STATE OF MAINE
DEPARTMENT OF -
ENVIRONMENTAL PROTECTION -

PAUL R. LEPAGE -
GOVERNOR -

PAUL MERCER
COMMISSIONER

December 30, 2016

TO: Interested Parties of Record

Sent via electronic mail
Delivery confirmation requested

RE: Maine Pollutant Discharge Elimination System (MEPDES) Permit #MEG150000
Maine Waste Discharge License (WDL) #W009004-5Y-C-R
Proposed Draft General Permit - Renewal

Dear Interested Party:

Attached is a proposed draft General Permit renewal which the Department proposes to issue as a final document after opportunity for your review and comment. By transmittal of this letter, you are provided with an opportunity to comment on the proposed draft General Permit and its conditions (special conditions specific to this permit are enclosed; standard conditions applicable to all permits are available upon request). If it contains errors or does not accurately reflect present or proposed conditions, please respond to this Department so that changes can be considered.

The General Permit will authorizes the Department's Invasive Aquatic Species Program (IASP) and its qualifying agents to discharge authorized aquatic herbicides to Class GPA, AA, A, B and C waters of the State, tributaries to Class GPA waters, and those waters having drainage areas of less than ten square miles, that contain populations of invasive aquatic plants. By copy of this letter, the Department is requesting comments on the proposed draft permit from various state and federal agencies and from any other parties who have notified the Department of their interest in this matter.

The comment period begins on December 30, 2016 and ends on February 1, 2017. All comments on the proposed draft permit must be received in the Department of Environmental Protection office on or before the close of business Wednesday, February 1, 2017. Failure to submit comments in a timely fashion will result in the proposed draft/license permit document being issued as drafted.

Comments in writing should be submitted to my attention at the following address:

Maine Department of Environmental Protection
Bureau of Water Quality
Division of Water Quality Management
17 State House Station
Augusta, ME 04333-0017
Cindy.L.Dionne@maine.gov

If you have any questions regarding the matter, please feel free to contact me.

Sincerely,

Cindy L. Dionne
Division of Water Quality Management
Bureau of Water Quality
ph: 207-557-5950

Enc.

ec: Barry Mower, DEP
Pamela Parker, DEP
Sterling Pierce, DEP
Lori Mitchell, DEP
John McPhedran, DEP
Paul Gregory, DEP
Henry Jennings, BPC-DACF
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David Webster, USEPA
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Sharri Venno, Houlton Band of Maliseet Indians
Trevor White, Indian Township Tribal Government
Dale Mitchell, Passamaquoddy Tribal Government
Dan Kusnierz, Penobscot Indian Nation
Fred Corey, Aroostook Band of Micmac Indians

Max Tritt, National Marine Fisheries Service
Laury Zicari, USFWS

STATE OF MAINE

DEPARTMENT OF ENVIRONMENTAL PROTECTION

General Permit
Application of Herbicides for the Control of Invasive Aquatic Plants

Maine Pollutant Discharge Elimination System Permit
Maine Waste Discharge License

Bureau of Water Quality December 8, 2016
Maine Pollutant Discharge Elimination System (MEPDES) Permit #MEG150000
Waste Discharge License (WDL) #W-009004-5Y-C-R

MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

GENERAL PERMIT FOR THE APPLICATION OF HERBICIDES FOR THE CONTROL OF INVASIVE AQUATIC PLANTS

Table of Contents

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION
17 STATE HOUSE STATION AUGUSTA, MAINE 04333-0017

DEPARTMENT ORDER

IN THE MATTER OF

GENERAL PERMIT		)	MAINE POLLUTANT DISCHARGE
HERBICIDES FOR THE CONTROL		)	ELIMINATION SYSTEM PERMIT
OF INVASIVE AQUATIC PLANTS		)	
STATE OF MAINE		)	AND
#W-009004-5Y-C-R		)	WASTE DISCHARGE LICENSE
#MEG150000	**APPROVAL**	)	**RENEWAL**

In compliance with the applicable provisions of *Pollution Control*, 38 M.R.S. §§ 411 – 424-B, *Water Classification Program*, 38 M.R.S. §§ 464 – 470 and *Federal Water Pollution Control Act*, Title 33 U.S.C. § 1251, and applicable rules of the Maine Department of Environmental Protection (Department), the Department has considered the renewal of Maine Pollutant Discharge Elimination System (MEPDES) General Permit (GP) #MEG150000 / Maine Waste Discharge License (WDL) #W009004-5Y-C-R, which was issued on October 4, 2011 for a five-year term, with its supportive data, agency review comments, and other related materials on file and FINDS THE FOLLOWING FACTS:

APPLICATION SUMMARY

Pursuant to applicable laws and rules of the State's MEPDES program, the Department's Bureau of Water Quality, Division of Water Quality Management has developed a GP for discharges of herbicides for the control of invasive aquatic plants. This GP authorizes the Department's Invasive Aquatic Species Program (IASP) and its qualifying agents to discharge authorized aquatic herbicides to Class GPA, AA, A, B and C waters of the State, tributaries to Class GPA waters, and those waters having drainage areas of less than ten square miles, that contain populations of invasive aquatic plants. GP #W-009004-5G-A-N / #MEG150000 was first issued as a Maine WDL on July 3, 2007 for a five-year period followed by GP #W-009004-5G-B-R / #MEG150000 issued on October 4, 2011.

REGULATORY SUMMARY

On January 12, 2001, the Department received authorization from the U.S. Environmental Protection Agency (USEPA) to administer the National Pollutant Discharge Elimination System (NPDES) permit program in Maine. From that point forward, the program has been referred to as the MEPDES permit program. The terms and conditions of this GP are consistent with the requirements established in the MEPDES permit program.

CONCLUSIONS

Based on the findings in the attached Fact Sheet, dated December 29, 2016, and subject to the conditions listed in Parts I and II of this GP, the Department makes the following CONCLUSIONS:

1. The discharge(s) covered under this GP, either by itself or in combination with other discharges, will not lower the quality of any classified body of water below such classification.

2. The discharge(s) covered under this GP, either by itself or in combination with other discharges, will not lower the quality of any unclassified body of water below the classification which the Department expects to adopt in accordance with state law.

3. The provisions of the State's antidegradation policy, 38 M.R.S. §464(4)(F), will be met, in that:

   (a) Existing in-stream water uses and the level of water quality necessary to protect and maintain those existing uses will be maintained and protected;

   (b) Where high quality waters of the State constitute an outstanding national resource, that water quality will be maintained and protected;

   (c) Where the standards of classification of the receiving water body are not met, the discharge will not cause or contribute to the failure of the water body to meet the standards of classification;

   (d) Where the actual quality of any classified receiving water body exceeds the minimum standards of the next highest classification that higher water quality will be maintained and protected; and

   (e) Where a discharge will result in lowering the existing water quality of any water body, the Department has made the finding, following opportunity for public participation, that this action is necessary to achieve important economic or social benefits to the State.

4. The discharge will be subject to effluent limitations that require application of best practicable treatment (BPT) as defined in *Conditions of licenses*, 38 M.R.S. §414-A(1)(D).

5. The discharge of authorized aquatic herbicides in accordance with the terms and conditions of this general permit will provide adequate protection of non-target species.

6. The discharge of authorized aquatic herbicides in accordance with the terms and conditions of this GP will not have a significant adverse effect on receiving water quality or violate the standards of the receiving water's classification.

ACTION

Based on the findings and conclusions as stated above, the Department APPROVES GP #MEG150000, APPLICATION OF HERBICIDES FOR THE CONTROL OF INVASIVE AQUATIC PLANTS to Class GPA, Class AA, A, B, and C waters, tributaries to Class GPA waters, and those waters having drainage areas of less than ten square miles, that contain populations of invasive aquatic plants, SUBJECT TO THE ATTACHED CONDITIONS, including:

1. The attached General Conditions included as Part I of this GP.

2. The attached General Conditions included as Part II of this GP.

3. *"Maine Pollutant Discharge Elimination System Permit Standard Conditions Applicable To All Permits"*, revised July 1, 2002, copy attached.

4. This permit becomes effective 60 days following the date of signature below and expires at midnight five (5) years after that date. If the GP is to be renewed, it will remain in force until the Department takes final action on the renewal. Upon reissuance of a renewal of the GP, persons wishing to continue coverage must apply for coverage under the renewal GP not later than 30 days prior to the effective date of the new GP.

PLEASE NOTE ATTACHED SHEET FOR GUIDANCE ON APPEAL PROCEDURES

DONE AND DATED AT AUGUSTA, MAINE, THIS _____ DAY OF _____2017.

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY:_____
PAUL MERCER, Commissioner

Date of Public Notice___on or about August 26, 2016____

Date filed with Board of Environmental Protection _____

This Order prepared by Cindy L. Dionne, Bureau of Water Quality
MEG150000 Proposed Draft 12/29/16

PART I – SPECIAL CONDITIONS

A. AUTHORITY

A permit is required for the direct or indirect discharge of pollutants to waters of the State pursuant to federal law, Title 33 USC, §1251. The Department may issue a GP authorizing the discharge of certain pollutants from multiple individual discharge sources and locations which all have the same type of discharges and which involve situations where the Department determines there is a relatively low risk for significant environmental impact pursuant to *General Permits for Certain Wastewater Discharges*, 06-096 C.M.R. 529 (last amended June 27, 2007).

The similarity of discharges for the application of authorized aquatic herbicides for the control of invasive aquatic plants has prompted the Department to issue this GP for those receiving waters not otherwise prohibited by Maine law and which contain populations of invasive aquatic plants as listed in 38 M.R.S. §410-N or as determined by the IASP under 38 M.R.S. §466, sub-§8-A. A violation of a condition or requirement of a GP constitutes a violation of the State's water quality laws, and subjects the discharger to penalties under Maine law, 38 M.R.S. §349. Nothing in this GP is intended to limit the Department's authority under the waste discharge and water classification statutes or rules. This GP does not affect requirements under other applicable Maine statutes and Department rules.

B. SPECIALIZED DEFINITIONS

In addition to the definitions found in *Definitions for the Waste Discharge Permitting Program* rule 06-096 C.M.R. 520 (effective January 12, 2001) and in the waste discharge and water classification laws, the following terms have the following meanings when used in this GP.

1. **Authorized Aquatic Herbicide.** "Authorized aquatic herbicide" means granular, solid, powder, liquid, or other formulations of herbicides whose sole active ingredients are registered with both the USEPA and Maine Board of Pesticides Control (BPC) and are applied in accordance with USEPA approved label used by a licensed applicator to inhibit the growth or control invasive aquatic plants.

   Specifically, the formulations that may be used under this permit are those below or successor formulations with substantially the same constituents. If new formulations replace these listed below, the Notice of Intent (NOI) will include those formulations proposed for use, their specifications, and information sufficient to allow the Department to conclude that conditions and safeguards in this permit will be met.

   a) **2, 4-Dichlorophenoxyactetic acid (2, 4-D) derivatives:**
   Dimethylamine salt, 2, 4-Dichlorophenoxyacetate, 2, 4-D DMA salt, (EPA Chemcode 30019; CAS Registry # 1929-73-3);

PART I – SPECIAL CONDITIONS

B. SPECIALIZED DEFINITIONS (cont'd)

b) **Diquat:**
Diquat dibromide (EPA Chemcode 32201; CAS Registry # 85-00-7);

c) **Endothall:**
Endothall dipotassium salt (7-oxabicyclo [2, 2, 1] heptane-2, 3-dicarboxylic dipotassium salt) (EPA Chemcode 38904; CAS Registry # 2164-07-0)

d) **Fluridone:**
Fluridone (EPA Chemcode CAS Registry # 59756-60-4)

e) **Triclopyr:**
Triclopyr triethylamine salt (triclopyr TEA) (EPA Chemcode 116002; CAS Registry #: 57213-69-1)

2. **Booster Treatment.** "Booster treatment" means one or more herbicide applications which are planned and executed as part of a comprehensive treatment program following an initial application within the same season.

3. **Invasive Aquatic Plant.** "Invasive aquatic plant" means an invasive aquatic plant as listed in 38 M.R.S. §410-N or as determined by the IASP under 38 M.R.S. §466, sub-§8-A. Invasive aquatic plants listed as of October 2016 include:

   Eurasian water milfoil (*Myriophyllum spicatum*);
   Variable-leaf water milfoil (*Myriophyllum heterophyllum*);
   Parrot feather (*Myriophyllum aquaticum*);
   Water chestnut (*Trapa natans*);
   Hydrilla (*Hydrilla verticillata*);
   Fanwort (*Cabomba caroliniana*);
   Curly-leaved pondweed (*Potamogeton crispus*);
   European naiad (*Najas minor*);
   Brazilian elodea (*Egeria densa*);
   Frogbit (*Hydrocharis morsus-ranae*); and
   Yellow floating heart (*Nymphoides peltata*).

4. **Invasive Aquatic Species Program (IASP).** "Invasive Aquatic Species Program" means the section of the Bureau of Water Quality within the Department which is responsible for coordinating the state's efforts to prevent, limit the spread, and reduce the harmful effects of invasive aquatic plants; and for preventing, controlling, and managing invasive aquatic plant populations.

5. **Licensed Applicator.** "Licensed Applicator" means a person licensed by the State of Maine Department of Agriculture, Conservation and Forestry (DACF) BPC to apply aquatic herbicides.

PART I – SPECIAL CONDITIONS

B. SPECIALIZED DEFINITIONS (cont'd)

6. **Non-target Organisms.** Includes the plant and animal hosts of the target species, the natural enemies of the target species living in the community, and other plants and animals, including vertebrates, lining in or near the community that are not the target of the pesticide.

7. **Notice of Intent ("NOI").** "Notice of Intent" or "NOI" means a notification of intent to seek coverage under this GP, submitted by the IASP to the Department on a form provided by the Department.

8. **Notice of Termination ("NOT").** "Notice of Termination" or "NOT" means a notification of intent to end coverage of a herbicide treatment program for a waterbody licensed under this GP, submitted by the IASP on a form provided by the Department.

9. **Public Water System.** "Public water system" means water systems which regularly serve 25 or more people per day or which have at least 15 service connections as defined in Chapter 22 M.R.S.§ 2601 and 10-144 C.M.R. 231 Section 2 in the State of Maine Rules Relating to Drinking Water.

10. **Treatment Program.** "Treatment Program" means an initial herbicide application and any booster applications within the same season and/or follow-up applications which are planned for subsequent years at rates and intervals specified in an NOI. It may also include the use of other non-chemical methods which will be used in combination with herbicide application to enhance its efficacy.

11. **Waters of the State. "**Waters of the State" means any and all surface and subsurface waters that are contained within, flow through, or under or border upon this State or any portion of the State, including the marginal and high seas, except such waters as are confined and retained completely upon the property of one person and do not drain into or connect with any other waters of the State, but not excluding waters susceptible to use in interstate or foreign commerce, or whose use, degradation or destruction would affect interstate or foreign commerce, as defined at 38 M.R.S. §361-A.7.

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PART I – SPECIAL CONDITIONS

C. APPLICABILITY AND COVERAGE

Coverage under this GP is limited to those receiving waters that conform to the Area of Coverage described below and that have had a completed NOI accepted by the Department. Applicability of this GP is limited to activities described in the NOI that are in conformance with the terms and conditions of this GP.

1. **Area of Coverage.** The geographic area covered by this GP is the entire State of Maine. This GP covers application of authorized aquatic herbicides by a licensed applicator to fresh waters of the State classified by Maine's water classification laws as Class GPA, Class AA, Class A, Class B, Class C, tributaries to Class GPA waters, and those waters having drainage areas of less than ten square miles, which contain populations of invasive aquatic plants. Waters of any other classifications than those noted above are not covered by this GP.

2. **General Restrictions.** Authorized aquatic herbicides may only be used where the hydrology of the receiving waterbody proposed for treatment allows for sufficient contact time to prove effective against the target plant species.

3. **Applicability and Requirements of Applicant.** The IASP is the only approved GP licensee. However, the IASP may use qualified agents under its direct supervision and control in conducting activities approved by this GP. The Department may deny applications within an area when the Department determines that proposed aquatic herbicide treatments are duplicative or ineffective in controlling the target species.

4. **Concentrations and Application Rates.** Maximum application rates and water concentrations must comply with amounts specified on USEPA registered product labels and as specified in this permit. The IASP will calculate actual dosages based upon the particular species pursuant to the table of target concentrations in the Fact Sheet, degree of spread, site conditions, and other appropriate factors, and must supply this information with the NOI. The IASP must comply with all applicable state laws.

5. **Treatment Plan.** Prior to herbicide application, the IASP must develop a treatment plan specifying the treatment program for the infested water body as directed in the Department's *Rapid Response Plan for Invasive Aquatic Plants* (February 2006). The NOI will be available for inspection.

6. **Application Methods.** The IASP must use optimal methods, materials, and rates for successful treatment, while adhering to USEPA registered product label requirements and limiting impacts to non-target organisms and resources. Herbicide formulations will be applied to achieve even distribution of the herbicide within the water volume targeted for treatment. Specific application methods are described in the Fact Sheet. An application will consist of either a whole lake treatment, where the objective is to develop a uniform concentration throughout the waterbody, or a spot or area treatment, where the objective is to develop a uniform concentration in a limited area of the waterbody.

PART I – SPECIAL CONDITIONS

D. DISCHARGE CONCENTRATION LIMITS

In conducting an approved invasive plant treatment program, herbicide concentrations developed in the waterbody may at no time exceed USEPA approved label rates. As it is routine practice in integrated pest management, lesser rates which achieve treatment efficacy will be applied to protect non-target organisms and resources.

Table 1. Maximum volume-weighted concentration for authorized herbicides.

Herbicides	2, 4-D	Diquat	Endothall	Fluridone	Fluridone	Triclopyr
Formulation	Liquid or Solid AE	Liquid or Cation Equivalent	Liquid or Solid AE	Liquid AE	Solid AE	Liquid or Solid AE
Maximum Permit Concentration	4.00 ppm	0.37 ppm	5.00 ppm	0.150 ppm	0.075 ppm	2.50 ppm

(*AE* = Acid Equivalent, *ppm* = parts per million)

Aquatic plants designated by the Department as invasive after the effective date of this permit pursuant to 38 M.R.S. §466, §§8-A may be treated with an authorized herbicide provided that at no time may the concentration exceed the highest amount specified for any of the herbicides in Table 1.

The Department is identifying in this permitting action that the previously established concentration limits were established in error. Section 402(o) of the Clean Water Act contains prohibitions for anti-backsliding. Generally, anti-backsliding prohibits the issuance of a renewed permit with less stringent limitations than were established in the previous permit. The Clean Water Act contains certain exceptions to anti-backsliding at Section 402(o)(2). In the case of this GP, the Department has determined that establishing concentration limitations more stringent that the USEPA label rates constitutes a technical mistake in issuing the permit. Section 402(o)(2)(B)(ii) of the Clean water Act contains an exception to anti-backsliding for this reason. Therefore, this GP renewal is establishing concentrations limits for the above-referenced herbicides in accordance with USEPA label rates. (It is noted that anti-backsliding prohibitions and exceptions are mirrored in Chapter 523 of the Department's rules.

E. MONITORING

All sampling and analysis must be conducted in accordance with: (a) methods approved by 40 Code of Federal Regulations (CFR) Part 136, (b) alternative methods approved by the Department in accordance with the procedures in 40 CFR Part 136, or (c) as otherwise specified by the Department. Routine water quality samples that are sent out for analysis must be analyzed by a laboratory certified by the State of Maine's Department of Health and Human Services (DHHS). Samples that are sent to a publicly owned treatment works (POTW) licensed pursuant to *Waste discharge licenses,* 38 M.R.S. §413 are subject to the provisions and restrictions of *Maine Comprehensive and Limited Environmental Laboratory Certification Rules,* 10-144 C.M.R. 263 (last amended April 1, 2010).

PART I – SPECIAL CONDITIONS

E. MONITORING (cont'd)

Herbicide samples must be analyzed by laboratories certified by the State of Maine's DHHS, other laboratories that have satisfactorily demonstrated the ability to perform USEPA-designated testing for the herbicide, or by approved proprietary methods. Monitoring requirements are described in summary below and in further detail in the Fact Sheet and constitute minimum monitoring requirements. Additional monitoring will be based on waterbody specific and treatment specific conditions and properties and will be specified in the NOI as needed. The IASP's monitoring plans must also consider information received from consultation with the Maine Department of Inland Fisheries and Wildlife (DIFW), Maine Natural Areas Program, Maine Atlantic Salmon Commission, U.S. Fish and Wildlife Service (USFWS), and U.S. National Oceanic and Atmospheric Administration (NOAA) Fisheries.

1. **Herbicide Concentration Monitoring**. Unless otherwise designated in the NOI, herbicide sampling must occur at location(s) below and as specified on a map submitted with the NOI. Monitoring regimes are determined by general treatment type and include the following:

   a. **Whole Lake Treatment**: The IASP must monitor treated waters according to the schedule in Table 2 below to track herbicide concentrations and dissipation rates to ensure accurate and effective application. Sample collection must occur at the most representative location, usually at the deepest part of the treated waterbody.

   b. **Spot or area treatment:** The IASP must monitor treated waters according to the schedule in Table 2 below to track herbicide concentrations and dissipation rates to ensure accurate and effective application. Sample collection must occur within the treated area at a location(s) representative of the characteristics (depth, density of plant growth, substrate) of the treated area. For treatment programs with multiple treatment areas, no more than three individual treatment areas within the waterbody must be monitored.

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PART I – SPECIAL CONDITIONS

E. MONITORING (cont'd)

Table 2. Required herbicide sampling type and frequency for whole lake and spot treatments, unless otherwise specified in the NOI. Mid-water column sample depth for the first sample will be based on treatment type and thermal profile at the deep hole or within the treated area for spot treatments. Treatments in very shallow water (e.g., ≤ 1 meter) may not require multiple depth samples to characterize concentrations.

Herbicide	First Sample(s)	Second Sample	Ongoing Until Sampling Endpoint Specified
2, 4-D: Liquid and granular (solid) formulations	Within 24 (liquid) or 72 hours (granular) of initial treatment: • 0.5 m below surface grab • mid-water column grab • 1 m off bottom grab	5-14 days after first sample: Liquid: 0.5 m below surface grab or representative water column composite Granular: 1 m off bottom grab	Monthly after 2nd sample: 0.5 m below surface grab or representative water column composite
Diquat dibromide: Liquid formulation	Within 24 hours of initial treatment: • 0.5 m below surface grab • mid-water column grab • 1 m off bottom grab	5-14 days after first sample: 0.5 m below surface grab or representative water column composite	Monthly after 2nd sample: 0.5 m below surface grab or representative water column composite
Endothall Liquid and granular (solid) formulations	Within 24 (liquid) or 72 hours (granular) of initial treatment: • 0.5 m below surface grab • mid-water column grab • 1 m off bottom grab	5-14 days after first sample: Liquid: 0.5 m below surface grab or representative water column composite Granular: 1 m off bottom grab	Monthly after 2nd sample: 0.5 m below surface grab or representative water column composite
Fluridone: Liquid and granular (solid) formulations	Within 72 hours of initial treatment: • 0.5 m below surface grab • mid-water column grab • 1 m off bottom grab	5-14 days after first sample: Liquid: 0.5 m below surface grab or representative water column composite Granular: 1 m off bottom grab	Monthly after 2nd sample: 0.5 m below surface grab or representative water column composite
Triclopyr Liquid and granular (solid) formulations	Within 24 (liquid) or 72 hours (granular) of initial treatment: • 0.5 m below surface grab • mid-water column grab • 1 m off bottom grab	5-14 days after first sample: Liquid: 0.5 m below surface grab or representative water column composite Granular: 1 m off bottom grab	Monthly after 2nd sample: 0.5 m below surface grab or representative water column composite

PART I – SPECIAL CONDITIONS

E. MONITORING (cont'd)

c. Outlet Monitoring. Outlet monitoring is required when a whole lake treatment is performed and there is outflow during the time of target application concentrations. If there is outflow, one grab sample must be collected on the same frequency specified in Table 2 for whole lake treatment monitoring. The sampling location will be designated on a map submitted with the NOI and will be representative of downstream conditions.

Unless specified in the NOI due to proximity to the outlet, outlet monitoring is not required for spot or area treatment as the extensive dilution within the receiving water is anticipated to result in no release of effective or biologically active herbicide concentrations downstream.

d. Duration of Herbicide Monitoring. Monitoring is started based on the initial annual herbicide application and continues pursuant to Table 2 based on that initial event, regardless of the presence or number of booster treatments administered. Monitoring must continue until the herbicide can no longer be detected in laboratory analysis (i.e., non-detect level), to an alternate Department-specified sampling endpoint defined herein, or annually to ice-in, or through November in each year that treatment occurs, whichever comes first. If non-detect or the pesticide-specific sampling endpoint is not reached by ice-in or the end of November, monitoring will be suspended over winter.

Monitoring will resume within one month of ice-out in the following spring and will continue every month until the concentration falls below the detection limit, reaches the pesticide-specific sampling endpoint, or until re-treatment occurs. If retreatment occurs in a new calendar year, the IASP must resume monitoring pursuant to Table 2, beginning with the requirements for first samples. Laboratory detection limits may vary over time. This GP requires that the IASP utilize detection limits current at the time of sampling.

2. Water Quality Monitoring. The IASP will sample lake water quality prior to and after a whole-lake treatment for the following parameters: temperature-oxygen profile, Secchi disk transparency, and total phosphorous. Monitoring must take place in a representative part of the waterbody (usually the deep station for lakes) and conform to the Department's Standard Field Methods for Lake Water Quality Monitoring. This monitoring is not required for spot or area treatments unless the area treated exceeds 25% of the lake surface area.

PART I – SPECIAL CONDITIONS

E. MONITORING (cont'd)

3. **Plant Community Monitoring**. Plant community monitoring must be conducted as follows. Plant population sampling will be by one or more of the following methods: Point Intercept (Madsen 2000), diver surveys, underwater camera, and surface observations or commonly used methods suitable for the plant community and physical characteristics of the treated area. Treatment areas will vary in size and plant composition, therefore sampling methods must reflect this. For example, the number of points sampled will vary in the point intercept method to reflect the density and heterogeneity of the community. Species sampled will be listed by scientific name as well as observation of their relative abundance.

   a. **Whole Lake Treatment.** The IASP will monitor the plant populations within the treated area once before initial annual treatment and within one year after the treatment program ends to evaluate treatment efficacy and effects on non-target plant species. For the purposes of this requirement, the end of a treatment program is considered to be the end of the growing season during which the last treatment occurs.

   b. **Spot treatments.** The IASP will monitor the plant populations within the treated area(s) once before each initial annual treatment and within one year after the treatment program ends to evaluate treatment efficacy and effects on non-target plant species.

   c. **Lake Outlet.** For whole lake treatment with outflow, the IASP must survey one representative area below the outlet once before treatment and within one year after the treatment program ends. Monitoring must be at a time chosen to be representative of the normal growing season conditions. The IASP must record aquatic plants found by scientific name and report any evidence of negative effects of the treatment program on those plants.

4. **Non-Target Fauna Observations**. The IASP will also conduct visual observations in the waterbody and outlet throughout the treatment program for treatment-related effects on macroinvertebrates, fish, and other aquatic organisms and report the occurrence and significance of any adverse findings within 24-hours. The IASP and the Department must evaluate the occurrence and determine an appropriate course of action.

PART I – SPECIAL CONDITIONS

F. REPORTING

The IASP must conduct monitoring programs as described in Permit Special Condition E. The IASP must report monitoring results to the Department as follows:

1. Herbicide concentration monitoring results must be reported on a quarterly basis, with the results of monitoring conducted from January through March and April through June each year (2 quarters) reported to the Department on or before July 15; the results of monitoring conducted from July through September each year reported on or before October 15; and the results of monitoring conducted from October through December reported on or before January 15 of the following year.

2. Water quality monitoring results for each calendar year in which treatments occur must be reported to the Department on an annual basis submitted on or before January 15 of the following year.

3. Plant community monitoring results for each calendar year in which such monitoring is required must be reported to the Department, submitted on or before January 15 of the following year.

4. Non-target fauna observation results must be reported as described above. Additionally, results for each calendar year in which treatments occur must be reported to the Department, submitted on or before January 15 of the following year.

A signed copy of all reports required herein must be submitted to the Department's assigned compliance inspector (unless otherwise specified) at the appropriate DEP regional office (Portland, Augusta, Bangor, Presque Isle), to be assigned upon approval of the NOI, based on the location of the treatment program.

G. NOTIFICATION AND ACCEPTANCE

1. **NOI Required.** The IASP must submit a completed NOI with the appropriate initial permit fee to the Department for review and approval. NOI forms may be obtained from, and completed forms must be sent to:

Department of Environmental Protection
Bureau of Water Quality
Division of Water Quality Management
Permitting Section
17 State House Station
Augusta, ME 04333-0017

PART I – SPECIAL CONDITIONS

G. NOTIFICATION AND ACCEPTANCE (cont'd)

Alternately, the IASP may hand-deliver completed NOI forms to the Department's Augusta office. The Department reserves the right to request additional information from the IASP as necessary to determine if the application of authorized aquatic herbicides is warranted and justified.

2. **Required NOI Information.** A complete NOI must contain the following information for each individual herbicide treatment program the applicant proposes to conduct.

   a. The legal name, mailing address, telephone number, e-mail address and signature of IASP staff member responsible for the invasive plant control project.

   b. The legal name, mailing address, telephone number, e-mail address (if available) and affiliation of any agents assisting, in full or in part, with the application of herbicides acting as agents of the Department.

   c. The legal name, mailing address, telephone number, e-mail address (if available) and Maine Board of Pesticides Control license number of the licensed applicator to perform the aquatic herbicide treatment.

   d. A statement demonstrating a <u>significant need to control the target species</u> and why application of the authorized aquatic herbicides is the most effective means of plant control. The statement must identify the affected waterbody and town(s) in which it is located and provide reasonable justification for the proposed treatment. Significant need to control the target species includes, but is not limited to:

      1. demonstration that a target population of aquatic plants cannot be controlled by non-chemical means;
      2. the potential for the plant(s) populations to spread rapidly;
      3. any significant disruption of aquatic habitat caused by the target species;
      4. if treatment is required to enable a broader scale plant control project under an aquatic plant management plan;
      5. if treatment is needed to restore habitat and/or that failure to rapidly control the species threatens to result in significant environmental harm to this or other natural resources.

   e. Information on any previous treatment efforts and why herbicide use is proposed over other treatment options which were considered or are being used secondarily. If aquatic herbicides were previously used, identification of the aquatic herbicide(s), the years that application(s) occurred, and where treatment(s) occurred.

PART I – SPECIAL CONDITIONS

G. NOTIFICATION AND ACCEPTANCE (cont'd)

f. A statement whether the proposed aquatic herbicide application(s) will be performed:

1. in conjunction with a specific written management plan for the control of invasive aquatic plants and including a reference to that plan; or
2. if the treatment is a rapid response project requiring immediate action to contain a newly identified invasive plant population, and why that rapid response is necessary.

g. Information on whether the program will involve spot or whole lake herbicide treatments.

h. A detailed project timeline describing before, during, and after treatment data collection and monitoring.

i. A topographic or similar map (or copy thereof) extending approximately one mile beyond the proposed treatment site and specific detailed written directions to the proposed treatment site.

j. A map of the waterbody to be treated showing monitoring location(s) and the area(s) to be treated if spot treatments are proposed.

k. A description of each area to be treated, including, but not limited to, range of depths, average depth, substrate character (sand, gravel, mud/organic, etc), identification of any intermittent or permanent inlets to or outlets from the waterbody, presence or absence and characterization of non-target aquatic plant species within the waterbody, and any physical aspects of the site(s) to be treated that affect operations.

l. The estimated size of the area(s) to be treated reported in square meters or acres.

m. The estimated volume(s) to be treated reported in cubic meters or acre-feet.

n. The USEPA registration number, formulation, concentration, maximum application rate, and frequency of application for all authorized aquatic herbicides proposed for use. Include a copy of the herbicide label(s).

o. Selection of the appropriate herbicide monitoring regime for the herbicide used and type of treatment pursuant to Part I.E. of this GP. Any deviations from these standard protocols will be detailed and a justification for deviation supplied with the NOI.

p. Selection of the appropriate water quality monitoring regime pursuant to Part I.E. of this GP. Any deviations from these standard protocols will be detailed and a justification for deviation supplied with the NOI.

PART I – SPECIAL CONDITIONS

G. NOTIFICATION AND ACCEPTANCE (cont'd)

q. Selection of the appropriate monitoring regime for the effects of the herbicide(s) on aquatic plants, including non-target species, pursuant to Part I.E. of this GP. Monitoring must be sufficient to evaluate the community of aquatic plants as to species present and relative abundances before and after the treatment program. Any deviations from these standard protocols will be detailed and a justification for deviation supplied with the NOI.

r. Submit a statement that the DIFW Non-Game Program, DIFW Regional Fisheries Biologist, and the DACF Natural Areas Program have received notice of the proposed treatment and have responded that no elements of special concern for rare, threatened, or endangered species or natural communities are known in the affected area or that the treatment as proposed is considered to not significantly threaten the species or natural communities in question. The permittee must also notify the Maine Department of Marine Resources Bureau of Sea Run Fisheries and Habitats, USFWS, and NOAA Fisheries. Further, the permittee must consult with the DHHS Drinking Water Program and any identified public water supplies.

s. Provide information demonstrating notification of potentially impacted landowners abutting all affected resources (efforts to notify when unsuccessful), lake/watershed associations, municipalities bordering affected resources, counties and/ or Land Use Planning Commission (LUPC) Regional Offices, and measures to post / restrict public access.

t. A copy of the press release or advertisement publication, date, and name of newspaper with general circulation in the area of the proposed treatment program.

