

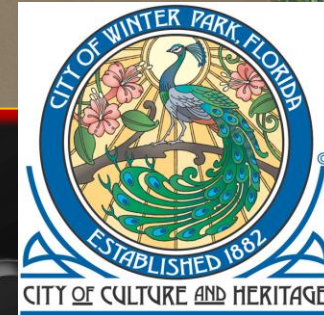
HYDRILLA WITH AN
APPETITE FOR DESTRUCTION

WELCOME TO THE JUNGLE:



ADAPTIVE MANAGEMENT OF
MULTI-RESISTANT HYDRILLA

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ICAIS 2017



CITY OF WINTER PARK

- 25 lakes and ponds (1,700 acres/687 ha)
- 5 miles (8 km) of natural creek channel
- 6 canals
- 1440 stormdrain inlets
- 134 outfalls
- 17 ditches
- 15 lakefront park sites
- 3 public boat ramps
- Interlocal agreements w/ 3 municipalities
- **Winter Park Chain of Lakes – 6 lakes + Howell Creek

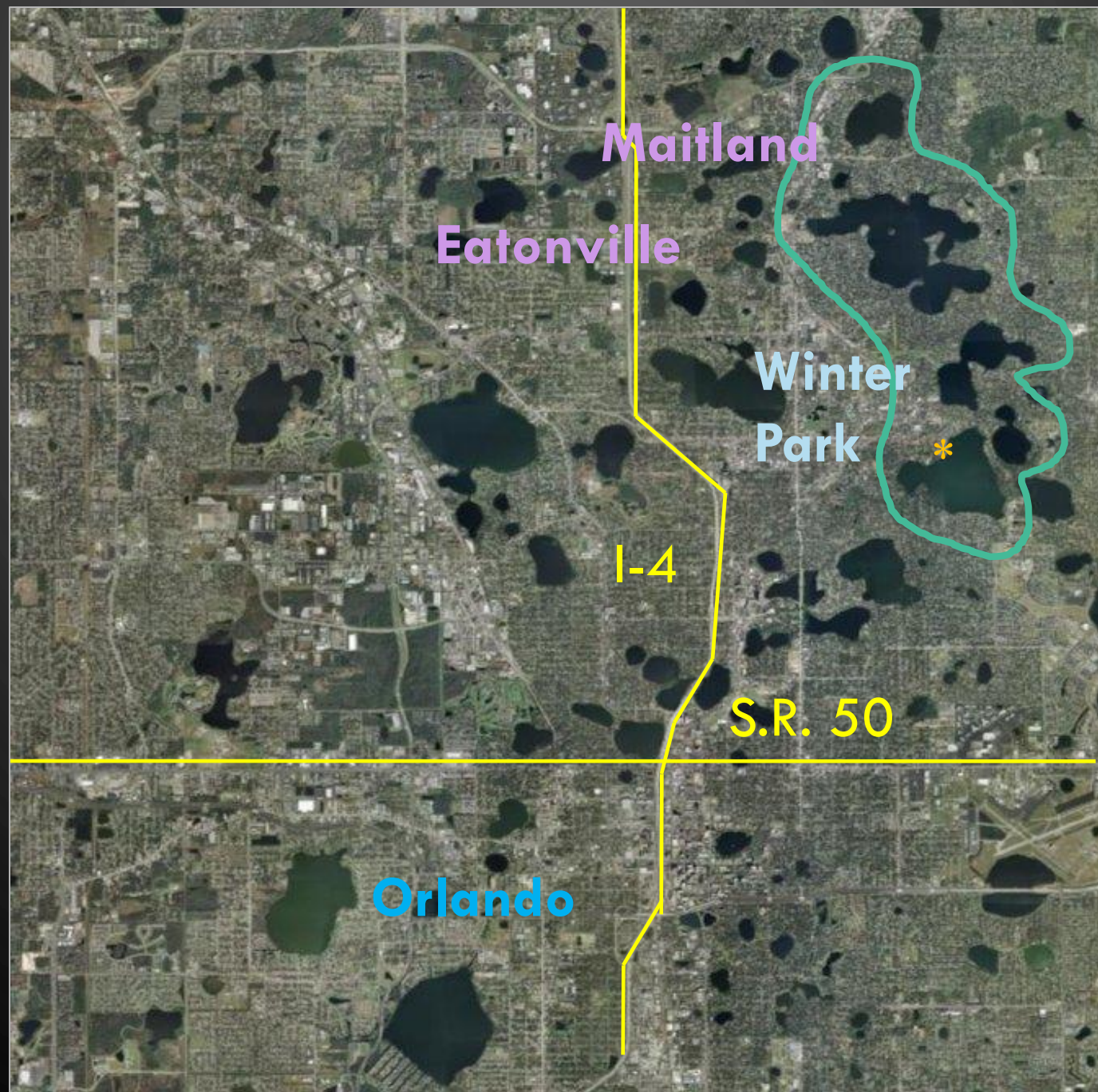


LAKES DIVISION

- 6 certified aquatics applicators
- 3 heavy equipment operators
