THE CITY OF EAST LANSING’S 2015 SRF PROJECT PLAN IDENTIFIED 11 PROJECTS INCLUDING:

• W-3, WASTE ACTIVATED SLUDGE THICKENING IMPROVEMENTS, FY2019
• W-4 BIOSOLIDS DEWATERING IMPROVEMENTS, FY2019
• BIOSOLIDS MASTER PLAN, FY2017
Purpose

- The WRRF’s existing solids thickening, dewatering, and handling equipment had reached and/or exceeded its useful life and did not provide redundancy for major processes during maintenance or down times.
- Before proceeding with merely replacing the existing equipment, duplicating existing process methods, and continuing with its reliance on landfilling the WRRF staff wanted to review its current operations and explore future alternatives.
- The city and its contributing entities- Michigan State University and Meridian Charter Township also wanted to explore green initiatives and other alternatives that would truly make the facility a “resource recovery facility”.

Objectives

- Understand current and projected flows and loadings
- Evaluate all available options to manage and dispose of biosolids generated at the ELWRRF
- Compare the economic impacts of each alternative
  - Capital cost
  - Annual operating cost
  - Life cycle cost
  - Impacts to user rates
- Provide a 20-year strategy for biosolids handling which meets the goals of the ELWRRF:
  - Sustainability
  - Operational Reliability
  - Public Acceptance
Immediate Needs

- Aging belt filter presses require frequent downtime for corrective maintenance
- Lack of redundancy due to single load out conveyor
- Belt filter press runtime constrained by hauler schedule
- 20-30 minute down time during dumpster change out
  - Change out 4 to 6 dumpsters per day (weekdays only)
  - Up to 2.5 hours of downtime per day due to dumpster changeover alone
Status of Landfilling Biosolids

- Landfills are limiting biosolids based on ratio of solid waste : biosolids
- Governor Snyder’s Recycling Initiative
  - Senate Bill 943 will increase tipping fees ($0.36 to $4.44) to encourage recycling
Non-Economic Evaluation Metrics

**Sustainability (30%)**
- Energy Balance
- Recycled Nutrients
- GHG Emissions
- Land Availability

**Operational Reliability (40%)**
- Redundancy
- Simplicity
- Staffing Level
- Future Flexibility
- Regulatory Acceptance

**Public Acceptance (30%)**
- Renewable Use
- Odor
- Traffic
<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Status Quo</td>
<td>Landfill</td>
<td>Thickening, dewatering, no storage, sent to landfill</td>
</tr>
<tr>
<td>2</td>
<td>Anaerobic</td>
<td>Class B Liquid</td>
<td>Thicken, anaerobic digestion, thicken, liquid storage, land application</td>
</tr>
<tr>
<td>3</td>
<td>Digestion</td>
<td>Class B Cake</td>
<td>Thicken, anaerobic digestion, dewater, cake storage, land application</td>
</tr>
<tr>
<td>4</td>
<td>Lime Stab.</td>
<td>Class B Cake</td>
<td>Lime Stabilization, cake storage, land application</td>
</tr>
<tr>
<td>5</td>
<td>TPAD</td>
<td>Class A Liquid</td>
<td>Thicken, TPAD, thicken, liquid storage, land application</td>
</tr>
<tr>
<td>6</td>
<td>Lystek</td>
<td>Class A Liquid</td>
<td>Thicken, dewater, Lystek, liquid storage, land application</td>
</tr>
<tr>
<td>7</td>
<td>Cambi</td>
<td>Class A Cake</td>
<td>Dewater, Cambi, anaerobic digestion, dewater, cake storage, land application</td>
</tr>
<tr>
<td>8</td>
<td>Lime Stab.</td>
<td>Class A Cake</td>
<td>Lime stabilization w/heat, cake storage, land application</td>
</tr>
<tr>
<td>9</td>
<td>Drying</td>
<td>Class A Pellet</td>
<td>Thicken, dewater, dry, pellet storage, land application</td>
</tr>
<tr>
<td>10</td>
<td>Gasification</td>
<td>Class A Pellet</td>
<td>Dewater, dry, pellet storage, land application</td>
</tr>
</tbody>
</table>
Screening of Alternatives

- Lime Stabilization to produce a Class A or Class B Cake - increase in mass of end product, high disposal costs
- Gasification - unproven technology
- Anaerobic digestion alternatives - one anaerobic digestion alternative (TPAD) was selected. Preliminary cost analysis showed TPAD would be most cost effective digestion alternative.
## Short List of Alternatives

