



# **Ontario Greenhouse Strategies to Address Phosphorous in the Great Lakes**

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# Partners



# GREENHOUSE VEGETABLE AREA

## 2016

TOTAL AREA 2707 acres (1095 ha)

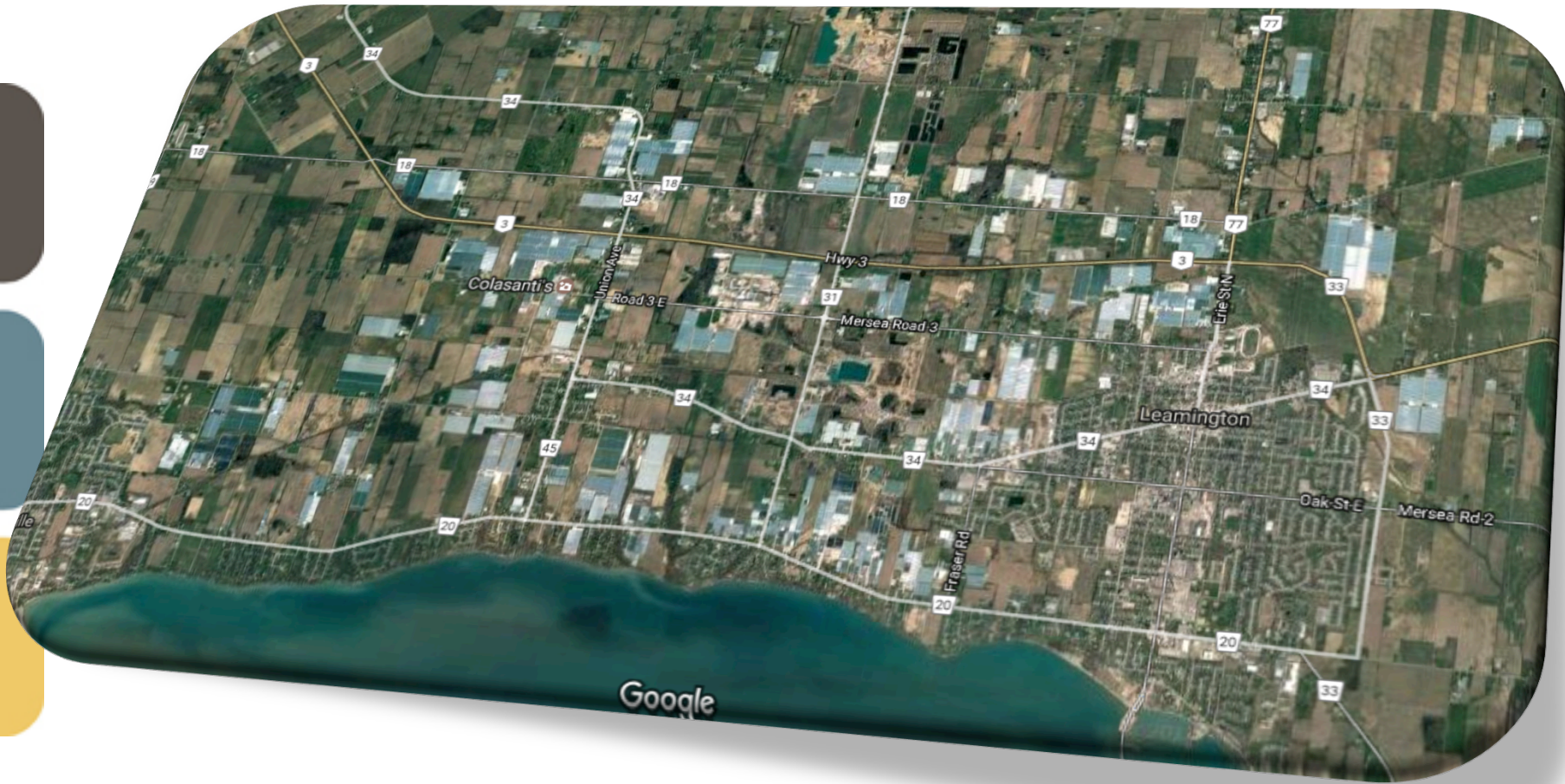
### Leamington Area

|          |               |
|----------|---------------|
| Tomato   | 943           |
| Cucumber | 656           |
| Pepper   | 828           |
| Total    | 2427 (982 ha) |
| Lettuce* | 2             |