- FWC funded program for public lakes
- Stormwater utility since 1991
- Plant management & water quality



WINTER PARK CHAIN OF LAKES



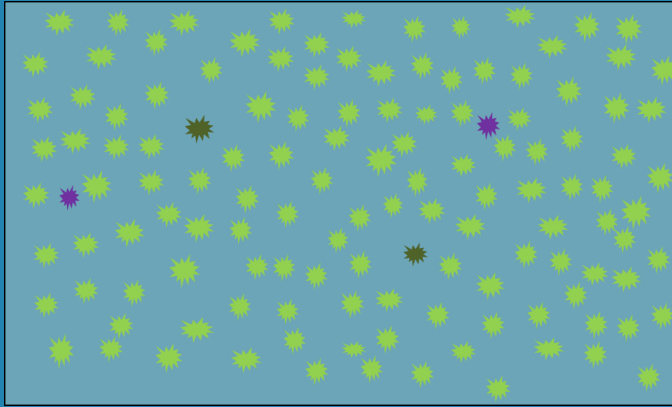
WHAT IS HERBICIDE RESISTANCE?

- **SUSCEPTIBLE** – CONTROL ACHIEVED USING NORMAL USE-RATES
- **TOLERANT** – NEVER CONTROLLED AT LABEL USE-RATES
- **RESISTANT** – ORIGINALLY SUSCEPTIBLE; BUT OVER TIME, CONTROL IS LOST AS RESISTANT PLANTS SURVIVE; REPEATED PRODUCT FAILURE
- ***MULTIPLE RESISTANCE** – RESISTANT TO HERBICIDES WITH **DIFFERENT** MODES OF ACTION (MOA)

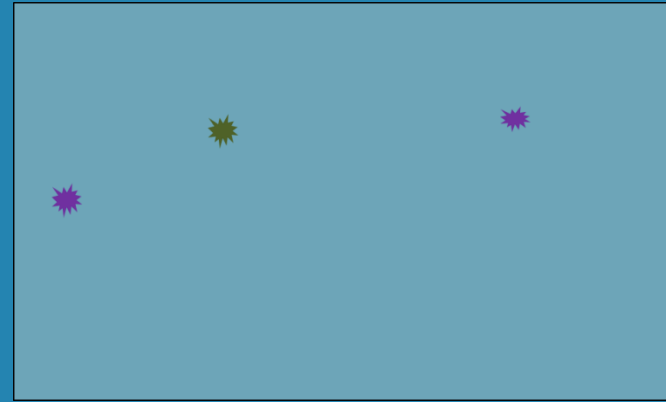


Lake Minnehaha, July 2007

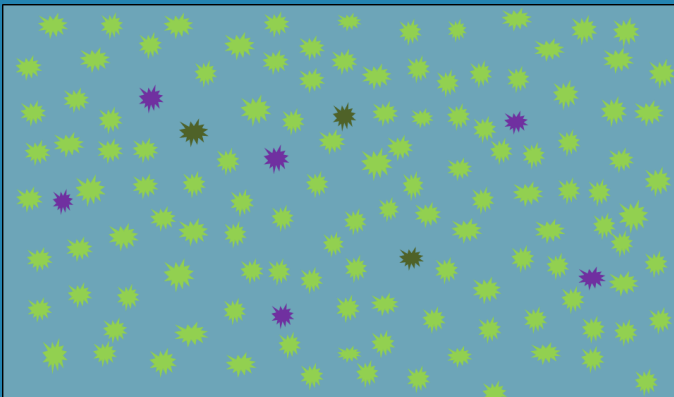
RESISTANCE – HOW DOES IT HAPPEN?



