Integrative Process Worksheet

LEED v4 IP Credit Integrative Process

For BD+C projects

Identify and document the items found under the following sections:

- Energy-Related Systems
- Water-Related Systems

For ID+C projects

Identify and document the items found under the following sections:

- Energy-Related Systems
- Site Selection

For one additional point, complete Water-Related Systems

Energy-Related Systems

Required for BD+C and ID+C projects

Describe the baseline assumptions for each component.

Site Conditions (BD+C only)	The existing site is a campus area with lawn, an existing building, parking, trees, and sloping topography.
Massing and Orientation (BD+C only)	The building will have a generally square aspect ratio with a partial lower level, four full floors and a mechanical penthouse.
Basic Envelope Attributes	Minimum - ASHRAE 90.1-2013 (Climate Zone 2A) Roof: U-0.039 Walls: U-0.084 Glazing: U-0.57; SHGC-0.25
Lighting Levels	Minimum - ASHRAE 90.1-2013 Building Area Method: School/University - 0.87 W/sf

Thermal Comfort Ranges	Cooling: 74°F ± 2.5° Heating: 70°F ± 2.5°
Plug and Process Load Needs	Office: 1.83 W/ft2 Lab freezers: 5 @ 1000 W
Programmatic and Operational Parameters	Building operates 6:00 AM to 6:00 PM Monday through Friday

Describe at least two potential load reduction strategies that were assessed for each aspect through simple box energy modeling before the completion of schematic design.

Site Conditions (BD+C only)	Given the constrained site, site measures were not explored.
Massing and Orientation (BD+C only)	Narrower aspect ratio, long sides facing east/west and north/south
Basic Envelope Attributes	Improved wall R-value (several options) Improved glazing performance (several options)
Lighting Levels	LED lighting - 0.51 W/ft2 LED lighting - 0.28 W/ft2
Thermal Comfort Ranges	Cooling: 76°F Heating: 65°F
Plug and Process Load Needs	Reduce office plug loads by 10% (1.83 W/ft2 to 1.65 W/ft2) More efficient freezer storage to reduce quantity of freezers by 2 (ie. I2SL Freezer Challenge)
Programmatic and Operational Parameters	Reduced summer hours (6:00 AM - 12:00 PM June - August) Closed during summer (June - August)

Describe how research and analysis uncovered through discovery influenced the project building program, form, geometry, and/or configuration.

Site Conditions (BD+C only)	Given the constrained site, site measures were not explored.
Massing and Orientation (BD+C only)	Altering the building form to have longer east/west exposures increased cooling load, especially with this form resulting in less sharing of walls with the adjacent existing building to the south. Glare was also increased. Altering the building form to have longer north/south exposures decreased cooling load and reduced glare, especially with greater northern exposure. The building form is unlikely to change from a square aspect ratio given site constraints and attachment to the existing building.
Basic Envelope Attributes	Improving wall insulation to R-17 decreases energy use by 11% and may be cost effective. Improved exterior wall performance will be further explored as design progresses. It is projected that using glazing with 0.25 SHGC and U-0.32 reduces energy use by approximately 11% and could be cost effective. Other options explored were not found to be cost effective. Improved glazing performance will be further explored as design progresses.
Lighting Levels	LED lighting at 0.51 W/ft2 was found to be most likely to be cost effective. High efficiency LED lighting will be implemented in the design.
Thermal Comfort Ranges	Raising the cooling temperature to 76F resulted in negligible savings (~1%). Lowering the heating temperature to 65F resulted in even lower savings, likely due to the low heating demand in this climate. Temperature setpoint adjustments are not recommended for energy saving purposes.
Plug and Process Load Needs	Reducing plug load energy use by 10% resulted in energy savings of about 6%. Depending on specific measures taken this could be a cost effective measure and will be explored further as design progresses. This building is not anticipated to have many lab freezers, but reducing the projected quantity from 5 to 3 would result in a small reduction in energy use. Users, however, may not be able to perform research as well with this reduction in freezer storage space.
Programmatic and Operational Parameters	Reduced summer hours would likely result in underutilized program since this building is intended for full-time research and some outpatient services.

Provide a brief explanation of how the research and analysis uncovered through discovery influenced the project design and/or resulted in system downsizing. If applicable, give reasons for not addressing topics.

Site Conditions (BD+C only)	Given the constrained site, site measures were not explored.
Massing and Orientation	While a massing favoring north and south exposures versus a square aspect ratio would result in some cooling system downsizing and improved daylighting (and resulting

(BD+C only)	decrease in lighting energy use), site constraints and attachment to the existing building to the south are likely to result in the baseline square aspect ratio carried through design.
Basic Envelope Attributes	Improved wall insulation and glazing performance reduce the building's cooling load, resulting in the potential for smaller coils, fans, and ductwork.
Lighting Levels	High efficiency LED lighting reduced the cooling load by a small amount, so system downsizing effects were negligible. It is possible some lighting panel efficiencies could be realized.
Thermal Comfort Ranges	A higher cooling temperature slightly decreased cooling load, and the lower heating temperature slightly decreased heating load. A lower heating temperature would also result in smaller reheat coil sizes and potentially smaller heating hot water piping.
Plug and Process Load Needs	Plug loads were found to contribute significantly to overall project energy use, so decreasing these could potentially result in reduced electrical infrastructure sizing as well as reduced cooling. Reducing the quantity of freezers would reduce plug loads a small amount, but the overall energy savings may not outweigh the potential inconvience of reduced storage space.
Programmatic and Operational Parameters	Reduced summer hours reduced total energy use by 10% and cooling energy use by 18%. Closing the building during the summer reduced total energy use by 22% and cooling energy use by 31%. Despite potentially significant cooling system downsizing, the primary use of this building is research and not education so reduced hours are unlikely to be implemented.

