STUDY GOALS

Develop a long-term, multi-species manure and nutrient management plan to support animal operations and research for current and future facilities at Waterman.
SCOPE AND SCHEDULE ASSUMPTIONS

The Charter states:

**IMPLEMENTATION**

- Duration: 3-5 months beginning in January 2021 and concluding in or before June 2021.
- Design Meetings: Every 2-3 weeks, adjustable pending time required for homework.
- Initial meeting with Executive and Design Team to evaluate goals, process, and milestones.
- Propose, discuss, and evaluate 3-5 options.
  - Examples and imagery.
  - Pros and cons.
  - Impact to Waterman footprint, construction cost, sustainability, transportation, and operations.
  - Possible benchmarks (virtual).
- Pause and select 1 option.
- Develop selected option to +/-- SD level with narrative, coordination with City of Columbus, details, probable construction cost, and operations impact summary. (Sketches may be generic. They will be used to inform the future design of the facility.)
- Scheduled updates to Executive Team at key milestones.

Our contract states:

Documentation of the preferred alternative will also include the following:

- **A memorandum summarizing the waste management strategy**
- **Scaled drawings (ie AutoCAD) illustrating infrastructure recommendations** for the MALC and Dairy, focusing on performance criteria and identification of similar product types. **Specifications will not be included**; those will be developed by the MALC Design Team.
- **Site plan updates and overlay diagrams** illustrating area to be dedicated to manure management infrastructure and operational considerations
- **A memorandum documenting understanding of permitting considerations** and understanding for the MALC.
## SCHEDULE

<table>
<thead>
<tr>
<th>Week of:</th>
<th>Activity</th>
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<tbody>
<tr>
<td>10/14</td>
<td><strong>Design and Exec Team Meeting</strong> – Review Final Recommendations</td>
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<tr>
<td><em>On-going</em></td>
<td><strong>Cost Estimation</strong> – Develop Cost Estimates for Preferred Options</td>
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<tr>
<td>TBD</td>
<td><strong>Exec Team Review</strong> – Digital Review of Final Documentation</td>
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<tr>
<td>TBD</td>
<td><strong>Study Closeout</strong> – Final Documentation Submission</td>
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AGENDA

01 Existing and Projected Conditions Analysis

02 Recommendations and Scenarios

03 Scenario Evaluation

04 Next Steps

05 Appendix: Detailed Assumptions
Planned Shifts for Animals at Waterman

• The completion of the MALC will significantly impact animal operations at Waterman:
  • Currently about 265 cows at Waterman, with roughly 100 of those in the active milker herd
  • Future total of between 80 – 100 cows, with roughly 60 in the active milker herd
• Additional species will be introduced to Waterman including:
  • Equine
  • Poultry
  • Swine
  • Ruminants
• Additional animal facilities impacted by Don Scott Airport runway expansion may also be accommodated in-part or in-full at Waterman in the future
• Robotic milkers at Dairy will reduce overall herd size and corresponding amount of overall waste generated
• Even with built-in safety factor, total future volume for the MALC and Dairy will be roughly 20% less than existing dairy operations

1For animal facilities under 700 AU, we normally include a 30-40% safety factor in the base wastewater calculations. This covers factors including varying animal numbers, accidents like a leaking faucet, employee errors, or unexpected weather events. At OSU we recommend using a 50% safety factor due to the increased variability created by a changing work force, multiple species, varying events, numerous visitors, and other atypical factors.
WASTE VOLUME BY SOURCE

TODAY:
1,877 total ft³/day

FUTURE:
1,268 total ft³/day proposed storage with safety factor
845 total ft³/day projected

LIQUID SLURRY
- Proposed Storage Design
  - 510 total ft³/day
- Projected Volume
  - 340 total ft³/day

RAW SOLID
- Proposed Storage Design
  - 524 total ft³/day
- Projected Volume
  - 349 total ft³/day

BEDDING W/ MANURE
- Proposed Storage Design
  - 234 total ft³/day
- Projected Volume
  - 156 total ft³/day

Detailed assumptions and calculations are included in the appendices located at the end of this document.
WASTE VOLUME BY SPECIES BY SOURCE

Detailed assumptions and calculations are included in the appendices located at the end of this document.

TODAY:
1,877 total ft³/day

- Liquid Slurry: 1,780 total ft³/day
- Raw Solid: 52 total ft³/day
- Bedding w/ Manure: 45 total ft³/day

FUTURE:
1,268 total ft³/day proposed storage
845 total ft³/day projected

- Liquid Slurry: Proposed Storage Design 510 total ft³/day
  - Projected Volume 340 total ft³/day
- Raw Solid: Proposed Storage Design 524 total ft³/day
  - Projected Volume 349 total ft³/day
- Bedding w/ Manure: Proposed Storage Design 234 total ft³/day
  - Projected Volume 156 total ft³/day
Consolidated storage tank located at existing dairy complex collects all liquid wastes from the facility and pumps periodically to the city sanitary sewer.

