



ARCTIC DESIGN GROUP //

Community & Data Driven Design
INUVIK ARCTIC DEVELOPMENT EXPO



Arctic Design Group / UVA Arctic Research Center

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Utqiagvik (Barrow), Alaska



ARCTIC LANDSCAPE & BUILT ENVIRONMENT is critical to understanding & addressing the challenges of global climate change.

We seek to **QUESTION CONVENTIONS** of the built environment and innovate cultural and material linkages.

COLLABORATION is essential to bring positive, action-oriented changes to the people & communities in the North.

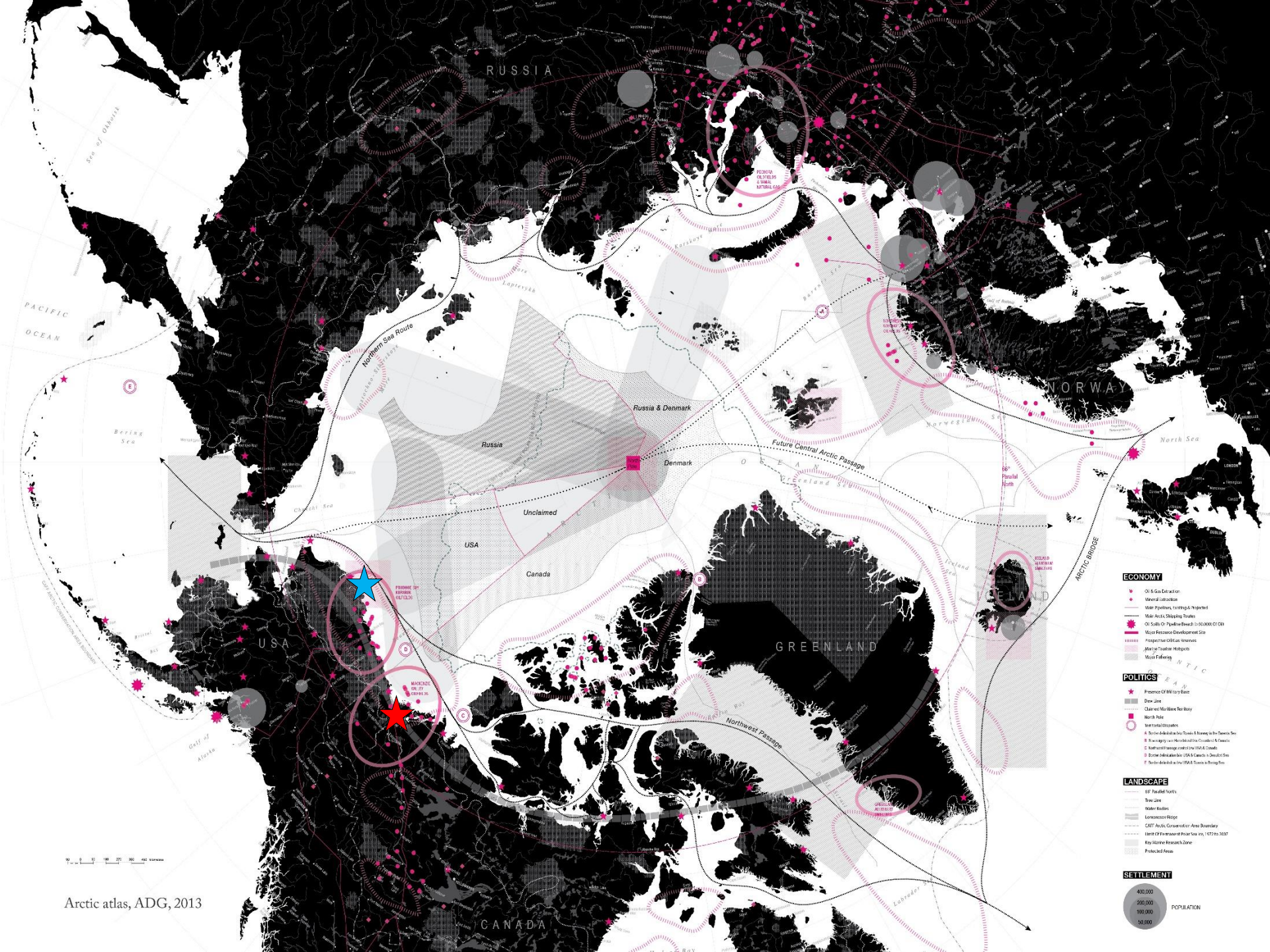
CULTURAL and **SOCIAL BENEFIT** is of equal or greater importance to technological innovation for the built environment



Youth Ambassadors, "Bridging Science, Art, and Community" Symposium, 2019



Inupiat photographer tracking caribou (left) and meeting with NSB Planning Dept (right)
Source: Leena Cho / Arctic Design Group



ECONOMY

- Oil & Gas Extraction
- Mineral Extraction
- Water Pipelines, Existing & Projected
- Maritime Shipping Routes
- Oil Spill Oil Spill Response 1:1000000:1 Oil
- Mineral Resource Development Size
- Prospective Oil/Gas Reserves
- Arctic or Transition Hubs
- Arctic Port

POLITICS

- Presence Of Military Base
- Draw Line
- Claimed/Disputed Territory
- Arctic Hole
- International Boundaries
- Arctic Hole
- Arctic Hole
- Arctic Hole
- Arctic Hole

LANDSCAPE

- Arctic Coastal Profile
- Draw Line
- Water Bodies
- Continental Shelf
- Arctic Basin
- Arctic Basin
- Arctic Basin
- Arctic Basin

SETTLEMENT



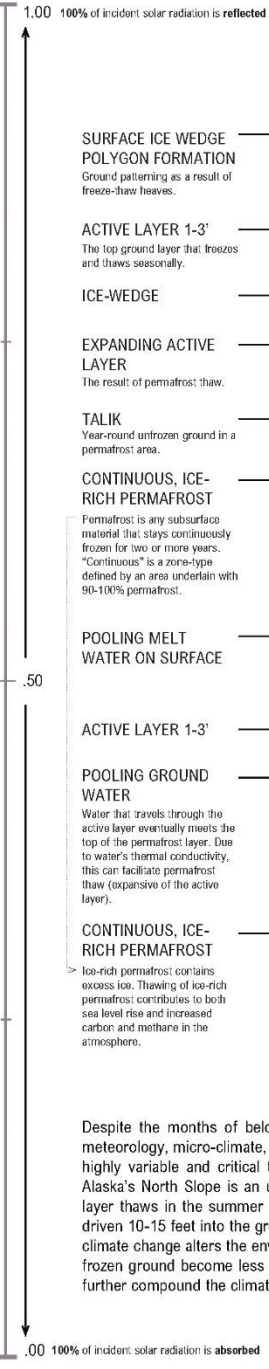
Arctic atlas, ADG, 2013



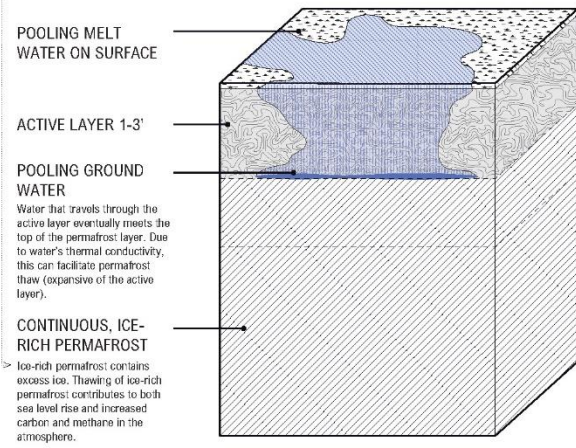
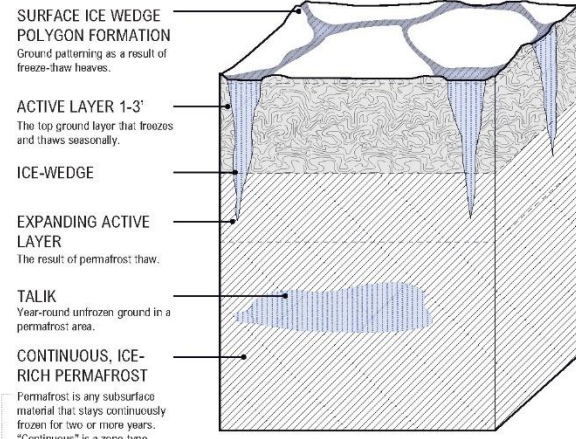




ARCTIC SURFACES ALBEDO COEFFICIENT



ARCTIC GROUND UTQIAGVIK, AK



Despite the months of below freezing weather and nearly year-round snow cover, meteorology, micro-climate, and thermal dynamics make the ground plane in Utqiagvik highly variable and critical to social and ecological practices. Key to inhabitation in Alaska's North Slope is an understanding of seasonally shifting ground as the active layer thaws in the summer months. For decades this resulted in building piles being driven 10-15 feet into the ground to root them solidly in the underlying permafrost. As climate change alters the environment, these methods of building with and on Alaska's frozen ground become less reliable and critical issues of urban heat and water runoff further compound the climatic challenges.

Water in the Arctic

SNOW + ALBEDO

SHALLOW & PRISTINE SNOW COVER
A thin layer of snow has minimal influence on ground surface albedo and will likely be around 0.3 - 0.4.

THICK & PRISTINE SNOW COVER
Once snow reaches a critical depth, it can have an albedo of up to 0.9. Older snow cover can be closer to 0.5.

THICK & IMPURE SNOW COVER
Dirty snow can have an albedo as low as 0.2. Melting snow sits between fresh, pure snow and dirty snow at 0.4.

SNOW + HEAT

SNOW DEPTH
Insulation depends on snow depth. Insulation capacity maxes out around 50cm of snow depth.

COMPACTION
More compact snow has less space for air which is the primary insulator in snow. Less air results in lower insulating capacity.

ICE CONTENT
Snow with higher ice content conducts more heat than snow with low ice content.

SNOW TIMING
Early snow will result in warmer ground temperatures below snow covered areas relative to snow fall later in the year due to ground temperatures at the time of cover. Similarly, late snow melt will result in cooler ground temperatures below areas still covered by snow.

