
Evolution of Aquatic Plant Management (<1989-2016+)

Historical Perspective

- <1989 Aquatic Nuisance Control
  - Focused on nuisance management
  - Max label rates commonly used
  - Holsitic Management?

Historical Perspective

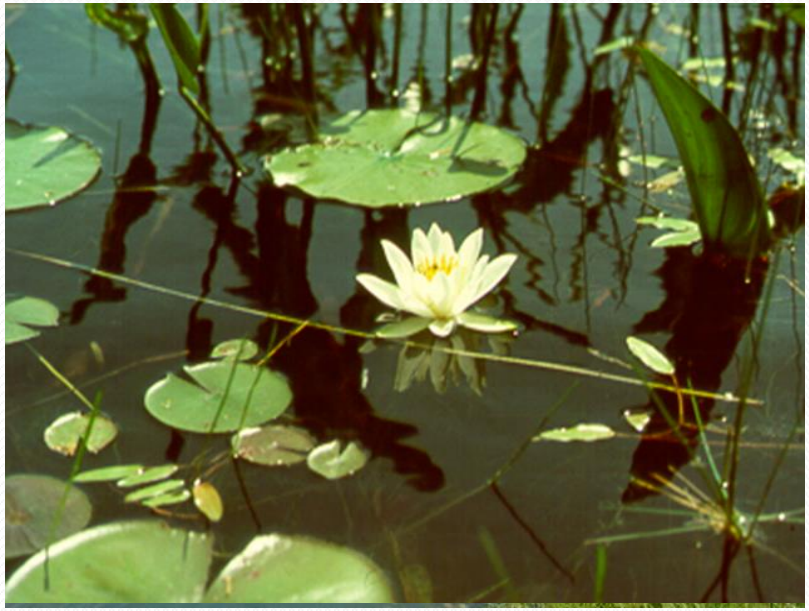
- 1989 Aquatic Plant Management
  - Primarily focused on nuisance management
  - More holistic approach
  - Lake “ecosystem”
  - Plans

Historical Perspective

- 2001 Act 16
  - Gave DNR authority for mechanical, manual and introduction of non-native plants (NR 109)
  - Lake "ecosystem" more in the forefront of management
  - Prevention, I&E
  - Start to shift towards AIS mgt.
  - Comprehensive Plans

Present - Implementing Integrated Pest Management (IPM)

- Present
  - Active research in a collaborative approach
  - Implementation of new techniques/methods
  - Holistic management is the norm
  - AIS focused/protect native species
  - Revision of code(s) to reflect new technologies and philosophy



3 main concepts of IPM

- Decision Making Process
- Use all available pest management techniques
- Prevent damage from pests while reducing the risk to human health and the environment

Have a Plan and Follow it!

Implementing IPM

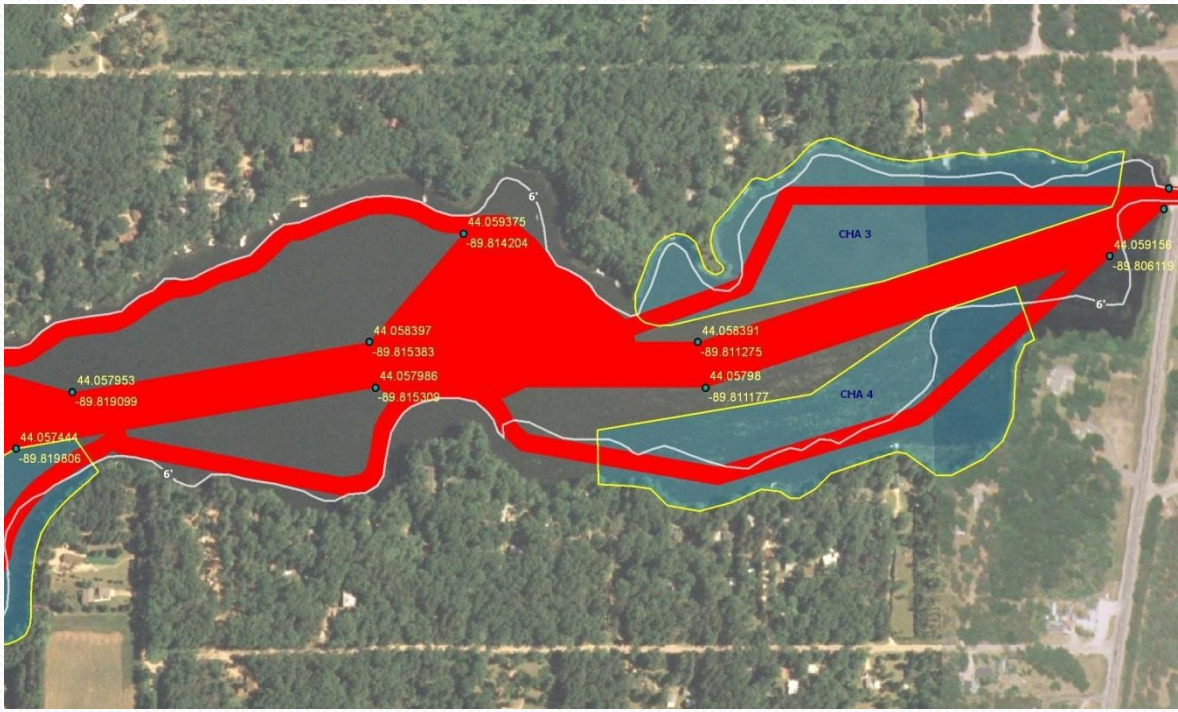
- Diverse methods
  - Prevention
  - Mechanical
  - Manual
  - Water Levels
  - Chemical
  - Biological
  - Observation
- Nontarget concerns
- I and E
  - Sea change (panic to “chill”)
- Science driven
  - Policy
  - Rules
  - Practice