Failure to submit all required NOI information may result in finding the NOI incomplete for processing and may delay processing or result in denial of the NOI.

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PART I – SPECIAL CONDITIONS

G. NOTIFICATION AND ACCEPTANCE (cont'd)

3. **Public Informational Meeting, Filing of a NOI, Public Notice Required.** Prior to approval of a NOI for an invasive aquatic plant control project under this GP, IASP must hold a public informational meeting in the vicinity of the treatment area or, if the treatment area is extremely remote, in a location convenient to most abutting landowners to all affected resources. The purpose of the meeting is for IASP to inform the public of the project and its anticipated environmental impacts, and to educate the public about the opportunities for public comment. At least 7 days prior to the public informational meeting, notice of the meeting must be mailed (electronically or via post mail) to the civil jurisdiction (for example, municipal office or in LUPC jurisdiction, the LUPC regional office and County Commissioners' office) in which the treatment will be located and to any affected lake associations / watershed associations identified, and with any public water system that uses the waterbody as a source. Also within this timeframe, notice of the meeting must be provided to the public via a press release or an advertisement published in a newspaper having general circulation in the area of the treatment program. The mailings and notices must provide, at a minimum, general information on the treatment purpose, treatment methods and materials, treatment location, and how to get more information, including copies of the NOI. The IASP must compile a record of all meeting attendees.

   A copy of the NOI must be filed with each civil jurisdiction in which the treatment will be located (as described above) and with the DIFW Non-Game Program, DIFW Regional Fisheries Biologist, DACF Natural Areas Program, Maine Department of Marine Resources (DMR) Bureau of Sea-Run Fisheries and Habitats, USFWS, NOAA Fisheries, and lake associations / watershed associations identified in proximity to the treatment area, and with any public water system that uses the waterbody as a source, at the time it is submitted to the Department. Further, notice that IASP is applying to conduct the proposed project must be provided to potentially impacted landowners abutting all affected resources via certified mail. Because of the potential for isolated spot treatments and due to complex hydrology in resources, not all property owners on a waterbody or in a watershed are necessarily directly affected by a treatment. Therefore, the IASP is required to inform the Department of how it determines potentially impacted abutters and the measures undertaken to provide greater contact to these parties. Additionally, a press release must be issued or an advertisement must be published in a newspaper having general circulation in the area of the treatment program within the 30-day period prior to submittal of the NOI to the Department.

   Written notice of consent by the water supplier must be received by the Department before the waterbody is treated (required by 38 M.R.S., Ch. 20-A, §1865). In addition, the treatment area(s) will be posted at likely access points with information about the treatment including advisories against swimming, drinking, and other uses if required by this permit or USEPA label.

PART I – SPECIAL CONDITIONS

G. NOTIFICATION AND ACCEPTANCE (cont'd)

4. **Review of NOI and Other Information.** Upon review of a NOI for determination of coverage under this GP, the Department may, at its discretion, require an applicant to apply for an individual permit for any proposed treatment. In making such a determination, the Department may consider factors including, but not limited to, the location of the waterbody and water quality issues particular to that area, expressed comments from state or federal agencies or the general public, consideration of invasive plant control strategies in or surrounding the proposed treatment sites, and potential effects on non-target resources and organisms and resources.

5. **Effective Date of Coverage.** The Department must notify an applicant of coverage under this GP within 30 days of receipt of each complete NOI as to whether or not coverage for the specific discharge is permitted. If the Department does not notify the applicant within 30 days, the NOI is accepted and coverage is granted. In the event coverage is not granted, the Department must notify the applicant of the reason(s) for not granting coverage. The IASP may apply for issuance of an individual MEPDES Permit / Maine Waste Discharge License if the proposed discharge(s) is not acceptable for coverage under this GP.

   Pursuant to the Department's administrative *Rule Concerning the Processing of Applications and other Administrative Matters*, 06-096, C.M.R. ch. 2, § 24(B)(1)(last amended October 19, 2015), "(w)*ithin 30 days of the filing of a license decision by the Commissioner with the Board* (of Environmental Protection), *an aggrieved person may appeal to the Board for review of the Commissioner's decision*." The Department notes that a permittee has the legal authority to proceed with an approved project upon approval by the Commissioner and subject to any conditions established. However, the Department advises that **if IASP proceeds with an approved project prior to the end of the 30-day appeal period, it assumes all risks and responsibilities in the event that the Commissioner's decision is overturned or modified on appeal.**

6. **Changed Conditions.** In the event that the IASP proposes to make or anticipates significant changes in the nature or scope of the aquatic herbicide treatment(s) described in a NOI previously submitted and approved, the IASP must notify the Department as soon as becoming aware of and before implementing such changes. Based on its evaluation of proposed changes, the Department may require the submission of a new NOI, modification of the previous GP approval, or application for an individual MEPDES Permit / Maine Waste Discharge License. Significant changes include, but are not limited to, changes in the extent of the waterbody or areas to be treated, changes in the hydrology in and surrounding the treatment area, changes in methods or materials used, changes in facts or information described in the NOI previously submitted and approved, or changes in anticipated impacts to non-target resources or organisms.

PART I – SPECIAL CONDITIONS

G. NOTIFICATION AND ACCEPTANCE (cont'd)

7. **NOT.** The permittee holding approval to discharge pursuant to this GP may submit a Notice of Termination (NOT) on a form provided by the Department at any time to voluntarily terminate coverage. A copy of the NOT form must be filed with each civil jurisdiction in which the treatment has been located and to the public via a press release or an advertisement published in a newspaper having general circulation in the area of the treatment program. Authorization to discharge under this GP terminates on the day the signed NOT is received by the Department. Thereafter, activities for aquatic plant control involving the discharge of pollutants to waters of the State are prohibited unless otherwise approved by the Department.

H. CONTINUING COVERAGE AND TERMINATION

1. **Term of Coverage and Payment of Fees.** The term of this GP is five years from the effective date indicated, unless reissued, replaced, or discontinued by the Department. Project coverage under this GP begins pursuant to the conditions described in Permit Special Condition Part I, G.5., *Effective Date of Coverage*, above and continues until the earliest of: changes to the GP as noted immediately above, expiration of the GP, action by the Department to end project coverage, or the Department's receipt of a signed Notice of Termination from the permittee or approved agent. Ongoing coverage within the effective period of the GP is also dependent upon payment of an annual fee pursuant to *Maine Environmental Protection Fund,* 38 M.R.S. §353-B. Failure to pay the annual fee within 30 days of the billing date is sufficient grounds for revocation or suspension of coverage. If changes occur or are proposed, the IASP must notify the Department as specified in Part I.G.6 of this GP.

   Upon reissuance or replacement of the GP, the permittee or agent of a treatment project approved pursuant to the immediately preceding GP may apply for coverage under the new GP by:

   a. completing and submitting a new NOI, excluding required and previously submitted maps, photographs, and other required attachments if no changes in the project are proposed;
   b. submitting a statement that the treatment project will be conducted consistent with the project as previously proposed and approved except where changes are required by the reissued or replaced GP; and
   c. submitting the difference, if any, in annual permit fees from the amount paid in the current year for coverage under the immediately preceding GP and the amount charged for coverage under the reissued or replaced GP.

PART I – SPECIAL CONDITIONS

H. CONTINUING COVERAGE AND TERMINATION (cont'd)

2. Individual Permit Coverage. The Department may require that the IASP apply for an individual permit to apply aquatic herbicides for the following reasons:

A. The aquatic herbicide application project is not in compliance with the conditions of this GP.

B. The aquatic herbicide application project is a significant contributor of pollutants. In making this determination, the Department may consider factors including, but not limited to, the following:

i. the location of the project with respect to waters of the State;
ii. the size of the discharge;
iii. the quantity and nature of the pollutants discharged to waters of the State.

C. The project as proposed is determined to present significant adverse impacts on non-target organisms and/or resources;

D. Any other factors the Department determines are relevant, including information pursuant to Part I, §G.4 and §G.6, and pursuant to Department Rules, 06-096 C.M.R. 529.

3. Exclusion from Coverage. When an individual MEPDES Permit/WDL is issued to the IASP, the applicability of this GP to the IASP for that project is automatically terminated on the effective date of the individual Permit/WDL.

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PART II – STANDARD CONDITIONS

The application of authorized aquatic herbicides for invasive plant control under this GP must, at all times, comply with the State's water quality laws, including, the following restrictions, limitations and conditions.

A. NARRATIVE EFFLUENT LIMITATIONS

1. The discharge must not contain a visible oil sheen, foam or floating solids at any time which would impair the uses designated for the classification of the receiving waters.

2. The discharge must not contain materials in concentrations or combinations which pose unacceptable risks to non-target species or which would impair the uses designated for the classification of the receiving waters.

3. The discharge may not impart color, taste, turbidity, radioactivity, settleable materials, floating substances or other properties that cause the receiving water to be unsuitable for the designated uses ascribed to its classification.

4. Notwithstanding specific conditions of this GP, the discharge must not lower the quality of any classified body of water below such classification, or lower the existing quality of any body of water if the existing quality is higher than the classification.

B. MONITORING REQUIREMENT. The Department may require, following approval of a NOI, any monitoring of an individual discharge in addition to the standard protocols contained in this permit as may be reasonably necessary in order to characterize the nature, volume or other attributes of that discharge or its sources.

C. OTHER INFORMATION. When the IASP becomes aware that it has failed to submit any relevant facts or submitted incorrect information in the NOI or in any other report to the Department, the IASP must promptly submit such facts or information.

D. OTHER APPLICABLE CONDITIONS. The conditions applicable to all permits in *Waste Discharge License Conditions,* 06-096 C.M.R. 523(2) and (3) (effective January 12, 2001) also apply to discharges pursuant to this GP and are incorporated herein as if fully set forth.

E. ACCESSIBILITY. Employees and agents of the Department may enter any property at reasonable hours in order to determine compliance with water quality laws or this GP.

F. SEVERABILITY. In the event that any provision, or part thereof, of this GP is declared to be unlawful by a reviewing court, the remainder of the permit must remain in full force and effect, and must be construed and enforced in all respects as if such unlawful provision, or part thereof, had been omitted, unless otherwise ordered by the court.

STATE OF MAINE

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Fact Sheet – General Permit
Application of Herbicides for the Control of Invasive Aquatic Plants

Maine Pollutant Discharge Elimination System Permit

Bureau of Water Quality December 29, 2016
Maine Pollutant Discharge Elimination System (MEPDES) Permit #MEG150000
Waste Discharge License (WDL) #W-009004-5Y-C-R

PART III - FACT SHEET

A. AREA OF COVERAGE AND RECEIVING WATER CLASSIFICATION

The area of coverage under this general permit (GP) is the entire state of Maine. This GP covers the direct discharge of authorized aquatic herbicides, as defined in Part I.B.1. of the GP, to fresh waters classified by Maine law as Class GPA, AA, A, B, C, tributaries to Class GPA waters, and those waters having drainage areas of less than ten square miles, that contain populations of invasive aquatic plants. Waters of any other classifications than those noted above are not covered by this GP.

B. PERMIT SUMMARY

The Maine Department of Environmental Protection (Department/DEP) has re-issued and revised this GP authorizing direct discharges (applications) of aquatic herbicides by the Department's Invasive Aquatic Species Program (IASP) and its qualifying agents to certain waters of the State for the control of invasive aquatic plants. The IASP must file a separate Notice of Intent (NOI) for each individual herbicide treatment program. A permittee is required to consult with the Maine Department of Inland Fisheries and Wildlife (DIFW) Non-Game Program, DIFW Regional Fisheries Biologist, and Maine Department of Agriculture, Conservation and Forestry (DACF) Natural Areas Program, as to the presence and possible effects on any elements of special concern for rare, threatened, or endangered species or natural communities in the affected area. A copy of the NOI must also be sent to each civil jurisdiction in which the treatment program will be located; Maine Department of Marine Resources (DMR) Bureau of Sea-Run Fisheries and Habitats, U.S. Fish and Wildlife Service (USFWS), U.S. National Oceanic and Atmospheric Administration (NOAA) Fisheries; lake associations/watershed associations in proximity to the treatment area, any public water system that uses the waterbody(s) proposed for treatment as a source, and to potentially impacted abutting landowners to all affected resources. A press release must be issued or an advertisement must be published in a newspaper having general circulation in the area of the proposed treatment program within the 30-day period prior to submittal of the NOI to the Department.

Coverage under this GP is dependent upon the ability to meet the eligibility, and the special, standard, and general conditions of the GP. Individual project coverage under this GP is continued during the term of the GP contingent upon compliance with its terms and conditions, payment of an annual fee, and provided the treatment project will be conducted consistent with the project as previously proposed and approved. Coverage for the IASP or waterbody may be terminated in the event of non-compliance with the terms and conditions of the GP or based on a Department determination that the discharge is having an adverse impact on receiving water quality, non-target organisms, or non-target resources. The IASP may apply for an individual Maine Pollutant Discharge Elimination System (MEPDES) Permit / Maine Waste Discharge License (WDL) for waterbodies or activities that are not covered by this GP.

PART III - FACT SHEET

C. REGULATORY SUMMARY

A permit is required for the discharge of aquatic herbicides pursuant to Maine law, 38 M.R.S. §413(1) and Department rule, *Regulations Concerning the Use of Aquatic Pesticides*, 06-096 C.M.R. 514 (last amended January 29, 1989). A GP authorizing the discharge of certain pollutants may be issued pursuant to Department rule *General Permits for Certain Wastewater Discharges*, 06-096 C.M.R. 529 (last amended June 27, 2007). The similarity of discharges resulting from the application of authorized aquatic herbicides for the control of invasive aquatic plants prompted the Department to issue this GP for those receiving waters not otherwise prohibited by Maine law and that contain population(s) of invasive aquatic plants. A violation of a condition or requirement of a GP constitutes a violation of the State's water quality laws, and subjects the discharger to penalties under Maine law, 38 M.R.S. §349.

Pursuant to Maine law, 22 M.R.S. §1471-A, the Maine Board of Pesticides Control (BPC) within the DACF, regulates the sale and application of chemical insecticides, fungicides, herbicides and other chemical pesticides. Maine law, 22 M.R.S. §1471-D requires certification of commercial and private applicators for the use of any herbicide within the State.

On November 27, 2006, the U.S. Environmental Protection Agency (USEPA) issued a final rule stating that pesticides applied in accordance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) were exempt from the federal Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) permitting requirements. The USEPA's determination specifically referenced the application of pesticides directly to waters of the United States in order to control pests that are present in those waters. On January 7, 2009, the US 6th Circuit Court of Appeals (*National Cotton Council, et al. v. EPA*) vacated USEPA's 2007 rule.

The following is an excerpt from the 2016 NPDES Pesticide GP Fact Sheet:

> "On January 7, 2009, the Sixth Circuit vacated USEPA's 2006 NPDES Pesticides Rule under a plain language reading of the CWA. *National Cotton Council of America v. EPA*, 553 F.3d 927 (6th Cir., 2009). The Court held that the CWA unambiguously includes "biological pesticides" and "chemical pesticides" with residuals within its definition of "pollutant." Specifically, an application of chemical pesticides that leaves no excess portion is not a discharge of a pollutant, and the applicator need not obtain an NPDES permit. However, chemical pesticide residuals are pollutants as applied if they are discharged from a point source for which NPDES permits are required. Biological pesticides, on the other hand, are always considered a pollutant under the CWA regardless of whether the application results in residuals or not and require an NPDES permit for all discharges from a point source."

PART III - FACT SHEET

C. REGULATORY SUMMARY (cont'd)

On June 8, 2009, the U.S. Sixth Circuit Court of Appeals granted USEPA a two-year stay of the mandate (until April 9, 2011) in *National Cotton Council et al v. EPA*. This stay was further extended by the Court until October 31, 2011. On October 31, 2011, USEPA published the Pesticide GP, which was renewed on October 31, 2016.

It is noted that Maine law, 38 M.R.S., Section 413, *Waste discharge licenses*, and Department rule *Regulations Concerning the Use of Aquatic Pesticides* 06-096 C.M.R. Chapter 514, already provide the Department with the authority to regulate such discharges. Therefore, this GP is being issued pursuant to the MEPDES permit and WDL program and Maine's delegated permit authority.

Nothing in this GP is intended to limit the Department's authority under the waste discharge and water classification statutes or rules. This GP does not affect requirements under other applicable Maine statutes and Department rules.

D. PROJECT AUTHORITY AND NEED

The Department is charged by statute with preventing the spread of invasive aquatic plants and managing infestations if they occur (38 M.R.S., Chapter 20-A&B). Invasive aquatic plants are as listed in 38 M.R.S. §410-N or as determined by the Department under 38 M.R.S. §466, sub-§8-A. Invasive aquatic plants listed as of October 2016 include:

Eurasian water milfoil (*Myriophyllum spicatum*);
Variable-leaf water milfoil (*Myriophyllum heterophyllum*);
Parrot feather (*Myriophyllum aquaticum*);
Water chestnut (*Trapa natans*);
Hydrilla (*Hydrilla verticillata*);
Fanwort (*Cabomba caroliniana*);
Curly-leaved pondweed (*Potamogeton crispus*);
European naiad (*Najas minor*);
Brazilian elodea (*Egeria densa*);
Frogbit (*Hydrocharis morsus-ranae*); and
Yellow floating heart (*Nymphoides peltata*).

The IASP is the section of the Department's Bureau of Water Quality that is responsible for coordinating the state's efforts to prevent, limit the spread, and reduce the harmful effects of invasive aquatic plants; and for preventing, controlling, and managing invasive aquatic plant populations.

PART III - FACT SHEET

D. PROJECT AUTHORITY AND NEED (cont'd)

Maine Law includes narrative water quality criteria for each of the water classes covered by this GP. The criteria describe the water quality values, habitat values, and designated uses that must be maintained for each of these water classes. Invasive aquatic species are non-native species that threaten the vegetational composition and diversity, habitat structure and suitability, values and uses of Maine waters. This GP is intended as a tool to facilitate the Department's mandates on invasive species and protection of Maine waters.

Aquatic plants perform important functions in Maine waters by releasing oxygen into the water, stabilizing sediments with root systems, providing habitat for macroinvertebrates that are prey for fish, and sheltering young fish from predators. Most Maine waters have a diverse assemblage of native plants that perform these functions. Non-native aquatic plants can out-compete the native plants and grow very densely into a monoculture because these non-native plants do not have the same growth control mechanisms (parasites, herbivores) outside of their native ranges. Dense stands of non-native invasive aquatic plants change the habitat by precluding growth of native plants which, in turn, indirectly alters the habitat for macroinvertebrates and fish. Seasonal die-off of large stands of invasive aquatic plants may lead to low dissolved oxygen concentrations. Non-native invasive aquatic plants may also inhibit recreational activity by humans and may even lead to declines in property values.

The aggressive tendencies and significant adverse effects of certain non-native aquatic plants on Maine's environment have caused those plants to be classified as invasive aquatic plants. This GP may be used to knock-back an established population of invasive aquatic plants so that other non-chemical techniques can be used, but it is more likely to be used in responding to incipient infestations. In 2006 Commissioners of the DEP and DIFW approved a statewide Rapid Response Plan for responding to new infestations of invasive aquatic plants and for dealing with invasive faunal introductions. This GP addresses only invasive aquatic plants (i.e., not fauna) but it is a critical part of the Department's ability to carry out its legislative charge and the directives in the Rapid Response Plan.

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PART III - FACT SHEET

E. ADMINISTRATIVE REQUIREMENTS

The administrative procedures and requirements associated with this GP are based on the following Department rules (06-096): *Rules Concerning the Processing of Applications and Other Administrative Matters* C.M.R. 2, (last amended April 1, 2003); *Regulations Concerning the Use of Aquatic Herbicides* C.M.R. 514,; *General Permits for Certain Wastewater Discharges* C.M.R. 529, (last amended April 27, 2007), and applicable Maine laws. In seeking coverage under this GP, the IASP must file a NOI containing sufficient information and facts to describe all proposed aquatic herbicide treatments and waterbodies, so as to allow the Department to determine if the proposed activities are anticipated to comply with the GP terms and conditions. Once a completed NOI is received, the Department has a maximum of 30 calendar days in which to act on it. If no other action is taken within that 30-day period, the NOI is considered approved at the close of business (5:00 p.m. Eastern Time Zone) on the thirtieth day following the Department's receipt of the NOI. Agency, abutter, civil jurisdiction, and public notice of the proposed treatment program must be provided as detailed in General Permit Part 1.G.3 and Fact Sheet Section B.

Pursuant to Chapter 2, section 24.B.1, "(w)*ithin 30 days of the filing of a license decision by the Commissioner with the Board* (of Environmental Protection)*, an aggrieved person may appeal to the Board for review of the Commissioner's decision*." The Department notes that a permittee has the legal authority to proceed with an approved project upon approval by the Commissioner and subject to any conditions established. However, the Department advises that if the permittee proceeds with an approved project prior to the end of the 30-day appeal period, it assumes all risks and responsibilities in the event that the Commissioner's decision is overturned or modified on appeal.

The term of this GP is five years from the effective date indicated, unless reissued, replaced, or discontinued by the Department. Project coverage under this GP begins pursuant to the conditions described in Permit Special Condition Part I, G.5., *Effective Date of Coverage*, and continues until the earliest of: changes to the GP as noted immediately above, expiration of the GP, action by the Department to end project coverage, or the Department's receipt of a signed Notice of Termination from the permittee or approved agent. Individual project coverage under this GP is continued during the term of the GP contingent upon compliance with its terms and conditions, payment of an annual fee, and provided the treatment project will be conducted consistent with the project as previously proposed and approved. In the event that an approved aquatic herbicide treatment program is not conducted in compliance with this GP or upon determination by the Department that the discharge is having an unreasonable adverse impact on receiving water quality, non-target organisms or resources, the Department may require that the permittee apply for an individual MEPDES Permit/WDL or cease discharge. Examples of significant changes in activities include, but are not limited to, changes in the extent of the waterbody or areas to be treated, the hydrology in and surrounding the treatment area, methods or materials used, facts or information previously submitted and approved, or changes in anticipated impacts to non-target organisms or resources.

PART III - FACT SHEET

F. DESCRIPTION OF AUTHORIZED ACTIVITIES

This GP authorizes the discharge (application) of authorized aquatic herbicides as defined in General Permit Part I.B.1 that are registered with both the USEPA and the Maine Board of Pesticides Control (BPC) and are applied in accordance with USEPA approved label use to inhibit the growth or control the existence of invasive aquatic plants. This GP requires the use of an appropriately certified applicator licensed by the MBPC for applications of the authorized aquatic herbicides to waters of the State. Authorized aquatic herbicides should be applied at the lowest appropriate labeled rates whenever possible (for example, when they can be applied during the most sensitive life stages of the target species or in specific areas so as to minimize non-target damage).

This GP authorizes applications of certain aquatic herbicides to those waterbodies specified in Section A of this Fact Sheet to control invasive aquatic plants. This GP is not intended to control or eradicate any aquatic plant species other than those specifically listed in this permit as invasive aquatic plants or as determined pursuant to 38 M.R.S., §466.8-A. It is noted, however, that certain waterbodies may contain several species of non-target plants. To the greatest extent possible, applications of herbicides under this permit should minimize impacts to non-target species. This may be done by a number of means, including the use of the most selective formulation allowed by this permit, using the lowest effective dose or duration of exposure of herbicides to achieve efficacy, differentially dosing areas of waterbodies to target species of concern, and altering the timing of herbicide use.

Herbicides are generally applied by either subsurface injection, surface spraying (liquid formulations or solids designed to be water-mixed before applications), or spread on the water surface and allowed to sink to the bottom (pelletized formulations). Application is usually done from a specially equipped boat, with pumps and metering devices (liquid applications) or with mechanical spreaders (pellets). It is usual for these boats to be equipped with GPS tracking devices which allow good areal coverage and to assure even dosing. Exceptions to uniform dosing occur when portions of waterbodies require differential amounts applied due to varying water volumes in treatment areas or where spot treatments are conducted. These latter are often done by pellet applications or by liquid applications within a curtained area ("limnocurtains").

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PART III - FACT SHEET

G. CONCENTRATIONS OF AUTHORIZED AQUATIC HERBICIDES

Typical herbicide concentrations and target durations of exposure along with highest rates allowed in this permit are specified in Table 1 of this Fact Sheet. As it is routine practice in integrated pest management, lesser rates which achieve treatment efficacy will be applied to protect non-target organisms and resources. In all cases, the permitted rate never exceeds the maximum USEPA approved label rate, and in most cases, the treatment concentration will be chosen in consultation with treatment contractors. However, the actual concentrations chosen need to be adequate to achieve significant control of the target species. Failure to do this may defeat the purpose of the applications and possibly invite environmental damage from more aggressive management that may be needed if the initial infestation is not reduced in a timely manner.

The following table provides the maximum USEPA approved label rate, and typical ranges of concentrations and treatment days for each of the currently listed invasive aquatic plants in Maine. Concentrations are in parts per million (ppm) and are volume-weighted.

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PART III - FACT SHEET

G. CONCENTRATIONS OF AUTHORIZED AQUATIC HERBICIDES (cont'd)

Table 1. Typical Herbicide Concentrations and Target Exposures for Control of Invasive Aquatic Plants

Authorized Aquatic Herbicides	**2, 4-D AE**		**Diquat CE**		**Endothall AE**		**Fluridone AE (liquid)**		**Fluridone AE (solid)**		**Triclopyr AE**	
Maximum General Permit & USEPA Label Rate	4.0		0.37		5.0		0.150		0.075 (0.150 Season ∑)		2.5	
	Typical Conc. (ppm)	Target Duration Days	Typical Conc. (ppm)	Target Duration Days	Typical Conc. (ppm)	Target Duration Days	Typical Conc. (ppm)	Target Duration Days	Typical Conc. (ppm)	Target Duration Days	Typical Conc. (ppm)	Target Duration Days
Invasive Species												
Eurasian water milfoil	0.5-2.0	1--3	0.1-0.2	TBD	2--4	0.5-2.0	0.006-0.015	>90-120	0.006-0.015	>90-120	0.5 - < 2.5	<3 - 0.75
Variable-leaf water milfoil	0.5-2.0	1--3	0.1-0.2	3	2--4	0.5-2.0	0.01-0.02	>90-100	0.01-0.02	>90-100	0.5 - < 2.5	<3 - 0.75
Parrot feather	< 4.0	TBD	< 0.35	TBD	2--4	0.5-2.0	< 0.050	TBD	< 0.060	TBD	0.75 to < 1.5 **	1-2**
Water chestnut	3.0-4.0	1	< 0.35	TBD	TBD	TBD	< 0.050	TBD	< 0.060	TBD	TBD	TBD
Hydrilla	< 4.0	TBD	< 0.35	TBD	2--4	0.5-2.0	0.005-0.03	>90-100	0.005-0.03	>90-100	N/A*	TBD
Fanwort	< 4.0	TBD	< 0.35	TBD	TBD	TBD	0.01-0.03	>90-150	0.01-0.03	>90-150	TBD	TBD
Curly-leaved pondweed	< 4.0	TBD	0.1-0.2	3	0.5--3	0.5-2.0	0.006-0.03	> 60	0.006-0.03	> 60	TBD	TBD
European naiad	< 4.0	TBD	0.1-0.2	3	1--4	0.5-2.0	0.006-0.03	> 60	0.006-0.03	> 60	N/A*	TBD
Brazilian elodea	< 4.0	TBD	0.1-0.2	3	TBD	TBD	0.01-0.03	>70-84	0.01-0.03	>70-84	N/A*	TBD
Frogbit	< 4.0	TBD	< 0.35	TBD	TBD	TBD	< 0.050	TBD	< 0.060	TBD	N/A*	TBD
Yellow floating heart	3.0-4.0	1	< 0.35	TBD	TBD	TBD	< 0.050	TBD	< 0.060	TBD	TBD	TBD
Plant species designated by the Department	< 4.0	TBD	< 0.35	TBD	TBD	TBD	< 0.050	TBD	< 0.060	TBD	TBD	TBD

PART III - FACT SHEET

G. CONCENTRATIONS OF AUTHORIZED AQUATIC HERBICIDES (cont'd)

Footnotes:

N/A* = Monocot species; probably not effective

** Based on one review (11) with limited data on duration of exposure. Concentrations based on mean depth= 4 ft and label rates. Probable that in the field application rates should be comparable to other *Myriophyllums*.

TBD = to be determined, as field data are limited. The target duration days for these species are usually equal to the maximum duration for other invasive species listed.

Concentrations are given as acid equivalents (ae) for Fluridone, 2, 4-D, Triclopyr, and Endothall and as cation equivalents (CE) for Diquat dibromide.

Concentrations designated at maximum permit rates are those for which limited target concentration data is available. Those herbicides are less likely to be used than other products with a proven track record.

Target duration days refers to the recommended number of days of exposure at the typical herbicide concentration listed to ensure efficacy.

H. DESCRIPTION OF AUTHORIZED AQUATIC HERBICIDES

1. This GP authorizes the application (discharge) of granular, solid, powder, liquid or other formulations of herbicides as described in the following sections on Fluridone, Diquat dibromide, 2, 4-D, Endothall, and Triclopyr. Specifically, the formulations that may be used under this permit are those below, or successor formulations with substantially the same constituents. From time to time, formulations may be re-registered or minor modifications, including product names, may be made subject to USEPA and BPC registration.

a) 2, 4-Dichlorophenoxyactetic acid (2, 4-D) derivatives:
Dimethylamine salt, 2, 4-Dichlorophenoxyacetate, 2, 4-D DMA salt, (USEPA Chemcode 30019; CAS Registry # 1929-73-3)

b) Diquat:
Diquat dibromide (USEPA Chemcode 32201; CAS Registry # 85-00-7);

c) Endothall:
Endothall dipotassium salt (7-oxabicyclo [2, 2, 1] heptane-2, 3-dicarboxylic dipotassium salt) (USEPA Chemcode 38904; CAS Registry # 2164-07-0)

PART III - FACT SHEET

H. DESCRIPTION OF AUTHORIZED AQUATIC HERBICIDES

d) Fluridone:
Fluridone (USEPA Chemcode CAS Registry # 59756-60-4)

e) Triclopyr:
Triethylamine salt (TEA) (USEPA Chemcode 116002;
CAS Registry #: 57213-69-1)

Descriptions of the properties and potential effects of each of these authorized aquatic herbicides are included as Fact Sheet Attachment A.

I. MONITORING AND REPORTING REQUIREMENTS

This GP requires monitoring of herbicide concentrations, water quality, plant communities, and non-target fauna, as described below. The monitoring requirements included herein constitute minimum monitoring requirements. Additional monitoring will be based on waterbody specific and treatment specific conditions and properties and will be specified in the NOI as needed. The IASP's monitoring plans must also consider information received from consultation with the DIFW, DACF Natural Areas Program, and other resource agencies and organizations.

1. Herbicide Monitoring: Herbicide monitoring is typically done to ensure that permit limits are not exceeded, to assure that target concentrations are met (or maintained in the event that booster treatments are required to maintain residuals over time), to determine when to re-apply (booster treatments), or to assess when concentrations drop below levels that will have an effect on plant populations. Detection methods are established by USEPA methods (2, 4-D, Diquat dibromide, Endothall, and Triclopyr) or by proprietary test methods (Fluridone).

   As described in the GP, Diquat dibromide has only a liquid formulation, while Fluridone, 2, 4-D, Triclopyr, and Endothall have both liquid and granular formulations. Depending on the product used, the maximum concentration of herbicide may occur at varying depths within the water column. To ensure homogeneous mixing of the herbicide and detection of the maximum instantaneous concentration, the first post treatment sampling for herbicide concentration will include surface, bottom, and mid-water column grab samples unless the water column is too shallow to require multiple samples to characterize concentrations. Complete mixing may take up to several days but, due to the fast-acting nature of the herbicides, samples for diquat dibromide, as well as samples for liquid formulations of 2, 4-D, Triclopyr, and Endothall will be collected within 24 hours of initial treatment. Granular treatments of 2, 4-D, Triclopyr, and Endothall and will be collected within 72 hours, reflecting delayed release times needed for active concentrations to develop. Fluridone (liquid or granular) will be sampled within 72 hours of initial treatment since this herbicide is more persistent than the others. Thermal profiles will be used to determine the location of the mid-water column grab sample.

PART III - FACT SHEET

I. MONITORING AND REPORTING REQUIREMENTS (cont'd)

The second post treatment samples reflect the tendency for maximum concentrations for liquid and granular formulations to be near the surface and near the bottom, respectively. Monthly samples following the second post treatment samples (subsurface grab or representative water column composite) assume homogenous mixing whether liquid or granular formulation is used.

The standard monitoring location for whole-lake treatments must be the lake deep hole (deepest point in defined basin(s)). For spot or area treatments, herbicide sampling must occur within the treated area at a location representative of the characteristics (depth, density of plant growth, substrate) of the treated area. However, multiple spot or area treatments will require no more than 3 representative areas monitored.

Outlet monitoring is required when a whole lake treatment is performed and there is outflow during the time of effective herbicide concentrations. If there is outflow, one grab sample must be collected on the same frequency as specified for whole-lake treatment monitoring. Sampling locations will be representative of downstream conditions. Unless specified in the NOI due to proximity to the outlet, outlet monitoring is not required for spot or area treatment as the extensive dilution within the receiving water is anticipated to result in no release of effective or biologically active herbicide concentrations downstream.

