VT Phosphorus Innovation Challenge

Integrating Technologies to Achieve Economical Phosphorus Removal and Redistribution

Vermont Organic Recycling Summit (VORS) Presentation, April 2019

Brian Jerose, President

Agrilab Technologies Inc.

VORS 2019 Session Topics:

What do you see as the role of composting and your specific method in addressing issues related to climate change and the demand for even greater agricultural productivity?

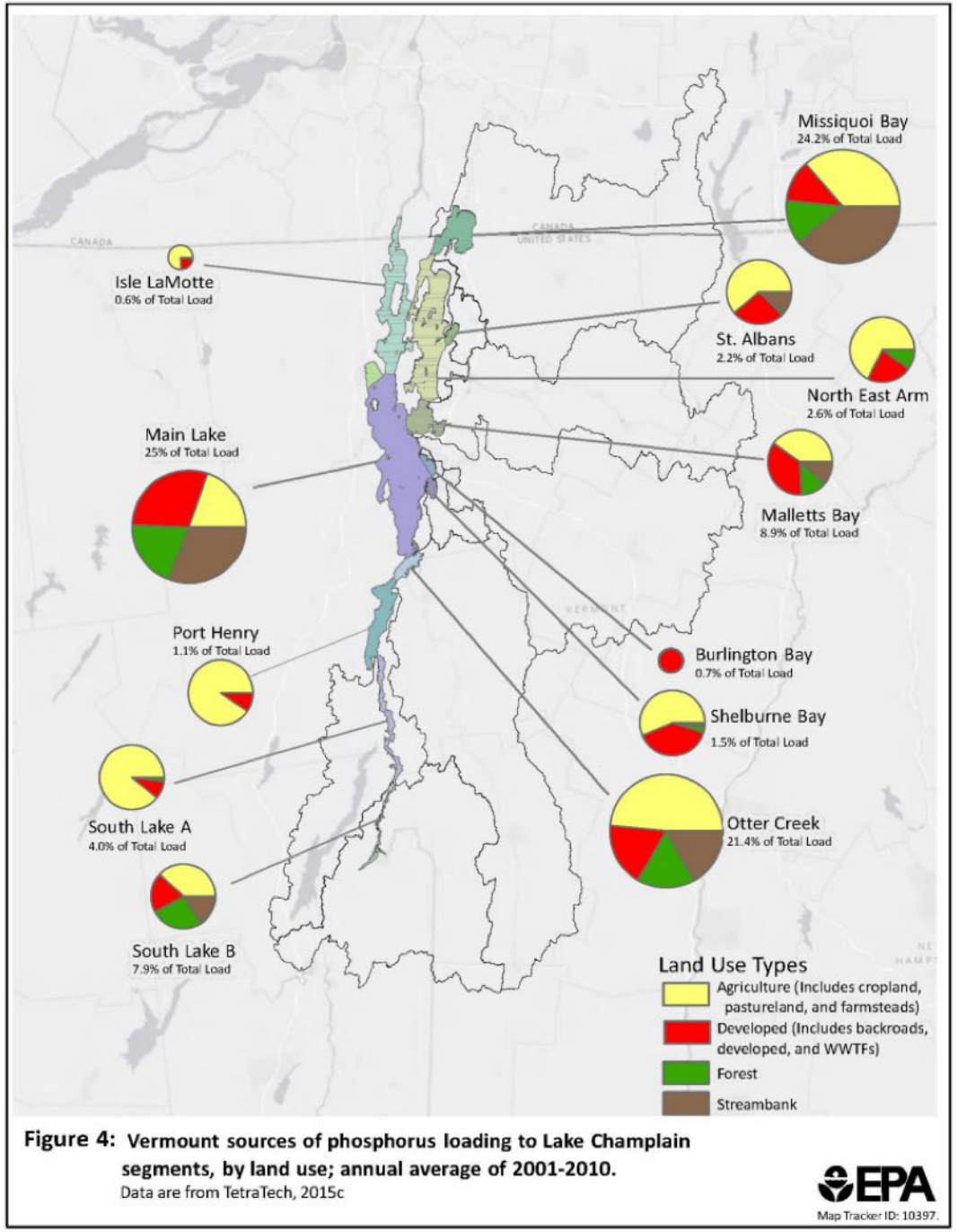
How do you think about input management for your process to reduce the risk of contamination and to ensure that you get a high quality output?