### Rest of Province

|          |              |
|----------|--------------|
| Tomato   | 44           |
| Cucumber | 119          |
| Pepper   | 117          |
| Total    | 280 (113 ha) |
| Lettuce* | 7            |







# Key Goals

- Ontario supports **environmentally responsible agricultural practices** which ensure the health of our Great Lakes and competitiveness of our food producers.
- Ontario is delivering on its commitment to **reduce phosphorus entering the Central and Western Basins of Lake Erie by 40%.**
- We will achieve this goal through committed, **cooperative action from many sectors**, including municipalities, industry and government.
- The **agriculture sector has a role** to play in addressing this challenge, and is already showing leadership in developing and implementing government enabled solutions.
- Ontario is working in **collaboration** with multiple commodity groups and industry associations to find ways **to enable industry success.**

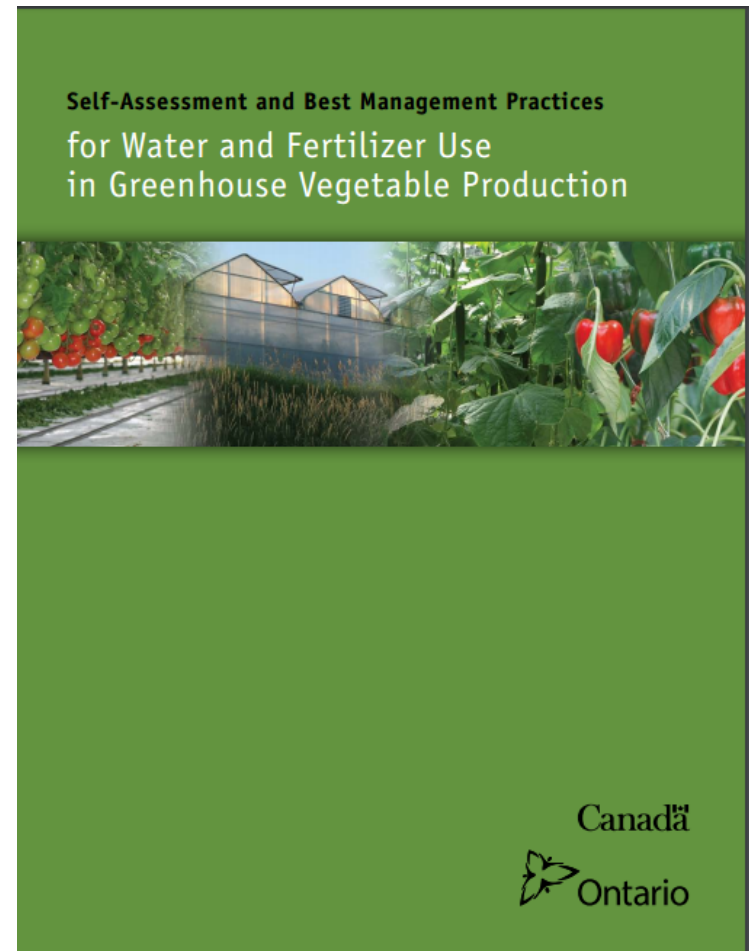
Effective and  
economical  
100% recycle  
of nutrient rich  
water in  
greenhouse  
operations



**“Water in Equals Water Out”**

# Actions

- Education sessions
  - Workshops
  - Study groups
  - Pilot projects
- Regulatory devices
  - NMA (Nutrient Management Act for GNF)
  - OWRA (Ontario Water Resources Act)
  - ECA (Environment Compliance Approval)
  - APS (Abatement Plans)