Prevention

No AIS; no AIS management

Mechanical

- Good map with accuracy
- BMP's
  - Depth
  - Timing
  - Spawning
  - AIS risks
- Safety



Manual

- Under utilized technique
- Follow whole lake treatments
- Spot treatments
- Citizen involvement

Water Level

- Careful planning
  - Timing
  - Nontarget effects
- Time demanding
  - Citizen resistance
  - Chapter 30
- Habitat restoration
  - Mimic natural regime

Biological

- Efficacy
- Targets
  - PL, EWM, Zebes, Insects
- Sustainability
  - Habitat needs
  - Physical constraints

Observation

- Track changes
- Learning to live with AIS
- Sea Change
- Yes, No is an option.

Chemical

- Careful planning
  - Timing
  - Nontarget effects
  - Dosages
  - Products
- Goals
  - Relief or control (?)
  - Habitat restoration
  - AIS management
  - Nuisance

Herbicides

Know Your Product!

- Many Products approved
  - EPA vs. DATCP
  - DNR permits application of approved products
- Match the product to the right application
- Non-target impacts
  - Native preservation
  - ?????

Why you need to know your products – lots of new ones!

- 2,4-D
  - AquaKleen
  - DMA 4
  - Navigate
- Copper
  - Aquatrine
  - Captain
  - Clearigate
- Imazamox
  - Raptor
  - Clearcast
- Diquat
  - Reward
  - Weedtrine
- Endotholl
  - Aquathol-K
  - Hydrothol 191
- Fluridone
  - Avast
  - Sonar
- Sodium Carbonate
  - Green Clean
- Glyphosate
  - Aquapro
  - Eagre
  - Rodeo
- Triclopyr
  - Renovate
- Imazapyr
  - Habitat
  - Chopper
- Flumioxazin
  - Clipper

http://dnr.wi.gov/lakes/plants/factsheets/

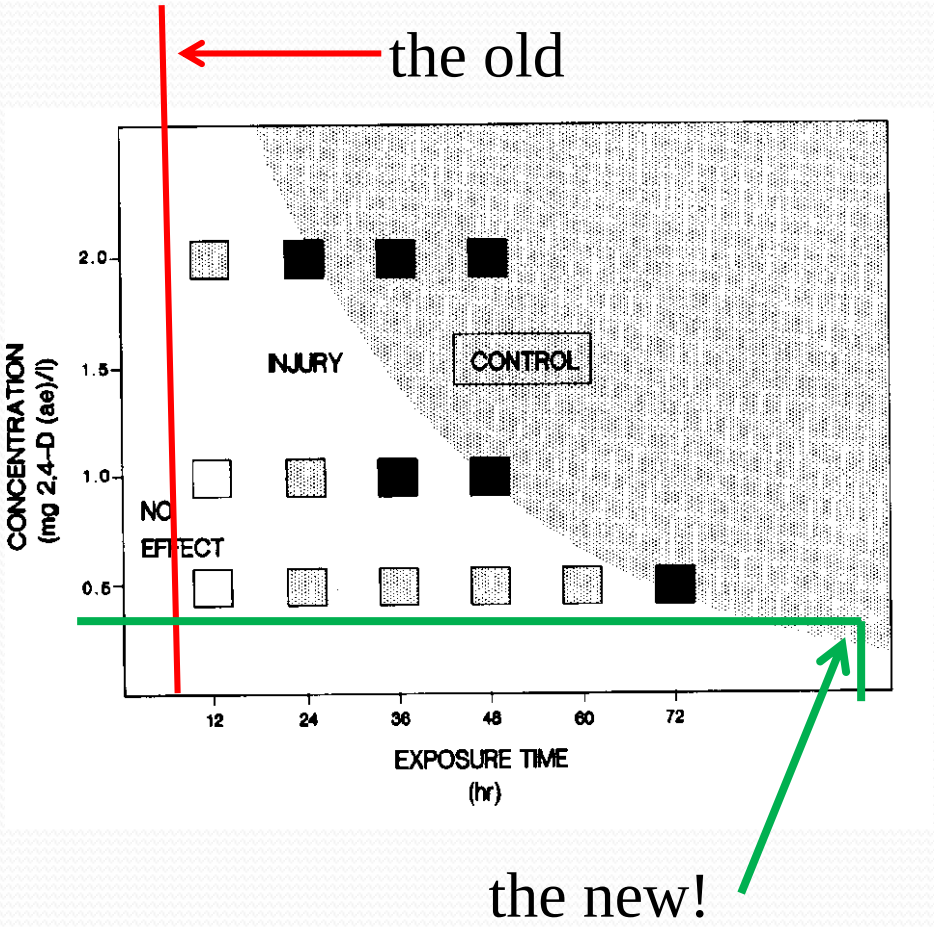
Choosing the right product.

