

**A MODEL FOR PUBLIC AGRARIAN ARCHITECTURE
ON THE SUBURBAN EDGE**

by

Piotr M. Kolodziej

Submitted in partial fulfilment of the requirements
for the degree of Master of Architecture

at

Dalhousie University
Halifax, Nova Scotia
March 2014

© Copyright by Piotr M. Kolodziej, 2014

CONTENTS

Abstract.....	iv
Acknowledgements.....	v
Chapter 1: Introduction	1
City and Farm	1
Agrarian Architecture	6
Food Revolution.....	9
The Suburban Edge	11
Critical Position	13
Thesis Question.....	13
Description of Site	14
Site Selection.....	14
Found Potential.....	18
Description of Program	25
Sheep Farming	25
‘Farm-to-Table’ Model	27
Architectural Characteristics.....	28
Process	28
Landscape	28
Transparency	30
Pragmatism and Vernacular	30
Chapter 2: Design	33
Framework.....	33
Landscape	35
Urban Response	35
Pasture and Ecology	37
Season and Rotation.....	40
Site Design.....	43
Distribution	43
Topography	43

Approach.....	43
Massing and Porosity.....	46
Process	46
Cross-talk.....	46
Seasonality	47
Building Design	52
Flow.....	52
Service and Served.....	61
Orientation	61
Tectonics and Materiality	64
Inside and Out.....	64
Chapter 3: Conclusion	71
Discoveries and Difficulties	71
Potential Directions.....	72
Appendix I: Infrastructure Integration.....	74
Appendix II: Site Option & Precedent Analysis.....	75
Appendix III: Case Studies	77
Appendix IV: GIS Data.....	83
Appendix V: Glossary.....	85
Bibliography.....	89

ABSTRACT

The thesis project is a study for the integration of farming, urban use, and ecology at the edge of the city. The aims of the test-of-principle are, first and foremost, to connect the urban consumer with the rural food producer, processing and productive landscape, and, secondly, to examine mechanisms for local self-sufficiency and the preservation of farmland from suburban encroachment.

The proposed model for this study is a sheep farm within the outskirts of Truro, Nova Scotia. At the landscape scale, the thesis takes the position that urban areas and farmland mutually benefit from co-localization. At the site and building scales, the thesis adopts the 'farm-to-table' model, seeking to vertically-integrate and express the full cycle of food-related programming. The public experience within this food hub is choreographed through visibility, porosity and overlapping circuits with farmer, sheep and product. By balancing the public, process and pragmatism, the thesis demonstrates a role for architecture within the agrarian domain.

ACKNOWLEDGEMENTS

Thank you to my thesis supervisor, Talbot Sweetapple, and advisor, Susan Fitzgerald, for their guidance through the research and design process, to Jonathan Mandeville for his input in the concept phase, and to all of the students and faculty who offered critique and who helped to shape the work.

Thank you to David Westlake and Crawford Macpherson of the Municipality of the County of Colchester both for providing GIS data and for the discussions on agriculture and development in and around Truro.

Thank you to Ron Muise of Wandering Shepherd Cheese and Fearann Kisha for taking time from a busy schedule as a full-time farmer and cheese artisan to provide a practical slant on sheep farming and dairy processing.

A special thank you to Mira for all of her support.

CHAPTER 1: INTRODUCTION

“Changes in diet are more important than changes in dynasty or even of religion.”

— George Orwell¹

City and Farm

Farmland has historically held a very close relationship with the city. Agriculture and urbanism co-evolved in an interdependent manner, with the cultivation of grain providing the large and stable food source necessary to support permanent settlement. Pre-industrial cities were relatively compact and surrounded by farmland; their size and configuration was limited by the carrying capacity of the immediate productive landscape, that is, by how much food could be imported by foot or waterway without spoilage. Fresh food (and in the case of livestock, still live) was brought into the heart of the city where it was stored, distributed, slaughtered, processed, sold and eaten in vibrant open-air markets and streets. Awareness of food and its place within the organic cycle must have been inescapable for the pre-industrial city dweller.²



Ambrogio Lorenzetti, *Allegory of Good Government*, 1338-9.

- 1 Janine De La Salle & Mark Holland, ed., *Agricultural Urbanism* (Winnipeg: Green Frigate Books, 2010), 21 (reprinted from George Orwell, *The Road to Wigan Pier*, 1937).
- 2 Carolyn Steel, “How Food Shapes Our Cities” (lecture, TED Conference, Oxford, July 24, 2009), accessed October 24, 2013, http://www.ted.com/talks/carolyn_steel_how_food_shapes_our_cities.html; Peter Ladner, *The Urban Food Revolution* (Gabriola Island, BC: New Society Publishers, 2011), 37.

Cities still depend on farming today. However, the industrial technologies which define the modern food system—notably intensive production methods (monocultures, agrochemicals, genetically modified organisms, feedlots, etc.) and globalized distribution chains (afforded by rail, air, shipping, and trucking networks)—have emancipated urban centers from the physical constraints of local food productivity. Food production and processing have been pushed well beyond urban boundaries and, in many cases even rural proximities, as the city has been permitted rapid and seemingly unlimited growth. Now coming from distant places, processed food (often in unrecognizable form) is brought into the city the “back way—through suburban warehouses and hidden loading bays behind centralized supermarkets” and sterile megastores.³ As a result, the various steps involved in the growing and processing of food have been rendered invisible to the urban consumer.

A major consequence of the removal of food production from the public realm is that food has been stripped of much of its ecological value and cultural meaning. In the United States, for example, approximately half of the food produced, at an expense of 10 calories input for every one calorie of food output, is thrown away.⁴ As food-architect and author Carolyn Steel notes, with the advent of the industrialized food system, “as far as urban consumers were concerned, all the ancient fears about food—the fertility of the soil, the sun and the rain, the strength of the harvest—translated into one concern: the size of their weekly shopping bill.”⁵ The lack of visibility has also afforded agri-business a large degree of impunity to exploit biological resources in ways (such as the overcrowding and mutilation of livestock, widespread application of antibiotics to promote livestock weight gain, and scales of processing which make it difficult, if not impossible, to ensure food safety) which would likely be unpalatable for the average individual sitting down for a meal.

3 Steel, “How Food Shapes Our Cities,” TED lecture; Ladner, *The Urban Food Revolution*, 37.

4 Steel, “How Food Shapes Our Cities,” TED lecture; De La Salle & Holland, *Agricultural Urbanism*, 21 & 27; Ladner, *The Urban Food Revolution*, 37.

5 Carolyn Steel, *Hungry City: How Food Shapes Our Lives* (London: Vintage Books, 2009), 38.



Alex S. MacLean, “Wheat Strips Run Perpendicular to the Prevailing Wind, Conrad Area, Montana,” date unknown (top) and “Housing Tone Shift - Seaside Park, NJ,” 2011 (bottom); from Alex S. MacLean.

This severance of the psychological and functional connection of the urban environment and the productive landscape has also caused a major oversight in the building of cities, especially in terms of land use, transportation and growth management.⁶ Low-density development of peri-urban land (“sprawl”) remains the standard response for accommodating city growth in North America, a practice which consumes the arable land which has traditionally surrounded and sustained urban nodes. Given the dramatic global increase in urbanism, we can only expect the issue to become more desperate. Proponents of local agrarian viability have reacted with calls for urban containment and densification, mandated preservation of agricultural land, and the integration of productive agricultural land with urban use at the interface.⁷

Perhaps the strongest argument against the 21st century food production system—that which contends claims that we need highly-industrialized, intensive techniques to produce lots of cheap food in order to feed the world—is that it does not perform particularly well. Roughly one billion people worldwide continue to starve while another one billion face an obesity epidemic.⁸ Furthermore, many critics assert that the efficiencies of the system are unsustainable, as they are wholly dependent on resource degradation, cheap foreign labour, and diminishing stocks of cheap energy and water.⁹ It can also be said that the system places all of its eggs in one basket, by design, in terms of economics (control by a small handful of mega-corporations), biology (for example, monocultures and proprietary seed technology) and geography (centralized mega-farms). This emphasis of efficiency over diversity makes the complex food supply chain susceptible to disruption by climatic, financial or socio-political crises. Considering that this supply chain affords a city only three days worth of food stores at any given time, the loss of food production from in and around cities has created a condition of insecurity of food supply.¹⁰

6 De La Salle & Holland, *Agricultural Urbanism*, 21.

7 Ibid., 28 & 39.

8 Steel, “How Food Shapes Our Cities,” TED lecture.

9 De La Salle & Holland, *Agricultural Urbanism*, 21; Ladner, *The Urban Food Revolution*, 37.

10 Jennifer Cockrall-King, *Food and the City: Urban Agriculture and the New Food Revolution* (Amherst, NY: Prometheus Books, 2012).



Mishka Henner, "Coronado Feeders, Dalhart, Texas," 2013, showing a U.S. beef feedlot and its waste lagoon; full digital copy of a satellite photograph (above) and detail (below); from Mishka Henner.

Agrarian Architecture

A farm isn't an architectural fantasy. It's something akin to a natural event, something that is like a humanized face of the earth, a form of geometric planting that is as much a part of the landscape as a tree or a hill, and as expressive of human presence as a piece of furniture or a machine.

— Le Corbusier¹¹

As described by architectural historian Meredith TenHoor, there is a long tradition among architects “to improve both the food supply and social relations through designs for farms and food distribution centers.”¹² These designs and proposals became particularly frequent in response to the urban conditions which followed the industrial revolution, and included a series of utopian schemes which identified farms and cities as interconnected systems rather than discrete elements. For example, Ebenezer Howard's ‘Garden City’ (1902) proposal, building upon the principles of Charles Fourier's *Phalanstere*, integrated all aspects of production and consumption, including agriculture, into the social fabric of the city (though the execution of this concept infamously failed to include the proposed land reforms and instead led to the modern suburb).¹³ Schemes for the reconciliation of city and country evolved through the 20th century, eventually coming to also include attempts to integrate both industrial and traditional/artisanal agriculture; one such project, ‘Agricultural City’ (1961) by Japanese Metabolist architect Kisho Kurokawa, allowed for a cellular urban growth around a hybrid agricultural framework of traditional development patterns and modern infrastructure.¹⁴

The utopian responses to the urban-agricultural paradox can be mapped as a distribution problem.¹⁵ At one end of the spectrum, F.L. Wright's ‘Broadacre City’ (1932-58), Ludwig Hillberseimer's ‘The New Regional Pattern/The New City’ (1945-9), and Andrea Branzi's ‘Agronica’ (1993-4) represent a decentralized agrarian urbanism, in which the modern industrial city is effectively dissolved into a “nearly undifferentiated field” of agrarian activity and lowest

11 Reprinted in Meredith TenHoor, “The Architect's Farm” in *Above the Pavement—The Farm!: Architecture & Agriculture at P.F.I.*, ed. Amale Andraos and Dan Wood (New York: Princeton Architecture Press, 2010), 172.

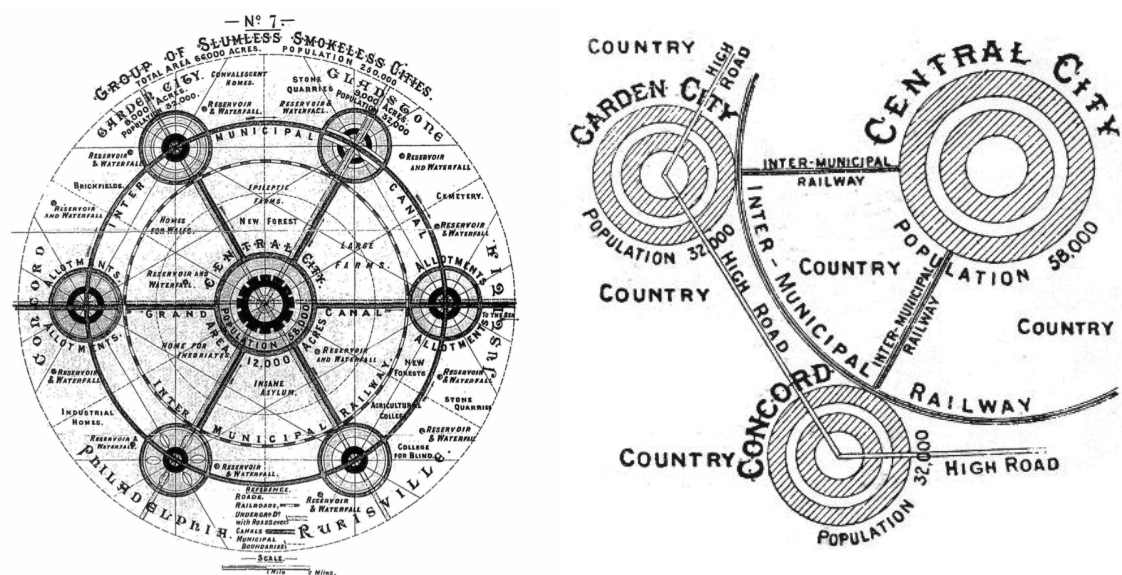
12 TenHoor, “The Architect's Farm,” 166.

13 *Ibid.*, 168-9.

14 *Ibid.*, 178.

15 Carolyn Steel, “Sitopia: How We Think Through Food” (lecture, TEDxDanubia, Budapest, March 25, 2011), accessed November 4, 2013, <http://www.youtube.com/watch?v=aLOHsc86IkC>.

potential for sociability (on the order of ten to one hundred residents).¹⁶ In the middle sits Howard's 'Garden City' (1902), in which intense nodes of urbanity (of approximately 30,000 residents) are surrounded by farmland and connected by networks. The other end of the spectrum—perhaps best reflected by Le Corbusier's agricultural outgrowth of the 'Radiant City' project, the 'Radiant Farm' (1934-5)—represents the current prevailing conditions, in which industrialized and consolidated farms organized around transportation and distribution networks support large but removed metropolitan populations.¹⁷ Though these proposals take radically different positions on the optimal spatial relationship between agriculture and urbanism, they share the fundamental principle of food and agriculture as a formative element in the utopian city's structure and order.¹⁸

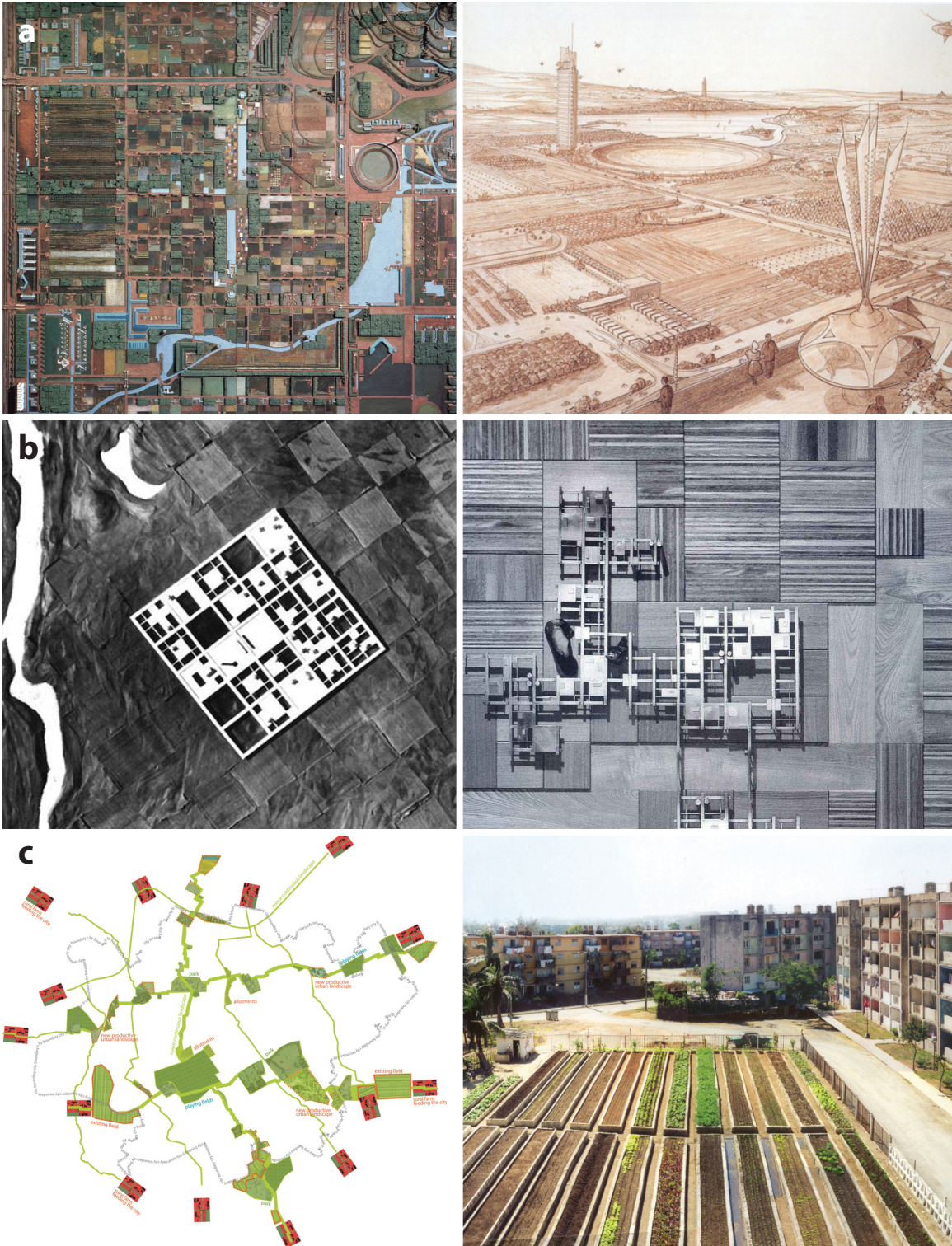


Ebenzer Howard, *Garden Cities of To-morrow*, 1989/1902; from Sustainable Cooperative for Organic Development.

16 Charles Waldheim, "Notes Towards a History of Agrarian Urbanism," in *Bracket—Almanac 1: On Farming*, ed. Mason White and Maya Przybylski (New York: Actar, 2010), 19-20.

17 Tenhoor, "The Architect's Farm," 171-2.

18 Steel, "How Food Shapes Our Cities," TED lecture.



(a) Frank L. Wright, "Broadacre City," 1934 (left) and 1950-5 (right); from Charles Waldheim, "Notes Toward a History of Urban Agriculture," online essay.

(b) Kisho Kurokawa, "Agricultural City," 1961; from Arxio.bak.

(c) Andre Viljoen and Katrin Bohn, "Continuous Productive Urban Landscapes (CPULs)," 2005-2007; from Bohn & Viljoen Architects (left) and Andre Viljoen, Katrin Bohn and Joe Howe, *CPULs: Designing Urban Agriculture For Sustainable Cities*, 138 (right).

Food Revolution

“Of all the underlying forces working toward emancipation of the city dweller, the most important is the gradual reawakening of the primitive instincts of the agrarian.”

— Frank Lloyd Wright¹⁹

There has been a recent groundswell of renewed interest and public actions to gain more information on and control over where and how food is being made, embodied by the “slow food” and “locavore” movements. With this has come a call from consumers to bring food production back into and around cities in order to promote more sustainable practices, improved public health, local economy, and a closer relationship between the consumer and the farmer.²⁰ Nova Scotia in particular—perhaps fueled by a productive potential coupled with an embattled economy—has embraced “eating local,” as is evident from the success of local artisans, farmers’ markets, and locavore restaurants.

Armed with an increasing social and environmental literacy, designers and planners have also shown enthusiasm for the integration of agriculture and urbanism. The initial reaction has largely focused on urban agriculture, rooted in the remediation of underused brownfield sites and the repurposing of greenfield sites into productive urban and peri-urban assets.²¹ A second response, brought about from the concept of food and agriculture as a formative element in urban design, has involved investigations into “agricultural urbanism.”²² The strategies of agricultural urbanism include spatial, programmatic, ecological, economic and infrastructural components, such as integration of food-related land uses and productive landscapes into the urban fabric, sustainable resource/waste management, support of small- and medium-scale producers, processors and suppliers, and both formal and informal public education on food and food production.²³

19 Steel, *Hungry City: How Food Shapes Our Lives*, 304.

20 Ladner, *The Urban Food Revolution*, Preface vii.; Waldheim, “Notes Towards a History of Agrarian Urbanism,” 18.

21 Waldheim, “Notes Towards a History of Agrarian Urbanism,” 18.

22 De La Salle & Holland, *Agricultural Urbanism*, 21.

23 *Ibid.*, 32-5.



Food Culture.

Peter Menzel and Faith D'Aluisio, "The Melansons of Iqaluit, Nunavut Territory, Canada" (top) and "The Ahmed family of Cairo, Egypt" (bottom); from *Time* online.

The food renaissance has also had an impact within the field of architecture, fueling, for example, “from-farm-to-table” design across all aspects of the food chain: restaurants, cafes, farmers’ markets, wineries, chicken coops, bee hives and barns.²⁴

The Suburban Edge

The edge condition between city and country provides an opportunity for intervention—to produce food locally and more sustainable, to preserve farmland from suburban encroachment, and to nurture a closer relationship between the consumer and the farmer. Urban and rural infrastructures, however, are often thought of as “diametrically opposed.” Farms require access roads, large-scale waste disposal, and industrial machinery, and may produce noise, odours and dust which can antagonize neighbours. Furthermore, agricultural land use in urbanized areas is often restricted by higher real estate values and zoning by-laws.²⁵

Nonetheless, having farms close to cities can be mutually beneficial.²⁶ On one side, urban residents benefit from fresh local food, attractive greenspace, and a rural lifestyle. On the other side, farmers gain access to a larger market (especially for value-added products) and labour pool, and potential for new revenue streams. For example, farmers close to cities can sell their products at their own retail store, host classes and other events, rent out barns for festivals, and, in some cases, carve off a slice of land for light industrial or commercial use (such as a welding shop or warehouse). The supplementary income which this provides can help offset the low-profitability of many, especially small-scale, farming operations.²⁷ Meanwhile, potential public disturbances from farm activity can be minimized through buffer zones of hedges, ditches, berms or linear parks, and zoning and ownership issues may be counter-measured through conservation easements, right-to-farm agreements, lease agreements with multiple private owners, and partnerships between landholders and farmers to create hybrid agricultural landscapes.²⁸

24 For examples, see the July 2013 issue of *Architectural Record* (vol. 201, no. 7), <http://archrecord.construction.com/features/2013/1307-design-from-farm-to-table/>.

25 Ladner, *The Urban Food Revolution*, 38, 40-42; Ellen Burke, “Farm Plus: Hybrid Agricultural Landscapes,” in *Bracket—Almanac 1: On Farming*, ed. Mason White and Maya Przybylski (New York: Actar, 2010), 89.

26 Ladner, *The Urban Food Revolution*, 40.

27 Ibid., 41.

28 Burke, “Farm Plus: Hybrid Agricultural Landscapes,” 89; Ladner, *The Urban Food Revolution*, 40.



Development on agricultural frontlines in Upper Onslow, Nova Scotia, adjacent to the town of Truro.

It has also been asserted by proponents of integration that infrastructure is not only compatible, but actually complementary; water, energy and organic waste resources from the city can be exchanged and made productive on the farm, and vice versa, in an ecologically-based closed loop.²⁹ For example, a farm may provide an adjacent urban neighbourhood with a landscape capable of stormwater retention, opportunities for composting, and organic waste-based energy recovery systems (for more details, see Appendix I).

Architect/designers Andre Viljoen, Katrin Bohn and Joe Howe have argued that urban planning concepts of city boundary, greenbelt and suburb are obsolete, and instead propose “continuous productive urban landscapes” in which agricultural fields are re-introduced into the social and physical fabric of the contemporary city.³⁰ In the resulting “edgeless city,” urban and suburban residents would become involved first-hand in farming, come to understand its value, and become invested in the preservation of agricultural land at the city’s edge. This model of agricultural urbanism, then, becomes a mechanism for the containment of urban sprawl.³¹

29 Bud Fraser, “Integrated Infrastructure for Local Food and Agriculture,” in *Agricultural Urbanism*, ed. de la Salle & Holland (Winnipeg: Green Frigate Books, 2010), 103-14.

30 Andre Viljoen, Katrin Bohn and Joe Howe, *Continuous Productive Urban Landscapes: Designing Urban Agriculture For Sustainable Cities* (Amsterdam: Architectural Press, 2005), 11-12.

31 Ladner, *The Urban Food Revolution*, 42.

Critical Position

The thesis project serves as a model for the integration of farming and urban use at the edge of the city. At the city/landscape scale, the thesis takes the position that urban areas and farmland are interdependent, and therefore both require consideration within a co-locality. At the building scale, the thesis adopts the 'farm-to-table' model, seeking to integrate the full range of food-related programs, including (a) production, (b) processing, (c) storage & distribution, (d) markets, (e) cooking, eating & celebrating food, and (f) waste recycling.³² At the human scale, the thesis takes the position that the different components of the food cycle must be made transparent to the public ("back of house is front of house") in order to educate the consumer and to strengthen the public's relationship with food production and processing.³³

Thesis Question

How can a suburban agrarian architecture connect the consumer with the food producer, process and productive landscape?

32 Steel, "Sitopia: How We Think Through Food," TEDxDanubia lecture; De La Salle & Holland, *Agricultural Urbanism*, 32-5.

33 De La Salle & Holland, *Agricultural Urbanism*, 32.

Description of Site

Site Selection

Several areas in Nova Scotia were considered for the site, including Halifax Regional Municipality, the Annapolis Valley, and the greater Truro urban area (Truro, Bible Hill and surrounding townships). These were screened for two criteria: (1) agricultural land use adjacent to an urban area, and (2) a relatively large urban population. The Annapolis Valley, Nova Scotia's bread-basket, was ruled out for the relatively small size of its urban centers, while Halifax, the only major metropolitan area in the province, lacked proximal agricultural activity. Truro was therefore selected for its representation of the urban-rural edge condition; the moderately sized urban population (approximately 23, 000 as of the 2011 Statistics Canada Census, including satellite communities) is situated along a strip of agricultural land associated with Cobequid Bay. A mapping study of the urban boundary expansion of greater Truro shows significant growth to the north-east, south, and west since 1931. This urban expansion has occurred at the cost of available agricultural land, particularly in Bible Hill and—following construction of the Trans-Canada Highway—Lower Truro/Truro Heights.

