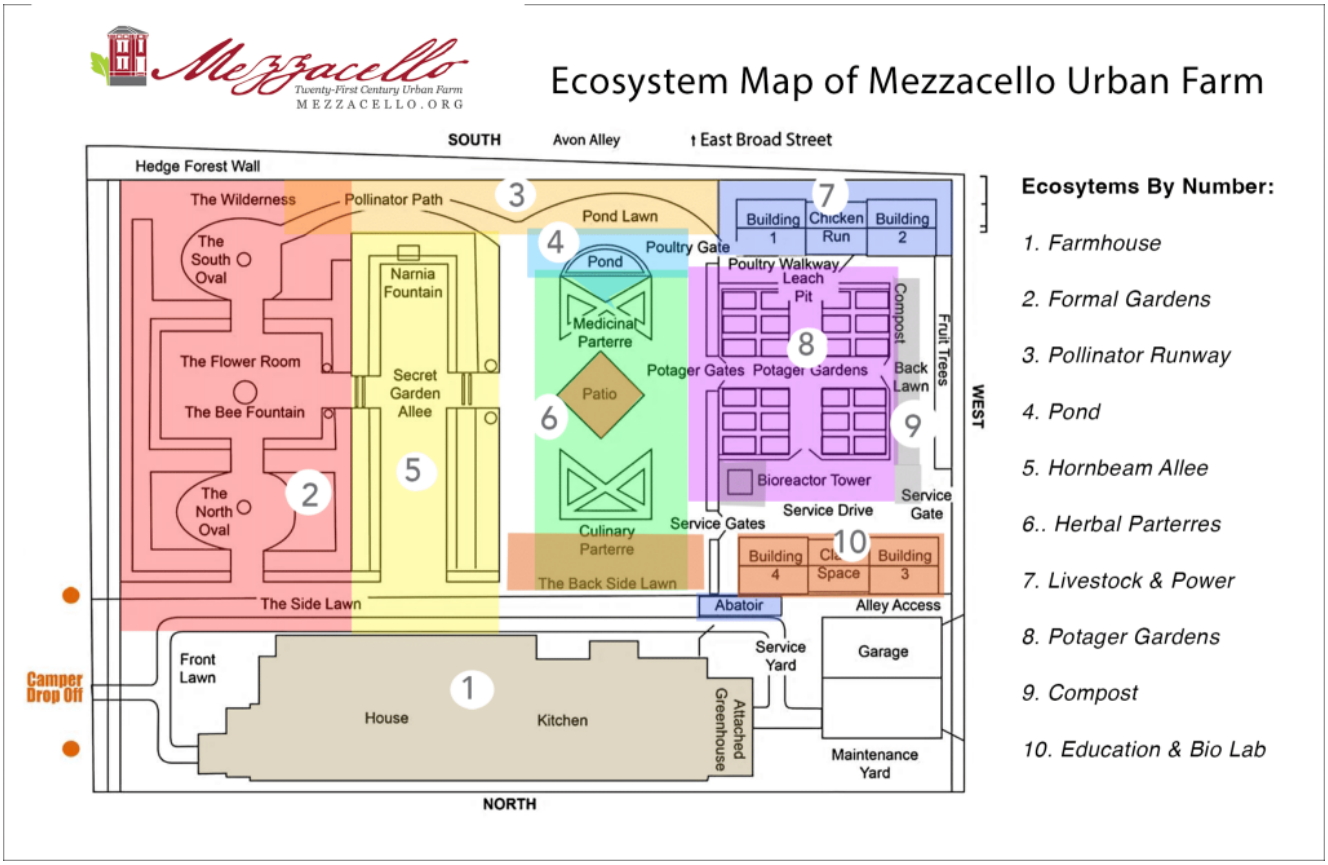
Engineering Systems



The Art and Science of Urban Ag and Gardens. The engineering systems of Mezzacello are numerous. From the structures, to the power generation, water management, and even the ground beneath the farm and the trees above are all influenced by the engineering systems at Mezzacello.

- Structures
- Integration
- Robotics
- Energy Production

- CAD Diagrams
- Maps and Plans
- Recyclables
- Technical Specs

Structures

Sheds

There are three sheds at Mezzacello, labeled Building 1, Building 2, Building 3 and Building 4. Each shed corresponds to one of the main areas of research and effort here at Mezzacello.

