MWEA Biosolids Conference

Biosolids Facility Planning:
One Approach, Three Communities

March 13, 2019

DONOHUE

Outline

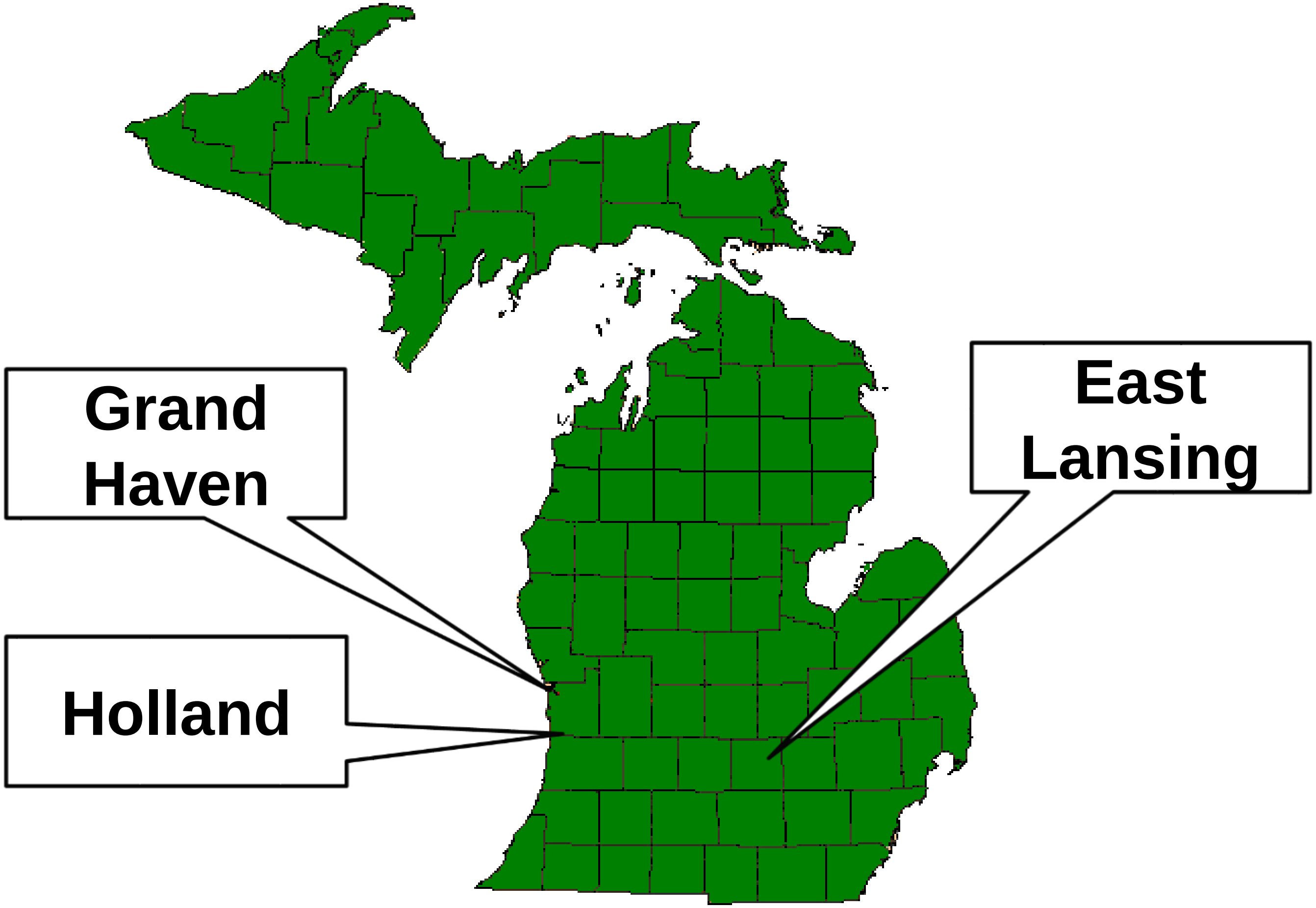
- Background
- Facility Overviews
- Driving Factors
- Approach
- Key Alternatives Comparison
- Outcomes
- Lessons Learned

Biosolids Facility Planning

Goal: provide a planning document that guides upgrades to a water reclamation facility's solids treatment train over time.