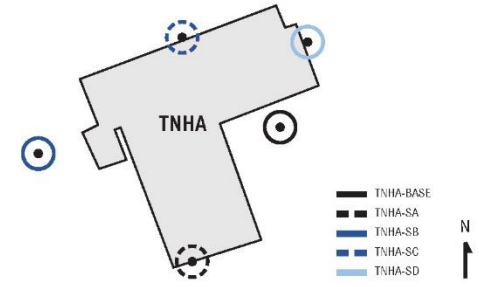
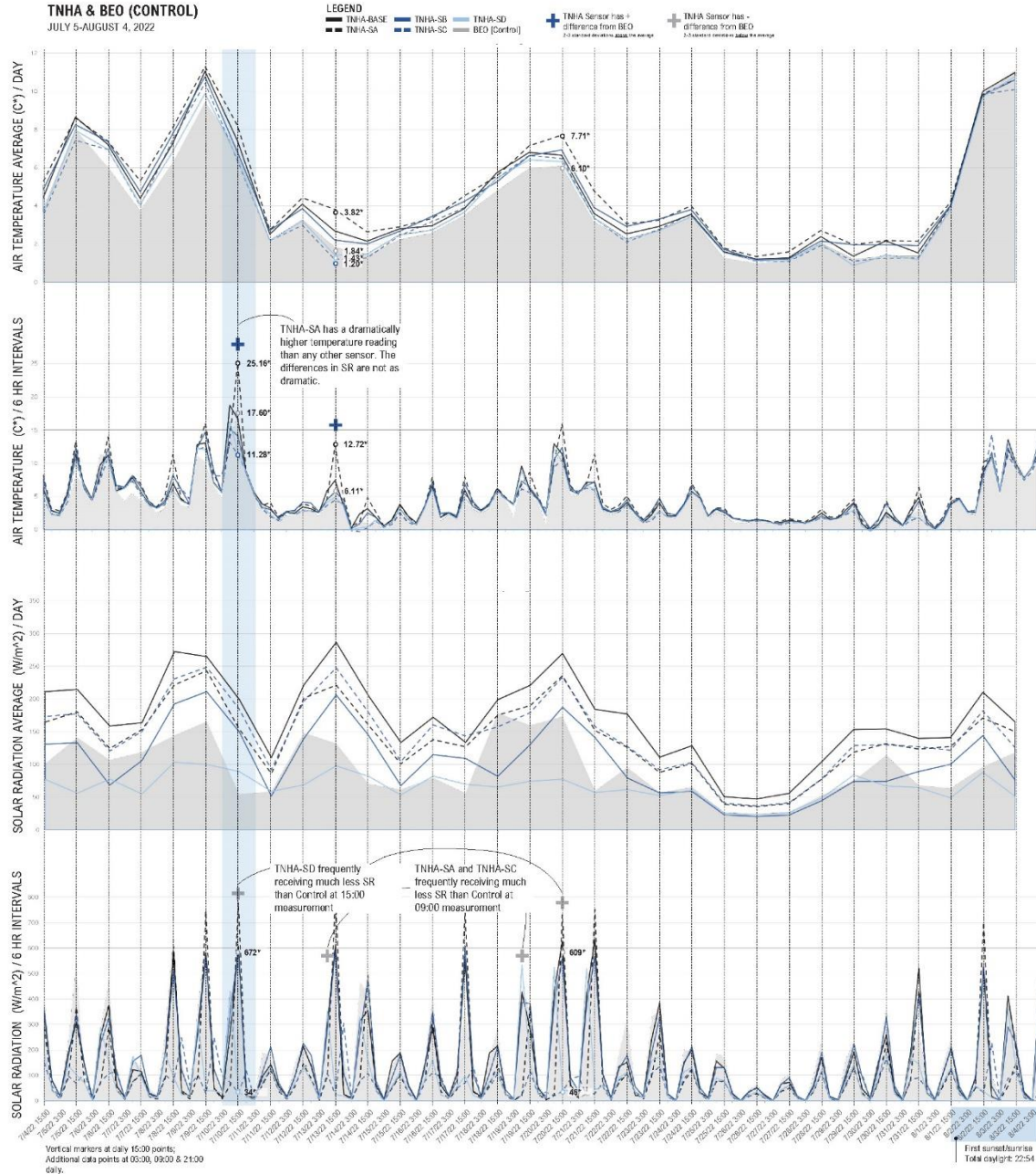
SNOW + WIND

As a result of its desert climate of Utqiagvik receives little precipitation, however a lot of snow accumulates in the city due to wind distribution. In this tundra environment, continuous winds compact the snow.

Snow will blow across the landscape until it encounters an obstruction. Snow fences, vegetation, and buildings result in snow drifts and eddies similar to the formations you see in sand and water.



Exploring the Data

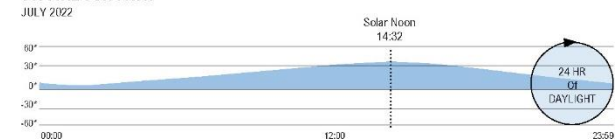


TRENDS

As is described in site plans, in section elevations, and axons, the TNHA site sits adjacent to the Lower Isatkoak Lagoon, Barrow Cemetery and Barrow High School. Two of the sites five sensors (BASE and SA) are on the south-facing side of the building. Station SB is attached to a telephone pole adjacent to the building on the west side. Station SC is attached to the building on the north side. Station SD is attached to a stairway on the east side of the building. The graphs and annotations on this and the following page are initial explorations of the sensor data captured by these sites as compared to that of the control site (BEO).

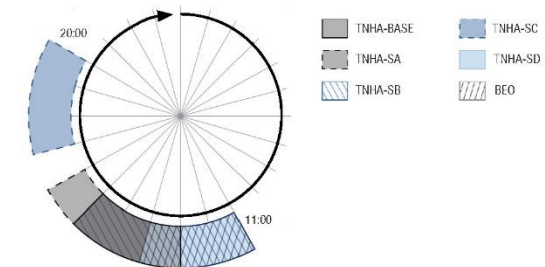
The graphs on this page look at the time scale of a month, July 5-August 4, 2022, as this is the window during which all three sensor sites (TNHA, BUECI, and the HOSPITAL) successfully collected data. By looking at the daily averages of TNHA's five sensor stations, we can confirm that urban heat island effects are at play. For much of the month, all five sensors describe higher air temperatures than that of the BEO site, however only several days see notably higher temperatures. Considering the data in at a more granular scale of six hour intervals (03:00, 09:00, 15:00, 21:00) allows us to begin to identify specific moments of difference and to interrogate those moments. Air temperature and solar radiation data at this time scale starts to highlight something interesting occurring between July 10-11, 2022. What could be causing a 12 degree difference between TNHA-SA and the BEO site?