Describe how this process informed changes made to the Owner's Project Requirements and Basis of Design.

Site Conditions (BD+C only)	Given the constrained site, site measures were not explored.
Massing and Orientation (BD+C only)	The baseline building form of a square aspect ratio was not changed in the OPR or BOD.
Basic Envelope Attributes	Roof assembly thermal performance target was set to U 0.039, with high-SRI roofing membrane. Exterior wall assembly thermal performance target was set to U 0.060. Glazing thermal performance target was set to U 0.57.
Lighting Levels	The lighting design will target a whole building lighting power density of 0.51 W/sf.

Thermal Comfort Ranges	Typical campus thermostat setpoints of 74°F cooling and 70°F heating were retained in the OPR and BOD.
Plug and Process Load Needs	Reduced plug loads were not added to the OPR and BOD but will be explored further as design progresses.
Programmatic and Operational Parameters	Typical office hours were unchanged in the OPR and BOD.

Water-Related Systems

Required for BD+C projects. One additional point for ID+C projects.

Describe the baseline assumptions for each component.

Indoor Water Demand	Water demand is driven by restroom fixtures (water closets and lavatories), water closets, and electric water coolers. Urinals are not anticipated to be part of this project. Water closets: 1.6 gpf Lavatories: 0.5 gpm Kitchen faucets: 2.2 gpm Showerheads: 2.5 gpm
Outdoor Water Demand (BD+C only)	Irrigation will be provided for landscaping, which includes a blend of native plants around the building perimeter (drip irrigation) and turf grass lawn to the north of the building (spray irrigation).
Process Water Demand	Process water demands will be limited to lab/exam room sinks (baseline 2.2 gpm).
Supply Sources	Municipal water supply.

Provide a brief explanation of how the research and analysis uncovered through discovery influenced the project design and/or changes to the design. If applicable, give reasons for not addressing these topics.

Indoor Water Demand	Water closets: 1.28 gpf - 15% water savings Lavatories: 0.35 gpm - 4% water savings Kitchen faucets: 1.0 gpm - 4% water savings Showerheads: 1.5 gpm - 1% water savings The above measures for water closets, kitchen faucets, and showerheads will be incorporated into the design. There are concerns about using lower gpm lavatories for hand washing.
Outdoor Water Demand (BD+C only)	The baseline landscaping scheme is projected to achieve about 30% water savings. Replacing the turf grass with native plantings using drip irrigation resulted in 76% water savings. Additional native plantings will be considered as design progresses, but may not be compatible with the project budget or landscape maintenance practices.
Process Water Demand	Corresponding with the kitchen faucet gpm reduction above, lab/patient room sinks will be 1.0 gpm fixtures.

Supply Sources	It may be possible to capture cooling coil condensate drain water. Projected condensate volume is between 6 and 12 gph. Due to the relatively low volume and additional system complexities, a condensate collection system is unlikely.

Describe how this process informed changes made to the Owner's Project Requirements and Basis of Design.

Indoor Water Demand	The following fixture flow rates will be pursued in design: Water closets: 1.28 gpf Lavatories: 0.5 gpm Kitchen faucets: 1.0 gpm Showerheads: 1.5 gpm
Outdoor Water Demand (BD+C only)	The baseline landscaping system and irrigation plan was not changed.
Process Water Demand	The following fixture flow rates will be pursued in design: Lab/patient room sinks: 1.0 gpm
Supply Sources	Condensate capture was not added to the OPR or BOD.

Explain how one on-site nonpotable water supply source was analyzed to reduce municipal supply or wastewater treatment for the demand components listed below. (For BD+C projects, potable water use must be reduced for at least two demand components.)

Indoor Water Demand	Condensate captured from cooling coils was determined to produce between 6 and 12 gph (0.1-0.2 gpm), or about 25% of annual design indoor water consumption. In order to feed plumbing fixtures, storage and treatment systems would be needed and the additional complexity was not determined to be cost effective.
Outdoor Water Demand (BD+C only)	Condensate capture could also be used for irrigation and would make up about 8% of peak month watering demand, but would still require storage (if not treatment). Due to budget constraints this system will not be included in the design.
Process Water Demand	Lab/patient room sinks were not considered appropriate uses for non-potable water supply.
Supply Sources	Condensate capture has been evaluated for indoor water and outdoor water use (see above).

Site Selection

Required for ID+C projects

Describe the project goals related to each component.

Building Site Attributes	
Transportation	
Building Features	
Occupant Well-Being	

Describe the suitability (or lack thereof) of the base building options considered for each site selection component.

Building Site Attributes	
Transportation	
Building Features	
Occupant Well-Being	

Provide a brief explanation of how the analysis informed building site selection.

Building Site Attributes	
Transportation	
Building Features	
Occupant Well-Being	

Provide a brief explanation of how the selected space meets the project goals related to indoor environmental quality and occupant well-being.

Building Site Attributes	
Transportation	
Building Features	
Occupant Well-Being	

Describe how this process informed changes made to the Owner's Project Requirements and Basis of Design.

Building Site Attributes	
Transportation	

Building Features	
Occupant Well-Being	