<table>
<thead>
<tr>
<th>#</th>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Status Quo</td>
<td>Landfill Thicken, dewater, no storage, send to landfill</td>
</tr>
<tr>
<td>5</td>
<td>TPAD</td>
<td>Class A Liquid Thicken, TPAD, thicken, liquid storage, land application, RIN credits</td>
</tr>
<tr>
<td>5B</td>
<td>TPAD</td>
<td>Class A Cake Thicken, TPAD, dewater, cake storage, land application, RIN credits</td>
</tr>
<tr>
<td>5C</td>
<td>TPAD</td>
<td>Class A Liquid Thicken, TPAD, thicken, liquid storage, land application, CHP offset</td>
</tr>
<tr>
<td>6</td>
<td>Lystek</td>
<td>Class A Liquid Thicken, dewater, Lystek, liquid storage, land application</td>
</tr>
<tr>
<td>9</td>
<td>Drying</td>
<td>Class A Pellet Thicken, dewater, drying, pellet storage, land application</td>
</tr>
</tbody>
</table>
### Status Quo - Landfilling

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Status Quo—Familiar Process</td>
<td>• Requires landfill space availability</td>
</tr>
<tr>
<td>• No post-processing storage requirements</td>
<td>• Dependent on hauler schedule</td>
</tr>
<tr>
<td>• No need to meet land application requirements</td>
<td>• Reliant on future cost stability</td>
</tr>
<tr>
<td>• Utilizes existing space available at the facility</td>
<td>• Does not improve upon ELWRRF sustainability</td>
</tr>
<tr>
<td>• Provides flexibility for future upgrades to the solids handling train</td>
<td>• New equipment is confined to existing space constraints and challenges</td>
</tr>
<tr>
<td>• Currently experience low disposal costs</td>
<td></td>
</tr>
<tr>
<td>• Supports local landfill and its biogas production</td>
<td></td>
</tr>
</tbody>
</table>
Status Quo - Landfilling

- New Thickening and Dewatering Equipment, Pumping
- WAS Storage Tank
- TWAS + PS Storage Tank
- Load Out Staging Area
- Load Out Loop
- New Load Out Bldg.
- Decommission
- Demolish all Thickening Equip.
**TPAD-Liquid**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Higher digestion rate than conventional anaerobic digestion, leading to</td>
<td>▪ Large footprint</td>
</tr>
<tr>
<td>smaller tank volumes and increased gas production</td>
<td>▪ High capital cost</td>
</tr>
<tr>
<td>▪ Class A product may not require same day incorporation</td>
<td>▪ Increased operational complexity compared to</td>
</tr>
<tr>
<td>▪ Nutrient recovery</td>
<td>conventional anaerobic digestion</td>
</tr>
<tr>
<td>▪ Potential for energy generation/recovery</td>
<td>▪ Requires large amounts of liquid storage with no</td>
</tr>
<tr>
<td>▪ Reduces odor</td>
<td>back up disposal method</td>
</tr>
<tr>
<td>▪ Potentially higher energy cost/offset</td>
<td>▪ Continuous thickening recommended to feed digesters</td>
</tr>
</tbody>
</table>
TPAD-Liquid

Demolish all Thickening Equip.
Digestion Complex
Liquid Storage Complex
Decommission
Thickening
Digestate Storage
HSW Receiving
Load Out Station
**Advantages**

- Production of a Class A product reduces land application regulations/constraints
- Nutrient recovery
- Smaller footprint than any anaerobic digestion alternative
- Lower capital cost than any of the anaerobic digestion alternatives
- Dewatering within the treatment train allows cake product to be sent to landfill as a backup
- Liquid product with a high solids content, reducing volume
- Fully enclosed with low odor potential

**Disadvantages**

- No biogas production for energy generation/recovery
- High chemical requirements leading to high chemical costs and safety concerns
- Requires high temperature and pressure
- Relatively new technology
- 10% Nitrogen reduction due to alkali material

![Lystek Process Diagram](https://via.placeholder.com/150)
Lystek

- Thickening, Dewatering, & Lystek
- Dewatered Biosolids Load Out Bldg.
- Demolish all Thickening Equip.
- Decommission
- Liquid Storage Tanks
- TWAS + PS Storage Tank
- WAS Storage Tank
- Liquid Load Out Station

Liquid Storage Tanks
### Advantages

- Production of a Class A product reduces land application regulations/constraints
- Higher quality product resulting in easier disposal or potential fertilizer sales
- Nutrient recovery
- Greatly reduces solids volume
- Scalable and common technology
- Relatively small footprint

### Disadvantages

- High annual energy costs
- No biogas production
- Dust potential creates safety concerns
- High heat creates safety concerns and requires specialized storage systems
- Potential for end-product odor issues
Drying