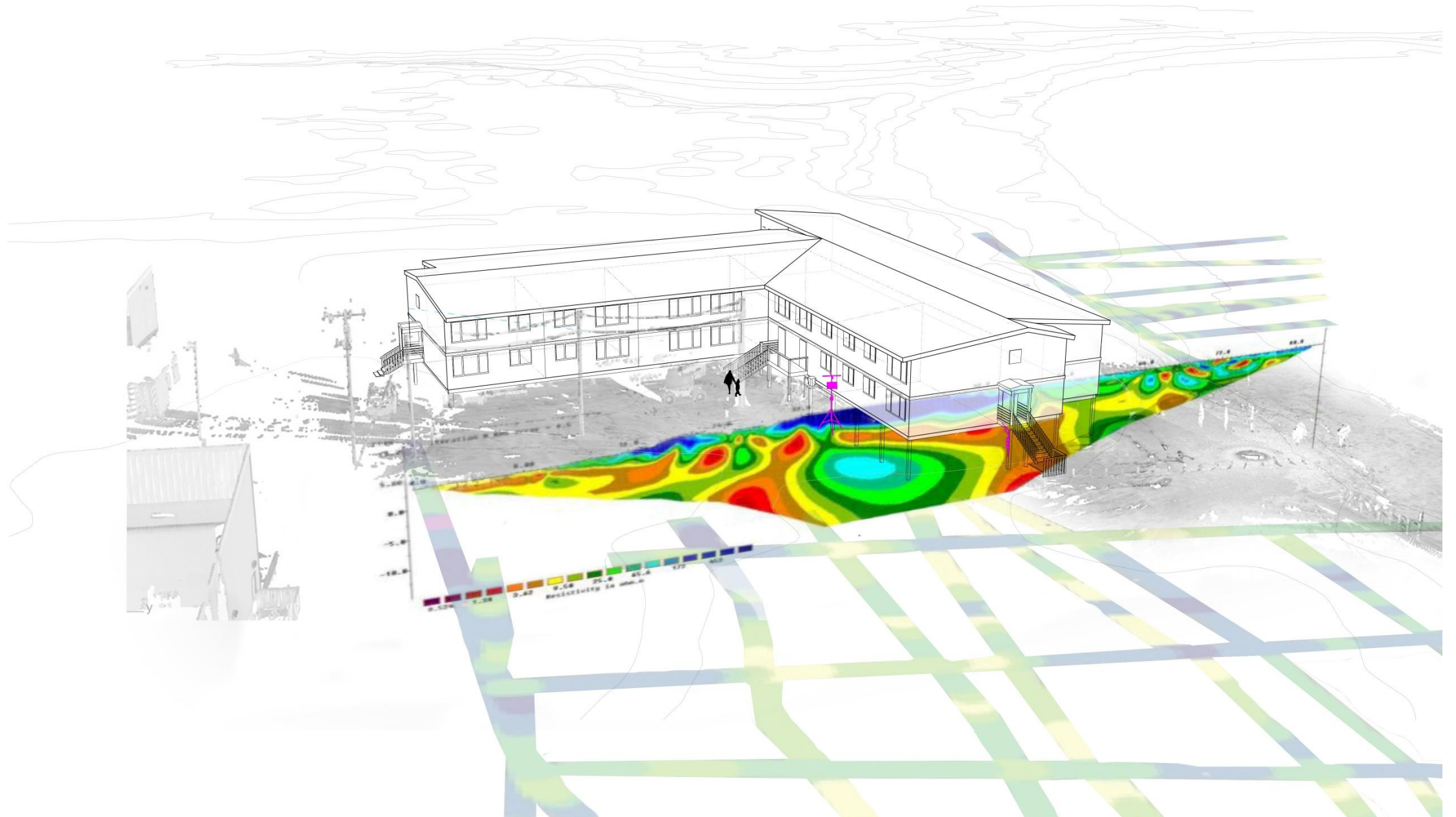
TYPICAL SUN PATH



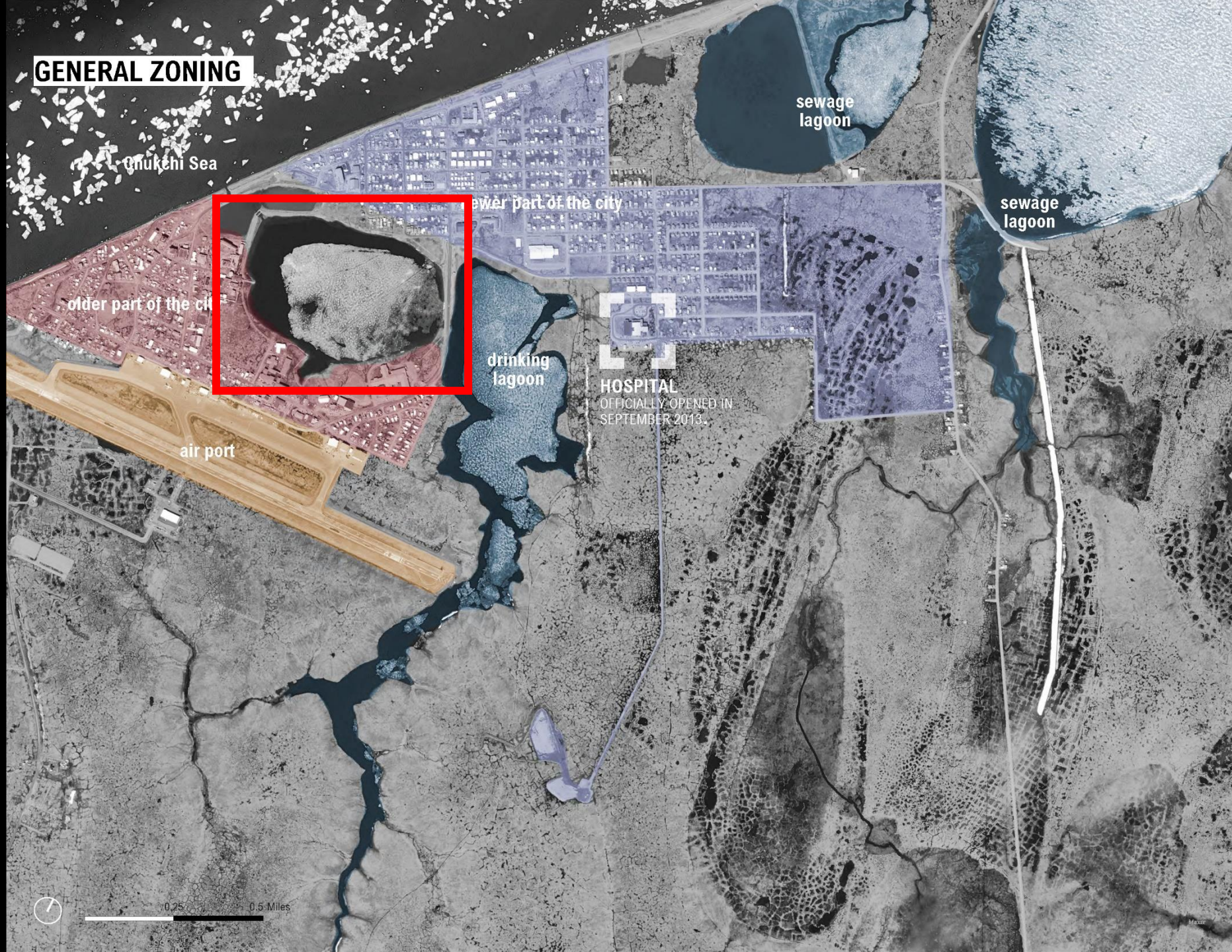
PEAK SOLAR RADIATION

24 CYCLE, JULY 2022





GENERAL ZONING



Chukchi Sea

older part of the city

newer part of the city

air port

drinking lagoon

sewage lagoon

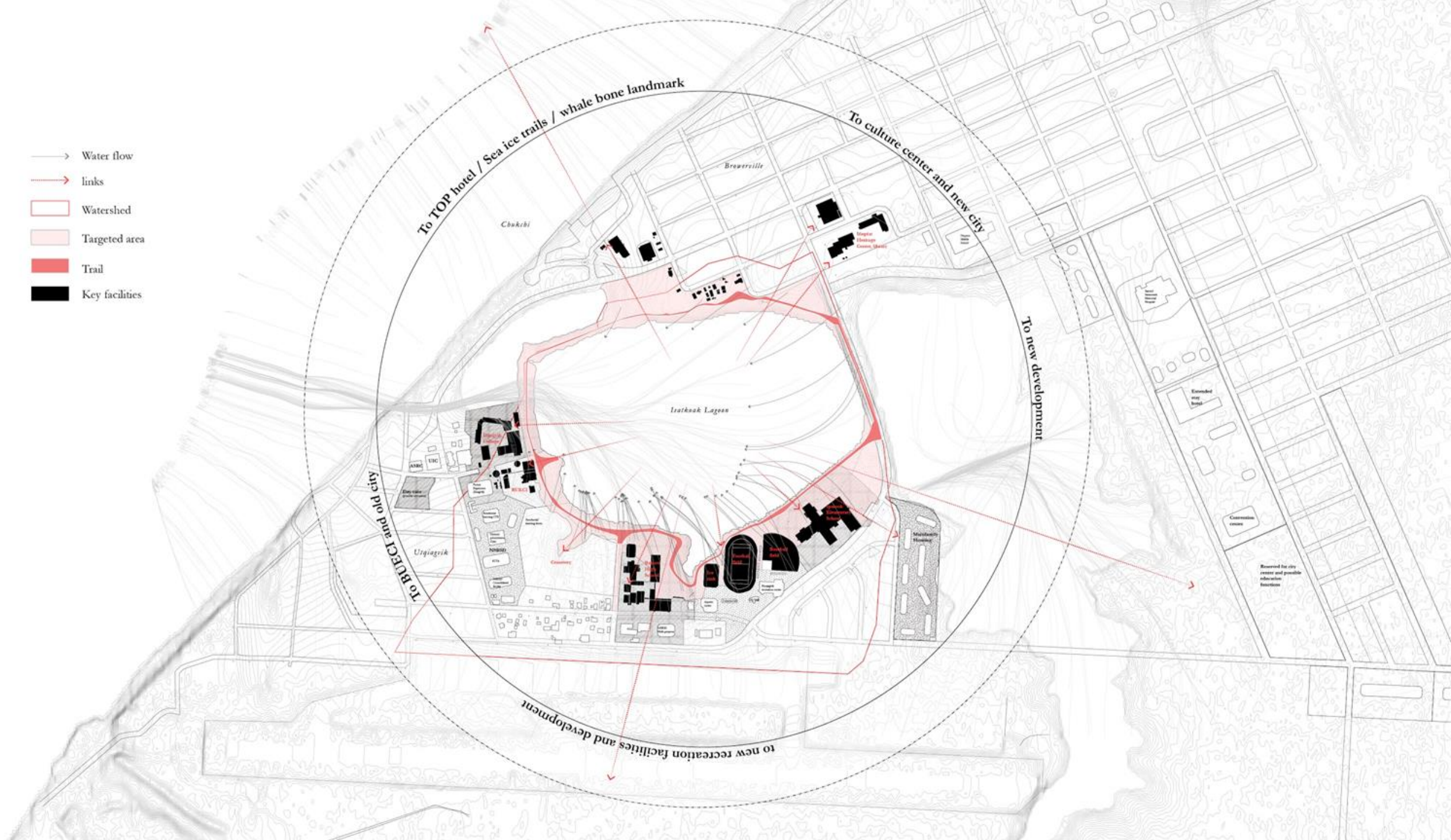
sewage lagoon

HOSPITAL
OFFICIALLY OPENED IN
SEPTEMBER 2013.