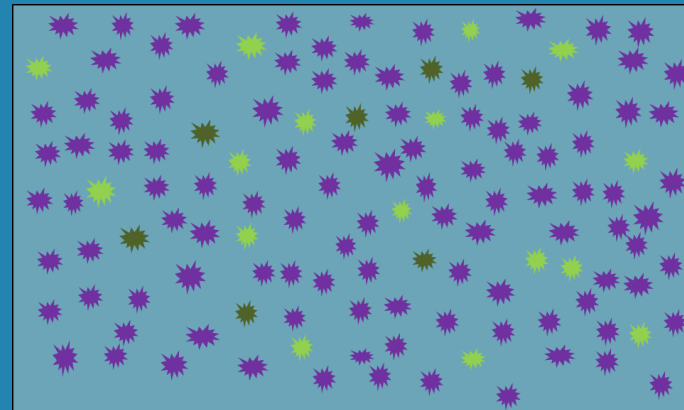
Naturally resistant plants exist within the population




Resistant plants survive the treatment



After regrowth, percentage of resistant strain increases



With repeated use, resistant plants become dominant strain

 Susceptible

 Semi-Resistant

 Resistant

HISTORICAL TREATMENT INFO

- **1960s** – relied on mechanical harvesting
- **1970s-1990s** – infestations intensively targeted with Hydout (endothall)
- **1990s** – Sonar (fluridone)
- **2007** – fluridone discontinued after failed treatments on several lakes; ***fluridone resistance**
- **2008** – lakes stocked with low rates of **STERILE grass carp**; widespread spot-treatments with endothall
- **2009** – entered FWC state-funded program
- **Late 2009/early 2010** – two failed whole lake endothall treatments; lethal concentrations reached lakewide;
****first documented case of endothall resistance (Lakes Maitland & Minnehaha)**



Challenges affecting hydrilla management

- **Deep lakes = \$\$\$ treatments**

- Average depth of Lake Maitland = 13.5' (4.1 m), Killarney = 14' (4.2 m)

- **Excellent urban fishery**

- Highest overall largemouth bass catch rate in any central FL creel since 1999

- **Average sale price of lakefront homes 2011-2013 - \$2M**

- **“Open” system/no carp barrier on north end**

- **Migratory bird population affects carp stocking**

- **Extensive ornamental landscaping**

- Residents accustomed to irrigation restrictions <14d

- **Diverse and abundant native plant community**

- Alum injection, stormwater infrastructure, street sweeping, active public education
- 2,300+ inlets, 46 miles (75 km) of pipe treat 17 mi² land (45 km²)
- *Very productive urban fishery
- **essential for nutrient uptake, erosion protection, habitat, water clarity, etc.