- Understand future solids production
- Evaluate potential biosolids treatment technologies
- Plan implementation strategy
- Prepare biosolids facility plan report

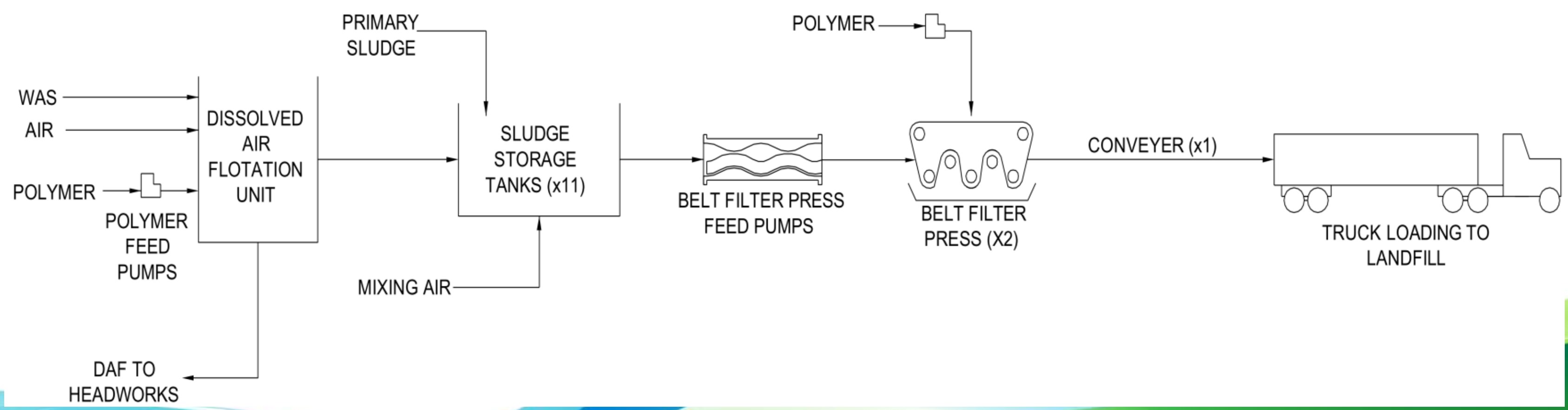
Three Communities



East Lansing

- Biosolids Master Plan completed in 2017
- Average day flow: 12.3 MGD
- Design capacity: 18.75 MGD
- Conventional Activated Sludge

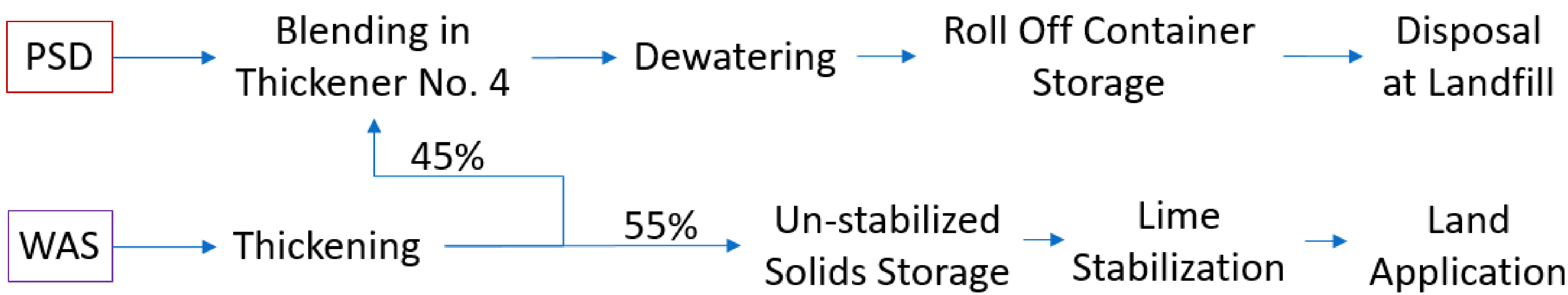
Solids Handling System



Holland

- Biosolids Alternative Evaluation completed in 2018
- Average day flow: 9 MGD
- Design capacity: 12 MGD
- High-Purity Oxygen Activated Sludge System