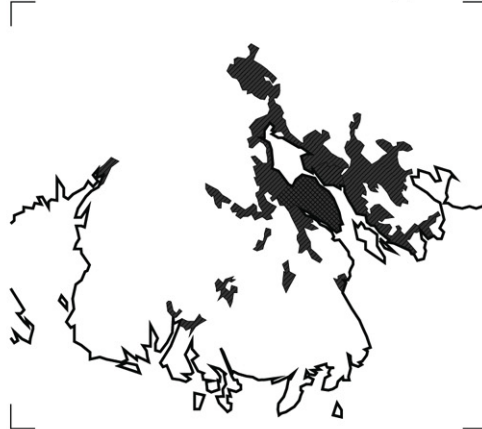
Three potential agricultural sites at the expanding urban boundary were identified: Lower Truro at the west edge, Salmon River at the east edge, and Onslow to the north. Although Bible Hill/Valley was noted by Crawford Macpherson, the Director of Community Development at the Municipality of the County of Colchester, as the subregion undergoing the greatest development,³⁴ it was excluded from consideration because it already contains two urban/peri-urban agricultural sites, the Dalhousie Agriculture Campus and the Innovation Agri-Tech Park. The relative suitability of each of the three site options was evaluated based upon (a) potential for interface with the urban edge, (b) projected risk of urban development, (c) distribution of premium agricultural Class II soil, and (d) proximity to related agricultural amenities and services. This comparative analysis guided the selection of Lower Truro for the thesis project site (see Appendix II for details).

³⁴ Crawford Macpherson (Municipality of the County of Colchester), e-mail to author, November 19, 2013.

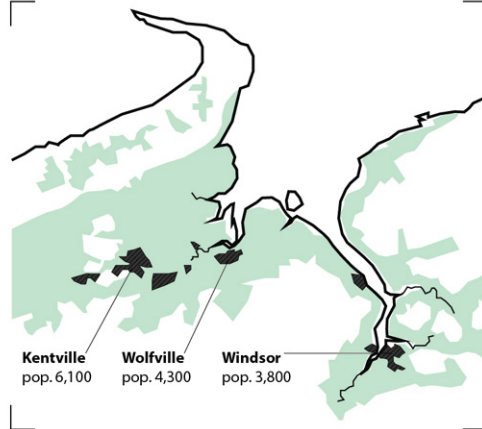
Halifax Regional Municipality



pop. 375,000



Annapolis Valley



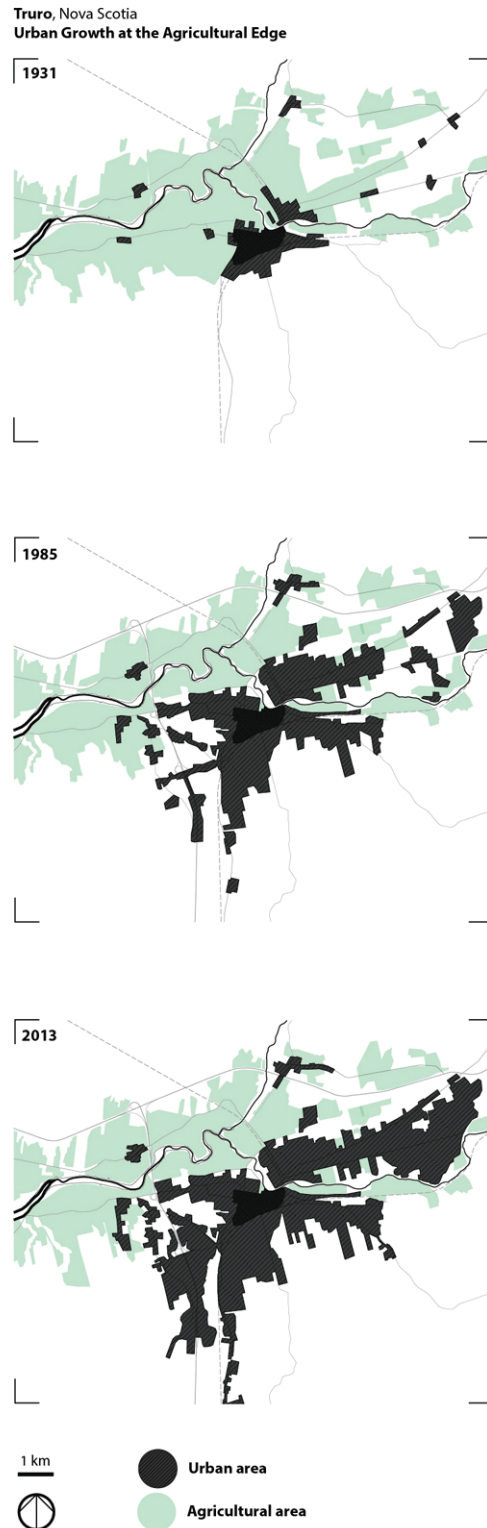
Truro (urban area)



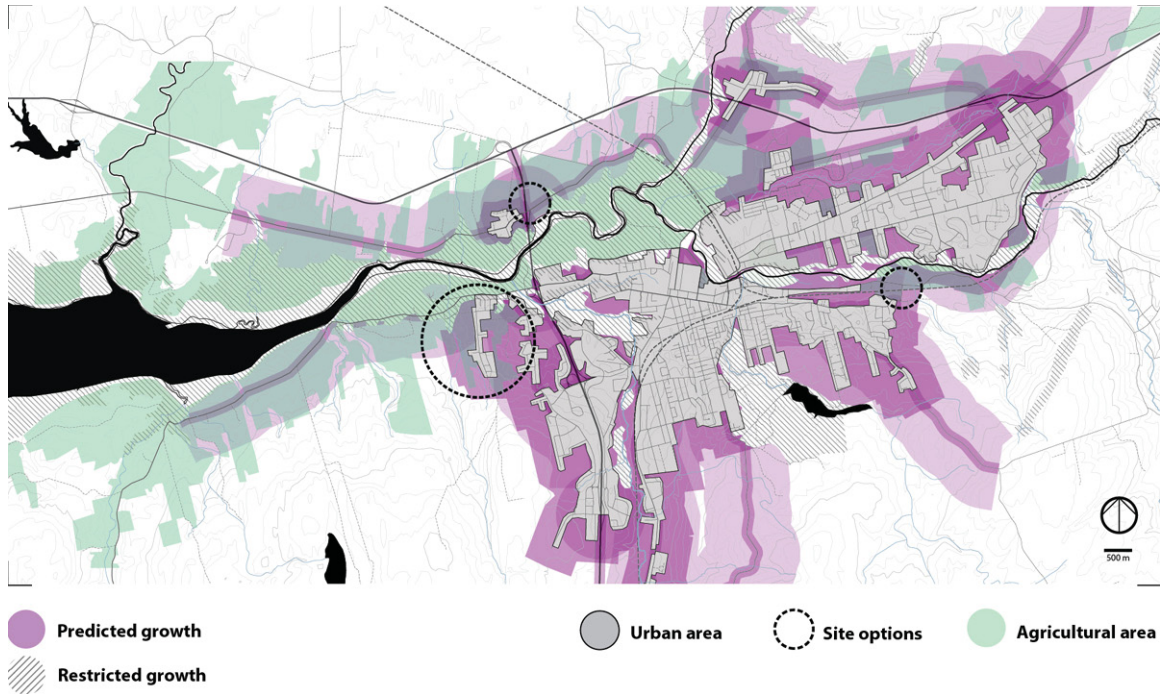
pop. 23,200



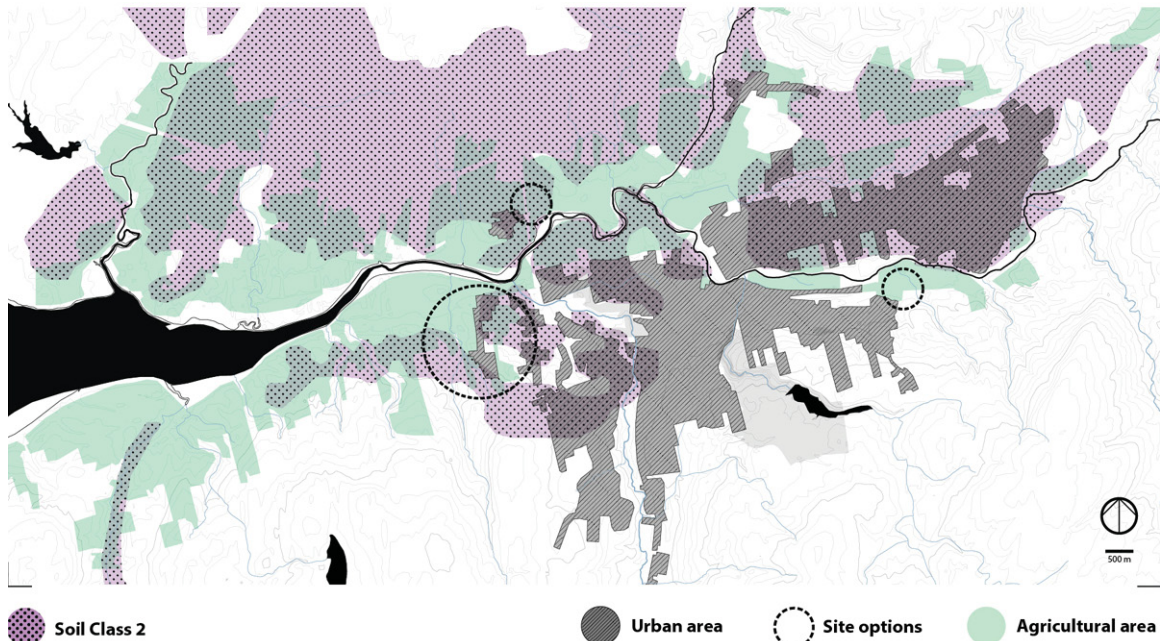
Mapping of the urban and agricultural areas of and around Halifax, the Annapolis Valley and greater Truro, 2013; source aerials (at left) from Bing Maps.



Mapping of the urban expansion of greater Truro and loss of available agricultural land over time; 1931 data from the McCully Collection of aerial photographs, Nova Scotia Virtual Archives; 1985 date from US Geological Surevey (USGS) Landsat; 2013 data from USGS Landsat and GoogleEarth.



Projection mapping for the urban expansion of greater Truro, 2013. Specific parameters include the 500m adjacency to the urban boundary, the 125m and 1km adjacencies to a major road, and 1km nodes at highway intersects, based upon Mauricio Aguayo *et al*, "Revealing the Driving Forces of Mid-Cities Urban Growth Patterns Using Spatial Modeling;" projection of development was precluded by the 1:20 year floodplain, steep slope >30%, and protected land uses, as per the 2012 Town of Truro Municipal Planning Strategy.



Mapping of of distribution of Class II soil (the premium soil for agriculture in Nova Scotia) relative to urban and agricultural program; 2010 soil data from Natural Resources Canada, reprinted in Nova Scotia Agricultural Land Review Committee, "Preservation of Agricultural Land in Nova Scotia."

Found Potential

The site in Lower Truro represents a point of friction between suburban and agricultural land use. It is at the westernmost reaches of urban development within greater Truro, situated in what is effectively a buffer zone between Truro and the Old Barns/Clifton agricultural district. The Old Barns/Clifton district was subject to recent efforts to formalize zoning in order to protect agricultural land use and farmers' right to farm (although a formal plan could not be reached),³⁵ suggesting some degree of pressure to develop. The site can be framed within the context of local agricultural programs, services and amenities in and around Truro, most notably the Dalhousie Agriculture Campus (research and development; training), the Perennia/Innovation Agri-tech Campus (home to agri-business incubation, research and development), the Truro and Avery's farmers' markets, as well as various suppliers. In this regard, it serves as a node within a larger industry network which may share resources, research and markets.

The full extent of the site totals approximately 320 acres—equal to two 'quarter-sections,' the traditional homestead tract in North America—of which 240-260 acres are agriculturally productive. The large site includes a diverse ecology and rich array of surrounding land uses, including the Soley Brook cattle dairy farm to the west and undeveloped woodlands to the south.

The northern boundary is defined by the tidal Salmon River, which shapes a coastal, salt marsh estuary. The natural salt marsh has been drained through landforming (dyking, ditching and *aboiteaux*), the built heritage of Acadian settlers, to create a productive and relatively stable agricultural dykeland. Nonetheless, since this river is subject to oceanic storm surges and freshwater flooding from high rainfall and/or snowmelt, the dykeland remains a major floodplain. The tidal floodplain is comprised of 'Acadian Association Soil,' a silty alluvial soil, which—due to high levels of natural fertility, lack of stoniness or rockiness, and level topography—accounts for some of the most productive agricultural soils in the province.³⁶

35 Crawford Macpherson (Municipality of the County of Colchester), e-mail to author, November 19, 2013; Municipality of the County of Colchester, "Agricultural Planning for the Clifton District Federation of Agriculture," accessed November 19, 2013, <http://www.colchester.ca/planning>.

36 K.T. Webb *et al.*, "Soils of Colchester County, Nova Scotia," Report No. 19, Nova Scotia Soil Survey, (Ottawa: Research Branch, Agriculture Canada, 1991), 31.



1. Dalhousie Agricultural Campus

Working research farm & institutional facilities

- + Chef's Garden (organic demo farm)
- + Ruminant Animal Centre (beef & sheep barn)
- + Veterinary School
- + Experimental orchard & greenhouses
- + Rural Research Centre
- + Atlantic Centre for Agri-Business
- + Organic Agriculture Centre of Canada

2. Innovation Agri-Tech Park

Research farmland and indoor growing operations, with governmental and agri-business programs.

- + Perennia Centre
- + Nova Scotia Federation of Agriculture
- + Agriculture and Agri-Food Canada
- + Northumberland Marketing Coop
- + Sheep Producers Assoc. Nova Scotia

3. Truro farmers' market

4. Avery's farmers' market

5. Farmers Cooperative / Agropur dairy

6. Suppliers (machinery, feed, seed, etc.)

7. Glenwood Drive Community Garden

8. The Marshlands (agricultural floodplain)

site of community garden

9. Brookside Co-op Abattoir

10. Farm fair

11. Atlantic Stockyards

12. Upper Brook Sheep Farm

13. Wastewater Treatment Plant

14. Clifton Agricultural District

Map of the site in relation to the agricultural network of Truro, Nova Scotia; data from Google Maps.



Agricultural land use in and around Truro, Nova Scotia.

- (1) Cobequid Bay from Old Barns
- (2) Acadian dykes in Lower Truro
- (3) Farm fair in Onslow
- (4) Corn field next to Stanfield's Clothing factory in downtown Truro

The uplands portion of the site is characterized by rolling contours of agricultural fields and pastures which provide views towards Cobequid Bay, the Salmon River and the town of Truro. The site includes watercourses, wetlands and riparian zones, as well as the Ridgewood Golf Course. This hummocky terrain is characterized by the related 'Truro Association' and 'Woodville Association' soils, both of which are highly productive under good management. The Woodville soils, found only in the highest regions of the site, have a higher clay content which produces a poorer drainage capacity, while the Truro soils are sandy in comparison, which permits good drainage but also engenders a susceptibility to erosion.³⁷

Truro, like many other coastal areas of Nova Scotia, benefits from milder winters, cooler summers and longer frost-free periods compared to interior locations as a result of the moderating effects of the ocean. The extended growing season runs from late April until the end of October, and is comparable in range and temperatures to that of the Annapolis Valley.³⁸ The prevailing wind in the area is from the west-southwest during the summer season and from the west during the winter; however, as with the rest of the Atlantic coast, periodic winter storms bring strong winds from the northeast.³⁹ The summer season sees the lowest precipitation of the year, while highest rainfall occurs in the fall and highest overall precipitation is seen during the winter months. The resulting meltwater can produce wet soil conditions during the spring, which otherwise sees only moderate precipitation.⁴⁰

The site is partially bounded by suburban development. A commercial/light industrial zone and the Truro Heights Road residential subdivision frame the eastern boundary, while the Kent Road residential subdivision bisects the productive land of the site. In effect, one half of the site spills into the natural and agricultural landscapes of Cobequid Bay, while the other half is largely enclosed by a built landscape. The population of the neighbouring subdivisions, based upon a count of dwellings and the 2011 census, is approximately 600 to 700 residents.⁴¹

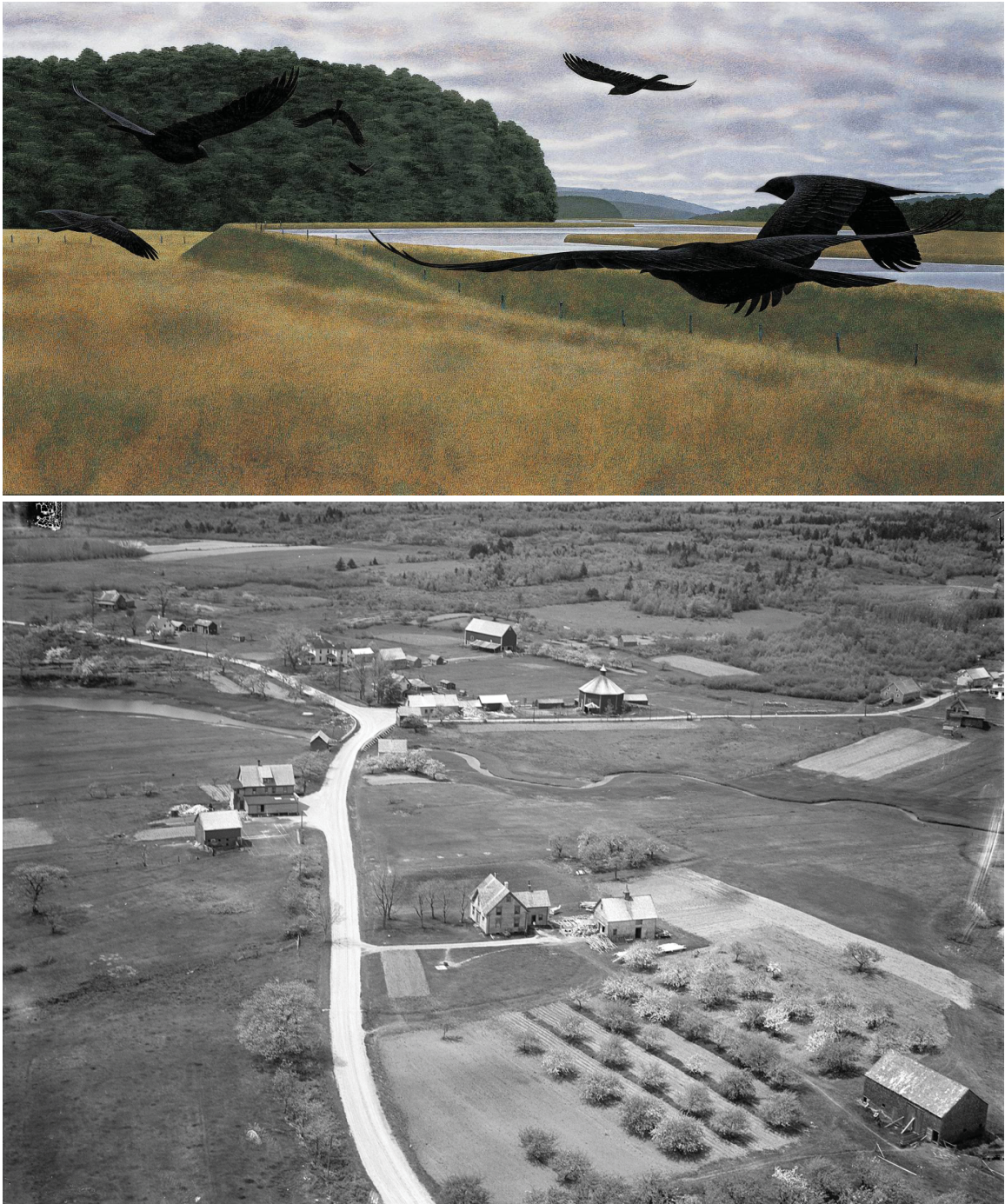
37 Webb *et al.*, "Soils of Colchester County, Nova Scotia," 66 and 71.

38 *Ibid.*, 12.

39 Windfinder, "Wind & weather statistics Debert/Truro," accessed November 13, 2013, http://www.windfinder.com/windstatistics/debert_truro.

40 Environment Canada, "Canadian Climate Normals 1971-2000 Station Data," accessed November 13, 2013, http://climate.weather.gc.ca/climate_normals/index_e.html.

41 Statistics Canada, "Census Profile: Truro," 2011 Census.



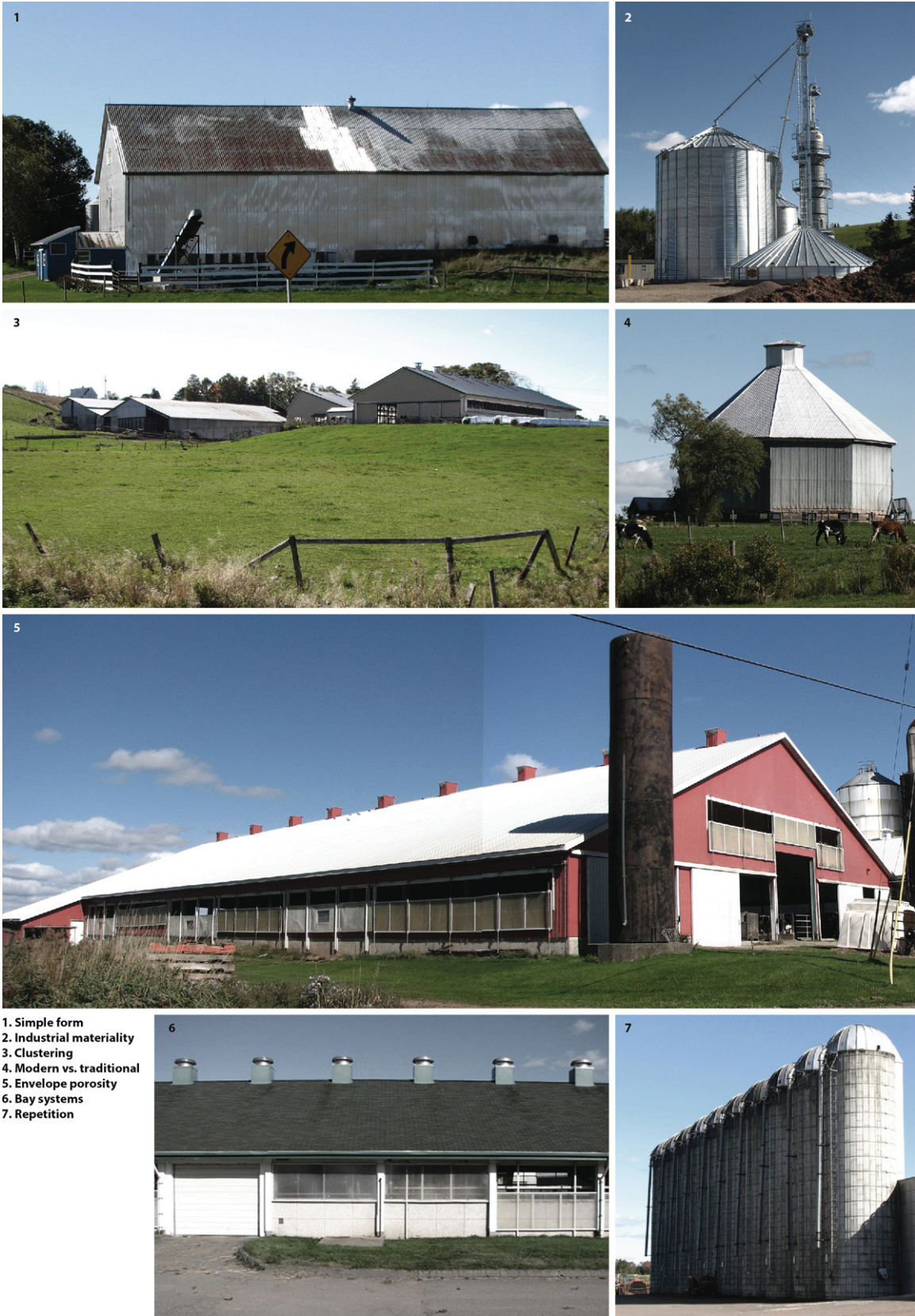
Found site potential.

Top: Alex Colville, *Seven Crows*, 1980, illustrating the Acadian dykes and tidal rivers of Nova Scotia; from the Chronicle Herald.

Bottom: Richard McCully, "Farms and Round Barn (Old Barns, Nova Scotia)," aerial photograph, 1931; From the Nova Scotia Virtual Archives, McCully Collection, illustrating vernacular architecture and clustering. The octagonal barn still exists at the date of this study.



Tidal ecology at Lower Truro, Nova Scotia; Salmon River (left) and salt marsh (right).



Study of traditional and contemporary farm building vernacular, in Lower Truro / Old Barns (1-4), Clifton (5), and the Dalhousie Agriculture campus (6, 7). Nova Scotia.

Description of Program

Sheep Farming

The thesis platform is a proposed sheep farm on existing agricultural land in Lower Truro, Nova Scotia. The program focuses on all the three outputs of sheep farming: lamb meat, wool, and dairy. Sheep farming was selected in response to the productive potential of the site and for its social potential (for public interaction). The climate, soil and topography of the region are naturally suited to pastureland and forage production.⁴² For example, grazing the steeper slopes of the site offers greater resistance to erosion (if managed responsibly) compared to a regiment of crops, largely because groundcover is never removed and heavy machinery is not required. Grazing the lower floodplains also offers advantages over crops, notably in the mobility of the productive asset (discussed in more detail in Chapter 2). Furthermore, unlike orchards and commodity crops, pastures and forage production do not require herbicide or pesticide spraying, which could otherwise be problematic for the surrounding residences.