→
Navigable
Canal

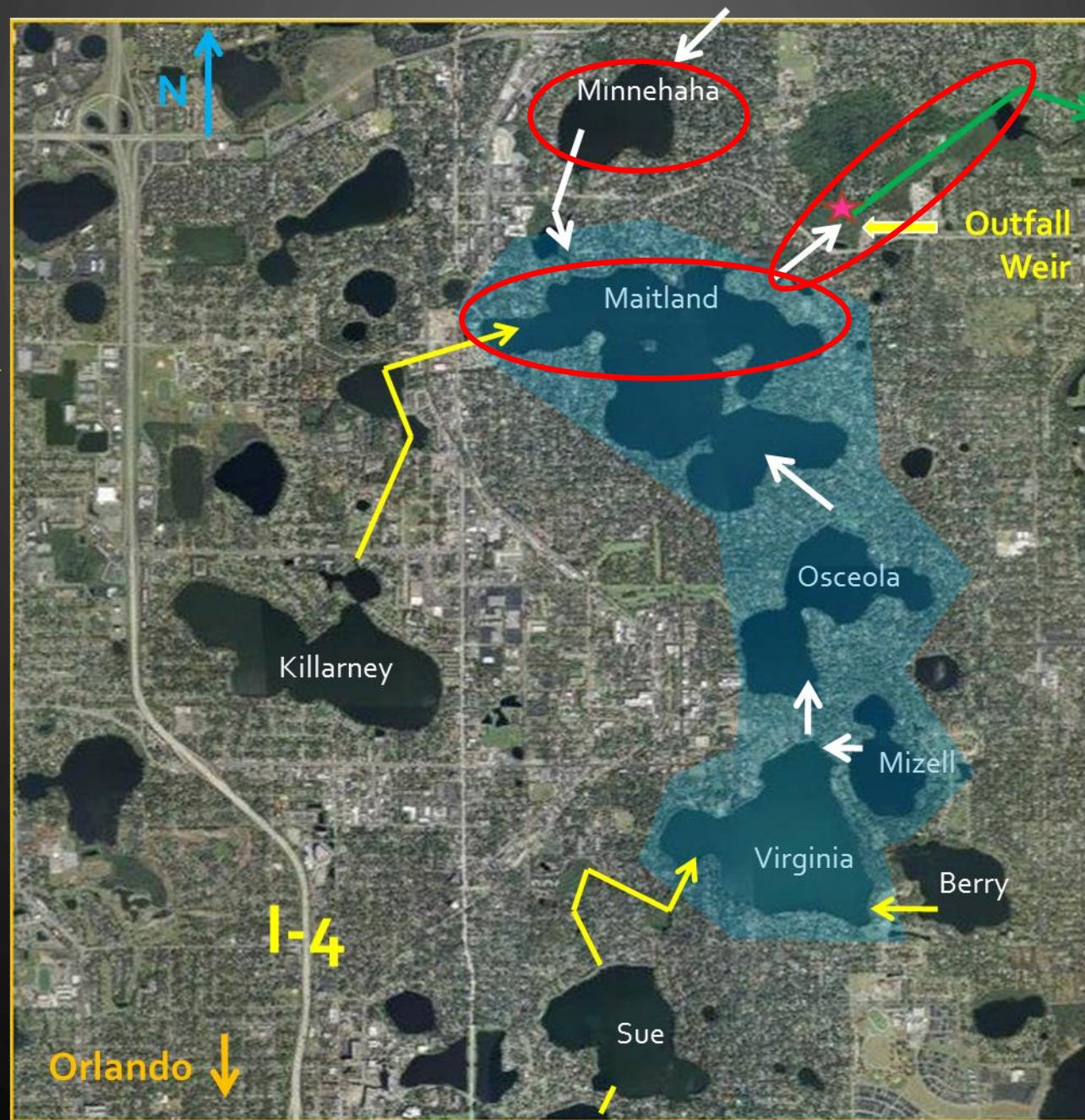
Stream Inflow

Stream Outflow


No barrier



Infestations





Lake	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017 (Apr)
Minnehaha 95 ac 38 ha	0 0	6 2	95 38	20 8	140 57	44 18	49 20	122 50	23 10	3 1	2 1	0 0	4 2	2 1	1 <1
Maitland 436 ac 176 ha	2 1	<1 <1	3 1	4 2	37 15	216 88	832 446	66 27	169 68	10 4	8 3	13 5	22 9	17 7	8 3
Waumpi 12 ac 5 ha													12 5	18 7	0 0
Total acres (ha) hydrilla treated	2 3	7 3	98 39	24 10	177 72	260 106	881 466	188 77	192 78	13 5	10 4	13 5	38 16	24 15	9 4



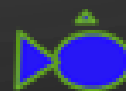
Failed *low* rate fluridone treatment



Failed *high* rate fluridone treatment



Failed endothall treatments (target concentrations reached lakewide)



carp stocking

MULTI-RESISTANT HYDRILLA

- Resistant to herbicides with different modes of action (MOA)
 - **fluridone** – disrupts carotenoids and chlorophyll
 - **endothall** – undefined; not specific to any particular plant process
- Maitland, Minnehaha, and (now) Waumpi hydrilla produces higher levels of protein phosphatase, which endothall normally inhibits....**higher levels of this enzyme = tolerate higher levels of endothall (well above label rate)**



6 WAT



Multi-resistant hydrilla in culture at UF

MANAGEMENT STRATEGIES

- Boat ramp/small patches

- Hydrothol granular at 4-5 ppm

- > 2 acres in lakes

- Flumioxazin (200 ppb)
- Flumioxazin (200 ppb) + diquat (0.37 ppm)
- Endothall (2-3 ppm) + diquat (0.37 ppm)
- Diquat (0.37 ppm)