- Contact
  - < CET
  - < selective
  - Timing critical
  - Limitations
    - pH
    - Temp
    - Suspended solids
- Systemic
  - > CET
  - > selectivity*
  - Timing less critical
  - >control*

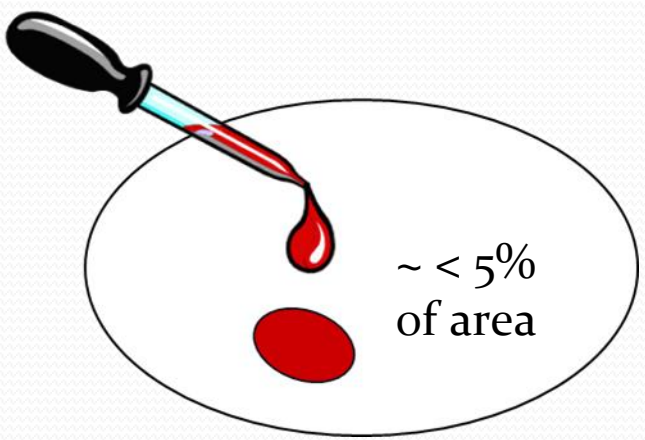
What we learned about Contact Exposure Times

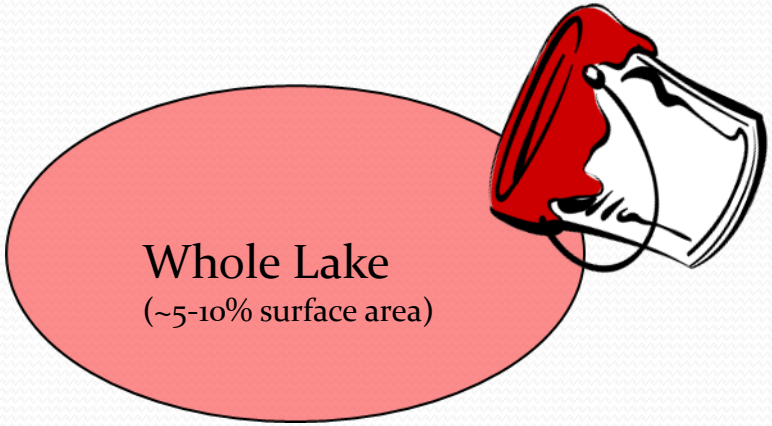
- CET crucial
- Got the right product?
  - Mode of Action
  - HRT (flowages)
  - Sediment type
- Granular vs liquid

(See handout)



So…when does a spot treatment become whole lake?





Wisconsin now requires applicants to calculate whole lake concentration on treatments over 5% of the lake surface area.

Is treatment area greater than 5% of surface area? ◯ Yes ◯ No

If yes, calculate whole lake concentration (in ppm). Refer to DNR Lake pages dnr.wi.gov/Lakes to answer the following:

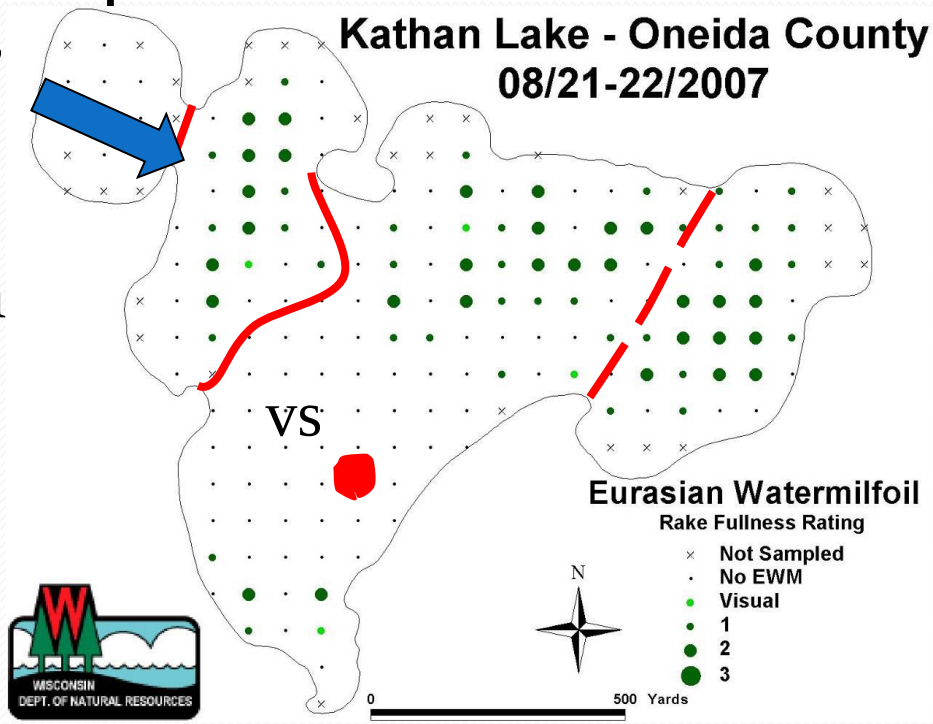
Does the lake stratify? ◯ Yes ◯ No

If yes, calculate whole lake concentration using volume above thermocline.
If no, calculate whole lake concentration using total lake volume.

