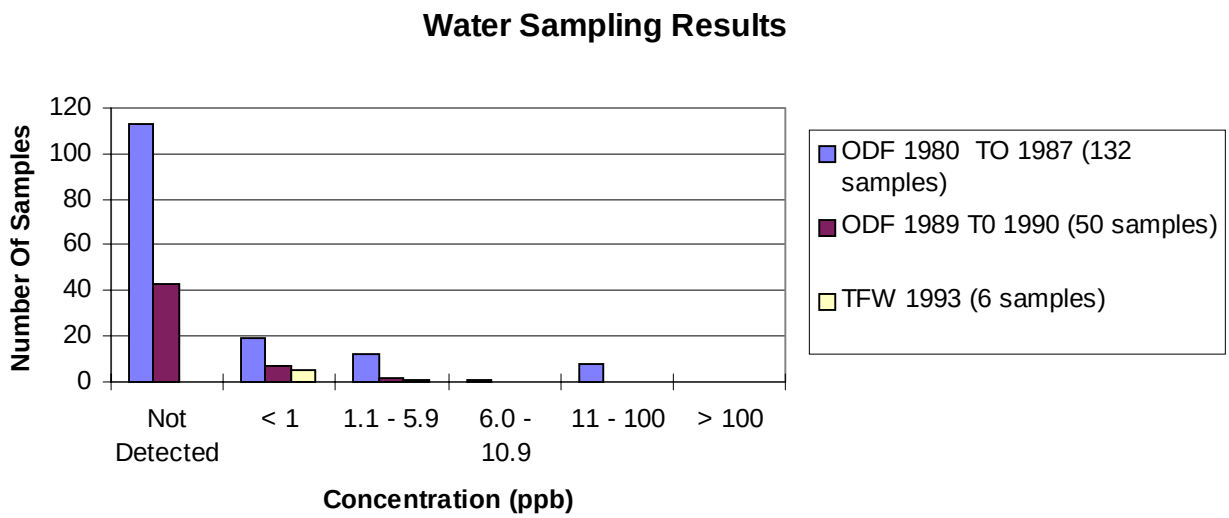

Figure 1. Chemical monitoring results from three studies in Washington and Oregon.

Peak concentrations generated by precipitation: Additional peaks in pesticide concentrations may occur after the first rainfall and subsequent runoff. If streamflow increases, such that the active channel width increases, then the water may come in contact with pesticide deposits (Ice, 1994; Norris, 1980). The potential for subsequent peaks depends on the elapsed time between the pesticide application and the first runoff event, the expansion of the channel, the decay rate of the

pesticide and the antecedent storm conditions. In the TFW study, the authors determined that rainfall events which occurred within the first 72 hours of the operation were the most important. They recommended sampling within the initial 12 hours after runoff begins. Professional judgment must be used to determine when there is sufficient rainfall to produce runoff.

Toxicity Criteria

The forest practices staff, with input from Dr. Nancy Kerkvliet (Oregon State University) and Dr. Robert Pratt (Portland State University), developed Best Management Practices Target Criteria for Forest Chemical Operations (Table 1). These criteria, expressed as the 24-hour average concentration were developed to evaluate pesticide water sampling results. Based on previous findings that forest chemical applications rarely result in chemical concentrations greater than 1 ppb, there is sufficient rationale to focus monitoring resources on chemicals with a low toxicity criteria. Therefore, ODF will focus monitoring efforts on chemicals with a criteria less than 10 ppb, unless future information indicates a need to do otherwise.

Chemical Use

During the time of project implementation, ODF will assess which chemicals are being used most frequently. The operation selection will be weighted towards these chemicals. If it is evident that a particular chemical is lacking in background information, but it is not commonly used, ODF will consider sampling for that chemical. Insecticide application is highly variable from year to year and fungicide applications are rare. In Oregon during 1993 and 1994, there were one and no insecticide applications, respectively. The initial goal of ODF is to monitor all non-biological insecticides (carbaryl) and fungicide applications.

Regional Distribution

During 1993 and 1994, there were 1478 and 1168 operations respectively, involving aerial application of pesticides. Numbers of operations and regional patterns were similar for both years. Herbicide applications were generally concentrated in the same 10 counties in 1994 and 1993 (Table 2). There were fewer fertilizer applications, and they varied geographically from year to year.