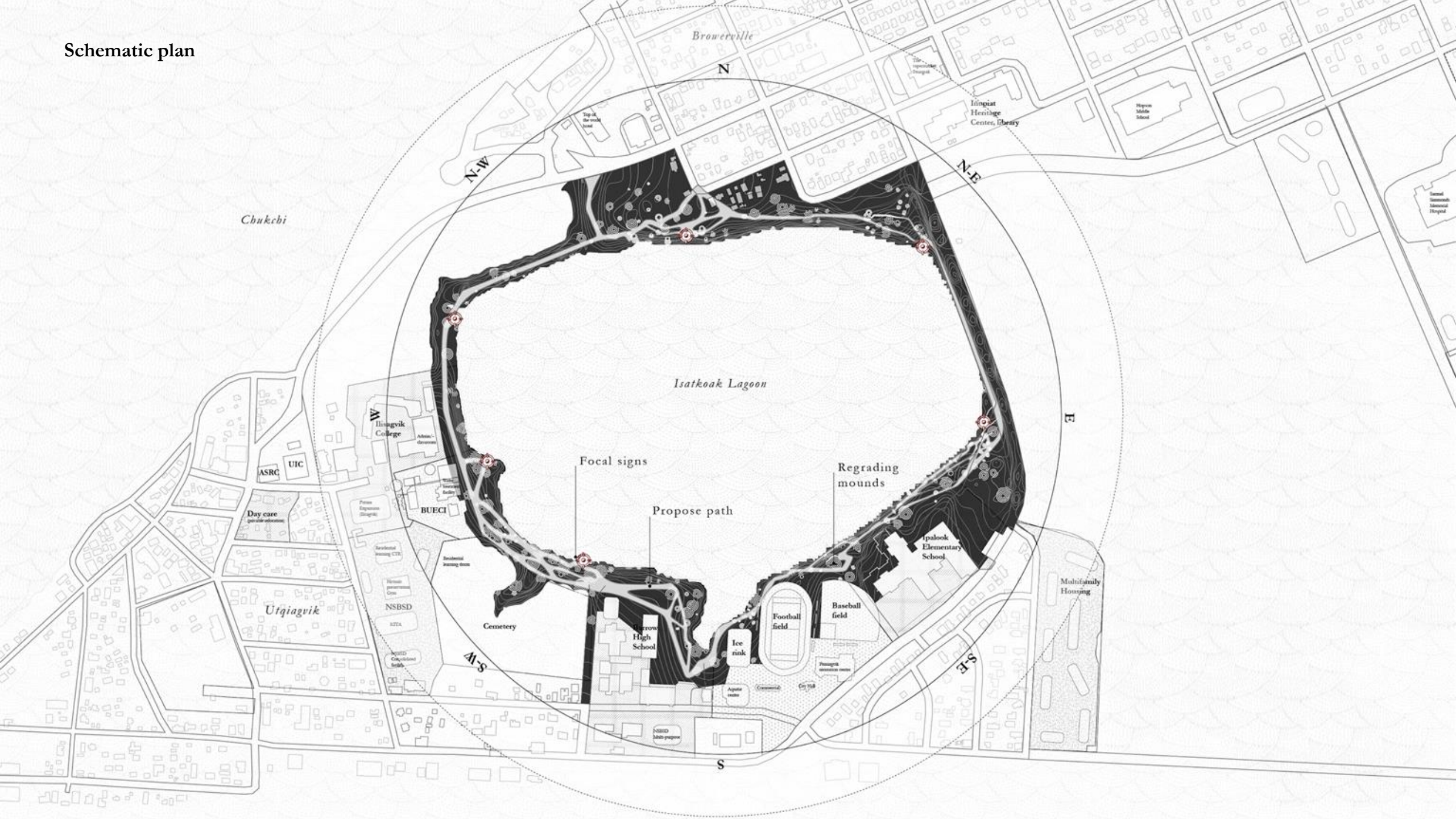


0.25 0.5 Miles

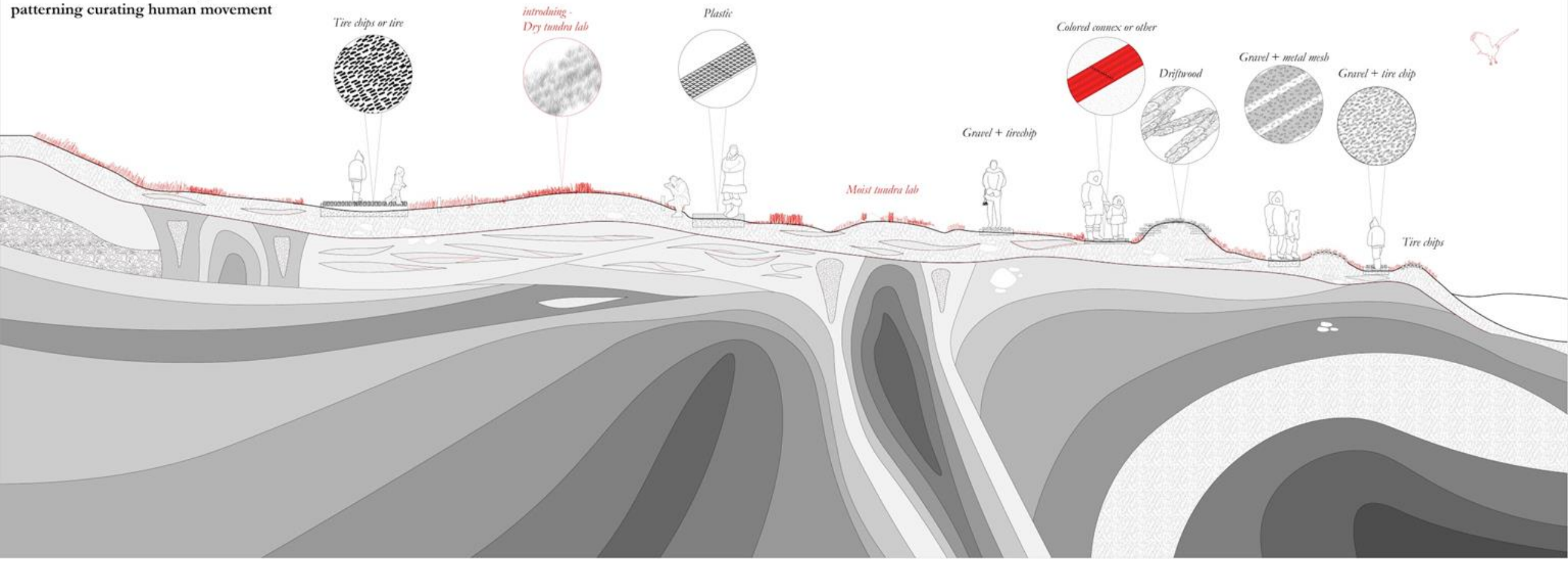
-  Water flow
-  links
-  Watershed
-  Targeted area
-  Trail
-  Key facilities



Schematic plan



Summer time - material and ground
patterning curating human movement



GENERAL ZONING



Unukahi Sea

older part of the city

air port

newer part of the city

drinking lagoon

sewage lagoon

sewage lagoon

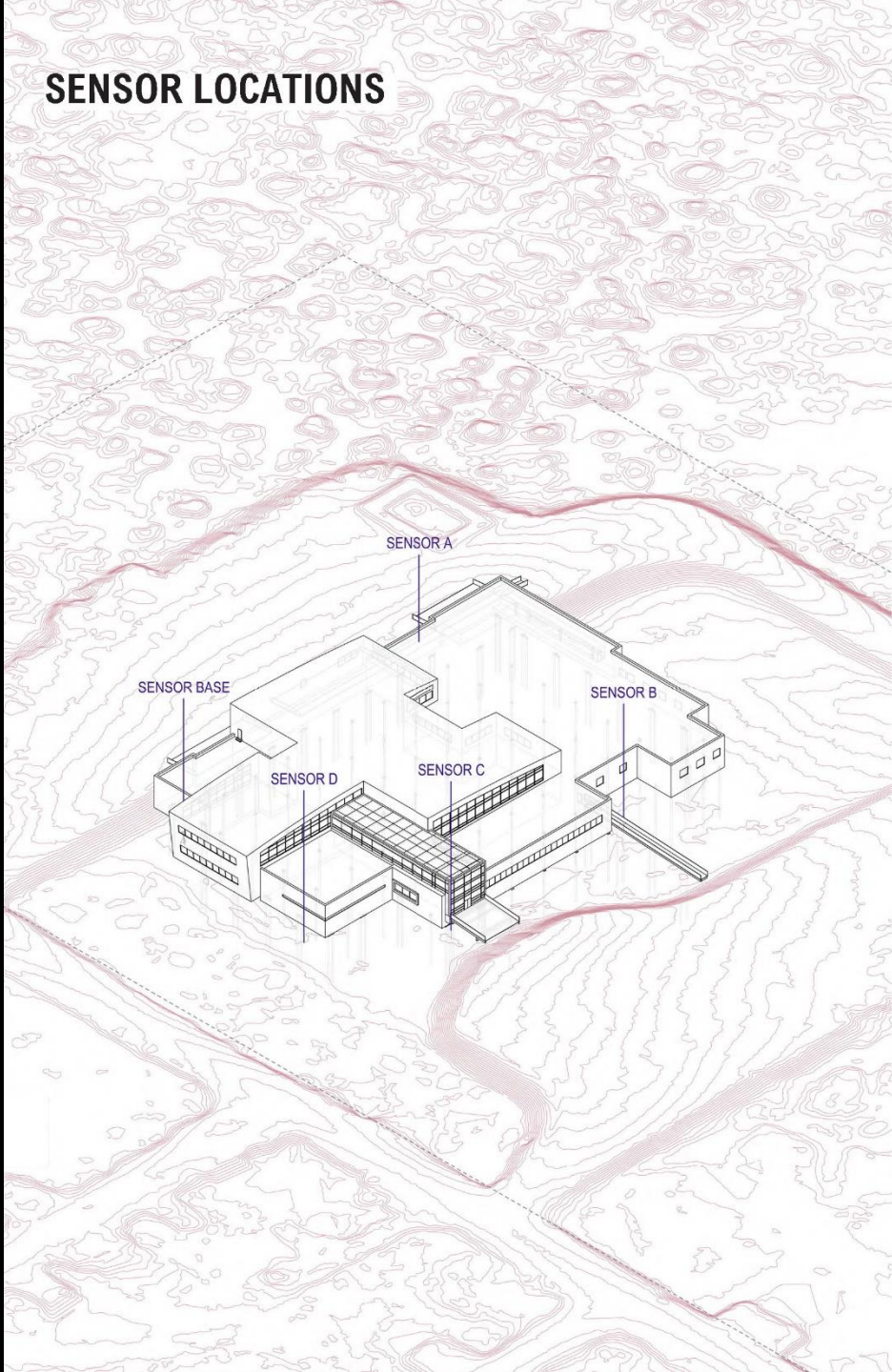


HOSPITAL
OFFICIALLY OPENED IN
SEPTEMBER 2013.