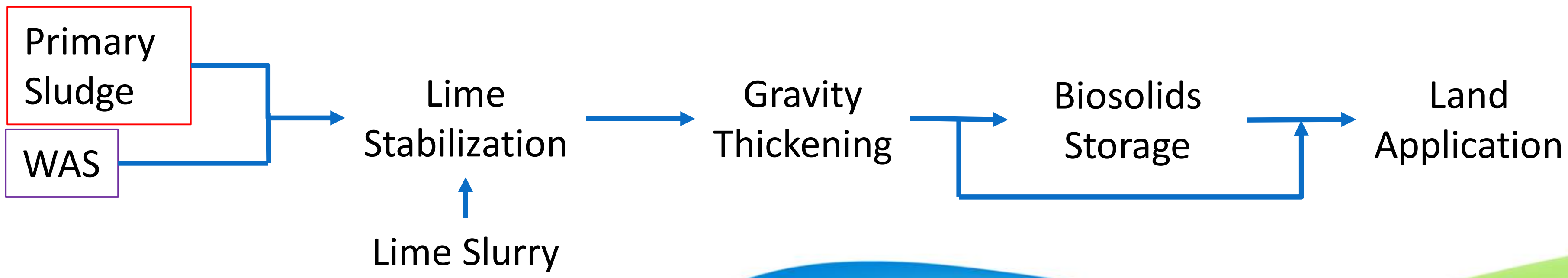
Solids Handling System



Grand Haven

- Biosolids Alternative Evaluation completed in 2018
- Average day flow: 3.7 MGD
- Design capacity: 6.67 MGD
- Conventional Activated Sludge

Solids Handling System



Driving Factors

East Lansing	Holland	Grand Haven
• Aging equipment • Increase process redundancy • Potential to reduce biosolids disposal costs • Improve WRF sustainability	• Increasing solids load • Reaching capacity of existing storage • Rising landfilling fees • Restrictions on solids sent to landfill	• Reaching capacity of existing storage due to limited biosolids load out • Desire for increased disposal flexibility • Interest to move away from lime stabilization

Biosolids Facility Plan Approach

- Assess existing system
- “Universe of Possibilities”
- Short List of Potential Solutions
- Economic and non-economic evaluation of potential solutions
- Selection of final solutions
- Implementation planning

Assess Existing System

- What is the expected solids loading over the planning period?
  - Existing flow or loading projections
  - Projected population growth
- What is the capacity of existing equipment?
  - Is the existing equipment capacity sufficient for the projected solids loading?
- What are existing process deficiencies?
  - Equipment age
  - Consistent operating challenges
  - Frequent repairs

"Universe of Possibilities"

- Thickening Equipment
  - Dissolved Air Flotation
  - Gravity Belt
  - Rotary Drum
  - Centrifuge
- Dewatering Equipment
  - Belt Filter Press
  - Screw Press
  - Rotary Fan Press
  - Centrifuge
- Digestion
  - Aerobic
  - Anaerobic
  - TPAD
  - Two-Phase Acid
- Thermal Chemical Hydrolysis
  - Lystek
  - Cambi
  - Pondus
- Lime Stabilization
- Composting
- Drying
  - Rotary Drum
  - Belt
  - Paddle
  - Fluidized Bed

Short List of Potential Solutions

- Thickening Equipment
  - Dissolved Air Flotation
  - Gravity Belt
  - Rotary Drum
  - Centrifuge
- Dewatering Equipment
  - Belt Filter Press
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  - Belt
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Alternatives Comparison

