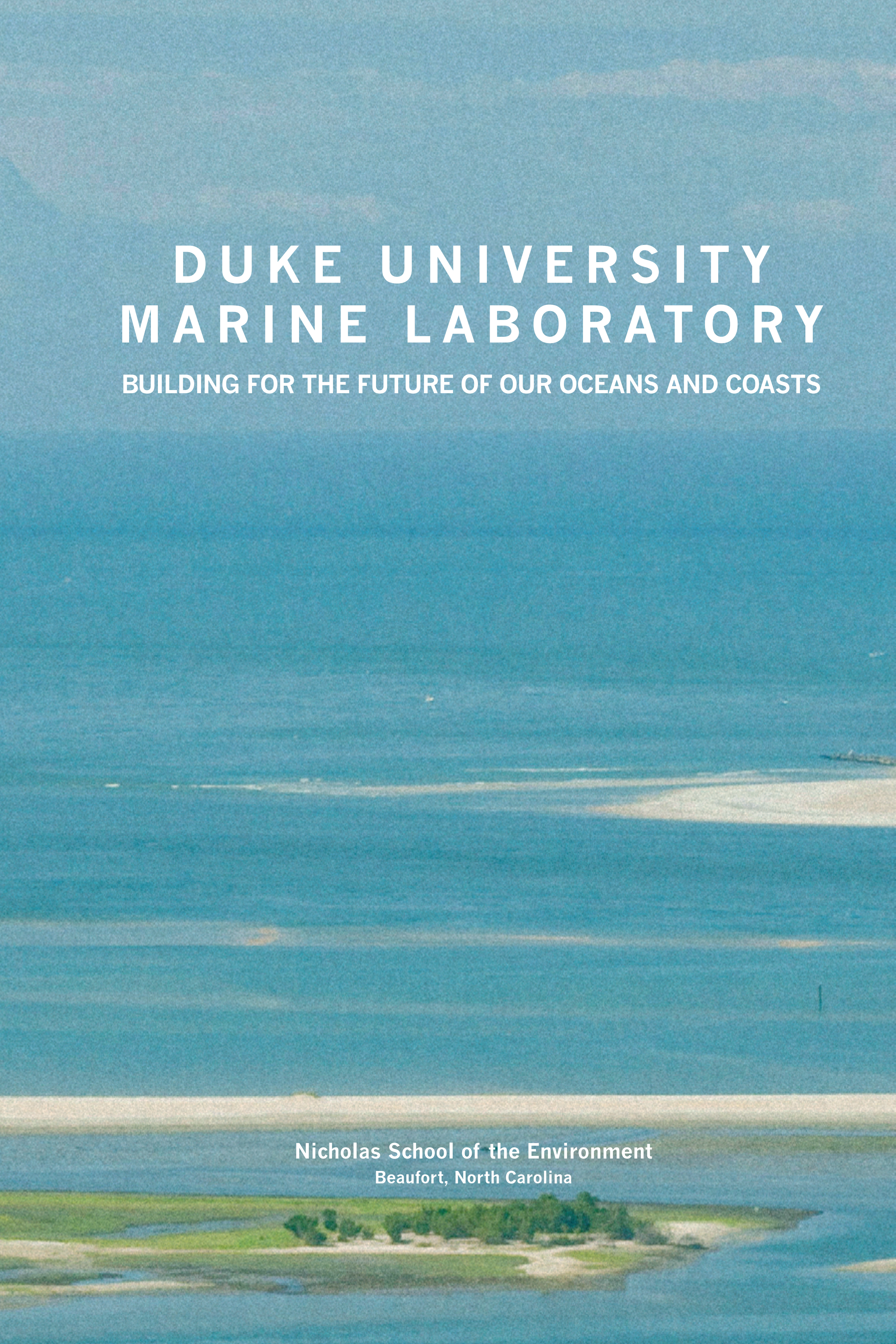


DUKE UNIVERSITY MARINE LABORATORY

BUILDING FOR THE FUTURE OF OUR OCEANS AND COASTS

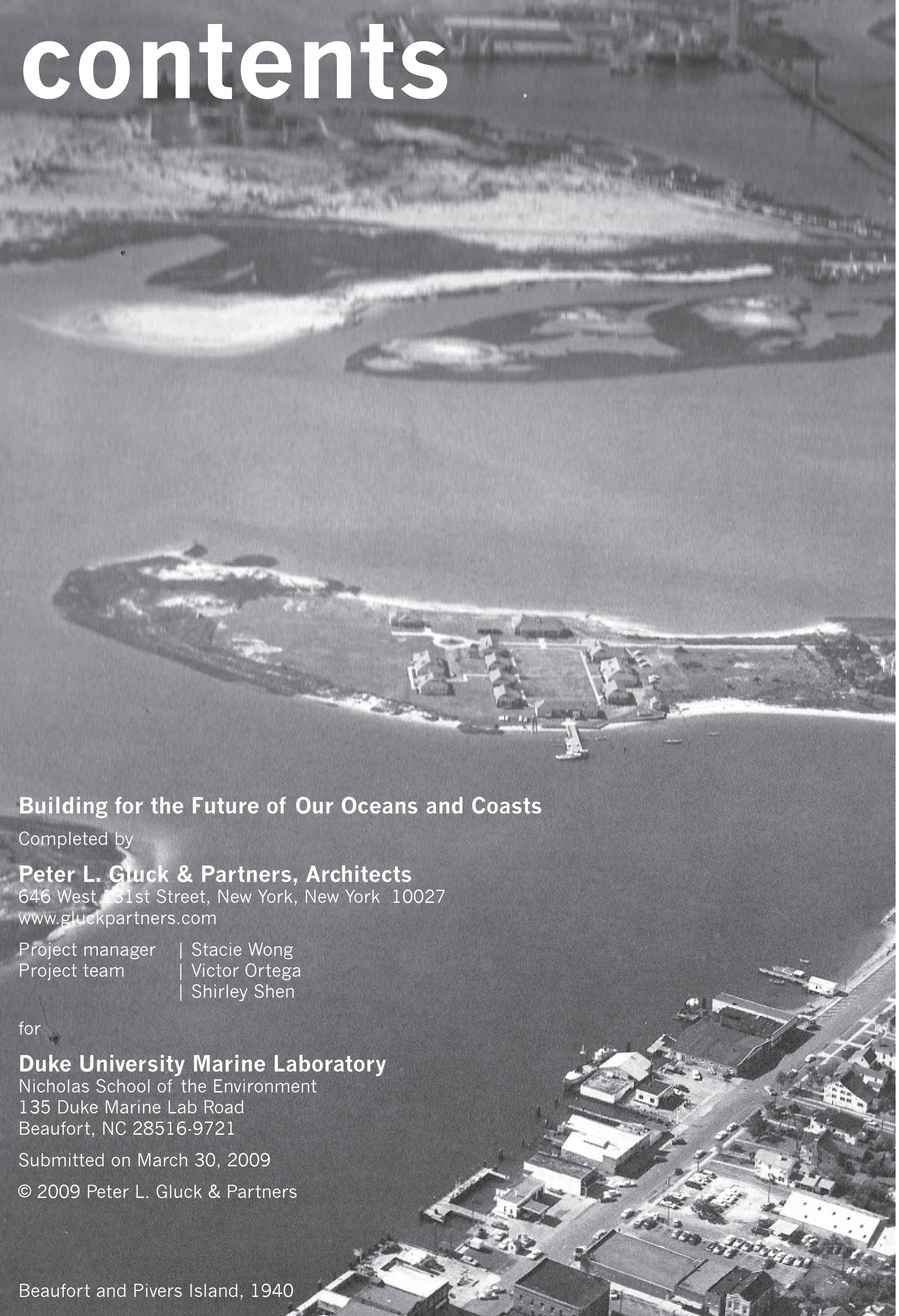
Nicholas School of the Environment

Beaufort, North Carolina

"Our past, our present, and whatever remains of our future, absolutely depend on what we do now."

Sylvia Earle
Oceanographer and Explorer
Duke PhD 1966

contents



Building for the Future of Our Oceans and Coasts

Completed by

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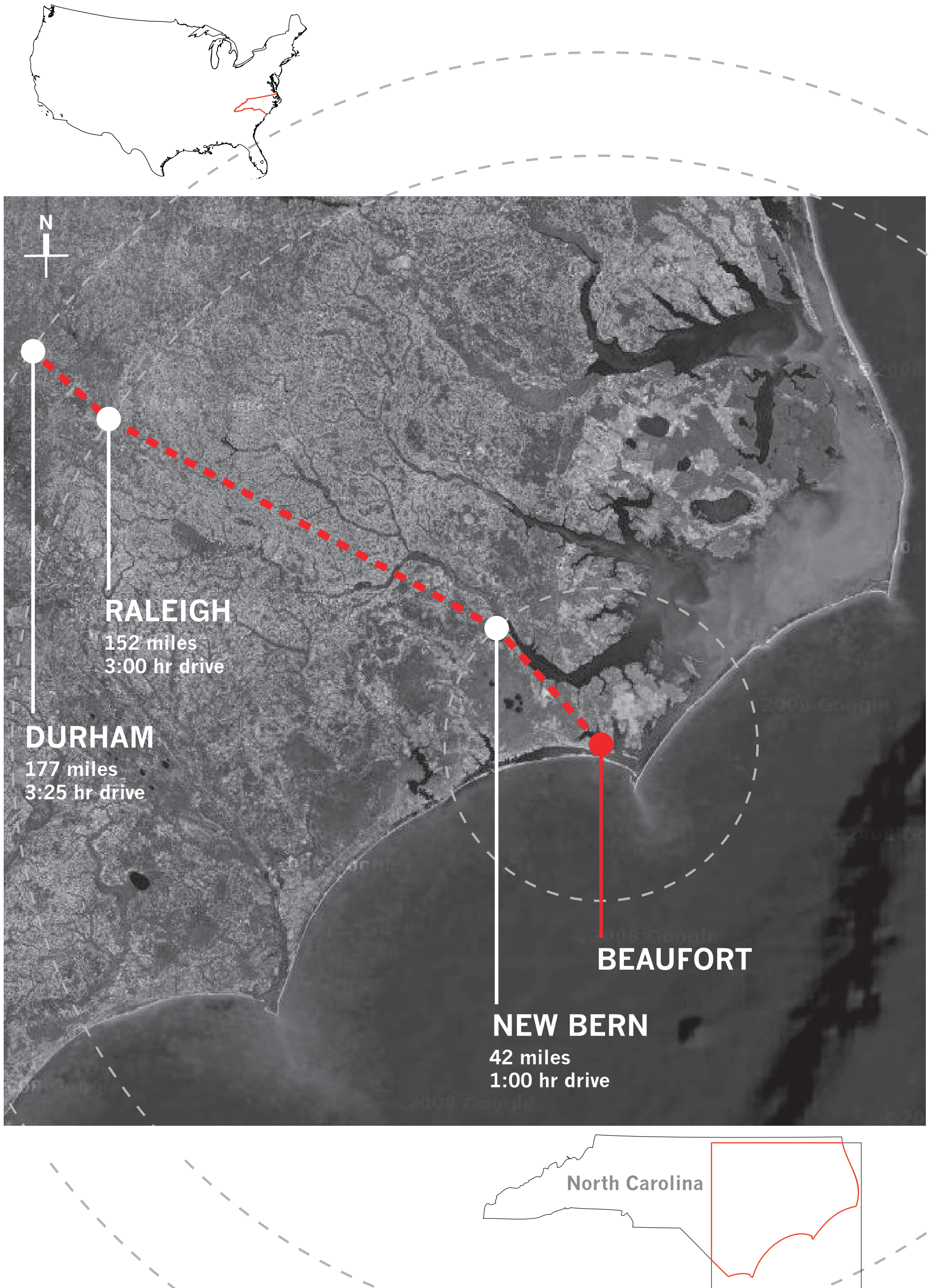
Nicholas School of the Environment
135 Duke Marine Lab Road
Beaufort, NC 28516-9721

Submitted on March 30, 2009

Beaufort and Pivers Island, 1940



abstract

The situation is critical. Ocean temperatures are rising. Marine life is threatened. Plant health is diminishing. Coral reefs are disappearing. Less than 1% of the Earth's oceans are protected. Now is the time to invest in oceanographic research and policy.

The Duke University Marine Laboratory (DUML) is at the forefront of marine research and education. Its Pivers Island location is ideal, with the surrounding barrier islands, sounds and estuaries providing diverse habitats for marine research. With an interdisciplinary approach and expertise in both science and policy, DUML is well situated to be a leading force in ocean conservation and restoration.

The physical buildings and infrastructure at DUML must keep pace with the times and match the quality of research and education provided. No new research laboratories have been constructed since 1972. Laboratory suites are substandard size. Overcrowding and space constraints are major problems. Building systems are inefficient, outdated and need constant repair. Renewable energy is severely underutilized. New, state-of-the-art buildings are desperately needed.

A campus master plan is vital to guide decision making for future development. A sustainability plan must be implemented as carbon footprint and emissions directly contribute to the degradation of marine life.

This feasibility study aims to identify needs, critically examine existing conditions, and propose future steps that are sensitive to both the campus' coastal setting and the culture of the people who work, study and live on the island.

site location

34.7178°N
76.6722°W

MOREHEAD CITY
total 5.7 sq mi
land 5.1 sq mi
water 0.6 sq mi
population (2000) 7691
population density 1508/sq mi

FORT MACON STATE PARK

RADIO ISLAND

PIVERS ISLAND
NOAA
DUML

BEAUFORT
total 3.6 sq mi
land 2.7 sq mi
water 0.8 sq mi
population (2000) 3771
population density 1374/sq mi

history

1949 Research lab L-2
1954 Research lab L-3
1957 Boathouse addition

1958 Second quad is prepared with dredged sand and topsoil, research lab L-4 built.

1960 Research lab L-5, dining hall expansion
1962 Southern end of island enlarged from 7.5 to 11.5 acres.

1962 Modern brick dorm D-4
1964 Oceanic lab L-6, pier extended

1963-1966 Construction of sea wall and added backfill increases useable land from 11.5 to 16 acres.

1967 Two-lane concrete bridge and asphalt road improve access to the island.

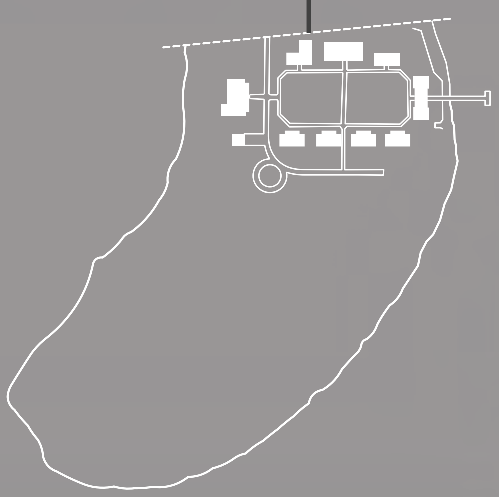
• 1954 Aerial view of Piver's Island

• L-3 later renamed Pearse Laboratory

• Boathouse with wing additions

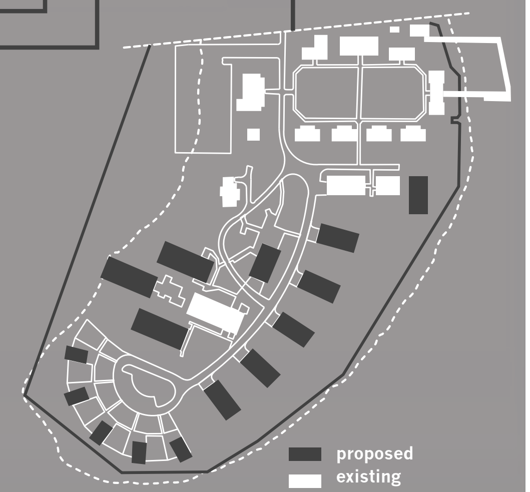
• 1966 Aerial view of Piver's Island

1930 1940 1950 1960



• D-4 was sited on an isolated part of the island. subsequent masterplans tried to integrate it by mirroring or duplication. however, these plans were not implemented and the dorm was eventually destroyed by hurricane Rita.

• L-2, L-3, L-1, north side of quad



1938 DUML is founded by Dr. Arthur S. Pearse. The original campus consisted of the boathouse, research lab L-1, and dormitories D-1, D-2, D-3.
1939 - The dining hall and caretaker's residence are added to complete the quadrangle.

1956-1960 Expansion of the physical plant using government grants and funding by Duke University.
1958 - DUML director Bookhout submits a Long Range Proposal including requests for new research labs, new residences for researchers, and expansion of the dining-seminar hall.

1961 10-year Projection for the Marine Laboratory submitted by director Bookhout with the help of W.K. Howard, including unrealized proposals from 1958.

1962 Expansion study master plan by W.K. Howard featuring circuit around new library, 5 labs east of the main road, 5 residences fanning the southern end and a cluster of dorms north of the residences. Enlargement of the island to increase buildable land.

planning

history

2005 D-4 is destroyed by hurricane Rita and is replaced by a temporary trailer

2006 Repass Center

2007 Student center

1972 Three-storey research lab L-7 (Bookhout)

1974 IE Grey library-auditorium

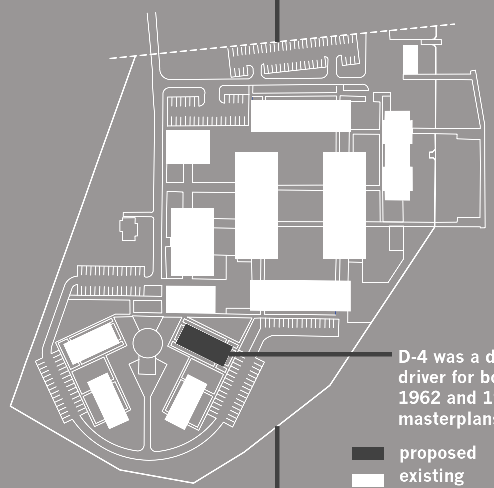
1976 Service complex & motorhouse

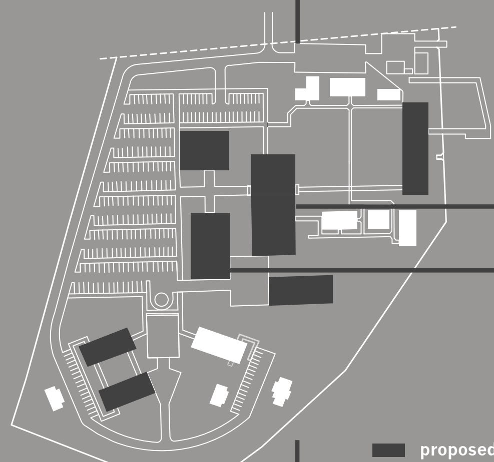
• Original design of Bookhout showing phase 2 completed. Roughly 2/3 of the building was built; the fenestrated facade design was cut due to cost concerns.

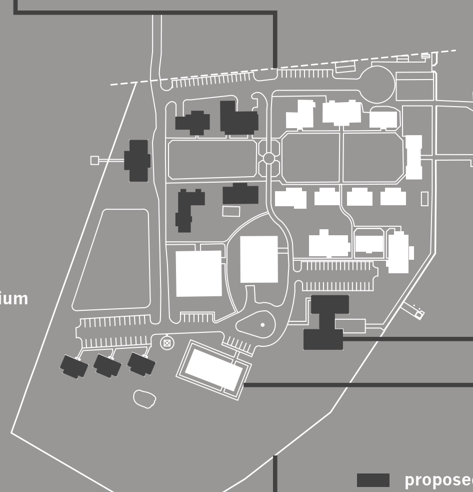
• IE Grey library-auditorium, and Bookhout with a flat facade. Phase 2 of Bookhout was never completed, leaving an unsightly blank wall and exterior fire escape.

• Service complex & motorhouse

1970 1980 1990 2000







1969 Master plan by Halloway-Reeves Architects. Modernist blocks replace the old quad; only the caretaker's house and D-4 are preserved. Lacking sensitivity to pedestrian scale, the design is largely dictated by vehicular traffic and parking. Very little land is left undeveloped.

1969 Revised master plan by Halloway-Reeves. More of the existing buildings are preserved in this version, resulting in a partial quad bookended by monolithic buildings to the east and west. Bookhout was to be a 30,000 SF, three-storey masonry building. This determined the siting of the library-auditorium and Bookhout. A significant area of the island is dedicated to parking and little land is left undeveloped.

1993 Master plan by Robert Winston Carr Architects. The old quad is extended westward by moving the dining hall and adding buildings. New dorms to the south-west are proposed but never built; a site is selected for the new research center (now the Repass Center), south-east of Bookhout.

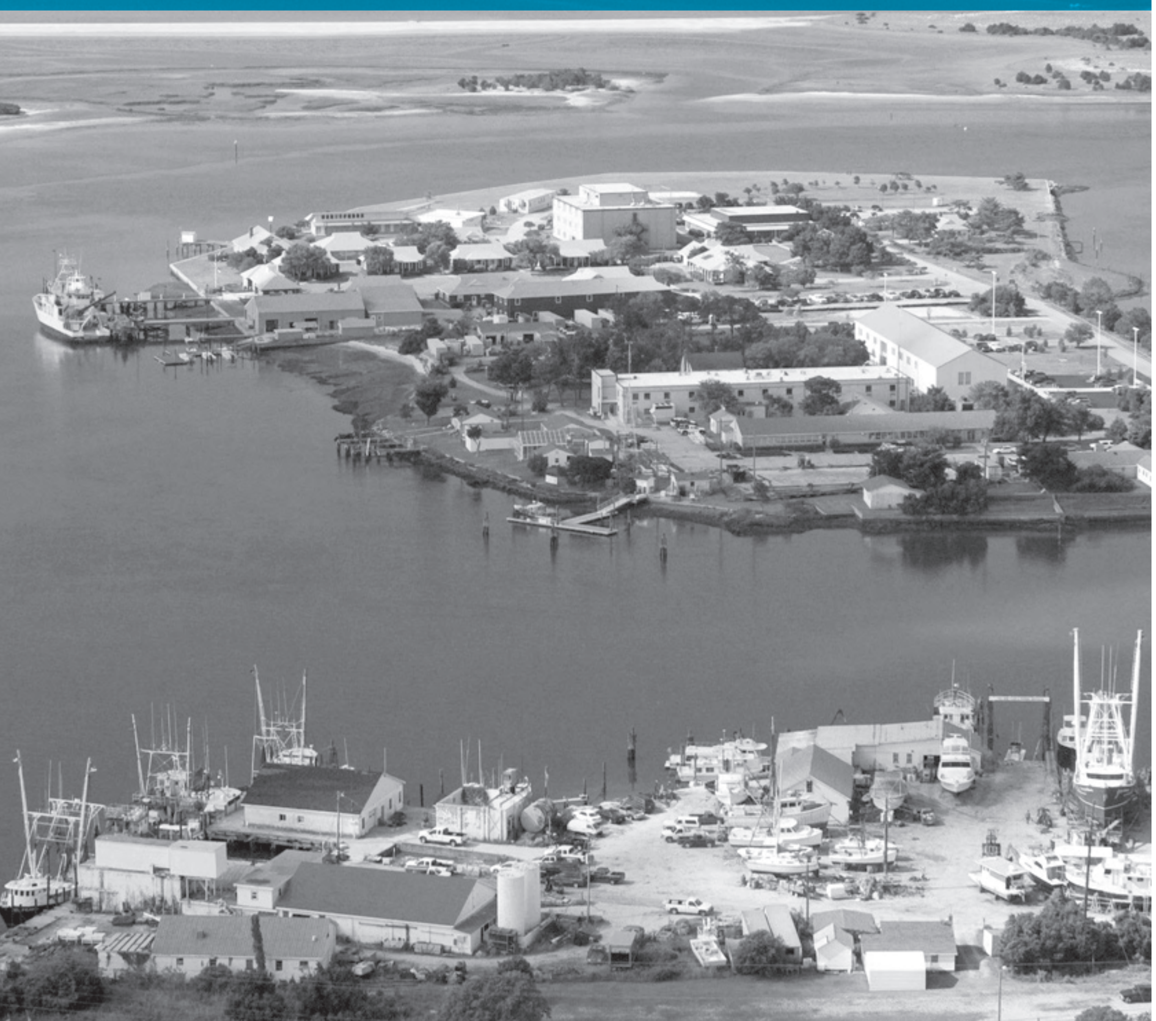
2009 Feasibility study for future development takes lessons from previous actions.

planning

Site analysis provides an understanding of existing conditions in order to identify areas for improvement, and helps establish a plan of action that will improve performance, quality of life, and the value of the campus.

Historical research of building development explains the decisions that shaped the campus's current configuration. The trend has been hasty expansion to meet immediate programmatic needs. Old master plans show sprawled development lacking the density necessary to activate outdoor spaces, and failing to preserve undeveloped land. This feasibility study seeks to consider all aspects of the campus and develop a sensitive master plan that avoids this type of haphazard development.

Existing campus conditions are evaluated to build upon positive features and change negative ones. A sensitive response to environmental and climatic conditions is critical, as DUML is committed to being a role model for sustainable development.



positives

A survey of existing conditions identifies positive aspects to preserve and negative aspects to change or eliminate.