A sheep farming program is supported by a network of organizations and precedent farms across Nova Scotia, including Lismore Sheep Farm (River John), Brook Ridge (Antigonish), Ross Farm (New Ross), Gaspereau Valley Fibres (Annapolis Valley), Bellemeade Farm (Mabou) and Wandering Shepherd Cheese/Fearann Kisha (Cape Breton). Collectively, these farms represent specialism in sheep breeding, wool products, lamb meat and dairy. As mentioned, Truro and its surrounding area is home to an extensive agricultural infrastructure, some of which is tailored for sheep farming. This includes the Dalhousie Agriculture Campus (home to the Ruminant Animal Centre, a sheep breeding program, the Veterinary School, Organic Agriculture Centre of Canada, and the Chef's Garden, a demonstration organic farm), the Perennia Center and AgraPoint (authors of the Maritime Pasture Manual), the Northumberland Co-operative (marketing, sales and slaughter), the Truro and Avery's farmers' markets, the Atlantic Stockyards (livestock auction), and Upperbrook Farm (a sustainable sheep farm and wool processor in Central North River).

⁴² Nova Scotia Department of Agriculture, *Sheep Industry*, accessed November 20, 2013, <http://growingnovascotia.ca/opportunity-profiles/sheep-industry>.

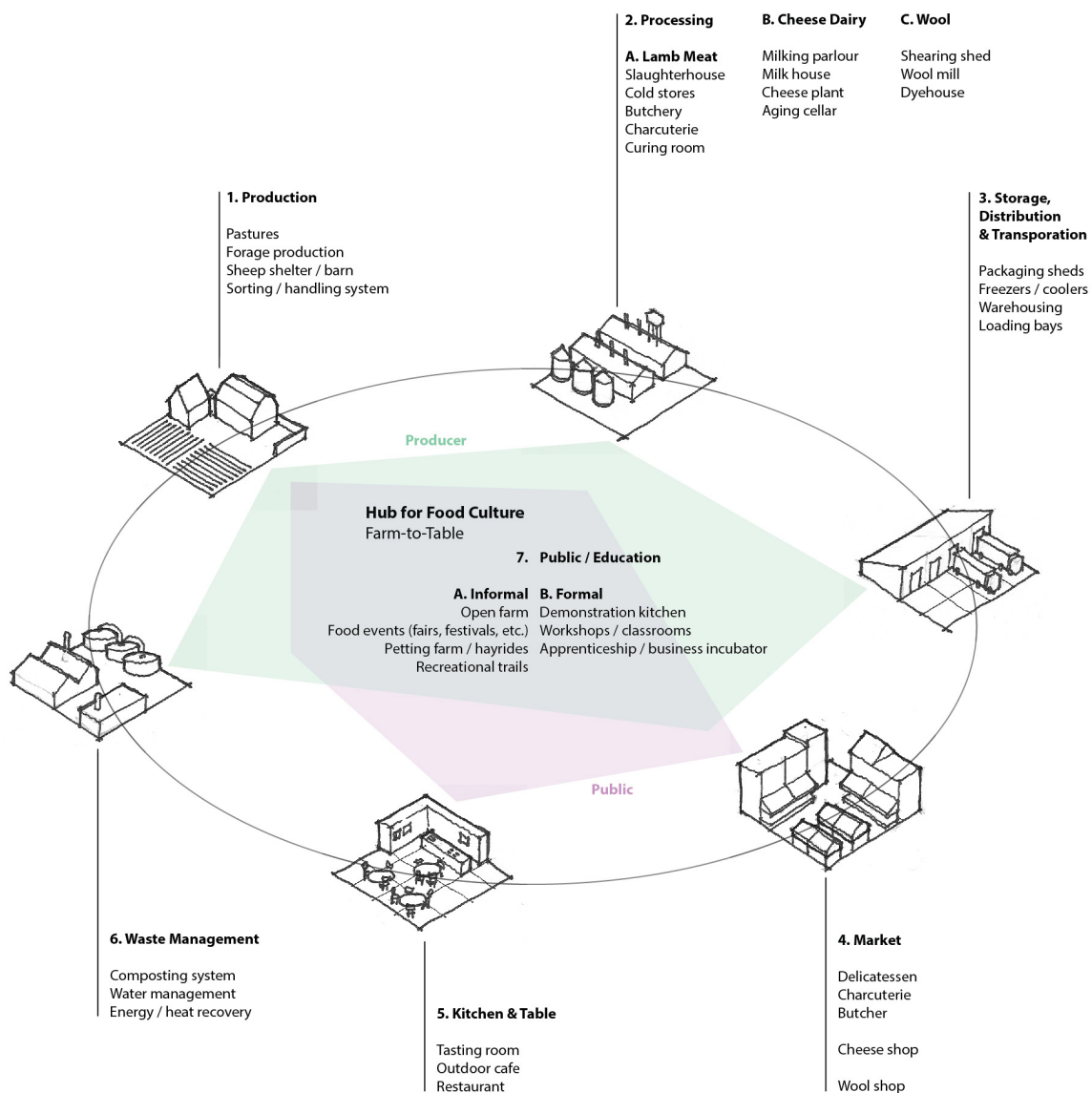


Diagram of the program for the proposed sheep farm, illustrating public and producer engagement with the complete food cycle.

There is also a potential within sheep farming to engage with the public through landscape, architecture and activity. Firstly, three different sheep products offer separate occasions to express manufacturing processes. Secondly, well-maintained pastures can provide views comparable to golf courses, but with animal activity.⁴³ Given the docile nature of sheep, there are also opportunities for direct interaction with the animals (farm fairs and petting zoo) and to use the flock to graze public grounds, as has been previously implemented in Curitiba, Brazil.⁴⁴

'Farm-to-Table' Model

The program of the proposed sheep farm integrates and expresses the complete cycle of the food industry—(a) production, (b) processing, (c) storage and distribution, (d) market, (e) cooking, eating & celebration of food, and (f) waste recycling—and includes all three productive outputs of sheep farming: lamb meat, wool, and dairy. Having all of these elements of the food cycle on one site, in the 'farm-to-table' model, enables the public constituents (that is, grocery shoppers, agri-tourists, local residents, and other farmers) to engage with the different aspects of food culture. The thesis project incorporates the program of the complete food cycle into a master plan, while building design focuses on the complex of processing facilities for meat, wool and cheese, and complementary public elements of cafe/tasting room and market.

A precedent for the farm-to-table model is the Stone Barns Center in Pocantico Hills, New York (see Appendix III for more information). This center includes an extensive and open productive landscape, with vegetable fields, herb and terrace gardens, livestock pastures, and year-round greenhouses, which both supplies the seasonal restaurant on-site and provides a venue for public education (on, for example, gardening, seed saving and composting), including demonstrations, workshops, school programs and teacher training.

⁴³ Ladner, *The Urban Food Revolution*, 56.

⁴⁴ Global Footprint Network, "Measuring the Footprint of the 'World's Greenest City,'" last modified July 12, 2010, http://www.footprintnetwork.org/en/index.php/GFN/blog/measuring_the_footprint_of_the_worlds_greenest_city.

Architectural Characteristics

Process

An analogy for the ‘farm-to-table’ approach is the winery archetype, which connects the public to the different stages of food processing (in this case, of the grape) and the productive landscape (vineyard). One consistent theme across winery designs is the use of the sequential processing of the grape as a fundamental ordering principle for internal organization,⁴⁵ exemplified by the linear spatial structure of Bodegas Protos (Rogers Stirk Harbor + Partners). In the case of the Bodegas Portia/Faustino winery (Foster + Partners),⁴⁶ the public is placed in the center of the process, while at Bodegas Baigorri (Inaki Aspiazu Iza)⁴⁷ the path of the public coincides with the path of the grape. This approach can be translated to organize the clustering patterns and internal structures of processing building on the sheep farm, in order to both optimize process and choreograph the public experience.

Landscape

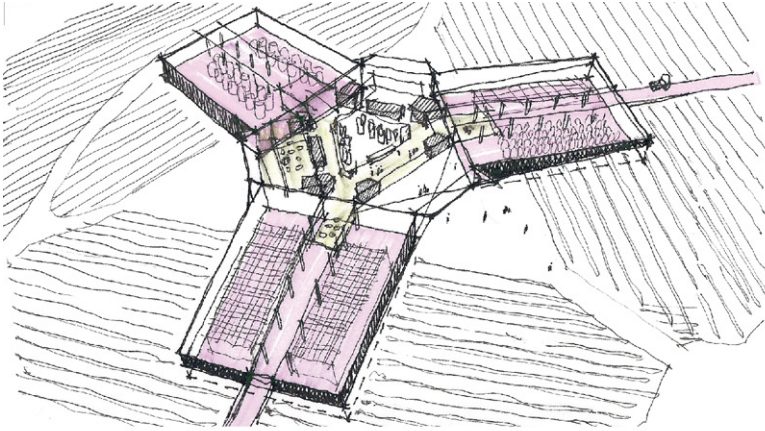
The second theme in winery design is the relationship to the productive landscape. This is, in a sense, an extension of the first theme, as the landscape represents the initial step in any agricultural process. The relationship to the external vineyard is often articulated in terms of siting, plan (as is the case for Herzog & deMeuron’s Dominus winery⁴⁸) and section (for example, in Bodegas Baigorri and Faustino). A sheep farm is similarly functionally linked to the productive landscape, in terms of pasture, forage, and ecology. The processing program also suggests an architectural relationship with the landscape in respect to grade, as a number of spaces, specifically, the cheese cave, meat dry-curing cellars and cold stores, can benefit from the cooler temperature and humidity found below grade.

45 Heinz-Gert Woschek, Denis Duhme and Katrin Friederichs, *Wine and Architecture* (Munich: Edition Detail, 2012), 20-23.

46 Woschek, Duhme and Friederichs, *Wine and Architecture*, 30-33.

47 Sean Stanwick and Loraine Fowlow, *Wine by Design* (Chichester, England: Wiley, 2006), 114-9.

48 Stanwick and Fowlow, *Wine by Design*, 44-7.



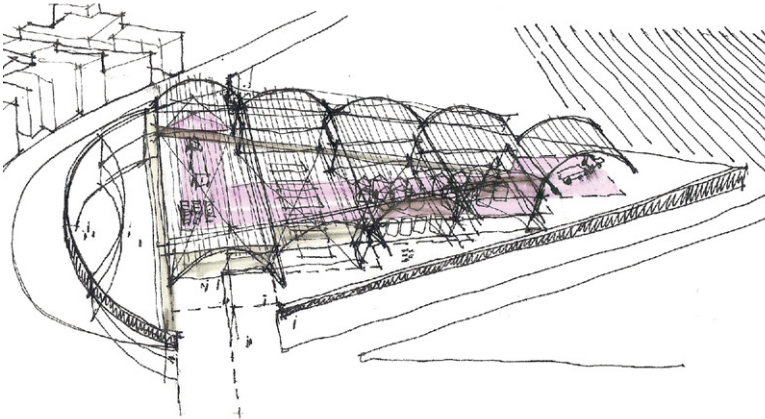
Case Study: **Faustino Winery (Bodegas Portia)**

Location: Burgos, Spain

Project date: 2004-2010

Architect: **Foster + Partners**

Source drawing for interpretive drawing from open-buildings.com; data from Woschek, Duhme & Friedrichs, *Wine and Architecture*.



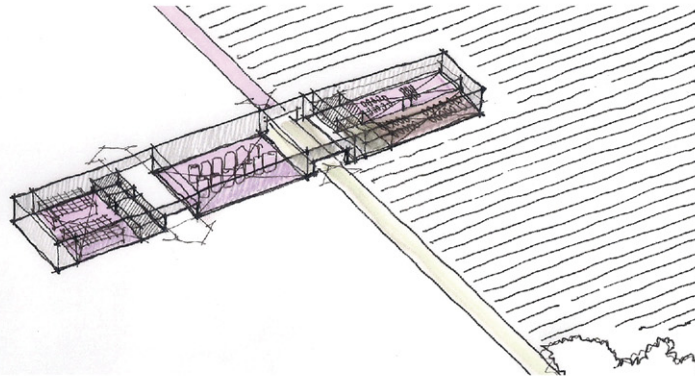
Case Study: **Bodegas Protos**

Location: Peñafiel, Spain

Project date: 2004-2008

Architect: **Rogers Stirk Harbour + Partners**

Source drawing and data for interpretive drawing from Richard Rogers Partnership.



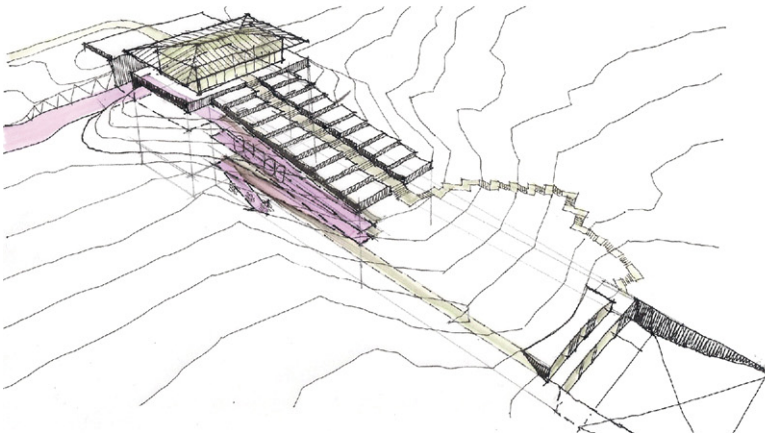
Case Study: **Dominus Winery**

Location: Napa Valley, California

Project date: 1997

Architect: **Herzog & deMeuron**

Data for interpretive drawing from Stanwick and Fowlow, *Wine by Design*.



Case Study: **Bodegas Baigorri**

Location: Samaniego, Spain

Project date: 1997

Architect: **Estudio de Arquitectura
Iñaki Aspiazua Iza**

Source model and data for interpretive drawing from Stanwick and Fowlow, *Wine by Design*.

Legend:

- Path of the grape
- Path of the public

Analytical drawings of process and procession in the winery archetype.

Transparency

The social issue of transparency relates to the architectural characteristics of public versus private, envelope, orientation and porosity. The thesis seeks to make extrovert those processes which are typically considered “back of house,” so that they may be observed and, in some cases, experienced by the public. Certain processing steps, however, lend themselves to public engagement more than others. Food tasting, on-site workshops, markets, and open pastures, for example, allow for a degree of direct experience. Shearing and cheese making, on the other hand, are processes which are largely limited to passive observation, due to considerations over public safety and food contamination, respectively. Different degrees of visibility may be architecturally manipulated to facilitate grades of engagement; from exclusion to passive observation to experience and active participation.

Lamb slaughter represents a uniquely sensitive issue. While the inherently violent nature of the process suggests that it should be screened from the general public, there is also a case to be made for the “glass abattoir.” Food journalist Michael Pollen and animal scientist Dr. Temple Grandin, a leading consultant on abattoir design, have both argued that the process of slaughter should be made more visible to encourage improved livestock treatment. A precedent for such a transparent abattoir exists in Lorentz Meats of Cannon Falls, Minnesota, which allows customers to directly view the kill floor.⁴⁹

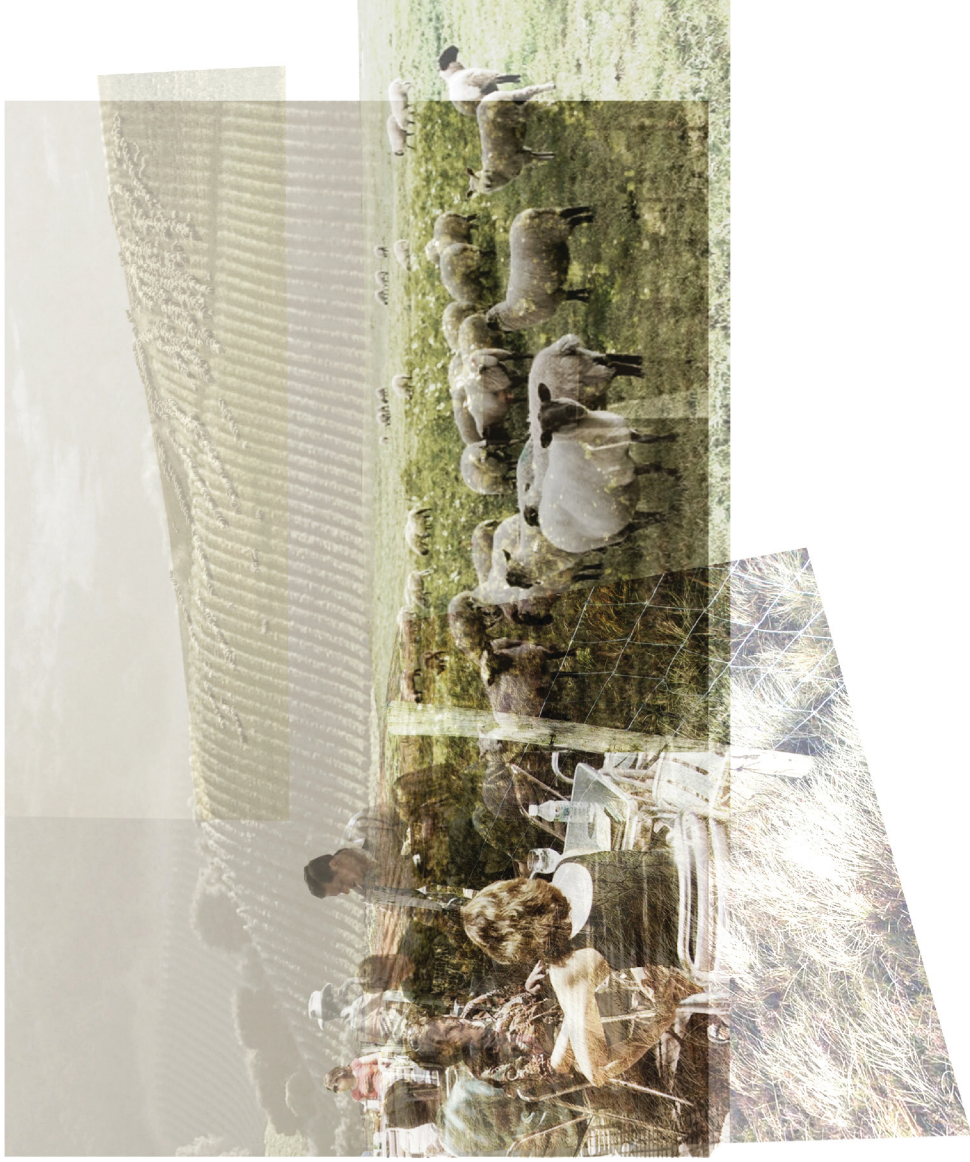
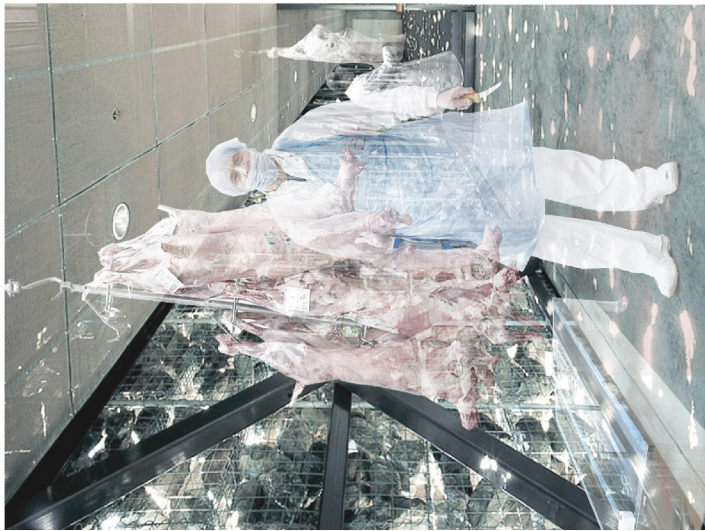
Pragmatism and Vernacular

Agrarian architecture is rooted in simplicity, durability, and ease of maintenance. Design takes on the functionalist perspective of the farmer, seeking to facilitate farm processes and to attain maximum effect through minimal means. Local vernacular includes both modern and traditional variants of stereotomic earthworks—concrete manure bins and silos, and Acadian dykes, respectively—and of lightweight tectonic structures—metal-clad pole barns and wood-framed sheds (such as the octagonal barn of the adjacent community of Old Barns).

49 Michael Pollan, *The Omnivore's Dilemma: A Natural History of Four Meals* (New York: Penguin Press, 2006), 332; Melissa Pasanen, “For Temple Grandin, changing slaughterhouses meant long-term commitment,” *Burlington Free Press*, January 13, 2012.



Early concept for a sheep 'farm-to-table' program based upon the winery archetype, illustrating the shearing shed and cheese cave; image of Jackson-Triggs Winery by KPMB Architects (left) from Finn O'Hara; image of Antinori Winery by Archea Associati (right) from Pietro Savorelli.



Early concept for a sheep 'farm-to-table' program based upon the winery archetype, illustrating a slaughterhouse and public cafe overlooking pastures; image of the Herzog & deMeuron's Dominus Winery (left) from Henry Plummer, *The Architecture of Natural Light*.

CHAPTER 2: DESIGN

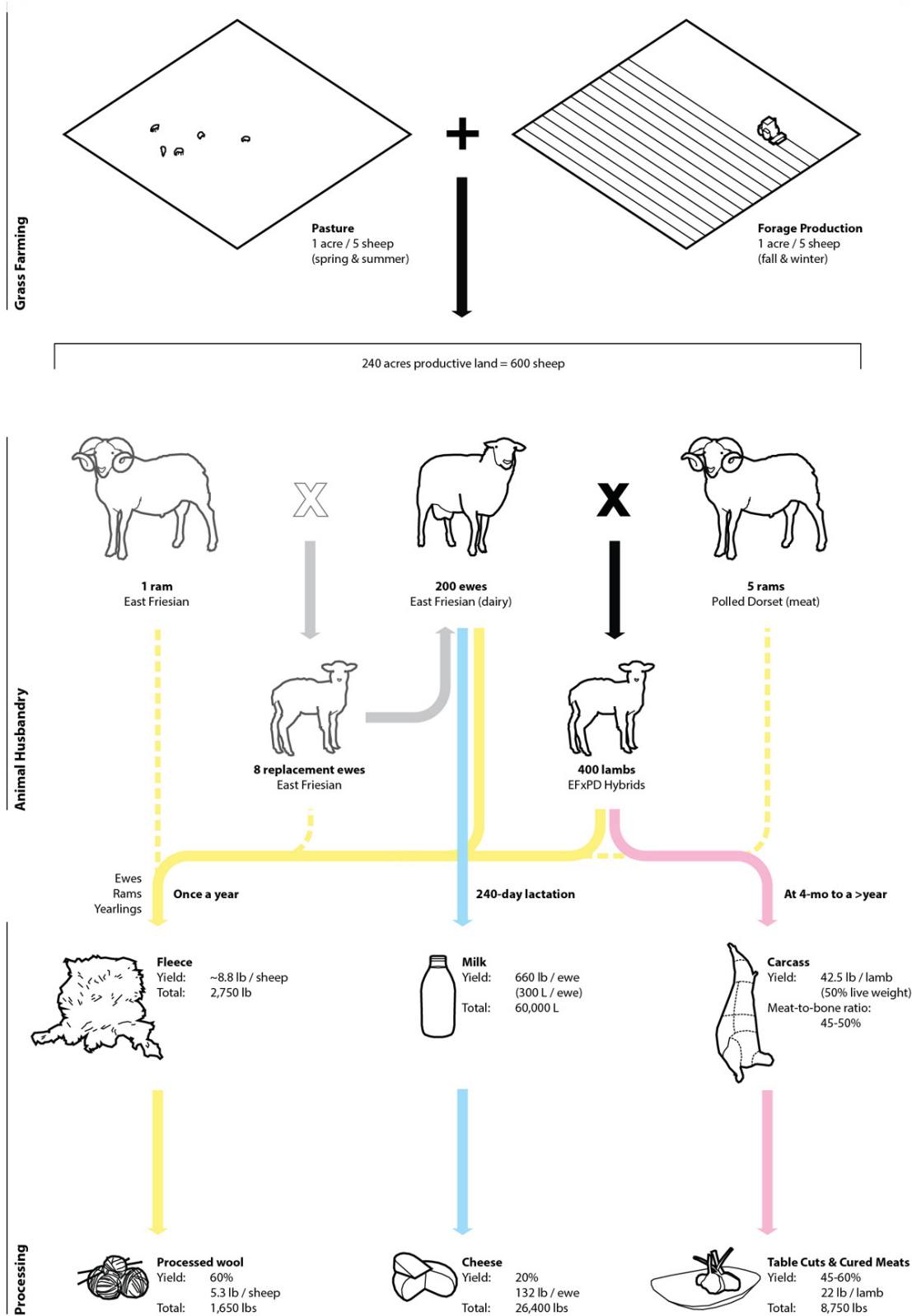
Framework

The scale of the building designs is calibrated by the maximum number of sheep which can be sustained by the site and by the subsequent output metrics for wool, cheese and lamb meat processing. These outputs include both the final product and the waste/by-product associated with each step of the sequence. For this specific site, the agricultural land base (>240 acres) is large enough to support a flock of approximately 600 sheep self-sufficiently, year-round. Provided that ewes lamb at a rate of approximately 2 lambs per year, this allows for 200 ewes and 400 lambs. The animal husbandry strategy—developed in consultation with Ron Muise (Wandering Shepherd Cheese / Fearann Kisha), a sheep farmer, cheese artisan and the first commercial sheep cheese producer in Nova Scotia—involves crossing a dairy maternal line with a dual-purpose (meat and wool) terminal sire to produce a hybrid lamb; this simple model provides a flock of ewes with great milk yields and lambs with improved meat quality/yield (for example, dress-out meat-to-bone ratio) and wool production.⁵⁰

Although a detailed resource management plan for water, energy and waste is outside of the scope of this thesis, preliminary considerations were made for each of these three issues. For water, supply for pastures and buildings is provided via on-site dug wells and/or streams, while wastewater treatment can be conveniently handled by the nearby wastewater treatment plant, via the municipal sewage system of the bisecting subdivision. The strategy for organic waste involves a composting system which converts manure, animal mortalities (dead stock), slaughterhouse offal and other organic residuals into fertilizer (soil amendment) for pastures, greenhouse and garden plots. Bin composting, the simplest method of in-vessel composting, is employed to contain odours and minimize potential contamination of water sources.⁵¹ In regards to energy, passive ventilation and temperature regulation of buildings is adopted where possible, while excess heat recovered from the composting process is used to warm the greenhouse.