Solids including manure and soiled bedding are occasionally scraped and applied on-site.

Contaminated runoff (from rain) from the southern area drains into a pit until pumped into the sanitary sewer (no separation process today).

Detailed assumptions and calculations are included in the appendices located at the end of this document.
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ASSUMED BASELINE MANURE MANAGEMENT SYSTEM
(Upon completion of the MALC)

Existing waste storage tank at dairy to be retained
This study will provide a long-term strategy for a manure and nutrient management system at Waterman that:

1. Eliminates bedding and straw and reduces the total volume and BOD\(^1\) levels of waste entering the sanitary sewer

2. Maximizes the amount of nutrients utilized on-site

3. Balances biosecurity with operational and capital costs

4. Without requiring major system investment, preserves limited opportunities for future research primarily through point sampling along the proposed system lines.

\(^1\) Biological Oxygen Demand: measure of the amount of oxygen required to remove waste organic matter from water in the process of decomposition by aerobic bacteria (high BOD = high degree of organic pollution)
RECOMMENDATIONS
1. Continue use of City sewer to accept the liquid wastes.
   • Any alternatives will cause the State of Ohio’s minimum storage requirements to be in effect, thus requiring at least 6 months storage.

2. Reduce and process all liquids being sent to the municipal sewer. Processing should reduce the BOD load being currently sent via this path.

3. Aggressively reduce storm water entering the waste stream.
   • Primarily, avoid allowing storm water from animal areas to become contaminated, thus requiring handling as a waste.
   • Additionally, the projected silage ag-bag area should be topped with a semipervious layer such as gravel to reduce total runoff.
   • The remaining runoff from an ag-bag area should utilize an initial catchment basin to intercept any incidental solids, followed by a traditional vegetated filter per NRCS guidelines to avoid adding this volume to the concentrated waste stream from the animals.
1. Utilize only fresh water in the new swine waste system. This will be minimal water use, still within the parameters of reducing the total amount used by at least 25%. This will reduce the complexity of the waste system in this area.

2. By the nature of being educational facilities, CFAES should plan that operations will likely use more wash water and bedding than normally seen in a farm setting.
GENERAL OPERATIONS

1. Continue to directly field apply locally the recently collected wastes when conditions allow to reduce total volumes going to other more costly alternatives. Also, this method has environmental benefits due to minimal handling and inputs combined with maximizing utilization.

2. Set-up to utilize the off-site processing of solid wastes at least partially. By doing so, CFAES will establish and maintain this logistics stream, if it becomes more important in the future.

3. CFAES should plan for floor drains from each major MALC species area. Also, plan for some waste solids to be present in any drainage from these.
1. The entire liquid system should not go through the existing dairy waste tank. This tank is 40 years old and using it as a final collecting tank for all the liquids on site is too high of a risk for infrastructure of this age and likely design. We recommend at least one separate tank for MALC manure. Additional scenario-specific waste tank recommendations can be found with the system alternatives presented later in this document.

2. Considering the age of the existing dairy tank and vintage of the design, it is suggested to replace it with an in-ground tank, even if it serves the dairy only. This could be planned for future phased construction or addressed as required if this tank were not utilized as the primary Waterman collection tank.
• To mitigate biosecurity risks to the greatest extent possible within the current MALC design specifications, this study recommends that the Commodity Barn is re-organized to separate feed / bedding and waste storage activities to reduce the potential for cross contamination.
MANURE MANAGEMENT SYSTEM SCENARIOS

• Modified Baseline: Unprocessed liquids to city sewer (no solids reduction)

• Alternative: Reduced BOD liquids to city sewer, partial on-site solids processing (remainder contracted haul-off)

• Backup: If city sewer connection becomes unviable; liquids hauled and applied at OSU remote with partial on-site solids processing (remainder contracted haul-off)
Modiﬁed Baseline
UNPROCESSED LIQUIDS TO SEWER

- No reduction of solids (no squeeze press)
- Swine liquid direct to sewer
- Lowest cost

MATERIAL LEGEND

- Primary (solid line)
- Secondary (dashed line)
- Raw Solid Manure
- Bedding w/ Manure
- Liquid Slurry
- Solids Applied On-Site

- Valve Decision Point
- Research Sample Collection Point
- Collection Area

REMOTE HAUL

MUNICIPAL SEWAGE TREATMENT

DIRECT LOCAL FIELD APPLICATION (when conditions permit) ±40%

New Reduced Dairy Volume Plus Wash Water Direct to Sewer

Excess Unprocessed Solids (±60%)

Swine Pull-plug Plus Added Wash Water Direct to Sewer
Scenario
Requirements
• 3 storage tanks
• New dairy
• New swine
• Other MALC
Alternative REDUCED B.O.D. LIQUIDS TO SEWER