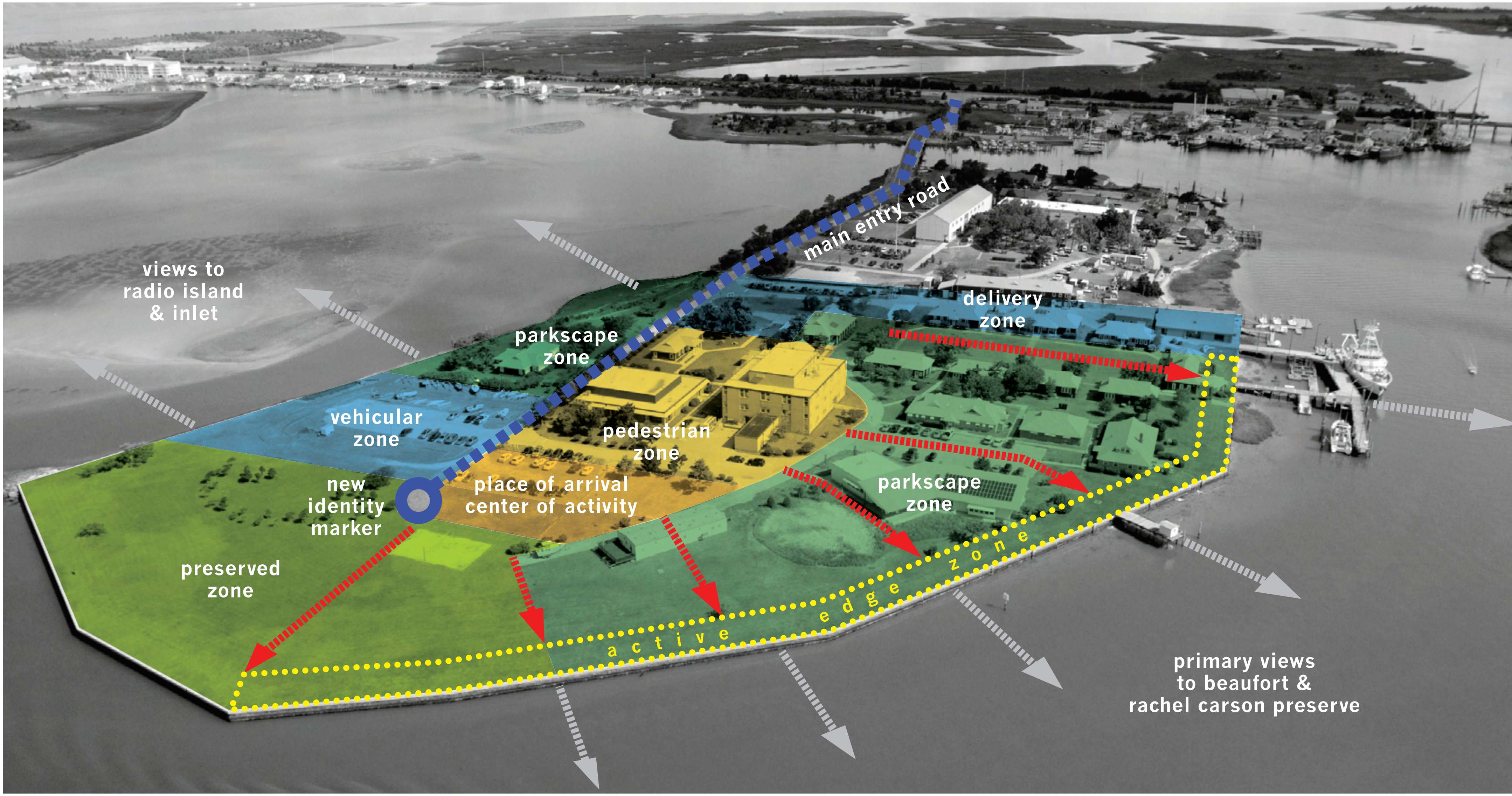
- sufficient & accessible parking
- porous grass parking aid stormwater management & reconfigure easily
- bike rental & bike racks promote clean commuting
- naturalized shore attracts campus life to island edge
- main road defined & landscaped
- cars restricted from main campus
- landscaping designed to work with buildings & prioritizes native plantings
- sustainability prioritized in new construction
- geothermal & solar hot water
- retrofit sustainability explored with solar hot water on dorm
- service/delivery restricted to discreet area
- buildings form outdoor quad
- boathouse is gateway to shore
- outdoor deck provides communal gathering space
- piers & boat activity make shoreline part of campus life

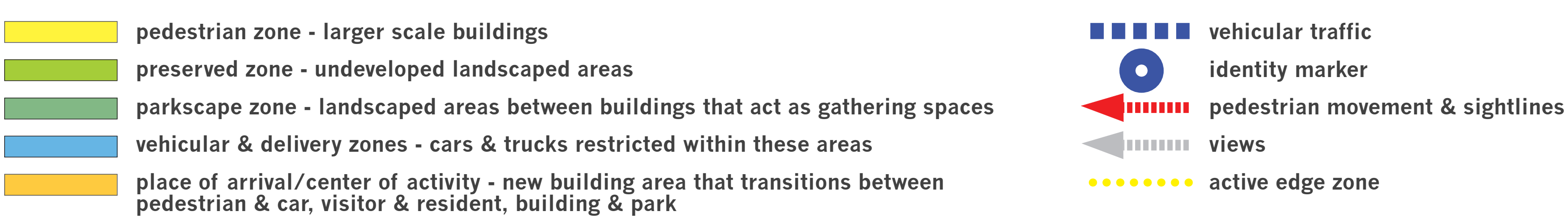
- vegetation unprotected by buildings less likely to thrive
- campus plan fails to encourage activity at island edge
- parking lots dominate center
- trailer dorm inefficient & isolated from residential life
- exposed outdoor equipment is unsightly, degrades quickly in salt air, and requires constant replacement
- "object" buildings do not relate
- failure to make usable outdoor spaces
- buildings do not take advantage of unique site conditions
- parking takes up areas that could be for people
- pedestrian pathway too wide & contributes to stormwater runoff
- mechanical equipment clutters outdoor areas, which discourages use as gathering space
- building acts as barrier to shoreline

negatives

campus organization

The proposed campus organization restricts cars and service vehicles within discrete areas, maximizes pedestrian and park areas, and encourages activity along the waterfront.





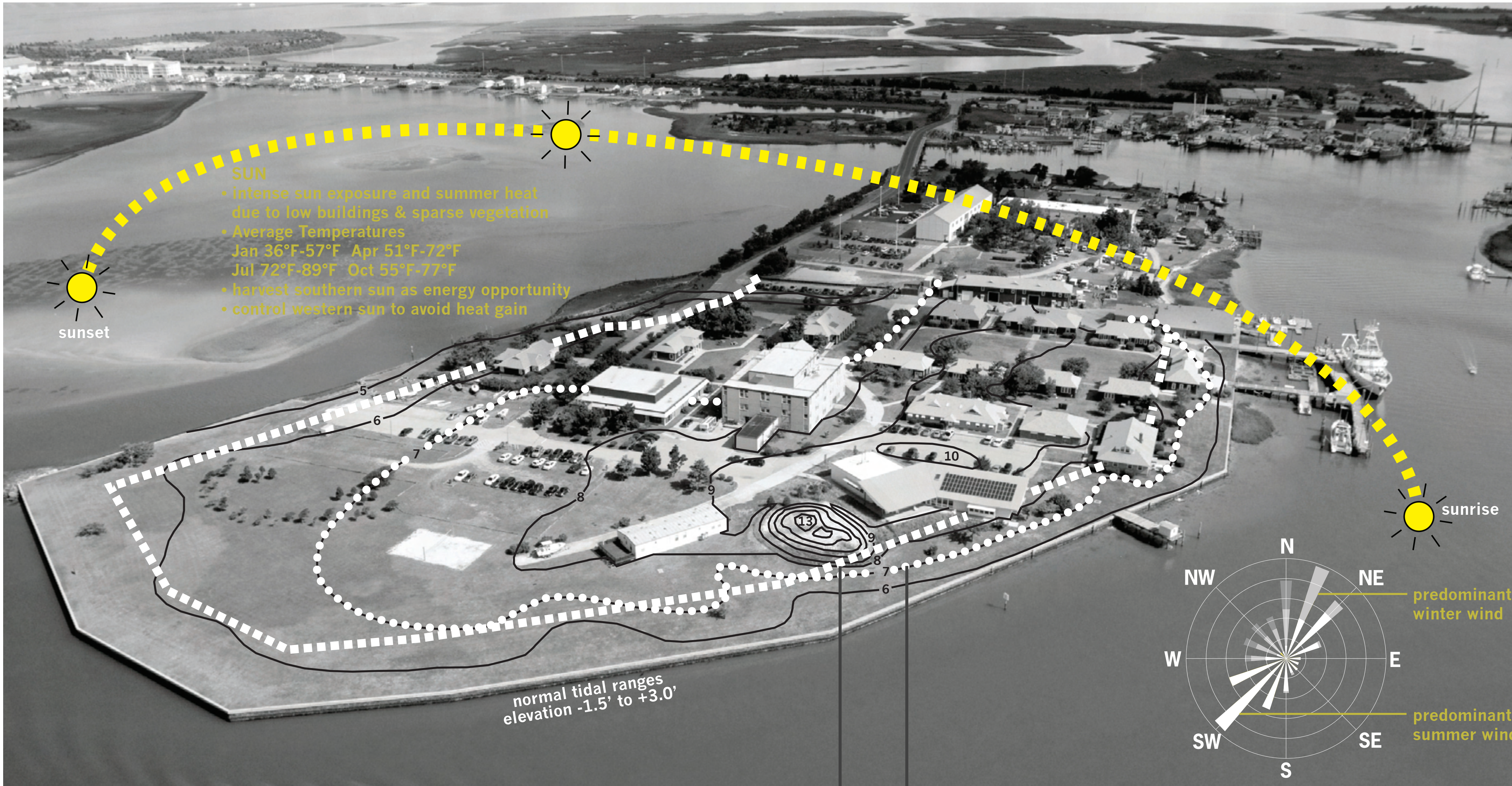
environment

The physical environment influences siting, location and orientation of buildings. This includes climatic conditions (wind, sun, rain) and governing restrictions (code, zoning, flood, and coastal management).

RAIN
- average annual precipitation 52 inches
- stormwater runoff at edge problematic
- reduce impervious hard surface
- incorporate stormwater management plan to control and filter water
- use landscape to divert water

WIND
- annual wind pattern predominantly northeast (winter) southwest (summer)
- high wind conditions
- mitigate with berms & landscaping
- harvest energy with wind turbine

SITE



GOVERNING RESTRICTIONS:
- North Carolina Building Code (2009)
- FEMA FIRM Maps 3720639600J & 3720639500J
- Code of Ordinances County of Carteret
- Town of Beaufort, North Carolina Zoning Ordinance
- CAMA Handbook for Development on Coastal North Carolina
- Duke University Design Guidelines

- FEMA 100-year flood zone line
- inside of line flood zone X (not within 100 nor 500-year plood plains)
- outside of line flood zone AE (area inundated by 100-year flooding, base flood elevation 7')

- 75' Coastal Area Management Act setback line
- commercial structures require permit

code

selected sites

Several sites were analyzed for their development potential. The pros and cons of each were weighed and a consensus was arrived at for the new building site.

SITES B & C considered for Teaching, Research Administration

pros:
- concentrates teaching & research at southeast end of island
- extends shoreline activity further south
- creates outdoor courtyard spaces when grouped near existing buildings
- locates administration near parking and main road, easily accessible to visitors
- avoids building in a flood zone

SITE C considered for Visiting Scientist Housing

pros:
- facilitates construction by concentrating utilities and services in one location
- scenic views and quiet away from student dorms a perk for visiting scientists

SITE A considered & rejected for Teaching, Research & Administration

pros:
- Administration easily accessible from main road
- keeps center and east areas of the island undeveloped

cons:
- site is within the 100-year flood zone
- parking lots would be relocated to the center of the island
- new buildings have no relationship to existing buildings
- western views are less scenic than eastern
- requires relocation of Caretaker House

SITE D rejected for Visiting Scientist Housing

pros:
- location near dorms reinforces residential quad

cons:
- noise from Dining Hall loading, Student Center & delivery/service area

rejected sites

actions PROPOSED

Actions of varying time frames are required in order to implement the proposed campus master plan.

immediate action

long-term future action

- consider relocation of caretaker building to allow space for future development
- enhance main road landscape
- reconfigure & loading area
- analyze existing campus mech systems & energy usage
- develop campuswide sustainability strategy
- consider geothermal loop for future retrofit of existing buildings
- reprogram lab 2 into dorm & relocate seawater class to lab 5
- reprogram lab 5 for seawater OR replace lab & tank farm with new bldg
- relocate admin to new building & reprogram into future lab

- new stormwater bioretention area
- convert paved parking to porous surface
- reconfigure for maximum capacity on less land
- create focal point at end of main road
- eliminate parking lot
- use land for new teaching, research, admin buildings
- create outdoor gathering spaces between buildings

- eliminate trailer
- relocate dorm rooms to residential quad
- use land for new buildings and outdoor gathering spaces

- remove pavement
- create outdoor gathering spaces between Bookhout, library, and new building

- new pedestrian educational path along shoreline as part of stormwater plan

- eliminate parking lot
- transform into pedestrian quad

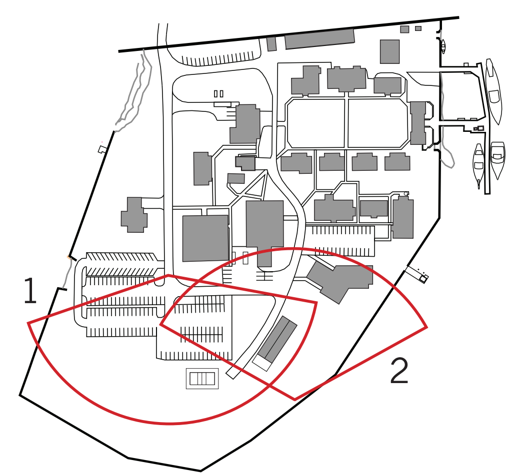
- reduce width of pedestrian path
- eliminate portion of path to make space for new buildings

landscape STRATEGIES

These six landscape strategies will greatly improve the quality of life on campus.

1 • consolidate unsightly parking away from panoramic vantage points

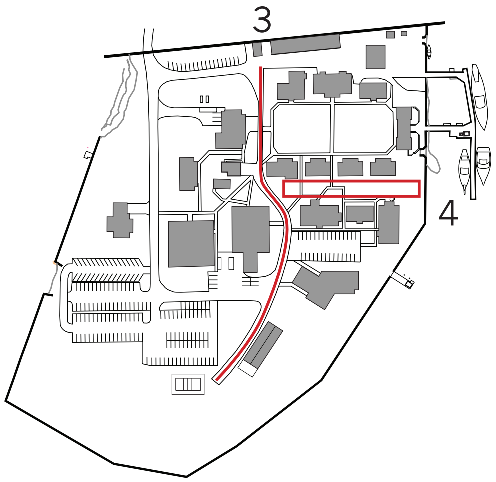
2 • sculpt planar campus grounds to define open dwelling space



landscape STRATEGIES

3 • convert wide internal roads to pedestrian-friendly corridors

unclutter green space by removing machinery and visual obstructions • 4

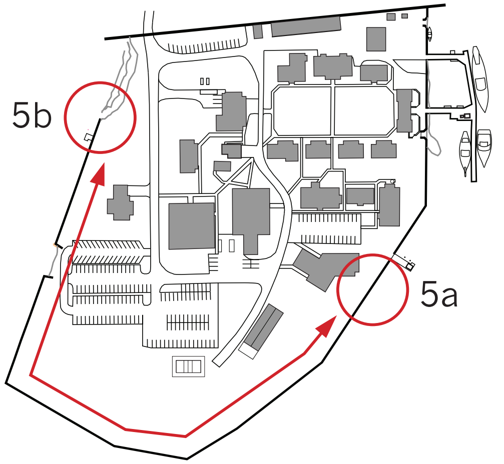


landscape STRATEGIES

5a • connect shores with scenic pathway

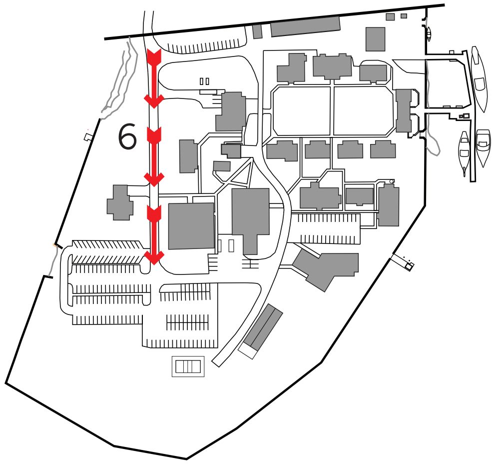
• 5b

SITE



landscape STRATEGIES

6 • create a welcoming campus by reinforcing direct wayfinding



SITE

circulation EXISTING

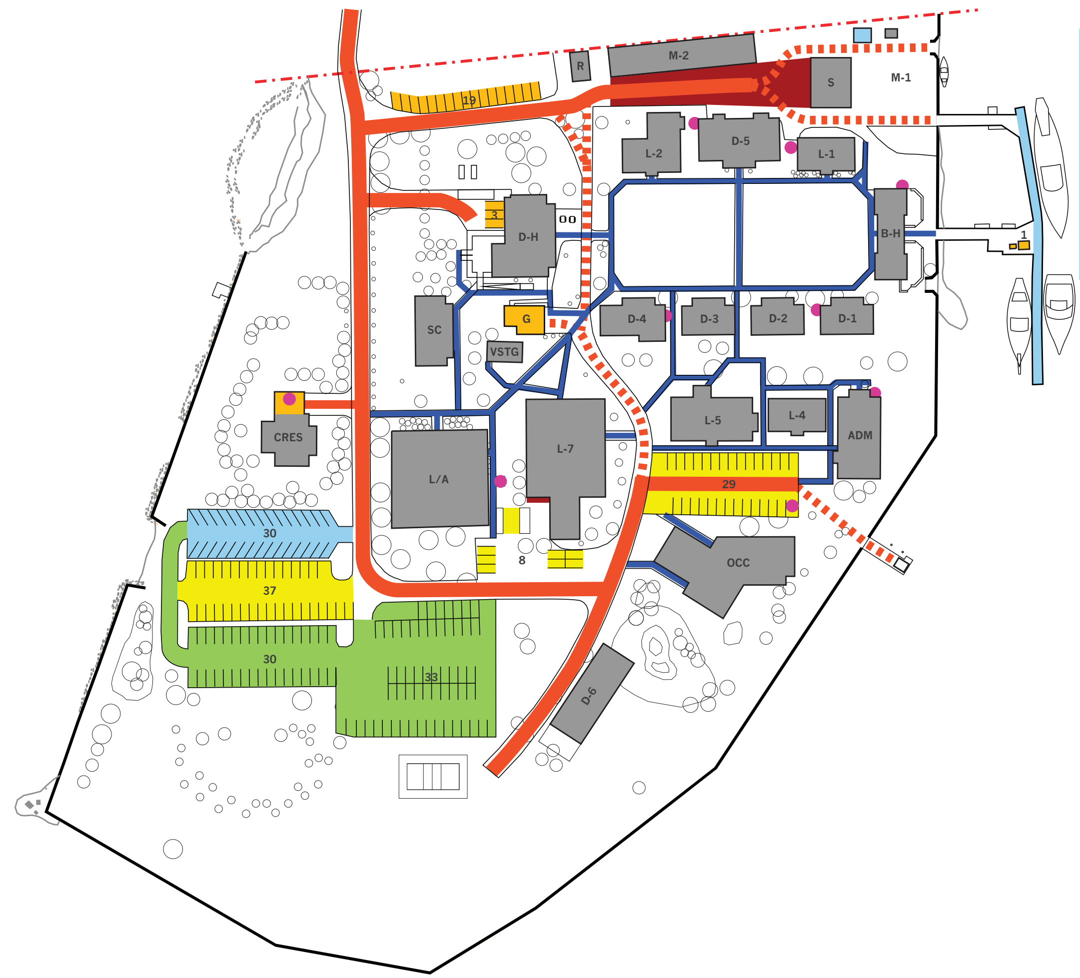
Existing circulation and parking conditions on site:

POSITIVES

- well-used pedestrian network linking buildings on the old quads
- main access road provides controlled access onto island
- delivery/loading area easily accessible from entry point of campus and avoides bringing large vehicles into the center of the island
- vehicular and pedestrian circulation is separated
- bike racks provided at multiple locations on island
- electric carts for distributing from loading to campus buildings are an effective way to eliminate vehicles in pedestrian areas

NEGATIVES

- complicated wayfinding from main access road to administrative building
- lack of designated pedestrian paths beyond the main road (west and south quadrants of the site) and on the waterfront
- uncomfortably wide paths around Bookhout and library-auditorium
- excess parking lots consume landscape and potential outdoor gathering spaces
- parking scattered in pedestrian zones reduce quality of outdoor space
- parking blocks panoramic views
- south and east sides of library-auditorium and Bookhout lack pedestrian paths



BUILDINGS

ADM	administration building
B-H	boathouse
C.RES	caretaker's residence
DH	dining hall
D-#	dorms
G	garage
L-#	labs
L/A	library & auditorium
M-1	maintenance building 1
M-2	maintenance building 2
OCC	repass center
R	recycling
S	storage building
SC	student center
VSTG	volatile storage

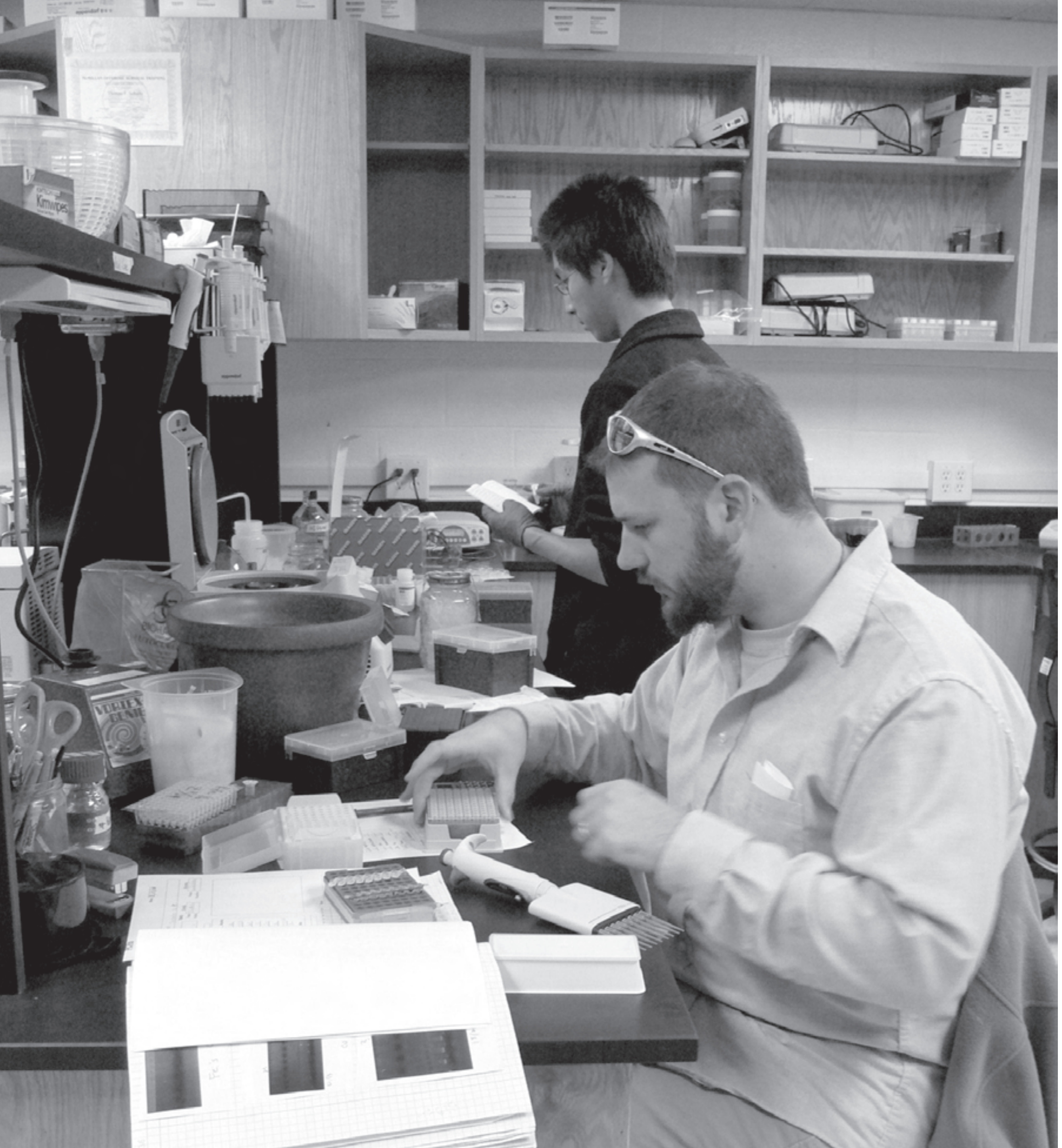
PARKING

- unpaved fixed vehicular parking
- unpaved seasonal vehicular parking
- staff & utility vehicular parking
- paved fixed vehicular parking
- boat parking
- loading zone
- bicycle parking
- # number of parking spaces