⁵⁰ Ron Muise (Fearann Kisha/Wandering Shepherd Cheese), e-mails to author, Dec. 16 & Feb. 8, 2013.

⁵¹ R.V. Misra, R.N. Roy and H. Hiraoka, *On-Farm Composting Methods* (Rome: Food and Agriculture Organization of the United Nations, 2003), 24.



Animal husbandry strategy illustrating pasture and forage base, breeds, and metrics of productivity. The breeding model was developed in conjunction with Ron Muise of Fearann Kisha/Wandering Shepherd Cheese (e-mails to author, February 8-9, 2014).

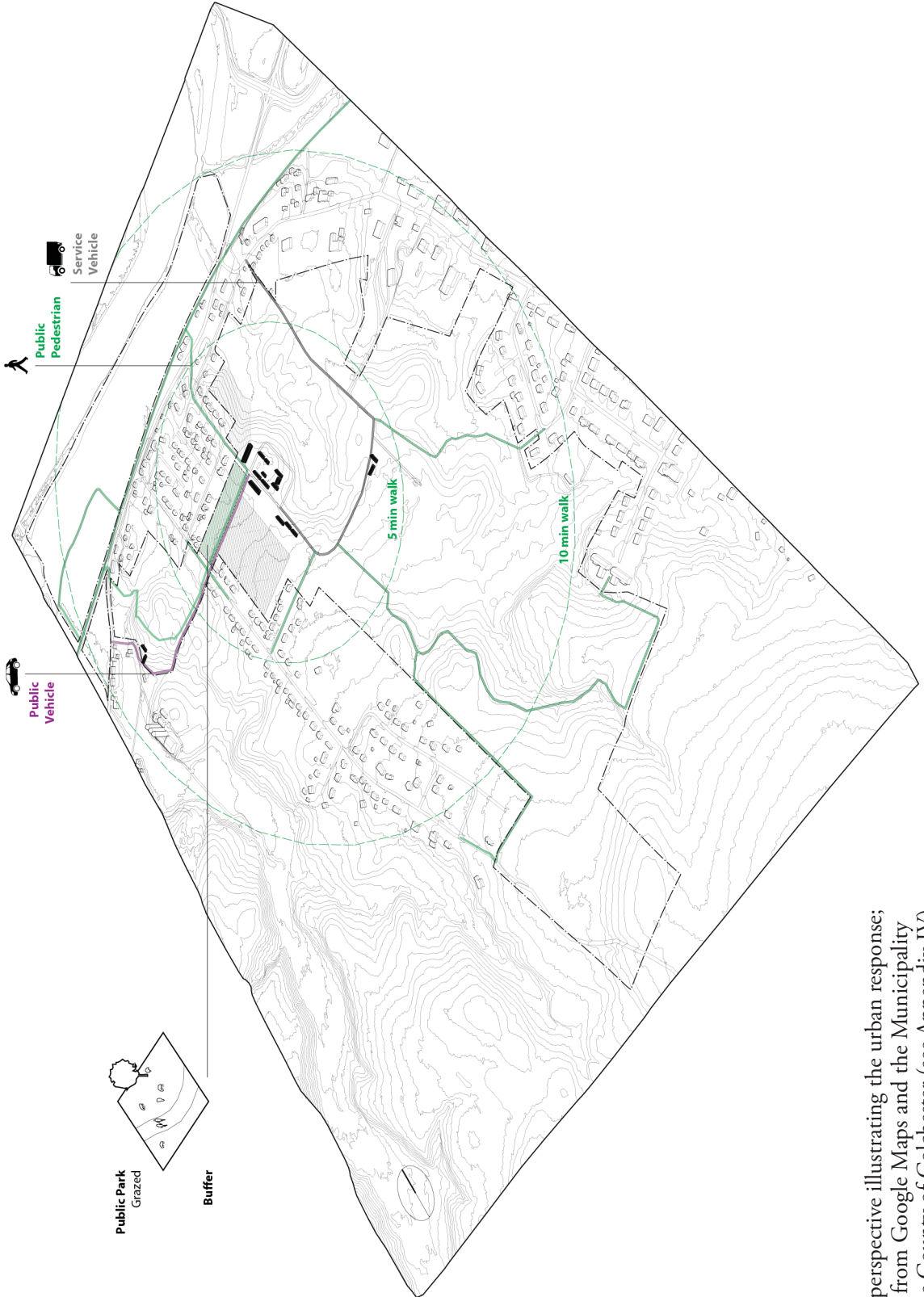
Landscape

Urban Response

The surrounding suburban fabric represents the constituency of local residents and the urban public as a whole. The project is therefore situated in a position of visibility. It establishes itself as an extension of the urban grid and provides a public plaza for the subdivision. Engagement with the residential context, however, must be balanced with spatial buffering, which helps minimize any conflict resulting from the noise, odour and pollution (water and air) which may be periodically emitted from a livestock farm. The complex is therefore positioned downwind of the immediate residences, and separated by large buffer spaces, including forage fields, public park and woodlands. The composting and manure storage facility is further isolated from both the main complex and neighbouring lots, as per provincial guidelines and regulations.⁵² It should be noted that, even with these spatial buffers, the agricultural and industrial program of the scheme would require re-zoning or zoning exemption in order to comply with current municipal regulations. Although the siting of the program conflicts with planning convention, it is fundamental to the very intent of the thesis project.

The pasture landscape is largely open to the public, with laneways connecting paddocks doubling as walking trails. This allows pedestrians to explore the landscape, connect across the site (*i.e.* walk from Kent Road to Truro Heights Road and/or the Cobequid trail) and access the project complex from a variety of directions.

52 Nova Scotia Department of Agriculture, *Environmental Regulations Handbook for Nova Scotia Agriculture* (2nd Edition, 2004), Section 6.19.4 and Appendix 2; Nova Scotia Department of Agriculture, *Manure Management Guidelines* (2006), 5-6.



Site perspective illustrating the urban response; data from Google Maps and the Municipality of the County of Colchester (see Appendix IV).

Pasture and Ecology

Of the available agricultural land, approximately half is dedicated to pasture and half to support forage production. Sheep graze the pastures during the spring, summer and fall, while forage fields provide feed stockpiles for the fall and the winter seasons.⁵³ The areas preferentially selected for pasture grazing include southern exposures, steep slopes, the floodplain and the golf course, leaving forage production to the remaining flatter uplands most resistant to erosion and water saturation during fall harvest. Areas not suitable for agriculture, notably the wetlands and riparian zones, serve to filter surface run-off and provide stormwater retention.

Grazing the floodplain provides a unique ecological opportunity. Dykelands and salt marshes can not only be grazed sustainably,⁵⁴ but sheep actually thrive on the coastal grasses of the saline *terroir* to produce a meat highly prized as a culinary delicacy. As a result, raising specialty “salt marsh lamb” is a common practice in France and the United Kingdom.⁵⁵ A second advantage is that the flock can retreat to higher ground under acute threat of flooding. Given the mobility of livestock, it is not necessary to make the dykeland edge static (*i.e.* landformed to resist flooding) as it is for horticulture. Drawing agricultural productivity through grazing makes it possible to revert part or all of the dykelands back to the native salt marsh form, in order to restore the coastal estuary ecosystem and to aid in flood control.

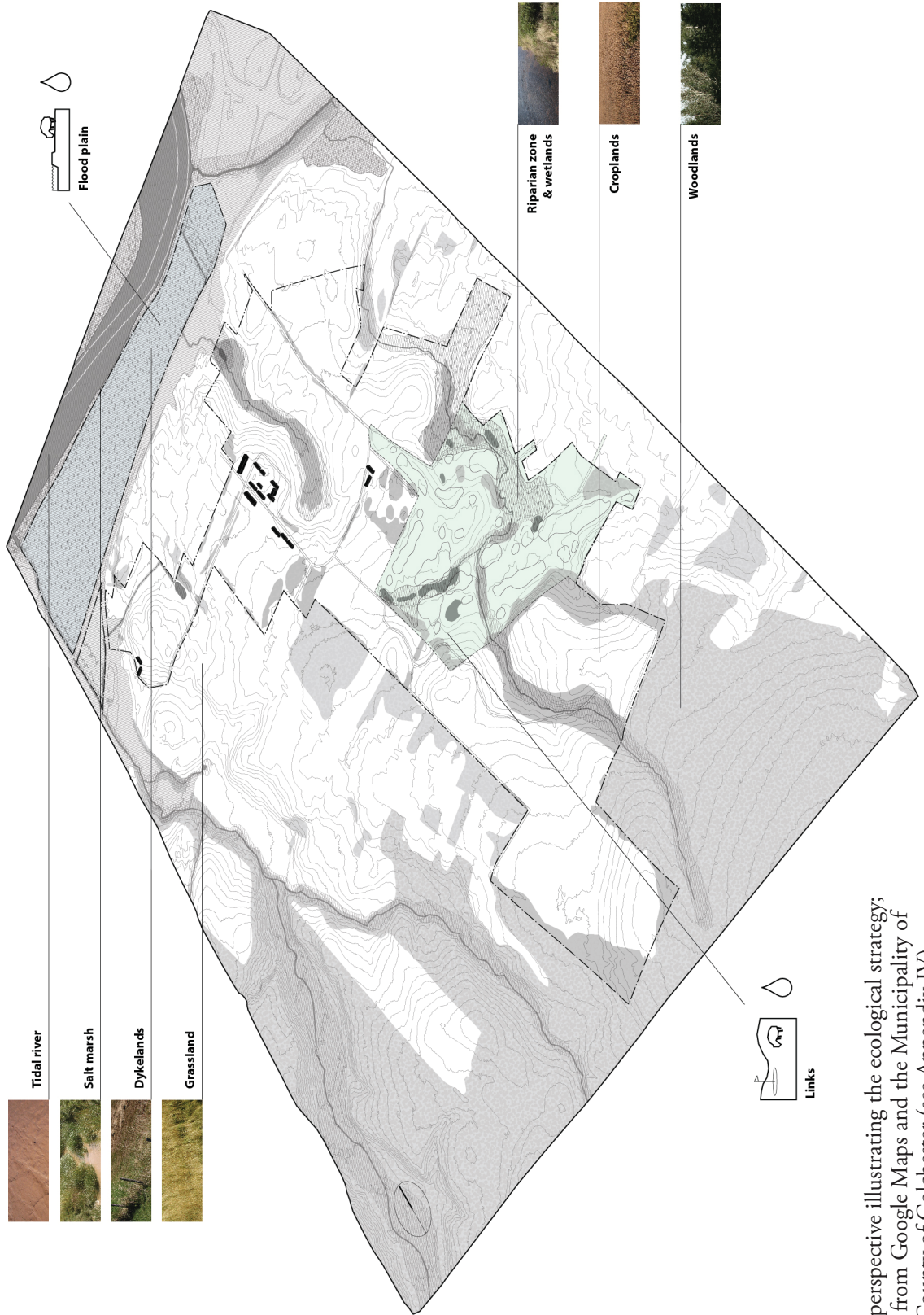
Using sheep to graze the golf course also adds ecological value to the landscape, while including a source of public recreation on the site. The sheep herd keeps the links (in particular, the roughs) well fertilized and nicely trimmed, and the golfers amused. There are historic and contemporary precedents for using sheep to freely graze “naturalized” golf courses, including Machrihandish Dunes in Scotland and the Lillooet Golf Course in British Columbia.⁵⁶ A similar strategy is used to graze the public park strip which serves the residential subdivision.

53 The Canadian Sheep Foundation, *Virtual Toolbox*, 65-9, accessed January 16, 2014, <http://cansheep.ca/cms/en/Resources/VTBox/VTBox.aspx>

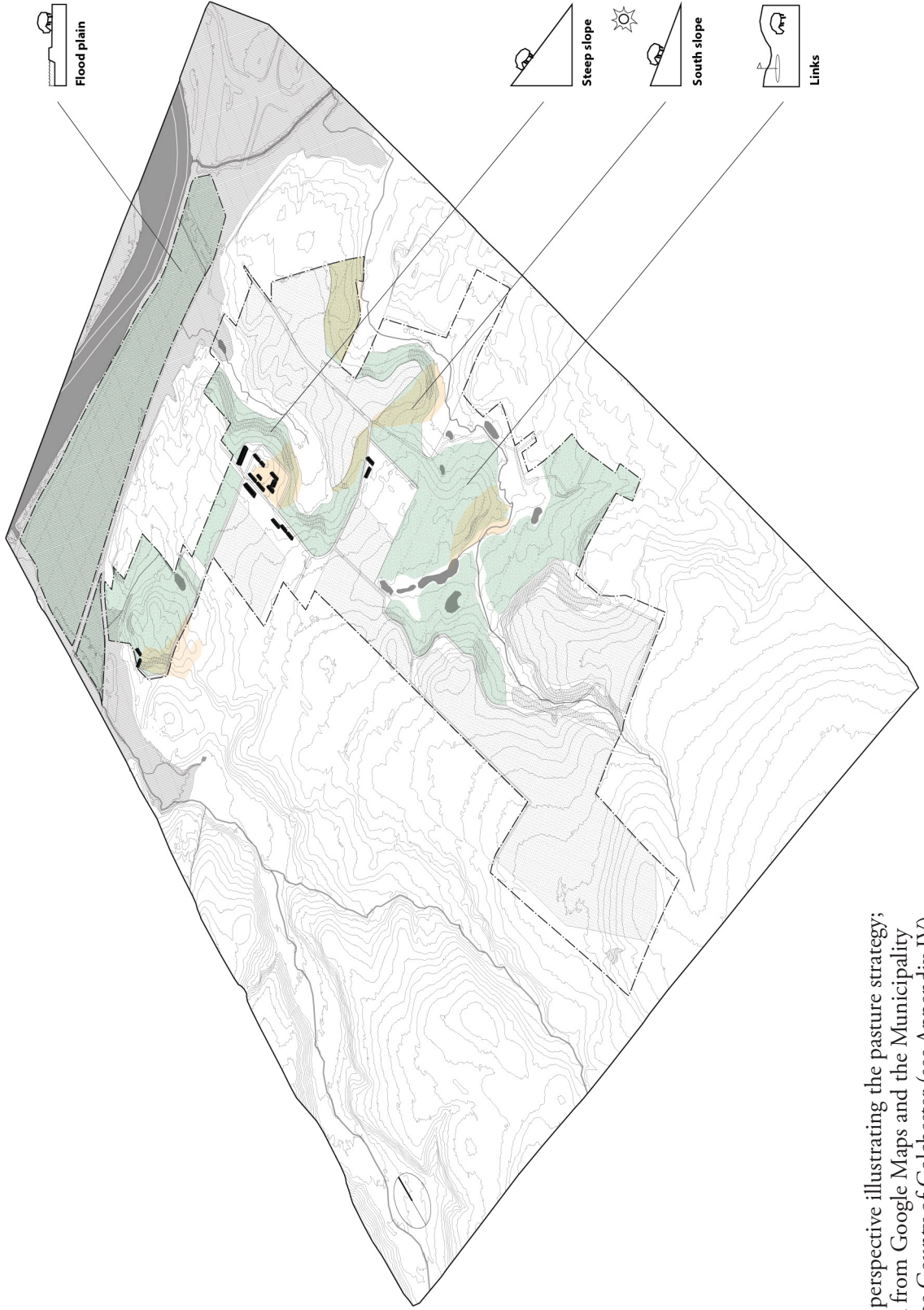
54 NSW Department of Primary Industries, “Grazing the Coastal Floodplain” (State of New South Wales, 2008), 3-6.

55 For examples, see Gower Salt Marsh Lamb, <http://www.gowersaltmarshlamb.co.uk/>, and Agneaux Pres-Sales du Mont Saint Michel, <http://www.presales-montsaintmichel.com/>.

56 Machrihanish Dunes, last modified 2014, <http://machrihanishdunes.com/golf/>; Lillooet Sheep Pasture Golf Course, last modified 2012, <http://www.lillooetgolf.com/>.



Site perspective illustrating the ecological strategy; data from Google Maps and the Municipality of the County of Colchester (see Appendix IV).



Site perspective illustrating the pasture strategy; data from Google Maps and the Municipality of the County of Colchester (see Appendix IV).

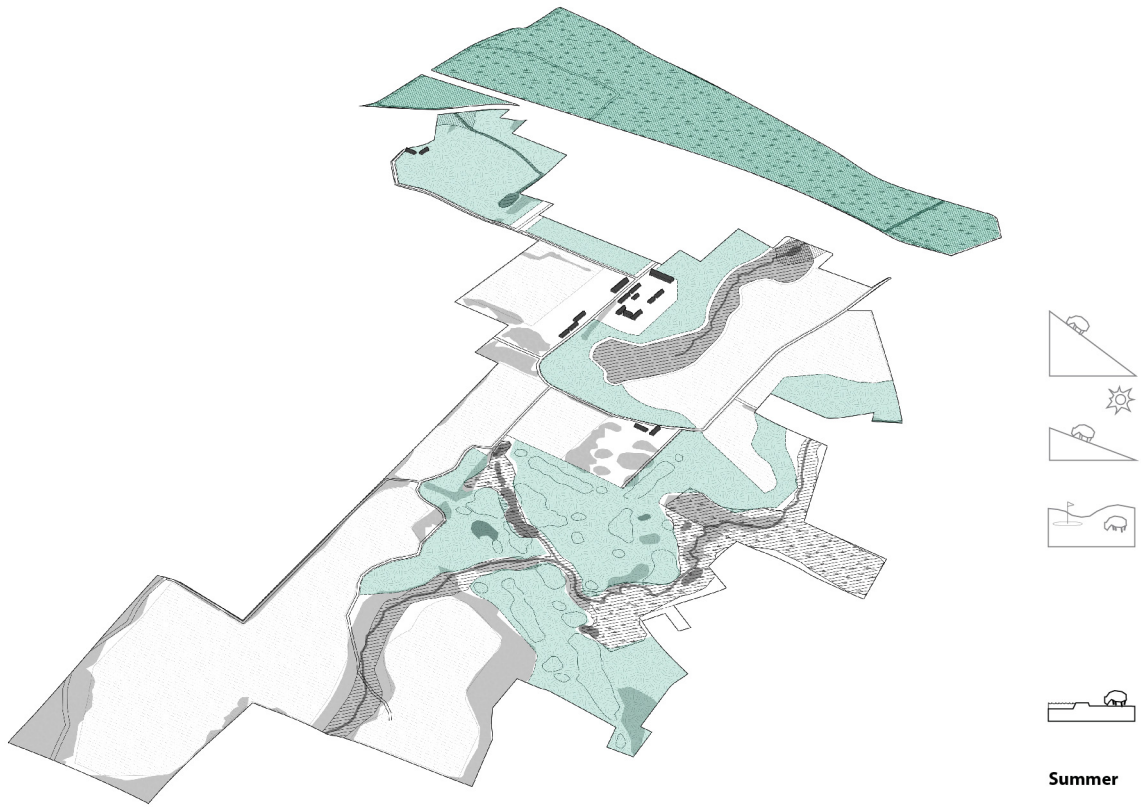
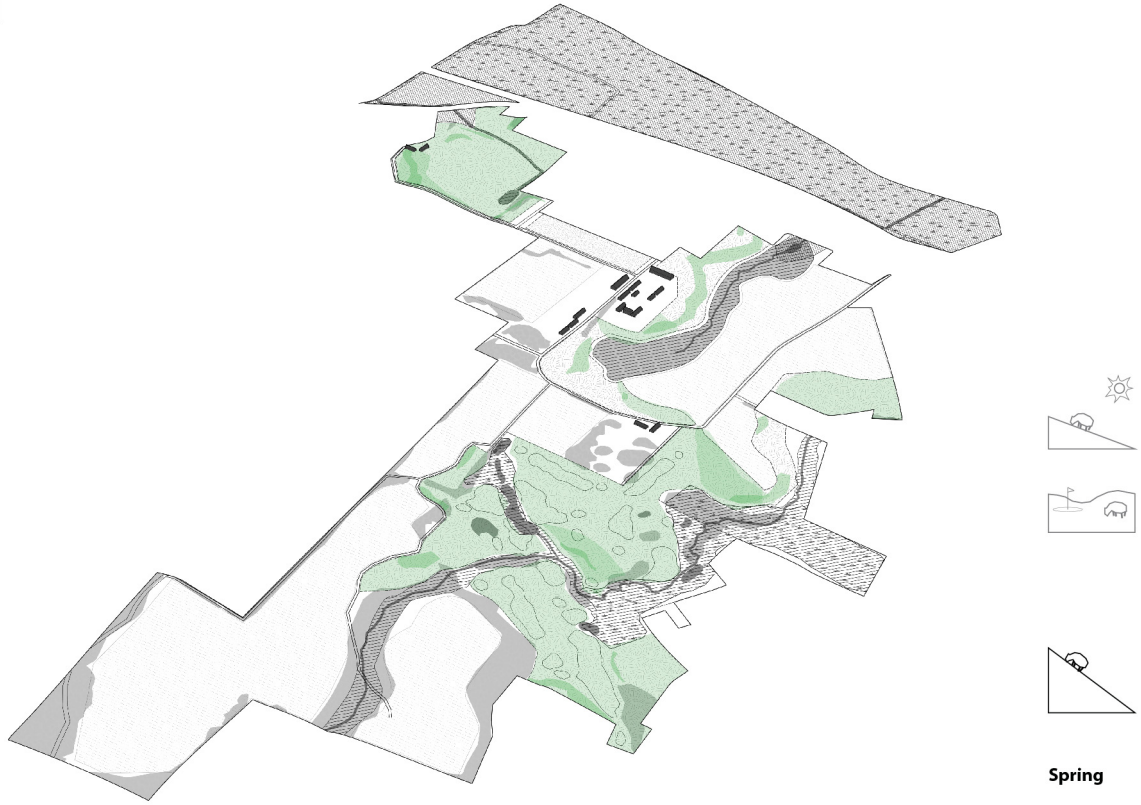
Season and Rotation

Pasture grazing is both rotational and seasonal in order to promote pasture fertility and ecological viability. Rotational grazing—though requiring more labor, complex management, and higher costs (for fencing and water supply)—allows for more uniform forage productivity, higher yields, more efficient manure management, and better weed and erosion control. A detailed fencing and water supply scheme is outside of the scope of this research, but would be necessary for flock and pasture management.