- In creek/flowing water

- Endothall granular (Super K) in back-to-back treatments at 5 ppm
 - Applied upstream in 4 areas dosed for volume of water
 - **noticeable decrease in efficacy in 2016





downstream



Lake Waumpi

upstream

repeated infestations

no Hydrilla

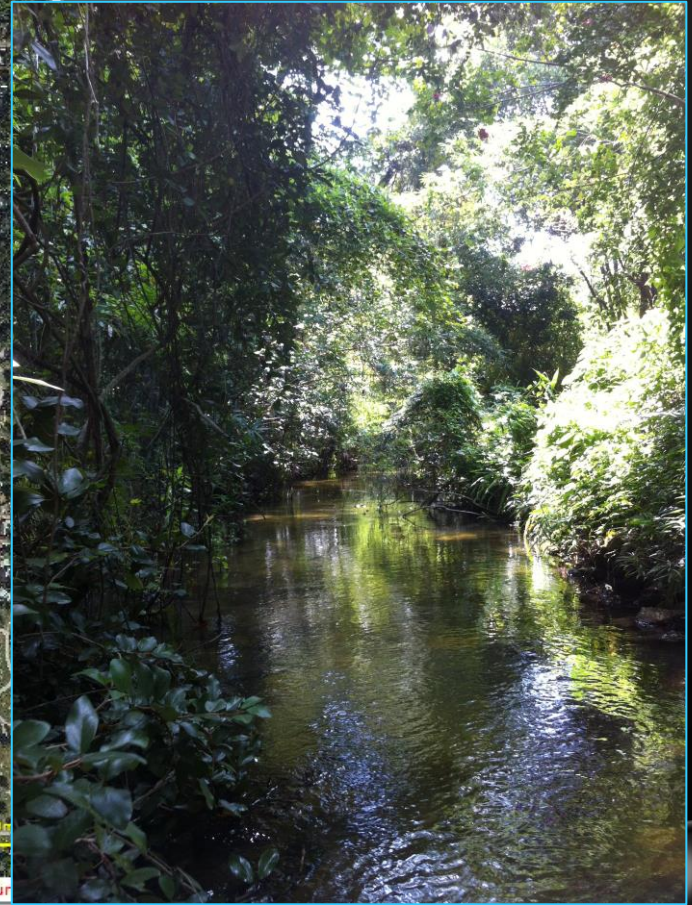
Snake Run

Occ

Venetian Way Pond

Lake Maitland

flows to north





Why are we seeing repeated infestations in the downstream portion of the creek only?

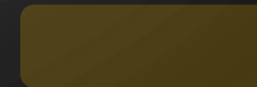
Three possibilities:



1. Dense canopy over creek; limits light



2. Carp go over the weir & stay where it is quiet



3. Increased frequency of treatments = pulsed doses of herbicide in upstream portions

weir with a 4' drop

flows to north

Lake Maitland

Lake Waumpi

repeated infestations;
canoeing, fishing

no Hydrilla

Created: 10/17/2016

This map is for reference only and is not a survey.