VERMONT CLIMATE OBSERVATIONS

- It is getting wetter. There has been a 9” increase in average annual precipitation over the past century
- Northern Vermont is becoming wetter at a faster rate than southern Vermont
- Very heavy precipitation events are more common, increasing 71% from 1958-2012 in the Northeast
- There was a 2.5°F (approx.) increase in annual average temperature in VT over the past century
- The VT growing season has increased by 3.7 days/decade
- Winter extreme minimum temperatures have become less cold across the Northeast
- https://www.uvm.edu/sites/default/files/media/FarmCCQuickFacts_0.pdf

Phosphorus (P) Sources

- Missisquoi Basin is key among Lake Champlain tributaries
- Reductions required around the lake basin
- P loads connected to land use



P Concentrations and Goals (Criteria)

- Note increasing P concentration trends and current failure to achieve in-lake concentration criteria (especially Missisquoi)
- Weather, Specific Land Uses and “Sensitive Landscapes” have increased P loading
- In some basins these negatives have outweighed positive conservation practices
- Time-lag of P reduction response in the lake

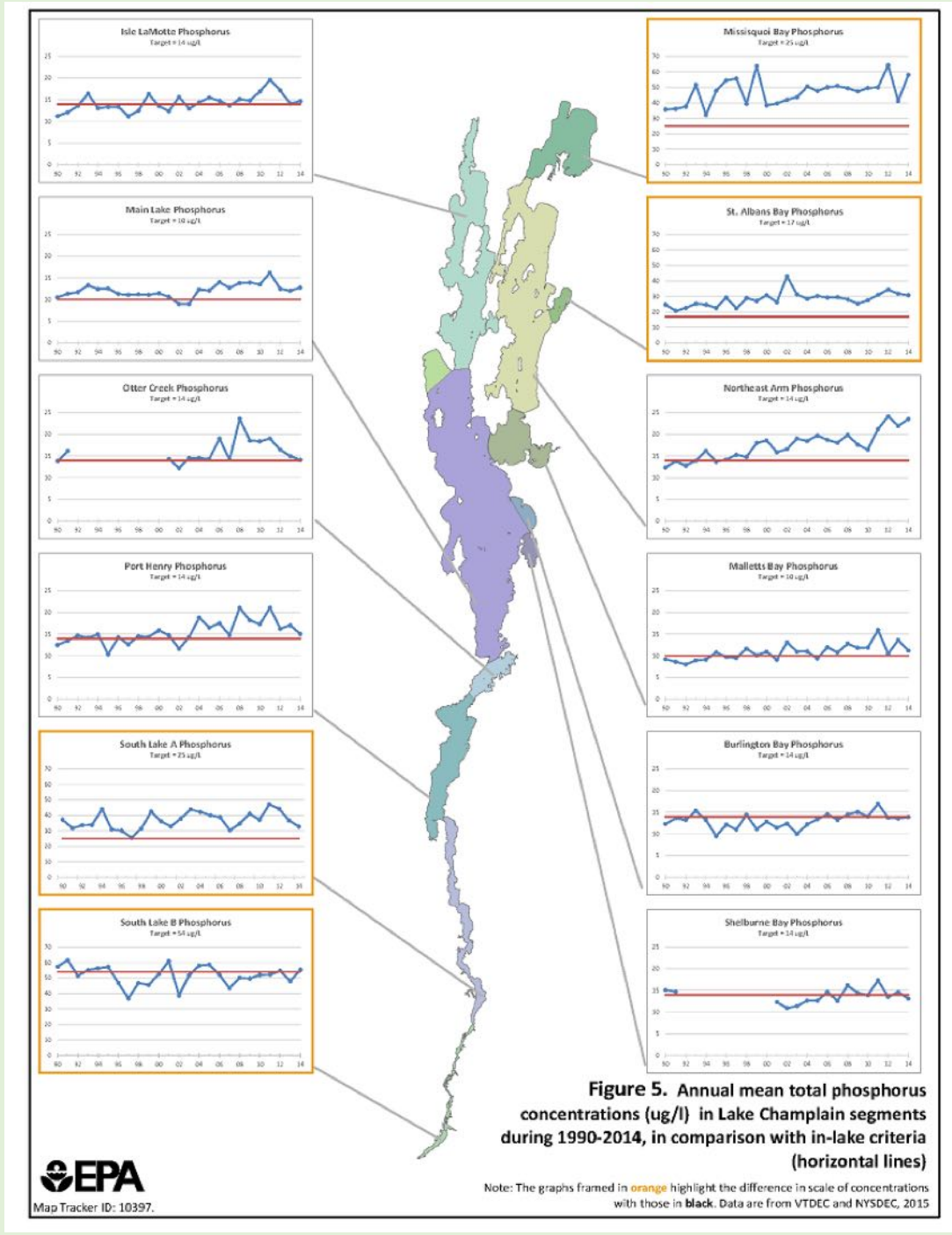
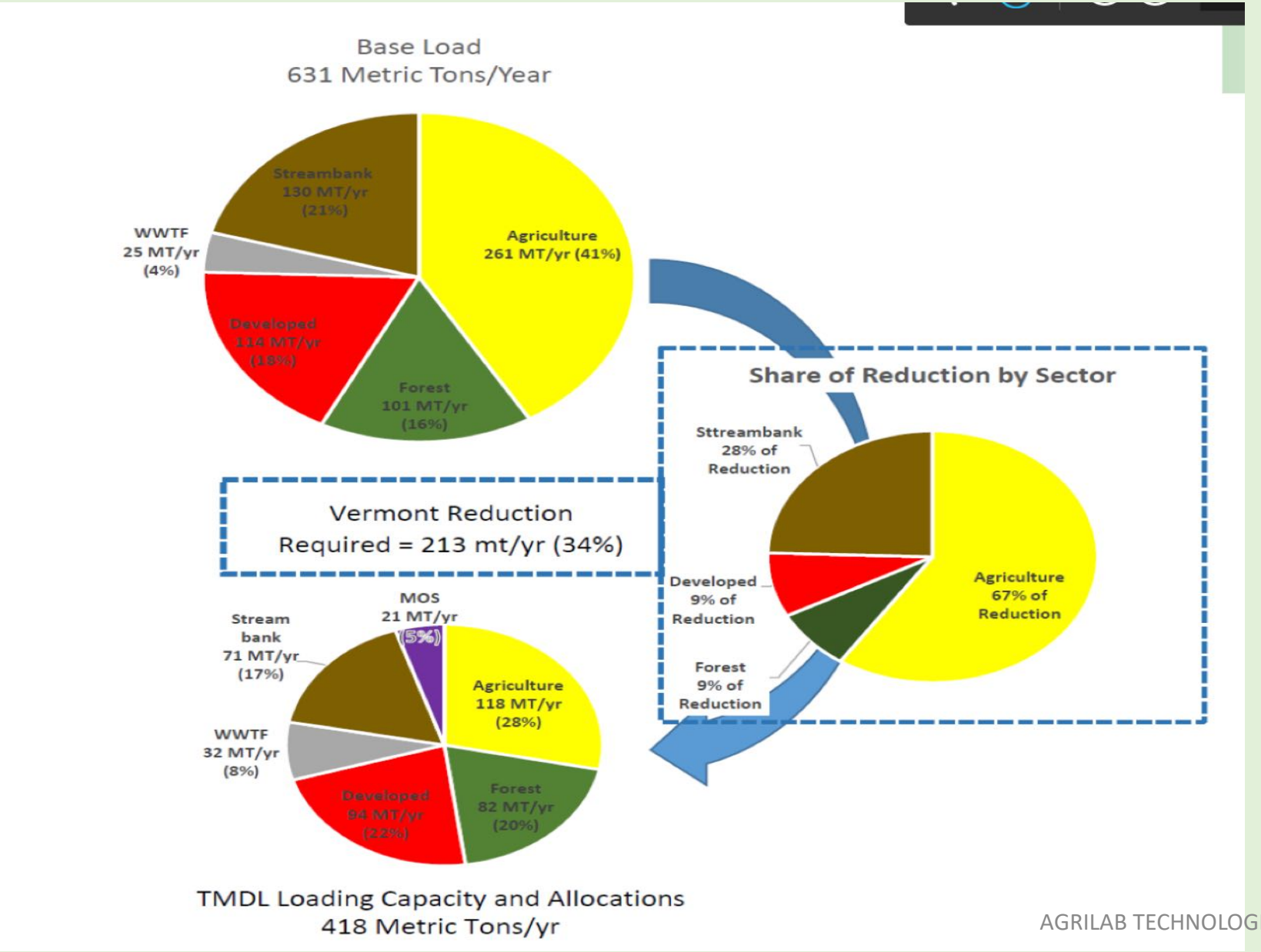