Future monitoring efforts will be weighted to the counties with historically greater numbers of operations. ODF is not currently committed to monitoring fertilizer operations due to difficulties in establishing background variability of naturally occurring nitrogen. ODF will continue to investigate fertilizer monitoring.

ODF Approach

Monitoring will take place during fall and spring applications to capture the suite of chemicals being used by forest managers. ODF will focus monitoring efforts on 2,4-D ester, Atrazine, Hexazinone, Triclopyr ester, all insecticide and fungicide operations. In addition, commonly applied chemicals such as glyphosate (accord), imazapyr (Arsenal) and sulfometuron methyl (OUST) will be monitored during the fall season. Sites will be selected predominantly from counties with the greatest rate of application.

Table 1. Proposed best management practices target criteria for forest chemicals operations. (Provided by Dr. N. I. Kerkvliet, OSU Extension Toxicology Specialist). Target criteria expressed as an average 24-hour concentration in surface water in significant wetlands, Type F or Type D streams, large lakes, other lakes with fish use, or other areas of standing open water larger than one-quarter acre at the time of the application.

All values in parts per billion (ppb)

CHEMICAL	**HUMAN HEALTH (10 day HA[a])**	**FISH 48- or 96-hr LC_{50} (÷100-fold safety factor)**	**INVERTEBRATES 48- or 96 hr LC_{50}**
MOST COMMONLY APPLIED FOREST HERBICIDES			
2,4-D amine			
2,4-D ester	300	salmon 3500	daphnia 4000
Atrazine	300	bluegill 7	daphnia 100
Clopyralid	100	trout 45	midge 720
Glyphosate (w/o surfactant)	500[aa]	trout 1030	daphnia 2.25×10^5
Glyphosate (w/surfactant)	17500	salmon 6800	daphnia 9.3×10^5
Hexazinone	17500	trout 13	daphnia 300
Imazapyr	2500[b]	trout 3200	daphnia 52000
Metsulfuron methyl	10000[bb]	trout 1100	daphnia 3.5×10^5
Sulfometuron methyl	2500[c]	trout 1500[d]	daphnia 1.5×10^{5}[d]
Triclopyr amine	1000[e]	trout 125[f]	daphnia 12500[f]
Triclopyr ester	50[g]	trout 1170	daphnia 1.2×10^{5}[h]
	50	trout 7.4	no data found
MOST COMMONLY APPLIED FOREST INSECTICIDES			
Bacillus thuringiensis			
Carbaryl	exempt	trout>12×10^9spores/L	N/A
	1000	brook trout 6.9	stonefly 1.7 to 29 daphnia 5.6
Diflubenzuron	200[i]	trout 1350	stonefly 2.0 daphnia 0.015
MOST COMMONLY APPLIED FOREST FUNGICIDE			
Chlorothalonil	200	trout 0.5	daphnia 70
FERTILIZERS			
Free Ammonia	no data	salmon 83	general 53 to 22,800
Nitrate –N	10,000[j]	no data	no data
Ammonia-N	500	no data	no data
Ammonium sulfamate	30,000[k]	carp 10,000	no data
DIESEL (used as a carrier)	no data	fish 1.9	no data

Footnotes to Table 1:
a) unless otherwise indicated
aa) based on RFD of 0.5 mg/kg/day
b) 90-day HA
bb) based on rabbit NOEL of 400 mg/kg/day and a 400-fold safety factor
c) based on RFD of 0.25 mg/kg
d) based on LC_{50} > 150 mg/L
e) based on RFD of 0.1 mg/kg
f) based on LC_{50} > 12.5 mg/L
g) based on 1-yr dog NOEL of 0.5 mg/kg/day
h) based on 21-day EC50
i) based on 1-yr dog NOEL of 2 mg/kg/day
j) MCL
k) lifetime HA

Table 2. Herbicide and fertilizer operations in 1993 and 1994.

County Name	1993 Number of Herbicide Operations	1994 Number of Herbicide Operations	1993 Count of Fertilizer Operations	1994 Count of Fertilizer Operations
Baker	0	1		
Benton	30	59 *	0	3
Clackamas	68 *	46	7 *	9 *
Clatsop	35	39		
Columbia	44 *	63 *	3	6
Coos	58 *	123 *	2	2
Curry	21	32	1	9 *
Douglas	310 *	313 *	36 *	35 *
Hood River	12	8	18 *	2
Jackson	7	8		
Klamath	2	10		
Lake	95 *	2		
Lane	101 *	143 *	3	12 *
Lincoln	47 *	159 *	4	2
Linn	38	74 *	1	2
Marion	4	43		
Multnomah	45 *	9		
Polk	3	60 *		
Tillamook	3	7		
Washington	78 *	101 *	6	17 *
Yamhill	79 *	77 *	3	1

* = greatest number of operations

EFFECTIVENESS MONITORING

Effectiveness will be evaluated based on the results from the water quality sampling program, operator questionnaires, and a cooperative study by OSU on aquatic insect response. The following water quality sampling design is recommended for use by other parties participating in forest chemical application monitoring.