Whole Lake Concentration: _____ ppm

Spot/whole lake treatment strategies:
Know your product and application

- Products are soluble; need large areas instead of small spot treatment
- 5 acre minimum or “bumps” on smaller areas
- Pellets do NOT “hold” product in place
- Wind speed/direction



Whole Lake EWM tmts.

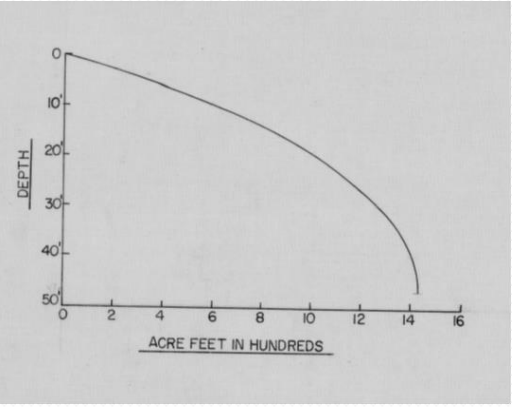
What you will need to plan…

- Volume of proposed spot treatment
- Depth (does it stratify?)
- Product label

Volume (acre feet)

Accurate measurements

- Calculated by contour depth
- Current bathymetry (flowages)
- Histograms (for estimates)



- Accuracy important for sub-ppm concentrations!

ArcMap Bathy Area	Contour Label	Contour Depth	Interpolated Contour Area*	Contour Interval	Contour Interval Volume	Cum. Volume At Survey Level	Cum. Volume At 1 Ft Low Water level	Cum. Volume At 2 Ft Low Water level
ac	ft	ft	ac	ft	ac-ft	ac-ft		
					1/3h(A1+A2+SQRT(A1*A2))			
37.856927	0	0	37.8569	0				
		1	36.4016	0 to 1	37.127	37.127		
		2	34.9748	1 to 2	35.686	72.813	35.686	
		3	33.5765	2 to 3	34.273	107.086	69.959	34.273
		4	32.2068	3 to 4	32.889	139.975	102.848	67.163
30.865547	5	5	30.8655	4 to 5	31.534	171.509	134.382	98.696
		6	30.1598	5 to 6	30.512	202.021	164.894	129.208
		7	29.4622	6 to 7	29.810	231.831	194.704	159.019
		8	28.7728	7 to 8	29.117	260.948	223.821	188.135
		9	28.0915	8 to 9	28.431	289.380	252.253	216.567
27.418434	10	10	27.4184	9 to 10	27.754	317.134	280.007	244.321
		11	26.8959	10 to 11	27.157	344.291	307.164	271.478
		12	26.3785	11 to 12	26.637	370.928	333.801	298.115
		13	25.8660	12 to 13	26.122	397.049	359.922	324.237
		14	25.3586	13 to 14	25.612	422.661	385.534	349.849
24.856228	15	15	24.8562	14 to 15	25.107	447.768	410.641	374.956
		16	24.2928	15 to 16	24.574	472.342	435.215	399.530
		17	23.7359	16 to 17	24.014	496.356	459.229	423.543
		18	23.1854	17 to 18	23.460	519.816	482.689	447.003
		19	22.6414	18 to 19	22.913	542.729	505.602	469.916
22.10378	20	20	22.1038	19 to 20	22.372	565.101	527.974	492.288
		21	21.4637	20 to 21	21.783	586.884	549.757	514.071
		22	20.8330	21 to 22	21.148	608.032	570.905	535.219
		23	20.2117	22 to 23	20.522	628.553	591.426	555.740
		24	19.5998	23 to 24	19.905	648.458	611.331	575.645
18.997344	25	25	18.9973	24 to 25	19.298	667.756	630.629	594.943
		26	18.2077	25 to 26	18.601	686.357	649.230	613.544
		27	17.4348	26 to 27	17.820	704.177	667.050	631.364
		28	16.6786	27 to 28	17.055	721.232	684.105	648.419
		29	15.9392	28 to 29	16.308	737.540	700.413	664.727
15.216609	30	30	15.2166	29 to 30	15.577	753.116	715.989	680.303
		31	14.4649	30 to 31	14.839	767.955	730.828	695.143
		32	13.7322	31 to 32	14.097	782.052	744.925	709.240
		33	13.0185	32 to 33	13.374	795.426	758.299	722.613
		34	12.3239	33 to 34	12.670	808.096	770.969	735.283
11.648345	35	35	11.6483	34 to 35	11.985	820.080	782.953	747.267
		36	10.7137	35 to 36	11.178	831.258	794.131	758.445
		37	9.8180	36 to 37	10.263	841.521	804.394	768.708
		38	8.9615	37 to 38	9.387	850.907	813.780	778.094
		39	8.1441	38 to 39	8.550	859.457	822.330	786.644
7.365733	40	40	7.3657	39 to 40	7.752	867.208	830.081	794.396

Depth of thermocline

Δ 1°C/1 m depth (UW-Madison, et al.)