Monitoring is started based on the initial annual herbicide application and continues pursuant to prescribed requirements regardless of the presence or number of booster treatments administered. Monitoring must continue until the herbicide can no longer be detected in laboratory analysis (i.e., non-detect level), to an alternate Department-specified sampling endpoint defined herein, or annually to ice-in, or through November in each year that treatment occurs, whichever comes first. If non-detect or the pesticide-specific sampling endpoint is not reached by ice-in or the end of November, monitoring will be suspended over winter.

Monitoring will resume within one month of ice-out in the following spring and will continue every month until the concentration falls below the detection limit, reaches the pesticide-specific sampling endpoint, or until re-treatment occurs. If retreatment occurs in a new calendar year, the IASP must resume monitoring pursuant to Table 2, beginning with the requirements for first samples. Laboratory detection limits may vary over time. This GP requires that the IASP utilize detection limits current at the time of sampling. Herbicide concentration monitoring requirements are described in GP Table 2.

PART III - FACT SHEET

I. MONITORING AND REPORTING REQUIREMENTS (cont'd)

2. Water Quality Monitoring: The primary need to do lake water quality monitoring is to detect whether there are increases in total phosphorus which can be obviously associated with releases from dying plants. Also, abnormally low Secchi disk transparencies (algae response to increased nutrients) or low dissolved oxygen beyond conditions typically expected in the waterbody, which may be due to plant decay, may be detected. Data taken as part of the treatment project will be compared to pre-treatment data, if available, to determine evidence of water quality impacts due to the treatment. Numerous field studies have recorded such shifts in water quality. Commonly, upon return to more natural plant densities, water quality returns to pre-treatment conditions, usually within a year or two. Longer term reductions in formerly high density plant biomass may result in more persistent planktonic algae increases, since the nutrients normally sequestered in high density invasive plant populations are available for re-cycling in the lake system. Most lake systems so affected usually return to lower productivity status after several seasons of lake flushing and sediment absorption /precipitation of nutrients. See Section L of this Fact Sheet.

   When required under this permit, lake water quality monitoring will be conducted twice per season, typically timed to entail pre and post treatment, during years when a lake is treated. Monitoring will include temperature-oxygen profile, Secchi disk transparency, and total phosphorous according to the Department's Standard Field Methods for Lake Water Quality Monitoring. Monitoring locations for whole-lake treatments will be in a representative deep water location, usually the deepest area of the treated basin. Similar monitoring will be done for spot treatments only if the total area treated exceeds 25% of the lake surface area or if hydrologic conditions suggest potential for dissolved oxygen (DO) depletion. In the latter case, sampling may be done within the treated area as appropriate.

3. Plant Community Monitoring: Plant community monitoring is conducted for two basic reasons: to assess the success of control on the target population(s) and to assess effects of treatment on the plant community as a whole. There are many ways to monitor plant populations, ranging from simple physical examination and field identification of plants to very labor-intensive quantitative sampling.

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PART III - FACT SHEET

I. MONITORING AND REPORTING REQUIREMENTS (cont'd)

The point-intercept method, as described in Madsen (2000), involves obtaining samples of plants growing at several spots in the area of interest based on a geographic positioning system (GPS) grid. The IASP has employed this method in past herbicide treatments, and uses a toothed grapnel or rake on a line to remove samples of plants from the bottom in areas likely to contain plant populations. This allows for identifying plant species and their relative abundance based on how many times a species is found. The number of points sampled can range significantly depending on the degree of precision needed. In general, as few as 20-40 samples in whole lake treatments should give a good representation of plant diversity and relative numbers. Depending on the size of the waterbody, the distance between sampling points is anticipated to be approximately 100 meters. The number of sampling points in spot treatments will vary depending on the size of the treated area. For very small treatment areas (e.g., 25 m^2) only 1 or 2 sampling points will suffice, while larger spot treatments may require up to 5 sampling points to characterize the plant community pre and post treatment. Where multiple spot treatments occur on a waterbody, plant monitoring must occur in a maximum of 3 treatment areas.

On a case specific basis, other commonly accepted means of plant monitoring may be preferable including quadrat or transect monitoring and visual surveys, by diver or from the surface, of sufficient scope to give reliable, though semi-quantitative, plant community assessment. Observations using submersible cameras and divers can add knowledge in areas where plants are in sparse or in deep waters for qualitative evaluations.

This sampling must occur before treatment, and, during the growing season at a time likely to give good community representation, when possible. Annual monitoring of the target species must be done to assess treatment efficacy and may use one or more of the following methods for whole lake treatments: point intercept survey, diver survey, underwater camera, or surface observations. Point intercept surveys will be used for spot treatments. IASP experience on Pickerel Pond in Limerick (#ME0090670 / #W-8156-5U-B-R) and Pleasant Hill in Scarborough (#MEU508221 / #W-8221-5U-A-N) reveals that annual monitoring of non-target species during a multi-year treatment program does not provide significant additional information. Four years of annual non-target plant monitoring during the Pickerel Pond treatment program resulted in very similar patterns each year, i.e., most of the same non-targets are killed year after year. The real question is what plants will grow back once the herbicide treatment program ends. Monitoring of target and non-target plant species should be done during the growing season in the year after the last treatment to assess efficacy of control of the target plant(s) and reductions or potential loss of non-target species. This information, coupled with other qualitative observations, allows planning for follow-up manual or mechanical control methods.

PART III - FACT SHEET

I. MONITORING AND REPORTING REQUIREMENTS (cont'd)

In contrast, plant monitoring in outlet streams can usually be done from shore or wading, and semi-quantitative methods such as point intercept are not needed. The objective is to determine what plant species are present and a qualitative evaluation of relative abundance. Follow-up monitoring determines if there is obvious plant damage (often exhibited by chlorosis) from herbicide residuals in the outflow. Observations are also conducted for the presence of, and effects on, rare or threatened species.

In the event of only spot treatments in a waterbody, plant monitoring in the outlet stream will not be conducted due to the dilution by the volume of untreated lake water. The IASP will, however, conduct visual observations in the outlet stream for chlorosis on plants to ensure that there is no evidence of effect on downstream plants.

4. Non-target Fauna Observations: The IASP will also conduct visual observations in the waterbody and outlet throughout the treatment program for treatment-related effects on macroinvertebrates, fish, and other aquatic organisms and report the occurrence and significance of any adverse findings within 24-hours. The IASP and the Department must evaluate the occurrence and determine an appropriate course of action.

   Monitoring results of herbicide concentrations must be reported to the Department quarterly, while the results of monitoring for water quality, plant communities, and non-target fauna must be reported to the Department annually, as described in General Permit Part I.F.

J. PUBLIC HEALTH CONCERNS AND RISK REDUCTION

Aquatic herbicides covered under this permit have been reviewed by the USEPA during the registration process. USEPA considered studies on human exposure as well as laboratory and field studies of both acute and chronic effects on animals. The labels set limits that are unlikely to pose risk to humans given normal behavior such as swimming and using very conservative assumptions as to exposure and duration of herbicides in the environment.

At least two states, Massachusetts in 2004 and Washington during 2000-2004, published extensive reviews of environmental fate and effects of herbicides. These included reviews of human health effects of numerous herbicides, including those covered in this permit. Information in these reviews as well as USEPA documents were consulted when setting target concentrations as well as safeguards for human health, non-target species, and habitat.

PART III - FACT SHEET

J. PUBLIC HEALTH CONCERNS AND RISK REDUCTION (cont'd)

At the request of the Department, staff of the BPC also performed a review of these herbicides and considered if Maximum Exposure Guidelines (MEGs) should be revised or established. They were requested to consider the human health effects of herbicide use at the maximum label rates as well as the more likely rates proposed in this permit. The results of the BPC reviews are summarized in Fact Sheet Attachment A. In general, even at the maximum label rates, human health effects were considered extremely unlikely given the treatment scenarios allowed.

While the highest rates in this permit are equivalent to the USEPA approved label rates, the lowest rate and shortest duration of exposure required to achieve treatment efficacy will be used to protect non-target organisms and resources. Herbicide labels specify use restrictions such as in drinking water or plant irrigation. In all cases IASP follows safety and notice precautions as prescribed or is more stringent than label requirements.

K. CONDITIONS OF LICENSES / PERMITS

Discharges of authorized aquatic herbicides under this GP are subject to 38 M.R.S. §414-A.1(E), provisions and conditions of *Water Classification Program,* 38 M.R.S. § 464(4), 465, and 465-A and *Regulations Concerning the Use of Aquatic Herbicides*, 06-096 C.M.R. ch.514, *Waste Discharge License Conditions*, 06-096 C.M.R. ch.523 §2, and *General Permits for Certain Wastewater Discharges*, 06-096 C.M.R. ch.529.

L. REGULATIONS CONCERNING THE USE OF AQUATIC PESTICIDES

06-096 C.M.R. ch.514, §1 states, "an aquatic pesticide is any substance applied in, on or over the waters of the State or in such a way as to enter those waters for the purpose of inhibiting the growth or controlling the existence of any plant or animal in those waters". In accordance with 06-096 C.M.R. ch.514, §2:

§§ A, "Except as provided in *Experiments and scientific research in the field of pollution and pollution control,* 38 M.R.S. § 362-A, no permit for aquatic pesticide use will be issued for a pesticide which is not registered for the intended use by the United States Environmental Protection Agency and the Maine Department of Agriculture".

§§ B, "No permit for aquatic pesticide use will be issued unless the applicant or agent for the applicant is certified and licensed in aquatic pest control by the Maine Board of Pesticides Control".

§§ C, "A permit for aquatic pesticide use will be issued only if the applicant provides adequate protection for non-target species".

PART III - FACT SHEET

L. REGULATIONS CONCERNING THE USE OF AQUATIC PESTICIDES (cont'd)

§§ D, "A permit for aquatic pesticide use will be issued only if the applicant can demonstrate a significant need to control the target species and that pesticide control offers the only reasonable and effective means to achieve control of the target species. Demonstration of significant need may included, but not be limited to, health risk, economic hardship, or loss of use."

§§ E, "In addition to paragraphs (A) through (D), any discharge of aquatic pesticides, alone or in combination with all other discharges, must meet all other applicable requirements of Maine's waste discharge laws including, but not limited to, the provisions of 38 M.R.S. Sections 464 and 465".

Prior to granting coverage under this GP, the registration status, both federal and state, of selected products must be verified with the Maine BPC. The permittee must utilize a pesticide applicator who is certified and licensed in aquatic pesticide control by the BPC and must provide proof of certification/licensing to the Department with the NOI. The licensee has disclosed that effects on non-target species are anticipated due to the scope of treatment projects, but that such effects must be minimized to the extent possible.

In submitting a NOI for coverage under this GP, the licensee has demonstrated a significant need to control the target species, has explored potential treatment methods, and has designed an effective treatment program that incorporates both chemical and non-chemical methods. The Department anticipates that proposed treatment programs will result in short-term adverse impacts to non-target aquatic vegetation and organisms, but that such impacts are necessary in order to eliminate invasive aquatic plant species, prevent long-term adverse impacts to non-target aquatic vegetation and organisms, and ensure long-term maintenance of receiving water quality and uses in both treated and connected waters. The Department finds that the aquatic herbicide treatment program described herein complies with 06-096 C.M.R. 514. Additional details on the aquatic herbicide treatment program water quality and plant population monitoring program and reporting requirements are detailed in this Fact Sheet.

M. RECEIVING WATER QUALITY STANDARDS

This GP authorizes discharges to Class GPA, AA, A, B and C waters of the State, tributaries to Class GPA waters, and those waters having drainage areas of less than ten square miles. Maine law, 38 M.R.S. §465 describes the standards for Class AA, A, B, and C waters, 38 M.R.S. §465-A describes the standards for Class GPA waters, and 38 M.R.S. §464(4) describes the standards for tributaries to Class GPA waters and those waters having drainage areas of less than ten square miles.

PART III - FACT SHEET

N. RECEIVING WATER QUALITY AND HABITAT CONDITIONS

The active ingredients in the aquatic herbicides authorized for use under this GP are generally characterized pesticides (herbicides) formulated for aquatic use. Further discussion on the basic identification and information about formulations covered under this permit are included in Fact Sheet Attachment A. This GP does not authorize the use of other compounds; thus concerns with chemical toxicity are limited to the specific authorized aquatic herbicides, for which such information is provided herein.

Lakes, ponds, and streams dominated by invasive aquatic plants do not exhibit natural habitat characteristics, suffering reduced habitat suitability for fish and other aquatic life. Invasive aquatic plants disrupt natural systems by crowding out native plants and altering the physical and biological structure of the aquatic habitat. In cases of very dense growth, they can also reduce water circulation, generate significant oxygen and pH swings on a diurnal basis, and contribute to significant buildup of organic matter in localized areas. Eradication of invasive plants is rarely feasible, but significant protection for native plant communities can be achieved by reducing densities of aggressive invasive plants. This reduces their ability to spread to new habitat within the infested water or to other waterbodies.

Herbicide applications under this permit are designed to kill non-native species in an attempt to restore and preserve the natural habitat characteristics of the specific water of the state. As stated in Fact Sheet Section L, the Department anticipates some short-term adverse impacts, but considers such impacts as necessary in order to control invasive species, prevent long-term adverse impacts to non-target aquatic vegetation and organisms, and ensure long-term maintenance of receiving water quality and uses in subject waterbodies and connected waters. In general, negative effects on non-target fauna, and flora such as algae, are anticipated to be minor. Acute effects are unlikely given the treatment scenarios. Chronic effects should be minimal but still possible in some instances (e.g amphipods in sediment treated with granular herbicides). Most of the medium and longer term effects will come from habitat re-structuring as plant densities are reduced.

Herbicides range from non-selective to partly selective for the species of plant they affect. Thus both the target species and non-target, native species will be affected. Experience with control projects suggests that if herbicide treatments are not repeated, sensitive native species are usually not extirpated, and often recover in the treated areas, especially if herbicide treatments are followed up with selective non-chemical, mechanical means of control for the target species, such as hand removal. Post-treatment rebound of perennial, and especially annual, native species can reduce the ability of the target species to re-colonize areas. The re-establishment of native plant-dominated communities is thus considered to be an effort to restore habitat and water quality and limit further negative impacts of invasive plants when coupled with long-term management efforts.

PART III - FACT SHEET

N. RECEIVING WATER QUALITY AND HABITAT CONDITIONS

It is anticipated that waters in which invasive aquatic plant treatment programs are determined necessary are already significantly impacted in their abilities to attain their water quality classification standards and designated uses or in substantial danger of being so. The Department has not identified any significant geographical areas of concern that should be excluded from coverage under this GP. Additional diligence is required in applications in any waters known to contain rare, endangered, or threatened aquatic species, and in the treatment of water supplies. The Department anticipates that treatment programs approved under this GP will result in long term improvement in receiving water quality, habitat, and designated uses.

O. ANTIDEGRADATION

The State's antidegradation policy is set forth in Maine law at 38 M.R.S. §464(4)(F). The Department has determined that the discharge of the authorized aquatic herbicides in accordance with the terms and conditions of this GP will not violate the provisions of the antidegradation policy.

P. PUBLIC COMMENTS

Public notice of this GP was made in **the Bangor Daily News, Morning Sentinel, Kennebec Journal, Sun Journal, Portland Press Herald and The Star Herald, Ellsworth American newspapers on or about August 31, 2016.** The Department receives public comments on an application until the date a final agency action is taken on the application. Those persons receiving copies of draft permits must have at least 30 days in which to submit comments on the draft or to request a public hearing, pursuant to 06-096 C.M.R. 522 of the Department's rules.

Q. DEPARTMENT CONTACTS

Additional information concerning this licensing action may be obtained from and written comments should be sent to:

Cindy L. Dionne
Division of Water Quality Management
Bureau of Water Quality
Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017

Telephone: (207) 557-5950
Fax: (207) 287-3435
email: cindy.l.dionne@maine.gov

PART III - FACT SHEET

R. RESPONSE TO COMMENTS

Reserved until the end of the formal comment period.

ATTACHMENT A

(Properties and Potential Effects of Approved Aquatic Herbicides)

1. 2,4-Dichlorophenoxyacetic acid, Dimethylamine salt (DMA) and Butoxyethylester (BEE) (2, 4-D)

A. Typical Formulations

B. General Characteristics

C. Typical Application Methods and Concentrations

D. Human Health Effects

E. Human Contact / Toxicity

F. Potential Negative Effects

   i. Biomagnification and Bioconcentration

   ii. Non-target Plants

   iii. Non-target Animals

   iv. Low Oxygen

   v. Nutrient Releases

   vi. Drift to Non-target Areas

Fact Sheet Attachment A

1. 2, 4-D

A. Typical Materials / Formulations:

2, 4-D used for aquatic plant control is formulated in two derivatives, butoxyethylester (BEE) and the dimethylamine salt (DMA). BEE formulations are typically applied as granules and contain 27.6% BEE (19% ae) and 72.4 % inert ingredients, of which silica clay makes up about 6%. Granular applications sink to the bottom and release the within hours, so relatively accurate areal dosing can be achieved.

2, 4-D Dimethylamine (DMA) formulations are often applied as liquids but also are sold as solid which is diluted with water before application. 2,4-Dichlorophenoxyacetic butoxyethylester (BEE) is uses a pelleted formulation.

Specific products reviewed below were those registered by USEPA and in Maine with lake and pond use for invasive weeds. They are identified by name and formulation below. They may or may not be registered when the use is proposed, therefore all herbicides intended for use under this permit should have the registration status verified prior to approval of the permit.

B. General Characteristics:

2, 4-D is one of the most commonly used broadleaf weed herbicides in the United States and 2, 4-D BEE is the most common herbicide used to control aquatic weeds. It has been in use since the 1940s and registered for over 30 years. It is a relatively non-selective, fast acting systemic herbicide which kills the entire plant. 2, 4-D is absorbed by roots, shoots, and leaves and disrupts cell division by increasing cell-wall plasticity, biosynthesis of proteins and nucleic acid, and the production of ethylene. The abnormal increase in these processes is thought to result in uncontrolled cell division and growth which damages vascular tissue.

The USEPA has recently reviewed the eligibility of 2, 4-D for re-registration and has mandated labeling and operational restriction changes. The reader is referred to the actual approved product labels and the Re-registration Eligibility Decision (RED) document available at: http://www.epa.gov/pesticides/reregistration/status.htm for full descriptions of these. The RED document distinguishes between DMA and BEE and between surface applications and subsurface (submerged weed) applications. Some of the pertinent label restrictions for 2, 4-D are summarized here, and for simplicity are specified as the more restrictive of the two general constraints (usually for BEE). These are what the permittee will follow unless new labeling provisions are required by USEPA and the Maine BPC.

No more than 2 applications per year may be done to any treated area and a minimum of 21 days is required between applications. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas. Due to rapid action and potential for DO depression when treating dense plant growth, less than ½ of any lake or pond would be treated at any one time. Waters having limited and less dense weed infestations may not require partial treatments. If a larger area must be treated, per label instructions, 14 or more days should elapse between partial lake treatments to reduce overall DO depression. Applications would normally be in blocks or

strips to allow a refuge for fish and other taxa that may exhibit short term avoidance of 2, 4-D-treated water and to reduce localized DO swings. Typically, this means buffer lanes should be 50-10 feet wide and the treated and untreated areas are of equal width.

For information relative to environmental fate, transport, and effects of 2, 4-D, the reader is directed in particular to extensive reviews conducted by the state of Washington (2001) and Massachusetts (2003) (see references). Much of the information here is taken directly from these documents which provide an extensive compilation of field and laboratory study results. These and related documents also contain significant reviews of aquatic plant management techniques as well as reviews of other herbicides (see also Madsen, 2000).

C. Typical Application Methods and Concentrations:

2, 4-D is commonly used where agencies want a systemic herbicide with a relatively short contact time such as an end-of-season, rapid response situations or when hydrology restricts contact time. 2, 4-D is typically applied by surface spray or subsurface injection (liquid BEE and DMA) or more commonly by spreading granules on the surface, where they sink in place (BEE). Granular herbicides in general allow fairly precise areal dosing, can be applied accurately by use of granular spreaders, and are less prone to drift than liquid materials. Some care is needed to ensure that bottom-to-top mixing is adequate for establishing concentrations in the water column, particularly where there is a significant canopy of the target plant or stratification exists (waters greater than 10 feet).

BEE ester formulations (Aquakleen/Navigate) will be applied on the surface using mechanical spreaders and the granules will sink in place. Typically, spreading will be done in two or more overlapping passes with boat speed and granule spreading gauged to dispense partial doses on each pass and achieve even distribution. Liquid (DMA) materials intended for whole-water column treatments will be typically mixed with lake water on board the treatment vessel and injected 0.5 + meters below surface. Rate of injection and boat speed will be adjusted in overlapping passes to produce <= 4.0 mg/l ae as a whole water column average. For both BEE and subsurface DMA applications, GPS tracking will usually employed and areal dosing rate adjusted depending on water depth in various lake areas treated to achieve the target volume-weighted concentrations.

Concentrations Typically Applied: Concentrations are typically referred to as ppm or mg ae (acid equivalent)/l. The 2, 4-D acid is the active moiety affecting toxicity. Where “ai” is specified, it refers to “active ingredient” or the parent 2, 4-D molecule salt or ester. Concentrations applied under this permit will remain at or below the permit limit of 4 mg ae/l and will conform to the guidance in the 2005 USEPA–RED (re-registration decision). In practice, target concentrations will generally be well below this (typically 1-2 mg ae/l) as cited elsewhere in this Fact Sheet, and will be guided by site conditions, including plant species and density.

Liquid formulations can be expected to result in higher initial water concentrations than granular formulations, since all of the 2, 4-D is applied directly to the water initially. Granular formulations will generally yield higher near-sediment concentrations and somewhat longer persistence due to a prolonged release of 2, 4-D from the granules. Granular formulations can therefore result in lower initial water column concentrations that may persist somewhat longer than if liquid formulations are used.

The maximum target concentration for the whole water column average in a BEE application area is 4 mg ae/l based on instantaneous release. However, the actual concentrations developed will be less than that, due to delayed release from the granules. Reported cases typically show <= 3.5 mg ae/l near bottom and <= 2.0 mg ae/l near surface where hydrologic mixing is slow or incomplete.

For Weedar and Savage (DMA) applications for floating and emergent weeds, the worst case end concentration for surface application (4lbs ae/acre) in a 1 foot depth pond would result in 1.5 ppm acid equivalent if fully mixed in the water. IASP will surface apply only the weed mass-area, resulting in dissipation and dilution away from the target area and lower concentrations outside of the application area compared to liquid applications. The most likely scenario would be applications in areas averaging well over 2 feet depth resulting in a larger (2-4 times) near time dilution assuming the chemical mixed vertically. Absorption into the target plant mass should be fairly rapid, so drift off-site will be reduced by that mechanism, but will happen at an unpredictable rate. Applying in calm weather should increase absorption into the target plants and reduce offsite drift.

The USEPA-RED document has established the following rates for applications:

Amount of 2, 4-D Active ingredient to Apply for a Target Subsurface Concentration

Surface Area	Average Depth	For typical conditions - 2 ppm 2, 4-D ae/acre-foot	For difficult conditions* - 4 ppm 2, 4-D ae/acrefoot
1 acre	1 ft	5.4 lbs	10.8 lbs
1 acre	2 ft	10.8 lbs	21.6 lbs
1 acre	3 ft.	16.2 lbs	32.4 lbs
1 acre	4 ft.	21.6 lbs	43.2 lbs
1 acre	5 ft.	27.0 lbs	54.0 lbs

* Examples include spot treatment of pioneer colonies of Eurasian Water Milfoil and certain difficult to control aquatic species.

Persistence: Long term persistence in the water column is not expected. Detection limits for 2, 4-D are usually 0.05 ppm for 2, 4-D in sediment and 0.01 to 0.005 ppm in water. Derivatives of 2, 4-D acid are rapidly degraded by microbial action, photolysis, and hydrolysis. Applications of 1-3.5 ppm should result in concentrations of 0.1-0.5 ppm in 7-10 days, and below detection levels within two weeks to one month, based on literature reports. BEE is essentially insoluble in water. BEE hydrolyzes to the acid form within minutes or hours under neutral conditions and even faster under basic conditions.

While 2, 4-D has short life span in the water column, it may have a half life in aquatic sediment as long as 35 days and detectable residues may be found from a few weeks to 3 months, with rare reports of persistence as long as 6-9 months. Persistence of BEE granular applications tends to produce higher sediment concentrations as the granules release chemical over a longer period at the sediment surface.

Breakdown of 2, 4-D acid is increased by warmer temperatures, higher pH and oxygen, proximity of sediments, and high populations of microorganism capable of breaking down the material. These latter are increased in situations where the waters have been treated previously, in highly productive waters (where higher concentrations of microrganisms breaking down organic matter are present), and shallower, more intimate association of treated water column with sediment surfaces.

D. Human Health Effects:

At request, a review of 2, 4-D concerning human health was conducted by the Board of Pesticides Control (Maine BPC, 2007). Several citations from that assessment are paraphrased here.

If there is demonstrated sensitivity in the developing animal compared to adults, the Food Quality Protection Act (FQPA, 1996) requires a 10X safety factor (SF) for risk assessments involving exposure to children. The FQPA SF for 2, 4-D is 1X. Risk of a toxic response is mathematically equal to the toxicity factor times the exposure factor. The Reference Dose (RfD) is calculated as the No Observable Adverse Effect Level (NOAEL) for the most sensitive long term study divided a series of uncertainty factors including 10X for extrapolating from animals to humans and 10X for variability among humans. This approach is used for dietary exposures including drinking water. The other measure of risk is the Margin of Exposure (MOE). In this approach a level of concern (LOC) is established based on the uncertainty factors and the ratio of the NOAEL to the exposure dose is calculated. MOEs higher than the LOC are acceptable risks and those below require mitigation. USEPA uses the MOE approach used for occupational and residential exposures. 2, 4-D is classified as a Group D-non classifiable carcinogen by USEPA (USEPA 2006). Because of this, a cancer risk assessment was not performed as part of the review.

As a result of the aquatic use of 2, 4-D, two exposure scenarios are of concern; drinking water and swimming. Drinking water risks from 2, 4-D are calculated using the chronic RfD approach. Recreational uses of water following treatment with 2, 4-D are assessed using the MOE approach. USEPA is currently using Swimodel to assess exposure to swimmers (USEPA 2003).

The 2009 USEPA maximum contaminate level for 2, 4-D (MCL) in drinking water is 70 ppb (USEPA 2009). The 2010 Maine CDC Maximum Exposure Guideline (MEG) is also set at 70 ppb (ME CDC 2010). The 2005 RED contains specific provisions for setbacks to drinking water intakes, waiting times for use of treated water, and testing guidelines. The BPC review includes the proviso that the application of 2, 4-D follows the label restrictions concerning drinking water, and concludes: “The existence of a current MCL and an MEG along with guidance from the RED means that there is no further work needed to be done on drinking water risks.”

For swimming, BPC used the short term residential NOAEL (No Observable Adverse Effects Level) of 25 mg/kg/day from the rat developmental study. This is a more conservative exposure level than USEPA (67 mg/kg/day). If the Margin of Exposure (MOE) is greater than 1000, it

indicates that the total exposure estimated will be at least three orders of magnitude less than a level known to result in no observable adverse effects.

Using USEPA's Swimodel (USEPA 2003), exposures were calculated for 4 non-competitive swimmer age groups: adult males, adult females, children 7 - 10 and children 11 - 14 yrs old. The critical assumptions were: concentration was 14,700 ppb (maximum concentration following highest label use for subsurface applications); 3,400 ppm (the higher of the DEP's target concentration for subsurface applications) or 1, 500 ppb (the highest label rate for surface applications), the frequency of events was 5 hrs per day (from the model) for 7 days per year over a 2 year period. Resultant Margins of Exposures (MOEs) were 192 -799 (14.7 ppm current label rate), 862-3,453 (3.4 ppm, highest target range) and 1,938 to 6,596 (1.5 ppm. most likely application). According to BPC:

> "In conclusion, the risks to humans from water treated with 2, 4-D in compliance with DEP's targeted rates are primarily acceptable risk range (MOEs > 1,000). The exception is for children ages 7 to 10 with an MOE of 862. The waiting period of 24 hrs, should bring this MOE into the acceptable range. In addition, The NOAEL used in this assessment is for gestational developmental endpoints not applicable for children in the 7 to 10 age group. This could be why USEPA used the acute NOAEL in their calculation of the MOE, but it was not stated as such. Communication with the parties using and in and around the water bodies is critical in order that compliance with the water use restrictions on the label be observed. In addition to swimming and drinking consumers, ornamental (lawns and trees) applicators and agricultural users need to be aware of these restrictions to prevent crop damage and illegal residues of 2, 4-D in livestock and other commodities"

DEP also notes that plant types requiring surface applications are often in areas where swimming activity is reduced due to the nature of semi-emergent and floating leaved plants for which this technique would be used. Therefore, standard assumptions about time spent in the treated water are probably additionally conservative in human risk assessments as they relate to surface treatments.

E. Human Contact / Toxicity:

Because 2, 4-D is a plant growth hormone simulator, some concerns have been expressed that it could act as an endocrine disruptor. This is unlikely concerning mammalian exposure given the significant number of whole-animal studies done on rats (a standard mammal surrogate). Little related work has been completed on 2, 4-D in aquatic environments in treatment scenarios typically of lakes. Agents that disrupt growth systems in plants have significantly different modes of action than mammalian endocrine disruptors and pose little risk. However, Maine IASP's approach to the use of 2, 4-D (and herbicides in general) should mitigate chronic health or environmental impacts. IASP's operating principle is to avoid repeat applications to the same waterbody except in the rare instance where eradication of pioneer populations is feasible only with use of herbicides. It also uses the lowest effective doses and, in the case of 2, 4-D, with very limited environmental exposure times.

IASP will consult with DHHS-Drinking Water Program to determine if there are public drinking water supplies and would not apply the chemical to that waterbody without written consent of the utility and assurance that the area of the intake would not experience detectable residuals of the active ingredient. For drinking water sources, a variable minimum setback distance from

functioning potable water intakes must be observed depending on the concentrations developed. If no setback is used, then proper notification must be provided to the operator of the water intake to shut off use for a specified time period. For submersed applications, drinking water analysis must be done after a waiting period of 5 to 14 days depending on the concentration applied. After application, treated water must not be used for drinking water unless a setback distance from functional water intake(s) of greater than or equal to 600 ft. was used for the application, a waiting period of at least 7 days from the time of application has elapsed, or an approved assay indicates that the 2, 4-D concentration is 70 ppb (0.07 ppm) or less at the water intake.

Swimming in areas treated with BEE should not be done for a minimum of 24 hours after application. Prior notification must be given to parties responsible for the public swimming area or to individual private users to assure that the party is aware of the water use swimming restrictions

Phytotoxicity Issues: Where treated water is intended to be used only for crops or non-crop areas that are labeled for direct treatment with 2, 4-D such as pastures, turf, or cereal grains, the treated water may be used to irrigate and/or mix sprays for these sites at any time after the 2, 4-D aquatic application. If treated water is intended to be used to irrigate or mix sprays for unlabeled crops, noncrop areas or other plants not labeled for direct treatment with 2, 4-D, the water must not be used unless a setback distance described in the Drinking Water Setback Table was used for the application, a waiting period of 21 days from the time of application has elapsed, or an approved assay indicates that the 2, 4-D concentration is 100 ppb (0.1 ppm) or less at the water intake.

In addition to these USEPA requirements, IASP will normally survey owners/residents of an area within 1000 ft of the edge of the treatment area (if site fully curtained, within 250 feet) to determine where lake water is pumped directly for human consumption, irrigation or livestock watering or if there are shallow wells within 250 feet of shore. If concentrations in excess of 0.07 ppm (Maximum contaminant level for drinking water) are expected in areas beyond 1000 feet of the application area, the survey zone will be extended accordingly. These shoreline residents would be notified to avoid drinking lake water for at least 3 days, and bottled drinking water offered to them.

F. Potential Negative Effects of 2, 4-D

i. Biomagnification and Bioconcentration

Both lab and field studies indicate that bio-magnification in plants and animals and bio-concentration in higher trophic levels is not likely for 2,4 D DMA, 2, 4-D BEE or 2, 4-D acid. The only extremely high BCF levels observed in the field were for benthic organisms and zooplankton based on one study, but this is not consistently seen. Most organisms do not bioconcentrate 2, 4-D and those that do rapidly eliminate the compound so that it is unlikely to be passed along trophic levels. Animals do not appear to metabolize 2, 4-D. 2, 4-D BEE is rapidly converted to 2, 4-D acid which is quickly eliminated unchanged from the animal's body in the urine and feces.

Although concentrations of 2, 4-D BEE may accumulate in fish for the first three hours of exposure (up to 46.6-fold in bluegill) the test substance is degraded to 2, 4-D acid and eliminated from the fish within 48 to 120 hours. In one trial, fish that absorbed 2, 4-D from

the water eliminated the majority (more than 50%) of 2, 4-D from their tissues within a few days despite continued exposure. Other tests indicate that 2, 4-D DMA exposure by water or oral routes was not found at concentrations that exceeded 0.94 mg/L in the tissue of multiple species of fish occupying water treated with concentrations up to 6 mg ae/L.