CIRCULATION

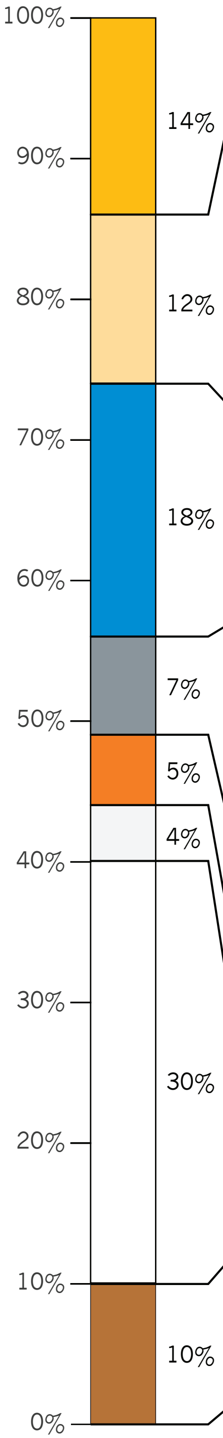
- paved two-way vehicular path
- paved one-way vehicular path
- utility vehicle access only
- paved pedestrian path
- unpaved pedestrian path

0 50 150 250 feet



Program analysis involves spending time with the end user to understand existing spaces and anticipate future growth. Existing spaces are evaluated by answering questions: are sizes sufficient for its intended use? Do spaces allow for flexibility and future retrofit? Do people like or dislike the spaces and why? What needs are currently not being served? Most of the information gathered will be utilized during later stages of the architectural design process. At this early feasibility stage, the primary focus is to identify the types, quantities and sizes of spaces in order to determine overall building size. In addition, program adjacencies are discussed and identified, as this can influence building configuration. Finally, program priorities are established to allow for phased growth.

program SUMMARY



Category	Room	Qty	Room Size (sf)	Area (sf)	Total Area (sf)
ADMINISTRATION	Director Office	1	10 x 20	200	
	Conference Room	1	10 x 20	200	
	Admin Assistant Office	1	10 x 15	150	
	Education Center	1	10 x 15	150	
	Finance Offices	3	10 x 13.5	405	
	Academic Services Offices	3	10 x 13.5	405	
	Reception/Grants Office	1	10 x 15	150	
	Copy/Mail Room	1	15 x 13.5	200	
	Ship Store	1	15 x 20	300	
	Auxiliaries Office	1	10 x 15	150	
	Expansion Office	1	10 x 13.5	135	
	Storage & Bulk Mail Room	1	15 x 20	300	2,745
FACULTY OFFICES	Geospatial Director Office	1	10 x 15	150	
	Molecular Biology Director Office	1	10 x 15	150	
	Molecular Biology Faculty Offices	3	10 x 15	450	
	Visiting Scientist Offices	2	15 x 20	600	
	Molecular Biology Research Associate Offices	3	15 x 20	900	2,250
MOLECULAR BIOLOGY	Molecular Biology Research Lab	1	28 x 55	1540	
	Cold Room	1	10 x 15	150	
	Dark Room	1	10 x 15	150	
	Appliance Room	1	15 x 26.75	400	
	Histology Room	1	10 x 15	150	
	Biochemical Chamber	1	8 x 8	65	
	Electrophoresis Room	1	10 x 15	150	
	Sequencer	1	10 x 15	150	
	Molecular Biology Teaching Lab	1	25 x 28	700	3,455
GEOSPATIAL	GIS Research Lab	1	31.25 x 31.25	980	
	GIS Videoconference	1	12 x 16.5	200	
	Server Room	1	12 x 16.5	200	1,380
SHARED TEACHING	Shared Instructional Teaching Lab	1	25 x 28	700	
	Shared Videoconference Room	1	15 x 20	300	1,000
SHARED COMMON	Entrance Lobby	1	20 x 20	400	
	Discussion Commons	1	16 x 24	385	700
SUPPORT	Mechanical & Bathrooms - 20%				2,306
	Circulation and ADA access - 25%				3,459
	ACADEMIC BUILDING TOTAL				**17,295**
HOUSING	**HOUSING TOTAL**	4	20 x 25	2,000	**2,000**

TOTAL PROGRAM AREA

19,295 sf

program AREA BY ROOM

administration
2,745 sf

- ship store 300 sf
- storage/ bulk mail 300 sf
- copy/ mail 200 sf
- director 200 sf
- conf 200 sf
- admin asst 150 sf
- grants 150 sf
- aux 150 sf
- ed center 150sf
- expan 135 sf
- acad serv 135 sf
- acad serv 135 sf
- acad serv 135 sf
- finance 135 sf
- finance 135 sf
- finance 135 sf

faculty offices
2,250 sf

- visiting scientist 300 sf
- visiting scientist 300 sf
- mol bio research assoc 300 sf
- mol bio research assoc 300 sf
- mol bio research assoc 300 sf
- GIS direct 150 sf
- mol bio direct 150 sf
- mol bio fac 150 sf
- mol bio fac 150 sf
- mol bio fac 150 sf

molecular biology
3,455 sf

- molecular biology research lab 1,540 sf
- molecular biology teaching lab 700 sf
- appliance room 400 sf
- seq 150 sf
- elect 150 sf
- hist 150 sf
- dark room 150 sf
- cold room 150 sf
- bioc 65 sf

geospatial
1,380 sf

- GIS research associate lab 980 sf
- GIS server 200 sf
- GIS video conf 200 sf

shared teaching
1,000 sf

- shared instructional computing lab 700 sf
- shared video conf 300 sf

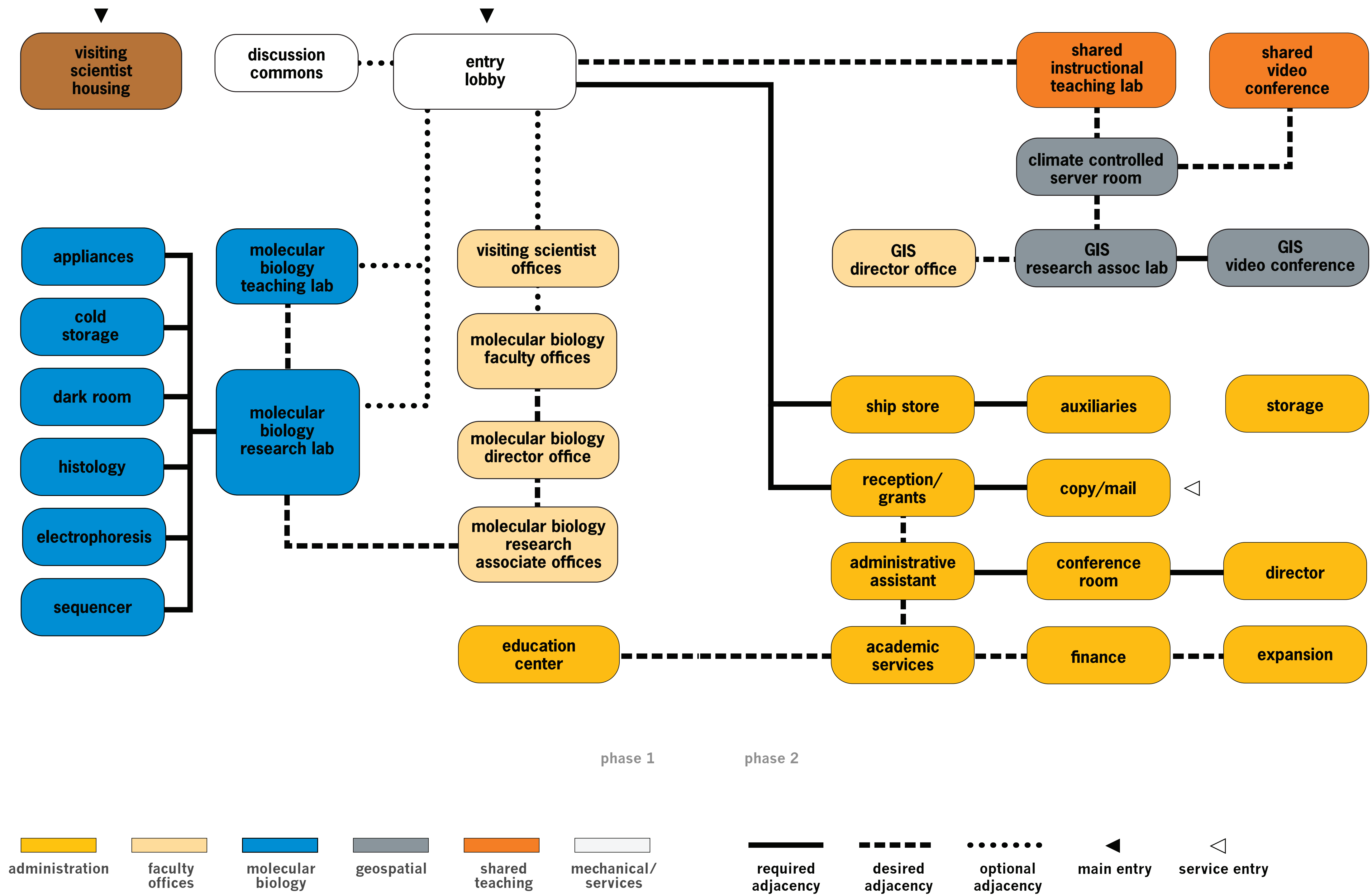
shared common
700 sf

- entry lobby 400 sf
- discussion commons 300 sf

visiting scientist housing
1,540 sf

- visiting scientist housing 385 sf
- visiting scientist housing 385 sf
- visiting scientist housing 385 sf
- visiting scientist housing 385 sf

program ADJACENCIES



DIRECTOR OFFICE

- location does not promote spontaneous interaction with students and faculty
- furniture layout not conducive to meeting with more than two people

CONFERENCE ROOM

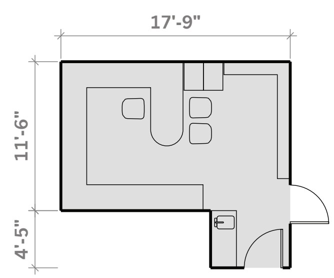
- size too small
- furniture too large, takes up too much space
- glare not conducive to videoconferencing
- videoconferencing not optimized
- insufficient storage for equipment
- insufficient white boards

ADMIN ASSISTANT OFFICE

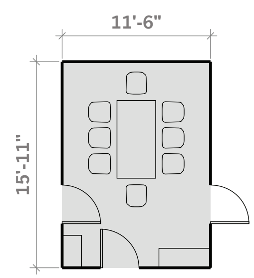
- insufficient "hidden'' storage for supplies
- poor acoustic separation - noise from hallway is distracting

EDUCATION CENTER

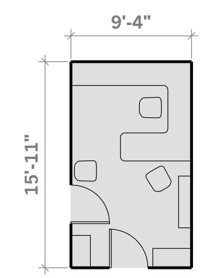
- community outreach program does not occur due to lack of space to develop education center program



225 sf

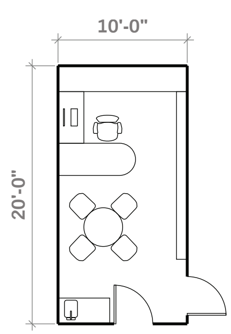


185 sf

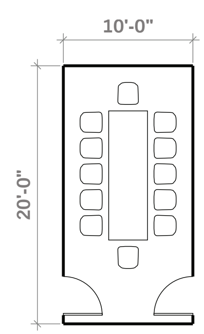


130 sf

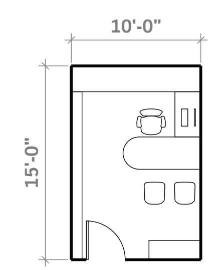
0 sf



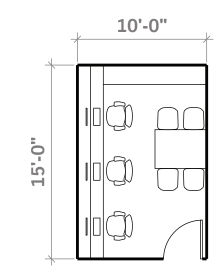
200 sf



200 sf



150 sf



150 sf

existing

new

FINANCE OFFICES

- reused built-in office furniture not the right scale, creates a cramped, non-ADA-compliant layout
- narrow size of room feels cramped when meeting with people
- lack of privacy - conversation can be heard through walls
- poor artificial lighting
- insufficient file space

ACADEMIC SERVICES OFFICES

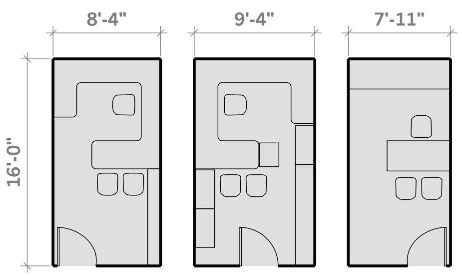
- lack of privacy in shared and individual offices - conversations can be heard through walls
- insufficient "hidden" storage for supplies
- insufficient layout space for student brochures and materials
- narrow room size not conducive to meeting with students - they often sit on the floor

RECEPTION/GRANTS OFFICE

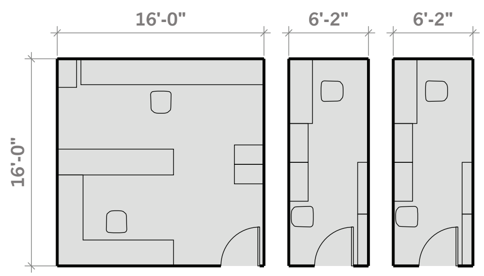
- furniture layout not conducive to meeting with visitors
- reused built-in office furniture not the right scale, creates a cramped, non-ADA-compliant layout
- file cabinets not immediately accesible from desk
- door to copy room cuts into seating space

COPY/MAIL ROOM

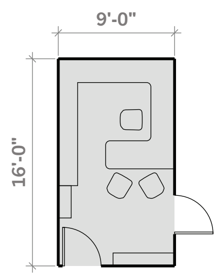
- copy room has insufficient countertop space
- insufficient storage for supplies
- insufficient counter space and lack of sink at kitchenette
- mail room is separated from the copy area
- location at building entrance is unattractive and hinders access
- lack of space for large packages



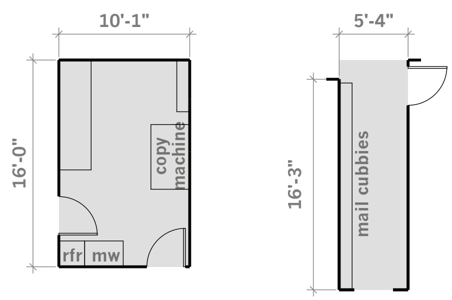
130 sf 175 sf 125 sf



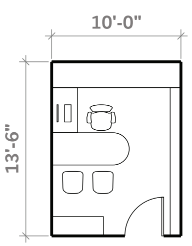
255 sf 100 sf 100 sf



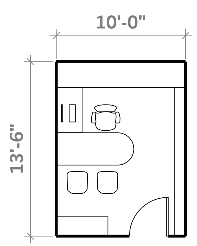
145 sf



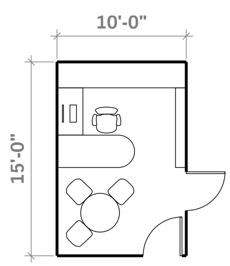
165 sf 85 sf



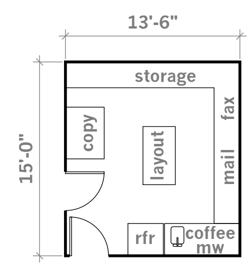
3 rooms @ 135 sf



3 rooms @ 135 sf



150 sf



200 sf

existing

new

SHIP STORE

- insufficient desk space
- products poorly displayed and difficult to find
- solid shelving blocks views and light
- shelving layout is cramped and inefficient, hinders supervision
- dead-end aisles create traffic jams
- poor artificial lighting
- feels more like a storage room than a store

AUXILIARIES OFFICE

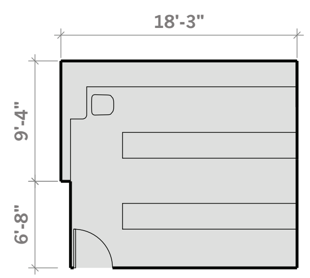
- window orientation results in too much heat gain
- views are blocked because window shades need to be down to control heat gain
- inefficient layout, same program could work effectively in a smaller room

EXPANSION OFFICE

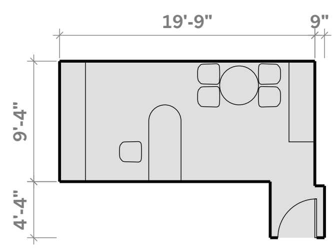
- isolated from all other offices
- not conducive to interaction

STORAGE & BULK MAIL ROOM

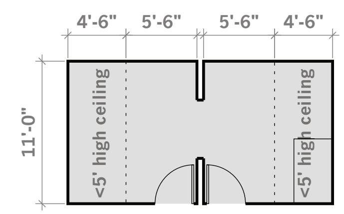
- room is larger than necessary
- not ADA-accessible due to second floor location
- remote location discourages alternative uses for layout space and mail sorting
- remote location discourages editing and purging of unnecessary files



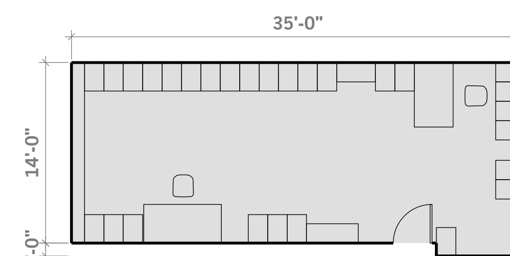
290 sf



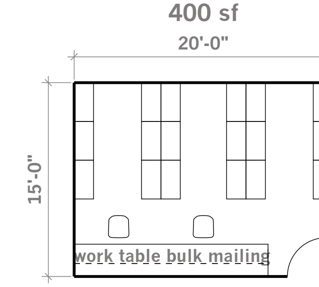
200 sf



120 sf

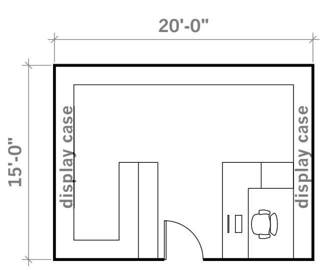


400 sf

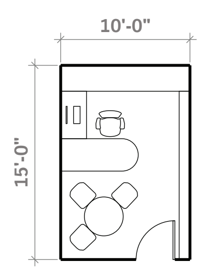


OR

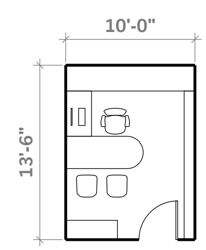
300 sf



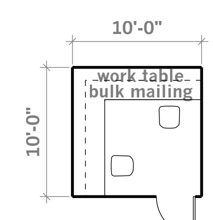
300 sf



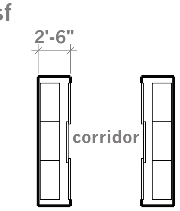
150 sf



135 sf



\+



equivalent bulk mailing space flexible as videoconference

total = 100 sf

storage closets distributed throughout instead of in a single room

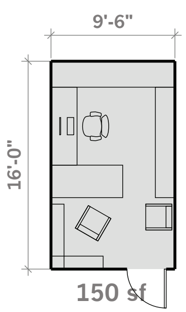
total = 200 sf

existing

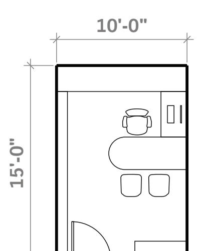
new

GEOSPATIAL DIRECTOR OFFICE

- Geospatial Director currently located on main campus
- current DUML facilities do not provide space for GIS director



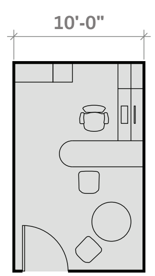
150 sf



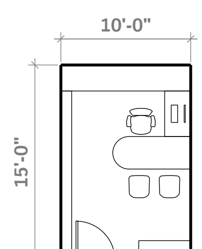
150 sf

MOLECULAR BIOLOGY DIRECTOR & FACULTY OFFICES

- Current Molecular Biology Director Office is far from the laboratory spaces
- current DUML facilities do not provide any space for Molecular Biology Faculty



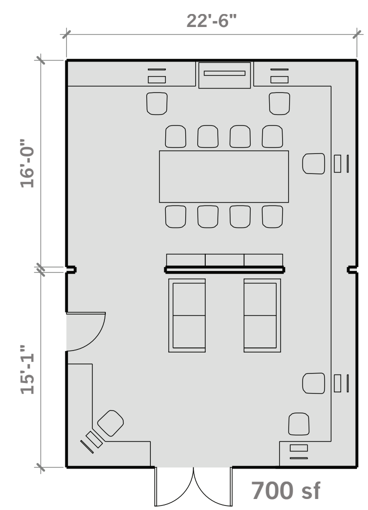
160 sf



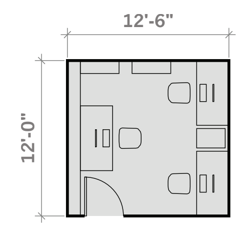
4 rooms @ 150 sf

MOLECULAR BIOLOGY RESEARCH ASSOCIATE OFFICES

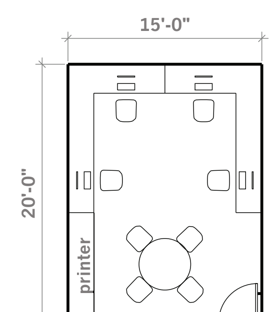
- scattered, isolated offices not conducive to academic discussion
- some offices too small/cramped
- some offices too large/inefficiently laid out
- poor artificial lighting
- insufficient file space



700 sf



150 sf

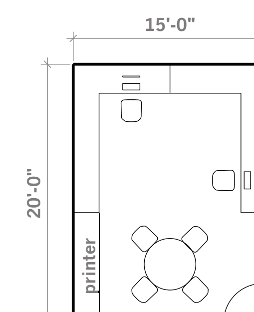


3 rooms @ 300 sf

VISITING SCIENTIST OFFICES

- DUML is not attracting enough visiting academics due to lack of space
- current DUML facilities do not cater to this important group

0 sf



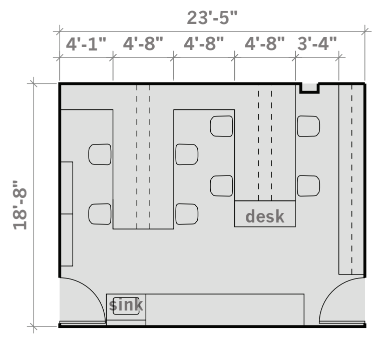
2 rooms @ 300 sf

existing

new

MOLECULAR BIOLOGY RESEARCH LAB

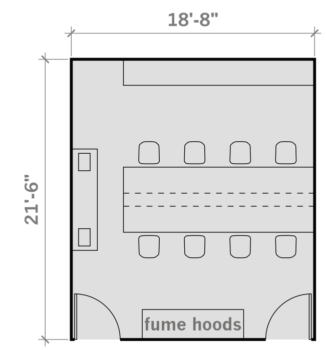
- insufficient bench space
- insufficient storage space
- insufficient quantity of white boards
- no natural light and no views, poor artificial light
- inadequate space between benches creates crowded conditions
- lack of modular bench components hinders flexibility
- lack of dedicated lab-wide subpanel with surge protector
- room too small to comfortably combine bench space and desk space
- room too small for multiple faculty to share a room, hindering interaction



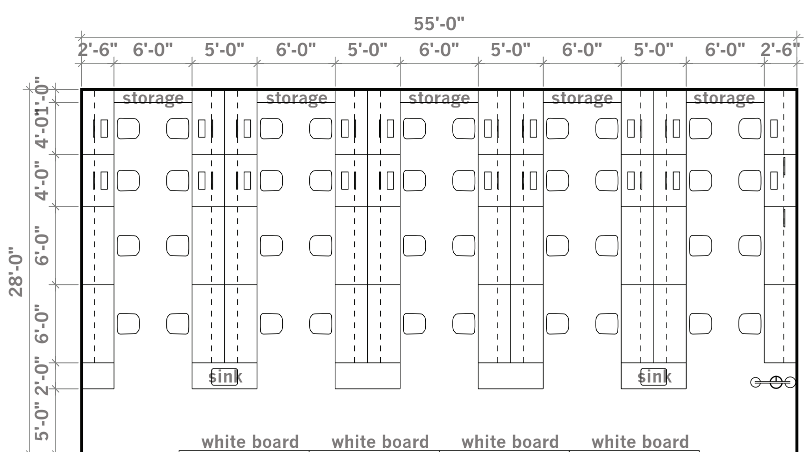
435 sf (8 seats)