Things to consider:

Does it stratify?

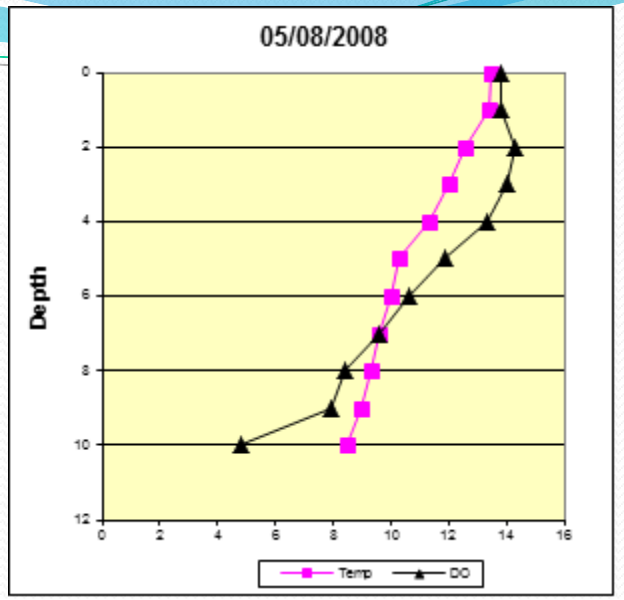
Spring may have weak stratification
- timing critical
- enough temp gradient?
- presence of other sensitive species?

Lake morphology

Herbicide characteristics
- Other products may mix better

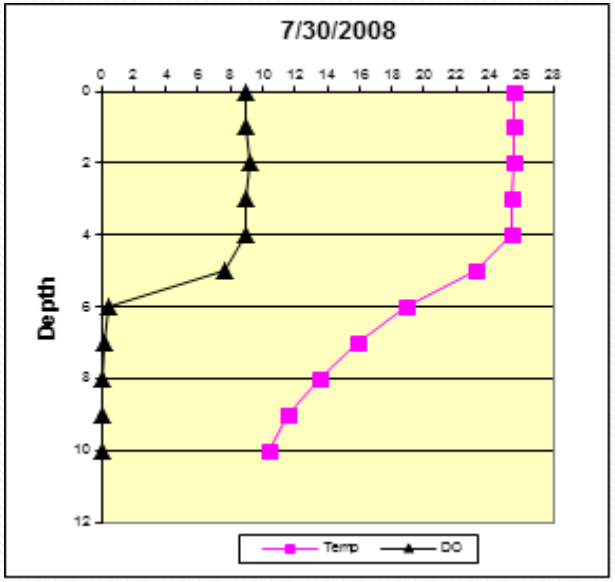
05/08/2008

DO	Temp	Depth
13.80	13.50	0
13.80	13.40	1
14.30	12.60	2
14.00	12.00	3
13.30	11.30	4
11.90	10.30	5
10.60	10.00	6
9.60	9.60	7
8.40	9.30	8
7.90	9.00	9
4.80	8.50	10



07/30/2008

DO	Temp	Depth
9.00	25.60	0
9.00	25.60	1
9.20	25.60	2
9.00	25.50	3
9.00	25.50	4
7.60	23.20	5
0.50	18.90	6
0.20	15.90	7
0.00	13.50	8
0.00	11.60	9
0.00	10.40	10