Water Quality Sampling Design

The goal of ODF is to monitor 25 operations (2.5 percent of the annual average number of operations). Potential sites will have safe access for sampling after nightfall and be near a small, medium or large fish-bearing or domestic source stream. The program will focus on herbicide, fungicide and insecticide applications. Samples will be collected before the operation (control), and 15 minute 2 hour, 4 hour, 8 hour and 24 hours after the first swath has been sprayed near the buffer strip.

Sample Location. Samples will be collected approximately 200 feet downstream of the treatment unit boundary. Access to the sampling site should be done without walking or driving through the treatment unit. The site should be protected from drift, have a uniform cross-section (no backwater or eddies), and have adequate flow to facilitate sample collection.

Sample Timing. A control sample will be collected within 24 hours prior to application. Five more samples will be collected 15 minutes, and 2, 4, 8, and 24 hours after the first swath has been sprayed near the buffer strip. The time of collection is based on the travel time of the water moving through the treatment unit. The time of collection is calculated as follows.

$$\frac{L / v}{60 \text{ seconds}} + 15 \text{ minutes} = 15 \text{ minute sample time}$$

L = length of stream between top of treatment unit and sample point plus length of stream between bottom of treatment unit and sample point divided by 2 (ft)

v = average velocity of stream (ft / sec)

Velocity will be measured with a velocity meter when the control sample is collected.

Runoff Sampling. The goal of ODF is to implement runoff sampling at all sites where a runoff event occurs within the first 72 hours of the chemical operation. Samples will be collected on a subset of these sites within the first 12 hours after the first runoff event.

Collection Procedures. The Oregon Department of Agriculture (ODA) Laboratory has defined specific container and storage temperature requirements for given chemicals (Appendix A). These procedures will be followed for ODF's sampling program. **NOTE**: If this protocol is implemented for other programs, but samples are to be analyzed at a lab other than the ODA

LAB, ask the lab for and comply with it's recommended collection-to-analysis holding procedures and times.

Monitoring personnel will get to the sampling site without physical contact with vehicles or personnel from the spray operation and comply with the following procedure :

1) All equipment will be clean and free of chemical residues.
2) For each sample, put on a new pair of surgical-type sanitary gloves and pick up container.
3) Fill out 2 labels and place on bottle and lid. When using a plastic container, the sample number should be written directly on the bottle as well as on the label.
4) Stand downstream of the sample location. Do not let clothing make contact with the water.
5) Triple-rinse sample container (unless a preservative is used) at the sample site, emptying rinse water downstream.
6) Facing upstream, slowly sink container into the mainflow of the water column until the lip is just below the surface and fill container.
7) Fill out ODF Water Quality Sampling form (Figure 2).

Upon submission of the water samples, a Universal Sample Collection and Laboratory Report form and a chain of custody form (not provided in this document) must be completed and turned in to the ODA Laboratory.

Sample Storage and Delivery to ODA Laboratory. The lab should be pre-notified of delivery. Samples will immediately be put in watertight cold storage with a leak-proof cooling device (blue-ice, frozen water jugs, double-bagged ice cubes) and remain so until analyzed. Glyphosate samples should immediately be packed in ice. Samples will be transported to the laboratory as soon as possible. At no time will the sample be in contact with personnel directly involved with the chemical operation.

Sample Analysis and evaluation. The samples will be analyzed individually to determine concentrations of the chemical throughout time. Instantaneous maximum and a 24-hour average will be used to evaluate effectiveness. A 24- hour average can be approximated with the following formula. This formula applies a time-proportionate weighting factor to each grab result.

24-hour avg. conc. = 15-min (0.02) + 2-hr (0.08) + 4-hr (0.10) + 8-hr (0.30) + 24-hr (0.50)

Chemical Sample Selection. Often times more than one chemical is applied in solution. The chemical applied at the highest concentration will be tested for. After obtaining the brand name and the applied ounces per acre from the landowner/operator, use the following formula and table 3 to identify the chemical being applied with the highest concentration. This is the chemical that will be tested for in the lab.