Of course, plants do accumulate 2, 4-D and that allows the toxic effects to be manifest. Eurasian water milfoil (*Myriophyllum spicatum*) appears to bio-accumulate 14C labeled 2, 4-D at concentrations up to 94 times higher than the surrounding water. When the plant releases the 2, 4-D upon death and decay, concentrations in the water column should not increase since the total amount of 2, 4-D taken up by the plant will typically be less than 1% of the total 2, 4-D found in the aquatic system.

ii. Non-target Plants:

Broadleaf herbicides will generally kill dicot plants with broad leaves but there may be exceptions; i.e. 2, 4-D can kill monocots with broad leaf morphology and certain "narrowleaf" dicots are not harmed at usual concentrations. Due to this characteristic, and the relatively short duration of exposure, Massachusetts and other states report good control of Eurasian and variable milfoils and generally sub-lethal damage to many native species. One particularly sensitive exception is *Lemna gibba* with an LC50 of 0.695 mg ai/L

2, 4-D shows greatest effectiveness against various milfoil species (*Myriophyllum* spp.) and water stargrass (*Heteranthera dubia*). At higher rates it is also effective against *Utricularia* spp. (bladderwort), *Nymphaea* spp. (White water lily), *Nuphar* spp. (spatterdock or yellow water lily), *Brasenia* spp. (water shield), *Trapa natans* (water chestnut) and *Ceratophyllum demersum* (coontail). Results from field studies indicate that crowfoot (*Ranunculus longirostris*), American waterweed (*Elodea canadensis*), pondweeds (*Potamogeton* spp.), and wild celery (*Vallisneria Americana*) may also be variably susceptible.

Diversity of aquatic macrophytes can be affected both positively and negatively by the use of 2, 4-D. After treatment of a Wisconsin lake for dense Eurasian milfoil, the native species regained all of their pretreatment standing crop by the end of the season. At Loon Lake, Washington, treatment with 2, 4-D BEE reduced Eurasian watermilfoil biomass by 98%, but the native pondweeds, naiads, American water weed, water celery, bladderwort, water stargrass and *Chara* spp. were largely unaffected

Propagules that are not actively growing or connected to the plants vascular system will not be affected by 2, 4-D. Therefore applications in early-mid season may be needed to control plant which form winter buds and similar structures.

Rare or threatened plants may be affected by treatments. Department staff will consult with the Maine Natural Areas Program of DOC as to occurrence records in the waterbody and conduct low intensity plant community screening in advance of treatment. Occurrence of these plants will require evaluation of treatment proposal to limit negative effects. In this review DEP will consider the negative effects of invasive species on the viability of the rare plants and communities and the consequences of delaying action.

Algae and Phytoplankton: 2, 4-D toxicity varies among taxa and between formulations.

2, 4-D is generally not very toxic to most indicator species of algae (LC50 = >60 mg ai/L = 50 mg ae/L). An exception may be some species of freshwater and saltwater diatoms which can have EC50s that are quite low (~2.0 to ~5.0 mg ai/L) for 2, 4-D DMA, 2, 4-D BEE and 2, 4-D acid. The acid form appears to be relatively non-toxic to most blue-green algae (cyanophytes) with EC50 = >2.02 to ~500 mg ai/L. One exception may be *Anabaena flos-aquae*. 2, 4-D acid exhibits low toxicity similar to that of 2, 4-D DMA to green algae (EC50 = 26 to 98 mg ae/L). 2, 4-D DMA has a very low toxicity to green algae (EC50 = 66 to 185mg ai/L) and bluegreen algae (EC50 153 = mg ai/L). 2, 4-D BEE also has moderate to low toxicity to green algae (EC50 = 25 to 75 mg ai/L) and high toxicity blue-green algae (EC50 = 6.37 mg ai/L) in laboratory tests. BEE may be toxic to some species of diatoms (EC50 =~2 to ~ 5mg ai/L) and may also be toxic to some blue-green algae (EC50 ~6.37 mg ai/L).

Use of 2, 4-D products at the labeled use rate (2 to 4 mg ae/L) will not have a significant impact on phytoplankton growth with the exception of short term growth increases due to large pulse of phosphorus and nitrogen released from decaying plants. At low concentrations (<10 mg ai/L), some products of 2, 4-D have been observed to stimulate the growth of green and particularly blue-green algae. Some effects on nitrogen fixation may occur in algae at higher concentrations of the acid form (ca. 400 ppm) though the ester may inhibit fixation as low as 36 ppm and reduced cell division of green algae has been reported at 20-50 ppm.

iii. Non-target Animals:

In aquatic toxicity testing, the most sensitive life stages and easily culturable species of algae, macrophytes, fish, frogs, free-swimming invertebrates benthic (sediment dwelling) invertebrates, and others with an extensive history of testing are evaluated for their response to acute and chronic exposure. In evaluating potential for acute or toxic effects, it is common to compared expected environmental concentration (EEC) to some measure of environmental effect. Evaluation of short term acute effects often rely on LC50 (concentrations which are lethal to >50% of a test population in a specified acute testing period, typically 24-96 hours) or EC50 (concentrations at which to >50% of a test maximum effect is seen) Chronic evaluations use longer time periods and compare EEC to no effects levels (NOEC).

EEC values may be calculated from the most typical initial concentration of 2, 4-D DMA (1.36 mg ai/L = 1.13 mg ae/L). The most typical concentration at zero time for 2, 4-D BEE and resultant 2, 4-D acid is 3.25 mg/L at the bottom of the water column and 0.19 mg/L at the top of the water column. Based on data from 15 British Columbia waterways, the short term EEC for a typical exposure is 0.100 mg ae/L after 2 to 6 days. 2, 4-D DMA should not affect fish or free-swimming invertebrate biota acutely or chronically when applied at typical use rates of 1.36 to 4.8 mg ai/L. However, more sensitive species of benthic invertebrates like glass shrimp may be affected by 2, 4-D DMA and BEE.

The Washington State DEC review (2001) concluded that the chronic toxicity of 2, 4-D-DMA has not been extensively evaluated. Field work indicates that 2, 4-D has no significant adverse impacts on fish, free swimming invertebrates and benthic invertebrates, but well designed field studies are in short supply. True chronic exposure probably does not

exist in the field since treatment with 2, 4-D DMA typically does not occur more often than once or twice per year. The BEE form is typically more toxic to both plants and fish than the amine salts in laboratory tests, but toxicity of BEE is rarely seen in field applications due to slower release and rapid hydrolysis to the less toxic acid form.

Acute toxicity for most aquatic animals is generally low. 2, 4-D DMA has virtually no acute toxicity to aquatic animals with an LC50 typically > 40-100 mg ai/L (83 mg ae/L); important exceptions are a few species of estuarine shrimp with LC50s of approximated ~0.15 to 8.0 mg ai/L and a few sediment organisms.

Fish: After hydrolysis of 2, 4-D BEE, 2, 4-D acid is not significantly toxic to the fish species tested (LC50 is typically >40 mg ae/L for all relevant. species). Based on laboratory data, 2, 4-D DMA is essentially non-toxic to fish (LC50 = >100 to 524 mg ai/L for the rainbow trout and bluegill sunfish respectively). 2, 4-D acid has a toxicity similar to 2, 4-D DMA to fish (LC50s from 20 to 358 mg ai/L for the common carp/cutthroat trout on the low end to rainbow trout).

Most species of fish are acutely affected by 2, 4-D BEE at relatively low doses in the lab. The acute toxicity LC50 ranges from 0.20 mg ae/L for rainbow trout fry and 2.5 mg ae/L for rainbow trout smolts up to 5.6 mg ai/L fathead minnow fingerlings. However, the likelihood of fish being exposed to lethal dosages of 2, 4-D BEE is small because the usual applied materials are slow release formulations in which BEE is rapidly degraded to the less toxic 2, 4-D acid (approximately one day or less). Limited field data with sentinel organisms (caged fish) and net capture population surveys indicate that 2, 4-D BEE lacks acute environmental toxicity to fish when applied at labeled rates which are greater than those proposed for this permit.

Chronic exposures studies for 2, 4-D are limited. The relatively short persistence of 2, 4-D in the field and ability of fish to avoid higher concentration areas suggest that the usual chronic exposure tests done under lab conditions would not be directly analogous to field conditions. The predicted or empirical *long-term* NOEC (no effects level) for 2, 4-D acid is 1.1 mg ae/L for the most sensitive species of fish (common carp).

While these values indicate some toxicity, these NOECs are well above the chronic EEC values likely to be encountered in the field (0.01 mg /L for water and 0.06 mg/L for sediment). There are a few early stage studies with Chinook salmon and fathead minnow that suggest the no effects level is well above the expected concentrations in the field and thus even BEE should not be of concern. No effect levels for coho salmon are reported as low (<1 ppm), but much higher for rainbow trout (50 ppm). Long term residue levels of 2, 4-D in British Columbia lakes treated with 2, 4-D BEE dropped below 0.001 mg/L within 5 to 22 days. True chronic exposure probably does not exist in the field since treatment with 2, 4-D BEE does not normally occur more often than once or twice per year in a water body. Field studies with both fish and invertebrates indicates that there are few if any direct permanent effects on the biota due to 2, 4-D BEE exposure.

Several species of fish including sheepshead minnow and mosquito fish, are known to avoid 2, 4-D BEE at concentrations typically found in the field. However, it is not likely that fish exposed in the field would or could avoid 2, 4-D BEE concentrations in the range

of 0.1 to 3.25 mg /L. Single exposures at maximum rates of 2, 4-D DMA in the field has been shown to not adversely impact survival, condition, or movement within the treatment area of largemouth bass or the nesting behavior of bluegill and redear sunfish. One review concluded there should be no adverse effect on numbers (including recreational or commercial fish catch) and no adverse effect on mean total length, condition, movement within the treatment area or nesting behavior of largemouth bass.

IASP expects that any displacement of fish or other biota due to avoidance behavior will be temporary. Medium-term effects (intra- and inter-season) may be seen as plant cover density is reduced, affecting concealment and predator-prey interactions. In the cases of very dense plant infestations, foraging may actually improve, especially for sight predators and fish that find dense vegetation hard to forage in. A secondary effect may be to reduce plant–associated invertebrate productivity, lowering fish productivity in the treated area. Increases in zooplankton and benthic invertebrates while plant decay takes place may make up for some of this.

Use of limno-barriers (curtains) or partial screening to reduce drift may be called for when the target plant community is in a limited area or reduction of water circulation will increase effectiveness, allow for reduced dosing, or protect sensitive non-target resources. Treatment of contained (limno-curtained) areas or whole cove treatments may result in localized, transient DO loss. Presence of a thermocline will inhibit vertical transport, so 2, 4-D should be applied to unstratified areas of lakes and avoid very shallow areas of high organic sediments.

The use of 2, 4-D in confined areas described is a concern for some life forms. In this case, initial concentrations may be higher than in unconfined applications and mobile fauna may find the curtains a barrier inhibiting avoidance behavior. Several strategies are available to reduce effects on motile organisms. Granular applications can be made going from inshore to outlying areas, thus giving some time for fish to move. Leaving the curtain partially open until the application is complete will allow some outward movement during this time. The limited residence time needed for 2, 4-D and its moderate toxicity allows quick removal of curtains which will reduce negative effects in these circumstances. Reducing plant disruption in non-target areas will also allow for better habitat integrity for fish post-treatment than would result from not using such curtains in instances where sensitive habitats abut treated areas. Effective restoration of native plant communities tends to mitigate human-induced impact of both the introduction of invasive plants and the short term management of them using herbicides.

Amphibians: Freshwater amphibian studies were conducted on frog tadpoles (*Rana pipiens*). Tests indicate that 2, 4-D acid, 2, 4-D DMA, and 2, 4-D ethylhexyl ester formulation (EHE) are practically non-toxic to tadpoles. Direct mortality to Amphibian larvae appears to be low, with LC50 generally above 100 ppm.

The acute 96-hour LC50 for 2, 4-D DMA and Acid were in the range of 200->300 mg ai/L for several species of frogs (e.g.*Limondynastes peroni* and *Rana pipiens*), but some may be more sensitive (Indian toad Bufo melanostictus LC50 at 8.05 mg ai/L). These data indicate that 2, 4-D DMA and acid are likely to be relatively non-toxic to amphibians while 2, 4-D acid is relatively non-toxic to most frogs.

Birds: 2, 4-D is classified as moderately toxic to practically non-toxic to birds on an acute oral basis. Wild birds have not been extensively tested for acute or chronic toxicity of 2, 4-D, but the few studies published such as those done on mallards, suggest that the materials (including BEE) are not toxic in amounts likely to be ingested in the diet. Lack of acute toxicity suggests little concern for chronic effects.

Mammals: Toxicity ranges for mammals do not show distinct differences between the acid, salts, amine salts, and esters as indicated for aquatic animals. There are no obvious indications that the exposure of mammals resulting from 2, 4-D applications as proposed are an issue, especially given the low water column persistence and limited routes of exposure. For example, rat LD50s are 790-1090 mg/kg which is far higher than any likely exposure. Aside for drinking recently treated water, serious exposure to mammals is unlikely, especially given its low tendency to bio-accumulate or bio-magnify.

Invertebrates: Acute toxicity tests of 2, 4-D acid and amine salts on freshwater aquatic invertebrates showed responses from slightly toxic to practically non-toxic. For free-swimming invertebrates, the toxicity of 2, 4-D acid and its sodium salt range from LC50 = ~135-209 to >2000 mg ai/L for *Daphnia magna* and freshwater prawn, respectively. It is also practically non-toxic to chironomids, pink shrimp, glass worms, eastern oysters, aquatic sowbugs and fiddler crabs with acute LC50s above 100 mg ai/L. The freshwater toxicities of the esters range from 2.2 mg ae/L for the 2, 4-D isopropyl ester formulation (IPE) to 11.88 mg ae/L for the 2, 4-D EHE (moderately toxic to slightly toxic). 2, 4-D BEE is moderately toxic to free-swimming daphnids (LC50 = 4.0 to 7.2 mg ai/L)

Only a very limited database is available for 2, 4-D products in their chronic effects on invertebrates, partly because of the low persistence of residues. Chronic toxicity tests for freshwater and estuarine/marine invertebrates have been done for 2,4- D acid, DMA, and BEE. The toxicity ranged from a NOEC of 16.05 mg ae/l for 2, 4-D DEA (survival and reproduction) and 79 mg ae/L for the 2, 4-D acid (number of young). The chronic freshwater NOEC is 0.20 mg ae/L for the 2, 4-D BEE (survival and reproduction). The experimental chronic toxicity (NOEC) is 0.29mg ai/L for *Daphnia magna*.

The toxicity of 2, 4-D DMA varies considerably for benthic invertebrates. It is highly toxic to glass shrimp (*Palaemonetes kadiakensis*, LC50 = 0.15 mg ai/L) and moderately toxic to seed shrimp (Cyridopsis vidua, LC50 = 8.0 mg ai/L). Animals that live in the sediment may be exposed to 2, 4-D concentrations that are many times higher than those in the water column. BEE is highly toxic to moderately toxic to most benthic invertebrates (LC50 = 0.44 mg to 6.1 mg ai/L). Although these values indicate a possible risk to the benthic biota from exposure to 2, 4-D acid due to treatment with 2, 4-D BEE, fieldwork indicates that the benthic biota are not greatly affected since the low solubility of BEE and rapid hydrolysis would tend to limit exposure to BEE.

Little work appears to have been done on treated sediment effects on benthic-associated invertebrates such as crawfish, amphipods, leeches etc. 2, 4-D BEE does not appear to be very toxic to a variety of arthropod shellfish such as the Orconectes nous (crayfish) which has an LC 50 = 100 mg ai/L (69 mg ae/L). The very mobile ones such as crawfish, may be able to sense and avoid high concentrations, but lower levels may be tolerated despite

longer term effects. Repeated treatments pose the potential for elevated concentrations which would likely affect in-fauna. Sediment concentrations due to single treatments should significantly decline over one season.

Change in plant cover and available organic matter can change both microrganism density and detritivore numbers. While BEE does not appear to have direct effects on benthic invertebrates, secondary effects such as a decrease of oxygen in the deep waters of small, stratified lakes for several weeks after treatment may result. This can cause a shift of dominant species from those that require high oxygen like Odonata and Ephemeroptera to those that are tolerant of low dissolved oxygen content like oligochaete worms and Tendepedid midges.

Short-term field studies indicate that zooplankton in water treated with 2, 4-D sodium salt appears to increase in numbers due to the secondary effect of increases in phytoplankton which occurs almost immediately and lasts up to 8 weeks. The community composition will likely change in the short term due to shifts in dominant algal species and heterotrophic bacterial populations with changes in nutrient availability.

Little toxicity data are available for insects, but a honey bee acute toxicity study indicated that technical 2, 4-D is practically non-toxic to the honey bee. Minimal risk is expected to non-target insects from 2, 4-D use.

Microorganisms: In general, there have been few studies done to ascertain the toxicity of 2, 4-D to microorganisms although 2, 4-D products are known to affect various species of bacteria and fungi. Fungal growth (at least in soils) may be affected by concentrations > 25 ppm. Fungi in freshwaters have also been observed to have an increased growth rate when exposed to low concentrations (3.0 mg/L) of 2, 4-D. Various species of heterotrophic bacteria found in the water column have been stimulated to grow by treatments which indicates 2, 4-D and its metabolites may be used as a carbon source. Increases in partly degraded plant materials and nutrients also stimulate growth of heterotrophic bacteria and fungi.

Rare or threatened animals are unlikely to be affected by treatments. Department staff will consult with the Non-game Program of DIFW as to occurrence records in the waterbody in advance of treatment. Occurrence of fauna of concern will require evaluation of treatment proposal to limit negative effects. In this review DEP will consider the negative effects of invasive species on the viability of the fauna and communities (especially habitat effects) and the consequences of delaying action.

iv. Low Oxygen:

Herbicide treatments which cause rapid plant death can result in increased oxygen demand and very low oxygen levels. 2, 4-D is fast acting so DO loss in treated areas with dense plant growth can be pronounced, especially with a late season treatment. Project reports and published research on 2, 4-D treatments that incorporate partial lake or spot applications according to label instructions rarely produce significant oxygen problems. Treatments in the spring occur when less plant biomass has been developed and resultant oxygen demand will be lower as well as spread out over the early growing season. Potential

problems with oxygen loss when treating dense plant populations or stress on fish can be mitigated by treating 1/3-1/2 of the area and waiting 1-3 weeks before finishing the project. This allows fish and other motile organisms to move other areas temporarily and allows decay of plant matter before additional dying plant material is added to the decaying mass.

v. Nutrient Releases:

Considerable amounts of phosphorus, nitrogen and other nutrients can be released from dying vegetation. Published reports include numerous instances of algae blooms in the days and weeks after treatments. Again, limited area treatments should reduce, but not eliminate this possibility. It is likely that any effects due to the treatment itself will be limited in time to one season unless there are large external phosphorus sources or the lake is prone to internal phosphorus recycling. In rare instances, removal of significant vegetation results in persistent algae blooms, which then limit light penetration and re-establishment of plant biomass which had acted as a nutrient sink before the treatment. In addition, a significant amount of phosphorus mobilized from the sediments by plants during the growing season is released during late-season senescence. Therefore, interrupting growth in early season may actually reduce annual P loading to some extent.

vi. Drift to Non-Target Areas:

In Lake: Drift off-site as well as vertical mixing will happen at an unpredictable rate and will be reduced by absorption into the target plant mass, which should be fairly rapid. Applying in calm weather only should increase absorption into the target plants and reduce off site drift. Use of limnocurtains in spot treatment areas where feasible can significantly reduce drift and reduce the initial concentrations needed for efficacy.

Downstream: Where an active lake outlet exists, or in the case of treatments to streams, there is a potential for 2, 4-D to be discharged downstream during the treatment period. Where feasible, pond levels will be drawn down to the lowest reasonable level (consistent with ensuring access for treatment equipment to infested areas and protecting habitat values, including provision for downstream minimum flows) just before treatment. Downstream areas often receive additional water from groundwater and tributaries, so dilution of 2, 4-D should occur. Regardless, there could be some negative effects on the downstream vegetation. Selected downstream areas may be monitored for obvious effects as well as the chemical residual monitoring. Treatments in streams are very unlikely unless there slack water areas where sufficient residence time can be relied upon for efficacy.

Sediment and Soil Concentrations: Due to its high water solubility and low soil/water distribution coefficient, 2, 4-D acid does not adsorb well to most soils. Therefore, in most cases the concentration of 2, 4-D in hydrosoil is rarely higher than 0.46 mg/Kg and dissipation to below the detection limit occurred within 17 days. There have been some reports of higher concentrations and persistence, but these are not representative of most studies and usually represent very heavy applications. Persistence in hydrosoils can be longer in sites that have not been previously treated (14-20 days or more half life) since the microflora responsible for breakdown take time to populate in response to the introduction.

Treatment with 2, 4-D DMA typically produces much lower concentrations of 2, 4-D in the sediment than treatment with 2, 4-D BEE. These concentrations are typically 0.005 to 0.046 mg/Kg for 2, 4-D DMA and 4.3 to 8.0 mg/Kg for 2, 4-D BEE. Due to the extremely high toxicity of 2, 4-D BEE, there is some limited potential for adverse impact to the biota based on the results of laboratory studies.

Ground Water: In spite of its mobility in various soil substrates, the leaching potential of 2, 4-D, and its potential impact on groundwater when used for aquatic plant control, is significantly reduced due to binding to organic materials in the soil, uptake in the target plants, and its relatively rapid degradation rates in aquatic environments.

Water in the treated area is expected to fall below the Federal Drinking water standard for 2, 4-D (0.07 mg/L) generally within 7-14 days after treatment. A recent field study in Barnstead, New Hampshire as well as work in Washington, suggests that while detectable residues are possible under unusual conditions such as very shallow, near-shore wells developed in coarse fill, the likelihood of 2, 4-D residues in supply wells is minimal Mitigation of potential effects on near shore wells will include a survey of properties within 1000 shoreline feet of the treated area. If we find that there are shallow (non-bedrock) private drinking water wells within 50 feet of the lake, we will evaluate feasibility of offering to test these wells for 2, 4-D residuals at least once post treatment. Consideration will also be given to suspending the proposed treatment in that area or substituting Diquat dibromide or Fluridone, depending on the priority of the site for treatment along with well characteristics and rate of use.

2. Diquat dibromide

A. Typical Formulations

B. General Characteristics

C. Typical Application Methods and Concentrations

D. Human Health Effects

E. Human Contact / Toxicity

F. Potential Negative Effects

   i. Biomagnification and Bioconcentration

   ii. Non-target Plants

   iii. Non-target Animals

   iv. Low Oxygen

   v. Nutrient Releases

   vi. Drift to Non-target Areas

Fact Sheet Attachment A

2. Diquat dibromide

A. Typical Materials / Formulations:

Liquid: Diquat dibromide [6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazinediium dibromide] (CAS# 85-00-7)

Specific products reviewed below were those registered by USEPA and in Maine with lake and pond use for invasive weeds. They are identified by name and formulation below. They may or may not be registered when the use is proposed, therefore all herbicides intended for use under this permit should have the registration status verified prior to approval of the permit. Concentrations below are in terms of the diquat cation unless otherwise indicated.

USEPA first registered Diquat dibromide in 1961. It has undergone re-registration by USEPA in 1986 and 1995, and a human health tolerance re-assessment was completed in 2002.

B. General Characteristics:

For the purposes of plant management in Maine, Diquat offers a tool for rapid suppression of infestations of invasive plants which require rapid response while longer term management alternatives are developed. Use will typically be on small, dense patches in situations where slower acting systemic herbicides will not be effective.

For information relative to environmental fate, transport, and effects or Diquat dibromide, the reader is directed in particular to extensive reviews conducted by the state of Washington (2002 and 2003) and Massachusetts (2003) (referenced at the end of this document). These and related documents also contain significant reviews of aquatic plant management techniques as well as reviews of other herbicides. See also Madsen (2000). Much of the information here is derived directly from the recently completed Washington State documents which provide an extensive compilation of field and laboratory study results.

Diquat dibromide is a liquid, non-selective, broad-spectrum contact herbicide which kills both submerged and emergent plants. Diquat interferes with photosynthesis and rapidly growing leaves wither as a result. It is absorbed through the leaf cuticle and is not significantly translocated. Diquat dibromide is rapidly absorbed, resulting in tissue concentrations well above ambient levels. It causes a rapid die-off of the shoot portions of the plant it contacts, but is not effective on roots, rhizomes or tubers, requiring subsequent applications if the objective is to kill plants with Diquat dibromide. Sunlight may enhance the activity, with emergent plants having effects within a few to 10 days and submerged plants taking 3-4 times as long. However, emergent and floating leaved plants are often treated by surface spray vs. injection, and the effective concentrations applied in the vicinity of the target tissues are thus much higher.

Diquat will bind to particulate and dissolved organic matter and to sediments, which limits its effectiveness in some locations. Binding to sediments and bacterial (especially aerobic) degradation are commonly cited as primary ways that Diquat dibromide is removed from the water column, though degradation by sunlight (photolysis) is also cited.

Diquat effectiveness for various species is listed on the label and in various reviews. Maine-listed invasive plants on which it is partly effective are European Naiad, Pondweeds (including Curly Leaved Pond Weed), Brazilian Elodea, Milfoils (including Eurasian, Variable and probably Parrotfeather) and Hydrilla. It is also listed as controlling native plants, including (*Ceratophyllym* spp.), bladderworts (*Utricularia* spp.), elodeas (e.g. *E. canadensis*), pondweeds generally (*Potamogeton* spp.), duckweeds (*Lemna*) and others.

C. Typical Application Methods and Concentrations:

Diquat dibromide is typically applied by surface spray (early season) or subsurface injection. It is commonly used where agencies want to achieve temporary plant population control and the use of systemic herbicides is not feasible due to time of year or other constraints. It is typically pre-mixed on board vessel and applied to surface by spray or preferably subsurface injection (nozzle depth at about 1+ ft depth). It is generally applied to small areas susceptible to low-moderate drift/ dilution and with limno- curtains where higher water exchange is expected. It is used for rapid suppression of species like Hydrilla, especially where the season is advanced and immediate interception of propagule formation is needed. It may also be used for early season suppression if rapid action is needed to reduce biomass or propagule production.

Concentrations Typically Applied: Unless otherwise noted, all Diquat dibromide concentrations in this summary document are reported as cation.

While label rates allow 1-2 gallons [per lake acre (essentially 720 ppb), most applications will be at 0.25-0.5 gal/acres for effective concentrations of <= 100-200 ppb. Short term localized concentration higher than this may be expected in the immediate vicinity of lake bottom where granular formulations are applied.

Persistence: Various sources including the product label indicate rapid reductions in concentrations applied. For example, we can expect that a 0.37 ppm diquat dibromide application on day one will drop to 0.1 ppm on day 2. The amount of available diquat continues to decrease so that by day 4 the water would contain <0.01 ppm of the chemical (Reward, Landscape and Aquatic Herbicide – Label). It is clear that diquat binds strongly to sediments and that repeated applications will result in significantly elevated sediment concentrations. However even at very elevated sediment levels (e.g. 250 ppm), diquat appears not to be lost in detectable amounts to the overlying waters. Other reviews' (e.g. Massachusetts 2003 and Washington 2002) information suggests that concentrations starting at 370-720 ppb should fall off to < 20 ppb by day 3 and to non-detect within 7-14 days. In reality, most applications under this license will result in water column concentrations of <= 100-200 ppb for the first day of applications and rapidly decrease.

At this time several acceptable methods are available for quantifying diquat in water and sediment, with lower limits of detection at around 0.004-0.008 ppm and 0.1 ppm for water and sediment respectively.

D. Human Health Effects:

The information below comes from USEPA label data, the USEPA Office of Pesticide Programs Environmental Fate and Effects Division (OPP), USEPA's ECOTOX database, IRIS (Integrated

Risk Information System, USEPA, see Appendix), and the July 2002 Risk Assessment by the Washington State Dept. of Ecology (on file with DEA, not included with this application).

At IASP's request, a review of Diquat dibromide concerning human health was conducted by the Board of Pesticides Control in 2005 (on file with IASP, not included with this application). The Maine Board of Pesticides Control (BPC) reviewed relevant information concerning Human health risks in information. Several citations from that assessment are quoted here.

"The Food Quality Protection Act (FQPA) of 1996… placed regulatory requirements on USEPA with regard to human health risk assessments. These include the use of a 10X safety factor when children are to be exposed and there is laboratory evidence that the developing organism is more sensitive than adults to a particular compound. Other requirements are to evaluate aggregate risks, (exposure via diet, drinking water and residential uses) and cumulative risks (exposure to compounds having a common mechanism of action)."

The BPC review also presented toxicity endpoints; specific toxicity studies, No Observable Adverse Effect Levels (NOAEL), Lowest Observable Adverse Effect Levels (LOAEL) and effects seen at LOAELs, which were used for risk assessment purposes chosen by the USEPA's Office of Pesticides Program in the 2002 review.

For drinking water, the USEPA's 2009 Maximum Contaminate Level Goal (MCLG) and Maximum Contaminate Level (MCL) for diquat are 20 ppb. The Maine CDC's 2010 Maximum Exposure Guideline (MEG) is also set at 20 ppb. The Reward label has a 3 day drinking water restriction following the aquatic uses of diquat dibromide at the highest labeled rate.

Application of an USEPA model for swimming exposure indicated that Margins of Exposures (MOEs) ranged from 338 to 800. Also noted: "In their exposure scenario USEPA uses 260 ppb for the high end diquat dibromide concentration. This is the highest level found in surface water monitoring and the MOEs ranged from 630 for a child (age 7 to 10) to 10,000 for an adult". The review also indicated that Diquat dibromide is classified as a Group E = evidence of non - carcinogenicity by USEPA. There is no label restriction for fishing and swimming.

BPC concluded that "…the risks to humans from water treated with diquat dibromide according to the label instructions for treating water bodies for invasive weeds is in the acceptable risk range (MOEs > 100). Communication with the parties using and around the water bodies is critical in order that compliance with the water use restrictions on the label be observed. In addition to swimming and drinking consumers, ornamental (lawns and trees) applicators and agricultural users need to be aware of these restrictions to prevent crop damage and illegal residues of diquat dibromide in livestock and other commodities." This risk assessment considered applications at full label rate (the limits proposed in the license). The highest concentration expected from this use will be 720 ppb, falling off to < 20 ppb by day 3 and to non-detect within 7-14 days. In reality, most applications under this license will result in water column concentrations of <= 100-200 ppb for short periods.

E. Human Contact / Toxicity:

Restrictions from the label include: drinking water restrictions for 3 days post application, but no restrictions for swimming. IASP will normally also post public swimming areas and an advisory to shoreline residents not to swim during the day of application and for 1 day post application, an added safety measure. Outreach to commercial users of lake water for irrigation and livestock consumption will note that "Food crops may not be irrigated with diquat treated water for 5 days post application" and that livestock may not consume diquat treated water for 1 day post application". Outreach to homeowners will include a note that "…diquat treated water cannot be used for irrigation of turf and ornamental plants for 1 to 3 days depending on the use rate." (Syngenta 2005). These are also label requirements.

IASP will consult with DHHS to see if there are public drinking water supplies and will not apply the chemical to that waterbody without written consent of the utility and assurance that the area of the intake would not experience detectable residuals of the active ingredient. IASP will normally survey owners/residents of an area within 1000 ft of the edge of the treatment area (if site fully curtained, within 250 feet) to determine where lake water is used for human consumption, irrigation or livestock watering or if there are shallow wells within 250 feet of shore. If concentrations in excess of .02 ppm (Maximum contaminant level for drinking water) are expected in areas beyond 1000 feet from the application area, the survey zone will be extended accordingly. These shoreline residents would be notified to avoid drinking lake water for at least 3 days, and bottled water offered to them. Due to the short half life of the material and tendency to bind to soil particles, transport to ground water in detectible amounts is unlikely in shallow wells.

F. Potential Negative Effects of Diquat Dibromide:

i. Biomagnification and Bioconcentration

Diquat is not expected to pose significant issues for bio-concentration or bio-magnification, in part due to its short residence time in the water column during typical treatments. Diquat does not tend to bioconcentrate to an appreciable degree in fish and other aquatic organisms. Bioconcentration factors for fish have been reported to be relatively low (< 2.5), but ranged up to 62 for other organisms. Other studies reported that no diquat residues were detected in channel catfish collected from pools five months after a single application or two months after a second treatment of 1 ppm diquat. In laboratory flow-through systems, diquat dibromide did not accumulate to a significant degree in *Daphnia*, mayfly nymphs and oysters, with maximum bioconcentration factors of 32. USEPA reviews (1994) cited rapid depuration for several organisms.

ii. Non-target Plants:

Diquat dibromide effectiveness for various species is listed on the label and in various reviews. Besides Maine-listed invasive plants on which it is partly effective, we anticipate effects on a significant variety of native plants, especially non-emergent species, Pondweeds (*Potamogeton* spp), Milfoils (*Myriophyllum* spp.), Coontails (*Ceratophyllym* spp.), Bladderworts (*Utricularia* spp.), Elodeas (e.g. *E. canadensis*), and duckweeds (*Lemna* spp.) and others. File observation suggest that seed-propagated annuals often return in significant numbers, especially if the applications is early in the season and that

re-growth of perennials rebounds in the next season. Significant plant biomass reduction may occur during the season of treatment (with attendant habitat displacement of fauna, including invertebrates), but persistent habitat alteration is unlikely. Surface spray applications, (possible for floating or semi-emergent invasive species) are less likely to reduce native submerged plant biomass, but would affect water lilies and some floating leaved potamogetons if present. Negative impacts to emergent wetlands is unlikely.