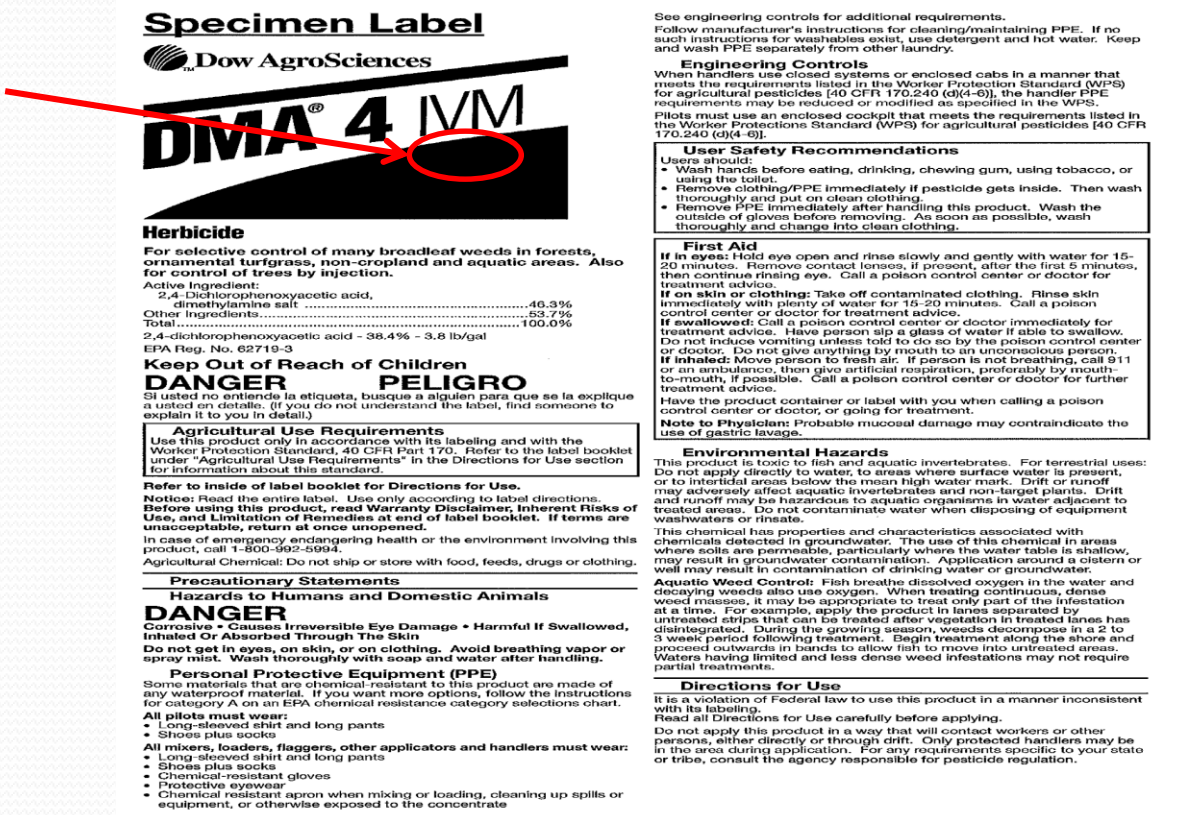
Product Label

Look for concentration

acid equivalent ?

active ingredient?

DMA 4 IVM is 3.8lbs/gal (a.e.)



Specimen Label

Dow AgroSciences

DMA® 4 IVM

Herbicide

For selective control of many broadleaf weeds in forests, ornamental turfgrass, non-cropland and aquatic areas. Also for control of trees by injection.

Active Ingredient:
2,4-Dichlorophenoxyacetic acid, dimethylamine salt 46.3%
Other Ingredients 53.7%
Total 100.0%

2,4-dichlorophenoxyacetic acid - 38.4% - 3.8 lb/gal

EPA Reg. No. 62719-3

Keep Out of Reach of Children

DANGER PELIGRO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. Refer to the label booklet under "Agricultural Use Requirements" in the Directions for Use section for information about this standard.

Refer to inside of label booklet for Directions for Use.

Notice: Read the entire label. Use only according to label directions. **Before using this product, read Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies at end of label booklet. If terms are unacceptable, return at once unopened.**

In case of emergency endangering health or the environment involving this product, call 1-800-992-5994.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

Precautionary Statements

Hazards to Humans and Domestic Animals

DANGER

Corrosive • Causes Irreversible Eye Damage • Harmful If Swallowed, Inhaled Or Absorbed Through The Skin

Do not get in eyes, on skin, or on clothing. Avoid breathing vapor or spray mist. Wash thoroughly with soap and water after handling.

Personal Protective Equipment (PPE)

Some materials that are chemical-resistant to this product are made of any waterproof material. If you want more options, follow the instructions for category A on an EPA chemical resistance category selections chart.

All pilots must wear:
- Long-sleeved shirt and long pants
- Shoes plus socks

All mixers, loaders, flaggers, other applicators and handlers must wear:
- Long-sleeved shirt and long pants
- Shoes plus socks
- Chemical-resistant gloves
- Protective eyewear
- Chemical resistant apron when mixing or loading, cleaning up spills or equipment, or otherwise exposed to the concentrate

See engineering controls for additional requirements.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

Engineering Controls

When handlers use closed systems or enclosed cabs in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

Pilots must use an enclosed cockpit that meets the requirements listed in the Worker Protections Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d)(4-6)].

User Safety Recommendations

Users should:
- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

First Aid

If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

If on skin or clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

If swallowed: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.

If inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage.

Environmental Hazards

This product is toxic to fish and aquatic invertebrates. For terrestrial uses: Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Drift or runoff may adversely affect aquatic invertebrates and non-target plants. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. Do not contaminate water when disposing of equipment washwaters or rinsate.

This chemical has properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination. Application around a cistern or well may result in contamination of drinking water or groundwater.

Aquatic Weed Control: Fish breathe dissolved oxygen in the water and decaying weeds also use oxygen. When treating continuous, dense weed masses, it may be appropriate to treat only part of the infestation at a time. For example, apply the product in lanes separated by untreated strips that can be treated after vegetation in treated lanes has disintegrated. During the growing season, weeds decompose in a 2 to 3 week period following treatment. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas. Waters having limited and less dense weed infestations may not require partial treatments.

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read all Directions for Use carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

Know product (a.i. or a.e.)
DMA 4 IVM = 3.8 lb/gal
Navigate = 19% or 0.19 ae
27.6% or 0.276 ai

Calculate volume of treatment area (acre feet)

Calculate amount of product at max label rate in treatment area

$$\frac{(2.7)(4.0\text{ppm})(59.9\text{ ac ft})}{3.8\text{ lbs/gal ae}}$$

170.2 gallons

170.2*3.8 **= 647 lbs ae**

Note: 2.7 = million pounds for acre feet

State of Wisconsin
Department of Natural Resources
Water Permit Central Intake - WT/3
PO Box 7185, Madison, WI 53707-7185
dnr.wi.gov

Chemical Aquatic Plant Control Application and Permit
Wisconsin Pollutant Discharge Elimination System (WPDES)
Pesticide Pollutant Permit Application
Form 3200-004 (R 11/11)

Notice: Use of this form is required by the Department for any application filed pursuant to s. 281.17(2), Wis. Stats., and Chapters NR 107, 200 and 205, Wis. Adm. Code. This permit application is required to request coverage for pollutant discharge into waters of the state. Personally identifiable information on this form may be provided to requesters to the extent required by Wisconsin's Open Records Law [ss. 19.31-19.39, Wis. Stats.].