MOLECULAR BIOLOGY TEACHING LAB

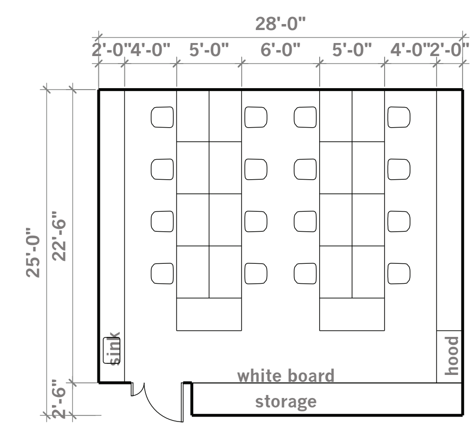
- insufficient bench space
- room too small for class sizes
- insufficient quantity of white boards
- insufficient storage space for equipment
- shelving on benches not ideal for teaching lab (blocks views, reduces flexibility for other teaching needs)



400 sf (8 seats)



1540 sf (20 seats)



700 sf (16 seats)

existing

new

APPLIANCE ROOM

- insufficient storage space for equipment
- aisle space between equipment too narrow
- ill-equipped for future growth

ELECTROPHORESIS ROOM & SEQUENCER

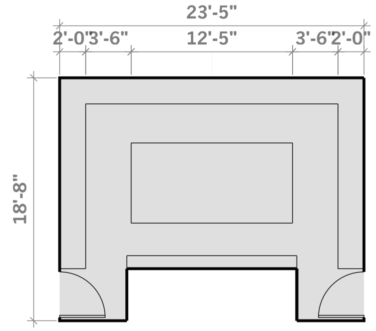
- absence of dedicated rooms for equipment is limiting future growth and research development
- equipment makes corridor look cluttered
- egress through corridor is compromised

COLD ROOM & DARK ROOM

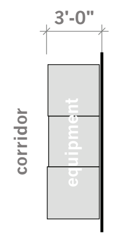
- while individual refrigerators provide easier access to contents and are cheap to replace, a dedicated cold room is better for maintaining a consistent temperature
- refrigerators make corridor look cluttered
- egress through corridor is compromised
- dark room's facilities outdated, limiting future growth and research in new fields

HISTOLOGY ROOM & BIOCHEMICAL CHAMBER

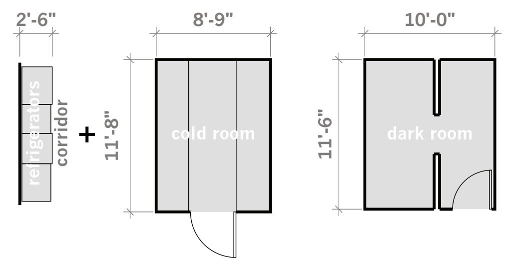
- absence of dedicated rooms for equipment is limiting future growth and research in new fields



385 sf



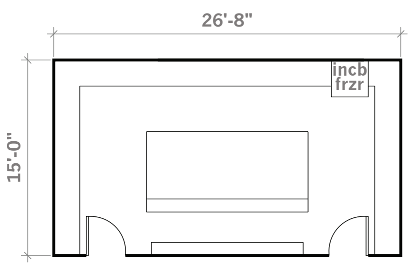
0 sf



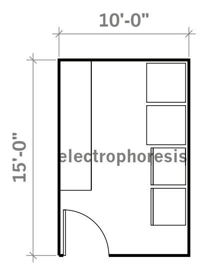
100 sf

115 sf

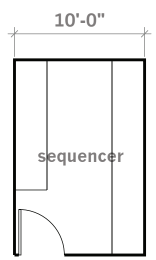
0 sf



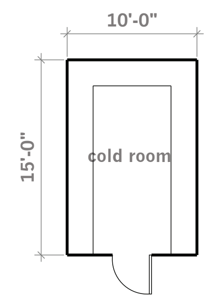
400 sf



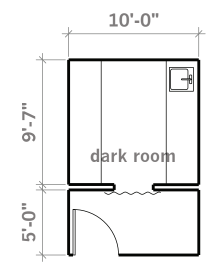
150 sf



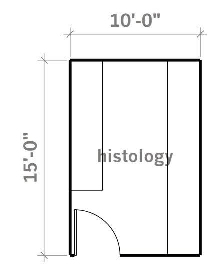
150 sf



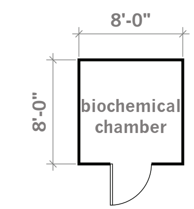
150 sf



150 sf



150 sf

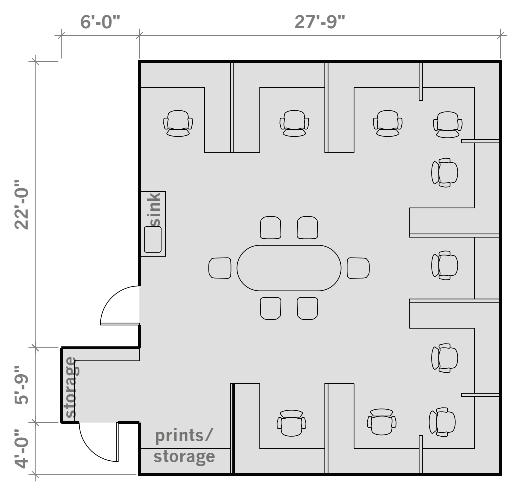


65 sf

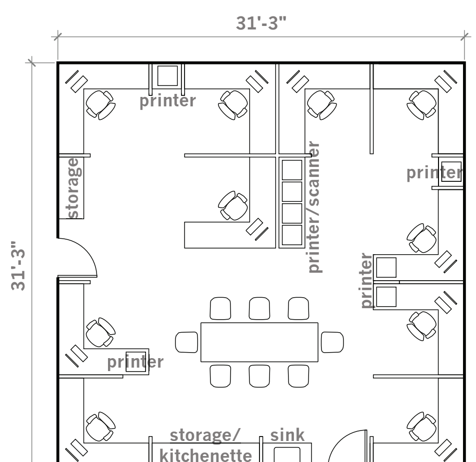
existing
new

GIS RESEARCH LAB

- GIS program is located on the main campus
- no space is provided at the DUML campus
- 3-person cubicles not ideal
- insufficient long-term storage for large equipment



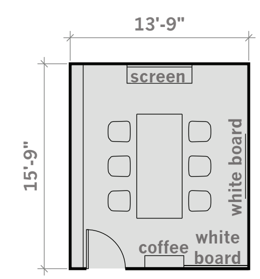
915 sf



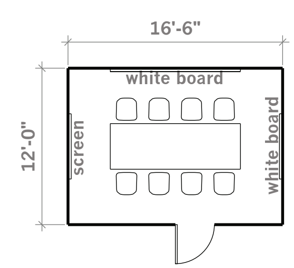
980 sf

GIS VIDEOCONFERENCE

- lacks natural light
- insufficient "hidden" storage for supplies
- shelving is not sturdy



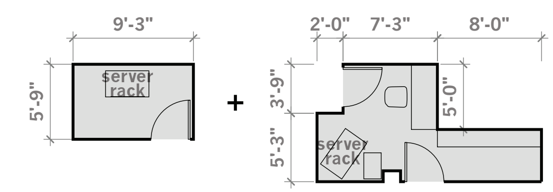
215 sf



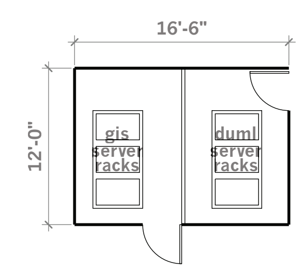
200 sf

SERVER ROOM

- insufficient climate control - overheating is a problem
- GIS and campus servers are not in separate lockable cages - security is a potential problem
- servers are scattered throughout campus and not centralized in one place



65 sf
110 sf

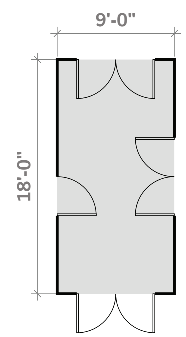


200 sf

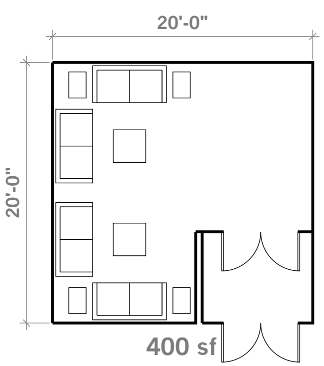
existing
new

ENTRANCE LOBBY

- no seating area hinders interaction
- small size hinders interaction
- does not provide a recognizable, welcoming face for the DUML
- no views or natural light
- poor artificial light



160 sf

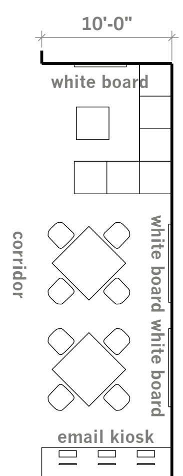


400 sf

DISCUSSION COMMONS

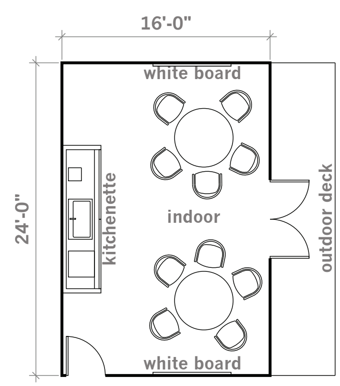
- current DUML facilities do not include dedicated space for meeting informally, hindering interaction between staff and students

0 sf



300 sf

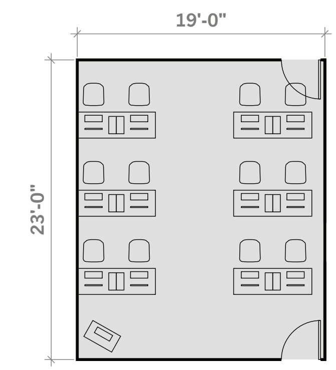
OR



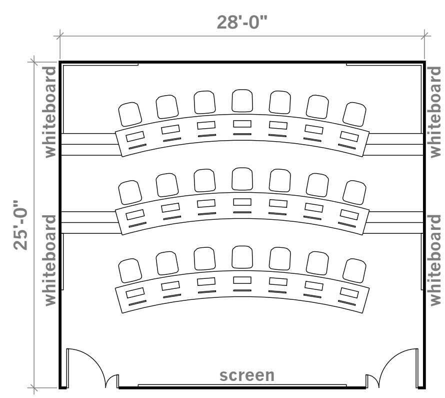
385 sf

SHARED INSTRUCTIONAL TEACHING LAB

- lacks windows, natural light and views
- poor artificial lighting
- layout is uninspiring
- insufficient desk space for group projects
- room too small for future growth



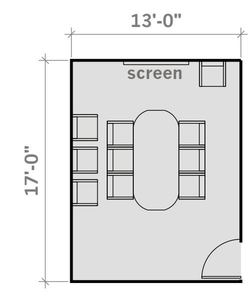
435 sf



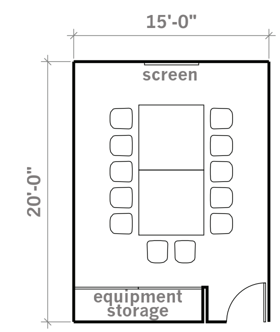
700 sf

SHARED VIDEOCONFERENCE ROOM

- oversized furniture takes up too much space
- seating around table not maximized
- not everyone has views to videoconference
- projection screen and portable projector outdated for videoconference technology
- poor artificial lighting
- uninspired aesthetics
- insufficient quantity of whiteboards



220 sf



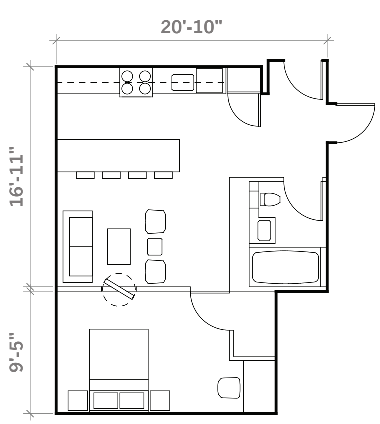
300 sf

existing

new

VISITING SCIENTIST HOUSING

- lack of affordable visitor's housing deterrs scientists from staying on Pivers Island to conduct research



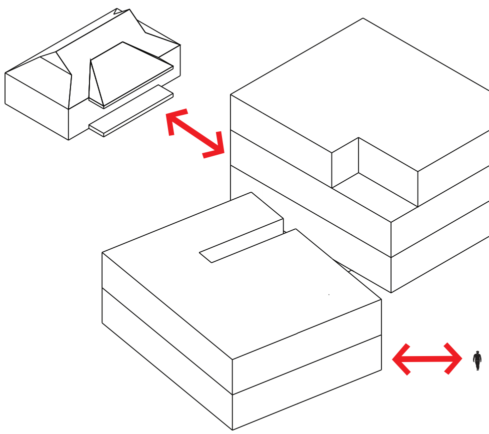
4 units @ 500 sf

existing

new

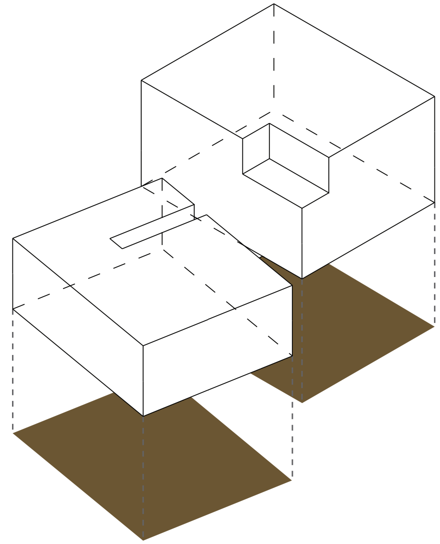
Building analysis takes the lessons learned from the site and program and develops a series of typologies, each expressing a different approach. Each typology uses the same programmatic requirements, but shows a different attitude toward building mass and scale, relationship to the land and other buildings, program interaction and adjacencies. These attitudes in turn affect sustainability, ease of construction, ease of phasing, efficiency, and cost. Several typologies have numerous advantages, but one typology is singled out as holding the greatest potential to balance aspirations with restrictions.

PHYSICAL CRITERIA



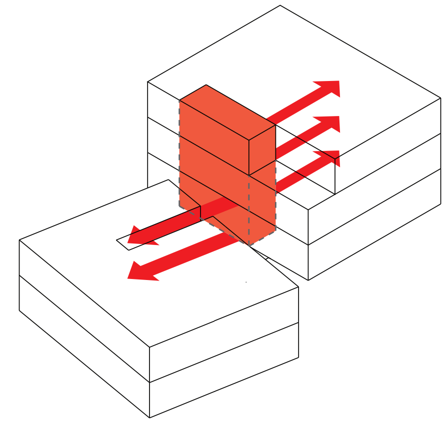
MASSING & SCALE

- building size should relate to people and to the surrounding context
- exterior composition (massing) should relate to interior space



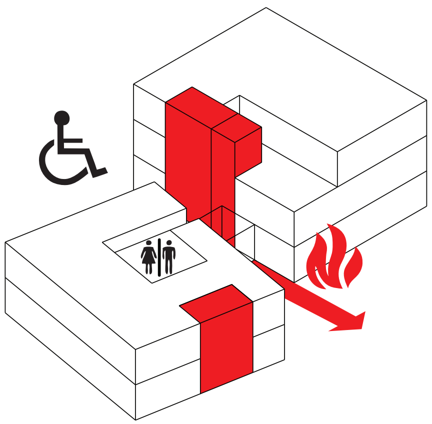
BUILDING FOOTPRINT

- environmental impact
- land preservation
- foundation costs



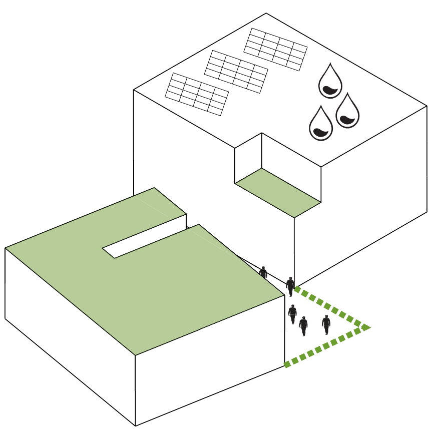
CIRCULATION

- horizontal and vertical circulation space should be minimized to increase efficiency and control costs
- circulation space can double as public gathering space



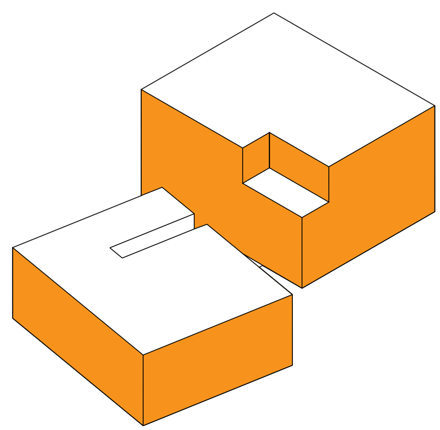
CODE

- fire safety, accessibility requirements and code requirements affect plan layout and overall building efficiency
- some typologies can be made code compliant more readily than others



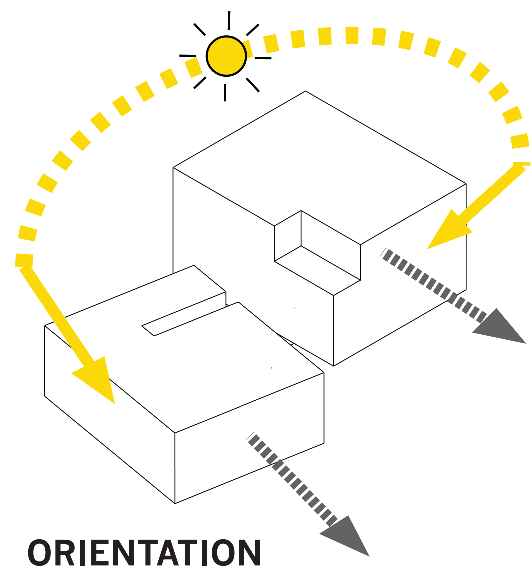
ROOF & OUTDOOR SPACE

- roofs can be used for solar/water collection
- rooftops can be used as terraces for users without direct access to ground level
- space between and around buildings can become gathering places



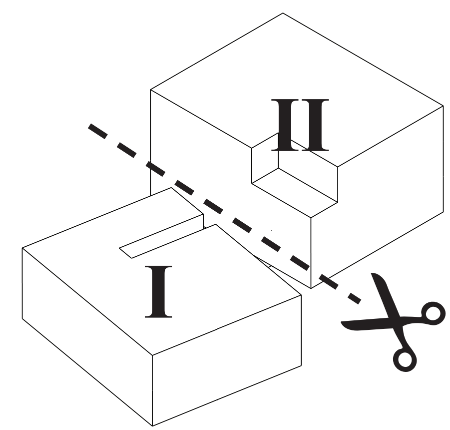
EXTERIOR SKIN

- amount of building envelope has cost and environmental implications
- minimizing solar gain and heat loss through the skin reduces energy consumption
- natural light is linked with productivity
- material and design affects weathering



ORIENTATION

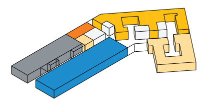
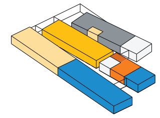
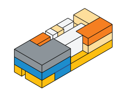
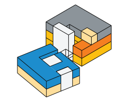
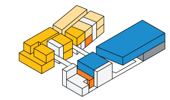
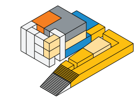
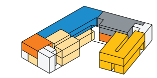
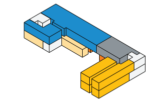
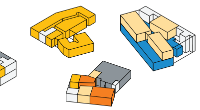
- situation in landscape
- situation relative to sun path
- control solar gain and wind exposure
- natural light linked with productivity
- consider alignment with other buildings
- consider views from and of building



PHASING

- phasing easier if clear programmatic or spatial separations exist
- buildings should appear coherent regardless of phasing outcome

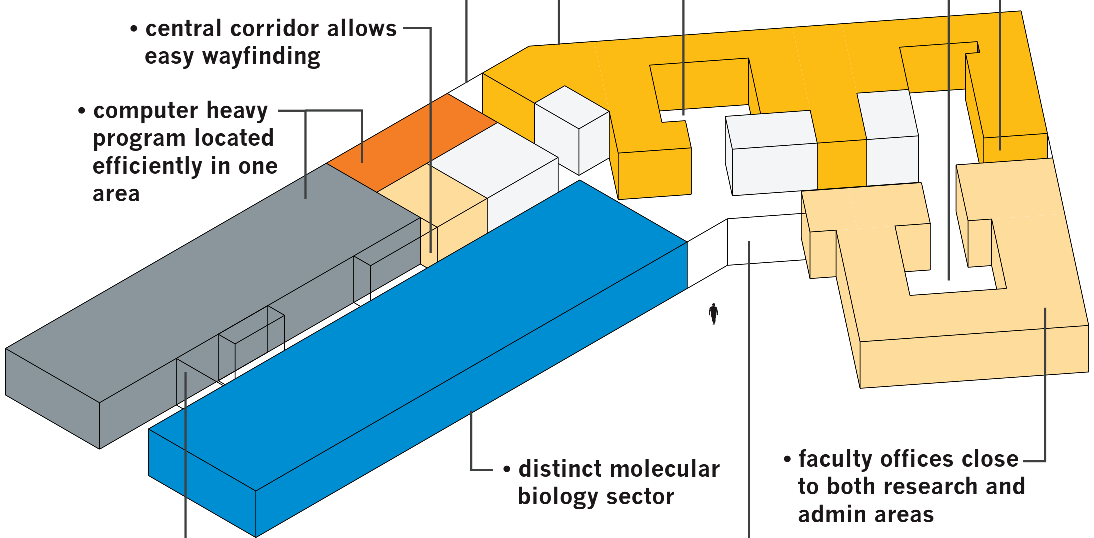
typology MATRIX

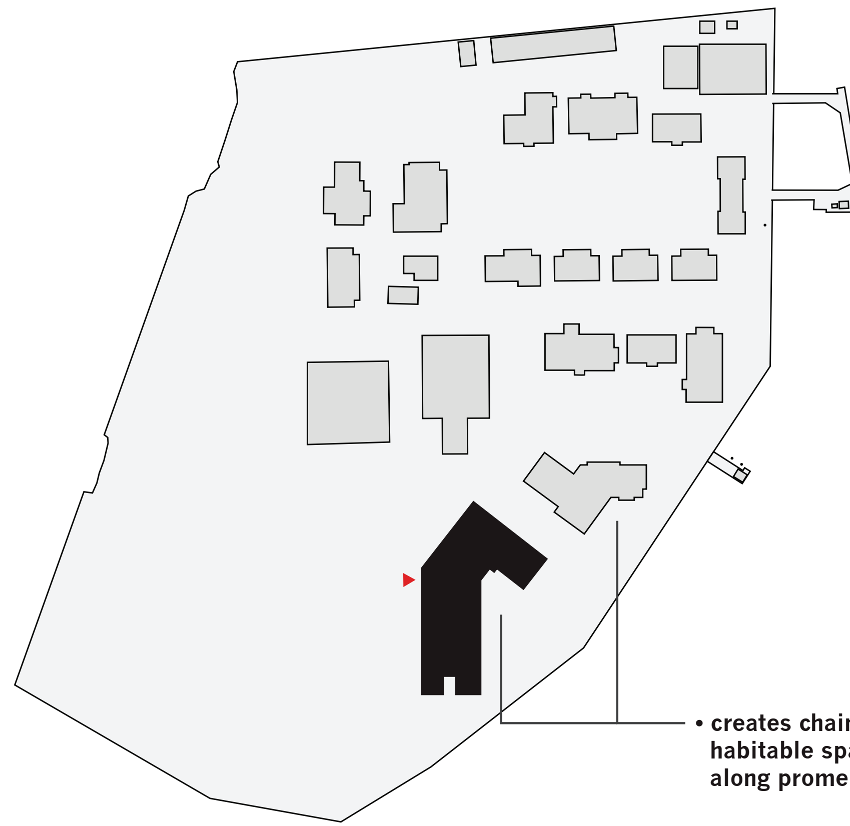
        

	I. 1 Storey Central Corridor	II. 1 Storey Double Corridor	III. 3 Storey Bar	IV. 2 & 3 Storey Connected Cubes	V. 2 Storey Fragmented Bars	VI. 3 & 1 Storey Tower On Plinth	VII. 2 Storey Horseshoe	VIII. 2 Storey Courtyard	IX. 1 & 2 Storey Village
MASSING & SCALE									
Number of storeys	1	1	3	2 & 3	2	3 & 1	2	2	1 & 2
Building Area Total (gsf)	17,530	16,990	17,545	17,825	18,275	17,335	16,860	16,995	17,300
Net Program Area (sf)	11,530	11,530	11,530	11,530	11,530	11,530	11,530	11,530	11,530
Efficiency = Net Program Area / Total Area	66%	68%	66%	65%	63%	67%	68%	68%	67%
Building Gross Area Multiplier	1.52	1.47	1.52	1.55	1.58	1.50	1.46	1.47	1.50
FOOTPRINT									
Footprint/Foundation Total (sf)	17,530	16,990	6,275	7,100	9,610	10,605	7,955	8,155	12,855
Footprint to Total Area Ratio	100%	100%	36%	40%	53%	61%	47%	48%	74%
ENVELOPE SURFACE AREA									
Roof Total (sf)	17,530	16,990	6,275	7,100	10,015	10,605	8,905	8,840	12,855
Roof for Solar Panels & Equipment (sf)	17,530	16,990	4,995	3,515	8,600	695	8,905	8,840	12,185
Roof for Terraces (sf)	0	0	1,280	3,585	1,415	9,910	0	0	670
Roof to Total Area Ratio	100%	100%	36%	40%	55%	61%	53%	52%	74%
Exterior Wall Total (sf)	8,200	8,220	12,120	14,955	17,990	10,795	13,740	13,525	14,460
Exterior Wall to Total Area Ratio	47%	48%	69%	84%	98%	62%	81%	80%	84%
Envelope Surface Area Total (sf)	25,730	25,210	18,395	22,055	28,005	21,400	22,645	22,365	27,315
Envelope to Total Area Ratio	147%	148%	105%	124%	153%	123%	134%	132%	158%
CIRCULATION									
Horizontal Circulation Area (sf)	2,320	2,705	1,930	2,145	2,535	2,150	1,725	2,050	2,285
Vertical Circulation (sf)	0	0	1,440	1,440	1,515	1,440	950	950	775
Total Circulation Area (sf)	2,320	2,705	3,370	3,585	4,050	3,590	2,675	3,000	3,060
Total Circulation Area to Total Area Ratio	13%	16%	19%	20%	22%	21%	16%	18%	18%

typology I

1 STOREY CENTRAL CORRIDOR





ADVANTAGES

- desired adjacencies easily achieved
- vertical scale fits existing campus
- simple construction
- easily phased/expanded
- no space wasted with vertical circulation
- ease of egress
- conducive to spontaneous interaction among users