Various species of algae and protozoans found in the water column are affected by concentrations of diquat >= 0.30 ppm c.e. and concentrations at near maximum label rates can suppress growth of a variety of cyanophytes, green algae and diatoms. Several taxa have had EC50 (concentration at which some negative effect is seen in 50% of a test population) as low as 0.05-0.1 ppm. Due to the short persistence of diquat, algal populations tend to rebound and at times increase significantly as decaying plants release nutrients. Though not extensively studied, we can also expect a short term increase in heterotrophic bacteria and protozoans taking advantage of the increased carbon and other nutrients. Algae blooms, especially in treated areas or even whole lake, may result during the treatment season depending on the degree of dilution and transport of nutrients post treatment.

Rare or threatened plants may be affected by treatments. IASP staff will consult with the Maine Natural Areas Program of DOC as to occurrence records in the waterbody and conduct low intensity plant community screening in advance of treatment. Occurrence of these plants will require evaluation of treatment proposal to limit negative effects. In this review IASP will consider the negative effects of invasive species on the viability of the rare plants and communities and the consequences of delaying action.

iii. Non-target Animals:

Fish: According to the Washington State EIS (WA 2003). “Limited field data with sentinel organisms (caged fish) and net capture population surveys indicate that diquat dibromide lacks acute environmental toxicity to fish and amphibians when applied at labeled rates.”

In virtually all cases, that standard 96 hour lab test for toxicity indicates little likelihood for toxicity from Diquat dibromide as typically used in the field. According to the Washington summary, Diquat dibromide has a high lab toxicity for a particularly sensitive species “….(*96 hour LC50 = 0.54* ppm c.e. for striped bass sac-fry. Other species that are known to be particularly sensitive to pesticides include the walleye (*Stizostedion vitreu*) (lowest LC50 = 0.75 ppm c.e), smallmouth bass (Micropterus dolomieu)(lowest LC50 = 1.5 ppm c.e.) and the largemouth bass (*Micropterus salmoides*)(lowest LC50= >1.62 ppm). If the USEPA’s typical worst case scenario of 0.224 ppm is used, no significant mortality should occur since the lowest defined LC50 is much greater than the EEC of 0.224 ppm c.e. However, if the 4-day geometric mean of 0.059 ppm c.e. is used as the EEC, virtually no fish are affected at this concentration and the risk quotient is less than or approximately equal to the level of concern of 0.1 (RQ = 0.11 = 0.059 ppm/0.54 ppm. Even the salmonids, which are of special concern as a game fish, aesthetically, and as representatives of an endangered group, are not particularly sensitive to diquat dibromide; the lowest LC50s are 6.1, 17.77, 20.5 and 30 ppm c.e. for rainbow trout fingerlings, brown trout fingerlings, and Coho salmon fingerlings respectively.”

Some field and lab trials indicate that fish can show avoidance behavior to Diquat dibromide, but in most cases we expect this displacement of fish will be temporary. Medium-term effects (season long) may be seen as plant cover density is reduced, affecting concealment and predator-prey interactions. A secondary effect may be to reduce plant – associated invertebrate productivity, lowering fish productivity in the treated area. Effective restoration of a native plant community tend to mitigate human-induced impact of both the introduction of invasive plants and the short term management of them using herbicides. Dissolved oxygen loss should be minimized by layout of the treatment area(s) and regimen.

Due to rapid action and potential for DO depression when treating dense plant growth, less than ½ of any lake or pond would be treated at any one time. If a larger area must be treated, per label instructions 14 or more days should elapse between partial lake treatments to reduce overall DO loss. Applications would normally be in blocks or strips to allow a refuge for fish and other taxa that may exhibit short term avoidance of Diquat dibromide - treated water and to reduce localized DO swings.

Use of limno curtains or partial screening to reduce drift may be called for when the target plant community is in a limited area or reduction of water circulation will increase effectiveness, allow for reduced dosing, or protect sensitive non-target resources. Treatment of contained (limno-curtained) areas or whole cove treatments may result in localized, transient DO loss. Presence of a thermocline will inhibit vertical transport, so Diquat dibromide should be applied to unstratified areas of lakes and avoid very shallow areas of high organic sediments.

The use of Diquat dibromide in limited areas described is a concern for some life forms. Several strategies are available to reduce effects on motile organisms. Granular applications can be made going from inshore to outlying areas, thus giving some time for fish to move. If the curtain is left partially open until the application is complete, it will allow some outward movement during this time. Again, the short residence time needed for Diquat dibromide means that the curtains can be removed in a short time after treatment and the low toxicity to fish should not result in mortalities even in this type of treatment. Reducing plant disruption in non-target areas will also allow for better habitat integrity for fish post-treatment than would result from not using such curtains in instances where sensitive habitats abut treated areas. As with other vertebrates, fish typically do not bio-concentrate Diquat dibromide. What is ingested during feeding and through respiration is typically depurated in a matter of a few days. Field reports also bear this out.

Rare or threatened animals are unlikely to be affected by treatments. IASP staff will consult with the Non-game Program of DIFW as to occurrence records in the waterbody in advance of treatment. Occurrence of fauna of concern will require evaluation of treatment proposal to limit negative effects. In this review IASP will consider the negative effects of invasive species on the viability of the fauna and communities (especially habitat effects) and the consequences of delaying action.

Amphibians: Acute effects of Diquat dibromide have generally not been characterized for amphibians. As reported in Washington (2002), “Chronic data and field data is available

for several species of amphibians. For the leopard frog (*Rana pipiens*) and the African clawed toad (*Xenopus laevis*), the MATC for development is 1.7 and 0.64 ppm c.e., respectively. While the chronic LC50 for leopard frog was >5.4 ppm c.e., the chronic LC50 for African clawed toad was ~0.41 ppm c.e.. Diquat dibromide at field applied concentrations of 1.0 ppm did not appear to have long term adverse impacts to the frog (*Rana temporia*) or the toad (*Bufo bufo*)." Therefore it is unlikely that significant direct effects will be seen on amphibians.

Birds: Acute oral data indicate that diquat dibromide is moderately toxic to birds when consumed in the diet. For example, reported acute oral LD50 for mallard ducks ranges from 60.6 ppm to 31 ppm. Other acute dietary (LC50) data are available for Japanese quail and bobwhite quail 264 and 575 ppm respectively). Chronic dietary exposure test for one-generation reproduction yielded no observable effect levels (NOELs) of 5 -25 ppm and >19.6 ppm (mallard ducks and bobwhite quail).

Mammals: Examples of acute oral effects LD50 levels range from 120 mg/kg in rats to 233 mg/kg in mice and 30 to 56 mg/kg for cows. These data indicate that Diquat dibromide is moderately toxic to rodents tested and highly toxic to cows, assuming significant levels of ingestion. A variety of chronic exposure tests have been done employing rabbits and rats, and relatively few low-dosage effects were reported.

There are no obvious indications that the exposure of mammals resulting from Diquat dibromide applications as proposed are an issue, especially given the low water column persistence and limited routes of exposure. Aside for drinking recently treated water, serious exposure to mammals is unlikely, especially given its low tendency to bio-accumulate or bio-magnify.

Invertebrates: The relatively few invertebrates which have been tested appear to be sensitive to the concentrations proposed. Most, such as damselfly larvae and dragonfly larvae (*Enallagma* spp.and *Libellula* spp. 48 hour LC50 >100 ppm c.e.) are unlikely to be affected. However, some invertebrates, such as the amphipod *Hyalella azteca* (48 and 96 hour LC50s = 0.12 and 0.058 ppm c.e) are likely to be significantly reduced. Water fleas (*Daphnia* spp.) are a standard test animal and often a large part of the zooplankton community. The lowest reported 48 hour LC50 is 0.324 ppm c.e.) which suggests that there will be significant mortality of this plankter and probably others. However, some field evidence suggests that rapidly reproducing species (most plankters) should rebound quickly. The community composition will likely change in the short term due to shifts in dominant algal species and heterotrophic bacterial populations with changes in nutrient availability. Longer term, chronic exposure studies of invertebrates are relatively few. There is some reason to assume that the most sensitive invertebrates may be affected by chronic exposures to Diquat dibromide, though whether effects would actually occur under the dissipation scenarios normally seen is hard to predict. Daphnia, which has a cited chronic toxicity level of 0.045 ppm) should not be significantly affected over the life span of treatments proposed, though higher concentrations (ca. 1 ppm) would hinder development.

Little work appears to have been done on treated sediment effects on benthic-associated invertebrates such as crawfish, amphipods, leeches etc. The relatively long residence time

of Diquat dibromide in sediments (vs. water column) may produce unquantified chronic effects on these taxa. The very mobile ones such as crawfish, may be able to sense and avoid high concentrations, but much lower levels may be tolerated despite longer term effects. Repeated treatments pose the potential for elevated concentrations which would likely affect in-fauna. Sediment concentrations due to single treatments should significantly decline over one or two seasons post treatment.

Few other taxa have been studied for acute or chronic toxicity. Of these, some are marine invertebrates such as and bloodworm larvae (*Tendipedinae*); Eastern oyster (*Crassostrea virginica*) or pocket shrimp (*Mysidopsis bahia*). The only freshwater snail species reported on, (apple snail, *Pomacea paludosa*), is somewhat sensitive with a 48 hour LC50 = 0.34 ppm c.e.. While water column concentrations are not likely to cause direct mortality, it is unclear if snails continuously exposed to treated sediments will experience elevated Diquat dibromide concentrations.

The Washington State review notes that "There have been arguments made that the presence of sediment reduces the toxicity of diquat by binding it tightly and making it biologically unavailable (Simsiman et al, 1976). It has also been shown that these high sediment concentrations are not biologically available to plants growing in contaminated sediment (Coats et al, 1967 and Daniel, 1972). Similarly, it is apparent that the presence of sediment can reduce the toxicity of diquat to the more sensitive benthic organisms. For example, in absence of sediment the 96-hour LC50 to *Hyalella azteca* is 0.048 ppm. However, if sediment is added to the system, this 96-hour LC50 rises to 6.8 ppm and thus might spare this very sensitive species from both the acute and chronic effects of diquat."

iv. Low Oxygen:

Herbicide treatments which cause rapid plant death can result in increased oxygen demand and very low oxygen levels. Diquat dibromide is fast acting, so DO loss should not be pronounced, especially with an early season treatment. This is borne out by project reports and published research on Fluridone treatments in waters similar to Pickerel Pond. Treatments in the spring occur when less plant biomass has been developed and resultant oxygen demand will be lower as well as spread out over the growing season.

v. Nutrient Releases:

There is a potential for increased phosphorus release from dying vegetation. The degree to which this will happen has not yet been determined, although it is likely that any effects will be limited in time to one season and in extent due to the relatively low biomass of plants treated in early season. In addition, a significant amount of phosphorus mobilized from the sediments by plants during the growing season is released during late-season senescence. Therefore, interrupting growth, especially of hydrilla, in early season may actually reduce annual P loading to some extent.

vi. Drift to Non-target areas:

Downstream: Where an active lake outlet exists or in the case of treatments to streams, there is a potential for Diquat dibromide to be discharged downstream during the treatment period. Where feasible, pond levels will be drawn down to the lowest reasonable level (consistent with ensuring access for treatment equipment to infested areas and protecting habitat values, including provision for downstream minimum flows) just before treatment. Downstream areas often receive additional water from groundwater and tributaries, so dilution of Diquat dibromide should occur. Regardless, there could be some negative effects on the downstream vegetation. Selected downstream areas may be monitored for obvious effects as well as the chemical residual monitoring.

Groundwater: If IASP finds that there are shallow (non-bedrock) private drinking water wells within 50 feet of the lake, IASP will evaluate feasibility of offering to test these wells for Diquat dibromide residuals at least once post treatment. Despite lack of published evidence of persistent groundwater effects, it may be prudent to monitor shallow dug wells/wellpoints if they are located in near shore areas.

3. Endothall

A. Typical Formulations

B. General Characteristics

C. Typical Application Methods and Concentrations

D. Human Health Considerations
   1. Risk Assessment Methodology and Terms
   2. Acute Risks
   3. Chronic Risks
   4. Adsorption, Distribution, Metabolism and Excretion
   5. Aquatic Uses Exposure Considerations
   6. Drinking Water
   7. Swimming
   8. Other Water Uses
   9. Restrictions for Lakes and Ponds Only:

E. Potential Negative Effects
   1. Biomagnification / Bioconcentration
   2. Non-target animals
   3. Aquatic Risks
   4. Fish
   5. Invertebrates
   6. Amphibians
   7. Microorganisms
   8. Birds
   9. Mammals
   10. Non-target Aquatic Plants
   11. Nutrient Release and Low Dissolved Oxygen
   12. Drift to non-target areas
   13. Sediment
   14. Ground water

Fact Sheet Attachment A

3. Endothall

A. Typical Materials / Formulations

This fact sheet is intended to provide background information relevant to review and use of the herbicide endothall. This review included information gathered on experiences of other states in use of these methods, and pertinent information on environmental effects. Some of the information is taken directly from agency reviews by the states of Washington and Massachusetts as cited in the references section.

Typically, Hydrothol formulations (N, N-dimethylalkylamine Salt) are significantly more toxic in several categories of exposure (oral, dermal etc) than Aquathol. Since Hydrothol is not registered for use in Maine and less toxic products are available (Aquathol-type formulations), Hydrothol information is not provided in this summary.

The physical/chemical properties of the K_2^+ salt and the acid are presented in Table 1. DEP has reviewed pesticide agents and physical suppression methods suitable for rapid response. This review included information gathered on experiences of other states in use of these methods, and pertinent information on environmental effects. DEP will specify herbicides to be used against high priority, invasive species on a taxa by taxa basis. Again, the number of water bodies treated in anyone year will be few, if any.

The agent currently addressed is Endothall (7-oxabicyclo [2, 2, 1] heptane-2, 3-dicarboxylic acid) di-potassium salt (CAS# 2164-07-0) (K_2^+ salt). The endothall (K_2^+ salt) dissociates into the acid immediately on addition to water (USEPA 2005c). The active component is the endothall acid (CAS# 145-73-3) (endothall acid equivalents (ae)) and use rates will be described in terms of the K_2^+ salt and endothall ae. The Aquathol K products registered by United Phosphorus in Maine for 2010 are:

> Liquid: 40.3% active ingredient, K_2^+ salt (28.6% endothall ae) (4.23 pounds (K^+_2 Salt /gal; 3 lbs endothall ae/gal).
>
> Solid: granular formulation 63% active ingredient by weight K_2^+ salt, (44.7% endothall ae).

Specific products reviewed below were those registered by USEPA and in Maine with lake and pond use for invasive weeds. They are identified by name and formulation below. They may or may not be registered when the use is proposed, therefore all herbicides intended for use under this permit should have the registration status verified prior to approval of the permit.

Table 1. Physical/Chemical Characteristics of Endothall (USEPA 2005a)
Characteristic Endothall acid Endothall K_2^+ salt

Table 1. Physical/Chemical Characteristics of Endothall (USEPA 2005a)		
Characteristic	**Endothall acid**	**Endothall K_2^+ salt**
Molecular weight	186.16	262.33
Density	0.481/cm^3	0.766 g/cm^3
CAS#	145-73-3	2164-07-0
Water solubility @ 25 C	13.1 g/L pH = 5, 12.7 g/L pH = 7, 12.5 g/L pH = 9	> 65 g/L pH 5, 7 or 9
Vapor pressure	3.92 X 10^{-5} mm Hg at 24.3 C	Not applicable
Octanol/water partition coefficient	Not applicable	< 0.02 and < 0.3 @ concentrations of 9 X 10^{-3} and 9 X 10^{-4} M

Maine DEP may use any or all of Maine-registered endothall formulations as long as they conform to the general descriptions in this document and have similar profiles action, persistence or effects as described herein. The reason for this is that products are occasionally re-registered under different labels and names, but the chemical formulations themselves do not often change significantly and permitted use should not be constrained by simple product name. New formulation and changes in the use directions changes would require a separate review.

B. General Characteristics

USEPA summarized the endothall mechanism of action as "interfering with plant respiration by affecting protein and lipid biosynthesis and by disrupting plant cell membranes" (USEPA 2005a). Endothall is a contact herbicide that disrupts solute transport processes in plant cells. The mode of action of Endothall is not fully understood, however, there are several hypotheses to explain Endothall's activity. All of the hypotheses indicate that Endothall disrupts biochemical processes at the cellular level, such as interfering with protein synthesis by affecting dipeptidase and proteinase enzymes. These enzymes are needed to support the production of proteins used by the plant for growth. There is also indication that Endothall interferes with lipid synthesis and metabolism in the cells (Mann, 1968). Lipids are incorporated, along with proteins, as structural components in the plant cells. Additionally, it has been suggested that Endothall may interfere with the transport of nutrients and cellular materials across the cell membranes (Maestri, 1966). This would suggest a weakening or disruption of the cell wall and is likely related to the structural components discussed above (Washington 2001).

For example, it has been shown that 5 μg ae/l of endothall caused an approximate 40% inhibition of incorporation of malonic acid into the lipid fraction of hypocotyl segments of the hemp plant *Sesbania exaltata*). It has also been suggested that endothall produces a number of cell membrane changes that cause drying and wilting of leaf tissue and an increased respiratory rate in plants. It has also been postulated that endothall acts to inhibit respiration. This was noted in a study in which the effect from endothall is greater in the dark, indicating the mechanism of action is not

light-dependent. Under light conditions, photosynthesis provides some energy for respiration; however, all energy under dark conditions is produced via respiration. Thus, it was suggested that this effect may be due to respiratory inhibition by endothall. It is also postulated that endothall interferes with metabolism of molecules involved in genetic coding (e.g., mRNA metabolism) (Massachusetts 2003).

Aquathol® K and Aquathol Super K are post-emergent contact herbicides used primarily to control submerged weeds but they may also be used to control surface weeds. According to the labels, the Aquathol K® products typically control a wide variety of *Potamogeton* species, *Sparganium* spp., *Ceratophyllum* spp. *Hydrilla verticillata*), *Myriophyllum* spp., *Najas* spp, *Zannichelllia* spp., (horned pondweed), and *Heteranthera* spp. among other species. See the Appendix I for an expanded list (United Phosphorus 2010a, United Phosphorus 2010b).

Some species of aquatic plants are known to resist or tolerate Aquathol® products. These species are *Nuphar* ssp. (spatterdock), *Nympaea* spp. (fragrant water lilies) and *Typha* spp. (cattails) (Shearer and Halter, 1980), *Elodea canadensis* (American waterweed) and *Chara* spp.(muskgrass) When the biomass of other aquatic species is decreased by Endothall use, tolerant species may become dominant and decrease plant diversity in the treated area. (Washington 2001).

C. Application Methods and Concentrations

Applied concentrations will be 0.5 to 5 ppm K_2^+ salt (0.35 to 3.5 ppm ae). A commonly used concentration is 2-3 ppm K_2^+ salt (1.4 to 2.1 ppm ae), with relatively few situations requiring maximum label rates. The most typical application scenario where maximum label rates would be achieved will be spot or area applications where, if limno-curtains or similar barriers to circulation are not feasible, the potential for dilution from outside water may require higher initial dosing. This would usually be around 3 to 5 ppm K_2^+ salt (2.1 to 3.5 ppm ae) in the immediate vicinity of the treated infestation. Large scale applications in whole lake scenarios will be uncommon and would typically be done at lower dose rates to reduce impact on native plants since the dilution expected in spot or area applications is not a factor.

Although labels typically give dosing rates in unit measures per acre based on mean water depth, the actual dosing will be calculated on the basis of the formulation used and actual water areas/volumes as determined by use of DEP file bathymetry or other specifically acquired information. In all cases, efforts will be made to tailor the dose to the hydrologic conditions and species encountered. A list of recommended rates is included in the Aquathol label, but some field experience in other jurisdictions may allow further fine tuning. For example, some recent work by the Washington Department of Environmental Conservation indicates that adequate, if temporary, control of European milfoil can be obtained at concentrations in the range of 1.5 ppm K_2^+ salt (1.1 ppm ae).

The use of adjuvants, such as wetting agents or surfactants, may be necessary, especially if treating floating leaved plants. While they are generally considered by USEPA to be relatively inert, they can have negative effects in some instances such as applications in very shallow water and at concentrations higher than usually used. A proposed adjuvant will need to be evaluated at the time of treatment design, but the Maine BPC does not currently register these agents.

Applications should occur when plants are actively growing. Application for submersed weeds will usually be by subsurface injection or surface spray from boats equipped with Global Positioning System (GPS) location devices to ensure even areal application for liquid mixtures and by calibrated spreaders if applying granular materials. These methods are consistent with those described in the GP.

It is recommended that when treating target plants that are 6 feet below the surface of the water, trailing hoses be used, perhaps also including an approved aquatic sinking agent. For applications to floating leaved plants a surfactant at 0.25 to 0.5% by weight may be combined with the slightly diluted liquid formulation to assist with sticking and penetration of the pesticide.

In treating large areas of heavy vegetation, low dissolved oxygen may become an issue due to decay of affected plants. In these cases, the labels require treating in blocks with 5-7 days between treatment of successive blocks to reduce the likelihood of mortality for fish and other motile animals. The maximum size of these blocks or spacing between them is not specified, but it is likely we would limit the treated areas to a few hundred feet in length along a shore with equal-sized non-treated blocks interspersed. Actual configuration will depend on local conditions.

D. Human Health Considerations

The herbicide currently under review is endothall K_2^+ salt. The active component of this and other endothall salts is the endothall acid. Use rates will be described in terms of the K_2^+ salt and endothall acid equivalents (ae) (USEPA 2005a, USEPA 2009c). A third form of endothall, the mono N N-dimethylalkylamine salt (CAS# 66330-88-9) (amine salt.) will not be addressed here because of greater toxicity to fish (TOXNET 2010, Washington 2001).

As seen in Table 1, the solubility of the endothall K_2^+ salt is greater than 65 g/L and is independent of pH. This is well above the highest labeled rates for aquatic weed control, 3.2 gallons of formulation per acre foot (Aquathol K) and 22 lbs per acre foot (Aquathol Super K) resulting in a maximum concentration of 5 ppm (5,000 ppb) endothall ae in the water column (United Phosphorus 2010a, United Phosphorus 2010b). The octanol/water partition coefficient is a physical end point used to assess the potential of a compound to bioaccumulate in the environment. USEPA states that endothall will not bioaccumulate (USEPA 2005a). Reported values for Endothall K_2^+ salt formulations are < 1 (Table 1) are well below the value of 10 which indicates elevated bioaccumulation potential (TOXNET 2010, Washington 2001).

Human health assessment information was derived primarily from the 2005 USEPA Re-registration Eligibility Decision (RED) (USEPA 2005a) and USEPA's 2005 and 2009 Health Effects Division (HED) Risk Assessments for tolerance actions (USEPA 2005b, USEPA 2009c). The 2001 Washington State Supplemental Environmental Impact Statement was a source of additional information. The Washington review, relied heavily on the primary references as interpreted by a consultant, Compliance Services International in 2001. These were some of the same studies reviewed by USEPA in support of endothall registrations (Washington 2001). Unless otherwise noted, all doses are in terms of the endothall acid. Toxicity endpoints of concern were identified by USEPA for use in risk assessment for acute and chronic dietary exposure and short and intermediate term occupational or residential exposure.

1. Risk Assessment Methodology and Terms

Risk is a mathematical function of toxicity and exposure. The most sensitive endpoint from the animal studies is determined and compared to an acceptable risk level. USEPA's classic risk assessment methodology is described below. Regarding pesticide uses, the states may be more restrictive than USEPA, but not less restrictive.

Risks from short/intermediate term occupational or residential exposure are evaluated with the margin of exposure (MOE) methodology. The MOE is the ratio of the lowest No Observable Adverse Effect Level (NOAEL) to the exposure dose. The uncertainty in this type of risk assessment is incorporated found in the acceptable MOE, at a minimum the factor of 10X for extrapolation from animals to people and a factor of 10X for variability in the human population. If a LOAEL is used rather than a NOAEL, the compound has some carcinogenic potential, or there is some other uncertainty in the data base another factor of 3 to 10X may be included.

Acute and chronic exposures (short term or lifetime exposure through diet and/or drinking water) are evaluated in terms of the reference doses (RfD). The acute RfD (aRfD) is determined using a short term exposure study and the chronic (cRfD) by using either a developmental or chronic study. Both the aRfD and the cRfD are calculated using the lowest NOAEL divided by the same uncertainty factors as the MOE (above). The Food Quality Protection Act of 1996 requires USEPA to include another safety factor of 10X if there is evidence of sensitivity in the developing organism and children are expected to be exposed. USEPA reduces the FQPA SF to1X if there is no evidence of sensitivity or in risk assessments such as occupational where exposure to children will not occur. If cancer risks are present, then a carcinogenic linear multistage model risk assessment is performed. To determine risks, the exposures from different sources are calculated, added together and compared to the RfD.

2. Acute Risks

Endothall is a caustic compound (USEPA 2005a, USEPA 2009c, USEPA 2009d) with high oral toxicity (LD_{50} in rats of 44.4 mg/kg in females and 50.2 mg/kg in males. It is also a severe skin and eye irritant with lethality in 4/6 rabbits exposed via the eye. Because of this endothall containing products have "Danger" signal words (United Phosphorus 2010a, United Phosphorus 2010b). The caustic/corrosive properties of a product depend on the concentration, volume, acidity (pH), ability to penetrate tissues and duration of contact of the solution, rather than mass per unit body weight (mg/kg). With caustic agents, toxicity is due to complications following severe tissue damage. These complications may include toxemia, shock, perforation, hemorrhage, infection and obstruction (Gosselin *et al.* 1984, Goldfrank *et al.*, 1998). These attributes of caustic agents make interpretation of the classic toxicology tests (oral and dermal LD_{50}; inhalation LC_{50}) difficult. This is seen when comparing NOAEL from the subchronic feeding study in rats to the LD_{50} in rats; with an LD_{50} of 44.4 mg/kg one would expect a NOAEL lower than 39 gm/kg/day in the feeding study (USEPA 2005a).

USEPA did not establish an aRfD because there was not an appropriate endpoint for acute exposure. The most sensitive indicator for acute oral toxicity was direct damage to the stomach in rats. The maternal stomachs were not evaluated in the prenatal developmental study and the study was not used for acute dietary risk assessment (USEPA 2005a).

The protective clothing requirements on the label for protective eye wear "goggles, face shield or safety glasses" and chemical resistant gloves are there to protect the applicator from the corrosive effects of the concentrated product (United Phosphorus 2010a, United Phosphorus 2010b).

3. Chronic Risks

In mammals endothall chronic rat study the NOAEL was 8 mg/kg/day and the LOAEL was 16 mg/kg/day based on decreased body weight and body weight gain (USEPA 2005a). Effects observed at the LOAELs in other sub-chronic/chronic reproductive or developmental studies included decreases in body weight, body weight gain, systemic toxicity (death) and dermal irritation in dermal studies and gastric epithelia hyperplasia and other stomach lesions in oral studies (USEPA 2005b).

Regarding chronic risk, USEPA established a cRfD based on parental effects observed in the 2-generation rat study. The LOAEL for the gastric lesion effect was 2 mg/kg/day, here again which localized the caustic effects as opposed to systemic effects. The cRfD is 0.007 mg/kg/day and the uncertainty factors are 10 for intraspecies extrapolation, 10 for interspecies variation and 3 for use of a LOAEL instead of a NOAEL. The NOAEL for effects in the offspring was 9.4 mg/kg/day with a LOAEL of 60 mg/kg/day based on decreased pup weight. USEPA set the FQPA SF at 1X (USEPA 2005b, USEPA 2009d).

Endothall wais negative in a battery of mutagenicity tests and is considered "not likely" to be a carcinogen (USEPA 2009b) or to cause adverse reproductive effects or birth defects (USEPA 2005a, USEPA 2005b).

4. Adsorption, Distribution, Metabolism and Excretion

In mammals, absorbed and non-absorbed endothall is excreted unchanged in the feces (89 to 98%) or urine (5 to 9%) following oral exposure. At 24 hours, tissue distribution was extensive but low with the highest level (<10%) found in the gastrointestinal tract. By 48 hours, endothall was essentially non-detectable in the tissues. Because of its caustic nature, endothall is poorly absorbed through dermal route of exposure. The dermal absorption factor is 7.3% at 24 hrs. Because of the tissue damage to skin at the dosing site, entry into the rat is self limiting. With this reasoning USEPA did not conduct a dermal risk assessment (USEPA 2005b).

The residues of concern in USEPA's most recent tolerance action are endothall acid and the monomethyl derivative (USEPA 2009c, USEPA 2009d). Exposures from aquatic uses would be the endothall acid (USEPA 2009c).

5. Aquatic Uses Exposure Considerations

As seen in the section on application methods, the commonly used concentration is expected to be 2-3 ppm K_2^+ salt (1.4 to 2.1 ppm ae), with relatively few situations requiring maximum label rates. Maximum label rates, 5 ppm K_2^+ salt (3.5 ppm ae), may occur in areas spot treated, target species resistance is high, or where hydrologic conditions require the higher rate.

6. Drinking Water

The USEPA 2009 maximum contaminant level (MCL) is 0.1 ppm (100 ppb) with health advisories of 800 ppb for 1 and 10 day exposures in children and 50 ppb for lifetime exposure in adults. The Maine CDC 2010 maximum exposure guideline (MEG) is 100 ppb, equal to the federal MCL (ME CDC 2010).

Older labels for Aquathol K and Aquathol Super K do not address drinking water setbacks or other water uses such as boating or swimming (United Phosphorus 2007a, United Phosphorus 2007b). The current USEPA approved labels state that:

> "Drinking Water (Potable Water): Consult with appropriate state or local water authorities before applying this product to public waters. State or local agencies may require permits. The drinking water (potable water) restrictions on this label are to ensure that consumption of water by the public is allowed only when the concentration of endothall in the water is less than the MCL (Maximum Contamination Level) of 0.1 ppm" (United Phosphorus 2010a).
>
> "Applicators should consider the unique characteristics of the treated waters to assure that endothall concentrations in potable drinking water do not exceed 0.1 ppm at the time of consumption. For applications of endothall, the drinking water setback distance from functioning potable water intakes is greater than or equal to 600 feet. Existing potable water intakes that are no longer in use, such as those replaced by a connection to a municipal water system or a potable water well, are not considered to be functioning potable water intakes" (United Phosphorus 2010a).

Any applications made under this GP will follow the 2010 USEPA approved label directions for drinking water or subsequent updates if applicable. In accordance with the GP, public water systems using the water will be notified and their permission to treat secured before such waters are treated. Invasive Aquatic Species Program (IASP) will consult with Department of Health and Human Services (DHHS) to see if there are public drinking water supplies in the treated water and will not apply the chemical to that water body without written consent of the utility and assurance that the area of the intake would not experience detectable residuals of the active ingredient.

IASP will normally survey owners/residents of an area within 1000 ft of the edge of the treatment area (if site fully curtained, within 250 feet) to determine where lake water is used for human consumption, irrigation or livestock watering or if there are shallow wells (e.g. those drawing from surface deposits as opposed to drilled-cased wells) within 250 feet of shore.

If concentrations in excess of 0.1 ppm (MCL) are expected in areas beyond 1000 feet from the application area, the survey zone will be extended accordingly. Examples of such situations may include local currents or suspected potential for hydrologic drift or applications at near the maximum label rate without the use of containment curtains**.**

These shoreline residents would be notified to avoid drinking lake water for at least 3 days after treatment, and depending on the situation, bottled water or other suitable alternatives may be offered to them.

According to the Washington EIS, endothall does not bind strongly to most soils or sediments. While this suggests that it may have the potential to contaminate groundwater, several factors in aquatic systems mitigate this. A combination of some binding, dilution and degradation means that even shallow wells close to a lake shore are probably not at risk. (Washington 2001). Regardless, IASP will assess these shallow well situations on a case by case basis and discuss options with the homeowners for reduction of risks. In appropriate cases, post-treatment testing of well water may be conducted if warranted. (Washington 2001).

7. Swimming

USEPA calculates the risk to swimmers as acceptable with , MOE of 280 for children and 900 for adults (acceptable MOE 100). Because endothall is an irritant and the potential for a swimmer to contact a concentration as high as 5 ppm K_2^+ salt (3.5 ppm ae), IASP will normally also post public swimming areas and advise shoreline residents in the treated area not to swim during the day of application and for 1 day post application, an added safety measure.

8. Other Water Uses

The current USEPA approved label for Aquathol K (USEPA# 70506-176) (United Phosphorus 2010a) contains the following restrictions:

Restrictions for Lakes and Ponds Only:
Do not contaminate water intended for domestic purposes.
Do not use treated water for animal consumption or for domestic purposes within the following periods:
0.5 ppm dipotassium salt — 7 days after application
4.25 ppm dipotassium salt — 14 days after application
5.0 ppm dipotassium salt — 25 days after application"

In addition to the above statements regarding drinking water intake setbacks and MCL, the current USEPA approved label for Aquathol Super K (USEPA# 70506-191) (United Phosphorus 201b) contains this statement:. "Do not contaminate water intended for irrigation or domestic purposes."

With the establishment of tolerances for multiple commodities (USEPA 2009d) the label restrictions for agricultural sprays are expected to change. IASP will identify and provide outreach to farmers, commercial users and area homeowners using lake water for irrigation and livestock consumption will note the label restrictions above.