DNR Use Only	
ID Number: NE-2014-20-145	Permit Expiration Date: 10-01-2014
Waterbody #: 600805	Fee Received: $495.00

Section I – Applicant Information – Name of Permit Applicant. Also indicate names and addresses of all individuals, associations, communities or town sanitary districts sponsoring treatment. Attach additional sheets if necessary.

Home Address	Lake Address
Name: Wayne D. Mueller	Name: Same
Street Address: W922 North Shore Drive	Street Address:
City: St. Cloud	City:
State: WI	State:
ZIP Code: 53079	ZIP Code:

Phone Number (include area code): Primary: (920) 753-5262 Secondary: (920) 901-2003
Email Address:

Section II – Aquatic Plant Control Location

Waterbody to be Treated (waterbody where treatment area is located): Wolf Lake
Lake Surface Area: 76 acres
Estimated Surface Area that is 10 Feet or Less in Depth: 25 acres
County: Fond du Lac
Section: 10
Township: 16 N
Range: 19 ☒ E ☐ W
Latitude: 43.863704
Longitude: -88.207282
Is the waterbody a private pond? ☐ Yes ☒ No
Does the waterbody have public access? ☒ Yes ☐ No
Adjacent Riparian Property Owner Names (attach sheets if necessary)
1. See Attached List
2.
3.
4.
5.
6.
7.
Name of Lake Property Owners' Association Representative or Lake District Representative (if none, please indicate)

Name of Applicator or Firm: Aquatic Biologists, Inc.
Street or Route: N4828 Highway 45 S.
City: Fond du Lac
State: WI
ZIP Code: 54937
County: Fond du Lac
Phone Number (include area code): (920) 921-6827
Email Address: info@aquaticbiologists.com
Applicator Certification Number for Category 5 Aquatic Pesticide Application: 95-010559 (BL) / 95-069697 (RL)
Business Location License Number (if applicable): 93-001865-009755
Restricted Use Pesticide License Number (if applicable): --

Area(s) Proposed for Control: (Note details in permit cover letter for final permitted sizes of treatment areas.)

	Treatment Length		Treatment Width			Estimated Acreage	Average Depth		Volume ac ft
A.	See Map	ft. X		ft. ÷ 43,560 ft² =		3.75	3.5	ft.	13.1
B.		ft. X		ft. ÷ 43,560 ft² =		2.10	4.0	ft.	8.4
C.		ft. X		ft. ÷ 43,560 ft² =		4.7	3.0	ft.	14.1
D.		ft. X		ft. ÷ 43,560 ft² =		5.3	3.0	ft.	15.9
E.		ft. X		ft. ÷ 43,560 ft² =		.7	3.0	ft.	2.1

Total Estimated Acres
Total from lines A - E: 19
Total from Attached Sheets:
Grand Total: 19

If the estimated acreage is greater than 10 acres, or is greater than 10 percent of the estimated area 10 feet or less in depth in Section II, complete and attach Form 3200-004A, Large-Scale Treatment Worksheet. Private pond treatments are exempted from this requirement.

Is this area within or adjacent to a sensitive area designated by the Department of Natural Resources? ☐ Yes ☒ No

DNR Use: NHI Review? ☐ Yes ☐ No Describe:

F. 2.1 2.3 5.3
G. included in F. 135'x100' (Algae + Nuisance) Σ=59.9

Calculate volume of epilimnion or whole lake for unstratified lakes.