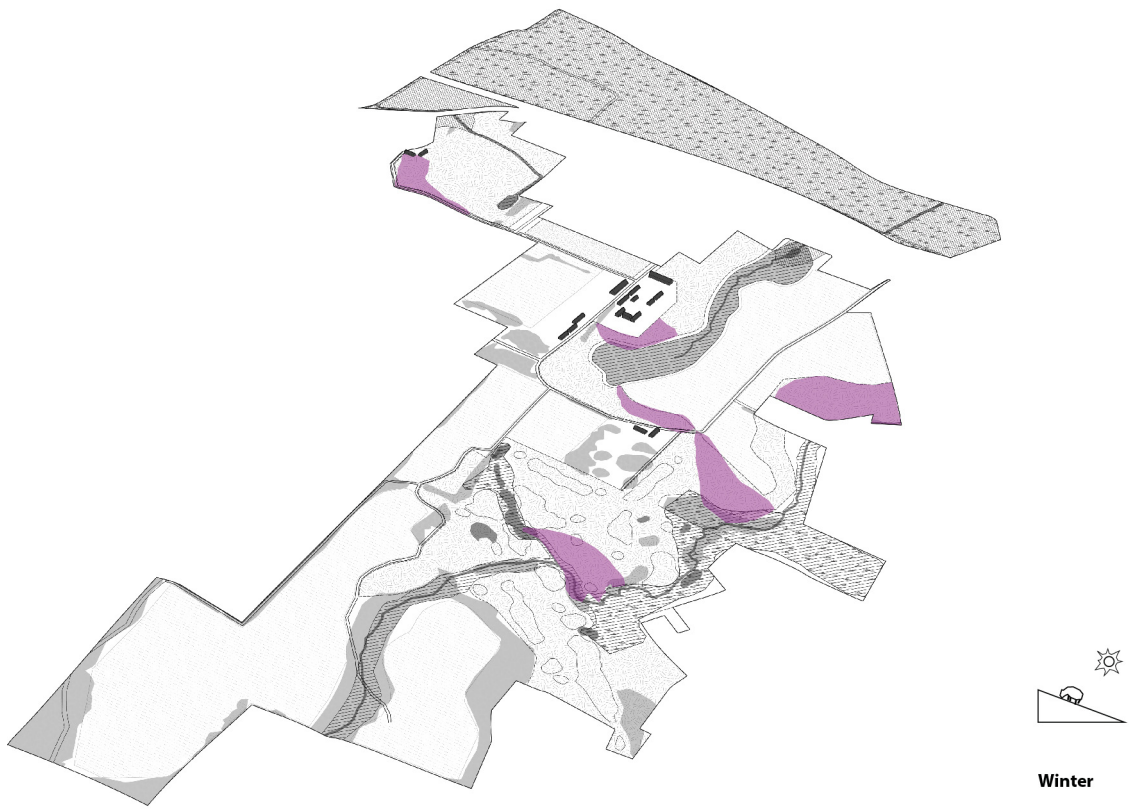
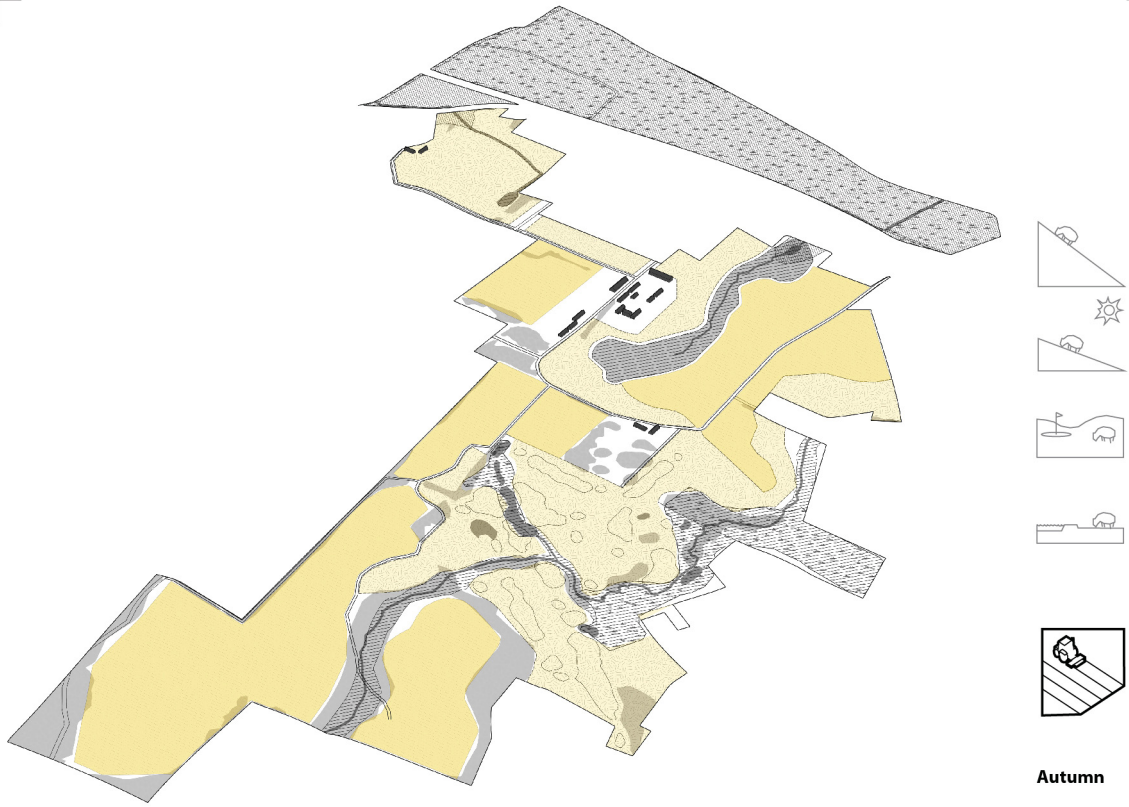
Under a traditional pasture rotation, small paddocks are worked for between several days and several weeks, depending on grass growth rates. Different paddocks are worked at different times of the year based upon sun exposure and the water drainage/saturation capacity of the soil and topography (for a comparable strategy in a different climate, see the Seasoned Pastures project in Appendix III).⁵⁷ The dykelands and salt marshes, for example, are subject to rutting and compaction during the wet periods of spring, late fall and after heavy rains, as a result of the low drainage potential of the terrain⁵⁸; consequently, grazing is restricted largely to the summer season. By late autumn the lowlands may be too wet to be sustainably grazed, but all other pastures must be employed to compensate for the declining growth rate of grasses. The stockpiling of forage following fall harvest allows the flock to be sustained through the late fall and winter season, during which grazing may otherwise be heavily restricted both by snow and the dormancy of grass growth. In the spring, the grass growth rate (and therefore paddock productivity) once again peaks; as such, the pasture rotation only requires a subset of the total pasturelands, and areas least saturated by meltwater and rains can be selectively targeted. In this manner, ecological stewardship is promoted through the careful choreography of landscape utility.

⁵⁷ AgraPoint, *Maritime Pasture Manual* (2009), 2-7, 20-26; http://www.perennia.ca/pasture_manual.php.

⁵⁸ Webb *et al.*, "Soils of Colchester County, Nova Scotia," 31.



Choreography of landscape use during the spring and summer.



Choreography of landscape use during the fall and winter.

Site Design

Distribution

While the thesis project incorporates the program of the complete food cycle into a master plan, the site design focuses on the central complex of barns, processing facilities, and public elements (cafe/tasting room and market). The centralization of the complex streamlines both animal management (in terms of shared sorting facilities, handling and access to pastures) and facility servicing (storage, equipment, dispatch, warehousing, and waste management). Furthermore, the densification of on-farm functions concentrates the activation of public courtyards and encourages the public to engage with the full range of the food cycle.

Peripheral buildings include the sheep barns, which double as shelters for flocks pastured on the flood plain and as gateway buildings for the west approach, and the composting facility and greenhouse to the south-east. While composting requires a significant buffer to minimize odour complaints and the risk of surface run-off contamination,⁵⁹ co-localization of the greenhouse allows the heat by-product of the composting process to fuel plant growth year-round.

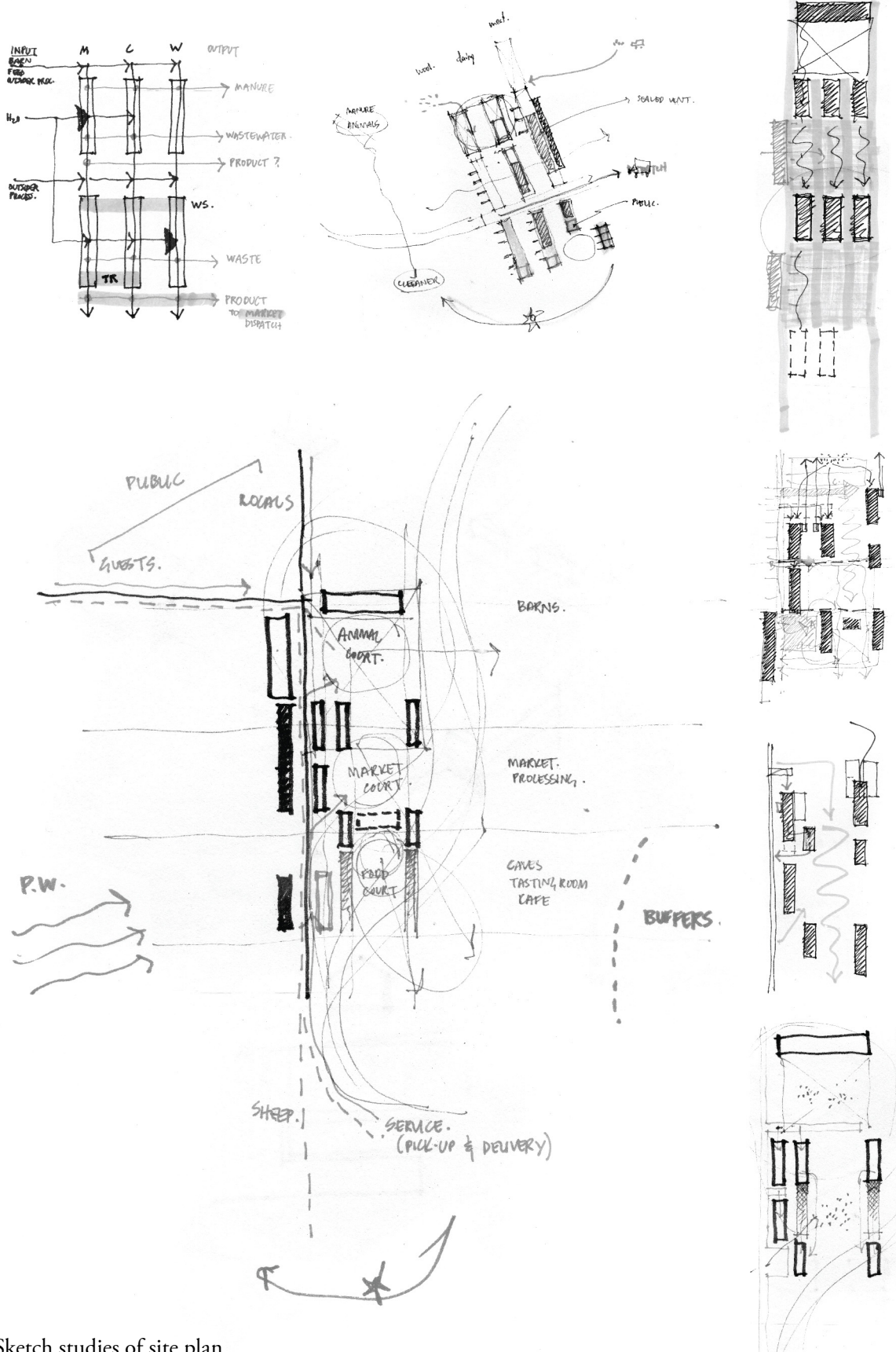
Topography

The siting of the complex on the rolling topography serves two purposes. First, the distribution of program on the hilltop supports sanitary surface run-off—away from the processing plants, public zones and the surrounding residential lots. Second, positioning processing and public facilities on the southern slope offers increased sun exposure to interior courtyards.

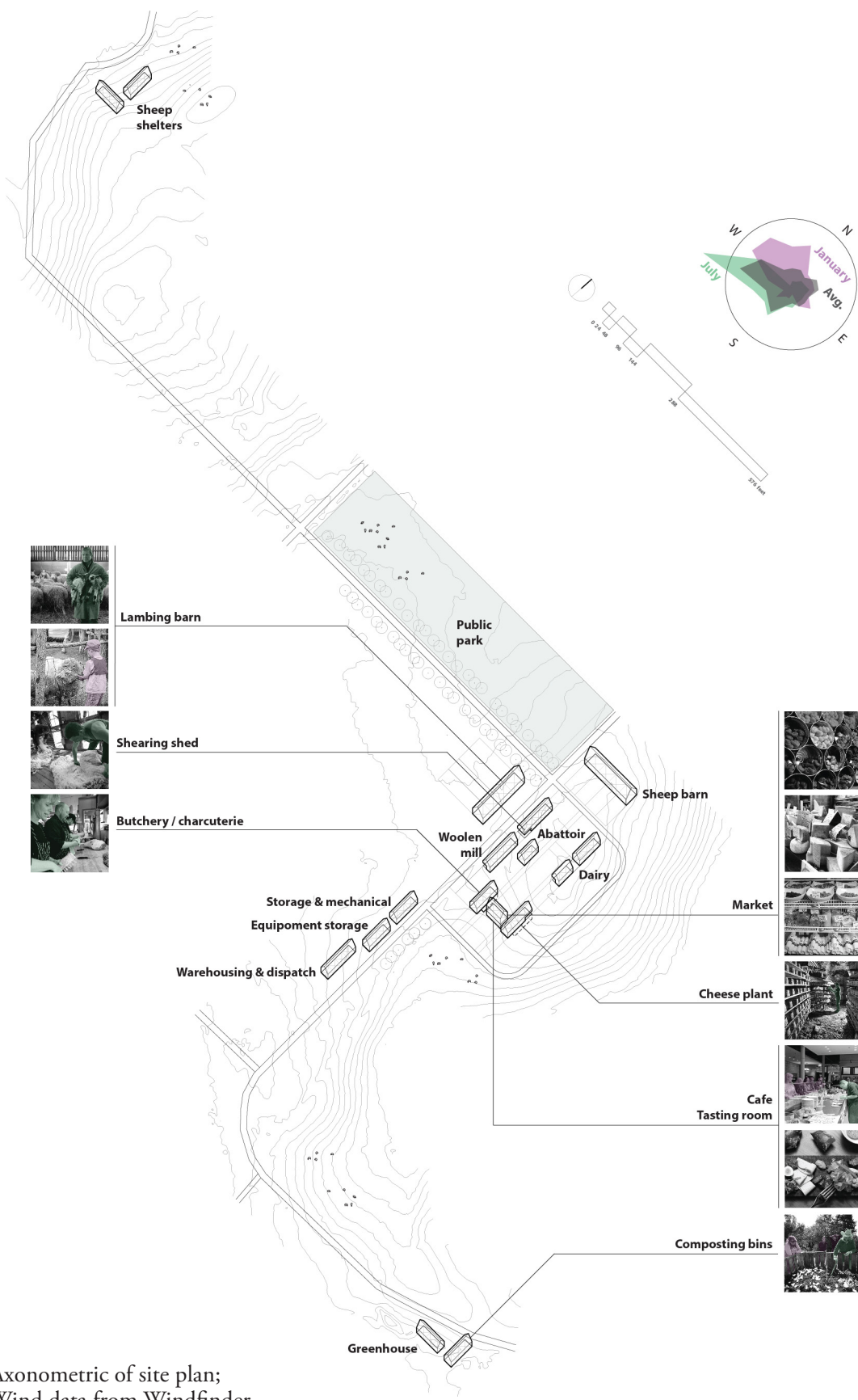
Approach

The public can approach the complex from a number of different directions. A formalized entrance from the west engages Cobequid Road and marks the start of the procession with the aforementioned gateway buildings. Locals on foot have a number of available access routes, centered around the residential bisect and afforded by the porosity of the site. Servicing (dispatch and distribution, delivery of outside sheep for processing, etc.) is provided from the east, where the lane can bypass residential areas and link to major transportation arteries.

⁵⁹ Nova Scotia Department of Agriculture, *Manure Management Guidelines* (2006), 5-6.



Sketch studies of site plan.



Axonometric of site plan;
Wind data from Windfinder.

Massing and Porosity

Linear monolithic forms—scaled both to their respective internal processes and to the adjacent suburban fabric—permit unimpeded flow within the interstitial space, which comprises the bulk of the public realm. The porosity of the scheme allows visitors to move between and around discrete buildings. The public may enter the cluster from the north (animal court) or from the southwest entry court. Lanes bring the public through the animal pens, past the community garden, through the market court, and down into the food court. The upper animal court is activated by animal pens, the middle market court by the weaving studio, the farmers market, and community garden plots, while the lower food court is framed by the tasting room/cafe and the cellars for aging cheese and dry-curing meats.

Process

The rationale of the scheme is rooted in the clustering of buildings by linear process. Incremental processing is directional along the north-south axis, in order both to streamline operations and to facilitate food security. The siting of individual structures follows the sequence of process from input to output: (1) livestock barns and pens at the north end, (2) primary processing facilities (shearing shed, abattoir and milking parlor) adjacent to the animal facilities, for ease of access to animals, (3) secondary processing facilities for value-added processing (woolen mill, butchery/charcuterie) in the middle, and (4) final product dispatch and warehousing at the south end. With each separate step of refinement, both interior and exterior spaces become progressively more sanitary.

Cross-talk

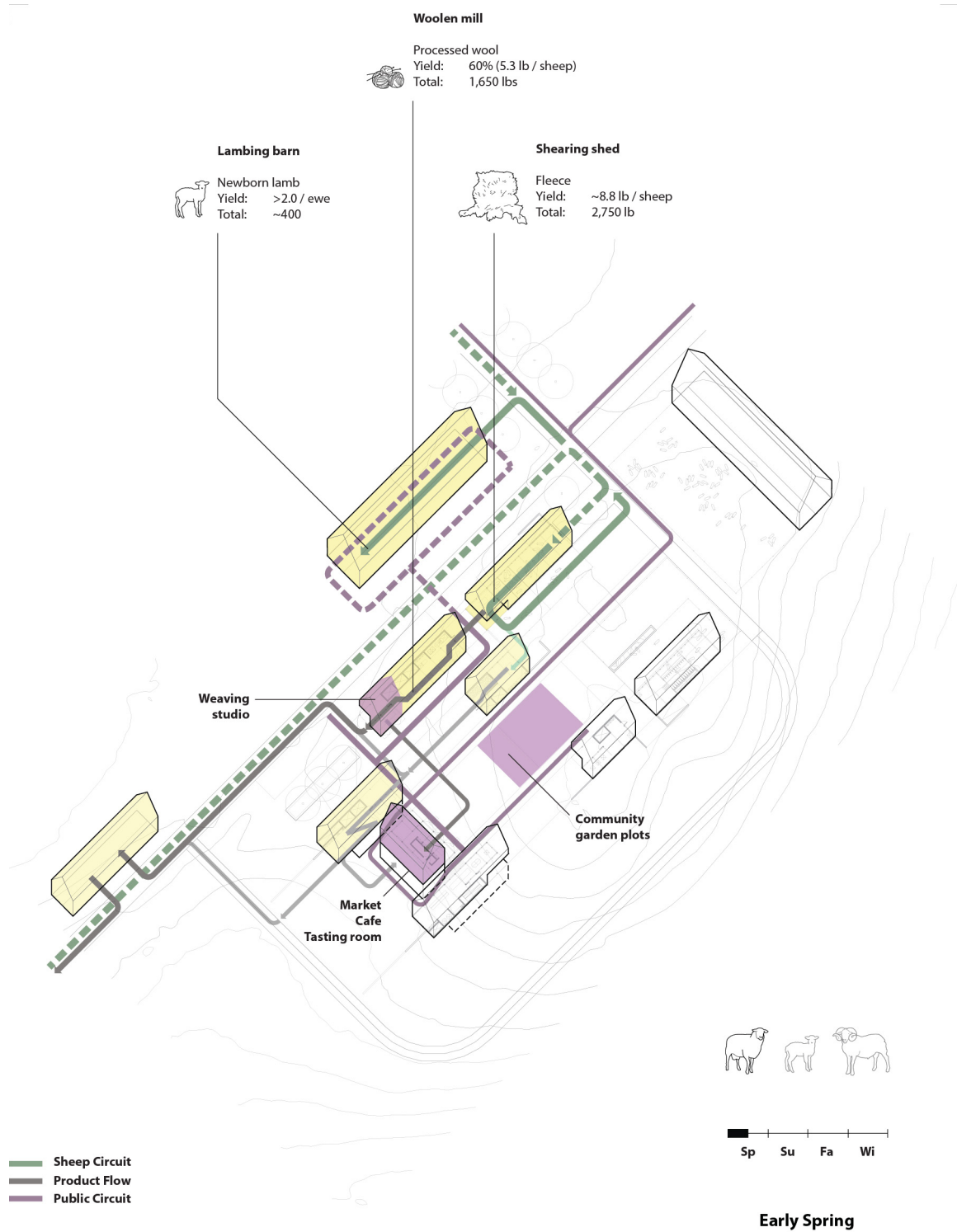
Buildings are also clustered according to relationships perpendicular to the flow of product, such as shared servicing (input and output), common food security and sanitary requirements, and compatible public use. For example, the adjacency of the shearing facility and the abattoir permits the sharing of holding pens between the two processes and provides a streamlined route of delivery for off-farm sheep (that is, for processing of animals from other farms). The secondary consequence of this relationship is that the interstitial space between these two processes is tighter, moderating the transparency of the abattoir.

Conversely, the dairy facilities—which serve only the resident farm—are sited away from the primary service lane and provided with more interstitial space. This courtyard space between dairy and meat processing represents the formal manifestation of food culture; it is here that the public grows (community garden), buys (market) and eats food (tasting room/café).

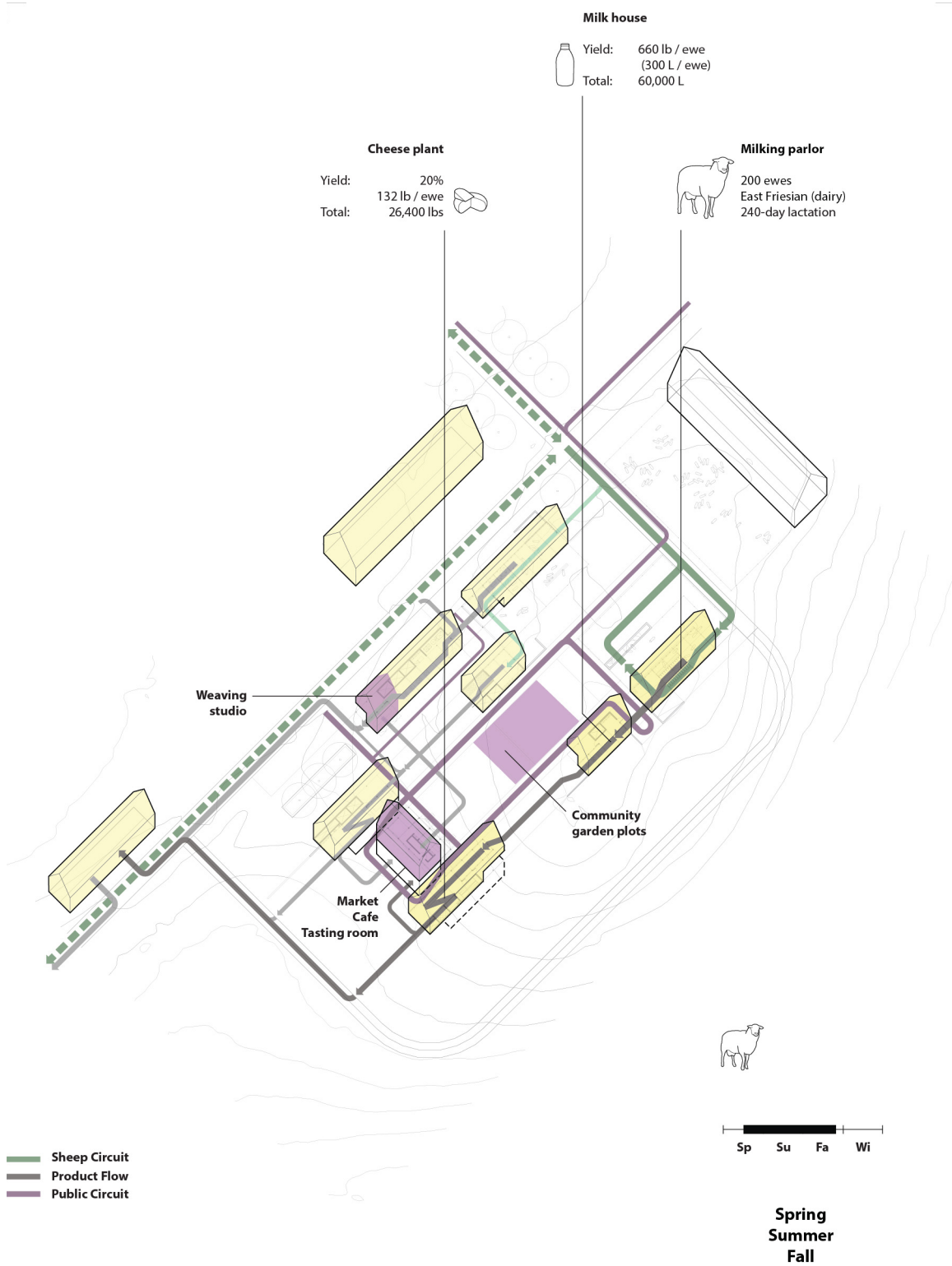
Seasonality

Many of the buildings within the complex are, like the landscape, largely seasonal: shearing and lambing occur within a short window during the early spring; dairy processing begins after weaning in the late spring and continues through the full lactation cycle into late fall; forage harvest, drying and storage occurs at the end of growing season; and while slaughter can happen at any time of the year (depending on desired lamb age and weight), the winter off-season provides a good opportunity to slaughter spring lambs before the next lambing cycle. Furthermore, the outdoor community garden is active only during the growing season. These different patterns of activity by season naturally affect product and animal flow and presumably also influence the public ebb and flow through the site.

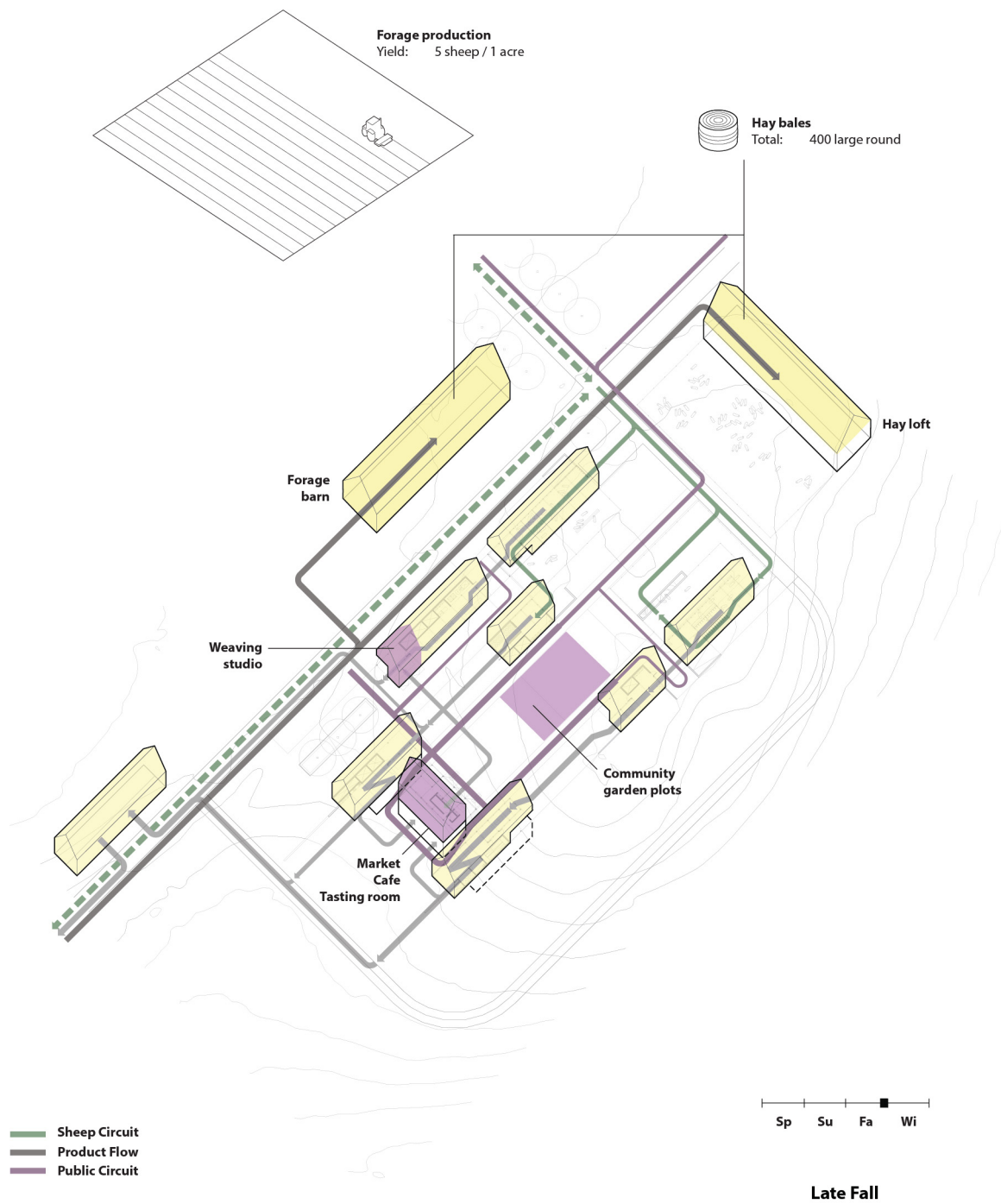
Value-added processing buildings (woolen mill, butchery and cheese plant) can continue to operate throughout the year, so long as stockpiled raw product (fleece, frozen milk or frozen lamb carcass) is available. These continuous processes frame the year-round “hotspots” of public activities on the site—specifically the market, weaving studio, and tasting room/café. Off-season buildings are either closed and shuttered (as with the milking parlor and milk house during winter) or adapted to a secondary use. For example, the shearing shed can, as previously mentioned, be used as the abattoir lairage as well as for fleece storage prior to processing, while the lamb barn may be used sequentially for lambing, lamb weaning, and forage storage.