0.25 0.5 Miles

SENSOR LOCATIONS

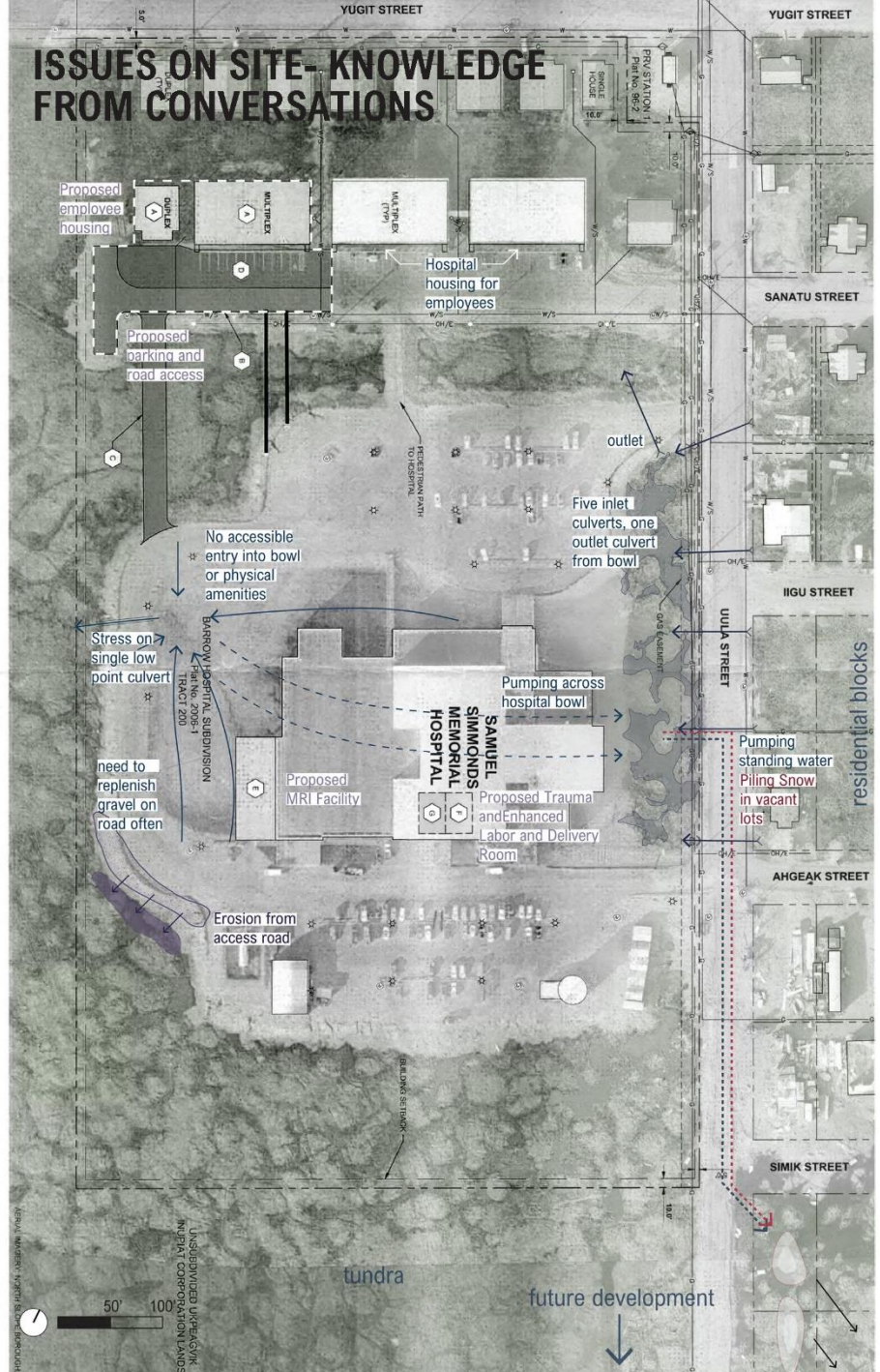


SENSOR B

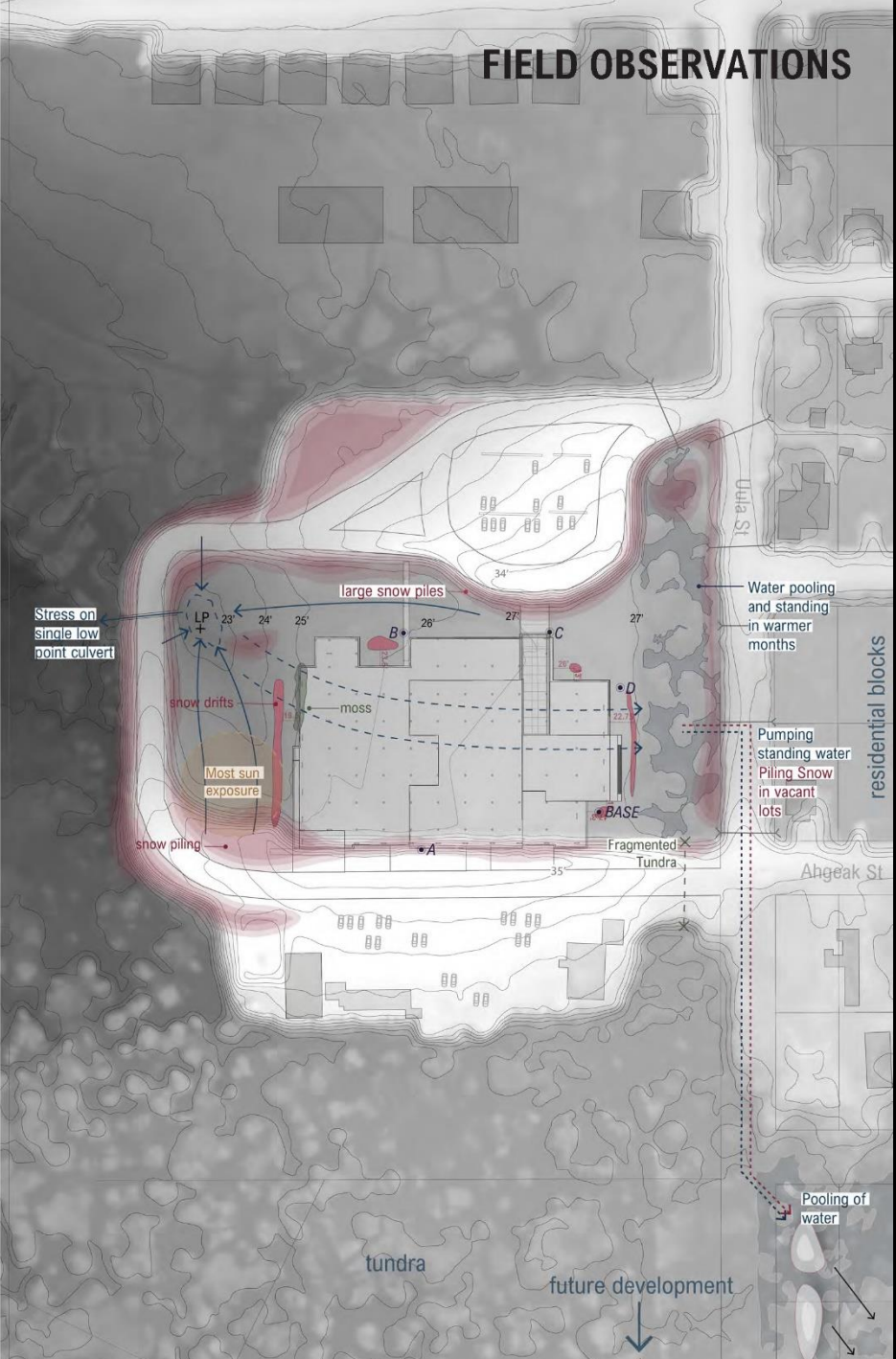


SENSOR C

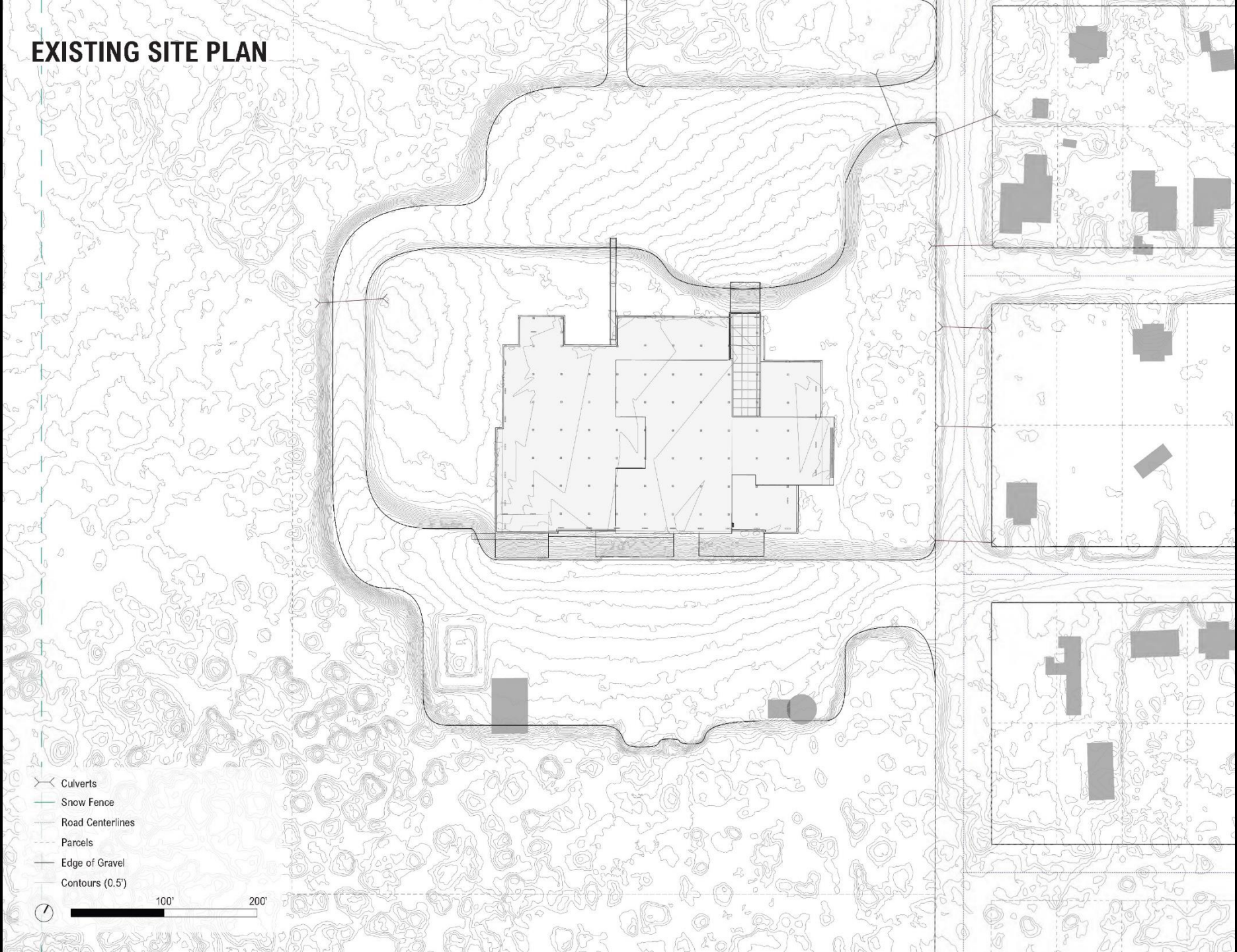
ISSUES ON SITE- KNOWLEDGE FROM CONVERSATIONS