E. Potential Negative Effects

This summary concentrates on direct herbicide effects on aquatic plants and wildlife. The indirect effects not discussed include habitat alterations due to diminished submersed plant densities. In general, the habitat structure and food source represented by an aquatic plant is a very important aspect of aquatic systems. The design of herbicide applications stresses minimizing non-target plant damage. The negatives of short term reduction in overall plant cover and productivity and of habitat disruption for taxa such as invertebrates is offset by the reduction in invasive, mono-specific plant stands and the rebound of native vegetation usually expected. This is particularly true with the use of fast acting contact herbicides.

1. Biomagnification / Bioconcentration

A bio-concentration factor (BCF) of 10 for mosquito fish was observed in a modified Metcalf model ecosystem. In a field study, a 5 ppm K_2^+ salt (3.5 ppm ae) water concentration resulted in BCFs ranging from 0.003-0.008 in bluegill sunfish. After 72 hrs in the above study, no endothall residue was detected in the fish flesh. In several organisms, it was noted that endothall concentrations exceeded the water concentration of endothall by more than an order of magnitude. Calculated BCF values of 150 for the water flea, 63 for green algae and 36 for a snail); however, the residue concentrations were transient and were not passed along trophic levels (Massachusetts 2003).

The octanol/water partition coefficient is very low for all endothall products so little bio-concentration or bioaccumulation is expected. Similarly, accumulation in the food chain should be minimal because of the very high solubility of endothall products in water.

2. Non-target animals

To estimate potential ecological risk, USEPA integrates the results of exposure and ecotoxicity studies using the risk quotient method. Risk quotients (RQs) are a screening level for potential risk and are calculated by dividing the estimated environmental concentrations (EEC) by median lethal concentrations (LC_{50}) or No Observable Adverse Effect Concentrations (NOAECs) for both acute and chronic risks respectively, for various wildlife species. RQs are then compared to levels of concern (LOCs) (USEPA 2005a, USEPA 2005c, Massachusetts 2003). USEPA's levels of LOCs for ecological risks are:

0.5 for acute risk,
0.1 for risks which could be mitigated by restricting the use of the product,
0.05 for endangered species
1 for chronic risks (USEPA 2005c)

3. Aquatic Risks

The lowest LC_{50}s and their RQs for the lowest (0.5 ppm) and highest (5 ppm) label rates are presented in Table 2 (USEPA 2005c).

Table 2. LC_{50}s [(a)] (ppm) and RQs [(b)] for Aquatic Species following Aquatic Uses at the Lowest (0.5 ppm) and Highest (5 ppm) Aquathol Label Rates (USEPA 2005c) Species

Table 2. LC_{50}s [(a)] (ppm) and RQs [(b)] for Aquatic Species following Aquatic Uses at the Lowest (0.5 ppm) and Highest (5 ppm) Aquathol Label Rates (USEPA 2005c)					
Species	**LC_{50} ppm**	**RQ 0.5 ppm**	**Exceeded USEPA LOC [(c)]**	**RQ @ 5.0 ppm**	**Exceeded USEPA LOC**
Rainbow Trout	9.1	0.055	ES [(d)]	0.55	AR[(e)], RU[(f)], ES
Sheepshead minnow	72	< 0.05	No	0.07	RU, ES
Daphnia	63.8	< 0.05	No	0.08	RU, ES
Eastern oyster	79	< 0.05	No	0.07	RU, ES

a) LC_{50} = Median Lethal Concentration
b) RQ = Risk Quotient = estimated environmental concentration/ lowest LC_{50}
c) LOC = USEPA's Level of concern
d) ES = Endangered Species
e) AR = acute risks = 0.5
f) RU = Restricted use = 0.1

4. Fish

Many species of fish are tolerant to Aquathol K ® products and endothall has a history of being relatively safe to fish. The acute LC_{50}s from aquatic toxicity reviewed by USEPA and classified as "core" for meeting regulatory guidelines range from 32 mg Aquathol K/L (9.152 mg ae/L) in the rainbow trout to 1,600 mg Aquathol K/L (457.6 ae/L) for the bluegill sunfish (USEPA 2005c). These toxicity values place Aquathol® K in the US USEPA's toxicological category of slightly toxic (LC_{50} = >10 to 100 mg/L) to practically non-toxic (LC_{50} = >100 mg/L). Other reported acute toxicity (LC_{50}) of Aquathol® K ranges from 82 mg formulation/L (23 mg ae/L) for Chinook salmon to 740 mg formulation/L (218 mg ae/L) for bluegill sunfish (Washington 2001).

As seen in Table 2, at the lowest labeled concentration, the RQs for freshwater fish, salt water fish and marine estuarine invertebrates fall below USEPA's LOC for all levels of concern except acute toxicity. At the highest concentration the RQs are higher than the LOC's with the exception of chronic risk (LOC = 1) (USEPA 2005c). Regarding chronic exposure was evaluated using the Rainbow Trout NOAEC of 1,790 ppb and the 60-day EEC from USEPA's model. The resulting RQs range form 0.1 to 0.7 and do not exceed USEPA's level of concern of 1 for chronic exposures (USEPA 2005c).

Washington State also evaluated the RQ's for early life stage and chronic fish toxicity. The Acute RQ for Aquathol® K using early life-stage walleye, is 0.09 (1.0 ppm ae/11 ppm ae) and the chronic risk assessment, using *Daphnia magna* or rainbow trout, is 0.012 to 0.028 (0.06 to 0.14 ppm ae/5.0 ppm ae). For both acute and chronic risk assessments the levels of concern for protection of the biota are not exceeded for under Washington State's review (Washington 2001).

Acute tests of Aquathol K using young fish had LC50 and NOEC concentrations of 11 and 4 ppm ae/l for walleye and 33 and 6 ppm for smallmouth bass. Similar tests on the acid form yielded LC_{50} as low as 4.3 for bluegill, but another indicated 43 ppm. LOEC was listed for this species as 18 ppm. Sheepshead minnow LC_{50} and LOEC was listed as 110 and 44 ppm. Although some aquatic toxicity tests indicate toxic responses at concentrations seen during treatments, most do not toxic effects (see Washington 2001).

Washington EIS states that salmon smolts showed respiratory damage during seawater challenges under Aquathol exposure as low as 3 ppm. While other fish generally show little effects of exposure to endothall, some caution is called for in instances where sensitive life stages are likely to be present since testing on early life stages is limited (Washington 2001).

Pond treatments monitored in Wisconsin showed no adverse effects on number of Bluegills, largemouth bass or pike but some changes in age structure of populations did occur, at least during the two years of the study. Despite the reduction in plant densities in the short term, overall catch rates were not depressed and numbers of bluegill/acre remained steady or even increased. Several invertebrate species numbers did fluctuate with the re-structuring of the plant community (such as increased Ostracods and dominance of Chara sp.) but overall invertebrate numbers were not significantly depressed and changes in zooplankton were not be seen (Washington 2001).

This does not assert that no negative effects occur to fish populations, especially considering the physical changes in habitat structure when plant populations are greatly reduced. However, it does indicate that significant mortality or loss of reproductive success is unlikely. The continued

viability of invertebrates and especially zooplankton, reduces the potential for significant food chain disruption for fish related to secondary productivity.

There is some potential that fish will avoid Endothall-treated areas. In acute and behavioral toxicity studies, goldfish did not avoid endothall at 0.17 ppm and 1.70 ppm, but avoided it at 17.0 ppm. Rainbow trout avoided Aquathol K concentrations above 10 ppm. (Massachusetts 2003). However, except for the no-effect results at 1.7 ppm, these concentrations do not correspond to ambient levels expected during treatments. The Washington review concluded that it should be possible to use Aquathol® according to the label without significant acute or chronic risk to aquatic animals (Washington 2001).

5. Invertebrates

USEPA evaluated the studies performed with the K_2^+ salt of endothall on *Daphnia* and scud. The 48 –hr EC_{50}s were 91.23 ppm ae in a supplemental study and > 28.6 ppm ae in the core study using *Daphnia*. When the test species was scud, the 48-hr EC_{50}s for the K_2^+ salt were 89.5 and 63.8 ppm ae in two core studies. USEPA rated the K_2^+ salt of endothall as slightly toxic to aquatic freshwater invertebrates on an acute basis (USEPA 2005c).

As seen in Table 2, the RQ for *Daphnia* at treatment levels of 0.5 ppm does not exceed USEPA's LOCs. For *Daphnia* at 5 ppm, the LOC is exceeded for restricted use and endangered species (USEPA 2005c). The 21-day lifecycle tests for *Daphnia* and *Griodaphnia* had NOAECs of 0.0159 ppm ae and 0.059 ppm ae respectively. The results observed at the LOAEC were decreases in survival and effects on the size of the *Daphnia* and effects on the number of broods. The Washington EIS lists a chronic risk quotient, using Daphnia magna, at 0.012 (0.06 to ae/5.0 ppm ae) (Washington 2001).

The use of maximum field rates of Aquathol® has not been shown to adversely impact the numbers or generic density (species diversity) of *Cladocerans* (*daphnids*), *Copepoda, Cyclopsida and Calanoida* when these species were monitored over a growing season which lasted from May through October. The direct impact of Aquathol®, secondary effects such as decreased oxygen content or decreased surface cover by resident plants had any observable adverse impact on the free-swimming invertebrate population. The only species of aquatic invertebrate that has exhibited mortality in the field is due to the indirect effect of Aquathol K is the *Hydrellia* fly. At concentrations of Aquathol® K that controlled *Hydrilla*, 74% of *Hydrellia* flies died. However, this mortality may have been due to a reduction in habitat as the number of *Hydrilla* leaflets decreased and not due to the direct effects of endothall (Washington 2001).
USEPA's prototype organism for marine invertebrates is the Eastern oyster. As seen in Table 2, USEPA's LOC for endangered species and restricted uses are exceeded at the highest labeled concentration, but not at the lowest concentration (USEPA 2005c).

For benthic (sediment dwelling) invertebrates, the toxicity ranges from an LC_{50} of ~200 to ~354 mg ae/L for *Gammarus* spp.; some marine and estuarine species exhibit similar toxicity to Aquathol K from 39 mg ae/L for the mysid shrimp to as high as 750 mg ae/L for the fiddler crab. Field studies have apparently not been conducted with sediment-dwelling invertebrates. However the very low toxicity seen in lab trials suggests a very low risk profile (Washington 2001).

The acute effects of Aquathol K and endothall acid on free-swimming invertebrates and sediment organisms (LC50 = 39 to 750 mg ae/L, RQ = 0.06) are less than those for fish. Therefore, it should be possible to use Aquathol at labeled use rates without significant acute impact to invertebrate segments of the biota. (1)

Chronic toxicity data for invertebrates is very limited and this lack makes statements on these effects difficult. While long term (ca 30 days) exposure is not likely to be significant, short-term chronic exposure (4-7 days) will occur.

6. Amphibians

One study was described by USEPA's Environmental Fate and Effects division in the 2005 risk assessment memo. The test compound was Hydrothol (endothall di-amine salt; 23.4% ae) and the test species was Fowler's toad. The EC_{50} was 0.28 ppm ae, the endpoint was not described (USEPA 2005c).

7. Microorganisms

Little information is available on eEndothall effects on microorganisms. Washington State's review did not review any chronic toxicity data for algae, plants or sediment organisms. While the amine form (Hydrothol) is used for control of algae, little information was encountered about the effects of the acid or disodium forms of endothall. Temporary increases in microbes that preferentially metabolize Endothall are expected post treatment, taking anywhere from less than a day to a week depending on the treatment history of the water involved.

8. Birds

In support of registration for outdoor uses where exposure to birds is likely to occur, USEPA requires acute toxicity test in bobwhite quail and mallard duck. There are data for the endothall acid and Aquathol (the di-sodium salt of endothall, Na_2^+ salt) for these two species for acute toxicity as oral LD_{50}s. Oral administration of endothall resulted in emesis making the determination of the actual dose a challenge. For the endothall acid, USEPA reported the NOAEL in the mallard duck < 30 mg ae/kg lowest dose tested (LTD) and < 198 mg ae/kg (LTD) in ring neck pheasant. The LD_{50}s for the bobwhite quail was 500 mg ae/kg. In a different study, the LD_{50} for the acid was 229 mg/kg in the mallard duck. With the Na_2^+ salt, the LD_{50} in mallard duck was 61.6 mg ae/kg. These data put endothall in USEPA's moderately toxic by the oral route of administration to avian species category (USEPA 2005c).

The dietary studies indicate that the acid and the K_2^+ salt formulation of endothall are practically non-toxic to bobwhite quail and mallard ducks. The 5-day LC_{50}s are between > 5,000 and > 10,000 ppm acid and Aquathol K formulation. The acid equivalents for the Aquathol K are > 1475 or > 2,860 ppm ae (USEPA 2005c).

Two supplemental avian developmental and reproduction studies were conducted. One indicated that endothall acid in the diet has a NOAEL and LOAEL of >250 ppm ae highest dose tested (HDT) in the mallard duck. In the bobwhite quail, the NOAEL was 50 ppm ae and the LOAEL of 250 ppm ae (HTD) showed there was an increase in early embryonic mortality. Because these studies were ranked supplemental, additional studies are required to support these registrations (USEPA 2005c).

Meaningful exposure to Endothall for aquatic birds eating primarily fish is not likely due in part to the low bioaccumulation profile of Endothall. Ducks eating vegetation may be exposed for short durations while the herbicide is active, but the rapid die off of affected plants should quickly make that food source unavailable or unattractive to ducks.

9. Mammals

Acute and chronic toxicity testing on mammals relies mostly on laboratory dosing via amended food or direct oral feeding of rats. While difficult to relate directly to environmental concentrations which would result in limited exposure to mammals during an aquatic treatment, they at least can indicate potential overall risk. USEPA relies on the evaluation of the laboratory animal studies by HED to estimate risks to wildlife mammals.

Endothall is a caustic compound. Direct application of the technical material to skin and eyes corrodes the tissue and can cause death. The oral LD_{50}s are 44.4 mg ae/kg in female rats and 50.2 mg ae in male rats. USEPA categorizes endothall as highly toxic to small mammals based on these data. The probability of a wildlife mammal coming into contact with the formulation concentrate as part of a routine application is low.

The LD_{50}s for rat studies were 99.5 and 186.8 mg formulation/kg for Aquathol K liquid and pelletized respectively. USEPA thus places these in the moderately toxic category. The likelihood of dosing of that level being achieved in aquatic mammals is probably slight given exposure pathways and duration (ingesting treated water, vegetation or fish, for example), but this is not directly stated in references reviewed. Other information on mammal testing results is included in the section on human health considerations (Washington 2001).

The reproductive NOAEL for endothall is 9.4 mg ae/kg/day from the 2-generation reproductive study in rats with a systemic LOAEL of 2 mg ae/kg/day for the same study based on proliferative lesions in the stomachs of the parental rats (USEPA 2005a, USEPA 2005b, USEPA 2005c).

10. Non-target Aquatic Plants

According to the label, the Aquathol® products typically control a wide variety of *Potamogeton species, Sparganium spp., Ceratophyllum spp., Hydrilla verticillata, Myriophyllum spp., Najas spp, Zannichelllia spp.,* (horned pondweed), and *Heteranthera spp.* among other species. See the label for an expanded list.

Some species of aquatic plants are known to resist or tolerate Aquathol® products. These species are *Nuphar ssp.* (spatterdock), *Nympaea spp.* (fragrant water lilies) and *Typha spp.* (cattails), *Elodea canadensis* (American waterweed) and *Chara spp.(*muskgrass*)*. When the biomass of other aquatic species is decreased by Endothall use, tolerant species may become dominant and decrease plant diversity in the treated area.

In general, for all herbicide treatments increased dominance by resistant native species, such as *Elodea canadensis* in the case of Endothall, at the expense of other species such as *Potamogeton richarsonii, P. crispus, Zannichelia palustris, Ceratophyllum sp.* and *Charopyhtes sp.* can be significant. Fast growing annuals may rebound over a few seasons, providing that sufficient seed bank is present. Slow growing perennials may take longer to reestablish a more balanced community Endothall effects on emersed plants is relatively low, so collateral damage to emergent wetlands is expected to be minimal.

11. Nutrient Release and Low Dissolved Oxygen
Current USEPA approved labels for Aquathol K and Aquathol Super K state:

> "If an entire pond is treated at one time, or if the dissolved oxygen level is low at time of application, decay of weeds may remove enough oxygen from the water, causing fish to suffocate. Water containing very heavy vegetation should be treated in sections to prevent suffocation of fish. Sections should be treated 5-7 days apart. Carefully measure size and depth of area to be treated and determine amount of AQUATHOL K to apply from chart (United Phosphorus 2010a)".

Nutrient release and possible alterations in pelagic productivity is also a potential negative effect of large scale plant die-off. Even with the areal/timing restriction designed to reduce DO loss, there is potential for changes in pelagic algae growth and perhaps also periphyton in near shore areas, especially over the short term (1-2 seasons). Some of this may be mitigated by a re-bound of native plant biomass.

Pre- and post- treatment monitoring will be designed to evaluate this effects on DO and phosphorus, but unless the invasive plant populations are very dense in whole lake treatments, we do not expect wholesale water quality changes (nutrients, DO) to result in most cases.

12. Drift to non-target areas
While application of Endothall under this permit is restricted to fresh waters only, potential for discharge to marine waters exists under certain circumstances. Endothall is slightly toxic to practically non-toxic to estuarine/marine invertebrates and estuarine/marine fish on an acute basis. (Washington 2001, USEPA 2005a). Any concentration of Endothall entering an estuary would be greatly diluted by both untreated river/creek water and untreated sea water from the tidal action.

Due to these factors, the low doses allowed, and the short residence times, chronic or meaningful acute exposure to Endothall in the marine environment is not expected from transient applications of the chemical to freshwaters during invasive plant management in Maine lakes or streams.

Discharge via outlets is always a potential issue in lake treatments. Treatment design will follow considerations outlined in the GP to avoid undue effects and will include pre and post application monitoring where appropriate. Precautions such as temporary outflow manipulation, spot treatments vs. whole lake applications, limno-barriers, and the like will be considered to reduce the discharge of chemicals downstream.

Spot or area treatments which are not contained by limnobarriers or similar devices will leach Endothall into surrounding water. Unless such treatments are limited to a few, relatively small areas, the use of limnobarriers is often of limited feasibility. However, the concern may often be less for any negative off-site effects than the dilution of the needed concentrations particularly at the edge of the treated areas. In such cases, treatments may have to be at higher nominal rates. The use of granular formulations should result in overall moderate concentrations at any one time while spreading out the release over time.

13. Sediment

Endothall persistence times in sediment, measured from the application dates, are frequently longer than that in water, since the maximum concentration in or on sediment is generally not reached immediately when liquid formulations are used. It may take several days for the herbicide to reach the sediment through the water column, build up, and then begin to decline. However, once the decline begins, the time to disappearance is usually fairly rapid, since the sediment concentration is rarely as high at its highest point as the concentration in water (Washington 2001).

Sediment adsorption would be expected to be greater in a shallower lake or pond where the sediment surface:water ratio is higher and there are more potential active sites on the sediment surfaces that are exposed to the endothall in the water. Sediment concentrations can be expected to be lower with liquid formulations since the chemical is injected in the upper water column, relatively far from the sediment surface, and must be carried to the sediment by water currents or dispersion.

Endothall exhibits variable adsorption to soil and sediment (Washington 2001). For most soils, adsorption is moderate to low, but the adsorbed material tends to stay bound to the soil particles once adsorbed. Studies reviewed indicate that higher organic matter content of soils and sediments results in higher adsorption of endothall. Soil clay content, cation exchange capacity, and pH have not been shown to affect the degree of adsorption. Overall, evidence indicates that endothall does not bind strongly to most soils or sediments. (Washington 2001)

14. Ground water

Groundwater can be affected by the concentrations and amounts of herbicides applied, ability of the material to bind to sediment, solubility of the chemical, and dilution, and several other factors. Due to the environmental fate characteristics of Endothall, it has a potential to leach to ground water in terrestrial applications and is known to be mobile in groundwater. It may also reach groundwater in aquatic applications, if ground water transfer in the vicinity of a treatment is high enough to transport water to the riparian saturated soils and thus remove material from active breakdown in the aerobic aquatic environment

Overall, evidence indicates that endothall does not bind strongly to most soils or sediments. This would normally raise concerns of potential groundwater contamination. However, rapid degradation in soils and aquatic systems means that endothall will be destroyed before it has a chance to move very far through the soil and therefore should not pose a significant threat to groundwater. (Washington 2001)

With short aquatic residence times, we do not anticipate that transport to ground water would be a possibility except for shallow dug wells in the immediate vicinity of an application area. Appropriate consultation with abutting landowners and water utilities and mitigation procedures as have been employed by Maine DEP during use of 2, 4-D and Fluridone treatments should avoid problems for domestic water supplies.

4. Fluridone

A. Typical Formulations

B. General Characteristics

C. Typical Application Methods and Concentrations

D. Human Health Effects

E. Human Contact / Toxicity

F. Potential Negative Effects

   i. Biomagnification and Bioconcentration

   ii. Non-target Plants

   iii. Non-target Animals

   iv. Low Oxygen

   v. Nutrient Releases

   vi. Drift to Non-target Areas

Fact Sheet Attachment A

4. Fluridone

4(1h)-Pyridinone, 1-methyl-3-phenyl-5-(3-(trifluoromethyl) phenyl) (CAS# 59756-60-4)

A. Typical Materials / Formulations:

Liquid: 41.7% Emulsifiable, flowable or soluble concentrates,
Granular: 5% pellets

Specific products reviewed below were those registered by USEPA and in Maine with lake and pond use for invasive weeds. They are identified by name and formulation below. They may or may not be registered when the use is proposed, therefore all herbicides intended for use under this permit should have the registration status verified prior to approval of the permit.

B. General Characteristics

Fluridone is a systemic herbicide that moves from submersed foliage to roots. Fluridone interferes with synthesis of RNA, proteins and carotenoid pigments and thereby inhibits photosynthesis. Plants with inhibited photosynthesis show chlorosis (bleaching) of growing leaves resulting in loss of vigor and eventual death. Initial effects are seen in 8-16 days but full effects require > 40-60 days of low level exposure.

Fluridone is a commonly used herbicide that has been registered for aquatic use for about 20 years. It is commonly used where agencies want to maximize selectivity of treatment and reduce concentrations required. It is also one of the least toxic agents available to non-target species.

The granular formulations are extended release materials with fluridone in an inert clay matrix designed for a limited area (partial lake or spot) applications. The clay carrier type affects the release of fluridone from the pellets depending on the formulation. Both the Sonar PR and Q pellets contain the same amount of active ingredient (5% fluridone). The clay used in Sonar Q allows for instant “swelling” of the pellet when exposed to water and results in a higher initial release rate. The denser type of pellet used in Sonar PR allows for a slower but more sustained release of fluridone compared to Q. Concentrations typically rise in the area of application over a period of days and persist longer than Sonar AS applications, but have less effect outside the area applied. Slow decay of the concentrations is expected. Selection of the Sonar pellet formulation to use is subject to site specific lake conditions and management objectives.

Combinations of liquid AS and granular formulations may be required where thermoclines restrict AS dispersion, additional spot dosing for dense populations or suspected groundwater input make slow release granular applications useful in attaining target concentrations and duration.

C. Typical Application Methods and Concentrations

Whole lake herbicide treatments will utilize Sonar AS (SePRO Corp) with the active ingredient fluridone. Treatments typically involve an initial whole-lake subsurface treatment at 6 to 30 ppb (ug/L), with the specific concentration based on target species susceptibility and concerns for non-

target plant species. Fluridone is a slow acting herbicide and contact times ranging from 45 to as long as 150 days are required for effectiveness. Typically, an initial treatment concentration of 15-30 ppb is followed by one or two lower-concentration (booster) treatments after 20 to 40 day increments, if needed, to maintain concentrations at 5-15 ppb for the remaining 60 to 80 days. The initial applications often occur in May or June when plants have begun to vigorously grow but before developing large biomass or producing propagules. Later season treatment may also be effective depending on the species.

Some treatment programs will also utilize a granular form of Sonar (PR or Q) for partial lake spot treatments where needed. Granular materials are usually surface applied by means of a solid materials spreader similar to agricultural seeding equipment. Area dosage may need to be controlled based on depth of water column. Unlike the liquid form, the necessary effective dose of granular Sonar will depend on lake sediment, water flow, and water chemistry. Each of these factors will also affect in-lake concentration beyond the spot treatment area. Treatments using Sonar PR and Q typically involve spot applications of pellets at between 30 and 60 ppb for the initial application (75 ppb is the maximum label rate that can be applied at one time for a partial lake treatment program) followed by one or more booster treatments between 10 and 30 ppb. The maximum cumulative seasonal rate is 150 ppb. These nominal rates are calculated as the total active agent in the application diluted instantaneously into the entire lake volume. Application rates for Sonar PR and Q will depend on the mix employed. Proprietary release curves developed by SePRO will be used to distribute material so as to approximate the target dose rate selected above in the area of application. The higher initial release rate of Sonar Q may be matched to lower/sustained Sonar PR rates to achieve target concentrations earlier in the cycle and to prolong them with the objective of reducing overall chemical use. Typically, local concentrations increase daily, as the herbicide leaches from the clay carrier medium, until peaking after 2-3 weeks with Sonar Q and 3-4 weeks with Sonar PR. Peak local concentrations of herbicide at the sediment/water interface may reach somewhat higher levels than would be achieved in a whole lake treatment, but can be kept below license limits. After reaching peak concentrations, herbicide levels decline due to plant absorption, declining release rates, dilution, and product breakdown.

Based on available information, MEDEP IASP anticipates that spot (partial lake) treatments of 60 ppb fluridone will result in whole lake concentrations well below 25 ppb in the entire water column within the treated area limit. If treatment areas are isolated by water column "limnocurtains", higher concentrations can be expected within the isolated areas. Re-application is usually necessary at least once during the primary 90-day treatment window. The booster application rates will depend on the observed initial release profile, but are typically less than half of the initial dosing. MEDEP IASP anticipates that one, and perhaps two, booster applications per season will be needed. Since material will be dosed based on the area to be treated, the amount of chemical applied will be lower than in a whole-lake treatment designed to achieve the same concentrations. The exact target concentrations and rates for each type of treatment will be developed by the contractor depending on bathymetry and hydrology for the waterbody, as a site-specific recommendation for IASP review. The instantaneous Fluridone concentrations in outlet streams will be designed to be lower than 25 ppb for Sonar AS and 50 ppb for Sonar PR and Sonar Q.

Whole lake treatment (liquid fluridone formulations such as Sonar AS) will be utilized for widely scattered populations that are not amenable to complete removal by hand. Partial lake (spot) treatments (granular fluridone such as Sonar PR and Q) will be utilized if high density clumps are

found in a few locations. Where possible in spot treatments, MEDEP IASP will utilize limnocurtains or partial screening to isolate treatment areas to limit herbicide drift, reduce overall material used, increase effectiveness, and/or protect sensitive non-target resources.

The initial applications will usually occur between mid-May and mid-June each year as needed, when plants have begun to vigorously grow but before developing large biomass. Treating early in the season yields better results because the plants are actively growing and have low potential for depressing dissolved oxygen concentrations as plant decay progresses. The total treatment times will usually consist of 90 to 110 days.

Fluridone (Sonar AS) is typically applied by specially equipped boat. The aqueous Sonar AS solution is diluted with lake water in an on-board tank and applied by means of surface spray or subsurface injector, capable of treating a swath behind the boat. MEDEP IASP's contractors will typically employ metering pumps and GPS tracking devices to dose areas based on water depth (volume), target plant densities or other factors, and assure even distribution over the target area. For whole lake treatments, this typically results in the entire lake being traversed in a grid fashion, with applications not being done in less than 2 feet of water due to navigational constraints. The granular Sonar PR and Q materials are distributed over the target area in overlapping passes by a boat equipped with GPS course tracking. Granular materials are usually surface applied by means of a solid materials spreader similar to agricultural seeding equipment. Area dosage may need to be controlled based on depth of water column. Discharge rates are determined by the weight per unit area covered based on application swath width and boat speed. Because the material is negatively buoyant, the granules sink at the application spot and drift off-target is not anticipated under normal conditions.

Persistence: In field trials the time for fluridone to reach no detectable levels in hydrosoil varied from 8 weeks to 12 months. In treated ponds, half life in water is about 14-20 days, though some studies found half lives as short as 2 days to as long as 26 days. Typical times for fluridone to drop below detection limits after single treatments is less than 60 days. The primary means of degradation is photolysis. Spring treatments result in shorter half lives than fall treatments due to higher water temperatures and solar radiation during longer days.

D. Human Health Effects

The information below comes from USEPA label data, the USEPA Office of Pesticide Programs Environmental Fate and Effects Division, USEPA's ECOTOX database, IRIS (Integrated Risk Information System, USEPA, see Appendix), and the July 2000 Supplemental EIS on fluridone effects by the Washington State Dept. of Ecology (on file with DEA, not included with this application).

Fluridone is not known to be teratogenic, mutagenic, or listed as (or likely to be) carcinogenic. The chronic Reference Dose for oral exposure is 0.08 mg/kg/day (e.g. 0.8 mg/day for a 10 kg child). This value is based in part on a "no effect level" (NOEL) of 8 mg/kg/day chronic exposure in rat studies and an uncertainty factor of 100 (4).

Mammalian and other studies have demonstrated no observable effects at exposure rates several times higher than would be generated by this proposed treatment. The Washington State SEIS evaluated drinking water intake and other avenues for human exposure including swimming

(incidental ingestion of water and trans-dermal transport) and fish consumption. Based on these avenues of exposure, the maximum concentrations in water to avoid exceedance of the reference doses for adults/children were:

617/ 170 ppm for adult/child dermal exposure,
350 ppm for fish consumption (adult),
2.8/0.8 ppm for direct water ingestion
28/8 ppm for incidental ingestion

Application of soluble fluridone to lake water at 0.005- 0.02 ppm over the time period proposed will result in substantially lower exposures than those cited above.

Washington State evaluated avenues for human exposure to fluridone and established a maximum exposure dose for direct water ingestion of 2.8 ppm for adults and 0.8 ppm for children.

According to labels, the maximum concentration of fluridone in water is 150 ppb and levels should not exceed 20 ppb (0.02 ppm) within 1320 feet of a functioning potable water intake. (The USEPA registration label requires waiting 7-30 days before use of treated water for irrigating plants, but this is to protect sensitive terrestrial plants and lawns, not for human health risks.) For information on specific crops, contact the MEBPC.

IASP requested an overview of human risk from the Board of Pesticide Control staff toxicologist (Lebelle Hicks). After review of pertinent literature and toxicology information in the IRIS data system, an Interim Maximum Exposure Guideline (MEG) of 0.6 ppm (600 ppb) was calculated. This was reviewed and concurred with by the Dept of Health and Human Services staff toxicologist, Andy Smith. This is almost 4 times the maximum label rate for aquatic use, and 28-80 times the concentrations which will be realized during most treatments.

Given USEPA's high tolerance level in drinking water and the low persistence of fluridone in natural waters, impacts on potability of drinking water from domestic wells are not anticipated.

E. Human Contact / Toxicity

There are relatively few restrictions on the USEPA label for fluridone. At the maximum label rate of 150 ppb, no specific waiting periods after application to lakes and ponds are cited for uses such as swimming or fishing. Waiting periods are specified when involving potable water intakes and irrigation of crops (variably 7-30 days or by assay). Further, applications must not exceed 20 ppb within one-fourth mile of potable water intakes. Application rates of 6-20 ppb may be applied closer to functioning potable water intakes.

Despite the low human toxicity of fluridone, IASP will normally also post public swimming areas and issue advisories for shoreline residents not to swim during the day of application and for 1 day post application, an added safety measure. Outreach to commercial users of lake water for irrigation will note that "crops should not be irrigated with fluridone treated water for 7-30 days post application". IASP will consult with DHHS to determine if there are public drinking water supplies and will not apply the chemical to that waterbody without written consent of the utility.

For spot treatments, IASP will normally survey owners/residents of an area within 1500 ft of the edge of the treatment area (if site is fully curtained, within 250 feet) to determine where lake water is used for human consumption, irrigation or livestock watering or if there are shallow wells within 250 feet of shore. If concentrations in excess of 20 ppb (0.020 ppm) are expected in areas beyond 1500 feet from an application area, the survey zone will be extended accordingly. These shoreline water users will be advised accordingly concerning recommendations and restrictions. Residents using lake water for human consumption will be advised to avoid drinking lake water for at least 3 days, or until in-lake residuals drop below 20 ppb, and bottled water will be offered to them during that period. For whole lake treatments, residents of individual properties will be contacted in advance or by posting notices on the dwelling, in addition to the usual public outreach before treatment.