(% Concentration)*(Applied ounces per acre)= Actual ounces per acre.

Table 3. Forest pesticides brand names, active ingredients and concentrations.

Brand Name	Active Ingredient	% Concentration
Herbicides:		
Low Vol 6	2,4-D	88.8
Amine 4 2,4-D	2,4-D	46.5
Weedar 64	2,4-D	46.8
Weedone LV4	2,4-D	60.8
Weedone LV6	2,4-D	83.5
Amine 4	2,4-D	47.3
Lo Vol-4	2,4-D	67.2
Lo Vol-6	2,4-D	87.3
Tordon 101	2,4-DP	49.8
Aatrex Nine-O	Atrazine	85.5
Atrazine 90 DF	Atrazine	85.5
Conifer 90	Atrazine	85.5
Accord	Glyphosate	41.5
Velpar	Hexazinone	25
Arsenal	Imazapyr	53.1
Chopper	Imazapyr	3.6
Escort	Metsulfuron methyl	60
Access	Picloram, Triclopyr	17.1, 32.5
Oust	Sulfometuron methyl	75
Garlon 4	Triclopyr	61.6
Garlon 3A	Triclopyr	44.4
Pathfinder	Triclopyr	16.7
Transline	Clopyradil	40.9
Fungicides:		
Bravo 720	Chlorothalonil	54
Insecticides:		
DiPel 6AF	Bacillus thuringiensis (BT)	2.15
Thuricide 48LV	Bacillus thuringiensis (BT)	2.4
Thuricide 32LV	Bacillus thuringiensis (BT)	1.6
Sevin 4-OIL ULV	Carbaryl	47.5
Sevimol	Carbaryl	40
Rodenticides:		
ORCO	Strychnine	0.5

Operator Questionnaire

The operators/landowners will fill out the operator questionnaire (Figure 3) for the monitoring sites selected as parts of ODF's monitoring program.

Aquatic Insect Sampling

ODF is cooperating with OSU entomology department in an aquatic insect sampling scheme to coincide with the effectiveness monitoring measures. Methodology is currently being developed for determining if there is a response of aquatic insects to pesticide applications.

Figure 2. Water Quality Chemical Sampling Form

Obtain or draw schematic map of unit, streams, buffers, and flight patterns.

Notification number:_____
Stream name: _____
Applied pesticide: _____
Basin name: _____
Monitoring personnel name(s): _____
Spray start time: _____

Average stream velocity (v): _____(ft/sec)
Distance from closest spray boundary to sampling area (l): _____
Distance from lower boundary to upper boundary (L): _____
'15 minute' sampling time: $(L+l)/2 * 1/v * 1/60$ seconds + 15 = _____ minutes

Determine which chemical to test for:

	Chemical	**% Concentration**	**Applied ounces per acre**	**Actual ounces per acre**
1)				
2)				
3)				
4)				

Get 'chemical' and the 'applied ounces/acre' information from the landowner. Use table 3 to determine the % concentration for a given chemical. Multiply '% concentration' by 'applied ounces/acre' to determine 'actual ounces/acre' for every chemical that is applied. The chemical with the highest value for actual ounces per acre will be tested for in the laboratory.

Chemical to test for at the < or = 2ppb level of concentration: _____
Sampling start time: _____ Date: _____

SAMPLE DESCRIPTION	SAMPLE COLLECTION		SAMPLE ID NUMBER
	DATE	TIME	
Control Sample			
'15 minute'			
2 hour			
4 hour			
8 hour			
24 hour			
Runoff Sample #1 (opt)			
Runoff Sample #2 (opt)			
Runoff Sample #3 (opt)			

Figure 3. Operator Questionnaire: Forest Chemicals Monitoring Project

Landowner: _____
Person completing questionnaire (name): _____
Unit Name: _____
Date of Application: _____

Weather Conditions:
Please fill in measurements of:

Time	_____	_____	_____	_____	_____	_____	_____	_____
Wind speed	_____	_____	_____	_____	_____	_____	_____	_____
Wind Direction	_____	_____	_____	_____	_____	_____	_____	_____
Relative Humidity	_____	_____	_____	_____	_____	_____	_____	_____
Temperature	_____	_____	_____	_____	_____	_____	_____	_____

Chemical Application
Start time _____
End time _____
On average, the chemical was applied 0-40 40-60 60-100 100+ feet from the stream. (Circle one)