# Key Points

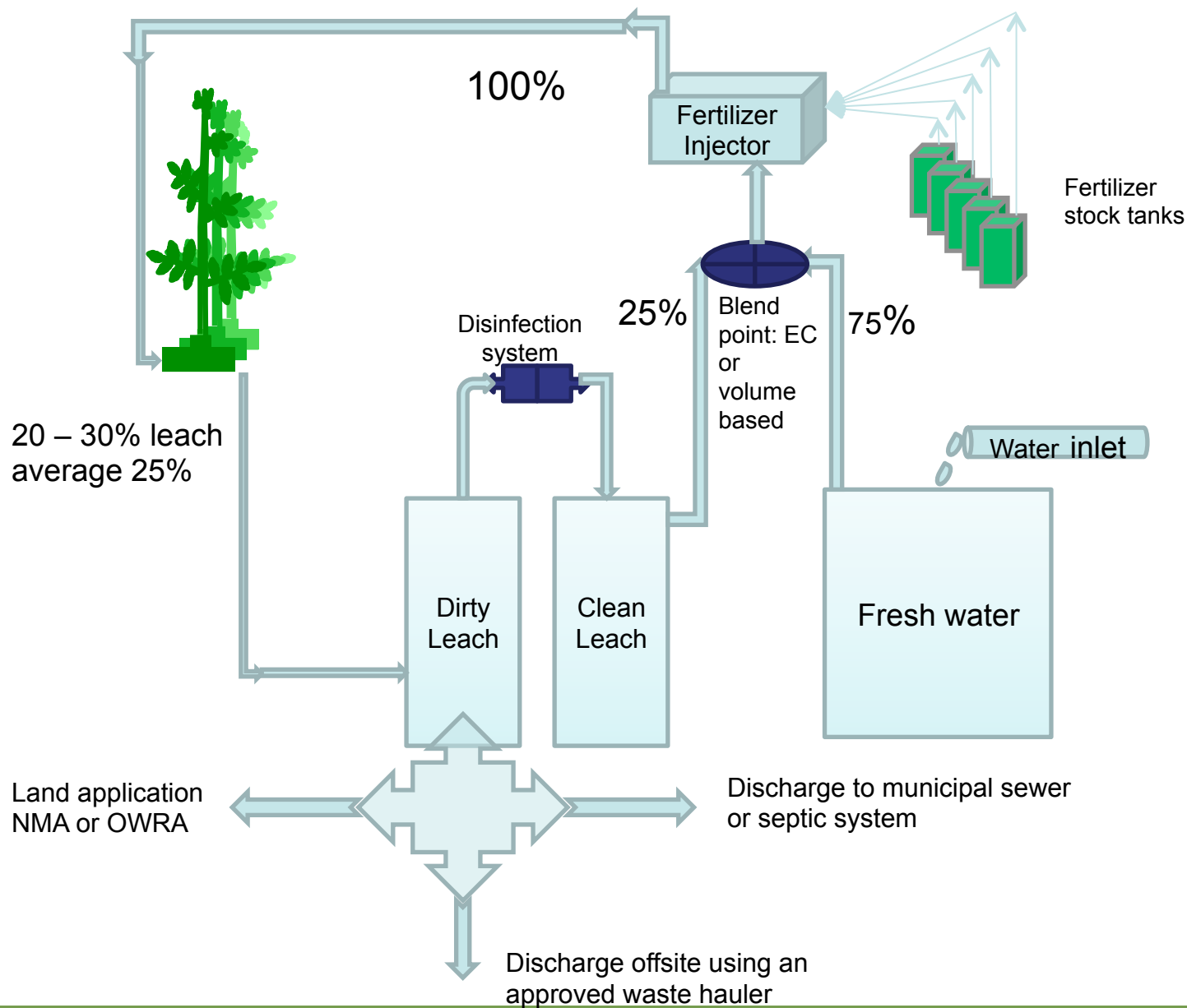
- Install an irrigation and collection system that is efficient in its delivery of the nutrient solution;
- Install a collection system that does not leak;