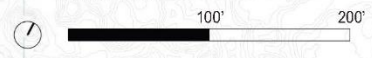
FIELD OBSERVATIONS



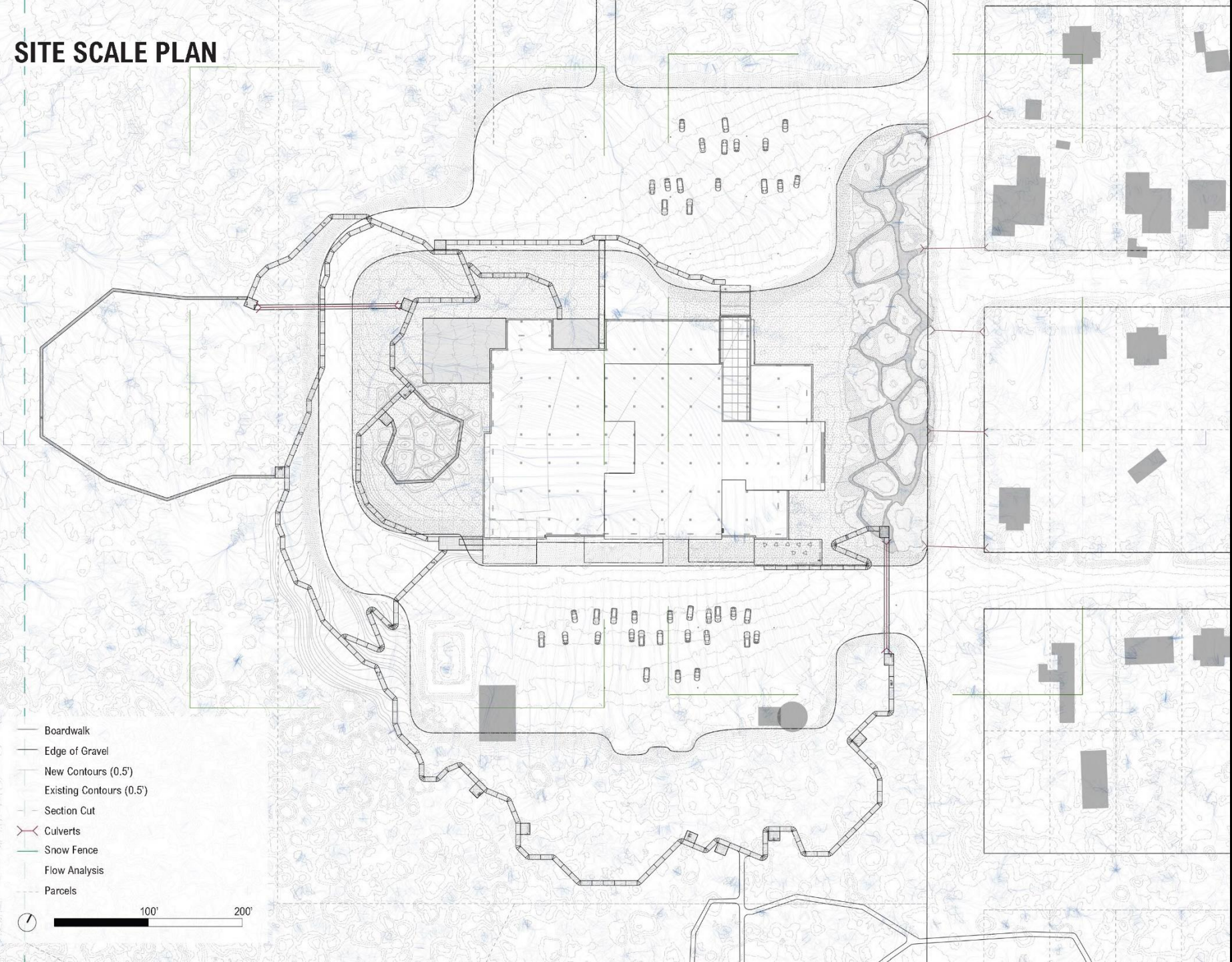
EXISTING SITE PLAN



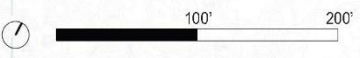
- Culverts
- Snow Fence
- Road Centerlines
- Parcels
- Edge of Gravel
- Contours (0.5')



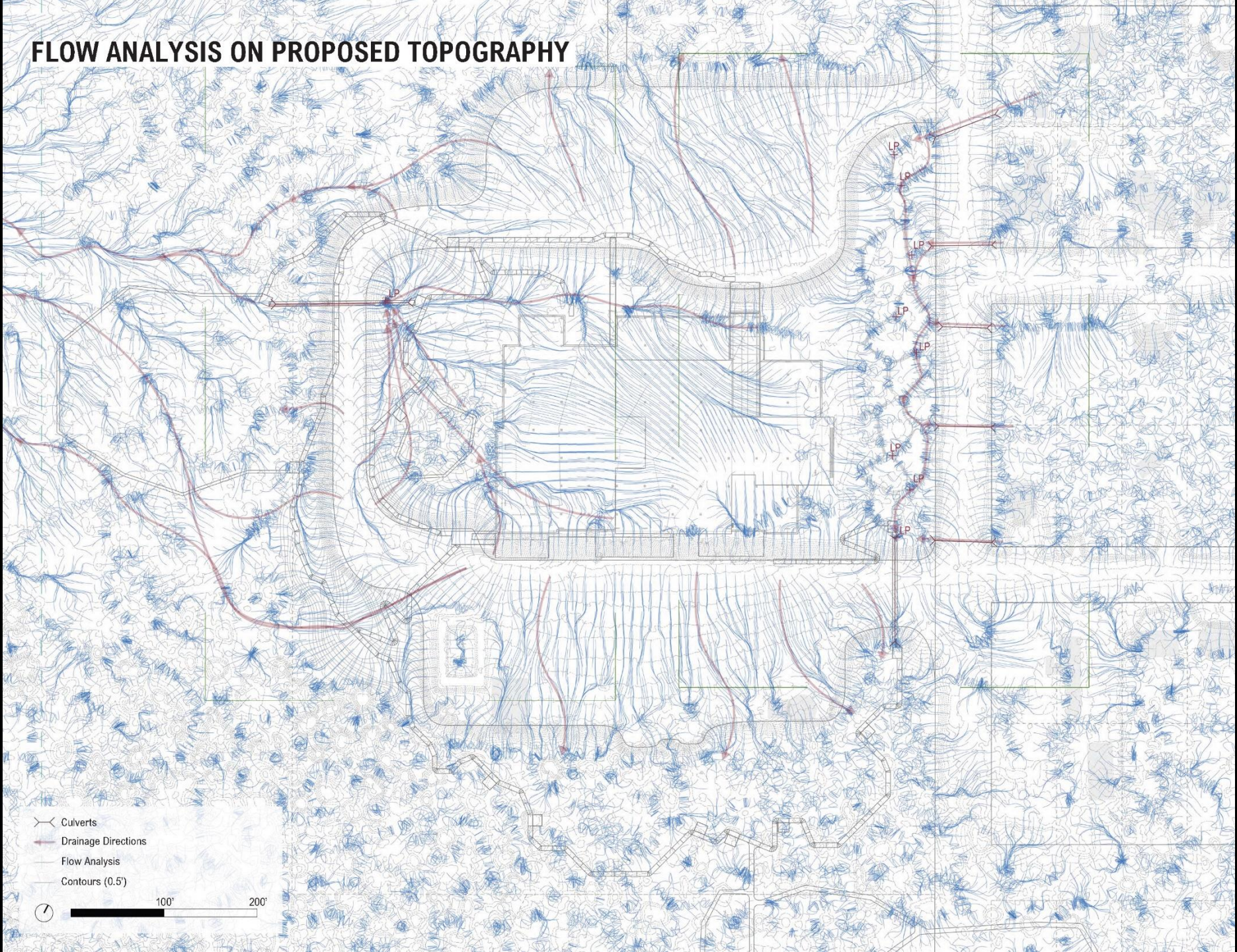
SITE SCALE PLAN







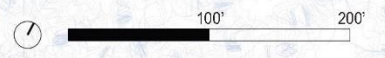
- Boardwalk
- Edge of Gravel
- New Contours (0.5')
- Existing Contours (0.5')
- Section Cut
- Culverts
- Snow Fence
- Flow Analysis
- Parcels



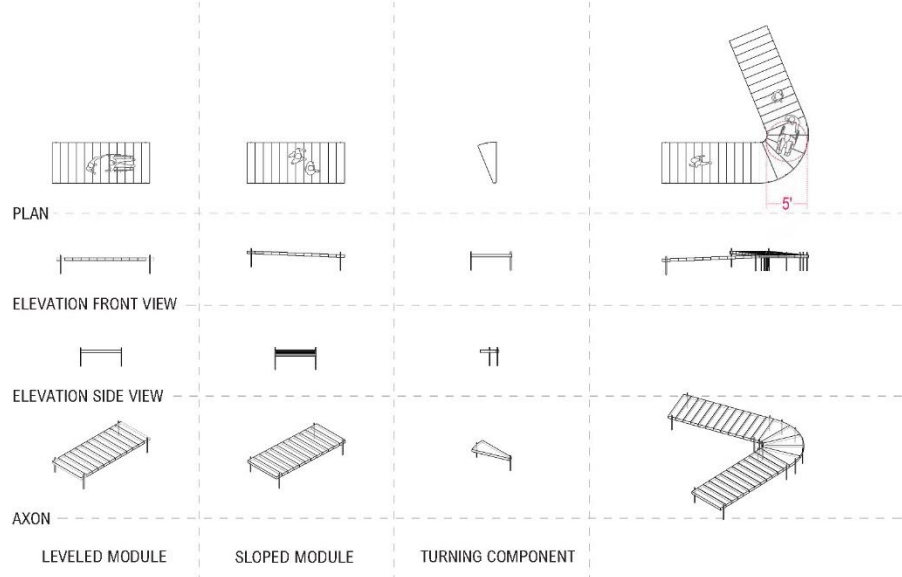
FLOW ANALYSIS ON PROPOSED TOPOGRAPHY



-  Culverts
-  Drainage Directions
-  Flow Analysis
-  Contours (0.5')