Figure 5. Annual mean total phosphorus concentrations (ug/l) in Lake Champlain segments during 1990-2014, in comparison with in-lake criteria (horizontal lines)

Note: The graphs framed in orange highlight the difference in scale of concentrations with those in **black**. Data are from VTDEC and NYSDEC, 2015

VT and EPA Base P-Loads and Reduction Targets



Scale of the Agreed Upon Reductions

Load Allocation (% reduction)

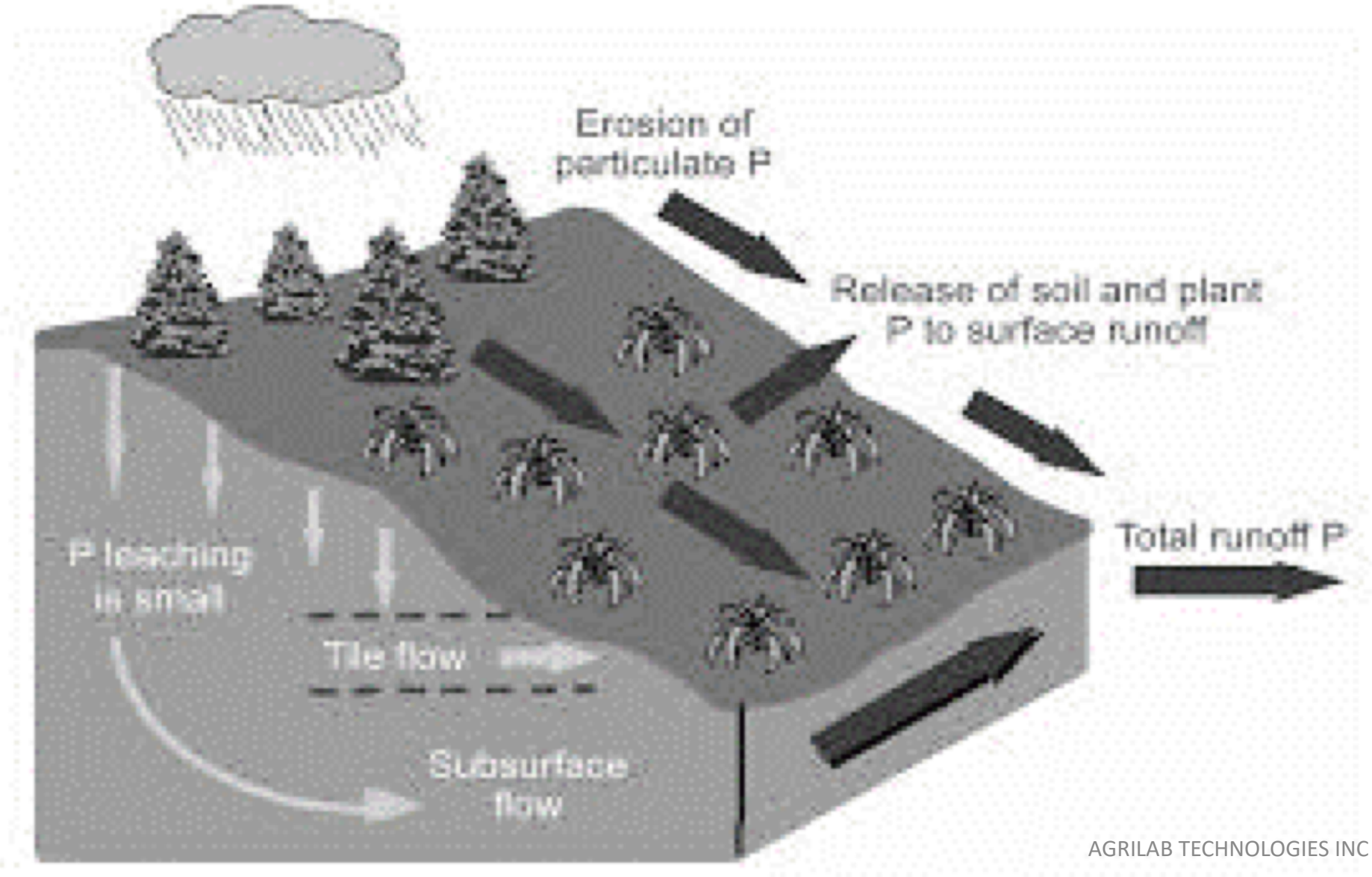
Lake Segment	Forests	Stream corridors	Agriculture
1. South Lake B	60.0%	30.5%	60.7%
2. South Lake A	5.0%		60.2%
3. Port Henry	5.0%		21.1%
4. Otter Creek	5.0%	40.1%	47.9%
5. Main Lake	5.0%	28.9%	49.1%
6. Shelburne Bay	5.0%	55.0%	22.2%
7. Burlington Bay	0.0%		0.0%
9. Malletts Bay	5.0%	44.9%	27.6%
10. Northeast Arm	5.0%		22.0%
11. St. Albans Bay	5.0%	55.0%	35.4%
12. Missisquoi Bay	60.0%	65.3%	82.6%
13. Isle LaMotte	5.0%		22.3%