- Thickening
- Dewatering
- Anaerobic Digestion
- Thermal Chemical Hydrolysis Processes
- Drying

Thickening Technology Comparison

	Dissolved Air	Gravity Belt	Rotary Drum	Centrifuge
Advantages	• Continuous, unattended operation • Low polymer usage	• Tried and true technology • Non-enclosed process – can easily observe thickening	• Totally enclosed – dry environment • Fully automated	• Enclosed design • Low polymer usage • Fully automated
Disadvantages	• Large footprint • Requires compressed air	• Wet environment • High polymer requirements	• High polymer usage	• May depend on sludge characteristics • High energy requirement • Higher capital cost

Dewatering Technology Comparison

	Belt Press	Screw Press	Rotary Fan Press	Centrifuge
Advantages	• Tried and true technology • Low energy use • Lower capital and O&M cost	• Enclosed design • Low energy use • Fully automated	• Enclosed design • Low energy use	• Enclosed design • Low polymer usage • Fully automated
Disadvantages	• Non-enclosed design • Sensitive to incoming sludge characteristics	• Large polymer demand • Requires wash water	• High capital and operating costs • Not easily scalable for larger facilities	• May depend on sludge characteristics • High energy requirement • Higher capital cost

Anaerobic Digestion

Advantages

- ✓ Energy generation
- ✓ Reduces mass of biosolids for storage and land application
- ✓ No chemical usage

Disadvantages

- × Large footprint
- × Large capital cost
- × Increased operational complexity
- × Class B application requirements/constraints
- × Odor concerns

Thermal Chemical Hydrolysis

- Anaerobic digestion pretreatment techniques that convert organic solids into soluble compounds by applying heat and pressure
- Increases digestibility, reduces digester sizing, increases biogas production, changes biosolids viscosity, and provides biosolids stabilization
- Commercialized processes provide equipment packages for thermal hydrolysis
  - Pondus, Cambi, Lystek

TCHP Technology Comparison

	Pondus	Cambi	Lystek
Advantages	• Minimizes reactor volume by treating only WAS • Utilizes a hot water supply as the heating source	• No chemical addition required • Pre-heating from Cambi may be sufficient to fully heat digester	• Potential for stand-alone treatment process • High solids content Class A liquid product
Disadvantages	• Cannot produce Class A product because primary sludge is not sent to TCHP	• Highest heat requirement, relying on high pressure steam for heat • For cake production, requires multiple dewatering steps	• Stand-alone process requires high chemical addition • Lystek re-circ may increase digester sizing • Uses steam for additional heat after digestion

Drying Technology Comparison

	Belt Dryer	Paddle Dryer	Fluidized Bed
Advantages	• Lower temp • Simple operation • Potential reuse of waste heat • May not require biosolids cooling	• Smaller footprint • Single pass process • Minimum air handling • Lower vertical profile	• Smaller footprint • High quality end product • Good thermal efficiency
Disadvantages	• Large footprint • Less desirable end product	• High temperatures • Non-uniform end product • Internal moving parts	• High temperatures • Requires recirc. of dried product • Potential for short circuiting