# Soilless Culture



Nutrient solution is captured,  
disinfected, amended and reused





# Nutrient Solution Disinfection Systems for Plant Pathogens



## Limit the buildup of the limiters;

- Precision Fertigation
  - Apply when the plant needs water
  - Apply the amount it needs and
  - Do not over leach
  - Alter the nutrient ratio to suit plant needs
  - Use *pure* fertilizers
  - Minimize non-essential elements

## What can be done?

- Inputs
  - Water use efficiency
  - High grade fertilizer
  - Better decisions
- Feedback system to computerized fertilizer injector
  - Specific ion sensors
  - Alpha Fourier Transform Infra Red Spectroscopy

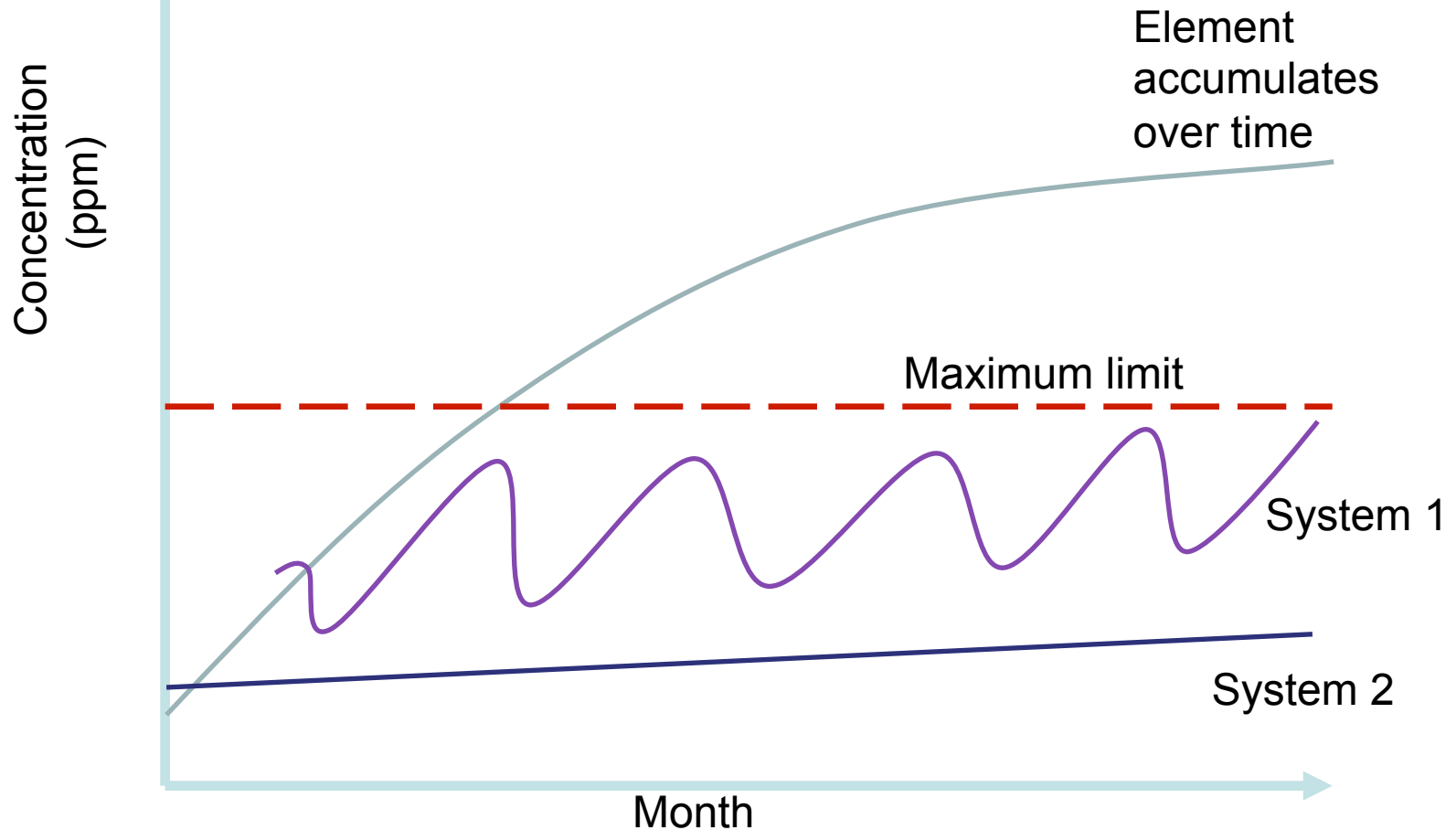




# Issues

- Selective uptake of nutrients by the plant
  - More  $\text{NO}_3$  at the start and then more K
- Some elements not taken up by the plants
  - Na, Cl,  $\text{SO}_4$
- Root exudates – sugars, proteins
- Build up of micro-organisms