Missisquoi Bay Basin – Largest Reduction Target

TMDL Equation (reduction requirements)

Lake Segment	WWTF	Develop-ed Land	Ag Prod Area	Forest	Streams	Ag	Total Overall
1. South Lake B	0.0%	23.7%	80.0%	60.0%	30.5%	59.5%	43.4%
2. South Lake A	0.0%	21.0%	80.0%	5.0%		59.5%	52.7%
3. Port Henry		10.6%	80.0%	5.0%		20.0%	15.8%
4. Otter Creek	0.0%	22.2%	80.0%	5.0%	40.1%	46.9%	24.7%
5. Main Lake	61.1%	23.8%	80.0%	5.0%	28.9%	46.9%	21.3%
6. Shelburne Bay	64.1%	21.3%	80.0%	5.0%	55.0%	20.0%	12.5%
7. Burlington Bay	66.7%	38.1%	0.0%	0.0%		0.0%	30.5%
9. Malletts Bay	0.0%	26.3%	80.0%	5.0%	44.9%	23.9%	17.6%
10. NE Arm		9.8%	80.0%	5.0%		20.0%	13.0%
11. St. Albans Bay	59.4%	9.8%	80.0%	5.0%	55.0%	34.3%	24.3%
12. Missisquoi Bay	51.9%	30.1%	80.0%	60.0%	65.3%	82.8%	64.3%
13. Isle LaMotte	0.0%	12.0%	80.0%	5.0%		20.0%	12.4%
Total	42.1%	24.1%	80.0%	23.4%	43.4%	51.5%	33.8%

Phosphorus movement through the landscape



Field Level – Transport of P

Small percentage of a field's total acreage is typically in flow areas

Floodplains – Most obvious "hydrologically sensitive area"

Corn and hay fields under water in the Black Creek Watershed/Missisquoi River Basin, Winter 2019

Flow Paths – Flow Accumulation Areas:

sufficient flow to transport P

Reducing P Transport

- Timing and Placement of Manure Applications
- Reducing or Eliminating Tillage in Flow Areas
- Maintaining Vegetative Cover
- Building Soil Organic Matter levels and increasing soil moisture infiltration and storage capacities
- Addressing P mass balance via feed, manure, fertilizer, soil loss and other sources
- Planning for the “rainy day” – in most years THE MAJORITY OF PHOSPHORUS IS TRANSPORTED TO THE LAKE IN ONLY 10 TO 15 DAYS.