Equipment Sizing

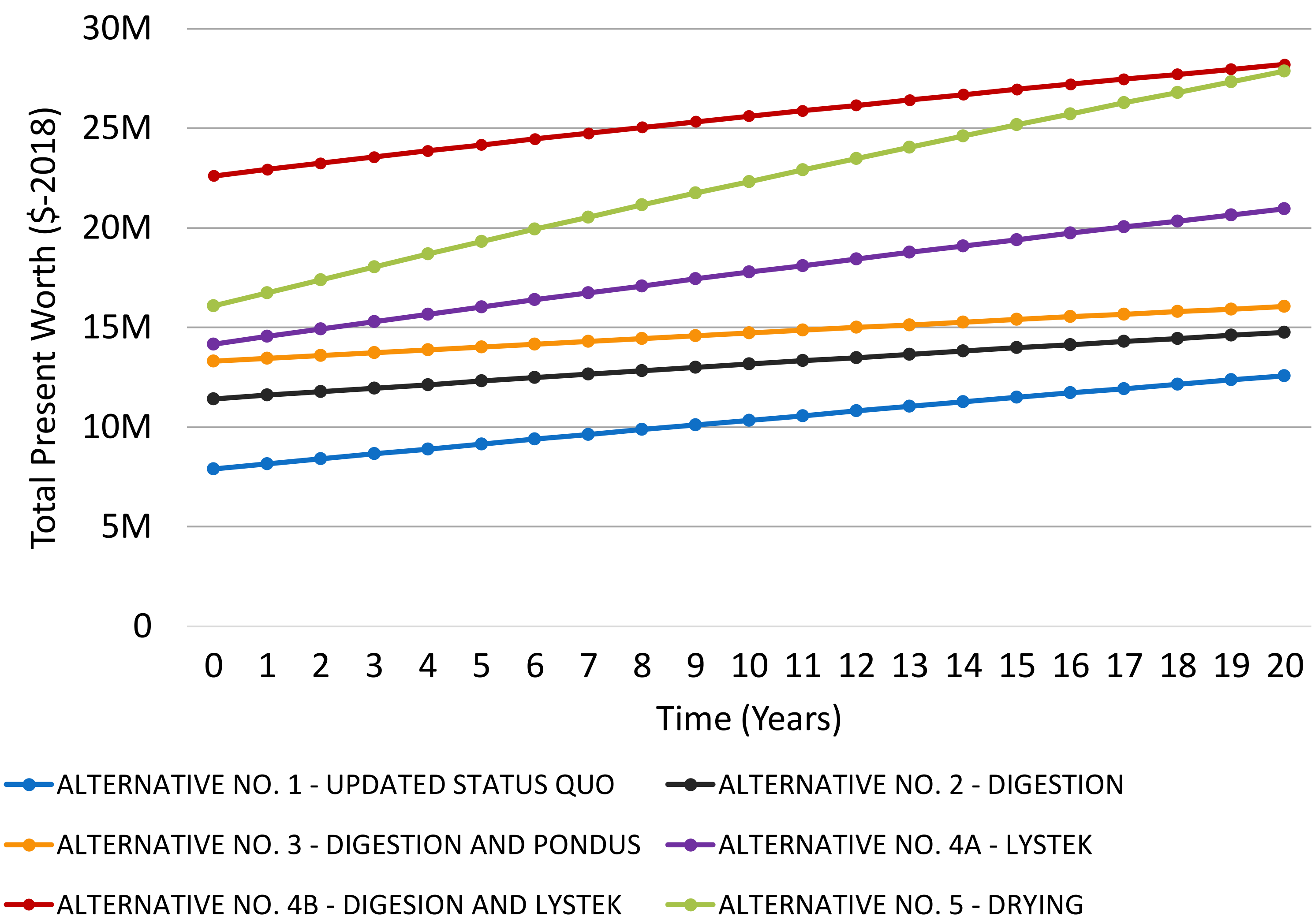
- Solids production is continuous, but operation of solids treatment equipment may not be
- Equipment and storage sizing must be selected based on the desired operating strategy

Parameter	Units	4 Hours/Day	8 Hours/Day	12 Hours/Day
Daily Solids Production	ppd	15,000	15,000	15,000
Hours Operated per Day	hr	4	8	12
Equipment Loading	pph	3,750	1,875	1,250

Economic Analysis

- Capital Cost
- Annual Operating Costs:
  - O&M
  - Disposal
  - Polymer/Chemical
  - Electricity
  - Natural Gas
- Potential for revenue generation or energy offset
- Total Present Worth