- Partial on-site solids processing (enclosed rotary composter)
- Remote contract hauling to excess solids (hailed off-site)

**MATERIAL LEGEND**
- Primary (solid line)
- Secondary (dashed line)
- Raw Solid Manure
- Bedding w/ Manure
- Liquid Slurry
- Solids Applied On-Site
- Valve Decision Point
- Research Sample Collection Point
- Collection Area
ASSUMED BASELINE STRATEGY

1 Assumed baseline approach reflects volumes calculated using figures derived from the MALC design process still in-development. Future baseline assumptions are subject to change in subsequent iterations.
Additional biosecurity and research benefits could potentially be realized by installing four total tanks to isolate dairy, swine, other MALC waste flows before combining in a final tank.
1. Don’t site the combined final liquid waste tank at any one animal facility / species barn (i.e., not all at the dairy) due to biosecurity concerns.

2. Add a separator to the backbone system to aid in the processing of waste streams sent to the City.
Backup
OSU REMOTE; ONLY IF SEWER REMOVED

- Liquids hauled and applied at OSU remote
- Partial on-site solids processing
- Contract excess solids

MATERIAL LEGEND

- Primary (solid line)
- Secondary (dashed line)
- Raw Solid Manure
- Bedding w/ Manure
- Liquid Slurry
- Solids Applied On-Site
- Valve Decision Point
- Research Sample Collection Point
- Collection Area

Direct Local Field Application (when conditions permit) ±40%
Scenario
Requirements
- 4 storage tanks
  - New combined
  - New dairy
  - New swine
  - Other MALC
- Separator (covered)
  - Requires commodity barn redesign
- Off-site liquid waste storage tank (with six-month capacity)
SCENARIO EVALUATION
SCENARIO EVALUATION

Weighting System: Each Section is worth 25 points. Total Potential Points: 100.

Total Score: 59
Total Score: 60
Total Score: 43
DETAILED ASSUMPTIONS
PROJECTED WASTE FROM DAIRY AND MALC

WASTE VOLUME BY SPECIES

- Swine: 44%
- Equine: 15%
- Sheep/Goats: 6%
- Beef: 12%
- Poultry: 20%
- Dairy: 2%

PROJECTED VOLUME BY SOURCE (LEFT) VS.
PROPOSED STORAGE VOLUME BY SOURCE (RIGHT)

- Liquid Slurry: 340 total ft³/day vs. 510 total ft³/day
- Raw Solid: 349 total ft³/day vs. 524 total ft³/day
- Bedding w/ Manure: 156 total ft³/day vs. 234 total ft³/day

Legend:
- Liquid Slurry
- Raw Solid
- Bedding w/ Manure
FIELD APP

SOLID WASTE
52 ft³/day

EXISTING DAIRY

WASTE
206 ft³/day

LIQUID ADD
1,574 ft³/day

BEDDING
45 ft³/day

TOTAL WASTE SLURRY
1,825 ft³/day

CITY
SWINE UNIT

Sow / gestation / boards 18
Wean to finish pigs 200

*Assuming 60% recycle
SHEEP / GOAT AREA

Females and offspring  40

WASTE

MISC. LIQUID
(150g)

20 ft³/day

BEDDING

2 ft³/day

FINAL TO SOLID HANDLING

(SOLID)

6 ft³/day*

4 ft³/day

*stored within barn in bedded pack and stacking area
POULTRY UNIT

Layers 450
Broilers (chickens or turkeys) 300

**BEDDING**
2 ft³/day
Cleanouts will be at flock changes

**WASTE**
**MISC. LIQUID**
(75 g)
10 ft³/day

**FINAL TO SOLID HANDLING**

*storage till removal is within rooms*
EQUINE AREA

Mares/foals 20
Riding program 40

FINAL TO SOLID HANDLING

BEDDING
32 ft³/day

(SOLID)
87 ft³/day

WASTE
2 ft³/day

LIQUID
(300 g)
40 ft³/day

(SLURRY)
42 ft³/day

TO SEPARATION AREA
BEEF AREA

Cow-calf pairs 50
Steers/heifers 15

LIQUID (500 g) 67 ft³/day

BEDDING 65 ft³/day

WASTE 8 ft³/day

FINAL TO SOLID HANDLING

(SOLID) 192 ft³/day*

127 ft³/day

STOP SEPARATION AREA

(SLURRY) 75 ft³/day

*storage till removal is within bedded pack and stacking area
DAIRY UNIT

- Milking: 60
- Dry, closeup heifer: 15
- Calves: 9

WASTE
- 138 ft³/day

BEDDING
- 40 ft³/day

TO SOLID HANDLING
- 15 ft³/day

LIQUID ADD
- 328 ft³/day

TO SEPARATION AREA

† 150 ft³/day