DISADVANTAGES

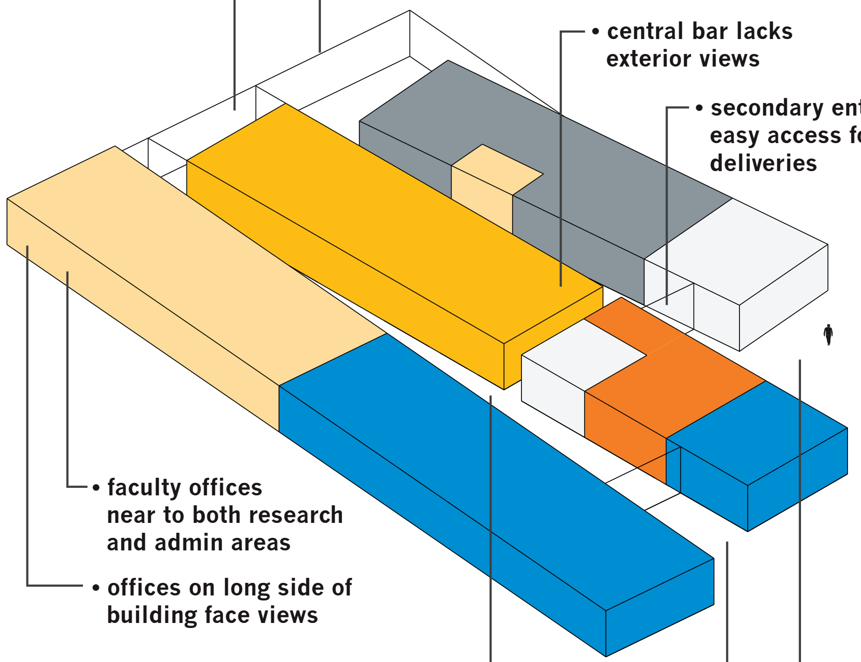
- large building footprint has negative environmental impact
- massive horizontal scale disproportionate with existing buildings
- blocks views and access to water
- long monotonous corridors

STATISTICS

TOTAL BUILDING AREA	17,530 sf
TOTAL FOOTPRINT	17,530 sf
TOTAL ENVELOPE (ROOF + WALL)	25,730 sf
CIRCULATION % OF TOTAL AREA	13%

administration | faculty offices | molecular biology | geospatial | shared teaching | mechanical/ services | existing buildings | proposed site | alternate sites

1 STOREY DOUBLE CORRIDOR



ADVANTAGES

- easy wayfinding
- vertical scale fits existing campus
- "fingers" frame views to water
- no space wasted with vertical circulation
- ease of construction
- ease of egress
- conducive to spontaneous interaction among users

DISADVANTAGES

- large footprint
- long corridors
- large horizontal scale
- no external views for rooms in central "finger"

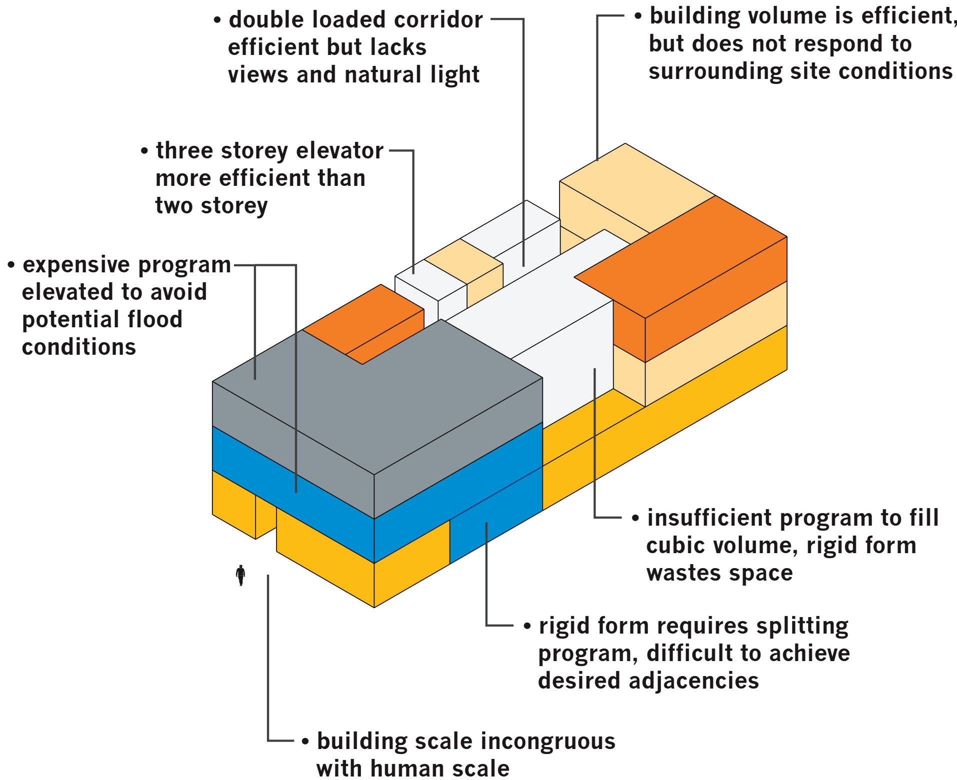
STATISTICS

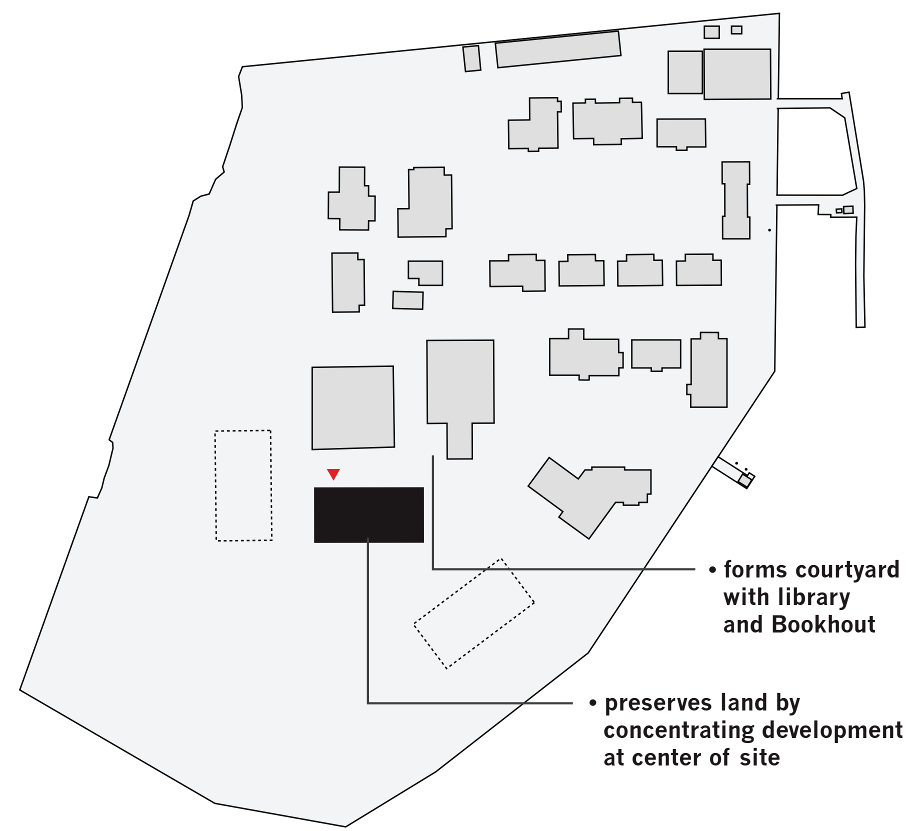
TOTAL BUILDING AREA	16,990 sf
TOTAL FOOTPRINT	16,990 sf
TOTAL ENVELOPE (ROOF + WALL)	25,210 sf
CIRCULATION % OF TOTAL AREA	16%

administration | faculty offices | molecular biology | geospatial | shared teaching | mechanical/ services | existing buildings | proposed site | alternate sites

typology III

3 STOREY BAR





ADVANTAGES

- elevated views
- efficient envelope-to-volume ratio
- small footprint
- efficient vertical circulation

DISADVANTAGES

- blocks views
- difficult to phase
- programs isolated by floor
- provides no new outdoor spaces
- large mass not in scale with existing buildings

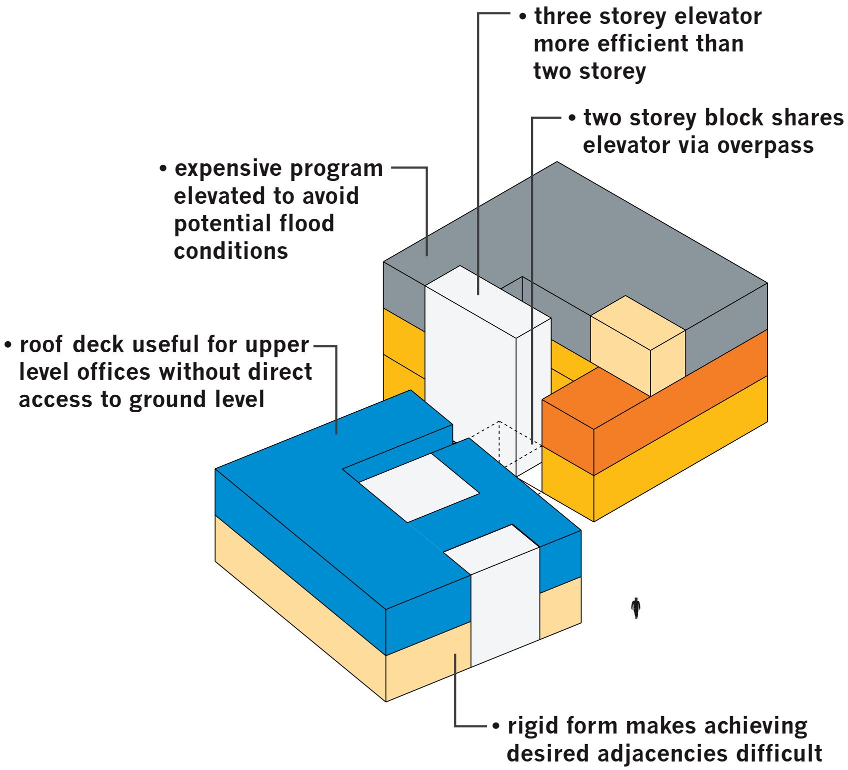
STATISTICS

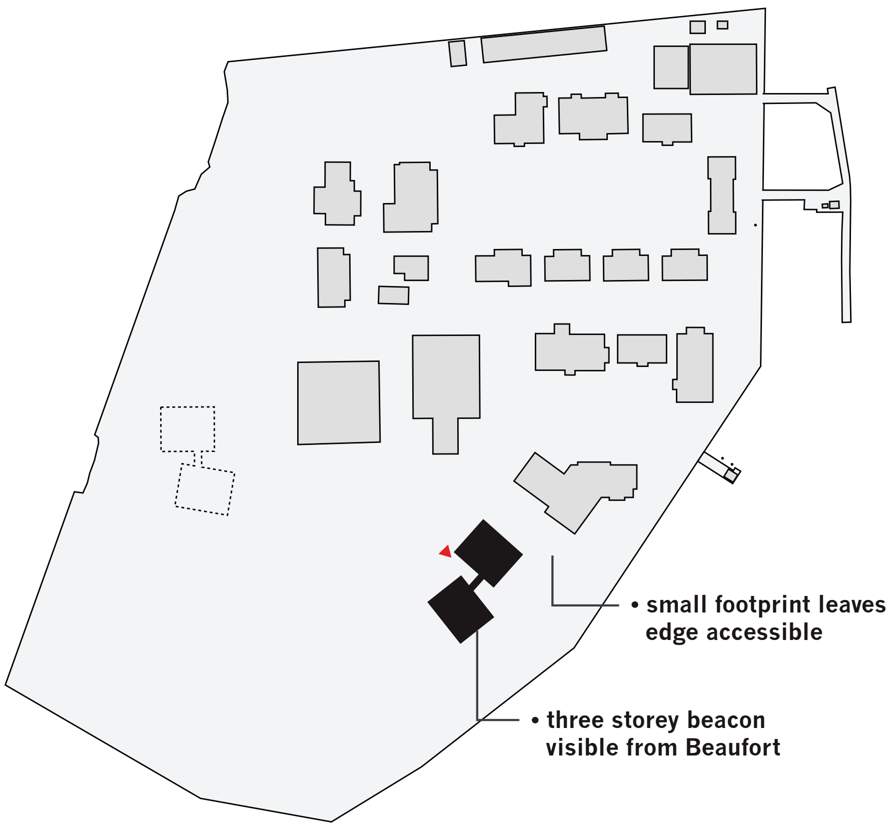
TOTAL BUILDING AREA	17,545 sf
TOTAL FOOTPRINT	6,275 sf
TOTAL ENVELOPE (ROOF + WALL)	18,395 sf
CIRCULATION % OF TOTAL AREA	19%

administration | faculty offices | molecular biology | geospatial | shared teaching | mechanical/ services | existing buildings | proposed site | alternate sites

BUILDING

2 & 3 STOREY CONNECTED CUBES





ADVANTAGES

- elevated views
- outdoor roof deck
- easily phased
- small footprint
- visually breaks up mass and provides a beacon in the landscape

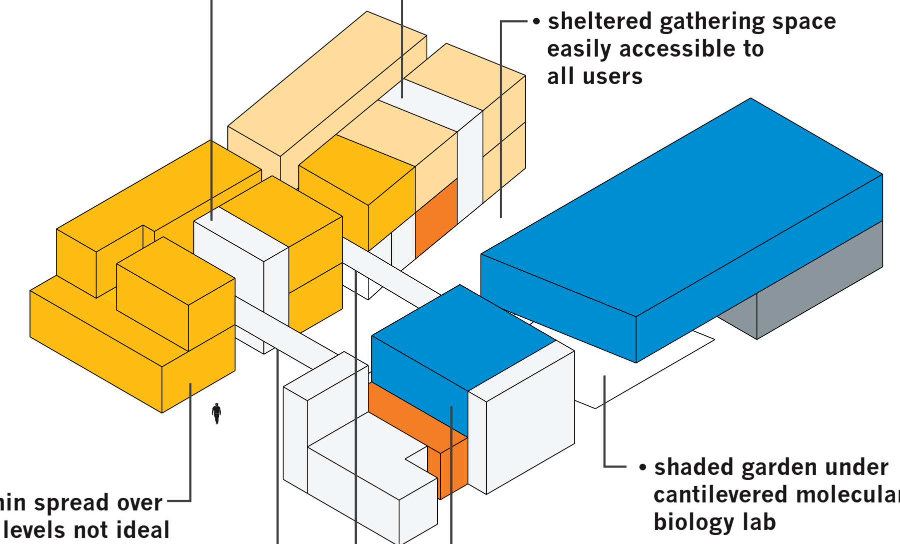
DISADVANTAGES

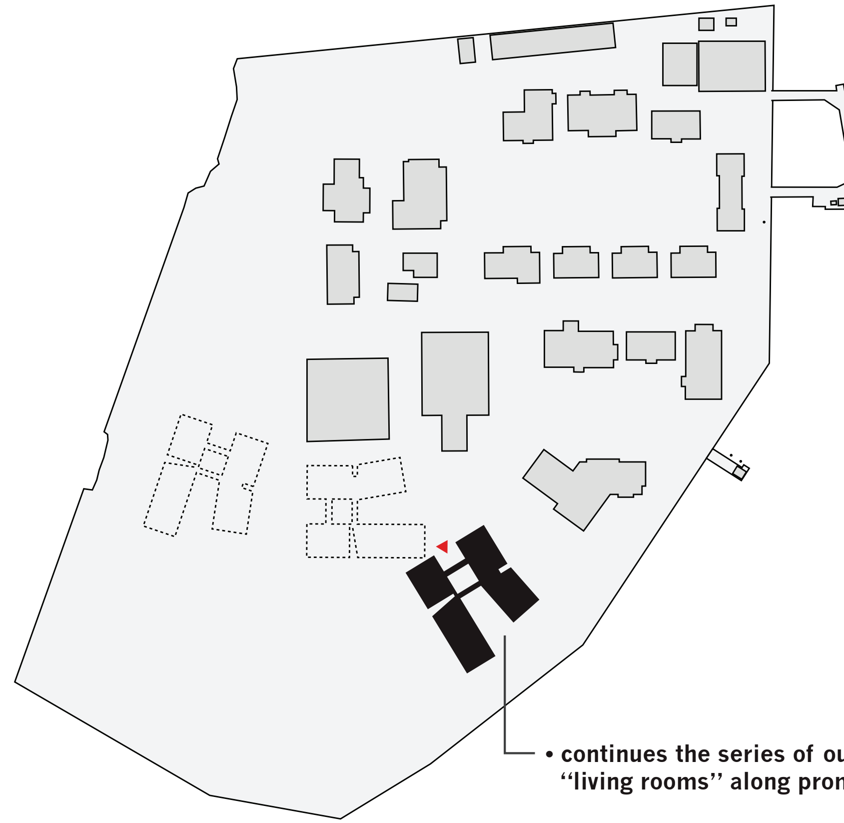
- difficult to expand program in future
- not conducive to interaction
- users separated into different buildings and floors
- building height not in keeping with scale of existing campus
- difficult to accommodate program adjacencies due to small floorplates

STATISTICS

TOTAL BUILDING AREA	17,825 sf
TOTAL FOOTPRINT	7,100 sf
TOTAL ENVELOPE (ROOF + WALL)	22,055 sf
CIRCULATION % OF TOTAL AREA	20%

2 STOREY FRAGMENTED BARS





ADVANTAGES

- cluster of smaller buildings create sheltered courtyard
- scale fits existing campus
- moderate sized footprint
- frames views

DISADVANTAGES

- needs more space for circulation and egress
- inefficient vertical and horizontal circulation
- difficult to phase
- large envelope surface area
- solar gain and heat loss potential issue

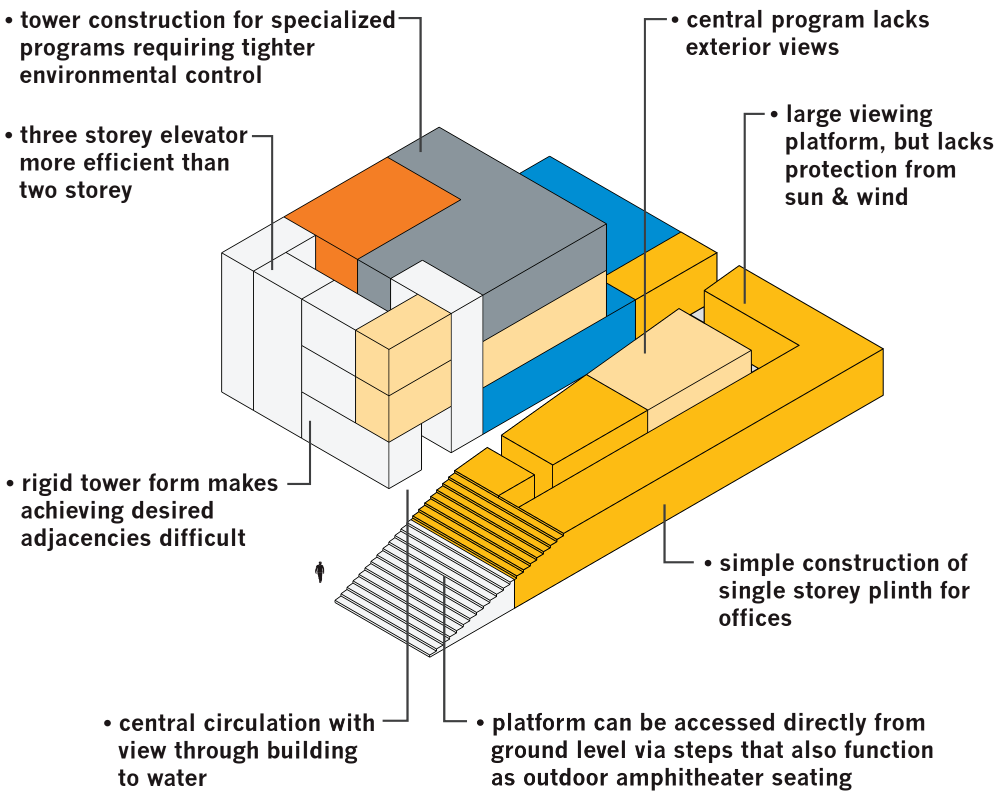
STATISTICS

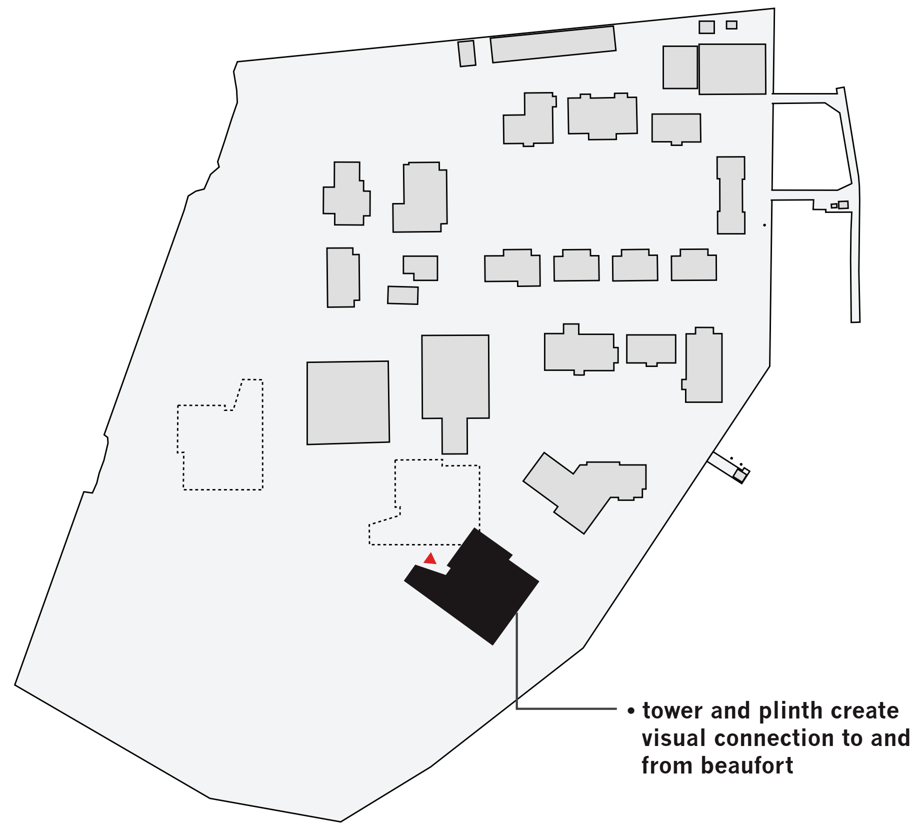
TOTAL BUILDING AREA	18,275 sf
TOTAL FOOTPRINT	9,610 sf
TOTAL ENVELOPE (ROOF + WALL)	28,005 sf
CIRCULATION % OF TOTAL AREA	22%

administration · faculty offices · molecular biology · geospatial · shared teaching · mechanical/ services

existing buildings · proposed site · alternate sites

3 & 1 STOREY TOWER ON PLINTH





ADVANTAGES

- plinth provides outdoor roof terrace for upper floors of tower
- elevated and panoramic views
- view through lobby to island's edge
- dual construction mode possible