- Building 1, Livestock, Biology, and Aquatic life
- Building 2, Engineering, construction and maintenance
- Building 3, Classroom and computer science, drones, coding, and robotics
- Building 4, Wet Lab and BioLab for processing and microscopy

Each shed is 10′ x 12′ and typical. The have concrete slab foundations, align on an east/west axis, have steel roofs, and dual doors. Each shed also has a complete solar panel array and a DC to AC inverter. The sheds do not have HVAC systems, but are lit by LED and are stud walls inside.

The sheds are also waterproof and easily cleaned and sterilized using systems that are available in the Building 1 biological and sanitation systems unit and Building 4 Bio Lab. There are both recycling and trash receptacles in each shed. The biology, engineering, and classroom sheds feather rubber walkways and patio areas that can be sterilized as well.

Building 1 and Building 2 have a frame with a tarp that connects them together. This access area is secured behind welded wire gates and is considered a biohazard area as it is where the poultry live. This area can be accessed by a door from each building and is accessed on the north and south faces by a gate.

Building 3 and Building 4 (Bio Lab/Greenhouse) also have a

covered run between them and a sterilizable rubber matte walkway beneath that. This space is reserved for experiments with coding, robotics, and sensor automation. The rubber mattes provide grounding surface as well as a smooth surface to roll things across.

Maintenance on these structures is minimal apart from cleaning and occasionally painting. They were designed with a 20 year lifespan and are both flood proof and modular making repairs with off the shelf parts easy. The walls are 2×4 lumber sheathed in Particle board 4’x8′ shipboard siding.

Ventilation is achieved by two doors, and a ridge-line vent feature and each building has a vent port in gable of each of the buildings. In addition, Building 1 has an addition of two small southern facing windows that allow for excellent cross ventilation to control temps and ammonia buildup.

Building 3 (Classroom) has three walls that contain whiteboards, and a dedicated monitor. It also contains communication and weather monitoring equipment. There is ample power available in this facility as well.

Bio Lab

Building 4 is a bio lab and green house is used for research in horticulture, propagation, limited storage and houses the hydroponic and aquaponic components of Mezzacello.

There are two skylights in the greenhouse structure that are designed to be opened for heat escape and ventilation. There is also a vent set into the gable of the east wall and double sliding doors for cross ventilations. The building has two doors, a dutch door in the west face and a double door in the north face.

The eastern floor of the bio lab structure contains the lithium iron battery array for the bioreactor. This is accessed by a trap door and must be kept warm in the winter

and cooled in the summer. This is achieved in winter by ground insulation and covers and in the summer is air cooled and has ducted fans to the outside.

Pond

The pond is a biohazard and a safety hazard. It is not typical and contains many features that make it important that safety and care – as well as adult supervision are required at all times. The chained area around the pond is off limits to all guests.

This pond uses electricity to power a 5,000 GPH pump to filter water through a sophisticated series of biofilters that isolate algae, ammonia and nitrates and bacteria for reuse on the farm. The biofilters are a closed loop hydraulic system that is considered a biohazard. [Biohazard Definition]

The BioFilter

The biofilter is a two stage system that pulls water into the top of the solids collection stage. The two stages of the biofilter are the solids collection stage and the microbacterial predator stage. Both systems rely on the pump and then gravity flow to function; there are no electrical components in either stage.

The solids collection stage has a central line that travels from the pond's pump and into the top of the higher stage. This line descends into the canister and down into the bottom of a five gallon bucket with a screened top that is filled with bio balls and plastic sponges. The material grabs and holds algae from the water flow and the water flows out the top of the canister and into the bottom of the next stage.

In addition to the biofilter system, water returning to the pond passes through a high-powered underwater UV filter to destroy any remaining algae and bacteria. This dead bacteria and algae can serve as food for the fish or other aquatic

pollinators or run back through the biofilter.

Pond Foundations

The form of the pond has an under-structure built of 2×10″ wood sealed with creosote and resting on four 10″x36″ concrete piers on the four corners of the pond structure. This frame is then covered with a felt pad and the EPDP Pond liner is attached to the frame and rests in the basin of the pond. The brick cowling around the pond is mortared in and is supported by gravel and the wooden understructure.