# Element Increase During Growing Season in Greenhouse Nutrient Solution

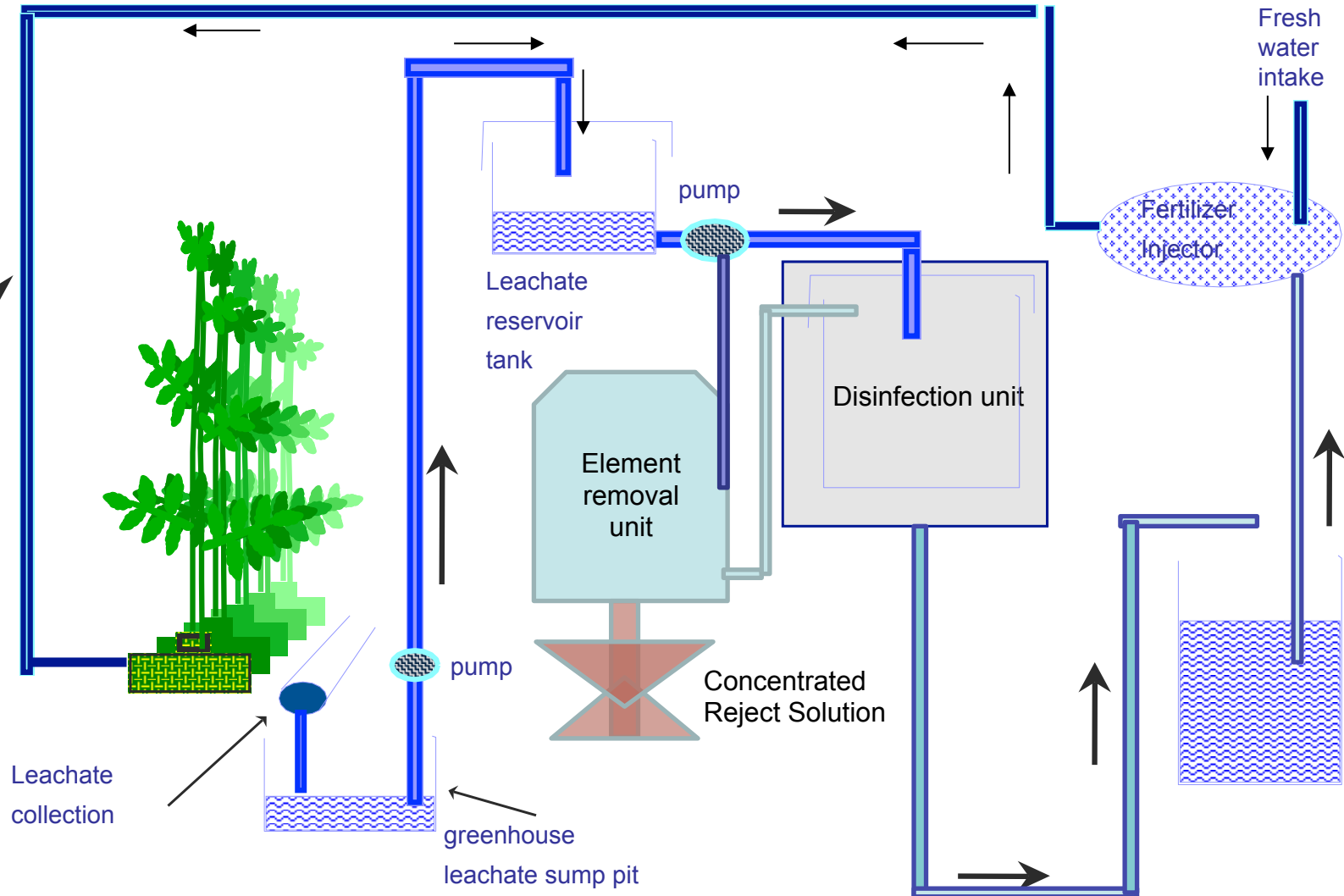


# Implement technologies designed to remove specific elements from the nutrient solution;

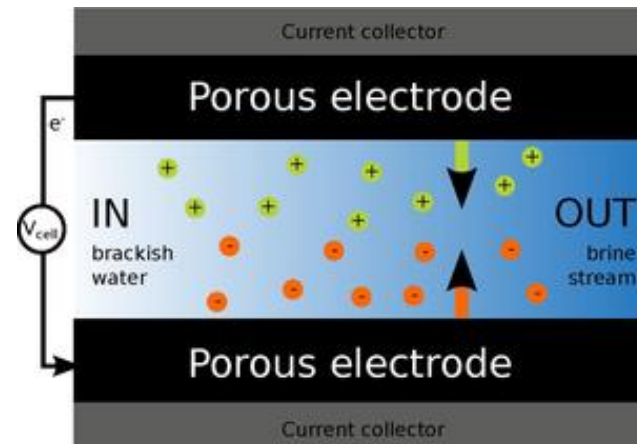