Target vegetation/pest: _____
Active ingredient pesticide: _____ oz/acre applied_____
Active ingredient pesticide: _____ oz/acre applied_____
Active ingredient pesticide: _____ oz/acre applied_____
Surfactant added: _____ oz/acre_____
Carriers used: _____
EPA Registration number _____Trade Name_____

Operation
Helicopter model: _____
Flight altitude: _____
Air speed: _____
Boom length: _____ Boom Pressure_____
Flight centerline offset from edge of buffer: _____
Half Boom used ____ Yes ____ No
Nozzle type, size, angle, orientation: _____
Number of nozzles: _____

Operator/community water system manager coordination
The goal of ODF will be to develop partnerships between ODF, landowners, and community water users. The objectives of the partnership would include increasing awareness of monitoring efforts and results, information sharing, and public education.

ODF will coordinate with existing programs between community water users and landowners/operators. When appropriate, ODF will promote use of the preceding water quality monitoring protocol. Data collected for community water system purposes may be available as additional data for ODF's program.

COMPLIANCE MONITORING

Compliance monitoring will consist of coordination with the State of Oregon's Pesticide Analytical and Response Center (PARC) and a vegetation survey implemented by ODF.

Public Complaints and Pesticide Analytical Response Center
Investigation of public complaints is a high priority for ODF. Upon receipt of a complaint ODF will assess the need for water quality sampling. ODF will coordinate with PARC. ODF is a participant in PARC, as are five other state agencies, as well as OSU. PARC's primary responsibilities are to:

1) Centralize and receive information relating to actual or alleged health and environmental incidents involving pesticides.

2) Mobilize the expertise necessary for timely and accurate investigations of pesticide incidents and analysis of associated samples.

3) Report in a standardized format the results of investigations of pesticide incidents.

PARC investigations are warranted when:

1) ODF determines that a chemical incident may create the potential for adverse human health effects and/or significant environmental damage.

2) The citizen complaints are received and it is evident to ODF that a multi-agency investigation is necessary to resolve the complaint.

ODF will annually summarize and make public the results of forestry-related PARC investigations.

Vegetation Surveys
This portion of the monitoring program is considered experimental. The intent is to test cost-effective monitoring methods which could be used in the future to assess chemical applications without having to implement a costly water-quality sampling program. Results of the vegetation surveys will be compared with the water quality sampling results to determine the usefulness of this measure.

Vegetation inspection surveys will be conducted in riparian areas on high priority operations and by Forest Practice Foresters in response to complaints. In addition, the surveys will be conducted on the 25 operations selected for ODF's monitoring program. At an appropriate time interval after application (depending on the chemical), monitoring personnel will implement the following procedure and fill out the Compliance Form (Figure 4).

1.) Assess if chemicals were directly applied to the buffer.

2.) Traverse the 3 lines parallel to the stream. Line #1: 10 feet from the spray boundary. Line #2: 30 feet from the spray boundary. Line #3: 5 feet from the stream channel.

3.) Along each traverse, note the percentage of the vegetation which has been killed or damaged by herbicide. Effects will depend on the particular chemical (i.e. glyphosate will result in tiny leaves which will not elongate on elderberry and salmonberry). Photodocument vegetation damage.

4.) Repeat 2 and 3 along a control reach upstream or downstream of the spray unit.

Summary

The combined information from the water quality analyses, aquatic insect results operator and vegetation surveys will be analyzed and summarized in a final report one year after completion of the program. At that time ODF will assess the need for future monitoring. Project time lines, major participants and budget are described in appendices B through D.

Any questions or comments regarding this document can be directed to:

Liz Dent (503) 945-7493
Monitoring Coordinator
Oregon Department of Forestry
2600 State Street
Salem, Oregon 97310

Figure 4. **BMP COMPLIANCE MONITORING**

Stream name _____ Notification number _____
Stream type _____
Date of Application: _____

Day of Application Observation
Was chemical directly applied to streamside vegetation?____
Rate difficulty in avoiding streamside vegetation (1-4).____

Based on the terrain, height of vegetative buffer, layout of unit, etc. rate the difficulty as:

1 = easily avoidable
2 = avoidable
3 = difficult to avoid
4 = extremely difficult to avoid

Vegetation Inspection
1.) Date of inventory: _____
2.) Streamside rules applied/prescription:_____
_____ (new versus old rules, width of no-cut buffer, alternative prescriptions)