Barriers The VPIC Project Seeks to Address

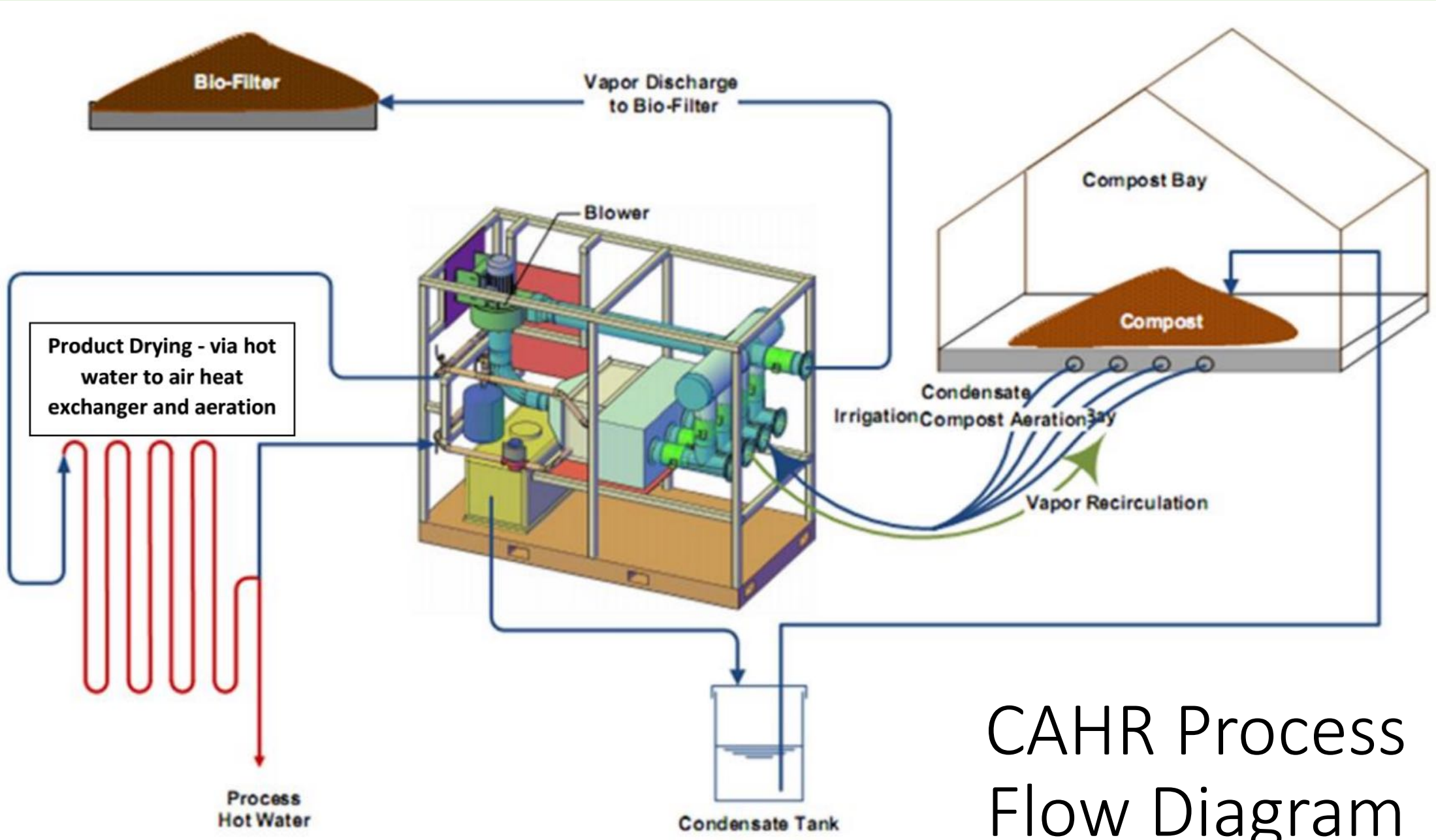
- P removal and concentration is technically feasible – examples in VT and beyond but not widely adopted
- P cake/concentrates are currently expensive to produce with few incentives for dairy farmers to install systems
- Marketplace has minimal awareness and demand for these products
- Materials are dense with high moisture, and have high trucking costs
- New supply chains must be created from source production, value-added processing, transportation/distribution to consumer end-use
- Bulk commodity outlets as well as bagged retail channels need development, from end-use demonstrations to determining price points