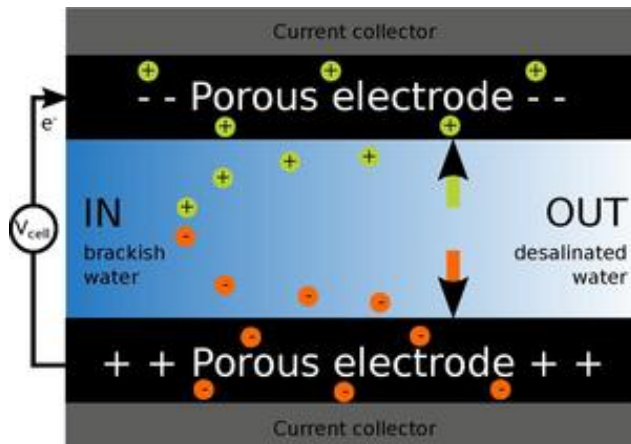
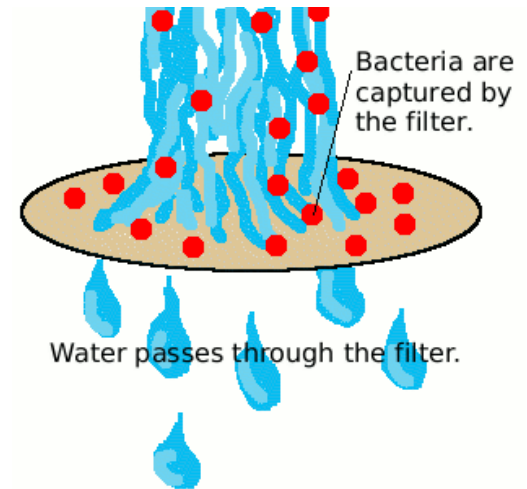
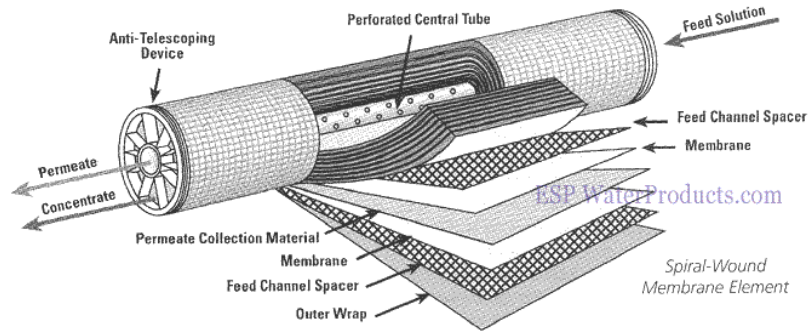
- Removal of selective elements
  - Allows water to be continually used
  - Issue
    - Discharge of unwanted elements/solutions
    - Alternative use