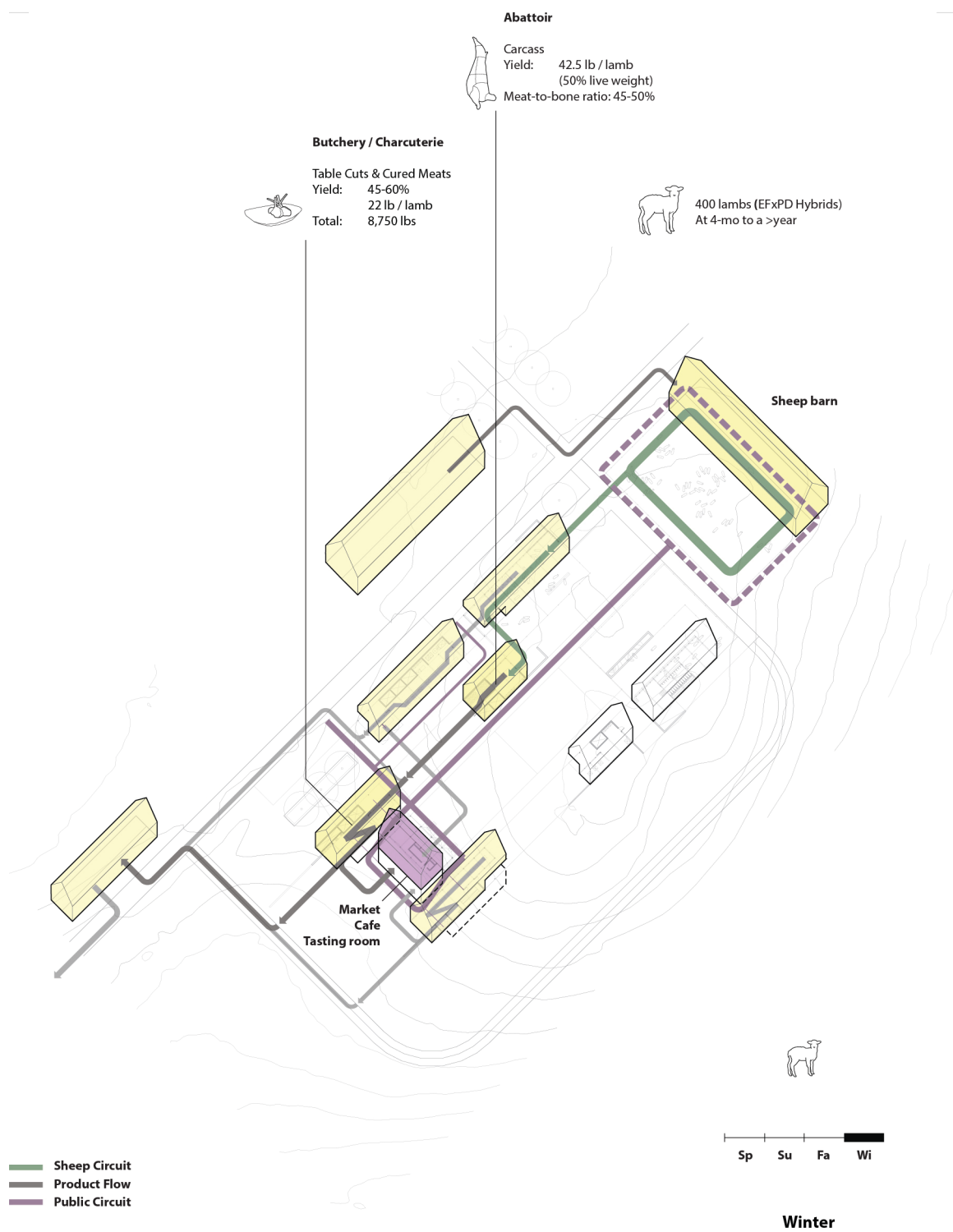
Circuit diagram of sheep, product and the public in early spring, highlighting wool processing.



Circuit diagram of sheep, product and the public in late spring, summer and fall, highlighting dairy processing.



Circuit diagram of sheep, product and the public in late fall, highlighting forage harvest.



Circuit diagram of sheep, product and the public in winter, highlighting lamb processing.

Building Design

Flow

Building design focuses on the wool, meat and dairy processing facilities and the associated public cafe/tasting room and market. Process flow serves not only as the ordering principle for the arrangement of functionally related buildings, as discussed for site design, but also the internal spatial configuration of individual buildings.

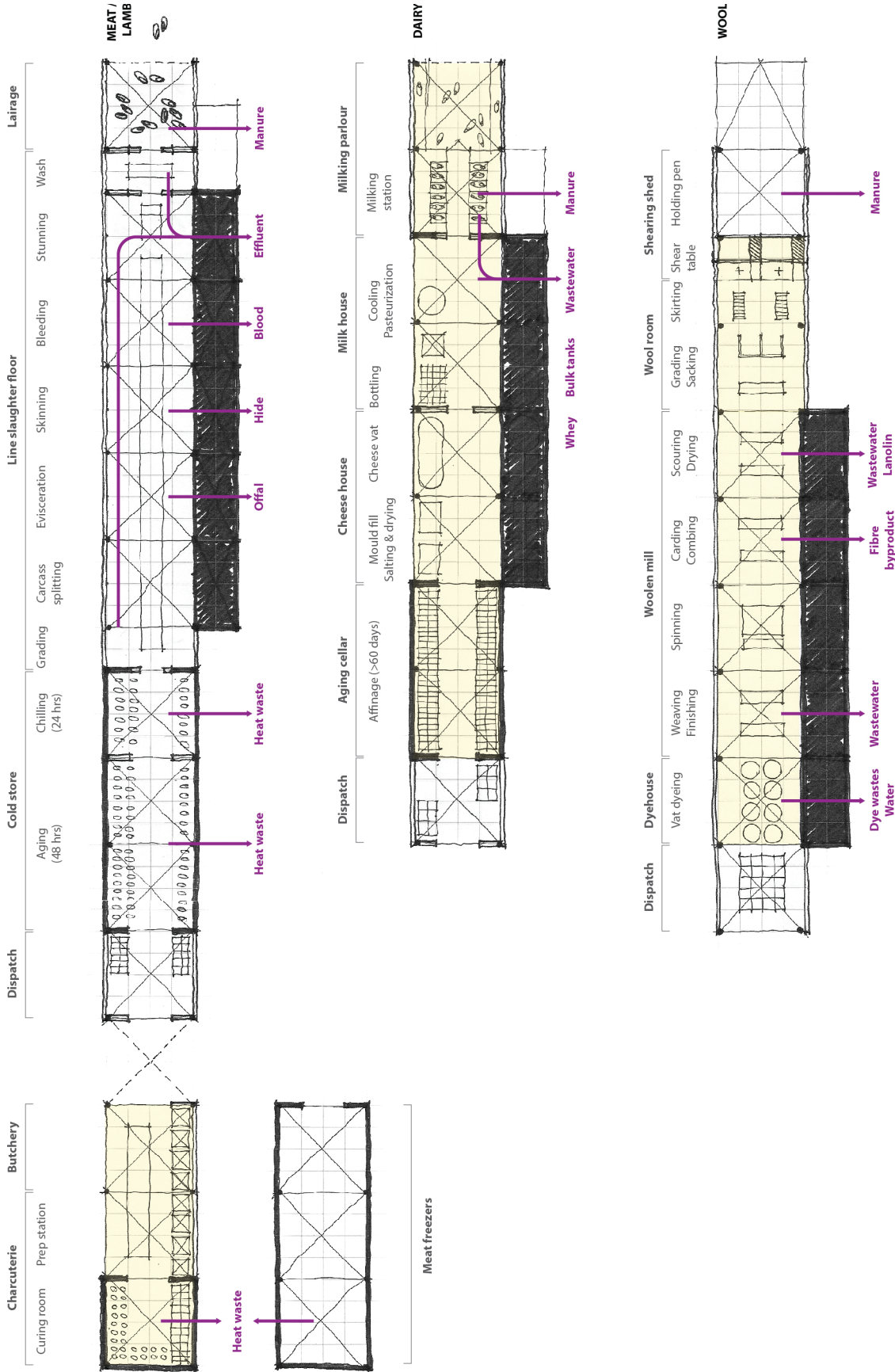
The dairy facilities demonstrate the rationale of efficiency and food security. The milking parlor is sited near the sheep barn to reduce travel distance, especially during inclement weather and when the animals are to sleep indoors rather than return to pasture. Ewes are milked using a double, parallel parlor over a pit, which provides the operator easy access to the sheep's udders. The milk line carries the milk through a line filter into a bulk cooling tank in the milk house, where it is rapidly chilled. The cheese plant is further separated from the rest of the dairy and animals to help maintain food security; as such, the milk must be transported from the milk house via a clean-in-place (CIP) system-treated pipeline to a second bulk tank within the cheese plant, where it can then be transformed into cheese within the vat works.⁶⁰ The unripened cheese is brought by ramp to the cave below grade, where it is aged through the process of *affinage* under tight environmental control.⁶¹ Finished product is packaged at the terminus of the cave, from where it may be dispatched to the south service lane.

The example above touches on how grading is recruited to facilitate process. Cellars for aging cheese and dry-curing meat require moderately cool temperatures (10 to 15 °C) and high relative humidity (75 to 95% for cheese, 65 to 80% for meat)⁶²; these spaces therefore exploit the thermal mass and humidity of the earth for passive environmental control. Furthermore, the product flows downhill throughout the process, from milk dairy to cheese plant to cheese cave, in order to minimize handling and energy input.

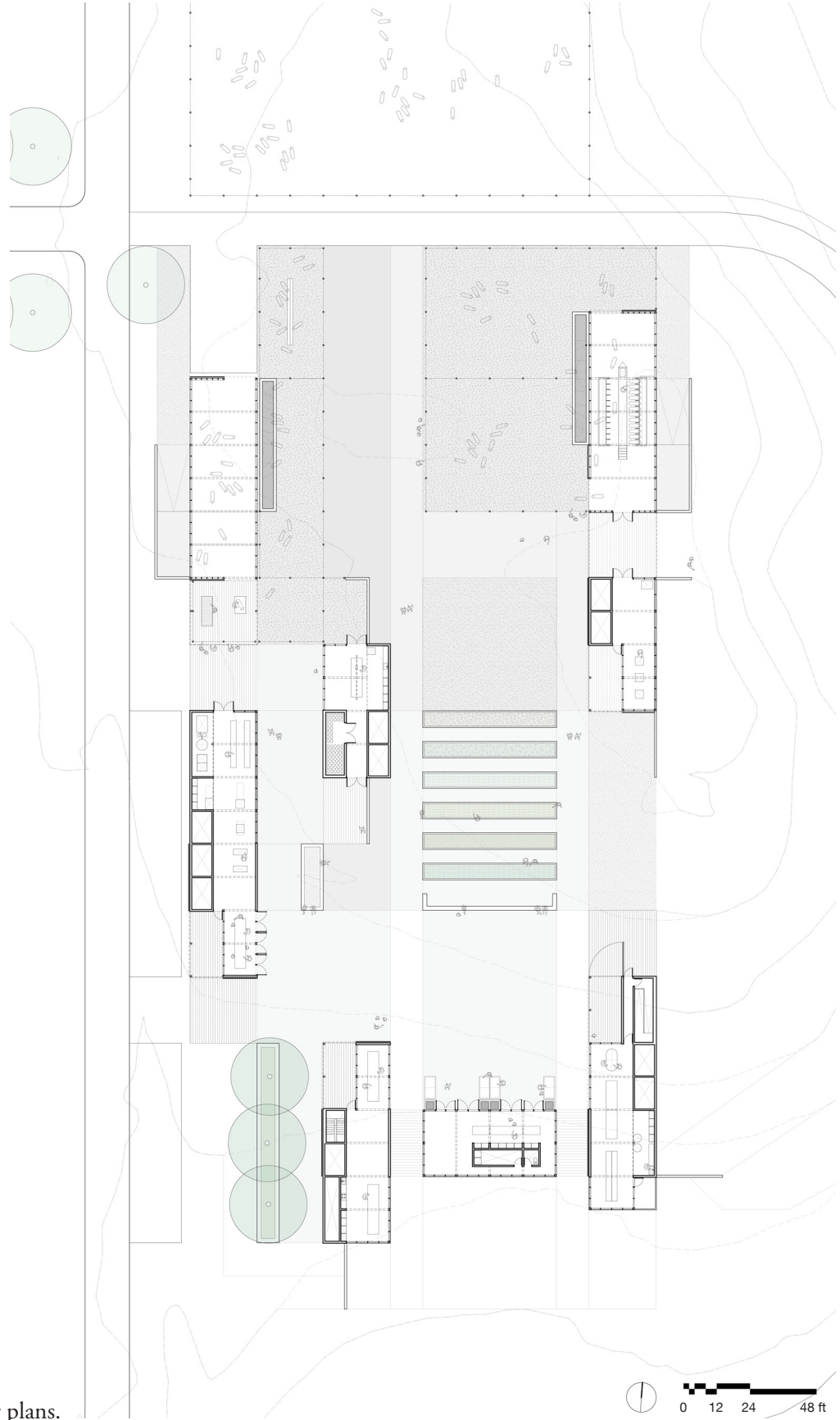
60 Ron Muise (Fearann Kisha/Wandering Shepherd Cheese), e-mail to author, Dec. 16 and Feb. 18, 2013.

61 Ron Muise, e-mail to author, February 28, 2013.

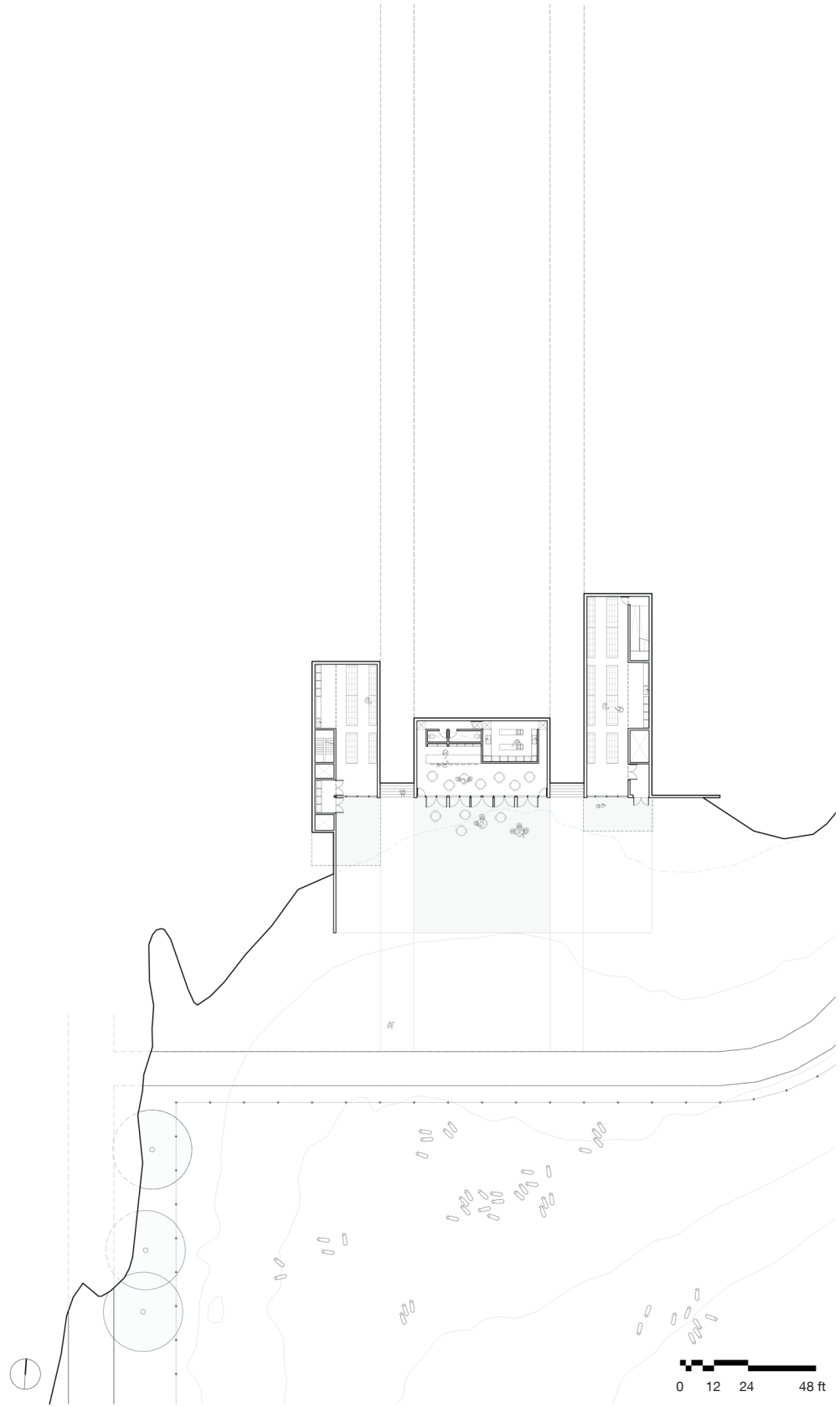
62 Mary Karlin, "Ripening and Aging Guidelines," from *Artisan Cheesemaking at Home* (Ten Speed Press: 2011), <http://www.artisancheesemakingathome.com/cheesemaking-ripening.html>; Matt Wright, "Meat Curing Safety," from *Wrightfood*, February 24, 2011, <http://mattikaarts.com/blog/charcuterie/meat-curing-safety/>.



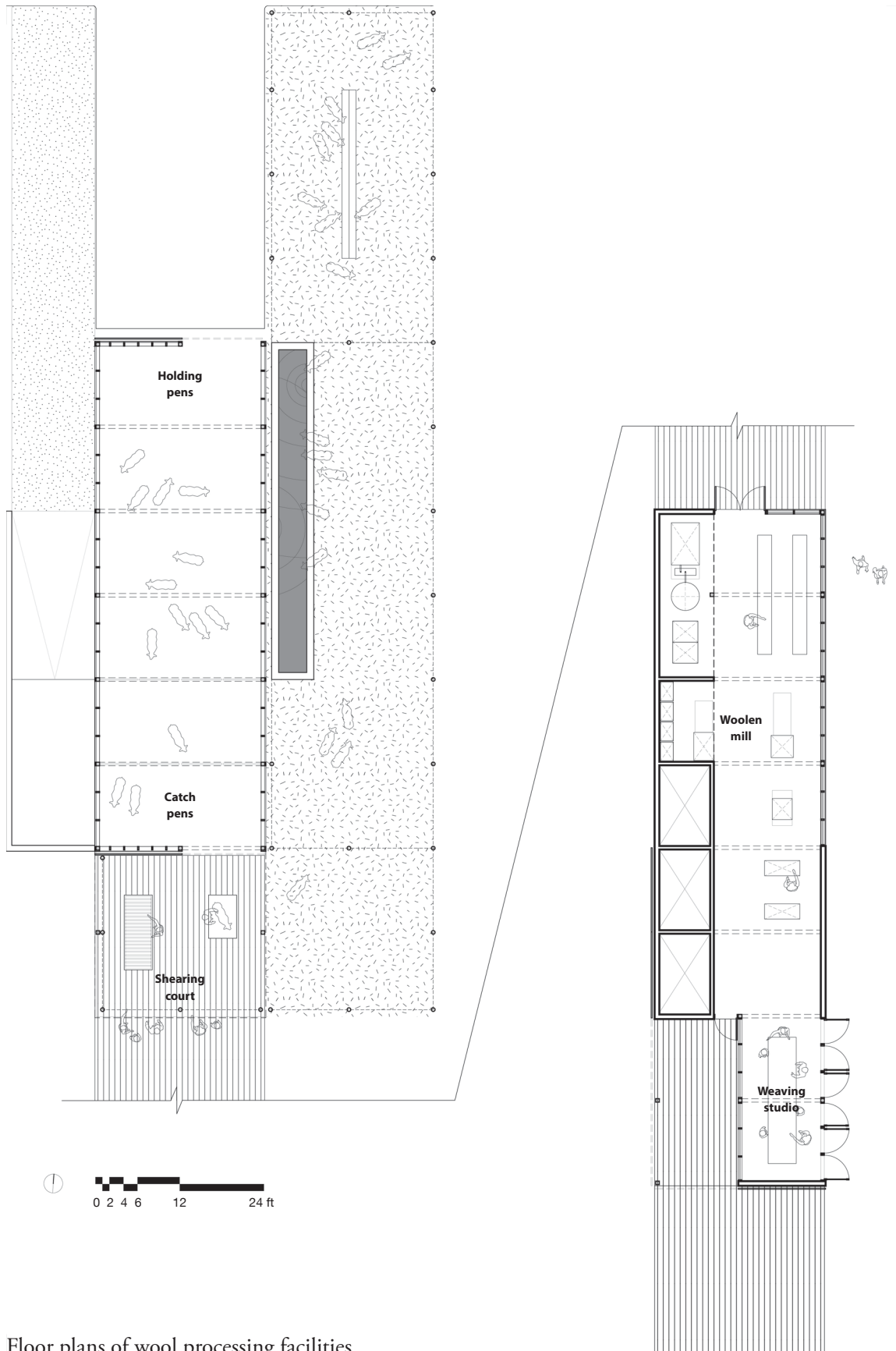
Sketch studies of the three sheep-related processes, in plan.



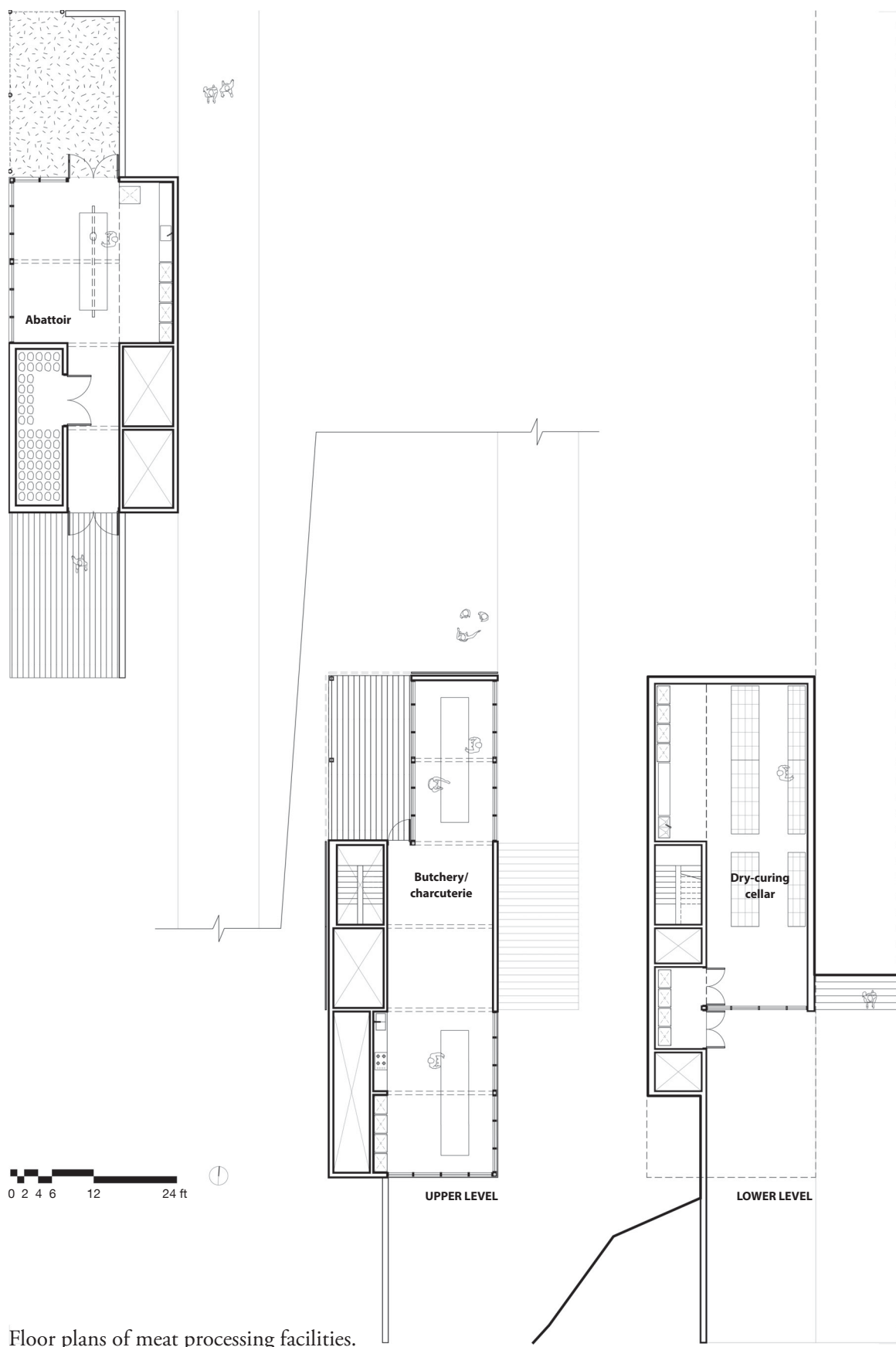
Upper floor plans.