DISADVANTAGES

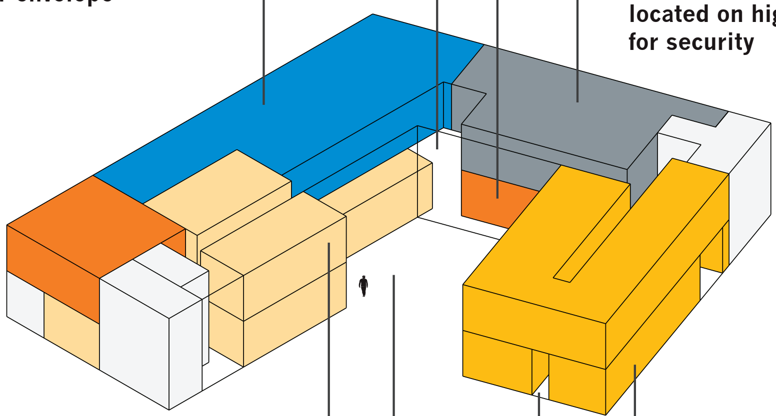
- difficult to phase
- phase two required for design to make sense
- outdoor space exposed to wind and sun
- building scale does not fit existing campus
- rooms at center lack views
- tower requires more complicated, and possibly more expensive construction

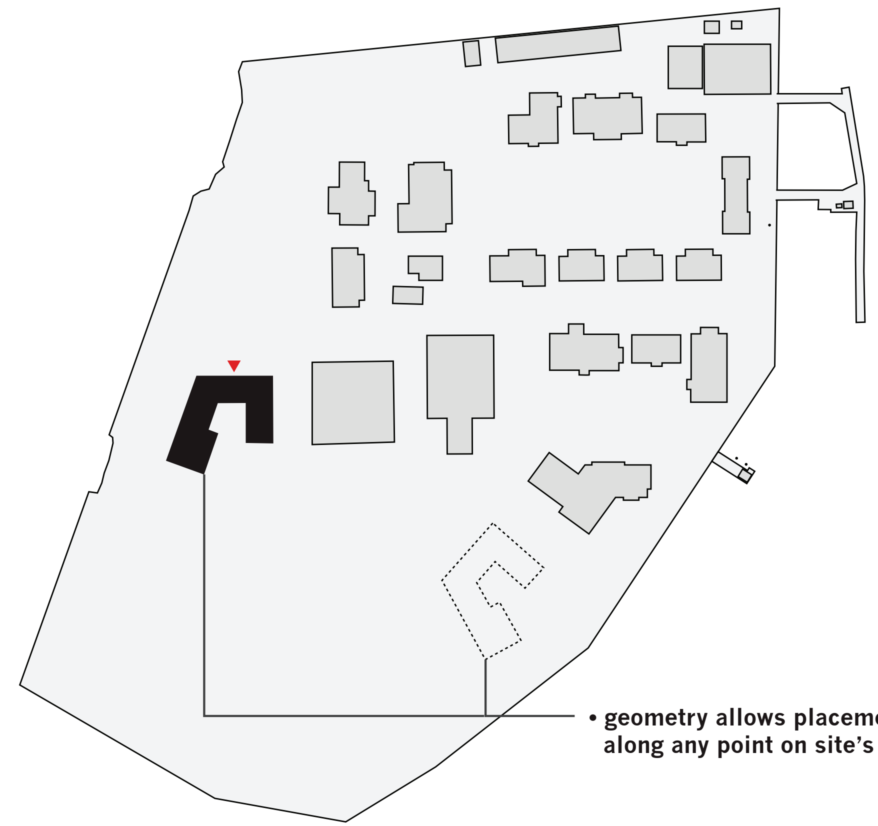
STATISTICS

TOTAL BUILDING AREA	17,335 sf
TOTAL FOOTPRINT	10,605 sf
TOTAL ENVELOPE (ROOF + WALL)	21,400 sf
CIRCULATION % OF TOTAL AREA	21%

administration | faculty offices | molecular biology | geospatial | shared teaching | mechanical/ services | existing buildings | proposed site | alternate sites

2 STOREY HORSESHOE





ADVANTAGES

- creates its own outdoor courtyard that is sheltered from sun and wind
- efficient circulation
- easy wayfinding
- conducive to spontaneous interaction among users
- vertical scale compatible with existing buildings

DISADVANTAGES

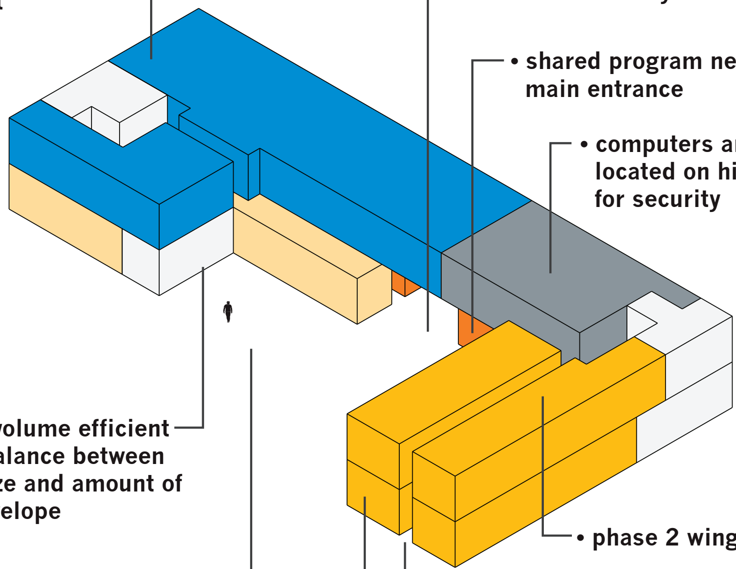
- difficult to phase
- phase two required for design to make sense

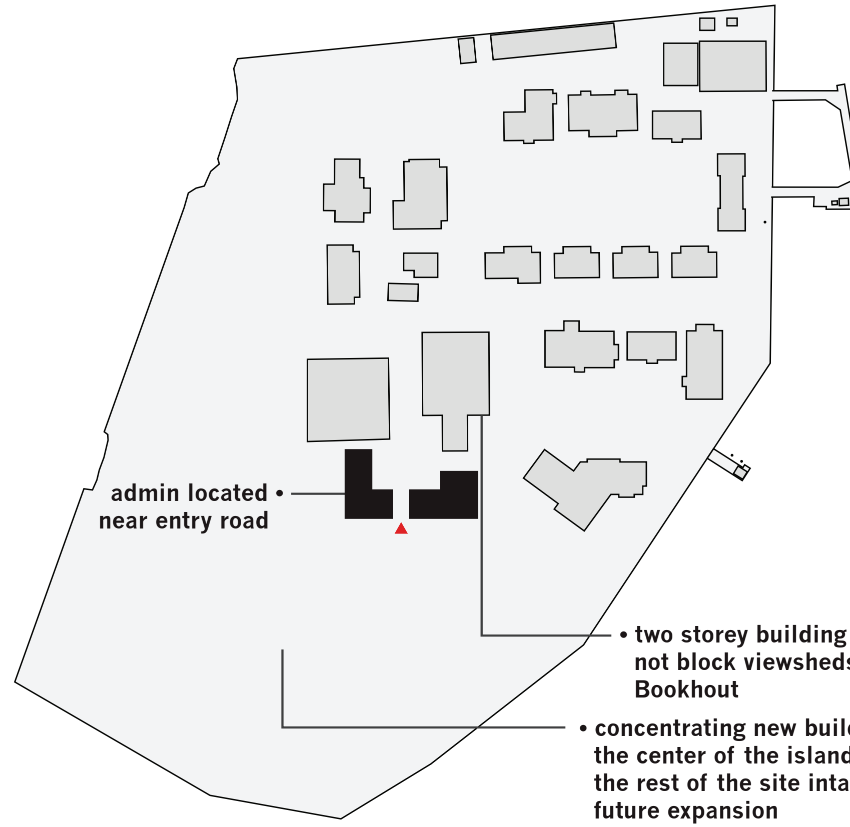
STATISTICS

TOTAL BUILDING AREA	16,860 sf
TOTAL FOOTPRINT	7,955 sf
TOTAL ENVELOPE (ROOF + WALL)	22,645 sf
CIRCULATION % OF TOTAL AREA	16%

administration | faculty offices | molecular biology | geospatial | shared teaching | mechanical/ services | existing buildings | proposed site | alternate sites

2 STOREY COURTYARD





ADVANTAGES

- creates outdoor courtyard that is sheltered from sun and wind
- prevents wind tunnel effect between libray-auditorium and Bookhout
- efficient circulation
- easy wayfinding
- conducive to spontaneous interaction among users
- vertical scale compatible with existing buildings
- densifies central core of campus and preserves green undeveloped areas of island

DISADVANTAGES

- difficult to phase
- phase two required for design to make sense
- relies on Bookhout; could affect future renovation or demolishing of Bookhout

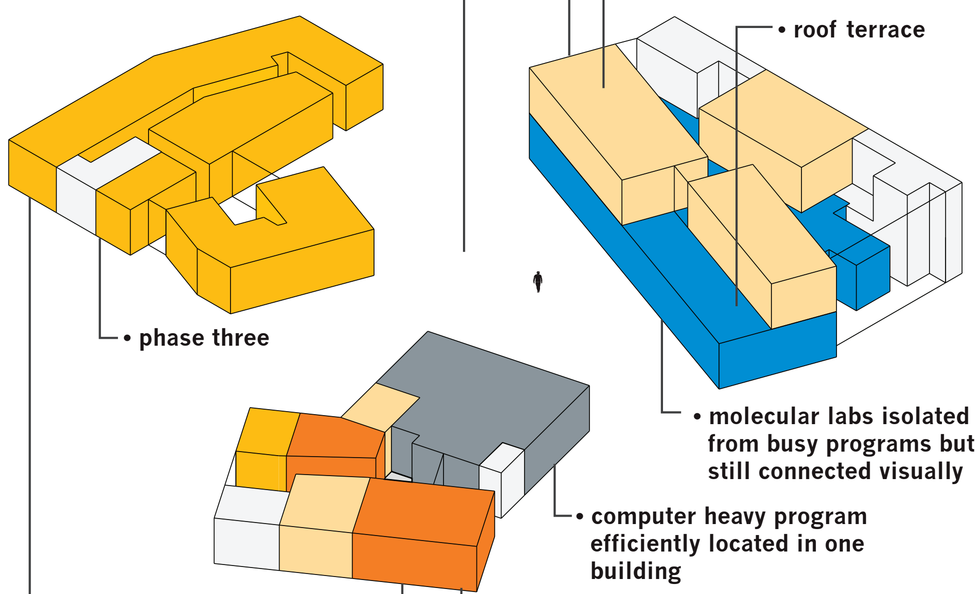
STATISTICS

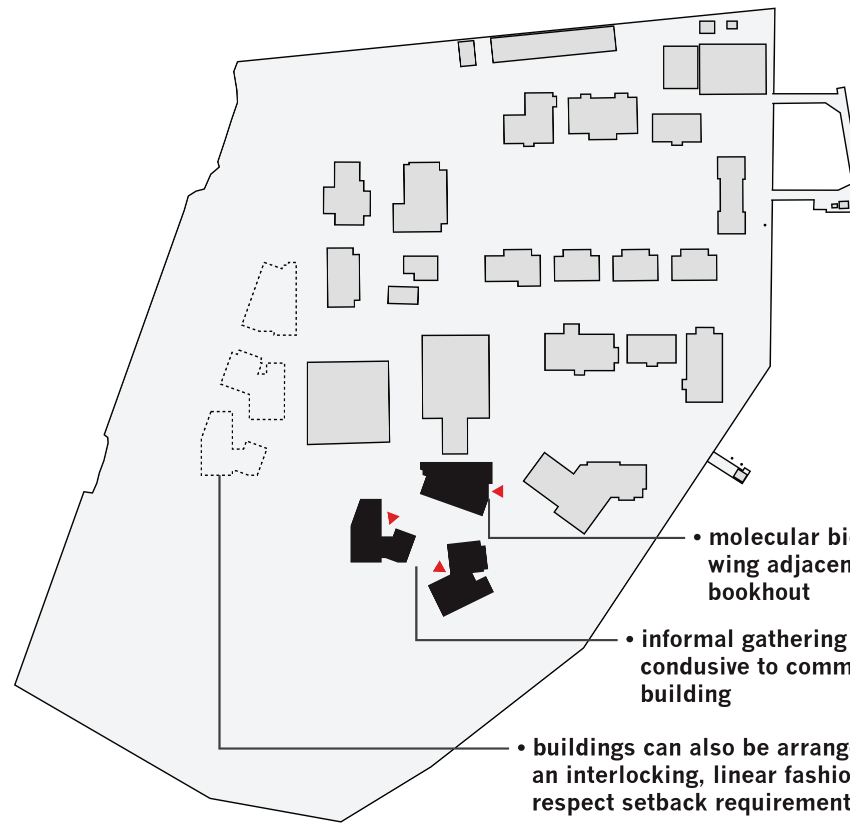
TOTAL BUILDING AREA	16,995 sf
TOTAL FOOTPRINT	8,155 sf
TOTAL ENVELOPE (ROOF + WALL)	22,365 sf
CIRCULATION % OF TOTAL AREA	18%

administration | faculty offices | molecular biology | geospatial | shared teaching | mechanical/ services

existing buildings | proposed site | alternate sites

1 & 2 STOREY VILLAGE
SELECTED TYPOLOGY





ADVANTAGES
- scale fits existing campus
- each building can be oriented to optimize sun and wind exposure
- creates sheltered outdoor zone
- generous natural light and views
- fosters interaction and community
- minimized circulation space
- easy to phase
- simple construction
- unique programs can be expressed architecturally
- allows departments to operate different hours

DISADVANTAGES
- large envelope surface area (must address solar gain and heat loss)
- large overall footprint (must compensate with green roofs and stormwater collection)

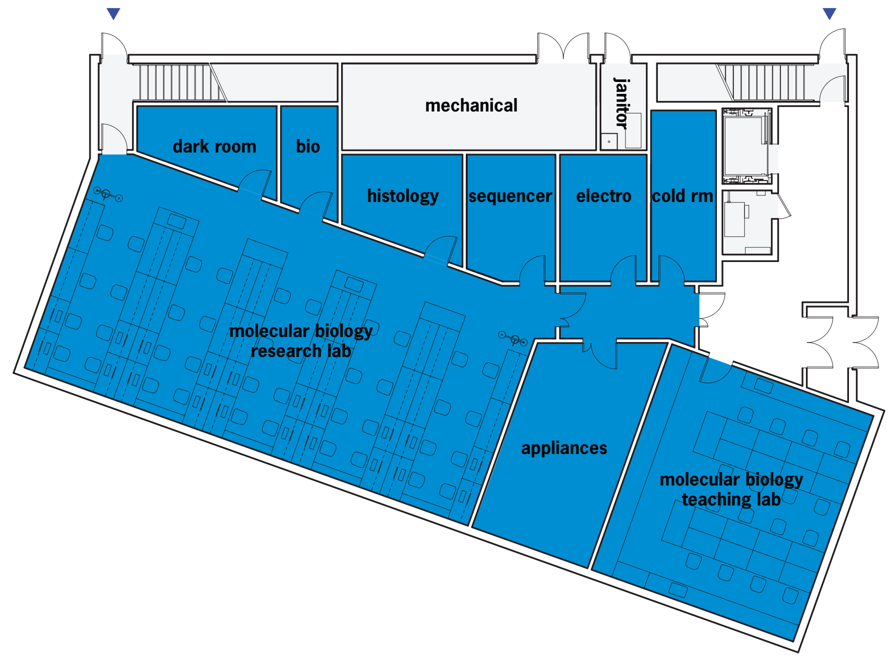
STATISTICS

TOTAL BUILDING AREA	17,300 sf
TOTAL FOOTPRINT	12,855 sf
TOTAL ENVELOPE (ROOF + WALL)	27,315 sf
CIRCULATION % OF TOTAL AREA	18%

administration | faculty offices | molecular biology | geospatial | shared teaching | mechanical/ services | existing buildings | proposed site | alternate sites

GROUND FLOOR PLAN

MARINE CONSERVATION GENETIC CENTER
5115 sf



VISITOR, EDUCATION & OUTREACH CENTER
4015 sf

MARINE GEOSPATIAL ECOLOGY CENTER
3725 sf

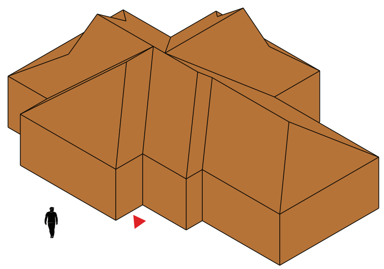
administration | faculty offices | molecular biology | geospatial | shared teaching | mechanical/ services

primary entrance | secondary entrance

0 10 20 40 feet

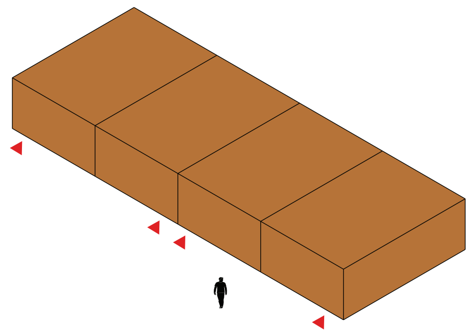
SECOND FLOOR PLAN

housing STUDY



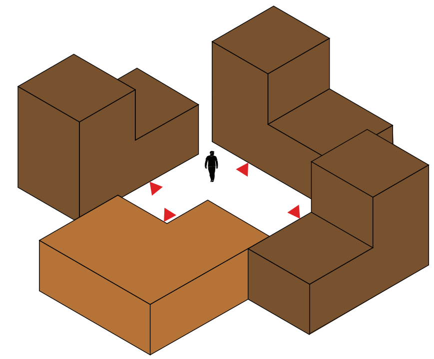
1 STOREY BUNGALOW

- matches style of caretaker's residence
- inefficient interior layout
- difficult to expand
- can not accommodate multiple families



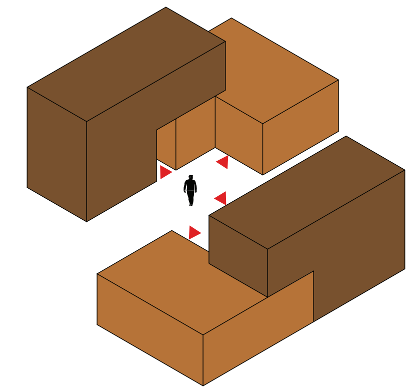
1 STOREY ROW

- easy and inexpensive to construct
- generic interior layout
- large footprint difficult to fit on residential quad
- lacks inspiration for green living



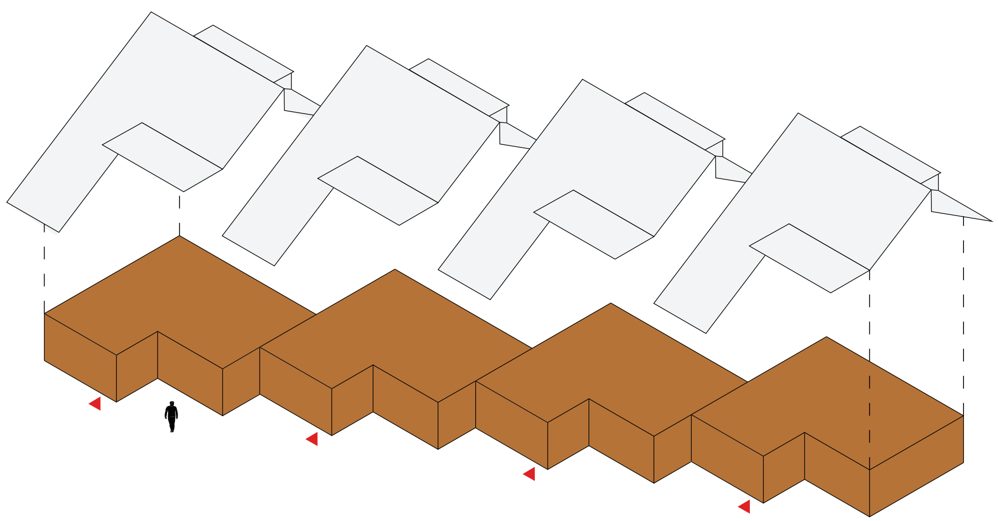
1 & 2 STOREY COURTYARD

- 3 non ADA units with second floor bedrooms and viewing terraces
- one ADA-accessible unit with ground floor garden access
- buildings create semiprivate, sheltered courtyard
- no ADA-accessible family suites



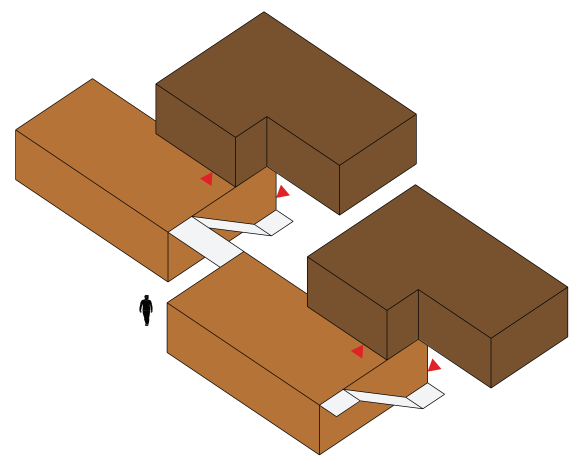
1 & 2 STOREY QUAD

- two ADA-accessible units
- two non ADA-accessible units with viewing terraces
- buildings create semiprivate, sheltered quad
- no ADA-accessible family suites



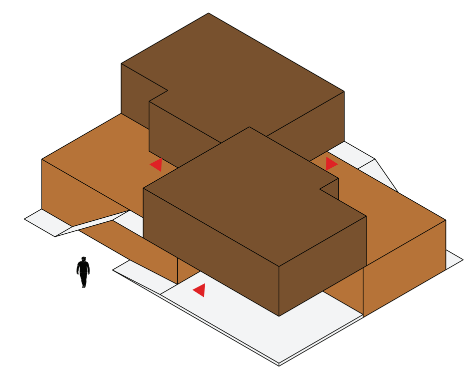
SINGLE STOREY ARRAY

- staggered row adds visual interest to island
- more surface per unit for heat gain and light
- highly articulated roof for water catchment and solar energy collection
- front porches link to create communal space
- can convert two adjacent units into ADA family suite
- large footprint difficult to fit on residential quad



2 STOREY CANTILEVER

- stacked for minimal footprint and enviromental impact
- two ADA-accessible units with shaded patios
- two non ADA-accessoble units with viewing terraces
- small courtyard
- no ADA-accessible family suites



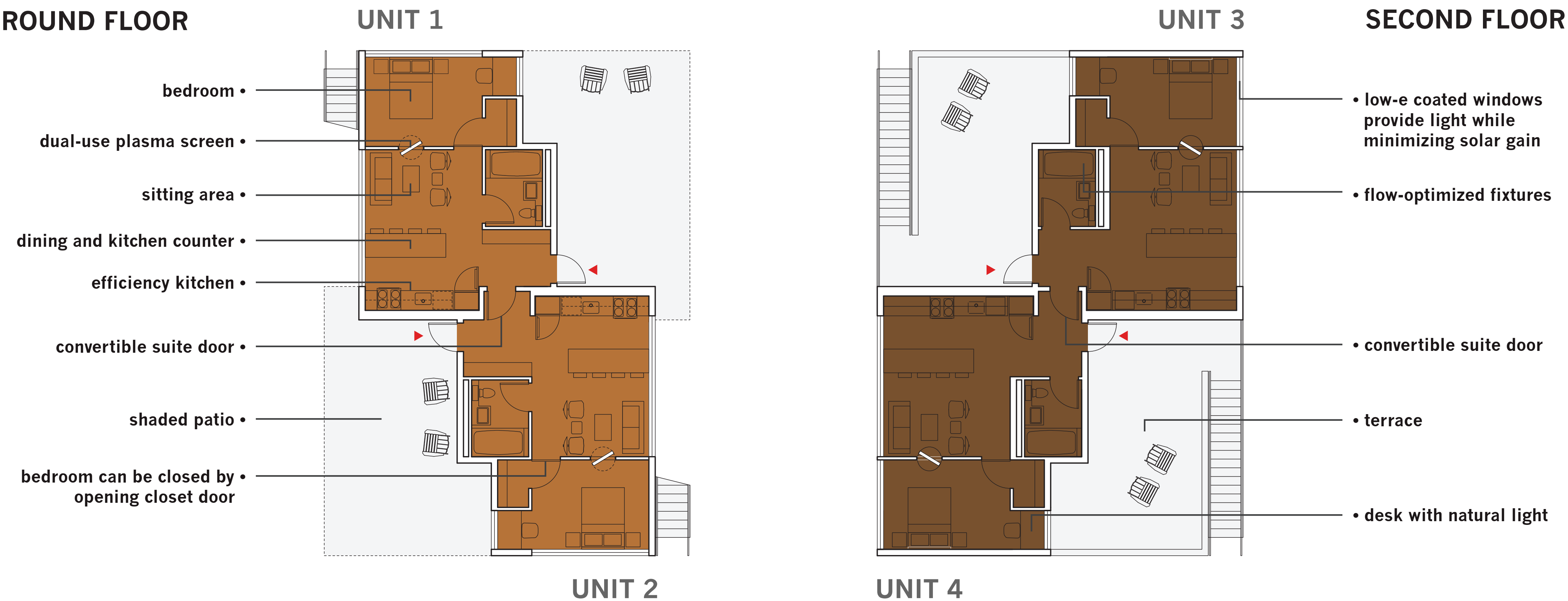
2 STOREY CLUSTER

- stacked for minimal footprint and enviromental impact
- two ADA-accessible units with shared patios
- two non ADA-accessIble units with viewing terraces
- ground floor ADA-accessible family suite
- top floor non ADA-accessible family suite