The pond also uses various systems and tools to provide both shade and feed to the aquatic life in the pond. There is a 3D CAD rendering available of the pond and it’s systems. The pond liner is hi-grade EPDP rubber and is heat welded and cushioned from the foundations below.

Portable Labs

Portable Labs at Mezzacello come in two varieties. Depending on the lab work being done, there is an option for the rolling workstations or the portable units.

- Rolling workstations
    - The rolling workstations are round three-tiered desks with embedded power, wifi, and mounts for a Raspberry Pi and a 24″ monitor.
    - Each of these 1M square structures has three levels, three stations and is on casters.
    - The rolling workstation is stored in the greenhouse (building 4).

- Portable Labs
    - The portable labs are mission-specific and contain all tools and pieces that are required for that

particular lab. Each portable lab has a manifest and a lesson plan embedded within it.
    - The portable lab is encased in a plastic tray and is stored in the tool shed (building 2).
    - Each portable lab is assembled on the day it is to be used according to the onboard manifest.

Bioreactor

The Bioreactor at Mezzacello is a permanent fixture that serves three purposes for the urban farm:

- Serve as a water tower to pressurize water from a 1,000L tank.
    - Water is delivered to the water tower automatically via solar-powered pump from rain barrels located at the house.
    - Water is accessed via a nozzle at the northern base of the water tower.
    - This water is NOT potable water, but is adequate for plants and farm animals.
    - Humans should NOT consume this water!

- Serve as a sensor/telecommunications/weather/power generation unit for the urban farm.
    - The top, middle and east and south faces of the bioreactor are loaded with sensors and sensing equipment.
    - See Systems Integration, Sensor Schematics
    - Power production aspects of the bioreactor unit are to be found in power production section of this page.

- Houses the automated bioreactor compost module at the

base of the unit.

- The 1,000L compost module is removable and replaceable on demand.
- The tool required to load and unload each of the bioreactor compost modules is a palette-jack located in the greenhouse (building 4).

Sanitary Systems

There are three systems for sanitation available at Mezzacello; Hand washing stations, boot washing stations, deep sink stations. All stations are fed from city water and hoses. Soap, sanitizer, and chlorine bleach are available as are towels.

Additionally, all walkways and work surfaces at Mezzacello are rubber mattes, lattice and gravel walkways, and paver or concrete so they are easy to sweep, clean and sterilize.

There is a leech pit that is buries and beneath a sanitary rubberized steel grate that is also sterilizable. The leech pit is filtered so water that does escape does not allow toxins into the ground water. All manure wastes are recycled professionally into a compost system dedicated to that purpose.

Rest Areas

There are multiple areas to relax at Mezzacello. The three benches around the formal gardens ands pond, the Pergola and patio, the tea tent, the classroom, and the front porch. All of these spaces have shade, seating and grace. Pick one and start a conversation.

Walkways

There are five types of walkways at Mezzacello.

- **Concrete**
  - Sidewalks, patios, porches, foundations for sheds
- **Lattice/grass**
  - The areas of the western farm, there are tracks of grass embedded with PVC lattice and gravel.
  - This allows tonnage of compost to rolled over mud and grass.
- **Rubber Mattes**
  - These 4’x6′ mattes cover all sections of Mezzacello that are necessary to be clean and sterile on demand.
  - They are strong, chemical resistant, and hold up well to bleach, power-washing, and brooms.
- **Grass**
  - The easiest to maintain and sterilize!
  - It rinses itself after a watering and a rain and it creates nitrogen on demand!
- **Mulch**
  - This is a walkway that is reserved only for moisture and nutrients.
  - It is used on the formal garden beds and walkways in the potager garden only.
  - It is not easy to sterilize, and is also not a sustainable and accessible resource.

Yard Equipment

this is a manifest of equipment available at Mezzacello.

Integration

There are four overlapping integrated systems at Mezzacello. They are ecosystems, water, power, and sensors. Their integration is not completely connected, but they are inter-dependent.

Robotics

Mezzacello houses three types of robots. A robot in this sense is any machine that does work in place of humans. At Mezzacello these are: Static, drones, and mobile units.