HOWELL CREEK – BETWEEN LAKE MAITLAND & LAKE WAUMPI



2008



2015

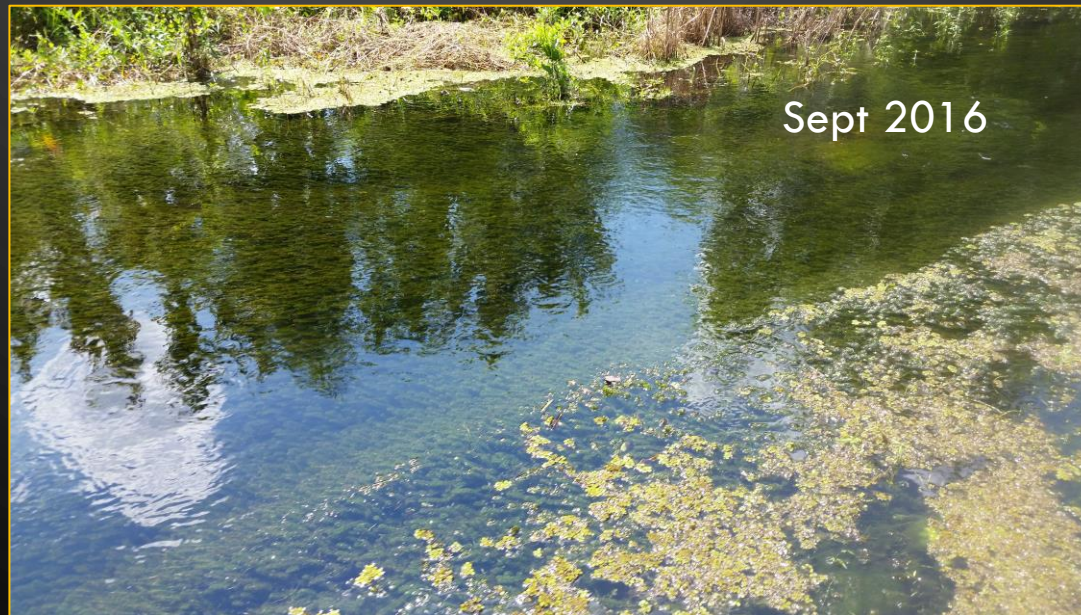
CHALLENGES



- **MULTI-RESISTANT HYDRILLA**
- **FLOWING WATER – AT TIMES IS HEAVY (> 20 CFS OR 566 L/S)**
- **CANOPY % COVER VARIES FROM 0 TO ALMOST 100%**
- **CARP ESCAPE**

ONGOING...

- **INTERMITTENT DRIP SYSTEM FOR CREEK:**
 - **ENDOTHALL (3 PPM) + DIQUAT (0.37 PPM) → 15 & 16 NOV 2016**
 - **FLUMIOXAZIN (200 PPB) + DIQUAT (0.37 PPM)**
- ****NOT MUCH DATA ON INTERMITTENT TREATMENTS (MDN)**
- ****CYCLICAL PATTERN OF EXPOSURE FOOLS PLANT INTO THINKING IT IS UNDER CONSTANT EXPOSURE = USE LESS PRODUCT AND GET MORE CONTACT TIME.**



DRIP TREATMENT #1:

Channel 15,200' (4632 m) x 35' (10.6 m) = 12 acres (or 4.85 ha) Avg depth 3' (1 m)	Typical	Intermittent/Channel Drip (discharge 2.7 CFS or 76.4 L/s)
	36,000 ac-ft (4440 ha-m)	6 ac-ft/day for 2 days (0.7 ha-m)
Aquathol K @ 3 ppm	70 gal (265 L)	24 gal (91 L)
Diquat @ 0.37 ppm	18 gal (68 L)	6 gal (23 L)
Cost	\$4,920	\$1,680*

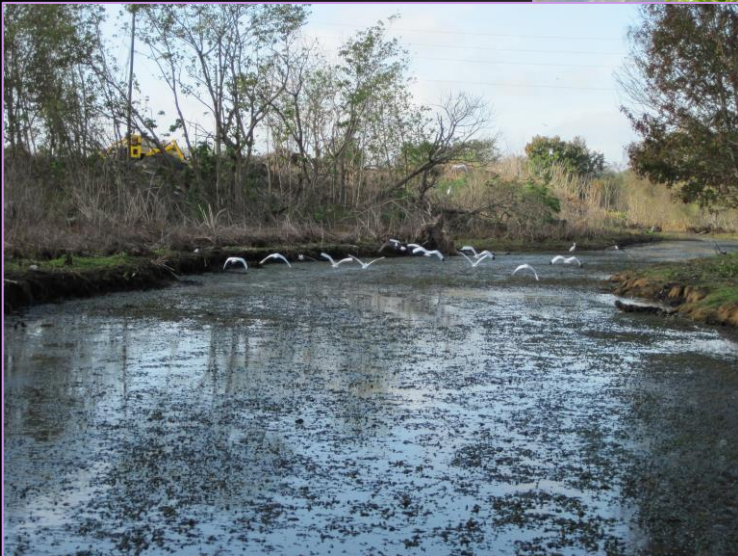


Aq K (ppm)	UP (+200 m)	MID (+800 m)	DOWN (+1200 m)
24 HAT	2.24	1.50	0.32
	2.32	1.37	0.34
30 HAT	2.24	1.36	0.51
	2.32	1.36	0.48
48 HAT	0.536	1.26	0.713
	0.533	1.72	0.762