ADA units | non-ADA units

entry to unit | positives | negatives

0 10 20 40 feet



ADVANTAGES

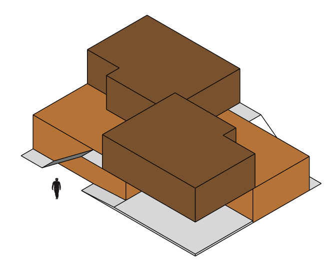
- efficient interior layout
- generous natural light in living spaces save lighting costs
- picture windows
- semi-private outdoor spaces
- two storey construction with smaller footprint and environmental impact
- identical units can be fabricated quicker and at lower cost
- stacked, composting toilets an option
- dual-use plasma screen saves energy
- ground floor units can be combined into ADA-accessible family suite
- second floor units can be combined into regular family suite

DISADVANTAGES

- not all units are ADA accessible
- no shared outdoor space

STATISTICS

UNIT 1	575 sf
UNIT 2	575 sf
UNIT 3	525 sf
UNIT 4	525 sf
TOTAL BUILDING AREA	2200 sf
TOTAL FOOTPRINT	1060 sf
TOTAL ENVELOPE (ROOF + WALL)	5025 sf
TOTAL DECK (PATIO + TERRACE)	1470 sf



master plan PROPOSED

- reconfigured dining hall loading driveway • access from service area instead of from main road
- new landscaping to shield back of buildings from main road •
- new location of dorm 6 •
- outdoor roof deck facing sunset •
- parking lot eliminated and replaced with landscaped quad •
- new education path as part of stormwater management plan •
- new porous grass parking area •
- new drop-off & ADA parking adjacent to administration building •
- new stormwater bioretention area •
- new focal point and observation tower •
- landscaped amphitheater •
- berm with native grasses and plantings •
- volleyball court sheltered from wind by housing, landscaped amphitheater and trees •
- new buildings create courtyard around existing landscape berm •
- new pedestrian path along shoreline •

① Marine Conservation Genetic Center

② Smart Home Away from Home

③ Marine Geospatial Ecology Center

④ Visitor, Education & Outreach Center

phase 1 new buildings

phase 2 new buildings

circulation PROPOSED

permit vehicular access only to neccessary areas •

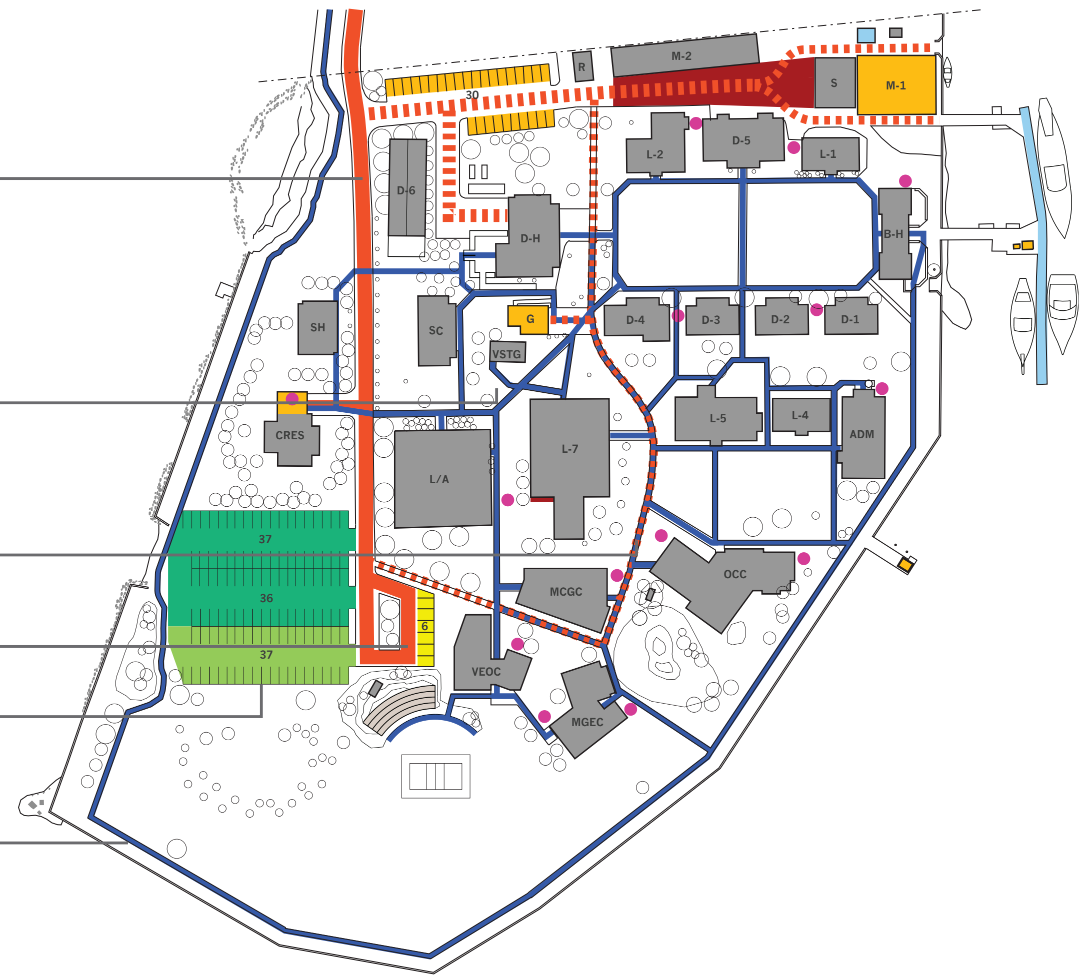
increase pedestrian connectivity between buildings especially • Bookhout, the library-auditorium, and the new building cluster

reduce width of pedestrian path •

terminate main access road next to admin building •

make parking more efficient and concentrated away from • pedestrian quads

encourage cycling by designating more parking locations and trails • including a scenic path circumnavigating the site



BUILDINGS

ADM	old administration building
B-H	boathouse
C.RES	caretaker's residence
DH	dining hall
D-#	dorms
G	garage
L-#	labs
L/A	library & auditorium
M-1	maintenance building 1
M-2	maintenance building 2
MCGC	marine conservation genetic center
MGEC	marine geospatial ecology center
OCC	repass center
R	recycling
S	storage building
SH	smart home away from home
SC	student center
VEOC	visitor, education & outreach center
VSTG	volatile storage

PARKING

- unpaved fixed vehicular parking
- unpaved seasonal vehicular parking
- staff & utility vehicular parking
- paved fixed vehicular parking
- boat parking
- loading zone
- bicycle parking
- # number of parking spaces

CIRCULATION

- paved two-way vehicular path
- paved one-way vehicular path
- utility vehicle access only
- paved pedestrian path
- unpaved pedestrian path

N

0 50 150 250 feet

BUILDING

south-east aerial view

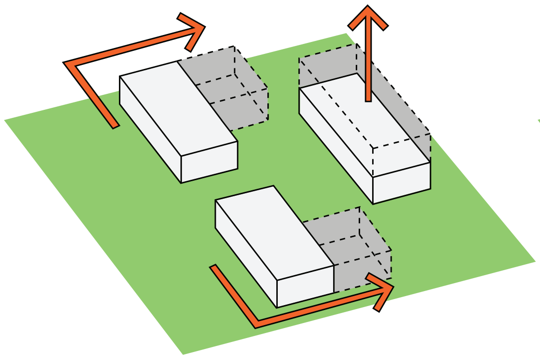
windmill in Beaufort circa 1890. photo courtesy of NC Division of Archives and History

Sustainability and environmental stewardship are priorities for the Marine Laboratory and for Duke University as a whole. As an example, implementation of an island-wide storm water management plan is currently underway. Solar hot water retrofits are being tested on select buildings. Students are creating stewardship initiatives, with efforts ranging from identifying methods of performing energy audits on the island to reducing dependence on cars by monitoring travel between the main and marine campuses. This, however, is just the beginning.

DUML is fully committed to demonstrating leadership in major ways. Adaptive reuse of existing buildings will continue to cope with changing needs. In addition, new construction is desperately needed and all new buildings will seek LEED Platinum certification. The campus as a whole will strive for a global strategy toward energy independence, which includes evaluation of the entire campus for energy recovery opportunities as well as development of innovative approaches to generating renewable energy.

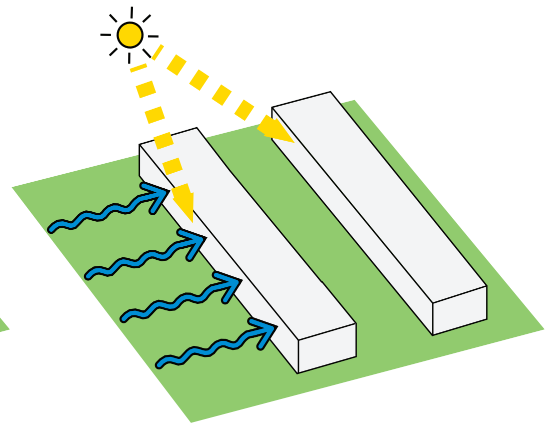
green concepts

Building massing is largely influenced by its program and context, but basic considerations for site and climate can make a building more sustainable over its lifetime. Fine-tuning exterior envelope, integrating renewable energy collection, and other passive measures to reduce energy consumption further improve performance.



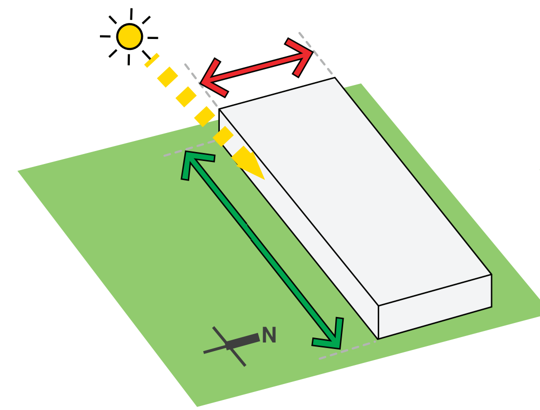
1. ORIENTATION

- maximize northern & southern exposure to optimize daylight
- minimize western exposure to control heat gain



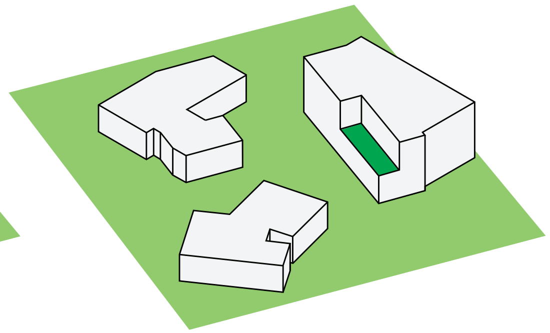
2. SUN & WIND

- separate building volumes to bring natural light into internal spaces
- create outdoor areas for habitable space with less buildout
- use building to divert wind from internal courtyards



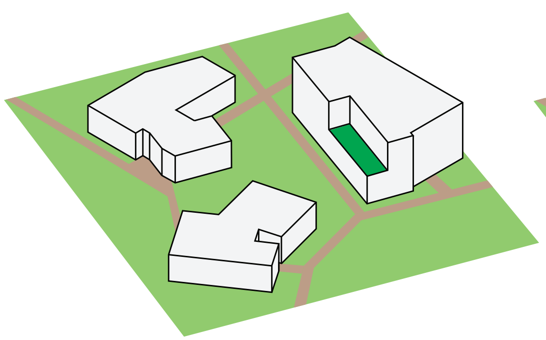
3. LAND USE

- stack vertically to reduce building footprint
- orient buildings to respond to climatic conditions & further protect outdoor areas



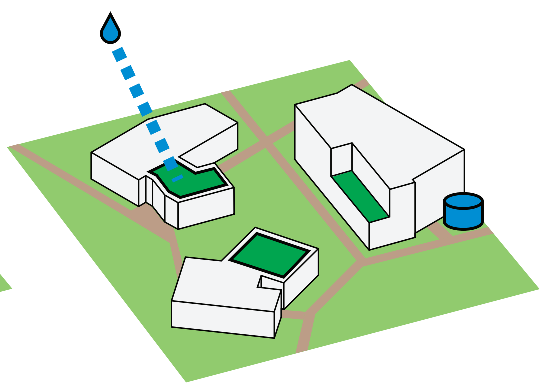
4. FINE-TUNE MASSING

- shape buildings to fit internal program efficiently without wasting space
- push & pull form to create additional outdoor spaces



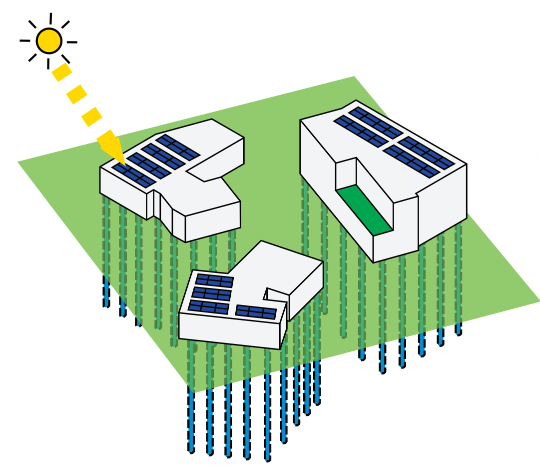
5. CONNECTIONS

- minimize width of pathways to minimize impervious surfaces
- consider alternative pathway materials to increase absorption



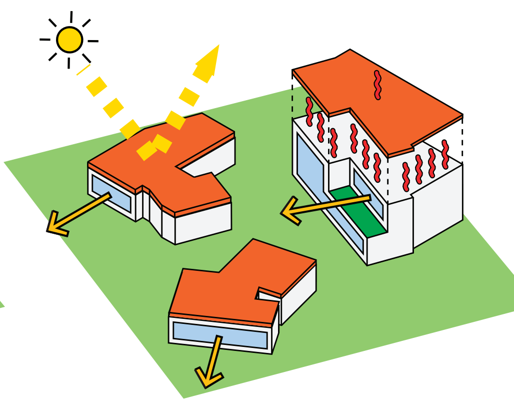
6. WATER MANAGEMENT

- reduce impervious surfaces by incorporating green roofs
- collect rainwater for irrigation & grey water plumbing fixtures
- berm landscaping for passive irrigation
- select native & drought-resistant plantings to minimize irrigation & reduce stormwater runoff



7. RENEWABLE ENERGY

- make roofs suitable for installing photovoltaic panels
- install solar thermal collectors
- utilize geothermal heating & cooling



8. FINE-TUNE ENVELOPE

- balance benefits of daylight & views with need for control over solar gain in summer & heat loss in winter
- maximize insulation where possible

green building

MICRO-SCALE SUSTAINABILITY: all new buildings will seek LEED platinum status. Healthy, efficient buildings with long life-cycles will contribute to DUML's desire to be a responsible steward and role model in the sustainable movement.

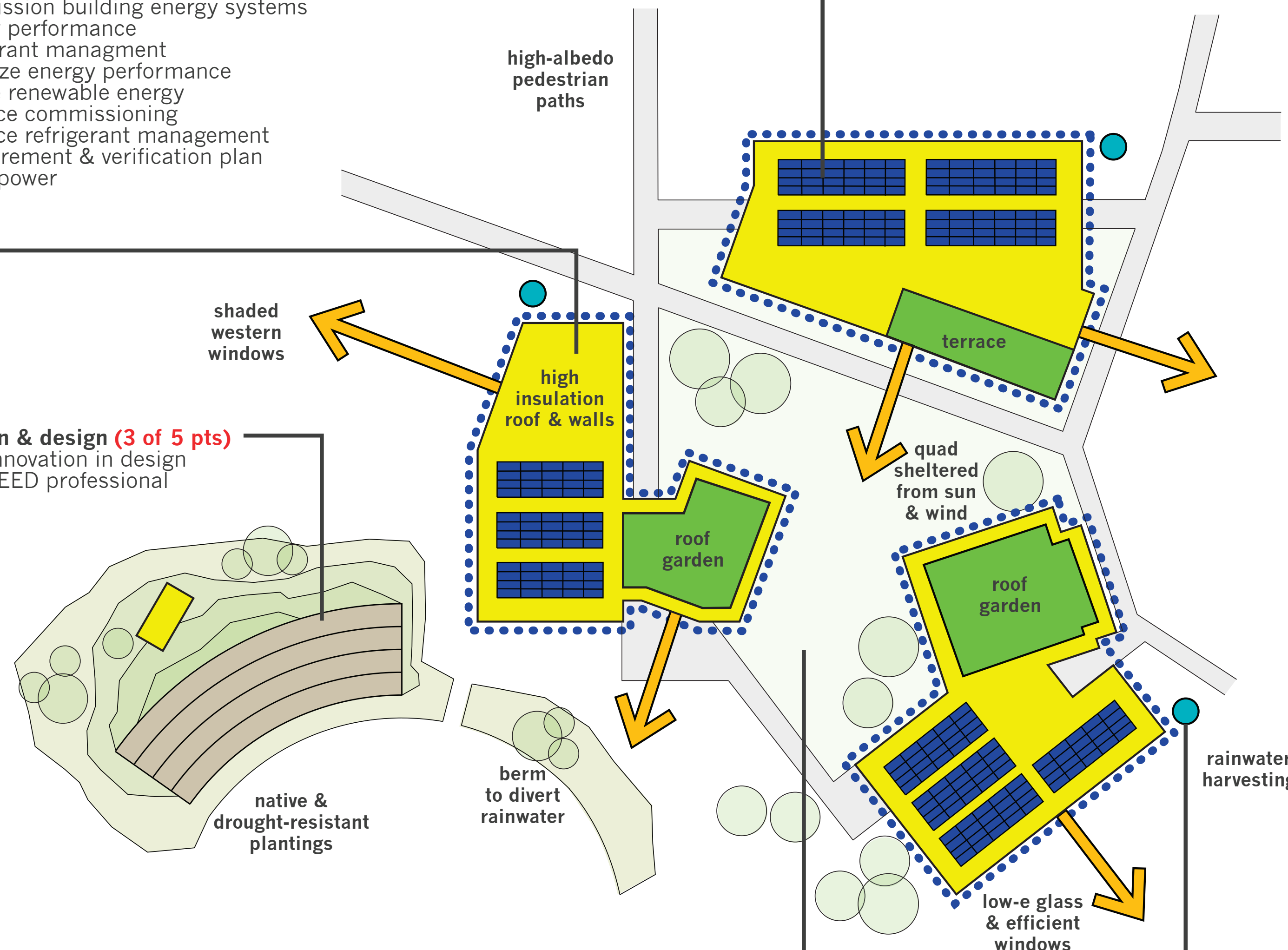
LEED platinum
58 points
out of 69 points available

energy & atmosphere (17 of 17 pts)
- **req** commission building energy systems
- **req** energy performance
- **req** refrigerant managment
- **10 pt** optimize energy performance
- **3 pt** on-site renewable energy
- **1 pt** enhance commissioning
- **1 pt** enhance refrigerant management
- **1 pt** measurement & verification plan
- **1 pt** green power

materials & resources (8 of 13 pts)
- **req** collect recyclables
- **1 pt** manage construction waste
- **2 pt** materials reuse
- **2 pt** recycled content
- **1 pt** regional materials
- **1 pt** rapidly renewable materials
- **1 pt** certified wood

innovation & design (3 of 5 pts)
- **2 pt** innovation in design
- **1 pt** LEED professional

indoor environmental quality (15 of 15 pts)
- **req** minimum IAQ performance
- **req** environmental tobacco smoke control
- **1 pt** outdoor air delivery monitoring
- **1 pt** increased outdoor air ventilation
- **2 pt** construction management plan
- **4 pt** low-emitting materials
- **1 pt** indoor chemical & pollution control
- **2 pt** controllability of systems
- **2 pt** thermal comfort
- **2 pt** daylight & views



sustainable sites (10 of 14 pts)
- **req** prevent construction pollution
- **1 pt** site selection
- **1 pt** bicycle storage & changing rooms
- **1 pt** provide no new parking
- **1 pt** protect or restore habitat
- **1 pt** maximize open space
- **2 pt** control stormwater
- **2 pt** reduce heat island effect
- **1 pt** reduce light pollution

water efficiency (5 of 5 pts)
- **1 pt** reduce potable water irrigation
- **1 pt** capture rainwater, recycle greywater
- **1 pt** innovative wastewater technologies
- **2 pt** reduce water use

green housing

MICRO-SCALE SUSTAINABILITY: the residential sector accounts for 22% of the nation's total energy consumption and 74% of the water, according to the US Department of Energy. Sustainable apartments can be a living laboratory that raises awareness and understanding on how to reduce that statistic.

LEED platinum
85 points
out of 136 points available

note: incorporates -10 pt adjustment for small apartment size

innovation & design (8 of 11 pts)
- 3 pt integrated project planning
- 3 pt durability management
- 2 pt innovative regional design

sustainable sites (17 of 22 pts)
- 1 pt site stewardship
- 7 pt landscaping
- 1 pt local heat island effects
- 6 pt surface water management
- 2 pt pest control alternatives

location & linkages (2 of 10 pts)
- 1 pt infrastructure
- 1 pt access to open space

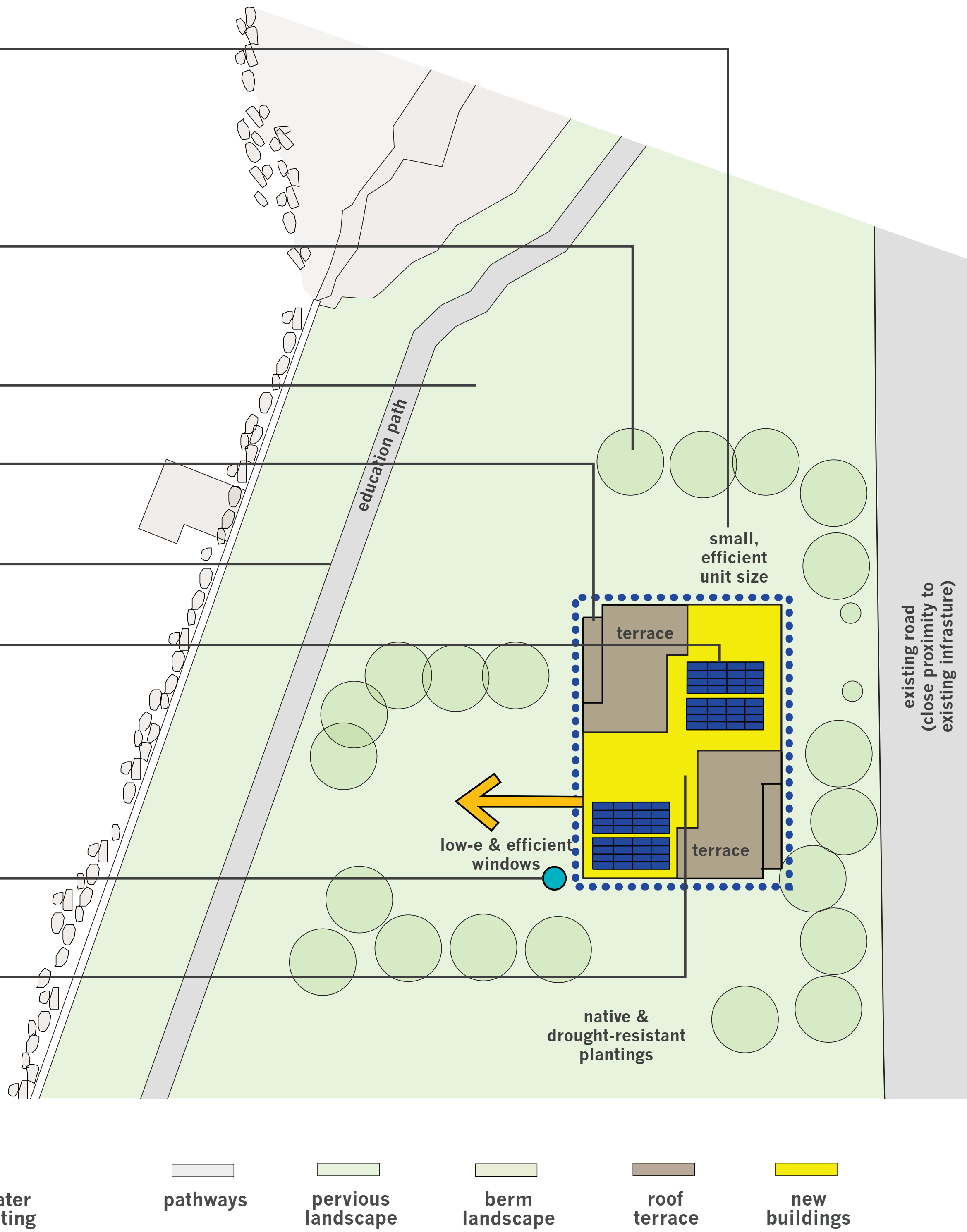
materials & resources (9 of 16 pts)
- 4 pt material efficient framing
- 4 pt environmentally preferable products
- 1 pt waste management

awareness & education (2 of 3 pts)
- 1 pt public awareness
- 1 pt building manager training

energy & atmosphere (21 of 38 pts)
- 2 pt insulation
- 2 pt air infiltration
- 2 pt energy performance windows
- 2 pt reduced distribution losses
- 2 pt space heating & cooling equipment
- 3 pt water heating
- 1 pt energy star lighting
- 2 pt high efficiency appliances
- 4 pt renewable energy
- 1 pt refrigerant management

water efficiency (15 of 15 pts)
- 5 pt water reuse
- 4 pt irrigation systems
- 6 pt indoor water use

indoor environmental quality (11 of 21 pts)
- 2 pt combustion venting
- 2 pt outdoor air ventilation
- 1 pt local exhaust
- 1 pt distribution systems
- 2 pt air filtering
- 3 pt contaminant control



green campus

MACRO-SCALE SUSTAINABILITY: DUML has made inroads towards a more sustainable campus, through student-led initiatives by the Green Wave organization as well as through partnerships with neighboring NOAA for an island-wide stormwater management plan. DUML seeks to be a leader in the sustainability effort, and must expand their scope in order to make a significant impact on reducing carbon footprint.