Total Present Worth



Non-Economic Analysis

Qualitatively discuss advantages and disadvantages

OR

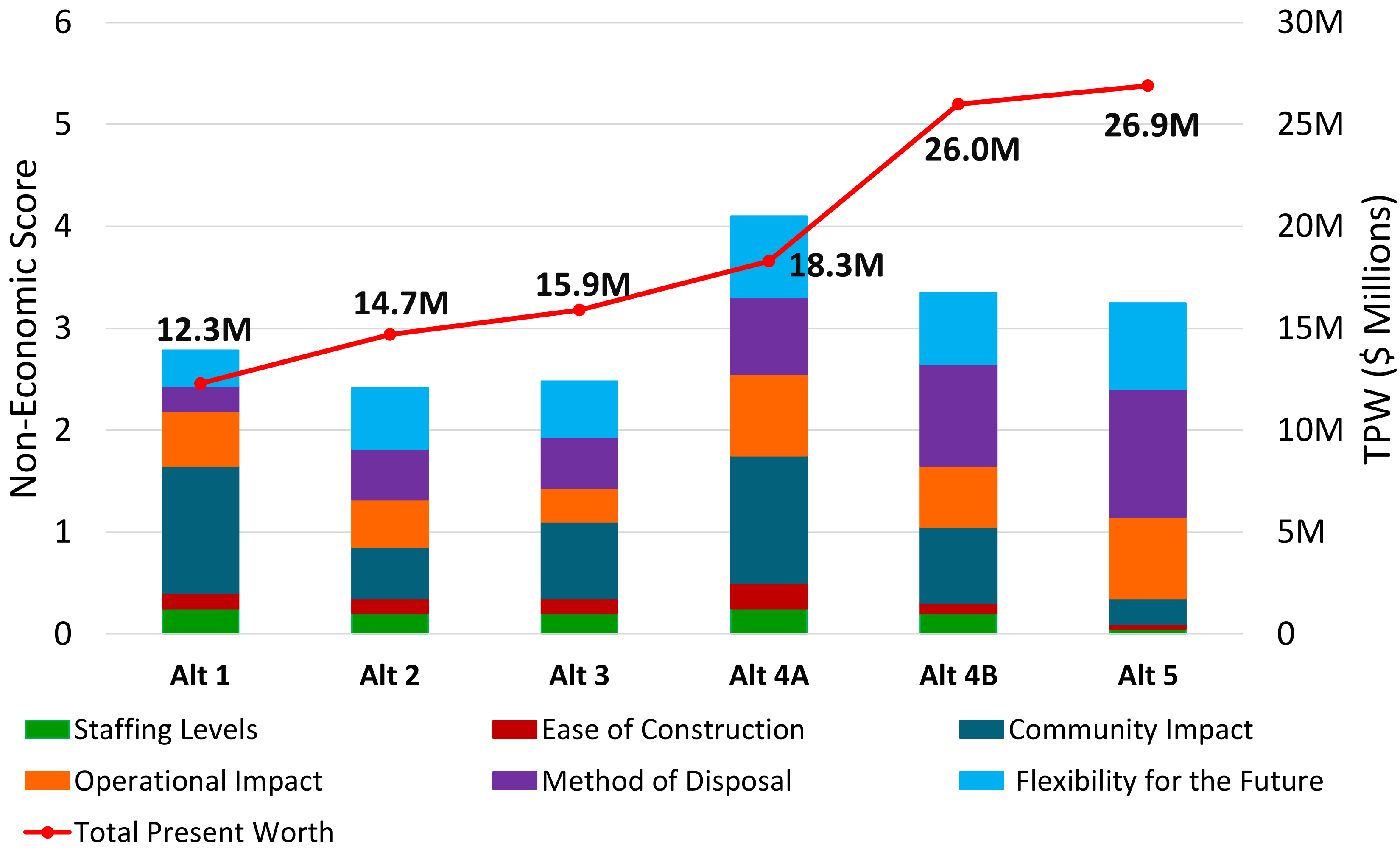
Select key performance criteria and assign a score for the performance of each alternative