Histograms or Σ cont vol,

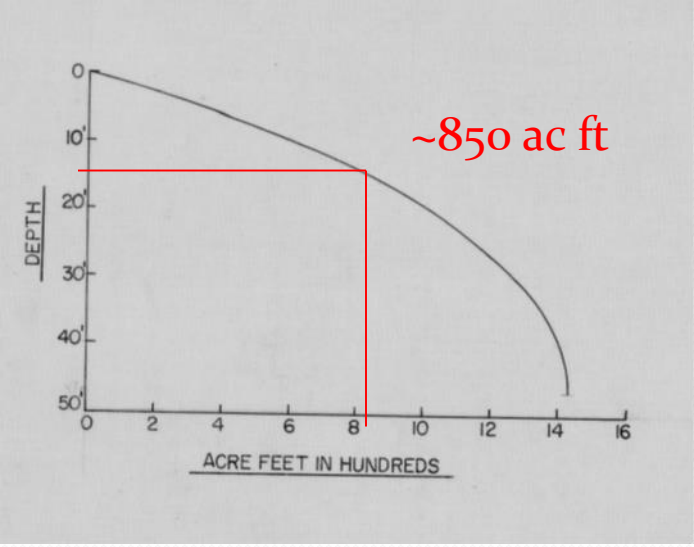
*assumed 15' thermocline for example

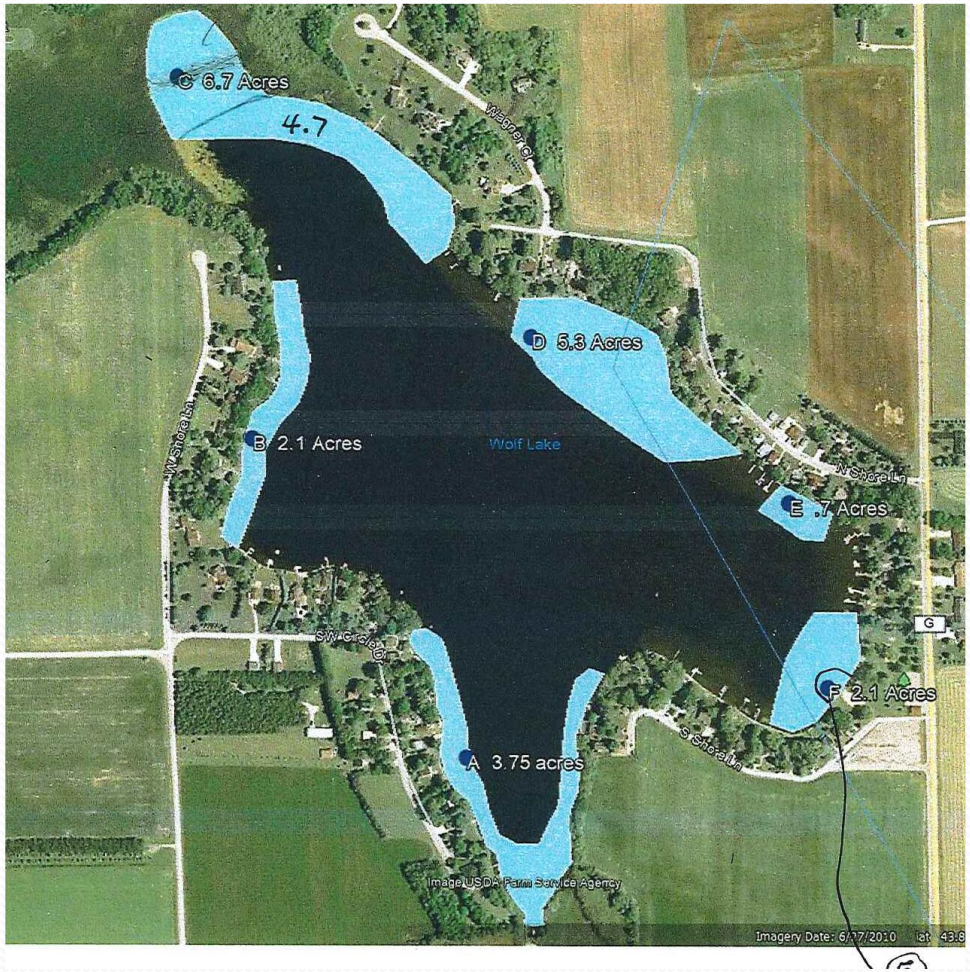
Rearrange equation to solve for concentration based on product:

$$ppm = \frac{(170.2\ gal)(3.8\ a.e.)}{(2.7\ mp/ac\ ft)(850\ ac\ ft)}$$

0.281ppm or 281 ppb

Should expect whole lake impacts





EWM control, but not without a price

Herbicide fate unpredictable
Long-term impacts to aquatic plant community not well defined
Consistent loss of some species*
No eradication
Must have follow up control (e.g. manual, DASH)

Wadley Lake				
pre-treatment survey total points	128			
post-treatment survey total points	126			
	2012 present	2013 present	p	Significant change
Myriophyllum spicatum	13	0	0.00024	***
Chara	75	101	0.000195	***
Iris versicolor	1	0	0.320167	n.s.
Myriophyllum sibiricum	7	0	0.007769	**
Najas flexilis	52	7	3.65E-11	***
Nuphar variegata	4	3	0.717226	n.s.
Nymphaea odorata	21	11	0.065285	n.s.
Polygonum amphibium	1	0	0.320167	n.s.
Potamogeton gramineus	21	8	0.011738	*
Potamogeton illinoensis	45	17	5.85E-05	***
Potamogeton proelongus	14	37	0.000247	***
Potamogeton pusillus	14	0	0.000134	***
Potamogeton zosterformis	4	0	0.045487	*
Schoenoplectus tabernaemontani	2	0	0.15893	n.s.
Schoenoplectus stricta	0	2	0.152419	n.s.
Typha latifolia	1	0	0.320167	n.s.
Sparganium eurycarpum	0	1	0.312546	n.s.
Vallisneria americana	5	4	0.75249	n.s.
Freshwater sponge	0	23	4.01E-07	***
Aquatic moss	0	1	0.312546	n.s.

Bringing it all together

- A good working plan
- Monitoring ready
- Define methodology

  e.g. Whole lake -> monitor -> DASH
- Data sharing/reporting
- Meet later to discuss results
  - DNR
  - Contractor(s)
  - Lake Partner(s)
- Re-assess and Adapt