Static Robots

Bioreactor

Automatic chicken door

Climate monitoring

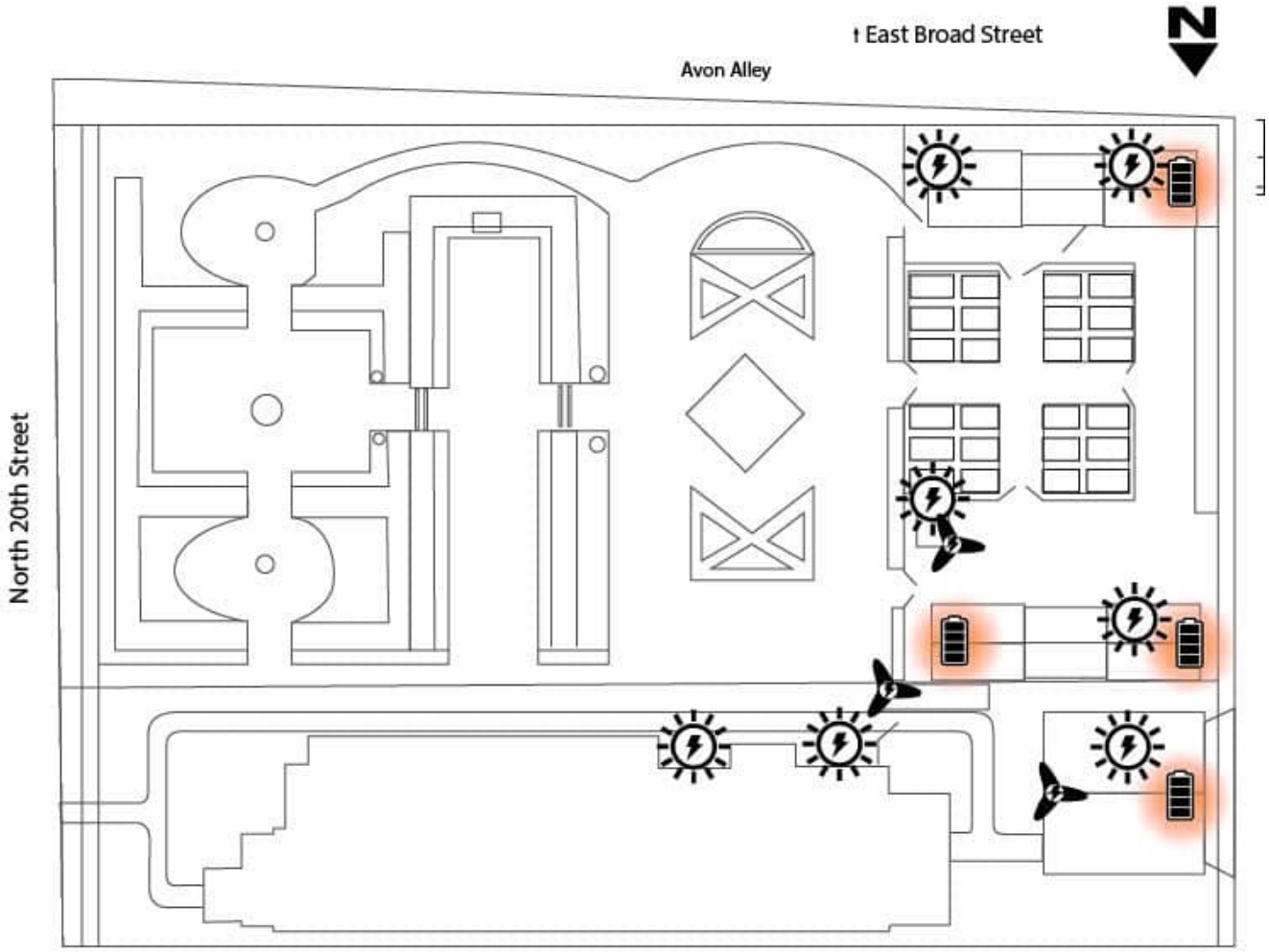
Drones

DJI Mini drones are flown at Mezzacello. We currently cannot fly drones at Mezzacello with an FCC license. All drones used at Mezzacello are for personal and promotional use only.

Mobile Units

Energy Production

Energy Renewables at Mezzacello currently exist in three forms, two renewable and one provided by AEP.



Energy Production Systems at Mezzacello

Solar Arrays

Wind Generators

Battery Arrays