BOARDWALK COMPONENTS AND ACCESSIBILITY

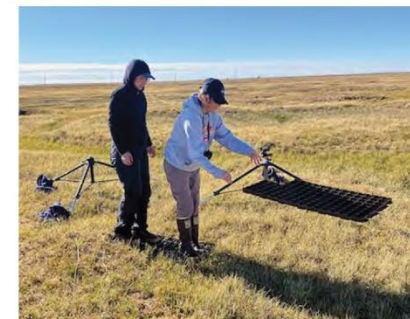


PRECEDENTS OUTSIDE OF UTQIAGVIK

UPPER LEFT: SVARFADARDALUR BRIDGES - TRANSITORY BOARDWALK

UPPER RIGHT: ALASKA KWIGILLINGOK

LEFT: TUNTUTULIAK BOARDWALK - ENDURING BOARDWALK



PRECEDENTS NEAR UTQIAGVIK

LEFT: BOARDWALKS ON OPEN TUNDRA - ENDURING BOARDWALK

RIGHT: USE OF RUBBER MATS TO CREATE PATHS THAT PROTECT THE GROUND - TRANSITORY BOARDWALK





Water Infrastructure Brief

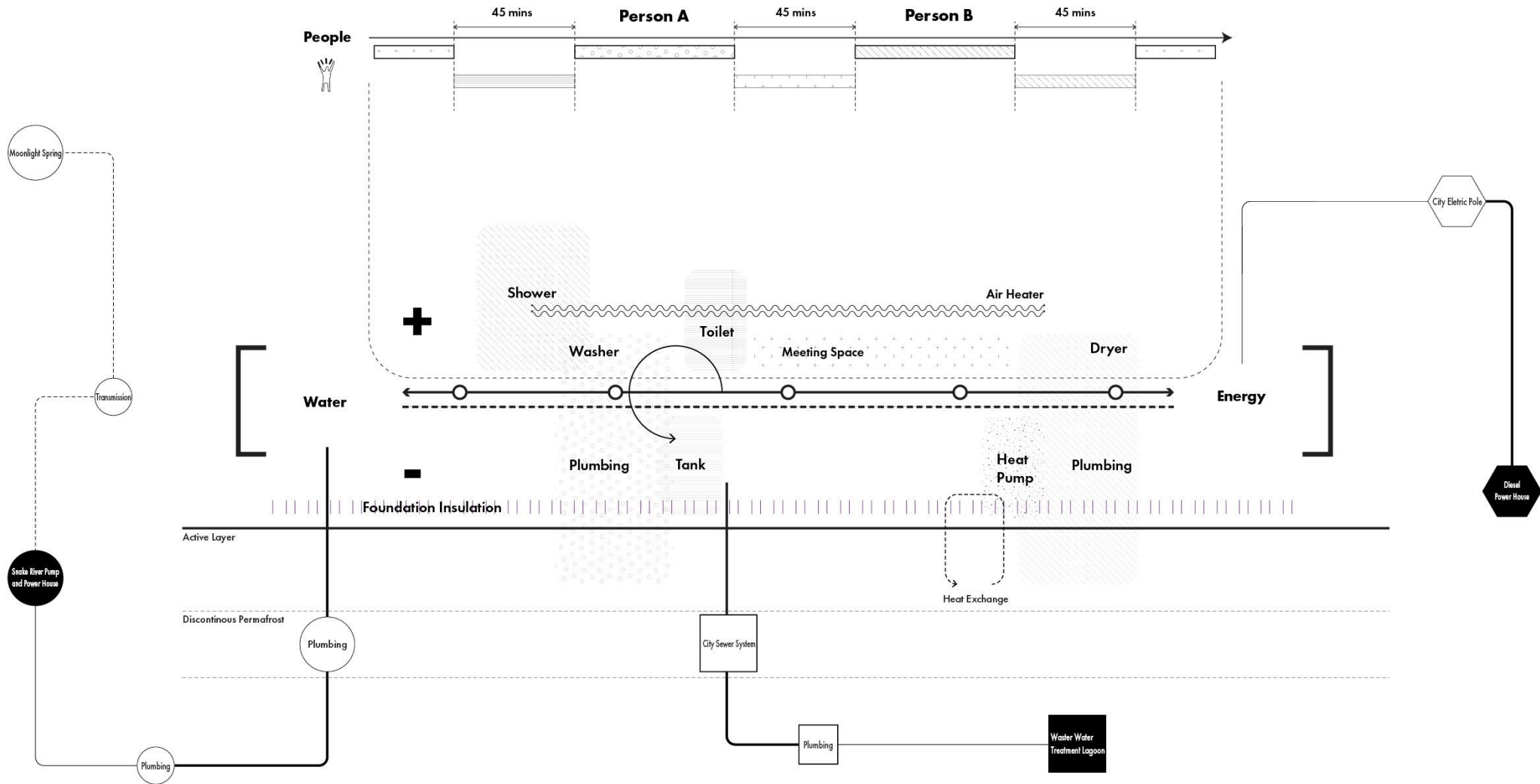
Opportunities and challenges for water utilities in unincorporated Alaska communities

This brief was produced in August 2020 by Kaitlin Mattos and Tatiana Blanco-Quiroga at the University of Colorado and the Alaska Native Tribal Health Consortium.

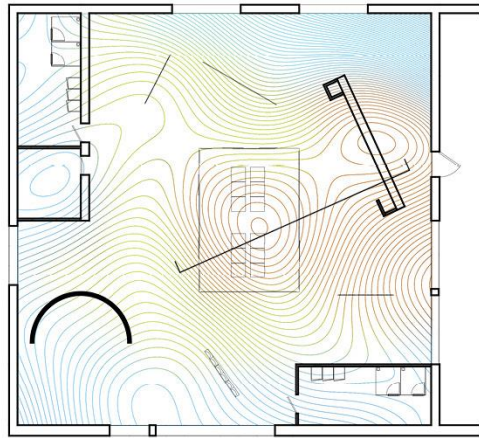


Above: Two functioning washers and two functioning dryers are shared between 400 people at Kivalina's washeteria.

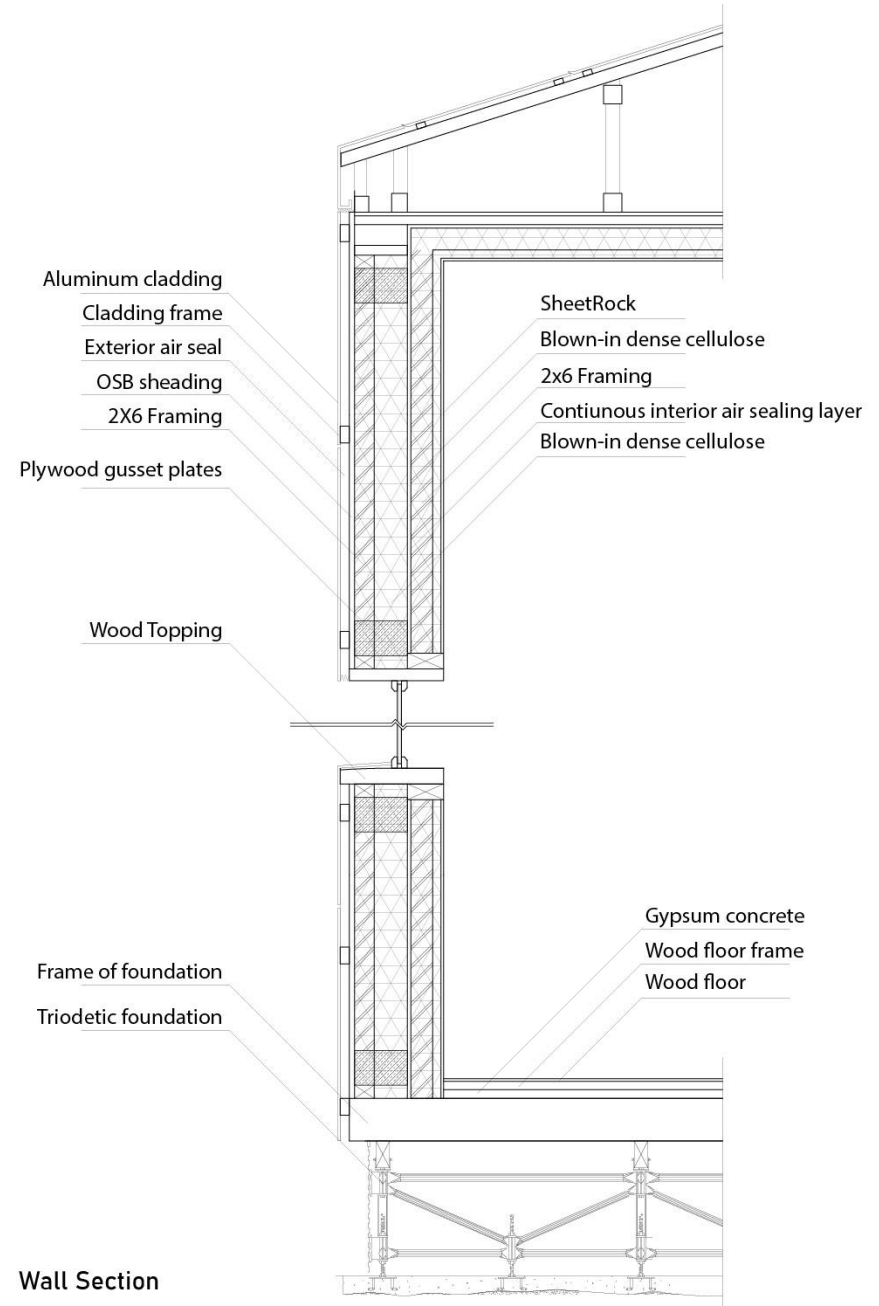
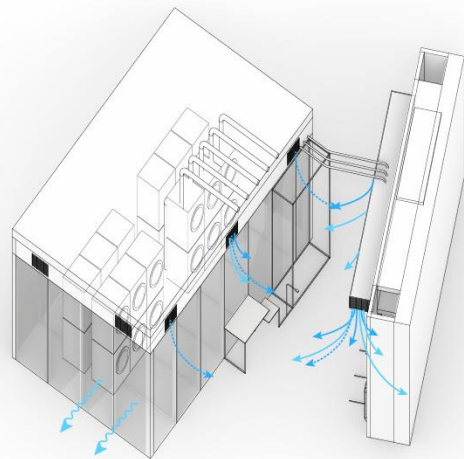
Design Proposal