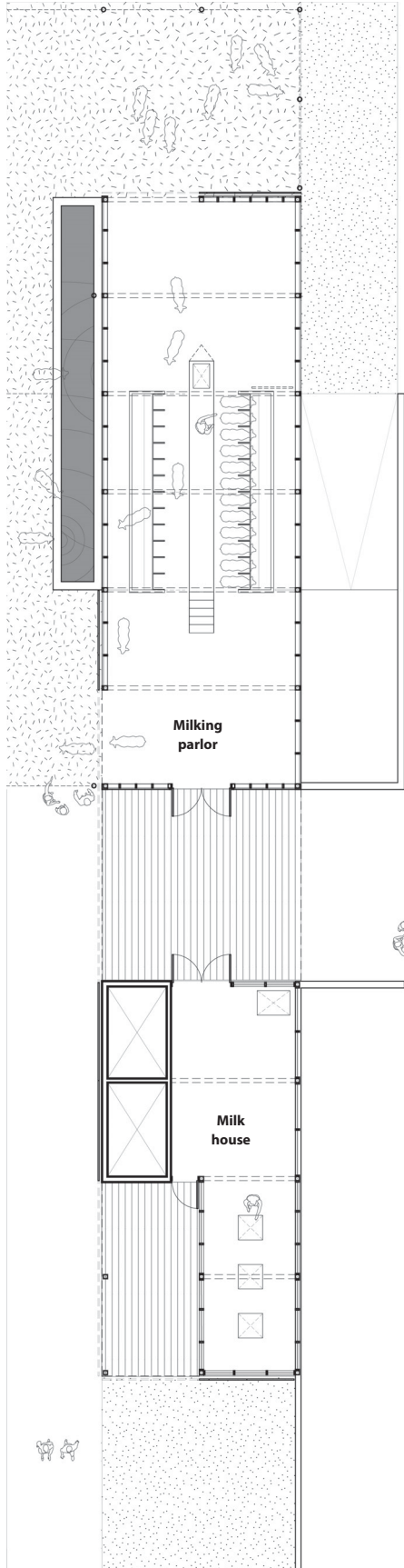
Lower floor plans of charcuterie, cafe/tasting room, and cheese cave.



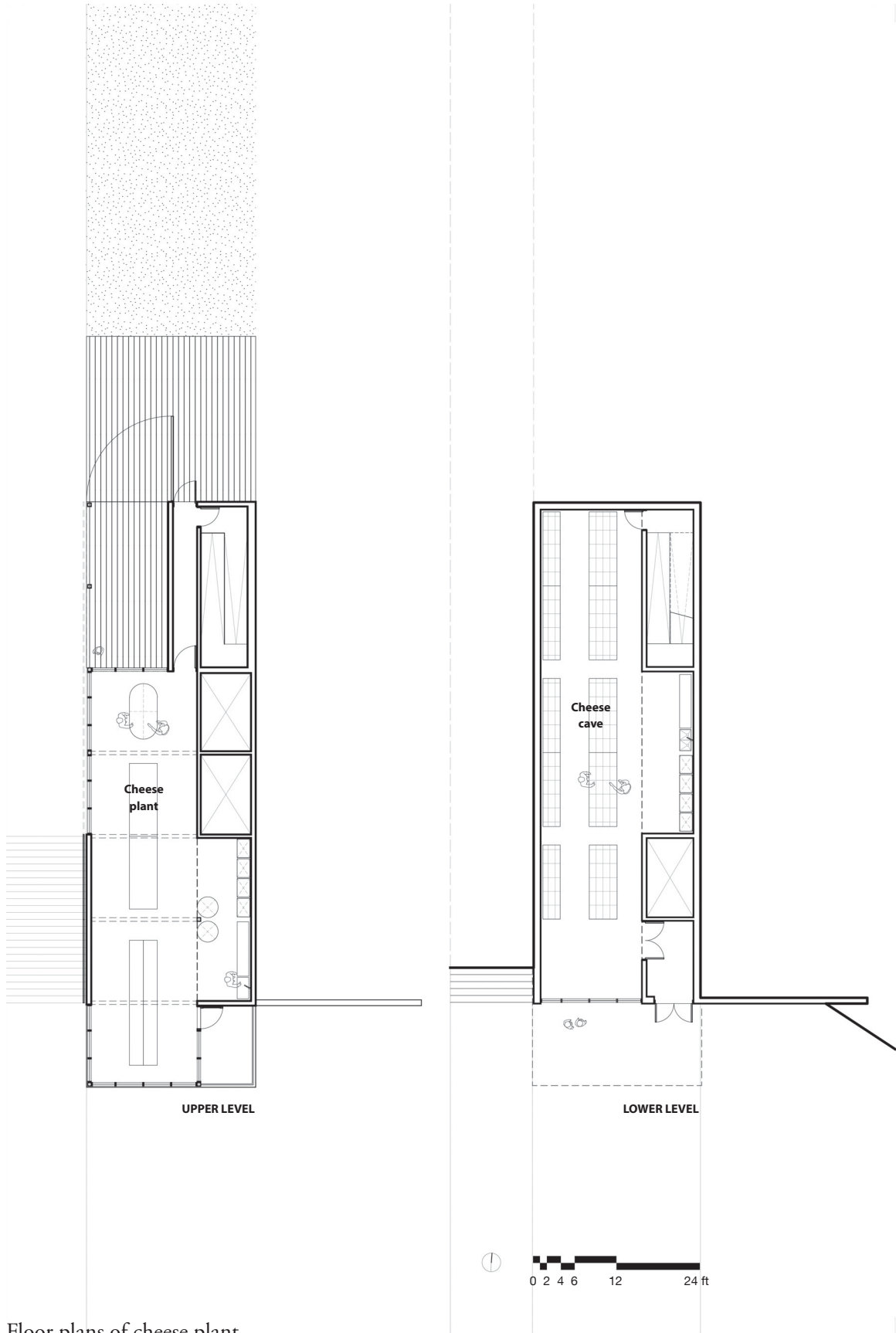
Floor plans of wool processing facilities.



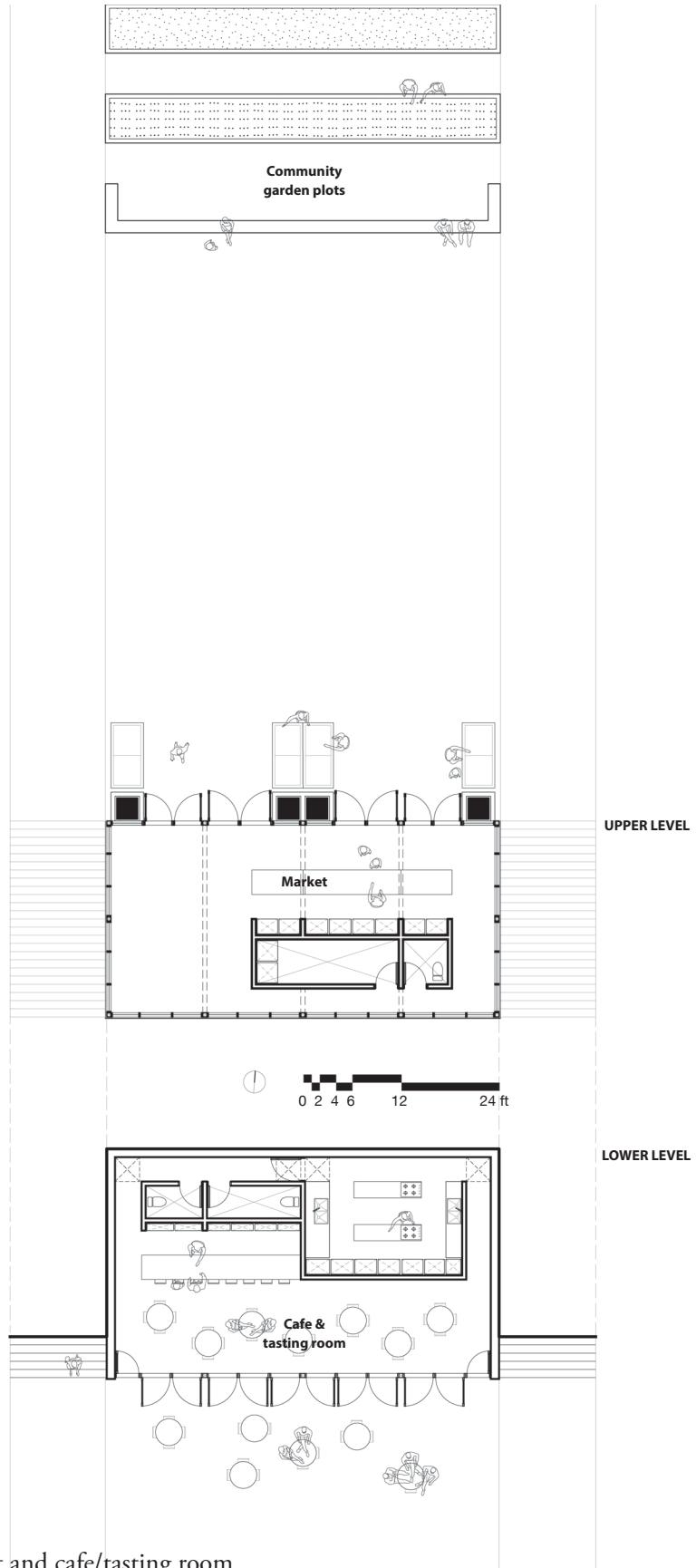
Floor plans of meat processing facilities.



Floor plans of dairy.



Floor plans of cheese plant.



Floor plans of market and cafe/tasting room.

Service and Served

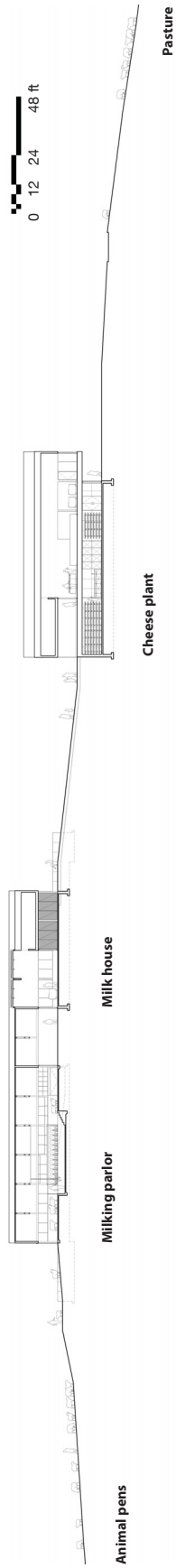
Service and served spaces are clearly delineated. The single-loaded service cores support linear throughput in an otherwise open plan by providing nested spaces, washing stations and other plumbing, equipment housing, mechanical & electrical rooms, waste management, and vertical circulation. Daylighting of served areas adjacent to cores is supplemented by skylights.

Orientation

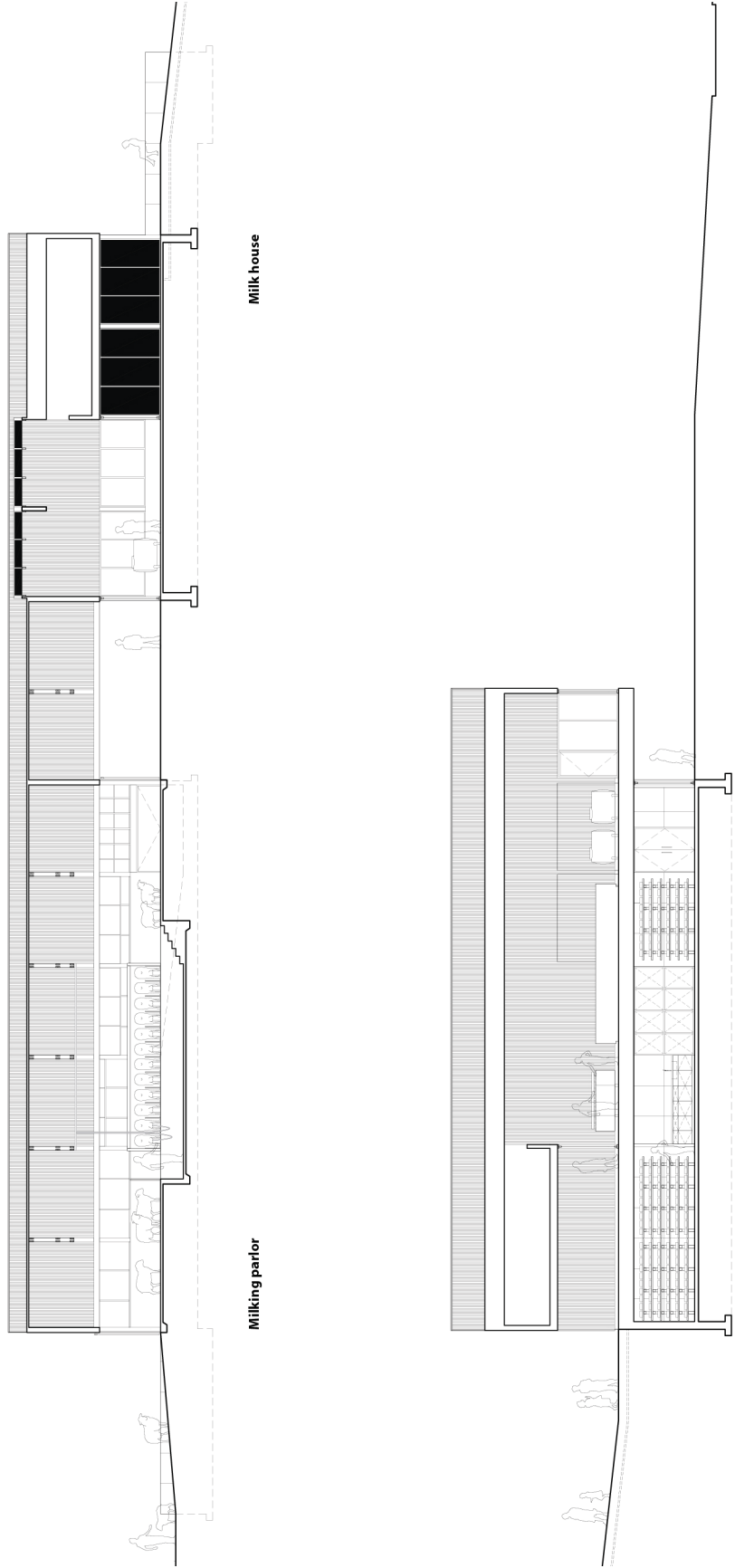
The orientation of processing buildings along the north-south axis is informed by needs for cross-ventilation (for animal sheds) and for reduced solar gain (for chilled food processing). An emphasis on natural cross-ventilation reduces both respiratory problems within livestock (see Appendix II for a case study on the Cornell Teaching Dairy Barn, which similarly employs a natural ventilation strategy) and the risk of compromise of downstream food security by airborne contaminants from upstream activity. Ventilation of the dairy facilities becomes progressively more sterile in the direction of processing: the uninsulated milking parlor opens to the exterior with barn doors and operable panels; the milk house employs limited operators with pest control screens for naturally ventilation; while the cheese plant requires mechanical ventilation, double doors, and positive pressure to minimize risk of contamination.⁶³

As meat and dairy processing both benefit from cooler operating temperatures (for example, the abattoir is actively chilled) to help retard bacterial growth and prevent food spoilage, processing facilities have minimal south elevations. In contrast, public buildings (market and cafe/tasting room) and over-wintering barns are oriented east-west to maximize solar exposure. The combinatory effect of perpendicular buildings blocking wind and catching sunlight is the creation of several microclimates within the arrangement of courtyards.

⁶³ Ron Muise (Fearann Kisha/Wandering Shepherd Cheese), e-mail to author, February 20, 2013.



Longitudinal section through dairy processing facilities.



Longitudinal section through dairy processing facilities.

Tectonics and Materiality

The tectonics of the project follows the pragmatic logic of the agricultural vernacular. Both formal decisions and materiality choices are informed by simplicity, affordability, durability, and ease of maintenance.

The relationship with the sloped landscape is negotiated with minimal concrete earthworks, which serve a number of structural (*i.e.* foundation, retaining wall, flooring) and programmatic (*i.e.* manure storage pits, composting bins, watering troughs, raised garden beds, public bench, exterior stairs, dry-curing cellar and cheese cave) functions. The use of concrete in agricultural and processing facilities is commonplace (and, in many cases, standard operating procedure) due to the durability, ease of cleaning and low maintenance costs of the material. Furthermore, concrete is readily available, provides thermal mass to modulate temperature fluctuations, and offers a degree of noise dampening for farm and processing operations.

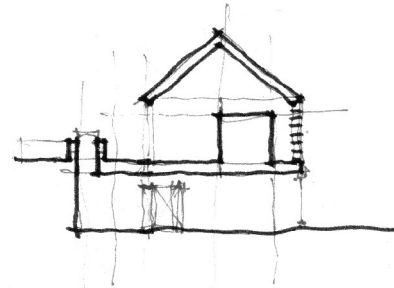
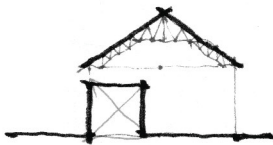
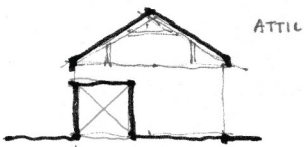
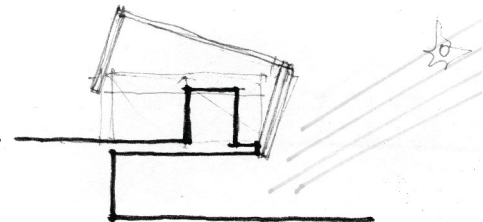
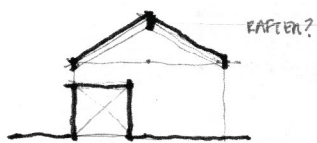
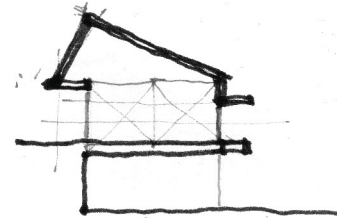
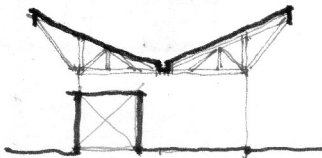
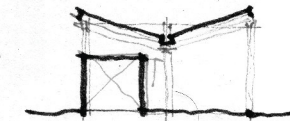
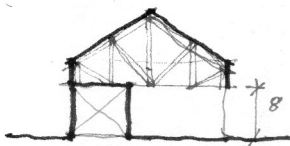
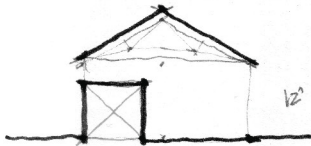
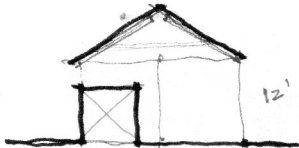
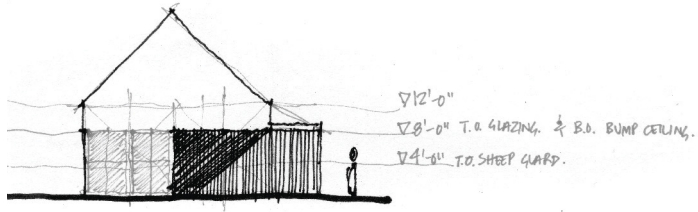
Between, and upon, these stereotomic interventions rest simple monolithic sheds. Gable roof forms create a calm consistency across the cluster of buildings, while also providing an efficient mechanism for shedding rain and snow and for chimney effect-assisted passive ventilation. A modular bay system allows for the growth and adaptation of the shed structures with the changing needs of the farmer/operator from year to year.

The exterior skin (both walls and roof) of the sheds consists of standard, industrial, corrugated galvalume. This material exhibits corrosion resistance and high heat reflectivity as well as several properties which make it ideal for interior use within processing facilities, notably low maintenance and ease of cleaning (especially by pressure washing). Therefore the wrapper is carried inside to reinforce the monolithic aesthetic of the sheds.

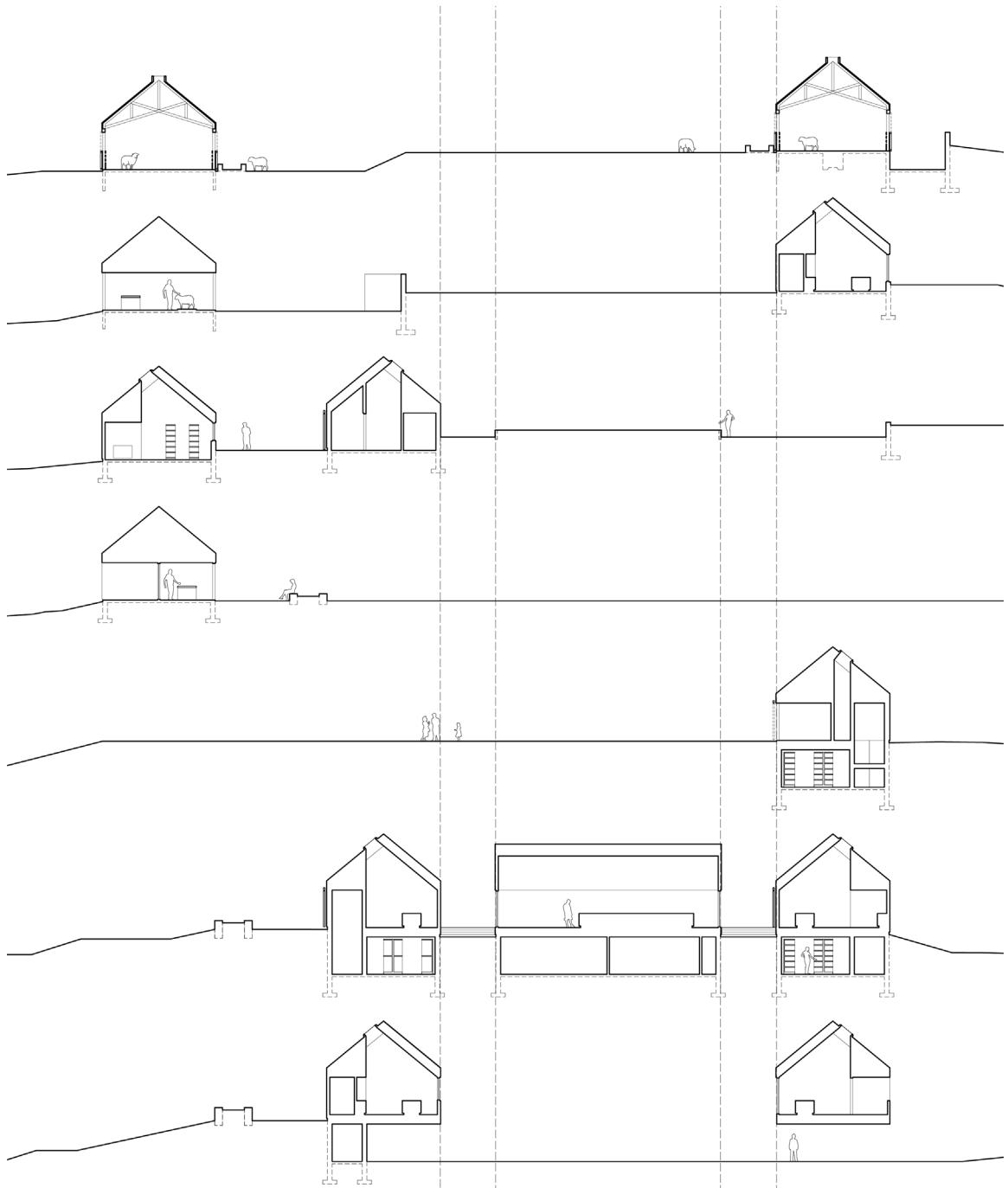
Inside and Out

Covered porches draw the surrounding landscape and courtyards into the shed structures and frame the public observation of the processes within. Public engagement with interior program is largely modulated through the manipulation of envelope and, as such, various degrees

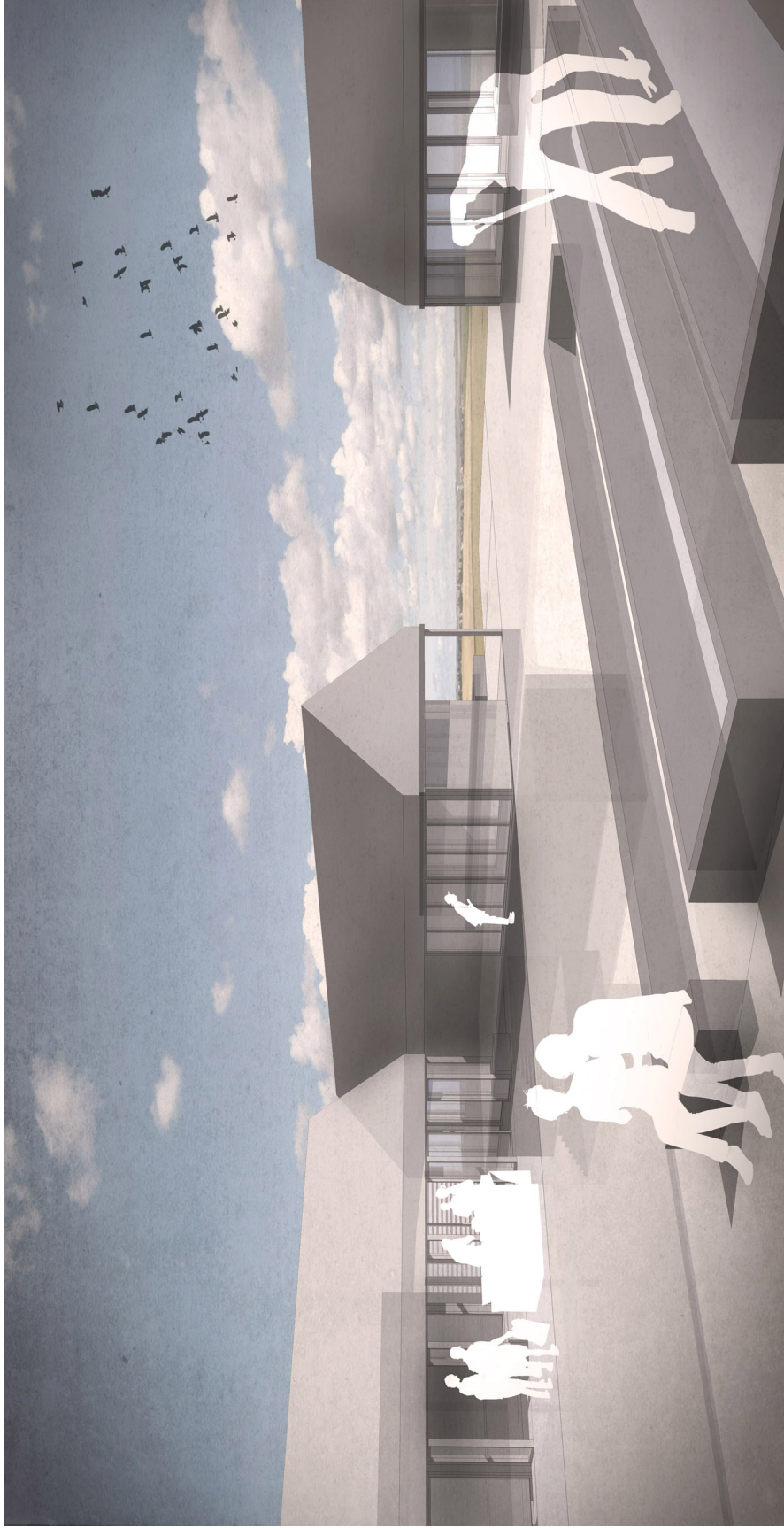
of transparency are employed: fully opaque walls, full or partial glazing, or translucent lexan siding. In the case of animal barns and holding facilities (*i.e.* shearing shed and milking parlor), delamination of the galvalume siding exposes both the processes inside and the structure of the shed. In the case of public interior spaces—specifically the weaving studio, market and cafe—the glass facade swings open to allow the program to spill out into the courtyards. Conversely, barn doors allow sheds to be shuttered off when not in use or in response to inclement weather.