EXISTING INITIATIVES

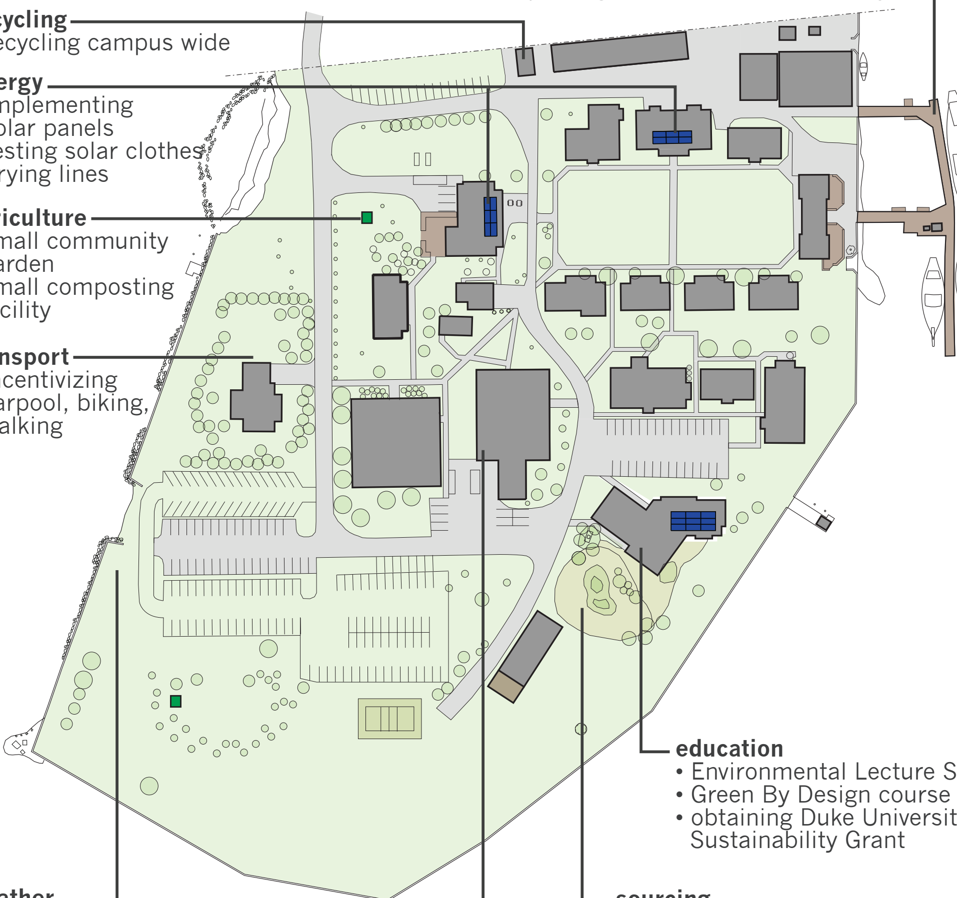
marina
- obtaining Clean Marina designation
- planning for fuel spills
- improving research vessel efficiency

recycling
- recycling campus wide

energy
- implementing solar panels
- testing solar clothes drying lines

agriculture
- small community garden
- small composting facility

transport
- incentivizing carpool, biking, walking



education
- Environmental Lecture Seminar
- Green By Design course
- obtaining Duke University Sustainability Grant

weather
- investigating hurricane environmental impact
- analysing stormwater runoff
- soon to test out stormwater management techniques including bioretention, cisterns for collection and rainwater filtering

sourcing
- planting native species
- increasing organic foods
- green cleaning & paper supplies

efficiency
- replacing low performing windows
- identifying way of to perform energy audit of entire campus

PROPOSED INITIATIVES

consider global strategy
- seek funding to evaluate existing systems campus-wide
- develop strategic sustainability plan
- retrofit electrical metering to enable individual monitoring
- identify existing energy waste
- retrofit systems to recover/convert energy
- evaluate retrofitting buildings vs. replacing with new

minimize future impact
- seek LEED platinum level for all new construction

maximize stormwater management
- remove impervious parking
- replace with porous surfaces
- harvest rainwater on more existing buildings
- berm landscape to maximize passive irrigation

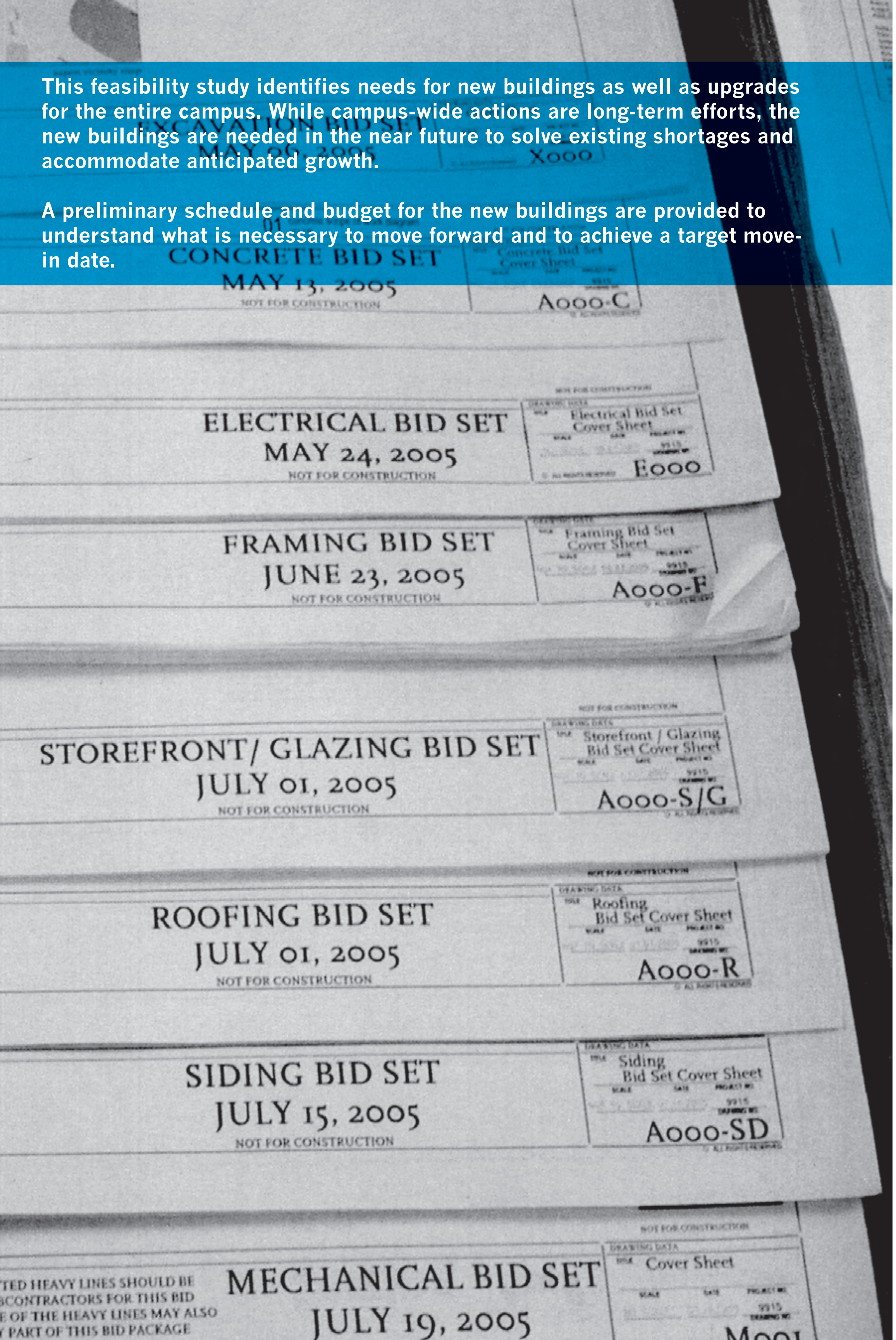
promote awareness
- extend proposed education path to incorporate energy generation

eliminate fossil fuel consumption
- generate renewable energy
- consider geothermal fields, wind tubine, tidal power, thermal power
- consider central plant and energy supply loop for retrofit of existing buildings

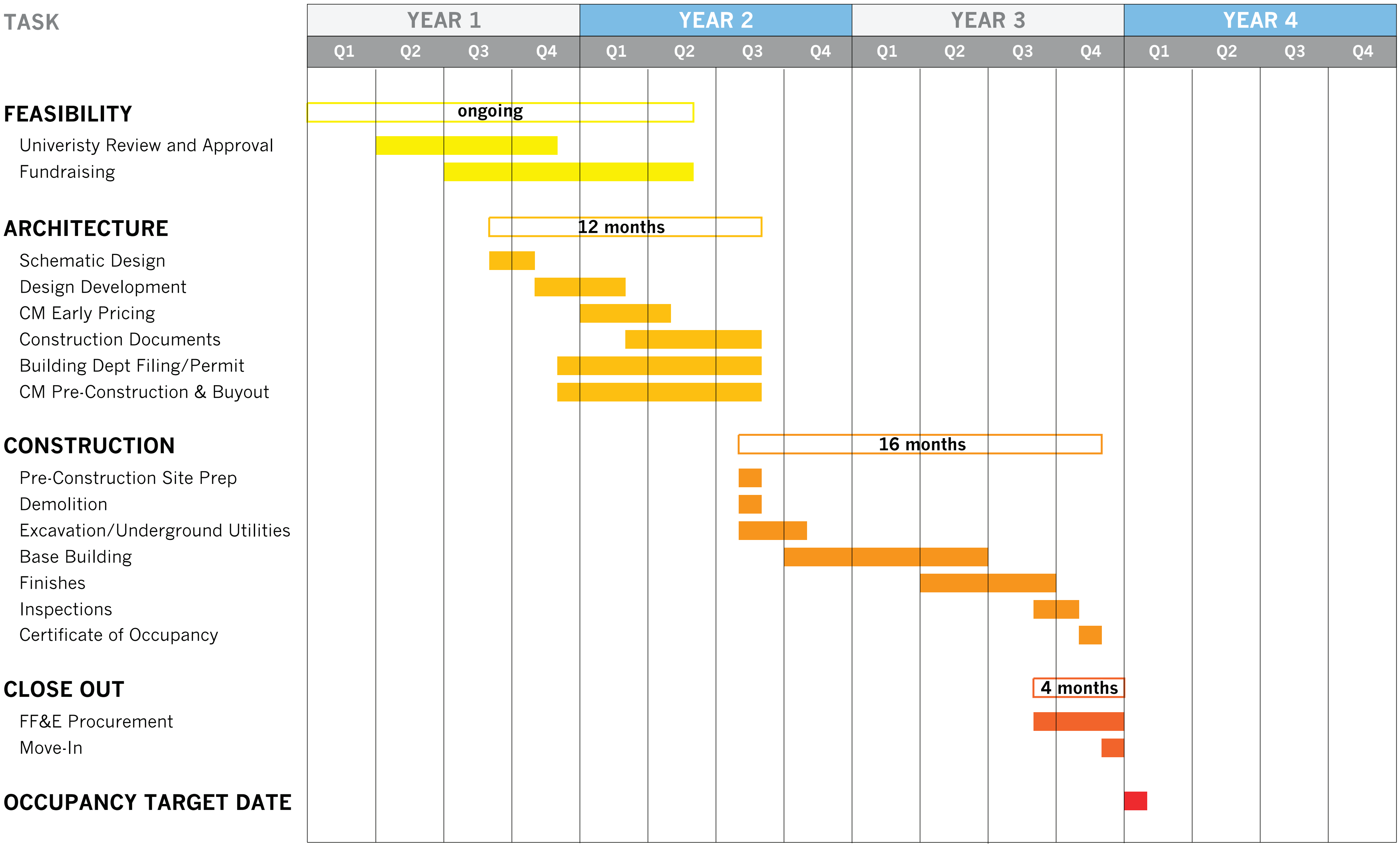
solar energy | geothermal field | tidal energy | wind energy | rainwater harvesting | organic garden & compost | pathways | pervious landscape | berm landscape | new buildings | existing buildings

This feasibility study identifies needs for new buildings as well as upgrades for the entire campus. While campus-wide actions are long-term efforts, the new buildings are needed in the near future to solve existing shortages and accommodate anticipated growth.

A preliminary schedule and budget for the new buildings are provided to understand what is necessary to move forward and to achieve a target move-in date.

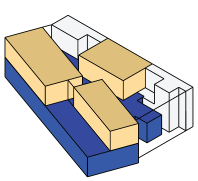


schedule

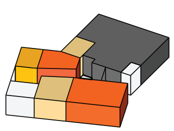

TASK
YEAR 1
YEAR 2
YEAR 3
YEAR 4
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
FEASIBILITY
ongoing
Univeristy Review and Approval
Fundraising
ARCHITECTURE
12 months
Schematic Design
Design Development
CM Early Pricing
Construction Documents
Building Dept Filing/Permit
CM Pre-Construction & Buyout
CONSTRUCTION
16 months
Pre-Construction Site Prep
Demolition
Excavation/Underground Utilities
Base Building
Finishes
Inspections
Certificate of Occupancy
CLOSE OUT
4 months
FF&E Procurement
Move-In
OCCUPANCY TARGET DATE

budget

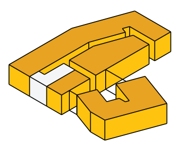
BUILDING COMPONENT	GROSS sf	CONSTRUCTION cost per sf	SOFT cost per sf	PROJECT cost per sf	PROJECT cost total
Marine Conservation Genetic Center	9,560 gsf	$352 / sf	$148 / sf	$500 / sf	$4,780,000
Marine Geospatial Ecology Center	3,725 gsf	$352 / sf	$148 / sf	$500 / sf	$1,862,500
Visitor, Education & Outreach Center	4,015 gsf	$352 / sf	$148 / sf	$500 / sf	$2,007,500
Smart Home Away from Home	2,000 gsf	$197 / sf	$103 / sf	$300 / sf	$600,000
TOTAL PROJECT	**19,300 gsf**				**$9,250,000**



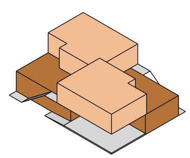
$4.8M



$1.9M



$2.0M



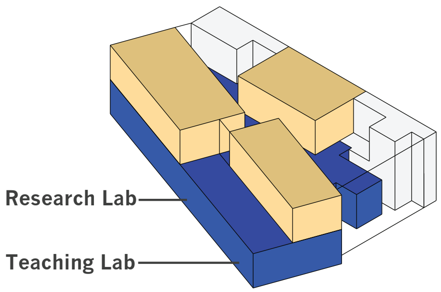
$0.6M

Please note the following:

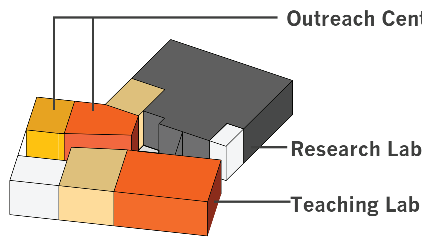
- Budget numbers are stated in 2009 dollars without escalation
- Budget numbers assume that all buildings are constructed simultaneously as one single construction project
- If phasing is necessary, budget numbers would increase due to additional costs associated with a lengthier construction schedule, escalation in construction prices, phasing coordination issues, professional and staff fees for multiple projects, etc.
- An estimated $550,000 premium is expected for phased construction assuming phase 2 occurs one year later

funding opportuni ties

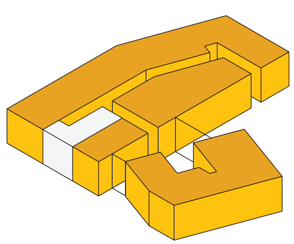
BUILDING FUNDING OPPORTUNITIES



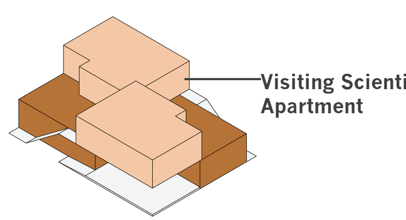
Marine Conservation Genetic Center



Marine Geospatial Ecology Center

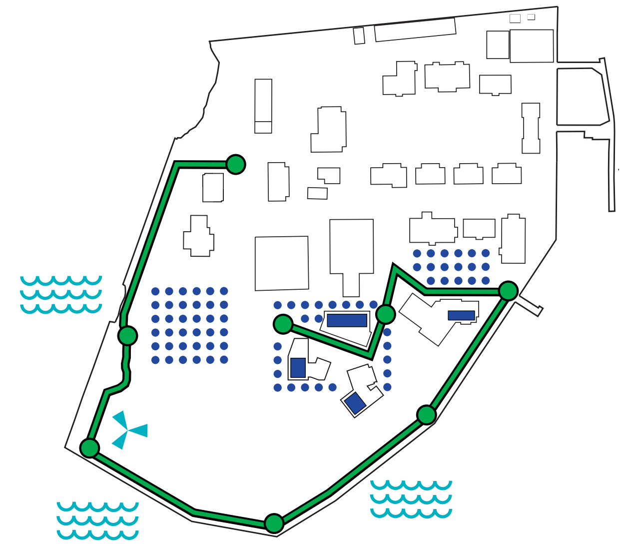


Visitor, Education & Outreach Center

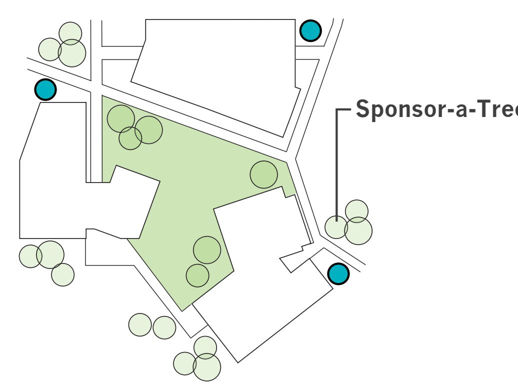


Smart Home Away from Home

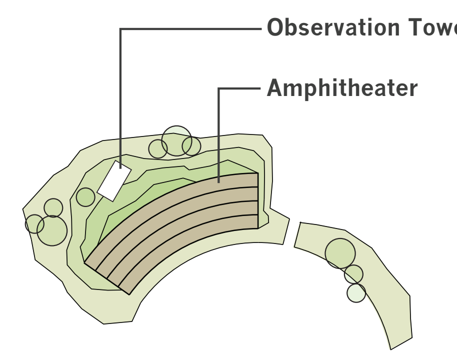
GREEN CAMPUS FUNDING OPPORTUNITIES



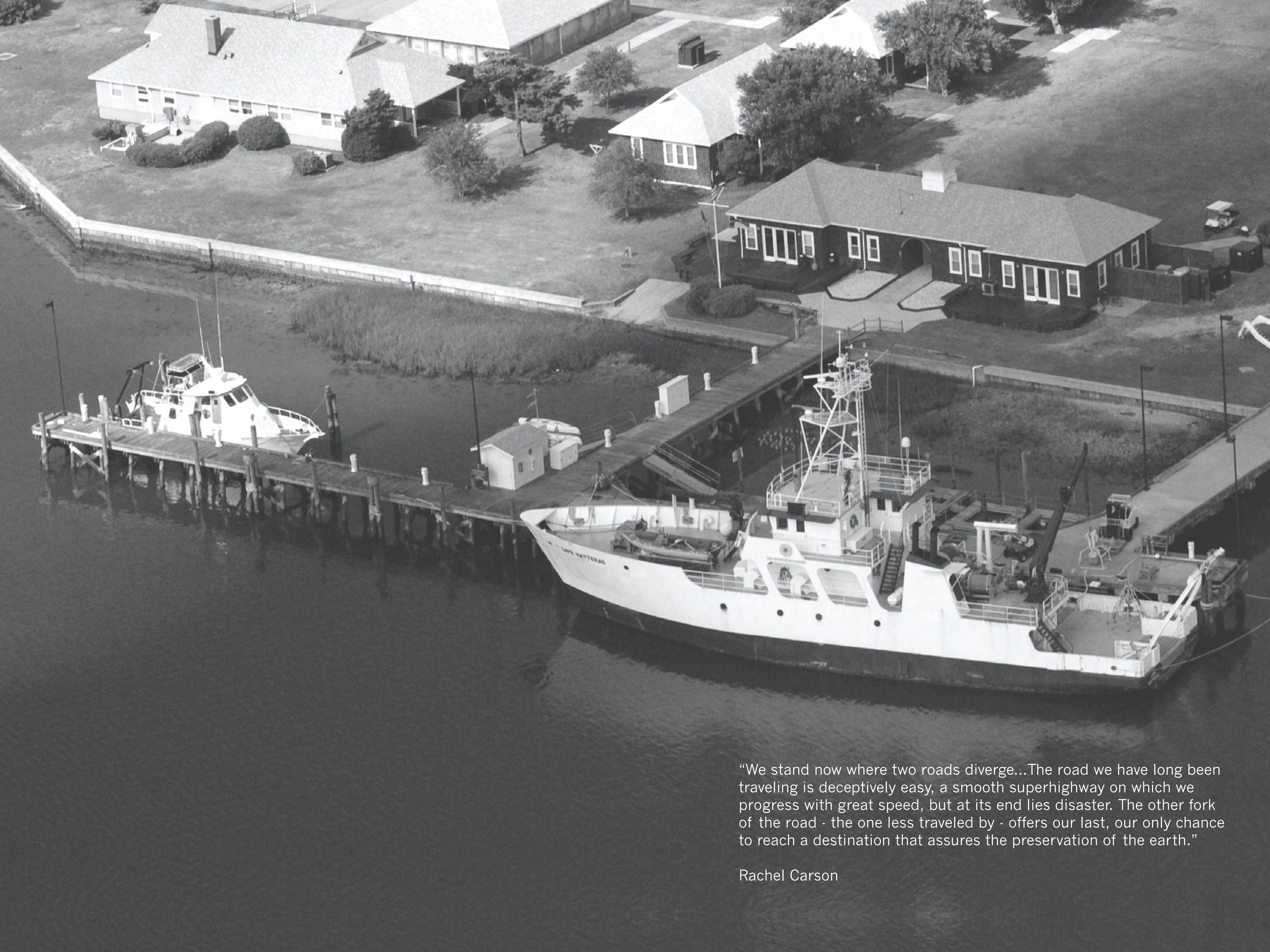
Renewable Energy Education Path



Sustainable Garden



Outdoor Education Center



"We stand now where two roads diverge...The road we have long been traveling is deceptively easy, a smooth superhighway on which we progress with great speed, but at its end lies disaster. The other fork of the road - the one less traveled by - offers our last, our only chance to reach a destination that assures the preservation of the earth."

Rachel Carson