Potential Non-Economic Factors	
Odor generation	Flexibility for future changes
Land availability for biosolids	Plant traffic
Regulatory acceptance	Renewable use of biosolids
Operational simplicity	Construction consideration
Operational redundancy	Staffing level

Non-Economic Scoring

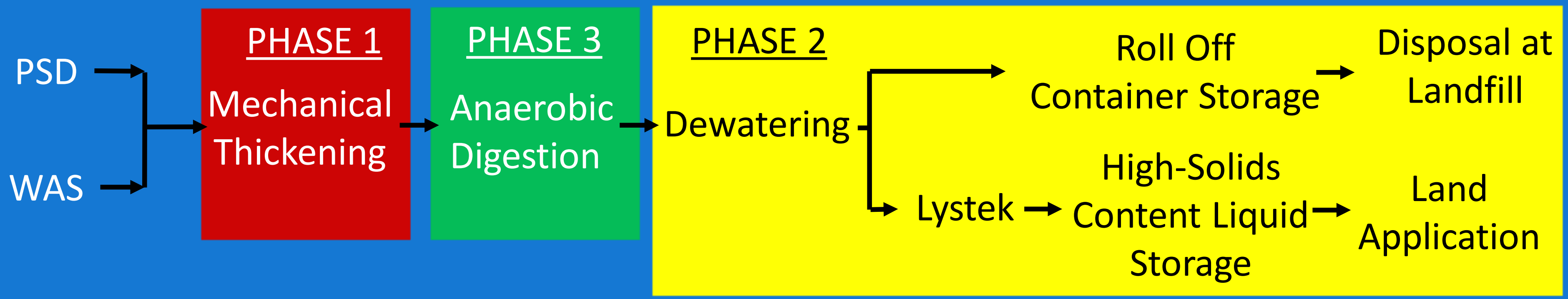
Non-Economic Factor	Weight	Alt 1 Upgraded Status Quo	Alt 2 Anaerobic Digestion	Alt 3 Anaerobic Digestion + Pondus	Alt 4A Lystek	Alt 4B Anaerobic Digestion + Lystek	Alt 5 Drying
Raw Score (1 to 5)							
Staffing Levels	5%	5	4	4	5	4	1
Ease of Construction	5%	3	3	3	5	2	1
Community Impact	25%	5	2	3	5	3	1
Operational Impact	20%						
Simplicity		5	3	1	4	1	2
Redundancy		1	2	2	4	4	5
Regulatory Acceptance		2	2	2	4	4	5
Method of Disposal	25%	1	2	2	3	4	5
Flexibility for the Future	20%						
Process Changes		1	2	2	5	2	5
Regulatory Changes		1	3	2	5	4	5
Economic Changes		2	2	2	3	3	4
Sustainability Changes		3	5	5	3	5	3
Combined Weighted Scores	100%	2.78	2.42	2.48	**4.10**	3.35	3.25

Selecting a Solution



Phased Approach

- Short term needs
- Long term goals
- Intermediate steps



Community Outcomes

	East Lansing	Holland	Grand Haven
Short term	Thickening and dewatering upgrades	Anaerobic Digestion	Thickening upgrades
Long term	Anaerobic digestion	TCHP or Drying	Lystek
Decision factors	• Local landfill provided low landfilling fees • Many upgrades needed to existing equipment • Desire for environmentally sustainable process	• Anaerobic digestion provided lowest 20 year TPW • Space constraints • Potential for energy production • Flexibility for future improvements	• Largest drivers were reduction in total load out volume and multiple disposal outlets • Available building space for Lystek

General Outcomes

- Detailed planning document
- Identification of current deficiencies and plans to address them
- Understanding of community and facility-specific decision factors
- Budgetary guidance

Lessons Learned

- Consider number of alternatives to evaluate versus level of detail during evaluation
- Assess “no-go’s” early in process
- Understand stakeholder’s needs when selecting non-economic criteria
- Consider final product: thoroughly document decisions, assumptions, and reasoning as you go
- Consider travel: example installations, conferences, equipment exhibitions

Thank You!

DONOHUE