Agrilab Technologies Inc. (AGT)
Stage II Project Summary

- Conduct composting and drying batch demonstrations of concentrated phosphorus (P) materials, separated dairy manure solids and blends with other agricultural and forestry biomass
- Build on the existing compost aeration and heat recovery (CAHR) process for value-adding and stabilization including utilization of renewable thermal energy for drying P cake, filtered concentrate and similar residuals
- Conduct parallel market evaluation for bulk products within VT and for bagged products in conjunction with VT Natural Ag Products (VNAP)
- Prototyping and other proposed tasks chosen to determine both technical and economic feasibility of multiple P-products and pathways to scale operations in Franklin County and all of VT

AGT Modular Compost Aeration and Heat Recovery (CAHR) Systems Suitable for Both Prototyping Phase and to Scale P-Processing Around VT

Aeration Pipe Assembly in Boston



CAHR Process Flow Diagram

Residuals to be Processed

- Centrifuge solids (cake) from Machia and Sons Dairy
- Concentrate from Digested Organics ultrafiltration unit
- Separated dairy manure solids as baseline/ control (manure slurry dewatered via screw press)

AGT Hot Box 250-R connected to aeration vapor pipes, plumbing, electrical and data

- Vermont Natural Ag Products Inc. (VNAP)
- Location for Stage II Prototyping in Middlebury, Vermont
- 10 acre certified composting facility with stormwater collection
- Makers of MooDoo and other compost/mulch/soil products sold in 12 northeastern states

Aeration Pipes Installed at VNAP for Active Composting or Batch Drying

Covered facility available for batch drying prototyping at VNAP

Project Tasks Timeline

Agrilab Technologies Inc. - Proposed Timeline

Vermont Phosphorus Innovation Challenge (VPIC)