## Advanced setup for Nutrient Solution Recycling in the Greenhouse



# Pilot Projects





## High Concentrate

Further studies

Alternate use

Dry down and discard or recycle



Vertical Flow Constructed Wetland



## Pilot Projects 2

Biofuel irrigation



Woodchip biofilter



Vegetated Filter Strip



Algae Production



# Land Application

1. Apply greenhouse nutrient feed (GNF) water to land under:
  - a) the Nutrient Management Act
    - Strategy and plan
    - Certified personnel
    - Agreements by all parties
      - Generator
      - Receiver
  - or
  - a) Ontario Water Resources Act;

# Land Application







# Treatments

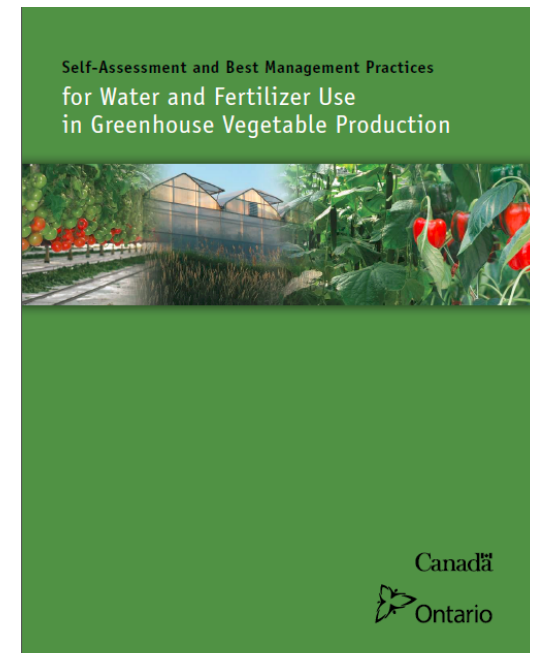
1. Release the GNF into the municipal sanitary sewage system or septic system designed to do so;
2. Truck to industrial facility where it is treated.





# Summary

- Alternate crops
- Land application under the NMA or OWRA
  - Strategy and plan
  - Certified personnel
  - Agreements by all parties
    - Generator
    - Receiver



- Improve water and fertilizer use efficiency
- Increased vigilance to nutrient solution composition
- Eliminate all leaks
- Larger tanks to hold the excess leachate and reuse and better management
- Sewer system
- Land application



# Key Points

1. Install an irrigation and collection system that is efficient in its delivery of the nutrient solution;
2. Install a collection system that does not leak;
3. Limit the buildup of the limiters;
4. Implement technologies designed to remove specific elements from the nutrient solution;
5. Apply greenhouse nutrient feed (GNF) water to land under:
  - a) the Nutrient Management Act or
  - b) Ontario Water Resources Act;
6. Release the GNF into the municipal sanitary sewage system or septic system designed to do so;
7. Truck to industrial facility where it is treated.