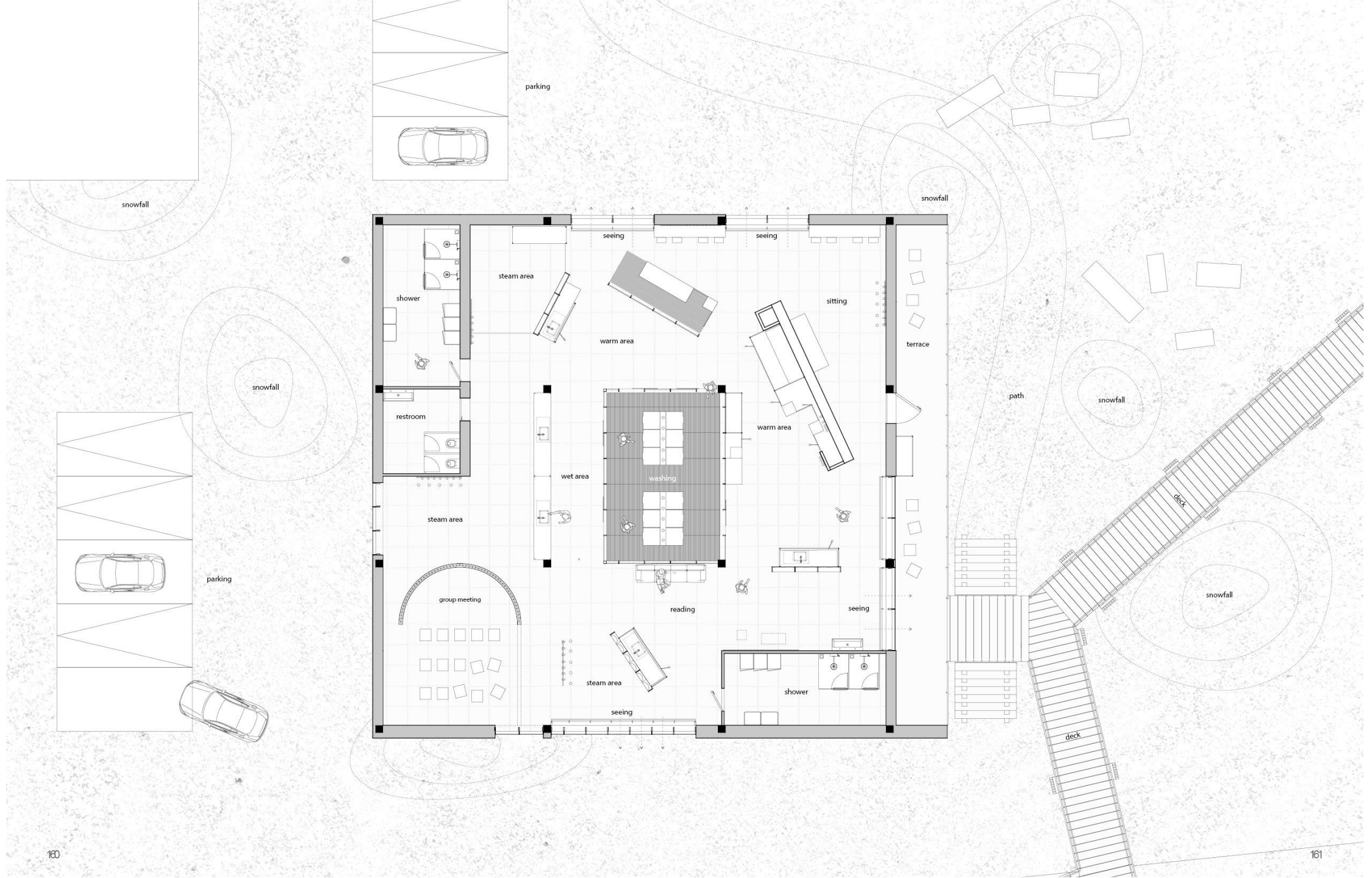
Micro Thermal Gradient

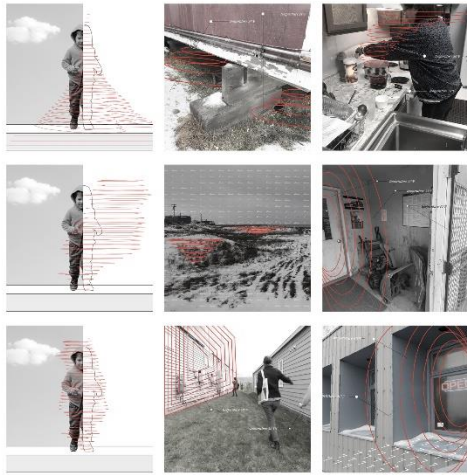


Comfort Flow Exchange

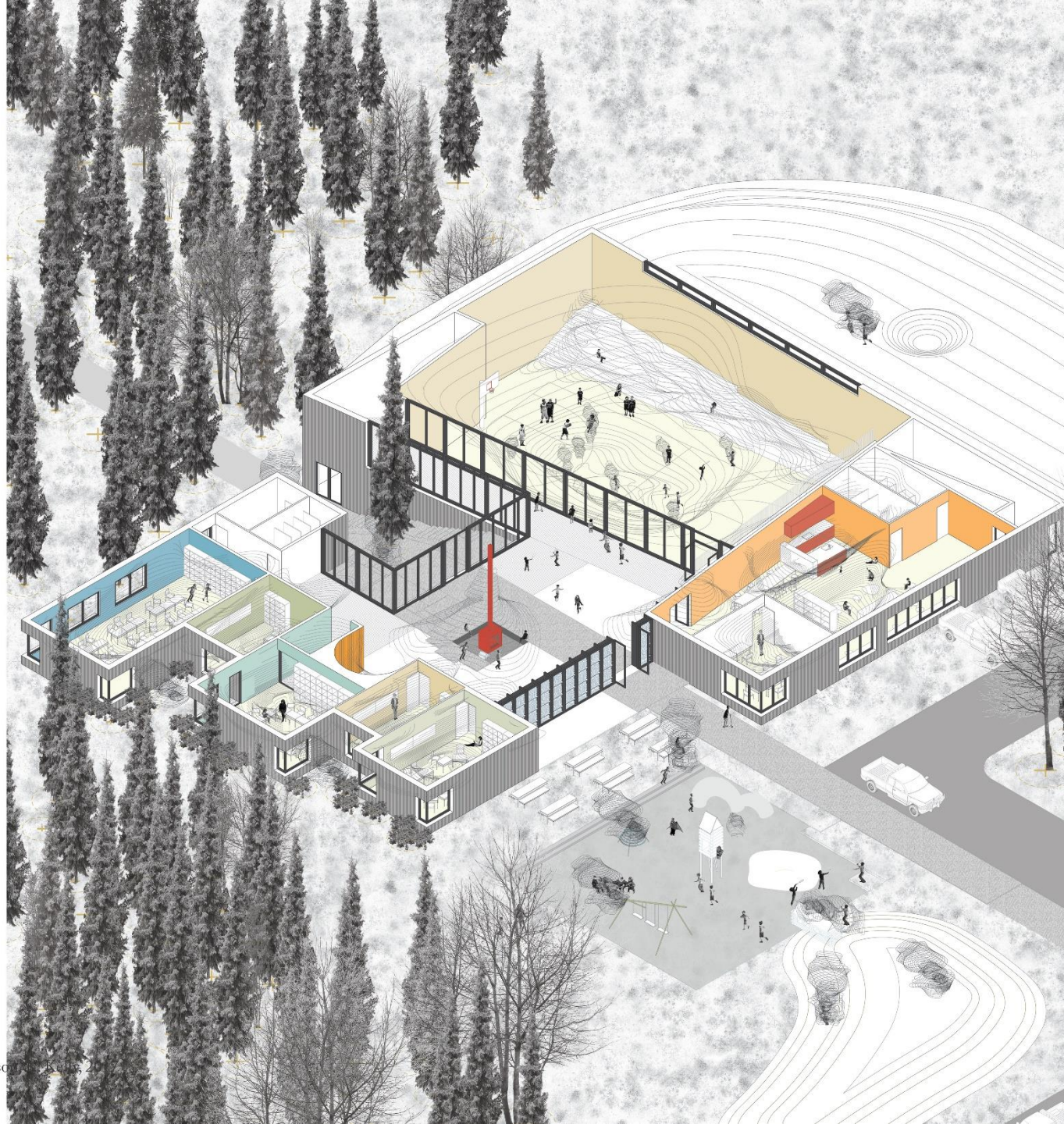
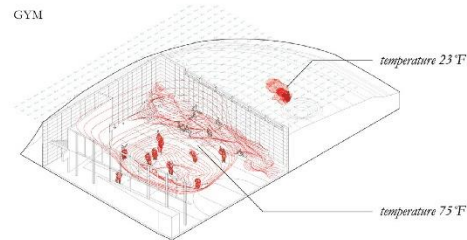
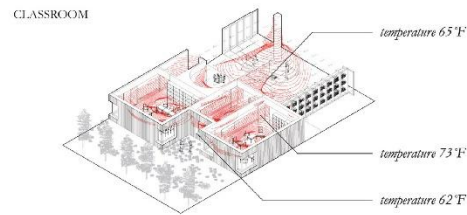
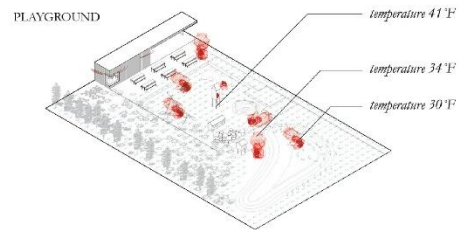


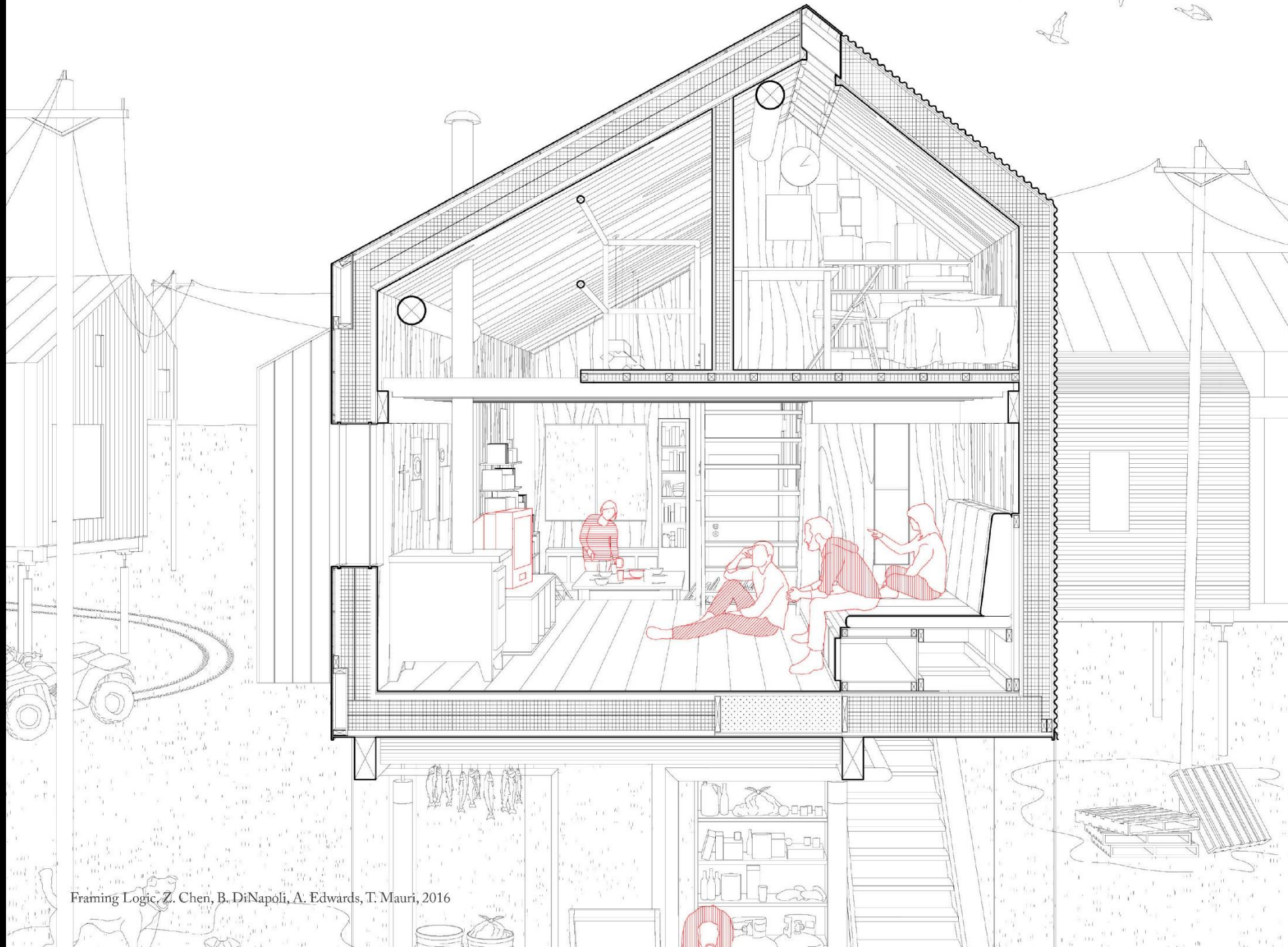
Wall Section





AIR FLOW AND HEAT TRANSFER





Framing Logic, Z. Chen, B. DiNapoli, A. Edwards, T. Mauri, 2016



Mediating Environments, AR+D, 2019



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