3.) Transect information to assess drift impacts

Predominant overstory species _____
Predominant understory species _____
Ground Cover species_____

4.) For each transect estimate the percent of vegetation damaged or killed by herbicide. Draw transects on map. Photograph damage for each species.

	overstory	understory
Transect A (10 feet from unit/buffer boundary)	_____	_____
Transect B (30 feet from unit/buffer boundary)	_____	_____
Transect C (5 feet from stream edge)	_____	_____
TOTAL	_____	_____

Literature Cited

Ice, George; D. Neary. 1994. A guide to monitoring streamwater quality, how and when. National pesticide use management training, National Advancement Resource Technology Center. Marana AR. 52 pp.

Oregon Department of Forestry. 1992. Forest herbicide application: water quality sampling study. Forest Practices Section. 40 pp.

Rashin, E.; C. Graber. 1993. Effectiveness of best management practices for aerial application of forest pesticides. TFW-WQ1-93-001. 127 pp.

Appendix A
Oregon Department of Agriculture Laboratory Specifications

Appendix B
Time Table

Proposed Time Table

Activity	Begin Date	Completion Date	Status
Protocol development	September 30, 1995	June 30, 1996	Complete
Pilot study	April 1, 1997	May 30, 1997	Complete
Implementation of effectiveness and compliance study	September 1, 1997	May 30, 1998	In Progress
Analysis of Laboratory Results	September 30, 1997	July 30, 1998	In Progress
Draft Report	August 1, 1998	September 30, 1998	Planned
Peer Review	October 1, 1998	November 30, 1998	Planned
Final Report	December 1, 1998	January 30, 1999	Planned

Appendix C
Major Participants

Forest Chemical Monitoring Protocol Development Committee:

Dave Peterson	ODA
DR. Nancy Kerekvliet	OSU
Bob Noelle	Medford Water Commission
Dr. George G. Ice	NCASI
Tally Patton	Boise Cascade Corporation
Dennis Ades	DEQ
Dick Miller	Taxon Aquatic Monitoring Company
Mark Gourley	Starker Forests
Norma Grier	NCAP
Alan Brog	ODF
Dr. Arne Skaugset	OSU
Liz Dent	ODF

Project implementation will involve the forest practices monitoring staff, private forest landowners, Oregon State University Professors and a graduate student. Watershed councils throughout Coastal Oregon have committed support to the project as well.

Table 1. Monitoring staff education and experience.

Personnel/position	Education	Related Experience
Liz Dent/ ODF Monitoring Coordinator	M.S. Forest Hydrology, B.A. Geography	Biological, physical, water quality sampling, analysis and research (California, and Oregon 1987 to present)
Jenny Walsh/ ODF Monitoring Assistant	M.S. Forest Science, B.A. Economics	Biological, physical, and chemical sampling, analysis and research (Virginia and Oregon 1991 to present)
Jim Paul/ ODF Monitoring Assistant	M.S. Forest Hydrology, B.A. Politics	Physical and chemical sampling, analysis, and research (Washington and Oregon 1994-present)
2 field crew personnel	B.S. in Natural Resources	Extensive field data collection

Table 2. Oregon State University Personnel

Dr. Paul Jepson	Department Head Entomology Department
Dr. Jeff Jenkins	Associate Professor Agricultural Chemistry
Jennifer Peterson	Graduate Research Student

Table 3. Coastal Watershed Councils offering support and endorsement of the Forest Practices Pesticide Monitoring Project within their watersheds and sub-basins are:

Watershed Council	Chairperson/Coordinator
Applegate River Watershed Council	Jan Pertu
Coos Watershed Association	Anne Donnelly
Coquille Watershed Association	Bob Kinyon
Euchre Creek Watershed Council	John Wilson
Little Butte Creek Watershed Council	Lu Anthony
Mid Coast Watershed Council	Lana Brodziak
Ten Mile Basin Partnership	Jennifer Karagavoorian
Upper Nehalem Watershed Council	Maggie Payton

Appendix D

ODF Chemicals Monitoring Project
Budget Proposal

Project period: **From: April 1997**
To: January 1999

Budget Category	Budget Request	ODF Funding	Total Funding
Personnel	10,000	40,000	50,000
Travel		8,600	8,600
Equipment		400	400
Supplies		400	400
Chemical Laboratory Analysis	25,000	10,000	35,000
Total	**35,000**	**59,400**	**94,400**