F. Potential Negative Effects of Fluridone:

i. Biomagnification and Bioconcentration

Fluridone is not expected to pose significant issues for bio-concentration or bio-magnification despite its long residence time in typical treatments. Observations reported in the 2001 Washington State EIS included the following:

The uptake rate and clearance of fluridone by aquatic organisms is very low. There has been one reported bioconcentration factor (BCF) of 91 for rainbow trout (estimated by a pharmacokinetic model) and 128 for an invertebrate (*Chironomus tentans*). However, the BCF reported for fluridone in fish ranged from 0.9 to 3.7 in one review to 1.6- 15.5 in another. The range of BCF for fluridone in catfish has also been reported as 2 to 9. It was observed in bodies of bluegills 15 days after treatment, but the amount in the head or body did not exceed the concentration in the water. Another field trial showed that channel catfish contained a low fluridone residue (0.015 PPM) 120 days after treatment of ponds, but no fluridone residue was detected in largemouth bass or bluegill fish. A BCF value of 100 is usually regarded as a significant factor. Given there is a low probability that fluridone will bioaccumulate or biomagnify in fish, the need for concern for bald eagles and other threatened or endangered predators of fish in treated areas is also low.

ii. Non-target Plants:

Fluridone is a non-selective herbicide, though some plants are more susceptible than others. Hydrilla is known to be one of the most susceptible species. However, several native plants such as elodea, coontail, and others are known to be affected (Getsinger et al, 2002). Most applications show reductions in native plant biomass for 1-3 years following Fluridone treatments. Complete eradication of any plant species (hydrilla or native plants) is rarely reported. Most field monitoring projects document native plant recovery within 2-3 years, with several projects showing increased native plant populations due to hydrilla suppression. Negative impacts to emergent wetlands are unlikely, though some emergent aquatic plants such as bulrush and rushes have been reported to be variably susceptible.

Rare or threatened plants may be affected by treatments and IASP staff will consult with the Maine Natural Areas Program of the Maine Department of Conservation (DOC) as to occurrence records in the waterbody and conduct low intensity plant community screening in

advance of treatment. Occurrence of these plants will require evaluation of treatment proposals to limit negative effects. In this review DEP will consider the negative effects of invasive species on the viability of the rare plants and communities and the consequences of delaying action.

The limited information that exists suggests growth of some phytoplankton, especially blue-green algae, may be inhibited at concentrations as low as those anticipated pursuant to this GP.

iii. Non-target Animals:

Toxicity to fish, fowl or invertebrates, including bottom dwelling insect larvae and crayfish, has not been demonstrated in laboratory or field projects at concentrations anticipated pursuant to this GP. Fish and invertebrate studies yielded LC 50's ranging from 1.3 to 34.0 ppm in 48 hour to 14 day studies. There is some evidence of bio-concentration in fish (factors ranging from 0.9 to 15.5 and one study at 91), although exposures of species including catfish and fathead minnows to elevated concentrations of fluridone over extended periods has not produced noticeable effects, including growth and reproductive effects. No effect levels for fish and aquatic macroinvertebrate studies ranges from 0.2 to 0.6 ppm in 21-60 day exposures and 0.1 or more for algae.

Rare or threatened animals are unlikely to be affected by treatments. IASP staff will consult with the Non-game Program of DIFW as to occurrence records in the waterbody in advance of treatment. Occurrence of fauna of concern will require evaluation of treatment proposal to limit negative effects. In this review IASP will consider the negative effects of invasive species on the viability of the fauna and communities (especially habitat effects) and the consequences of delaying action.

iv. Low Oxygen:

Herbicide treatments which cause rapid plant death can result in increased oxygen demand and very low oxygen levels. Fluridone is slow acting, so dissolved oxygen (D.O.) loss should not be pronounced, especially with an early season treatment. This is borne out by project reports and published research on fluridone treatments in waters similar to Pickerel Pond. Treatments in the spring occur when less plant biomass has been developed and resultant oxygen demand will be lower as well as spread out over the growing season.

v. Nutrient Releases:

There is a potential for increased phosphorus release from dying vegetation. The degree to which this will happen has not yet been determined, although it is likely that any effects will be limited in time to one season and in extent due to the relatively low biomass of plants treated in early season. In addition, a significant amount of phosphorus mobilized from the sediments by plants during the growing season is released during late-season senescence. Therefore, interrupting growth, especially of hydrilla, in early season may actually reduce P loading to some extent.

vi. Drift to Non-target Areas:

Downstream: Where an active lake outlet exists or in the case of treatments to streams, there is a potential for fluridone to be discharged downstream during the treatment period. Where feasible, pond levels will be drawn down to the lowest reasonable level (consistent with ensuring access for treatment equipment to infested areas and protecting habitat values, including provision for downstream minimum flows) just before treatment. Downstream areas often receive additional water from groundwater and tributaries, so dilution of fluridone should occur. Regardless, there could be some negative effects on the downstream vegetation. Selected downstream areas may be monitored for obvious effects as well as the chemical residual monitoring.

Ground Water: According to USEPA, due to its solubility fluridone may potentially leach into groundwater, but IASP has seen no evidence cited that it actually does. Fluridone degrades quite rapidly in groundwater and pond water, but may persist at low levels in hydrosoil for several months to one year. In situations where lake bottom is coarse or sandy material such as in Pickerel Pond, sediment adsorption is lower than in situations where finer sediments dominate. Groundwater inputs from lake water through lake sediments, especially fine sediment layers, is very difficult to estimate and is likely to vary depending on location along the lake shore and time of year (groundwater table affecting recharge or discharge flow). Given USEPA's high tolerance level in drinking water and the low persistence of fluridone in natural waters, there should be no impact on potability of drinking water from domestic wells.

If IASP finds that there are shallow (non-bedrock) drinking water wells serving camps within 100 feet of the treatment water, IASP will evaluate feasibility of offering to test these wells for fluridone residuals at least once post treatment. Despite lack of evidence of persistent groundwater effects, it may be prudent to monitor shallow dug wells/wellpoints if they are located in near shore areas.

5. Triclopyr

A. Typical formulations

B. General Characteristics

C. Typical Application Methods and Concentrations

1. Concentrations
2. Methods
3. Restrictions and Operational Considerations
4. Wildfowl and other animals: risk avoidance
5. Water Supplies
6. Recreational Use of Water in Treatment Area:
7. Protection from Oxygen Loss/ fish avoidance:
8. Persistence

D. Human Health Considerations
1. Risk Assessment Methodology and Terms
2. Swimming
3. Risks from Exposure to Trichloro-2-pyridinol (TCP)

E. Potential Negative Effects

1. Biomagnification/Bioconcentration
2. Non-Target Plants
3. Non-target animals
4. Low Dissolved Oxygen
5. Nutrient Release
6. Drift to non-target areas

Most information and sections of the text in this summary are excerpted directly from review documents, product labels, and the like. Citations are referred to by numbers in parentheses. Particularly useful are the documents from Washington State DEC (ref. # 6 & 7) and the USEPA Reregistration Eligibility Decision (RED, ref. #1) Also included is information from a review done by the Maine Bureau of Pesticides Control in Nov.-Dec. of 2010 (21,22).

Fact Sheet Attachment A

5. Triclopyr

A. Typical Materials/Formulations

Triclopyr herbicide ((3, 5, 6-tricholoro-2-pyridinyl oxyacetic acid) is typically supplied in two forms: the salt (TEA) and an ester (BEE). This summary may contain some mention of BEE, but the formulations registered for aquatic use in Maine by the Bureau of Pesticides Control are based on the TEA form. The Chemical Abstract Services number (CAS#) for triclopyr TEA is 57213-69-1. Triclopyr TEA dissociates in water rapidly (within 1 minute) to the active herbicide, triclopyr acid (CAS# 55335-06-3) (USEPA 1998). The TEA salt of triclopyr will be referred to as the salt and the quantities expressed as acid equivalents (ae). To our knowledge, there are no known impurities identified by the manufacturers or the US USEPA that are known to be of toxicological or environmental concern (1, 7).

The two products being reviewed for the GP are:

Liquid: triclopyr TEA at 44.4% in an emulsifiable concentrate at 31.8% ae (3 lbs ae/gal) (3)

Solid: 14% granular also containing triclopyr TEA at 10% ae (3)

Specific products reviewed below were those registered by USEPA and in Maine with lake and pond use for invasive weeds. They are identified by name and formulation below. They may or may not be registered when the use is proposed, therefore all herbicides intended for use under this permit should have the registration status verified prior to approval of the permit.

Maine DEP may use any or all of the above or other Maine-registered formulations as long as they conform to the general descriptions in this document and have similar profiles action, persistence or effects as described herein. The reason for this is that products are occasionally re-registered under slightly different labels and names, but the chemical formulations themselves do not often change significantly and permitted use should not be constrained by simple product name changes in the future as long as BPC registration is maintained. These include but are not limited to: Navitrol DPF (USEPA# 228-597-8959), same formulation as Renovate OTF and Tahoe 3A (USEPA# 288-520), same formulation as Renovate 3 (NuFarm 2007).

B. General Characteristics

Triclopyr has been registered since 1979 for a number of terrestrial uses including broadleaf weed control, and is used in rice, pasture and rangeland, rights-of-way, forestry, turf, and home lawns and gardens (1, 7). It is a selective systemic herbicide (18 registered for control of a wide variety of broadleaf weeds. Desirable broadleaf plants may be affected if treated (3, 4,).

Triclopyr TEA is new to the aquatic market and there is relatively little data available on the effects of Triclopyr treatment on water quality. However, data from studies such as in Lake Seminole (Georgia) and Lake Minnetonka (Minnesota) as well as ponds in California, Missouri and Texas indicate that no effective changes in water quality occur due to the proper use of Triclopyr TEA to control aquatic weeds. (7)

TEA and BEE forms have been shown to be sufficiently comparable in most non-acute toxicoligcal studies for USEPA to use results of tests done on either form to assess overall risks of Triclopyr in a variety of contexts. BEE displays disproportionate toxicity (see, for example the 1998 RED) and is not a constituent of products envisioned to be used under the GP (1,2). One plant/soil metabolite of concern due to its persistence and mobility is trichloro-2-pyrinylol (TCP) (CAS# 6515-38-4) (13, 17). The TCP metabolite was found in water following treatment (17, 1) and is included in the tolerances for triclopyr (14). The physical/chemical properties of triclopyr acid, the TEA salt and TCP are presented in Table 1.

Table 1. Physical/Chemical Properties of Triclopyr, triethylamine salt (TEA salt) and trichloro-2-pyrinylol (TCP) (USEPA 1998, TOXNET 2010)

Characteristic	**Triclopyr**	**Triclopyr TEA**	**TCP**
CAS#	55335-06-3	57213-69-1	6515-38-4
Molecular Weight	256.5	371.7	198.44
Water Solubility (mg/L)	430	4.12×10^{5}@ pH = 7	80.9 @ 25 C
Vapor Pressure (mm Hg)	1.26×10^{-6} @ 25C	$< 1 \times 10^{-8}$	1.03×10^{-3} @ 25C
K_{ow}	0.40	< 5	0.51
K_{oc} ml/g	NA	0.165 – 0.975	0.53 -1.95
pKa	2.93	NA	NA

Mode of action:

Triclopyr, utilizes a systemic mode of action used to control submerged, floating and emergent aquatic plants in both static and flowing water. In plants, triclopyr acts as an auxin (plant hormone, indolylacetic acid) mimic which interferes with growth after the plant emerges. Triclopyr, rapidly enters through the target plant's leaves and stems, accumulating in the meristematic regions and interfering with plant metabolism. It contacts leaves, where sugar is produced, and moves to roots, tips, and parts of the plant that store energy, thereby interrupting growth. This provides systemic control of most dicot (broadleaf) plants, while having little to no impact on most monocots (3, 6, 9)

Triclopyr Effects on Aquatic Plants

Triclopyr TEA is usually used to control invasive aquatic macrophytes such as Eurasian watermilfoil (*Myriophyllum spicatum*), parrotfeather (*Myriophyllum aquaticum*), waterhyacinth (*Eichhornia crassipes*), alligatorweed (*Alternanthera philoxeroides*), and purple loosestrife (*Lythrum salicaria*). (6, 11). Triclopyr is probably not effective at any labeled concentration on *Hydrilla verticilatta*, *Egeria densa* or fanwort (*Cabomba carliniana*,). There is also some doubt it has an effect on naiad, and it is not effective on crested floating heart (*Nymphoides cristata*). Yellow floating heart (*N. peltata*) has not been tested yet. (12)

Many species of native plants are not affected by triclopyr or are not affected except transitorily. However, at higher use rates (2.5 ppm ae), the more susceptible native species such as coontail, Southern naiad, and American waterweed may be reduced in numbers in some treatment situations (6).

Triclopyr is not typically used for algae control and most species of algae are not affected strongly by Triclopyr.

C. Typical Application Methods and Concentrations

1. Concentrations

Applied concentrations will be 0.75 to 2.5 triclopyr ae/l (ppm). The higher rate allowed is used when the weed mass is dense or in areas of greater water exchange. However, total application of Triclopyr may not exceed an application rate of 2.5 ppm ae for the treatment area per annual growing season (3).

2. Application Methods

Applications should occur when plants are actively growing. Application for submersed weeds will usually be by subsurface injection from boats equipped with GPS location devices to ensure even areal application for liquid mixtures and by calibrated spreaders if applying granular materials. These methods are consistent with those described in the GP (10). It is recommended that when treating target plants that are 6 feet below the surface of the water, trailing hoses are to be used, perhaps including an approved aquatic sinking agent (3).

For floating leaved or emergent vegetation, it is important to thoroughly wet all foliage with the spray mixture. A non-ionic surfactant at the labeled use rate may be combined with the diluted liquid formulation to assist with sticking and penetration of the pesticide. This has the effect of reducing both the application rate and the cost of the application. Care should be taken to select a surfactant that has been approved for aquatic use. Surfactants approved for aquatic use will not harm fish. Thickening agents like PolyControl® or one of the organosilicates are often added to herbicide solutions that are applied to the water surface in order to control drift (7). A repeat treatment may be needed to control re-growth or plants missed in the previous treatment (3).

Triclopyr labels specify safeguards to avoid off site drift during spray applications, which may be selected for treating floating leaved or emergent plants (3).

3. Restrictions and operational considerations.

Renovate carries very few restrictions on recreational use such as swimming and fishing, or on livestock consumption of water from the treatment area. Renovate can be used near active potable water intakes, but setback apply. Renovate OTF is sometimes used in conducting spot applications (docks, marinas), partial lake applications (shoreline, coves, bays) and sites with a high dilution potential (i.e. Eurasian watermilfoil control in deep water and moving water). (3)

The four triclopyr aquatic herbicide labels reviewed were the liquids; Renovate 3 (USEPA# 62719-37-67690) and Tahoe 3A (228-520) and the solids; Renovate OTF (USEPA# 67690-42*)* and Navitrol DFP (USEPA# 228-597-8959). The total application of triclopyr ae must not exceed an application rate of 2.5 ppm ae for the treatment area per annual growing season (Ref. 3, 4,5). Unless otherwise noted, restrictions below are required under USEPA labeling. The common use precautions and restrictions include:

- **Non-target plants and sites:**
  - **Do not** apply product directly to, or otherwise permit it to come into direct contact with grapes, tobacco, vegetable crops, flowers, or other desirable broadleaf plants; where runoff water may flow onto agricultural land as injury to crops may result or to salt water bays or estuaries or directly to un-impounded rivers or streams.
- **Irrigation:**
  - **Do not** apply on ditches or canals currently being used to transport irrigation water or that will be used for irrigation within 4 months following treatment. It is permissible to treat irrigation and non-irrigation ditch banks.
  - Water treated with Renovate may not be used for irrigation purposes for 120 days after application or until triclopyr residue levels are determined by laboratory analysis, or other appropriate means of analysis, to be 1.0 ppb or less. The labels describe both required and recommended uses of a chemical analysis for the active ingredient, triclopyr. SePRO Corporation recommends the use of an Enzyme-Linked Immunoassay (ELISA) test for the determination of the active ingredient concentration in water.

There is no specific restriction on use of water from the treatment area to irrigate established grasses. (3)

- **Livestock grazing and slaughter restrictions:**
  - Except for lactating dairy animals, there are no grazing restrictions following application of this product. **Do not** allow lactating dairy animals to graze treated areas until the next growing season following application of this product.
  - **Do not** harvest hay for 14 days after application. Grazed areas of non-cropland and forestry sites may be spot treated if they comprise no more than 10% of the total grazable area.
  - During the season of application, withdraw livestock from grazing treated grass at least 3 days before slaughter

Washington State recommends that treated water may be used for domestic purposes and for watering livestock if concentrations in treated water are not higher than 0.5 ppm ae(7).

4. Wildfowl and other animals: risk avoidance

The Washington DEC review (6) concluded that there is no likely risk to terrestrial animals, including birds, from ingestion of Triclopyr-treated water or consuming aquatic plants or animals in treatment scenarios. However, they propose a commonsense approach of avoiding treatment in areas that are heavily used for nesting until nesting is complete and also timing treatments to avoid concentration of migratory wildfowl.(6).

5. Water Supplies

There are set backs to active potable water intakes on the triclopyr products. These set backs are dependent on the number of acres treated and the desired concentration of triclopyr in the water (3). We note that New York State has increased the set back distances on their 24c labels (15,16).

To apply triclopyr in the set back zones the following conditions must be met:

- Intakes must be shut off and may not be turned on until as demonstrated by laboratory analysis or immune assay the concentration of triclopyr at the intake must be at or below:
  - 400 ppb for Renovate 3, Renovate OFT and Tahoe 3 (Ref. 3)
  - 50 ppb NY special local needs labels for Renovate 3 and Renovate OFT (15,16)
  - 40 ppb Navitrol DPF (Applied Biochemist 2010)

In addition to other provisions in the GP, application to waters containing public water supplies require variable setbacks depending on the size of the water and concentrations applied. For small lakes less than 32 acres, these setbacks vary from 300 to 2600 ft. In lakes greater than 32 acres, larger setbacks are calculated based on product label. An example from a current label (Renovate 3) is illustrated in Table 2

Table 2. Example setback distances for water supplies from the Renovate 3 label (USEPA# 62719-37-67690)

Area Treated (acres)	Required Setback Distance (ft) from Potable Water Intake				
	0.75 ppm	1.0 ppm	1.5 ppm	2.0 ppm	2.5 ppm
< 4	300	400	600	800	1000
> 4 - 8	420	560	840	1120	1400
> 8 - 16	600	800	1200	1600	2000
> 16 - 32	780	1040	1560	2080	2600
> 32 acres, calculate a setback using the formula for the appropriate rate	Setback (ft) = (800*ln (acres) – 160) /3.33	Setback (ft) = (800*ln (acres) – 160)/ 2.50	Setback (ft) = (800*ln (acres) – 160) / 1.67	Setback (ft) = (800*ln (acres) – 160)/ 1.25	Setback (ft) = (800*ln (acres) – 160)

To apply triclopyr around and within the distances noted above from a functioning potable water intake, the intake must be turned off until the Triclopyr level in the intake water is determined to be 0.4 parts per million (ppm) or less by laboratory analysis or immunoassay. (3)

6. Recreational Use of Water in Treatment Area:

There are no restrictions on treated water uses for recreation purposes, including swimming and fishing, on the Renovate 3, Tahoe 3A and Renovate OTF labels. New York State has issued a 24c label for the Renovate products with 3 hour restriction on swimming. The Navitrol DPF label has the 3 hr swimming restriction on their section 3 label (Ref 4). Washington State recommends a mandatory waiting time after application of 12 hours before swimming is allowed to mitigate any risk for eye irritations and contact by children (See Human Health Considerations below).

7. Protection from Oxygen Loss/ fish avoidance:

The Renovate 3 and the OTF formulations vary in the steps to take to prevent fish kills from oxygen depletion. The labels for the liquids limit the area treated to one third to one half with a 10 to 14 day interval between treatments and the labels for the solids limit the treatment area to one half with a 10 day retreatment interval (3). Washington State states that only about 20 percent of a water body should be treated at any one time. (6).

Treatment should begin along the shore and proceed outwards in bands to allow fish to move into untreated areas (3). DEP notes that we have seen no information suggesting fish or wildlife avoidance, so in the absence of such information this is a simple precautionary guideline.

8. Persistence

In aqueous environments, triclopyr TEA salt dissolves rapidly (less than one minute) to triethanolamine and Triclopyr acid. Triclopyr acid then dissociates to form the Triclopyr anion. The major photodegradation product observed in sterile solutions is 5-chloro-3,6-dihydroxy-2-pyridinoloxyacetic acid (TCP); oxamic acid is the major degradation product in natural river water (lab trials) (1) .

Laboratory studies indicate triclopyr is non-persistent (aqueous photolysis half-life of 8-9 hours for pH 7 sterile buffered solution; half-lives in river water ranging from 0.7-1.7 days under artificial and natural light sources). Triclopyr acid is stable to hydrolysis at pH 5, 7, and 9 in sterile buffered solutions and degrades slowly under aerobic and anaerobic aquatic conditions aquatic metabolism in laboratory settings. Triclopyr acid photodegraded in sterile aqueous buffered solutions (pH 7) with half-lives of 0.36 -0.6 days depending on light conditions. Lab trials suggest that Triclopyr acid is persistent under anaerobic conditions, decreasing to approximately 80% of initial levels after 365 days (1).

Triethanolamine is degraded by aerobic microbial processes to CO2. In aquatic conditions it is stable (half life 14-18 days) and then proceeds to rapid degradation. Triethanolamine is stable to degradation under anaerobic aquatic conditions (half-life > 2 years). Because of the rapid microbial degradation under aerobic conditions, it is not expected that volatilization, photodegradation, or bioaccumulation in fish will contribute significantly to the dissipation of triethanolamine (1).

Due to its demonstrated mobility in terrestrial soils and high solubility, Triclopyr acid is not expected to persist in high concentrations in anaerobic aquatic sediment and should be exposed to aerobic degradation and photolysis in lake water and not migrate to sediments (1). Although, Triclopyr is not predicted to persist in surface waters, information from two aquatic field dissipation studies conducted on rice (semi-terrestrial/wetland conditions) indicates that following application of Triclopyr, TCP can persist in waters that flood terrestrial/wetland applications (1).

Half lives calculated from lab trials are often not representative of field conditions, in particular the absence of a diverse microbial flora, absence of various solutes, or pH control may not mimic conditions in the field. In an experiment designed to mimic the worst case in the field, ponds in California, Missouri and Texas were treated with Triclopyr at concentrations of 2.5 ppm ae These duplicate pond mesocosms were fairly small (~30,000 ft2). The water half-lives for Triclopyr and its metabolites (TCP and TMP) were up to 7.5, 10.0 and 7.7 days, respectively. The sediment half-lives of Triclopyr and TCP were similar to those seen in the water column with DT50s as high as

4.6 and 7.0 days, respectively. Since Triclopyr does not significantly adsorb to the sediment, it is expected that the degradation rates in water and sediment would be similar. Relatively short half lives can still result in measurable, though low, concentrations for many weeks in mesocosms, though field applications usually result in more rapid approach to non-detect due to dissipation (7).

Dilution and dispersion play a big part in concentrations developed and maintained over time and half life can be extended measurably in colder temperatures (e.g 15 vs 25 C) (7). The environmental persistence of Triclopyr products in the field can be quite variable; the dissipation half-life in water varies from less than one day to approximately seven and one-half days (6). The longest half-life for TCP in river water exposed to summer sun at 1 meter depth should not be longer than 2 hours. TCP exposed in sterilized buffered water at the surface of the water column has a half-life of 0.073 hours. Therefore, it seems likely that TCP will be degraded and detoxified by photolysis under natural conditions (7).

Since sunlight can be extensively absorbed by the ambient plant cover and dissolved organic material, it seems likely that microbial degradation, advection and dispersion are the primary means by which Triclopyr is dissipated from the water column. However, photolysis can contribute substantially to the degradation of Triclopyr acid, Triclopyr TEA and Triclopyr BEE. These three Triclopyr products are degraded rapidly under natural sunlight (0.6 to 6.6 days) with both the dominant degradate and degradation rate varying somewhat with the product tested . Most authors believe that Triclopyr TEA, Triclopyr BEE and Triclopyr acid and the toxic degradate TCP are rapidly degraded by spring, summer and fall sunlight. The photolytic half-life of Triclopyr acid is generally less than 1 day at 40° to 50°C North latitude during the months when Triclopyr TEA might be used for the control of aquatic weeds. (7). Some factors that could affect the rate of dissipation due to aqueous photolysis include light quenching in water, vegetative cover and type, depth of the plot, and suspended sediment and whether that suspended matter quenches sunlight or acts as a sensitizer and increases the rate of photolysis (1,7).

The aquatic dissipation half-lives observed in the field are consistent with the shorter halflives observed in the photolysis in water studies. In general, results of the available studies suggest that Triclopyr acid is rapidly dissipated under aquatic conditions in the field (t = 0.5-3.5 ½ days in Lake Seminole, Georgia in an Aquatic Field Dissipation study; and 5 days in pond water in a Forestry Field Dissipation study). In the lake Seminole study, plots were approximately 65-75% covered with vegetation at time of application. The degradate TCP was detected at 0.06-0.18 ppm in surface (1-foot depth) and bottom (3 feet above the bottom) waters 1 to 8 hours after application, but was not detected (<0.05 ppm) in surface or bottom water after 1 day posttreatment. Triclopyr was detected at up to 0.64 ppm in the sediment layer (up to 5-10 cm deep) immediately posttreatment, but was <0.10 ppm (detection limit) at all other sampling intervals; TCP was not detected in the sediment (<0.05 ppm) at any interval (1). Another study in Lake Minnetonka (MN) resulted in water column TCP not higher than ~0.1 ppm. Cited studies generally show that TCP dissipates to concentrations below the detection limit at three days after treatment. Half-lives of Triclopyr in the sediment ranged from around five or six days, and the sediment half lives of TCP were approximately eleven days. (6).

Due to the low distribution coefficient for Triclopyr (0.165 to 0.925 mL/g), it does not bind tightly to sediment and therefore concentrations in sediment should remain low. This assumption is confirmed by results from field studies. For example, at Lake Minnetonka, concentrations of Triclopyr in sediment were never higher than 0.334 ppm ae and dissipation to concentrations of

<0.15 ppm was seen within 14 days after application. At Lake Seminole, Triclopyr was not seen at significant concentrations (<0.1 ppm ae) except for the day of application where concentrations as high as 0.64 ppm ae were detected. Even in the pond studies, the concentration of Triclopyr in sediment was very low and did not exceed 0.86 ppm ae during the first few days and dissipated to below the limit of quantification within four weeks (6).

The concentrations of Triclopyr in lakes that have been spot treated generally fall below the temporary drinking water residue tolerance (0.5 ppm ae) within one day but in rare instances can take as long as eight days. However, the concentration of Triclopyr in ponds (small waters subject to limited hydraulic circulation) can take three to four weeks to dissipate to concentrations below 0.5 ppm ae The concentration of the toxic metabolite (TCP) has generally been low in lake and pond water with concentrations of TCP not higher than ~0.1 ppm in Lake Minnetonka, Lake Seminole, and various ponds on the day of application and generally dissipating to concentrations below the detection limit at three days after treatment (6).

For purposes of calculating Expected Environmental Concentrations (EEC) consider the half-life of Triclopyr TEA in water typically ranges up to 4 days in open water and 7.5 days impounded water. Therefore, the 1 and 2-day time weighted average dosage would not be expected to vary significantly from the initial exposure concentration in still waters, which is a useful worst case scenario (7).

Concentrations of Triclopyr typically dissipate to levels that are below the MCLG (0.5 ppm ae) and MEG (400 ppb ae) in 7 to 14 days after application of 2.5 ppm Triclopyr and dissipate to very low levels (0.002 to 0.008 ppm) in about 42 days, especially in waters with limited circulation and light penetration (7).

D. Human Health Considerations

1. Risk Assessment Methodology and Terms:

Risk is a mathematical function of toxicity and exposure. The most sensitive endpoint from the animal studies is determined and compared to an acceptable risk level. USEPA's classic risk assessment methodology is described below. Regarding pesticide uses, the states may be more restrictive than USEPA, but not less restrictive.

Risks from short/intermediate term occupational or residential exposure are evaluated with the margin of exposure (MOE) methodology. The MOE is the ratio of the lowest No Observable Adverse Effect Level (NOAEL) to the exposure dose. The uncertainty in this type of risk assessment is found in the acceptable MOE, at a minimum the factor of 10X for extrapolation from animals to people and a factor of 10X for variability in the human population. If a LOAEL is used rather than a NOAEL, the compound has some carcinogenic potential or there is some other uncertainty in the data base another factor of 3 to 10X may be included.

Acute and chronic exposures (short term or lifetime exposure through diet and/or drinking water) are evaluated in terms of the reference doses (RfD). The acute RfD (aRfD) is determined using a short term exposure study and the chronic (cRfD) by using either a developmental or chronic study. Both the aRfD and the cRfD are calculated using the lowest NOAEL divided by the same uncertainty factors as the MOE (above). The Food Quality Protection Act of 1996 requires USEPA to include another safety factor of 10X if there is evidence of sensitivity in the developing

organism and children are expected to be exposed. USEPA reduces the FQPA SF to1X if there is no evidence of sensitivity or in risk assessments such as occupational where exposure to children will not occur. The acute and chronic population adjusted doses (aPAD and cPAD, respectively, are equal to the aRfD or cRfD divided by FQPA SF). If cancer risks are present, then a carcinogenic linear multistage model risk assessment is performed. To determine risks, the exposures from different sources are calculated, added together and compared to the RfD.

USEPA's most recent risk assessment for triclopyr human health was performed in 2002 in connection with the registration of aquatic uses (2) and tolerances on fish and shellfish (13). In addition in 2002, USEPA issued the cumulative risk assessment for the TCP (14). The re-registration eligibility decision (RED) was issued in 1998 (USEPA 1998).

Triclopyr TEA in the liquid formulations is corrosive to eyes, resulting in "Danger" signal word (3,5).The solid formulations carry a "Caution" signal word and a statement that it causes moderate eye irritation (3, 4). Protective equipment statements reflect these differences.

The target organ for triclopyr is the kidney. As the doses increase, effects are seen in the liver and red blood cells. In developmental/reproductive studies maternal toxicity is observed as an increase in lethality, clinical signs, decreases in food consumption, body weight gain, kidney, liver and body weights. Fetal effects in the developmental/ reproductive studies include fetal loss, decreased body weight and a variety of visceral and skeletal abnormalities. Dogs are sensitive to the effects of triclopyr and other organic acids because they have a limited ability to excrete them. USEPA considers this effect a "non-significant effect" in terms of human risks (13).

To evaluate acute dietary risk for the general population, USEPA used a developmental study in rats with a NOAEL of 100 and uncertainty factors (UF) of 10X for extrapolating form animals to humans and 10X for variability in the human population. The resulting aRfD was 1.0 mg/kg/day. The Food Quality Protection Act Safety Factor was reduced to 1X due to a lack of sensitivity in the fetus relative to the adult. This result in a population adjusted dose equal to the aRfD (13)

For acute dietary risk in the population of females from 13 to 50 and the chronic dietary general population risks from exposure to triclopyr, USEPA used the 2-generation reproduction study in rats with a NOAEL of 5 mg/kg/day and a LOAEL of 25 mg/kg/day. Effects at the LOAEL were exencephaly and a lack of eyelids in the F_2 generation. The same UF were used as in the general population risk assessment (100X) with the FQPA SF of 1X, the resulting aRfD/aPAD and cRfD/cPAD were 0.05 mg triclopyr/kg/day. Because triclopyr is ranked as a "D" carcinogen (not classifiable for human carcinogenicity) a cancer risk assessment was not performed (13).

Relevant to the current discussion is the short term (1 to 30 days) incidental risks to swimmers. USEPA used both of the developmental studies with triclopyr BEE and TEA. In these studies the NOAELs was 100 mg/kg/day and the LOAELs were 300 mg/kg/day. In the TEA study there was an increase in maternal mortality and clinical signs on gestational day 15. USEPA's aggregate short term risks calculations which include chronic food, residential, home post application and swimming results in MOEs of 477 to 11,500 well above the MOE of concern of 100 (13).

The set backs to active potable water intakes on the triclopyr products limit the EEC of triclopyr in drinking water to 1,000 ppb on an acute basis and 390 ppb on a chronic basis (13). Triclopyr is not currently regulated under the Safe Drinking Water Act (SDWA), therefore, a Maximum

Contaminant Level (MCL) is not established. Public water supply systems are not required to sample and analyze for Triclopyr. The maximum exposure guideline (MEG) recently set by the Maine Centers for Disease Control is 400 ppb (ME CDC 2010).

From a drinking water risk perspective this means that the drinking water levels of concern (DWLOC) for acute exposure range from 1,300 ppb for females between the ages of 13 and 50 to 35,000 for the general population. On a chronic basis, the DWLOCs range from 500 ppb for children 12 yrs old and younger to 1,700 ppb for adults (13).

2. Swimming

Risks from exposure to triclopyr from swimming following an aquatic application were included in USEPA's aggregate risks scenarios for short term exposure. The MOEs for aggregate exposure were above USEPA's MOE of concern of 100. New York State has issued special local need (24c) registrations for the aquatic uses of triclopyr that include a 3 hr post treatment restriction on swimming. One of the four product labels, Navitrol DPF has incorporated this restriction on its section 3 label (4).

According to the Washington State DEC (6), the only health concerns from Triclopyr for swimming are minor eye irritation and exposure to children immediately after application. The risk of eye irritation and overexposure for children decreases rapidly because of dilution (6). Washington performed exposure and risk calculations for hypothetical situations involving ingestion and dermal contact with treated water while swimming and drinking potable water. Calculation of Triclopyr exposures utilized the swimmer's weight, the skin surface area available for exposure, the amount of time spent in the treated water containing 2.5 and 0.5 ppm Triclopyr, amount of water swallowed while swimming over specific time periods, and the estimated human skin permeability coefficient. Risk analyses were completed for various populations. The most sensitive population was found to be children who swim for three hours and ingest water while swimming. However, a child would have to ingest 3.5 gallons of lake water where Triclopyr had been recently applied to cause risk factors to be exceeded (6). Washington recommended a 12-hour restriction for re-entry into Triclopyr treated water to assure that the eye irritation potential and any other adverse effects will not occur (refs 6,8).