POST-TREATMENT PICS

14 DAT

4.5 WAT



POST-TREATMENT PICS

8 WAT



10 WAT



CHALLENGES WITH THIS APPROACH

- CHANNELIZED FLOW & SPORADIC CONTACT TIME
 - BUMPS REQUIRED DEC 2016 (SUPER K) AND JAN 2017 (CLIPPER)
- SEDIMENT COMPOSITION W/ RESPECT TO DIQUAT
- TREATED LAKE WAUMPI SEPARATELY



LOOKING AHEAD

- ROTATING PRODUCTS AND/OR COMBINING MOA
- INCREASED NEED FOR PONDWEED TREATMENT DUE TO RELIANCE ON CARP
- WETLAND TREE REPLANTING TO INCREASE CANOPY
- WATERSHED TRAIL OPENING SOON!!

6

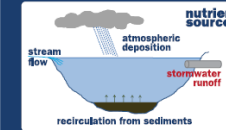
eutrophication

The role of nitrogen & phosphorus in lake degradation

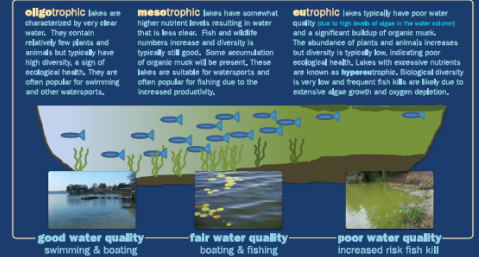
eu•troph•i•ca•tion

/yo•trif•i•sh•en/ process of nutrient (nitrogen and phosphorus) enrichment in a lake or other body of water, frequently due to runoff from the land, which causes increased biological productivity – in the extreme, causing dense plant growth which can result in the loss of fish and other biota due to lack of oxygen.

Essentially an aging process, eutrophication occurs naturally over a very long period of time. Activities related to urbanization of the watershed can greatly increase the rate at which nutrient enrichment occurs. This accelerated aging of a lake is referred to as cultural eutrophication.



Trophic state is a measure of a lake's biological productivity (the total amount of plants and animals in the lake). As nutrient levels increase from natural or manmade sources, lakes progress to higher trophic states.



P³ Pointless Personal Pollution is avoidable and can be eliminated through awareness with little or no cost and minimal changes in our daily activities.

10

fish & wildlife

the Winter Park Chain of Lakes is home to a diverse assemblage of animal life

macro-invertebrates
The huge variety of organisms including crustaceans, insects and mollusks live that in, on or near the bottom of our lakes are collectively known as **benthic macro-invertebrates**.

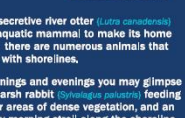


fish
Approximately 56 species of fish are found here, ranging in stature from the tiny and seldom-seen least killifish (*Heterandria formosa*) to the world-renowned largemouth bass (*Micropterus salmoides*).

reptiles
The largest reptile found here is the American alligator (*Alligator mississippiensis*). It shares our lakes with numerous species of turtles and snakes, including the red-bellied cooter (*Pseudemys rubrocapitata*).



mammals
While the usually secretive river otter (*Lutra americana*) is the only highly aquatic mammal to make its home on our waterways, there are numerous animals that associate strongly with shorelines.



Mornings and evenings you may glimpse a marsh rabbit (*Sylvilagus palustris*) feeding near areas of dense vegetation, and an early morning stroll along the shoreline may reveal evidence of the nocturnal foraging of a raccoon (*Procyon lotor*).



amphibians
True to their name, many amphibians like frogs and toads, utilize both terrestrial and aquatic habitats. The southern toad (*Bufo terrestris*) lives on land, but lays its eggs in lakes and ponds, which hatch into tadpoles (larval stage). The tadpoles then develop into adults and return to land.



birds
The great blue heron (*Ardea herodias*) is one of the many water dependent bird species that live and feed around our lakes. Winter Park is also home to a bird rookery that includes nests of common egrets (*Ardea alba*).



this trail made possible by a partnership between
ROLLINS
more info at
cityofwinterpark.org/lakes



ACKNOWLEDGEMENTS

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- JARED SEDLAK, EAGLE SCOUT CANDIDATE
TROOP 39