Jun-18

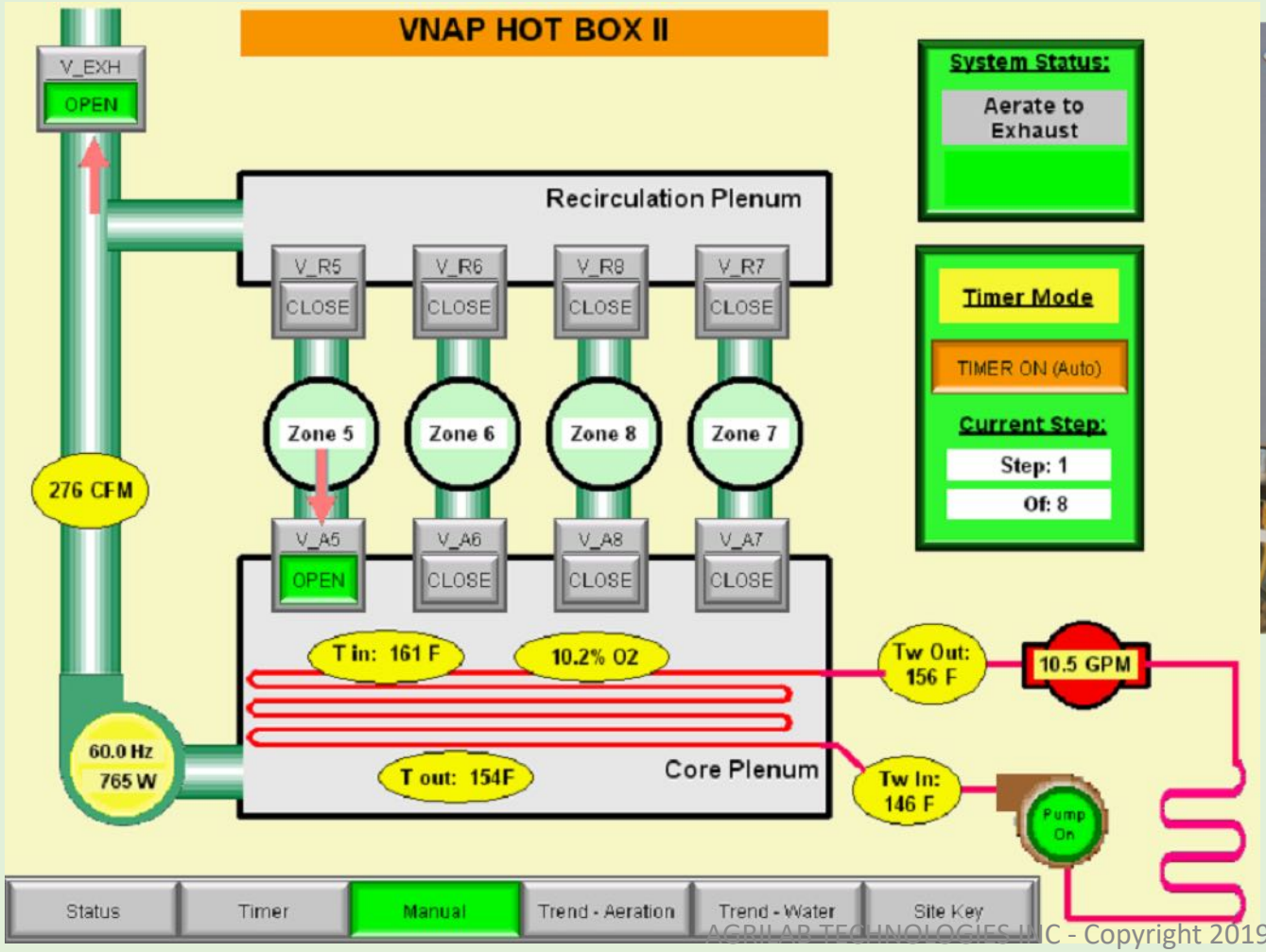
Revised April 2019

					Months Starting 2018							2019						
Order	Subject	Activity	Plan Start	Plan Duration	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1.1.1	Stage 1 preparation/development	Submission	6/29/18	1														
1.1.2	Stage 1 preparation/development	Submission - supplemental letters of support	7/6/18	1														
1.2.1	Review	Responses to reviewer questions	7/7/18	1														
1.2.2	Review	In-person interview	8/6/18	1														
2.1.1	Agreement Details	Revisions to Scope of Work if Needed	11/20/18	2														
2.2.1	Project Kick-off Meeting	Conference call to coordinate project team	12/21/18	1														
2.3.1	Procure materials/equipment	Prototyping ductwork, sensors, controls	1/9/19	2														
2.3.2	Team, vendor, sub coordination	Feedstock logistics, scheduling technicians	1/5/19	3														
2.3.3	Physical Batch Testing	Conduct processing trials	4/26/19	3														
2.3.4	Analytical Testing	Sample feedstocks and product mixes	4/26/19	3														
2.4.1	Market Analysis	Initial product selection for prototyping	1/12/19	2														
2.4.2	Market Analysis	Retailer outreach/interview - bagged line	2/4/19	5														
2.4.3	Market Analysis	Farmer/grower outreach - bulk products	1/10/19	6														
2.5.1	Economic Modeling	Cost tracking - processing	3/6/19	4														
2.5.2	Economic Modeling	Price projections - market feedback	3/13/19	4														
2.5.3	Economic Modeling	P mass balance projections and cost/lb P	3/13/19	3														
2.5.4	Economic Modeling	Facility pro-formas for implementation at scale	4/8/19	3														
2.6.1	Reporting	Draft final report	6/3/19	1														
2.6.1	Reporting	Final report	7/8/19	1														

How is Agrilab Technologies Inc. (AGT) ready to address VPIC needs?

- Strong core team with skills specific to all phases of design through implementation for composting, manure management and watershed protection projects
- Solutions focused experience in R&D, technical assessments and delivery of reports
- References from existing customers confirm ability to deliver quality, cost-effective systems and provide on-going service
- History of collaboration with Foster Brothers Farm/VNAP, watershed groups, state and federal agencies

On-site and remote data collection and control enable efficient operation and tracking



How Does This Lead Towards Reducing P Pollution at Meaningful Scale in VT?

- Stage II tasks have been selected to find most cost-effective practices to add value and stabilize P-cake and P containing residuals
- P-fortified composts, dehydrated P-cake and other blends will be selected from larger potential suite of bulk and bagged products
- Economic feasibility and market assessment will provide detail for product pricing, crop field trials and other market development needs
- Information is intended to identify equipment, infrastructure, labor and other needs to plan and develop Franklin County farm-based and commercial P-processing facilities to compliment VNAP capacity

Thank You!

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