3. Risks from Exposure to Trichloro-2-pyridinol (TCP)

Trichloro-2-pyridinol (TCP) is a water metabolite of triclopyr. It is a common metabolite from three pesticides, triclopyr, chlorpyrifos and chlorpyrifos-methyl. In 2002 USEPA evaluated the aggregate risks from exposure to this metabolite in food and water (14).

The toxicity endpoint used by USEPA to evaluate TCP risks was the NOAEL from the developmental study in rabbits, 25 mg/kg/day. At 100 mg/kg/day there were increases in hydrocephaly and dilated ventricles in fetuses. The default FQPA SF of 10X was used because TCP had not been evaluated by the FQPA SF committee. For acute exposure the population of concern is females of childbearing age (13 to 50). This results in an aRfD of 0.25 mg/kg/day and an aPAD of 0.025 mg/kg/day. From the chronic perspective, the endpoint used was the NOAEL of 12 mg/kg/day from the 2 yr dog study. The cRfD is 0.12 mg/kg/day and the cPAD is 0.012 mg/kg/day (14).

The peak EEC for TCP in water (from all three pesticides) on an acute basis is 510 ppb and the DWLOC is 590. On a chronic basis, for adults, the EEC of 340 is below the chronic DWLOC of 360 (women 13 – 50) and 420 for all others. Regarding children (≤ 12) the EEC of 430 ppb is higher than the DWLOC of 120 ppb. In water, chlorpyrifos and chlorpyrifos-methyl account for over 90% of the TCP residues and triclopyr uses accounts for 9.5% of the total TCP residues (14). Since USEPA made the exposure estimates, the uses of the chlorpyrifos and chlorpyrifos-methyl have been severely curtailed (13).

Following treatment with triclopyr-TEA, in water, the maximum concentration of TCP is found 1 to 3 hrs post treatment. This level of TCP is ~ 0.6 % of the triclopyr concentration (14).

At the potential applied rates (<= 2.5 ppm or 2500 ppb), the maximum environmental concentrations of TCP developed should be <= 15 ppb.

E. Potential Negative Effects

The field studies that have been conducted with Triclopyr TEA to control Eurasian water milfoil, purple loose strife and waterhyacinth indicate that fish, crayfish and bivalves (freshwater clams) are not affected by Triclopyr TEA when it is used at the highest recommended use rate. There have been no field studies conducted with Triclopyr TEA that have shown that it is directly toxic to fish at standard maximum use rates (7).

Some concern has been expressed concerning the acute and chronic toxicity of the main Triclopyr TEA metabolites, TCP (3,5,6-trichloro-2-pyridinol-2) and TMC (2-methoxy-3, 5,6-trichloropyridine. The acute toxicity of these metabolites are much higher than Triclopyr TEA. The 96-hour LC50s for these metabolites have been seen to be as low as 1.1 ppm in salmonids for TMP and 1.5 ppm in salmonids for TCP. Although these metabolites are classified as moderately toxic, they are unlikely to cause adverse impact on the fish biota since the LC50s are more than ten-fold higher than the time weighted environmental concentration at any exposure period. Similar observations have been made concerning the invertebrate biota. although the concentrations of these metabolites were not seen in Lake Seminole at concentrations of higher than ~0.1 ppm, (7)

When comparing typical expected environmental concentrations (EEC) of Triclopyr with laboratory LC_{50}s, the highest concentration that may be encountered immediately after application (2.5 ppm ae for control of submerged weeds or 4.4 ppm ae for control of floating and emerged weeds in shallow water) may affect more sensitive species. However, fish and non-mollusk species would not be adversely impacted by these concentrations of Triclopyr TEA.(6).

Washington State (6) considers Triclopyr TEA to be generally safe for fish, free-swimming aquatic invertebrates, and benthic invertebrates when the EC_{50}/LC_{50} is compared to typical four-day time-weighted average expected environmental concentration (TWA- EEC). In general, Triclopyr TEA can be considered to have very low toxicity to environmentally relevant fish and aquatic invertebrates. Triclopyr TEA appears to be extremely safe for use in the presence of threatened and endangered salmonid game-fish (6).

1. Biomagnification/Bioconcentration

In the context of RED review, while no fully acceptable laboratory studies of bioaccumulation in fish or accumulation in aquatic non-target organisms were reviewed for Triclopyr derivatives, USEPA stated that Triclopyr acid does not bioaccumulate in aquatic organisms. The requirement for environmental fate studies were waived for Triclopyr TEA due to its low octanol/water partition coefficient. (1). Washington DEC states that Triclopyr appears to bioaccumulate at low levels (~1.0 to 2.0) in crayfish and clams but residues dropped to <0.2 ppm in 8-21 days (7).

Laboratory bioconcentration studies with bluegill sunfish indicate that the BCF is 0.052 in edible tissue and 0.93 in inedible tissue. The main residues seen in edible fish flesh were Triclopyr (0.03 ppm ae), TCP (3,5,6-trichloro-2-pyridinol = 0.009 ppm) and TMP (2-methoxy-3,5,6-tirchloropyridine = 0.018 ppm) and an unidentified conjugate. A wide variety of fish have been observed to not bioaccumulate Triclopyr and concentrations in edible fish tissue harvested from the field vary from <0.051 ppm ae at day one and subsequent days after treatment in fish taken from Lake Minnetonka, Minnesota to <0.1 ppm ae at day 1 and subsequent days in fish taken from Lake Seminole, Georgia (7).

2. Non-Target Plants

Testing results (*Lemna gibba*) cited in the RED indicate that exposure levels of 8.80 or greater ppm active ingredient (ai) Triclopyr TEA may cause detrimental effects to the growth and reproduction of non-target vascular aquatic plant species (1).

Triclopyr has been claimed to be effective (6, 9)) for a variety of fully or partially aquatic plants including:

American lotus (*Nelumbo lutea*),
Eurasian watermilfoil (*Myriophyllum spicatum*),
Parrotfeather (*Myriophyllum aquaticum*),
Pennywort (*Hydrocotyle spp*.),
Waterhyacinth (*Eichhornia crassipes*),
Water lilies (*Nuphar* spp. and *Nymphaea odorata*)
Waterprimrose (*Ludwigia uruguayenis*),
Purple loosestrife (*Lythrum salicaria*).
Alligatorweed (*Alternanthera philoxeroides*),
American Frogbit (*Limnobium spongia*)

Many species of native plants are not affected by Triclopyr or are not affected except transitorily (6). Triclopyr TEA generally does not control native species like:

Rushes (*Juncales spp*. and *Scirpus spp*.),
Cattails (*Typha spp*.),
Duckweed (*Lemna spp*.),
Flatstem pondweed (*Potamogeton zosteriformis*),
Coontail (*Ceratophyllum demersum*),
Southern naiad (*Najas guadalupensis*),
American pondweed (*Elodea canadensis*)
Water paspalum (*Paspalum fluitans*)

At higher use rates (2.5 ppm ae), the more susceptible native species such as coontail, Southern naiad, and American waterweed may be reduced in numbers in some treatment situations (6). It is unclear exactly how high the Triclopyr concentrations must be to damage native plant species. Initial Triclopyr concentrations of 2.5 ppm ae that remained at levels of 1.0 ppm ae or higher for 7 to 14 days have been known to adversely impact coontail (*Ceratophyllum spp*.), southern naiads (*Naja guadalupensis*), and American waterweed (*Elodea canadensis*) in water impounds (ponds) (6).

Triclopyr is not typically used for algae control. Most species of algae including the green algae (Spirogyra spp., Cladophora spp., Mougeotia spp. Volvox spp., Closterium spp. and Scenedesmus spp.), Chara spp. and Anabaena spp. are not affected significantly at normal treatment rates (6). Algae or diatoms may be affected from exposure levels of greater than 5.9 ppm ai Triclopyr TEA or 32.45 ppm ai of Triclopyr acid. (1).

3. Non-target animals

a. fish

Most species of fish are tolerant of triclopyr TEA. Reported acute LC50 for TEA in many fish species is quite high (240-947 ppm) which is well above the maximum label rate of 2.5 ppm. LC 50 for breakdown product TCP LC 50 are lower (1.5-12.6 ppm). The Triclopyr degradate, TCP, is considered to be persistent in aquatic environments and aquatic concentrations of TCP may exceed 0.01of the LC for fish. More testing was indicated in the RED (1).

Sensitive and environmentally relevant species such as the various salmon species (*Onchorhynchus spp*.) have demonstrated LC50s that range between 96 and 182 ppm ae These toxicity values place triclopyr TEA in the US USEPA's ecotoxicological categories of slightly toxic (LC50 = >10 to 100 ppm) to practically non-toxic (LC50 = >100 ppm). There have been no verified cases of toxicity to fish when Triclopyr is used at the maximum use rate of 2.5 ppm ae (6).

When the toxicity of triclopyr is compared to other pesticides, it is classified according to the U.S. USEPA Ecotoxicological Categories as slightly toxic (ref 6)) to:

embryo/larval and juvenile eastern oyster (*Crassostrea virginica*)
rainbow trout (*Onchorhynchus mykiss*)
pink salmon (*Oncorhynchus gotbuscha*)
Chinook salmon (*Oncorhynchus tshawytscha*)
chum salmon (*Onchorhynchus keta*)
fathead minnow (*Pimephales promelas*).
tidewater silverside (*Mendia beryllina*)

For example, the most sensitive fish species reported here is rainbow trout with a 96-hour LC_{50} of 82 ppm a.e However, there is also a reported LC_{50} =107 ppm, which would be rated practically non toxic.

Triclopyr TEA is classified as practically non-toxic (LC_{50} >100 ppm , ref (6)) to:

bluegill sunfish (*Lepomis macrochirus*),
other salmon species (*Onchorhynchus* spp.),

Other sources cite 96 hour LC_{50} > 100 for channel catfish (*Ictalurus puctatus*), rainbow trout (*Oncorhynchus mykiss*) and Bluegill (*Lepomis macrochiris*) especially in water of pH 7-7.5. However, rainbow trout in water at 5.5 pH showed a much lower LC_{50} of 5-10 ppm. (9).

Salmon smolt exposure tests on Triclopyr, Diquat Dibromide, and Fluridone suggest that, at the concentrations and seawater/freshwater exposures tested, the herbicides are unlikely to affect seawater adaptation in free-living juvenile Pacific salmon (6).

Little chronic testing has been done with Triclopyr TEA. For example, the acute 96-hour LC50 for fathead minnow is 86 to 176 ppm ae while the chronic 31- day LC50 for this species is 52-81 ppm ae and the MATC = 41 ppm c.e.). A Risk Quotient (RQ) is the ratio of an expected concentration (EEC) and a selected reference value. Since the chronic risk assessment is less than the chronic level of concern of <1.0 (RQ = 2.5 ppm ae/41 ppm a.e). for fathead minnow, this and other fish are not likely to be adversely affected in their reproductive success when Triclopyr TEA is used to control aquatic weeds (7).

For fish and important invertebrates, the results of acute risk assessments have been confirmed by at least one field study in Lake Minnetonka, Minnesota. During a 28-day period when fish, crayfish and clams were exposed to an initial concentration of 2.5 ppm ae, less than 11 percent of caged sentinel organisms died. Between 5 and 11 percent of bluegill sunfish and largemouth bass died during the 28-day exposure period and none of the black bullhead, crayfish or freshwater clams died during this period. The mortalities that occurred during the exposure period were not believed to be due to the direct effect of Triclopyr TEA, but an oxygen slump caused by heavy growth of non-target macrophytes. The effects of chronic exposure were not determined in this experiment. However, due to a lack of increased mortality during long exposures, chronic toxicity effects are not believed to be a serious issue during the aquatic use of Triclopyr TEA (7).

b. Amphibians

Washington DEC states that amphibians can be affected by Triclopyr TEA both acutely (LC_{50} = 82 to 182 ppm ae = 114 to 254 ppm ai) and chronically (Max. Acceptable Toxicant Conc. or MATC = 27 to 61 ppm ae = 38 to 93 ppm ai) at concentrations similar to those affecting fish. What little data is available from the field indicates that *Rana pipiens* adults and tadpoles remained common 11 weeks after treatment of a Columbia, Missouri pond site at rates of 2.5 ppm ae

c. Birds

Toxicity studies indicate that triclopyr and its products used as aquatic herbicides do not pose a significant acute or chronic risk to wild birds (6). With tests using mallard ducks *(Anas platyrhynchus)* , USEPA concluded These results indicate that Triclopyr - triethylamine (TEA) is practically non-toxic to slightly toxic to avian species on an acute oral basis Using Northern Bobwhite Quail *(Colinus virginianus)*, the BEE form is slightly toxic. Triclopyr TEA and BEE are “practically non-toxic” to avian species tested on a sub-acute dietary basis (1).

Triclopyr acid is slightly toxic to birds when orally dosed or consumed in the diet, usually a pathway associated with terrestrial and wetland applications. The triethylamine salt is slightly toxic to practically non-toxic when orally dosed or consumed in the diet. Reproduction of birds may be affected at levels greater than 100 ppm (6).

d. Mammals

Rat studies indicate that Triclopyr acid is practically non-toxic to small mammals on an acute oral basis. Some reproductive/systemic toxicity effects were seen with an LEL of 250 mg/kg/day (1).

The Washington DEC review concluded that there is no likely risk to terrestrial animals, including birds, from ingestion of Triclopyr-treated water or consuming aquatic plants or animals in treatment scenarios. However, they propose a commonsense approach of avoiding treatment in areas that are heavily used for nesting until nesting is complete and timing to avoid concentration of migratory wildfowl (6).

Little review information has been found concerning mammals that are primarily associated with aquatic habitats. However, the lack of bioacummulation in plants or fish as well as the food habits of such animals as beaver, muskrat, otter and mink etc. make it unlikely that significant effects through exposure to food or water. Given the low toxicity of orally dosed Triclopyr in small mammals, even ingestion of mussels and crayfish should not pose a significant exposure pathway due to shore residue persistence times in the few prey species tested.

e. Invertebrates

In the field where Triclopyr TEA was used to control Eurasian watermilfoil, waterhyacinth, or purple loosestrife, no invertebrate mortality or changes in invertebrate population structure was seen that could be attributed to the use of Triclopyr TEA (several studies cited in (6). The most sensitive non-mollusk invertebrate is the red swamp crayfish with a 96-hour LC_{50} of >103 ppm a.e (6,9). Since this species has an LC_{50} that is >10-fold greater than the EEC that occurs immediately after application, it is not likely that it would be adversely impacted by Triclopyr TEA (6).

Direct exposure tests of honey bees *(Apis mellifera)* indicates TEA is relatively non-toxic. Aquatic invertebrate reproductive impairment by chronic exposure to TEA may occur at levels greater than 80.7 ppm (1).

The data indicate a lack of chronic toxicity for *Daphnia magna*. The 48-hour LC50 for *Daphnia magna* is 360 to 376 ppm ae and the 21-day LC50 = 367 ppm ae and the 21-day MATC is 35 ppm a.e (7). *Daphnia magna* tests indicate the TEA and acid forms are practically non-toxic with EC50 or LC50 of 1,496 and 132.9 ppm respectively (1).

A risk quotient (RQ) is the ratio of an expected concentration (EEC) and a selected reference value. Since the chronic risk assessment quotient is less than 1.0 (RQ = 2.5 ppm ae/35 ppm ae for *Daphnia magna*), invertebrate biota are not likely to be adversely affected in their reproductive success when Triclopyr TEA is used to control aquatic weeds (7).

Triclopyr TEA is also classified as practically non-toxic (LC_{50} >100 ppm , ref (6)) to:

grass shrimp (Palaemonetes pugio),
pink shrimp (Penaeus durorarum),
fiddler crab (Uca pugialtor),
red swamp crayfish (Procambarus clarki).

The most sensitive mollusk tested is the embryo larval stage of the eastern oyster with a 48-hour EC_{50} for improperly developed embryo/larvae of 22 ppm ae Since the risk quotient generated from this LC_{50} and the lowest initial EEC is greater than the low level of concern (0.1), this segment of the biota may be harmed by exposure to Triclopyr TEA.. However, since the risk quotient is not higher than the high level of concern (0.5), this segment of the biota will probably not be adversely impacted if Triclopyr is classified and used as a restricted use aquatic herbicide ($RQ = EEC/EC_{50}$ = 4.4 ppm ae/22 ppm ae = 0.2). Some concern has been expressed that the eastern oyster in not an appropriate species to use in evaluations of risk for compounds that may not be used legally in estuaries. Furthermore, any concentration of Triclopyr TEA entering an estuary would be greatly diluted by both untreated river/creek water and untreated sea water from the tidal action (6).

For fish and important invertebrates, the results of acute risk assessments have been confirmed by at least one field study in Lake Minnetonka, Minnesota (Petty et al, 1998 as cited in (7)). A summary is included in Section 3a above.

f. Microorganisms

No information has been located concerning microorganisms in USEPA or other references reviewed to date.

4. Low Dissolved Oxygen

Washington DEC cited a chronic exposure trial where a subset of native fish species suffered 5-11 % mortalities post treatment, However, the mortalities that occurred during the exposure period were not believed to be due to the direct effect of Triclopyr TEA, but an oxygen slump caused by heavy growth of non-target macrophytes (7).

Low dissolved oxygen conditions are a potential issue with any fast acting herbicide when treating large areas of dense plant growth. Relatively few issues have been reported with this since label restrictions require mitigation by treatment of no more than 1/3 to 1/2 of total water area and a 10-14 day waiting period before subsequent treatments.

5. Nutrient Release

Nutrient release and possible alterations in pelagic productivity is also a potential negative effect of large scale plant die-off. Even with the areal/timing restriction designed to reduce DO loss, there is potential for changes in pelagic algae growth and perhaps also periphyton in near shore areas, especially over the short term (1-2 seasons). Some of this may be mitigated by a re-bound of native plant biomass.

Pre- and post- treatment monitoring will be designed to evaluate this effect, but unless the invasive plant populations are very dense, we do not expect wholesale water quality changes (nutrients, DO) to result in most cases.

6. Drift to non-target areas

a. In-Lake drift and Persistence

Drift of herbicide to non-target sites in lakes will depend on several factors, including the persistence (half lives, etc) of the agent and water circulation. These effects account for some of the shorter residence times in fields applications. Given the rapid dissipation of concentrations to less than effective levels for plant control (ca 0.5--0.75 ppm) in cited projects (refs 1,6,7 7 9), it is unlikely that any but adjacent untreated areas will see meaningful concentrations of herbicide. Treatment and monitoring design will emphasize reduction in drift and detection of no-target effects. With short contact times and reduced concentrations by dilution, off-site effects should be significantly curtailed.

Relatively short half lives can still result in measurable, though low, concentrations for many weeks in mesocosms, though field applications usually result in more rapid approach to non-detect due to dissipation (7). The aquatic dissipation half-lives observed in the field are consistent with the shorter half lives observed in the photolysis in water studies. In general, results of the available studies suggest that Triclopyr acid is rapidly dissipated under aquatic conditions in the field (t = 0.5-3.5 ½ days in Lake Seminole, Georgia in an Aquatic Field Dissipation study; and 5 days in pond water in a Forestry Field Dissipation study). Some factors that could affect the rate of dissipation in cases where aqueous photolysis is an important dissipation factor include vegetative cover, type of vegetation, depth of the plot, and suspended sediment (1).

b. Downstream/Marine

While application of Triclopyr under this permit is restricted to fresh waters only, potential for discharge to marine waters exists under certain circumstances. Triclopyr TEA is slightly toxic to practically non-toxic to estuarine/marine invertebrates and estuarine/marine fish on an acute basis. The lowest cited acute LC50 was 58 ppm for oyster shell deposition (1).

As noted above, despite evidence that the eastern oyster displays sensitivity, it may not be an appropriate species to use in evaluations of risk for compounds that may not be used legally in estuaries. Furthermore, any concentration of Triclopyr TEA entering an estuary would be greatly diluted by both untreated river/creek water and untreated sea water from the tidal action (6).

Due to these factors, the low doses allowed, and the short residence times, chronic or meaningful acute exposure to Triclopyr in the marine environment is not expected from transient applications of the chemical to freshwaters during invasive plant management in Maine lakes or streams.

Discharge via outlets is always a potential issue in lake treatments. Treatment design will follow considerations outlined in the GP to avoid undue effects and will include pre and post application monitoring where appropriate. Precautions such as temporary outflow manipulation, spot treatments vs. whole lake applications, limno-barriers and the like will be pursued to reduce the discharge of chemicals downstream.

c. Sediment

Due to the low distribution coefficient for Triclopyr (0.165 to 0.925 mL/g), it does not bind tightly to sediment and therefore concentrations in sediment should remain low. This assumption is confirmed by results from field studies. For example, at Lake Minnetonka (MN), concentrations of Triclopyr in sediment were never higher than 0.334 ppm ae and dissipation to concentrations of

<0.15 ppm was seen within 14 days after application. At Lake Seminole (GA), Triclopyr was not seen at significant concentrations (<0.1 ppm ae) except for the day of application where concentrations as high as 0.64 ppm ae were detected. Even in pond studies, the concentration of Triclopyr in sediment was very low and did not exceed 0.86 ppm ae during the first few days and dissipated to below the limit of quantification within four weeks (6).

d. Ground water

Groundwater can be affected by the concentrations and amounts of herbicides applied, ability of the material to bind to sediment, solubility of the chemical, and dilution, and several other factors. Due to the environmental fate characteristics of Triclopyr acid, it has a potential to leach to ground water in terrestrial applications and is know to be mobile in groundwater. It may also reach groundwater in aquatic applications, if ground water transfer in the vicinity of a treatment is high enough to transport water to the riparian saturated soils and thus remove material from active breakdown in the aerobic aquatic environment.

With short aquatic residence times, we do not anticipate that transport to ground water would be a possibility except for shallow dug wells in the immediate vicinity of an application area. Appropriate consultation with abutting landowners and water utilities and mitigation procedures as are currently employed by Maine DEP during use of 2, 4-D and Fluridone treatments should avoid problems for domestic water supplies.

ATTACHMENT B

(References)

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Dr. William Haller, University of FLA
Dr John Madsen, Mississippi State University
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ATTACHMENT C

(Notice of Intent Form)
(6 Pages)

Form DEPLW0829A

Maine Department of Environmental Protection
General Permit Notice of Intent (NOI)
Aquatic Herbicides for the Control of Invasive Aquatic Plants

NOTE: A copy of this NOI Form must be filed with each civil jurisdiction in which the treatment will be located (municipal office or LUPC Regional Office and County Commissioners office) at the time it is submitted to the Department. Prior to submittal and at the time of submittal, the permittee must provide notice to the general public, potentially impacted abutting landowners, and various organizations and agencies as specified in the General Permit and as referenced below.

This NOI is subject to General Permit #MEG150000 / WDL #W-009004-5Y-B-R, issued by the Maine DEP for the herbicidal treatment of invasive aquatic plants. Project specific information may be obtained from DEP staff listed in Section 1 below:

1. MEDEP Invasive Aquatic Species Program (IASP) Contact

Name: _____

Mailing address: _____
Street Address

_____
Town State ZIP

Telephone: _____ E-mail: _____

2. Agent Managing the Project (if different from IASP Contact)

Name/Affiliation: _____

Mailing address: _____
Street Address

_____
Town State ZIP

Telephone: _____ E-mail: _____

3. Licensed Applicator Information

Name/Affiliation: _____

Mailing address: _____
Street Address

_____
Town State ZIP

Telephone: _____ E-mail: _____

Current Maine Board of Pesticides Control License Number: _____

4. Statement of Significant Need to Control Target Species

Name of waterbody and town(s): _____

Name of primary target species (must be State-listed or determined invasive by MEDEP):

_____

Names of any other invasive plants: _____

_____

Reasons for this project, please check all that apply:

- ☐ The target population of aquatic plants cannot be controlled by non-chemical means
- ☐ High potential for the plant(s) populations to spread rapidly
- ☐ Probability of significant disruption of aquatic habitat caused by the target species
- ☐ The treatment is required to enable a broader scale plant control project under an aquatic plant management plan
- ☐ The treatment is needed to restore habitat and/or that failure to rapidly control the species threatens to result in significant environmental harm to this or other natural resource.
- ☐ Other _____

_____

On separate paper, please provide information pertaining to the choices selected above, demonstrating an emergency need to apply pesticides pursuant to this General Permit. The statements must provide reasonable justification for the proposed treatment to be considered an emergency need.

5. Has the waterbody previously been treated for plant control by any means?

☐ Yes ☐ No

Other treatment options previously used (please check all that apply):

☐ MANUAL REMOVAL ☐ BENTHIC BARRIERS ☐ MECHANICAL HARVESTING ☐ OTHER HERBICIDES

On separate paper, please describe past treatment efforts and how they affect the decision to perform an herbicide treatment and why non-herbicidal means are not considered sufficient. If previous efforts involved aquatic herbicides, indicate where treatment(s) occurred, the aquatic herbicide(s) used, and the years that application(s) occurred.

6. This treatment (please provide additional detail on separate paper as needed):

☐ Is in conjunction with the following management plan for control of invasive plants

_____

_____

☐ Requires rapid response in advance of developing a management plan because

_____

_____

7. Treatment will include (please provide additional detail on separate paper):

- ☐ Spot Treatment(s) subsurface
- ☐ Spot Treatment(s) surface
- ☐ Whole Lake

8. Project Timeline (please provide on separate paper)

9. Topographic or similar map extending one mile beyond treatment site(s)

Directions to Treatment Site(s)_____

_____

_____

10. Map of waterbody showing monitoring location(s) and area(s) to be treated if spot treatments are proposed

11. Description of *each* area to be treated (number areas keyed to map)

Area ID label/#_____ Area to be treated _____(☐ sq Meter/☐ Acres)
Range of Depths (ft)_____Volumes to be treated _____(☐ cubic meters/☐ acre-ft)
Mean Depth_____
Substrate(s): ☐ Sand, ☐ Gravel, ☐ Mud/silt, ☐ Organic, ☐ Other_____
Include information on separate paper as necessary
Describe any special application methods (i.e. use of containment barriers) or timing issues:
_____
_____

12. Other Waterbody Characteristics (identify on waterbody map)

Active outlet (likely to be flowing during treatment) ☐ Yes ☐ No
Number of permanent streams which may be affected by treatment _____
Other physical aspects that affect operations (including hydrologic considerations) _____
_____
_____

13. Non-target plant species, and community characteristics

_____
_____
_____

14. Herbicides to be used:

a. 2, 4-D:
☐ BEE formulations:
_____% Active ingredient Current EPA Number _____
☐ DMA formulations:
_____ % DMA Current EPA Number _____

b. Diquat dibromide:
☐ _____ % Active ingredient; Current EPA Number _____

c. Endothall:
☐ Solid _____% Active ingredient; Current EPA Number _____
☐ Liquid _____ % Active ingredient; Current EPA Number _____

d**. Fluridone:**
☐ Solid _____% Active ingredient; Current EPA Number _____
☐ Liquid _____ % Active ingredient; Current EPA Number _____

e. Triclopyr:
☐ Solid _____% Active ingredient; Current EPA Number _____
☐ Liquid _____ % Active ingredient; Current EPA Number _____

MEBPC and USEPA registration status has been verified ☐ **Yes** ☐ **No**

15. For each herbicide proposed for use, list (please provide on separate paper if necessary):

Herbicide Name_____ **Include a copy of the label.**
Max. Application Rate_____(☐ Lbs/acre or ☐ gallons/acre)
Target Concentrations_____
Duration (expected time to non-detect)_____
Booster Treatments (number, interval)_____
Target Application date(s)_____

If spatially variable rate, or other treatment variations, provide details on separate sheet.

16. Herbicide Monitoring:

_____ Will be in accordance with Part 1E1, Table 2 of the General Permit
_____ Will require outlet monitoring
_____ Will deviate from standard protocol (attach explanation and justification)

17. Water Quality Monitoring:

_____ Will be in accordance with Part 1E2 of the General Permit
_____ Will deviate from standard protocol (attach explanation and justification)

18. Plant Community Monitoring:

_____ Will be in accordance with Part 1E3 of the General Permit
_____ Will require outlet monitoring
_____ Will deviate from standard protocol (attach explanation and justification)

19. Conservation Agency Consultation:

The following organizations have received written notification of this project, including but not limited to information in items 4-15 above, and have responded that no elements of special concern for rare, threatened, or endangered species or natural communities are known in the affected area or that the treatment as proposed is considered to not significantly threaten the species or natural communities in question. Please include responses.

☐ MDIFW Non-Game Program, pre-submittal consultation
☐ MDIFW Regional Fisheries Biologist, pre-submittal consultation
☐ Maine Department of Conservation-Natural Areas Program, pre-submittal consultation
☐ MEDMR Bur. Sea Run Fisheries and Habitats; USFWS, NOAA Fisheries, notification

If agency consultations indicate elements of concern, attach explanation and mitigation strategy

20. Public Water Supplies

☐ DHHS-Drinking water program has been consulted re: existence of public water supplies
☐ Public water supplies exist. Identify Public water supplies:

_____

_____

☐ Identified Public water supplies have been consulted
(Attach correspondence from each public water supply indicating consent and any conditions thereto. If consent is conditioned, indicate how conditions will be met.)

21. Public Notice:

List municipalities, counties, and/or LUPC Regional Offices to be notified by copy of NOI:

☐ Public Informational Meeting was held (provide date, list of attendees.)

☐ Potentially impacted abutting landowners to all affected resources have been notified of proposed project (attach list, method of determining impacted landowners, method of notification, comments received, actions taken. Note efforts undertaken to contact if unsuccessful.)

☐ Lake Association / Watershed Association has been notified of proposed project (list and include any comments received.)

☐ Provide information on any measures to restrict access and/or public posting of affected areas.

22. Copy of press release or advertisement publication date and name of newspaper with general circulation in the area of the treatment program

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. The information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature:_____ Date:_____

Affiliation_____

Printed Name:_____

Keep a copy as record of permit. Send the form with attachments via certified mail to the Maine Department of Environmental Protection, 17 SHS, Augusta, ME 04333-0017 or as described in the general permit. A copy of this NOI must be provided to the municipal office or County Commissioners' office and LUPC Regional Office if any part of the water body is LUPC jurisdiction. Authorization to discharge is valid for one year. Work carried out in violation of any applicable standard is subject to enforcement action.

This area for office use only.

NOI #	Date Received	Date Approved	Date Returned	Staff
#MEG150---				

ATTACHMENT D

(Notice of Termination of Coverage)
(2 Pages)

Form DEPLW1216

Maine Department of Environmental Protection
General Permit Notice of Termination (NOT)
Aquatic Herbicides for the Control of Invasive Aquatic Plants

NOTE: A copy of this NOT Form must be filed with each civil jurisdiction in which the treatment has been located (municipal office or LUPC Regional Office and County Commissioners office) at the time it is submitted to the Department. Notice of Termination of the treatment program must also be provided to the public via a press release or an advertisement published in a newspaper having general circulation in the area of the treatment program.

This NOT is subject to General Permit #MEG150000 / WDL #W-009004-5Y-B-R, issued by the Maine Department of Environmental Protection for the herbicidal treatment of invasive aquatic plants.

1. MEDEP Invasive Aquatic Species Program (IASP) Contact

Name: _____

Mailing address: _____
Street Address

_____
Town State ZIP

Telephone: _____ E-mail: _____

2. Agent Managing the Project (if different from IASP Contact

Name/Affiliation: _____

Mailing address: _____
Street Address

_____
Town State ZIP

Telephone: _____ E-mail: _____

3. Licensed Applicator Information

Name/Affiliation: _____

Mailing address: _____
Street Address

_____
Town State ZIP

Telephone: _____ E-mail: _____

Maine Board of Pesticides Control License Number: _____

4. Public Notice

Name of waterbody and town(s): _____

☐ A copy of the NOT was filed with the civil jurisdiction of _____
(name of municipality or the LUPC regional office and County Commissioners office)

☐ The public been notified of termination of project via a press release or an advertisement published in a newspaper having general circulation in the area of the treatment program (attach copy of press release or advertisement.)

5. Signature of Applicant

By submittal of this Notice of Termination form to the Department, I am voluntarily terminating coverage for an invasive aquatic plant control program permitted pursuant to the Department's General Permit for Application of Herbicides for the Control of Invasive Aquatic Plants. Authorization to discharge under the general permit terminates on the day the signed NOT is received by the Department. I acknowledge that future activities for invasive aquatic plant control involving the discharge of pollutants to waters of the State are prohibited unless otherwise approved by the Department.

I certify under penalty of law that this document was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. The information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I further certify that the applicant has sufficient title, right or interest in the property where the activity has occurred.

Signature:_____ Date:_____

Printed Name:_____

Assisting Parties. If the applicant has been assisted in preparing this NOT Form, the person(s) assisting must sign below.

Signature:_____ Date:_____

Printed Name:_____

Keep a copy as record of permit termination. Send the form with attachments via certified mail to the Maine Department of Environmental Protection, 17 SHS, Augusta, ME 04333-0017 or as described in the general permit. A copy of this NOT must be provided to the civil jurisdiction and notice to abutters provided as described earlier. Work carried out in violation of any applicable standard is subject to enforcement action.

This area for office use only.

NOI #	Date Received	Date Approved	Date Returned	Staff
#MEG150_ _ _				