- Thickening, Dewatering, and Drying
- WAS Storage Tank
- TWAS + PS Storage Tank
- New Load Out Bldg.
- Load Out Staging Area
- Decommission
- Storage Silos
- Demolish all Thickening Equip.
## Non-Economic Evaluation

<table>
<thead>
<tr>
<th>Metric</th>
<th>Alt 1 Landfill</th>
<th>Alt 5 TPAD</th>
<th>Alt 5B TPAD</th>
<th>Alt 5C TPAD</th>
<th>Alt 6 Lystek</th>
<th>Alt 9 Drying</th>
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</thead>
<tbody>
<tr>
<td>Energy Balance (Mmbtu/year convert to Scale 1 to 10)</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>1</td>
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<tr>
<td>Recycled Nutrients (dry tons/year convert to Scale 1 to 10)</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Greenhouse Gas Emissions (CO₂e convert to Scale 1 to 10)</td>
<td>3</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>7</td>
<td>1</td>
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<tr>
<td>Land Availability (Scale 1 to 10)</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>6</td>
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<tr>
<td>Operational Redundancy (Scale 1 to 10)</td>
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<td>7</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>5</td>
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<tr>
<td>Operational Simplicity (Scale 1 to 10)</td>
<td>10</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>6</td>
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<tr>
<td>Staffing Level (# convert to Scale 1 to 10)</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>6</td>
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<tr>
<td>Flexibility for Future Changes to Liquid Train (Scale 1 to 10)</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
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<td>Regulatory Acceptance (Scale 1 to 10)</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td>7</td>
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<td>6</td>
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<td>Renewable Use (Scale 1 to 10)</td>
<td>2</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>6</td>
<td>6</td>
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<tr>
<td>Odor (Scale 1 to 10)</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>7</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>53.0</strong></td>
<td><strong>64.1</strong></td>
<td><strong>65.0</strong></td>
<td><strong>62.3</strong></td>
<td><strong>62.1</strong></td>
<td><strong>43.9</strong></td>
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</tbody>
</table>
Economic and Non-Economic Analysis

Non-Economic Score

- Alt 1: 28M
- Alt 5: 46M
- Alt 5B: 43M
- Alt 5C: 46M
- Alt 6: 50M
- Alt 9: 44M

NPV ($ Millions)

- Alt 1: 0
- Alt 5: 10
- Alt 5B: 20
- Alt 5C: 30
- Alt 6: 40
- Alt 9: 50

Legend:
- Sustainability
- Operational Reliability
- Public Acceptance
- TPW
## Phased Approach

<table>
<thead>
<tr>
<th>Year</th>
<th>Phase</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>Phase 1 – Short Term Emergency Dewatering Project</td>
<td>RemEDIATE current challenges and ensure treatment capability is maintained</td>
<td>$1.6M</td>
</tr>
<tr>
<td>2021</td>
<td>Phase 2 – Biosolids Improvement Project</td>
<td>Implement Alternative 1 to improve the solids treatment system and meet future loadings</td>
<td>$14M</td>
</tr>
<tr>
<td>2033</td>
<td>Phase 3 – Biosolids Sustainability Project</td>
<td>Add anaerobic digestion, Lystek, or drying to divert waste from landfills and potentially provide energy generation</td>
<td>$26M</td>
</tr>
</tbody>
</table>
Based on the results of Donohue & Associates’ “Biosolids Master Plan” completed in September 2017, the City proceeded with the design portion of the biosolids thickening, dewatering and handling project in January 2018 following the recommendations for phase 2: biosolids improvement project.

The biosolids project would be one of three projects to be included in the FY 2019 SRF project.

Like all good deeds (and after several power outages) that’s when we decided to mix things up- the City decided to add a plant-wide backup generator to the project at a cost of over $1 million.

All of a sudden it was suggested that maybe we should be looking at modifying the project to constructing phase 2.257890 (i.e. something between phase 2 and the full phase 3 conversion to digestion, stabilization, and land application).
Thus, a cost effective analysis was initiated that looked at an alternative based on a simple, conventional mesophilic digestion approach, with combined heat & power generation (CHP), and continued landfilling.

The alternative had to be compatible with our ultimate future goals outlined as Phase 3 in the biosolids master plan.

The analysis resulted in a system that would increase the project cost of the basic Phase 2 project by approximately $5.5 million. However, the proposed project would result in approximately $650,000 annual savings in electrical costs to the WRRF and reduce the amount of biosolids by almost 50%. The project would result in a 12 year payback, using conservative estimates.

All three entities- the City of East Lansing, Michigan State University, and Meridian Charter Township eagerly embraced the proposed alternative, especially the ability to begin recovering our resources through a significant reduction in electricity and landfill space.
Where We Hope To Be in 2021
Thank You

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