Sketch studies of roof section options.



Cross-sections through processing facilities and market / cafe.



Perspective of market court.



Perspective of shearing court.



Perspective from the approach.

CHAPTER 3: CONCLUSION

Discoveries and Difficulties

The thesis provides a model for a suburban farm in which the urban consumer is connected with the food producer, process, and productive landscape through visibility, porosity and overlapping flows and circuits. These strategies are applied across a range of scales, including neighborhood, site and building. Visibility is attained through the suburban siting, programming, and envelope transparency; porosity is achieved through site accessibility, public interstitial space, and the insertion of public rooms and porches into individual buildings and processes; while the choreography of the public experience is rooted in the intersection of procession with the seasonal circuits of the sheep, farmer, and product.

The study represents an intersection between several broad issues: (1) *culture*, of the food cycle and artisanal farming/processing, (2) *urbanism*, in regards to greenspace, infrastructure, local food security, and growth containment, (3) *economy*, in terms of vertical integration, value-added products, and small-scale local industry, and (4) *ecology*, in terms of landscape, climate, and resource management. The ‘farm-to-table’ programming not only provides the public with a representative window into the complete food cycle, but also lends itself to operational self-sufficiency. The project secondarily examines mechanisms (rooted in the mutually-beneficial integration of farming with the suburban edge) by which peri-urban farming may be preserved, within the implicit framework of ecological sensitivity.

The thesis program relates to a number of agricultural, industrial and natural sciences and systems. As a result, a major challenge of the study involved gaining sufficient literacy in the practical and technical aspects of farming and food processing to be able to situate and design the public experience. Articulation of the public interface remained the primary goal, but with the explicit stipulation that the architecture serves rather than gets in the way of the farmer-operator. Even though the operational investigation was decidedly generalist—recognizing that expert consultation is required for further testing and development of the proposal—its broad scope limited, in part, the depth of study. As such, the thesis included landscape response, site design and general building tectonics, but not, for example, comprehensive building detailing.

Potential Directions

There are a number of issues raised by the thesis which would benefit from further study. Potential directions for future study include (1) the development of detailed water, waste and energy management plans, (2) careful feasibility and costing analysis, and (3) exploration of alternative farming programs.

Raising livestock and processing sheep products can place significant demands on water supply. The woollen mill and slaughterhouse, in particular, require large supplies of potable water which become effectively contaminated at the output. This warrants a more detailed study both of the necessary water infrastructure (*i.e.* water retention ponds, pasture supply lines and water storage tanks) and of creative opportunities for resource recovery (for example, on-site biological filtration/treatment systems and rainwater collection via eaves troughs, scuppers and cisterns). There is also a potential for agricultural energy conservation and recovery which has not yet been addressed by the thesis, including (1) alternative energy sources such as biogas digestion, thermal conversion, biomass and biofuel, and (2) shared and district energy systems.⁶⁴

A second major consideration is feasibility and economic viability. The complexity of the program creates major practical hurdles in terms of regulatory compliance, workforce, and operations management. For example, numerous provincial and federal regulatory acts, as well as the aforementioned zoning regulations, directly affect the program and require careful negotiation. Operation of the project would also necessitate significant capital expense and a complex management plan. A co-operative model (in which multiple operators specialize each in dairy, lamb, or wool) would reduce individual costs, risks and responsibilities but could face complications from unequal ownership and cash flow.⁶⁵ Wool, for example, currently holds a very low value compared to dairy products, although several Nova Scotian farmers (such as Gaspereau Valley Fibres, Lismore and Upperbrook) have been successful in marketing value-added wool products. Furthermore, an abattoir may require significantly higher through-put in order to remain viable than the current scheme allows.⁶⁶

64 Fraser, "Integrated Infrastructure for Local Food and Agriculture," 108-9.

65 Ron Muise (Fearann Kisha/Wandering Shepherd Cheese), e-mail to author, December 16, 2013.

66 Ron Muise (Fearann Kisha/Wandering Shepherd Cheese), e-mail to author, February 8, 2013.

One response to these challenges is phasing; a simpler scheme focused around dairy processing could be incrementally developed for additional wool and meat processing capacity. A second response is the closer integration with existing facilities in the area. For example, lamb slaughter could be outsourced to the Northumberland/Brookside co-operative abattoir or, conversely, the on-site abattoir could be expanded to include the through-put of the Brookside facility, increased viability and providing a new regional hub for the industry.

A third future consideration is alternative farming programs. The thesis employs sheep farming as a test-of-principle, but this programmatic strategy carries certain limitations. Lamb and sheep cheese remain speciality products in Nova Scotia and hold limited appeal for large segments of the public (based upon diet, culture, personal tastes and perhaps cost). Furthermore, the full dietary complement of grains, vegetable and fruit produce needs to be included, along with meat and dairy, for the farm and market to serve as true “food hub.” Though the present scheme allows for small-scale horticulture (greenhouse and garden plots) and for other producers to participate in the market, an alternative program could include extensive and mixed farming of livestock, crops and orchards. While the latter approach introduces additional complexity in terms of infrastructure, processing facilities and expertise, it provides some advantages for both farm and city. For the farm, it offers greater self-sufficiency (for example, in regards to the café menu), opportunities for resource integration (for example, using manure to fertilize crop production) and a broader market. For the local neighbourhood, it could mean complete food security and a stronger, holistic relationship with the farm.

Architecture holds an unrealized potential within the agrarian domain. Agricultural buildings and landscape have, by convention, adopted a strict utilitarianism which is aligned with both the pragmatism of and the public exclusion from farming operations. However, as agriculture is increasingly re-introduced into the public realm, architectural intervention ceases to be superfluous. At the point of friction, agrarian architecture can serve to mediate agricultural production and urban consumption, organic dirtiness and sanitary order, and operational practicality and public choreography. If agriculture is the “the humanized face of the earth,”⁶⁷ then architecture can represent the humanized face of agriculture.

67 Le Corbusier, reprinted in Meredith TenHoor, “The Architect’s Farm” in *Above the Pavement—The Farm!: Architecture & Agriculture at P.F.1*, 172.

APPENDIX I: INFRASTRUCTURE INTEGRATION

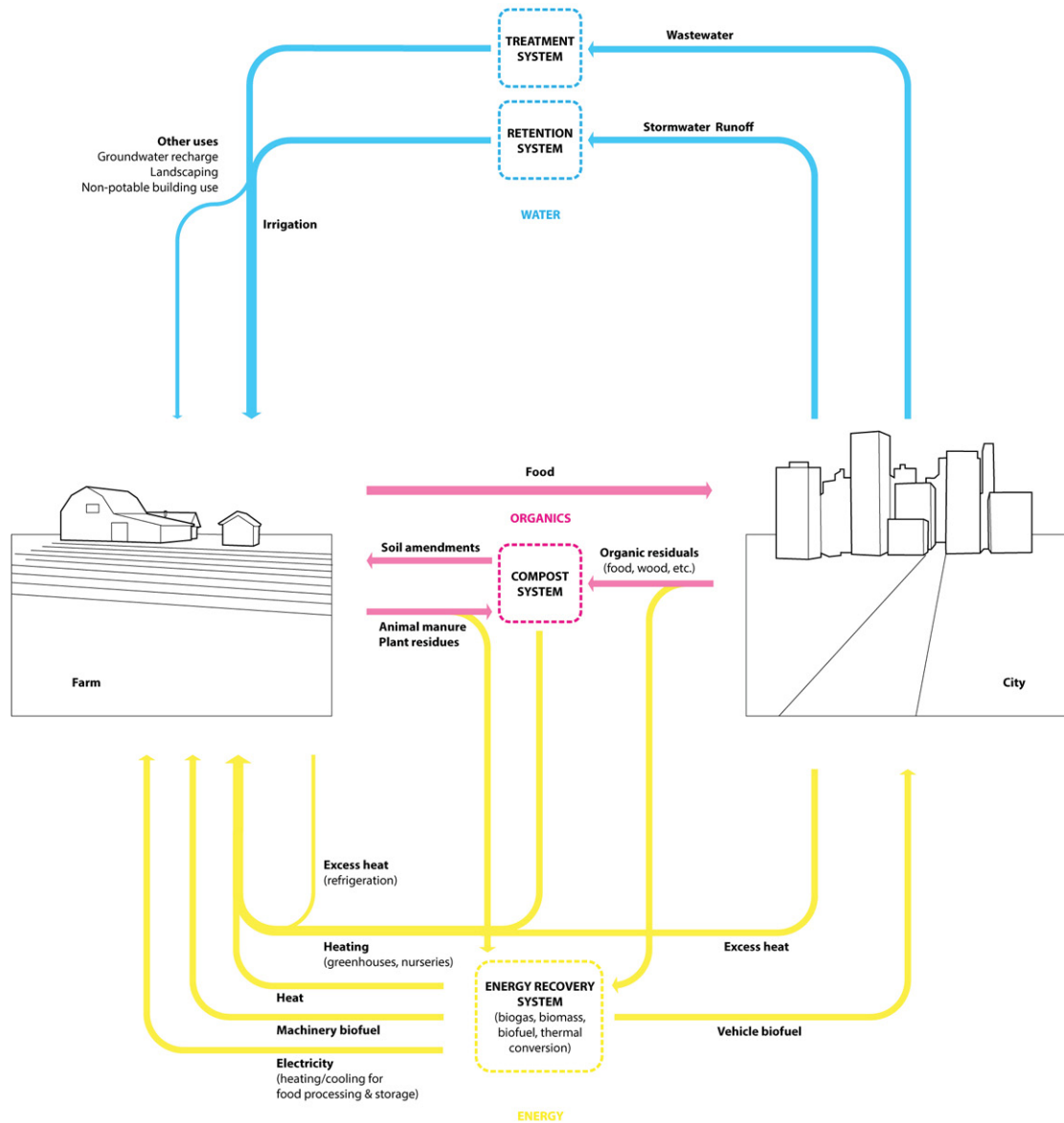
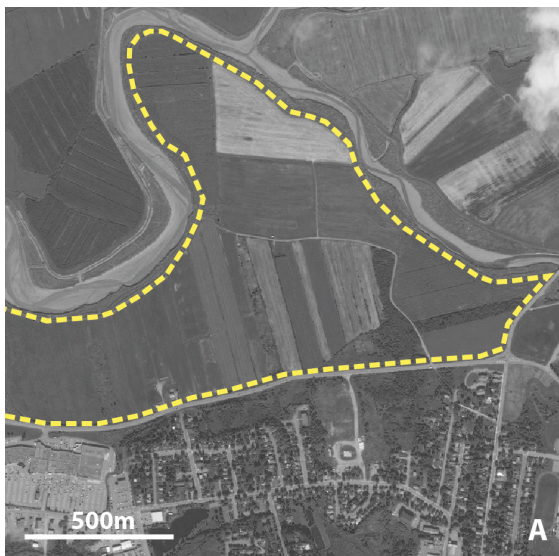


Diagram for the integration of urban and agricultural infrastructures, specifically energy, water, and organic resource systems; Based upon concepts from Fraser, Bud, "Integrated Infrastructure for Local Food and Agriculture," in *Agricultural Urbanism*, e.d. de la Salle & Holland, 2010; and Peter Ladner, *The Urban Food Revolution*, 2011.

APPENDIX II: SITE OPTION & PRECEDENT ANALYSIS



Precedent 1: The Marshlands

Soil

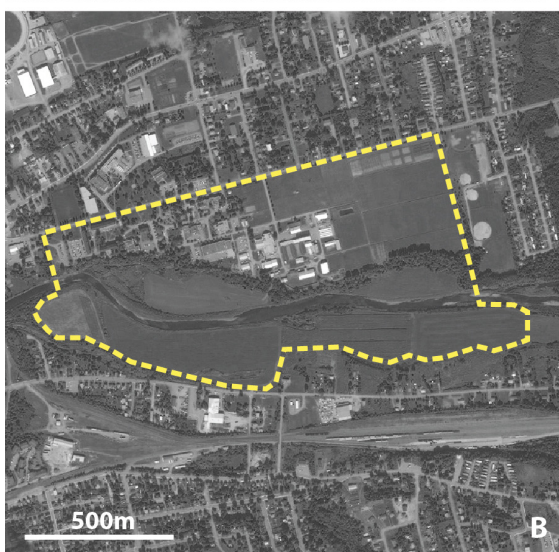
Predominantly Class 2; some Class 3

Urban Edge

Adjacent to residential, commercial & industrial

Status

Within 1:20 yr flood plain;
Site of community garden



Precedent 2: Dalhousie Agriculture Campus

Soil

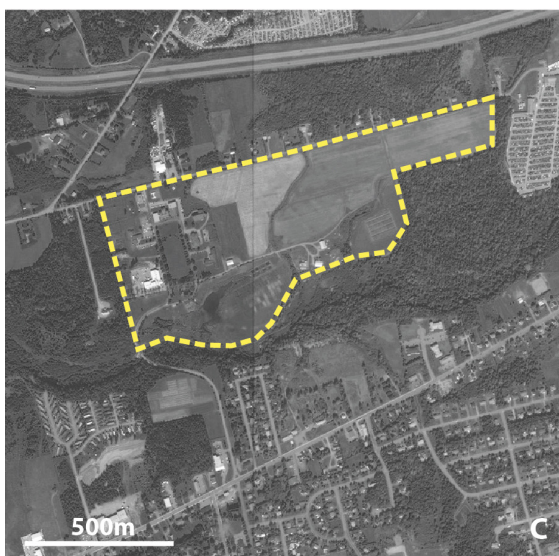
Class 2 on escarpment
Class 3 in Salmon River valley

Urban Edge

Adjacent to residential, recreational & light industrial

Status

Agricultural research (academic & governmental);
Additional institutional program on site;
Valley parcels largely within 1:20 yr flood plain



Precedent 3: Perennia Innovation Park

Soil

Class 2

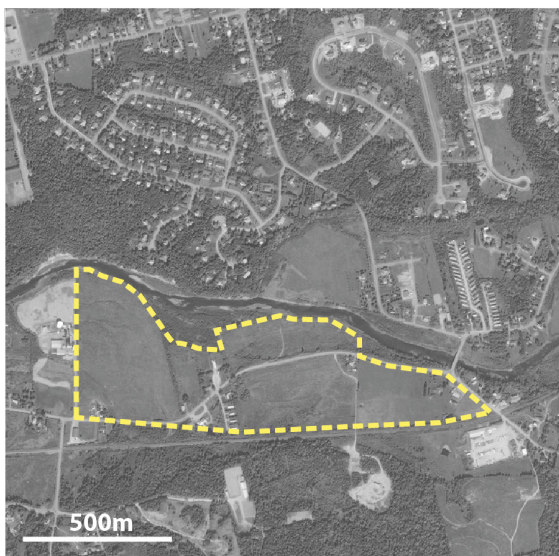
Urban Edge

Adjacent to industrial and river drainage way;
Proposed residential development (south-west)

Status

Agricultural research (private & governmental);
Additional institutional & commercial program
on site

All maps from Bing Maps.



Site option 1: Salmon River

Soil

Predominantly Class 3; some Class 4

Urban Edge

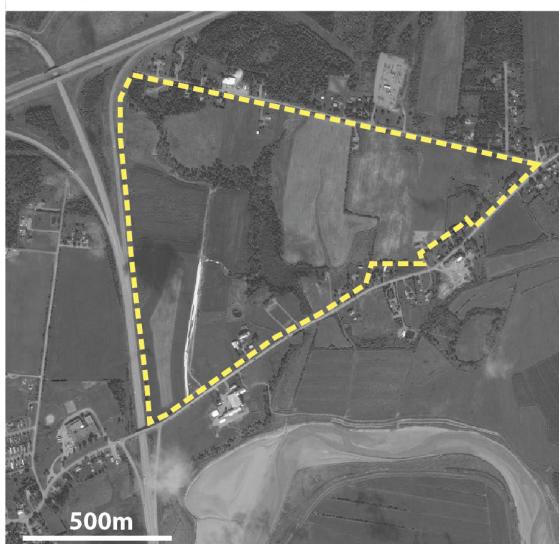
Adjacent to residential, commercial & industrial

Status

Moderate risk of development
Partly within 1:20 yr flood plain

Proximal Agricultural Services

Existing dairy (Farmers / AgroPur);
Farming equipment supplier;
Dalhousie agriculture campus



Site option 2: Onslow

Soil

Predominantly Class 2; some Class 3

Urban Edge

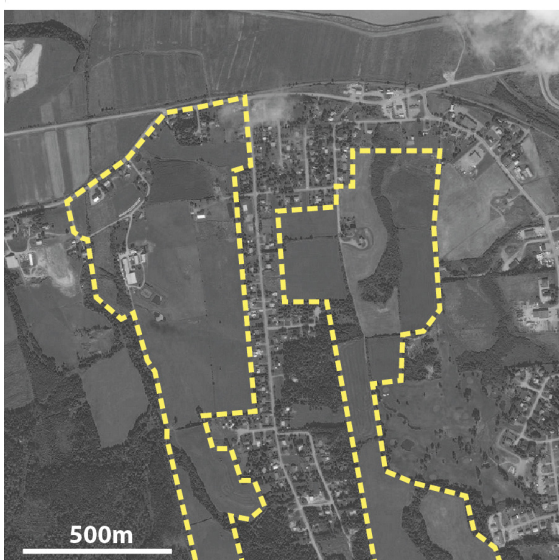
Rural / agricultural
Development of a commercial park has begun at the
traffic node of highway and freeway.

Status

Low-moderate predicted risk
Commercial development begun

Proximal Agricultural Services

Agricultural fair



Site option 3: Lower Truro

Soil

Predominantly Class 2; some Class 3

Urban Edge

Adjacent to planned residential subdivision,
commercial & light industrial

Status

Moderate risk of development;
Connection to lower fields within 1:20 yr flood plain

Proximal Agricultural Services

Farming equipment suppliers
Water treatment center

All maps from Bing Maps.

APPENDIX III: CASE STUDIES

List of case studies and sources:

1. **Stone Barns Center for Food and Agriculture -**

Grovesnor Atterbury and Machado & Silvetti Associates

Left photograph: “Courtyard, Blue Hill at Stone Barns Center,” 2004; from Blue Hill at Stone Barns.

Right photograph: “Shorn sheep in a barn at Stone Barns Center for Food and Agriculture, Pocantico Hill, New York,” 2011; from Jackie Weisberg, Flickr.

Analytical drawings by author; data from Stone Barns Center for Food and Agriculture, *Stone Barns Center for Food and Agriculture*, Machado and Silvetti Associates, *The Rockefeller Stone Barns*, and Animal Architecture, *Stone Barns Center*.

2. **Farm Logic (Shepherd’s Way Farm) -** Loom Studio

All illustrations from Loom Studio, “Farm Logic.”

3. **Seasoned Pasture -** Nick Glase

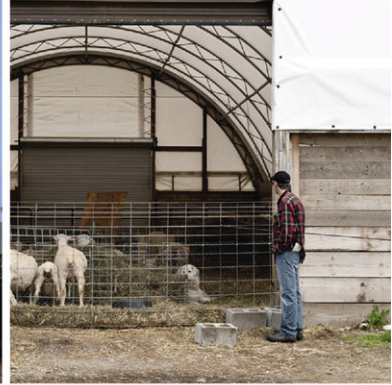
All illustrations from Nick Glase, “Seasoned Pasture: A Demonstration Range and Public Park.”

4. **Cornell University Teaching Barn -** Erdy McHenry Architecture

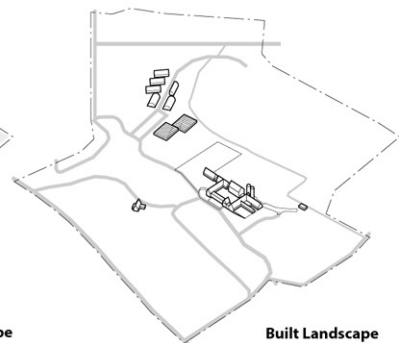
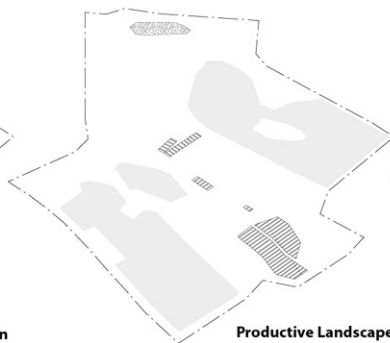
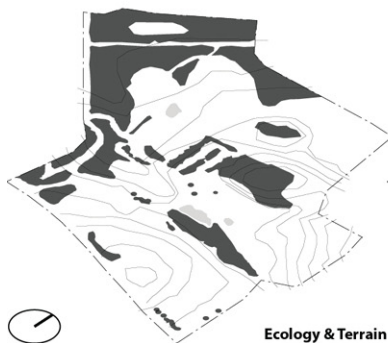
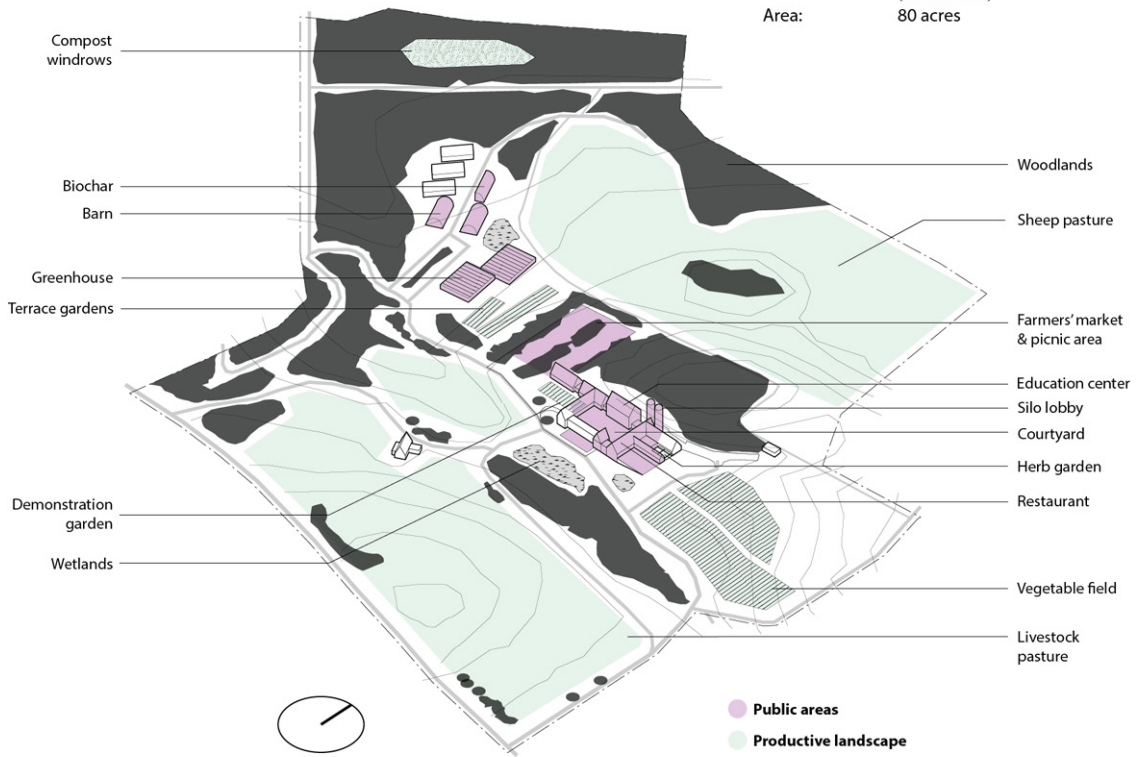
All illustrations from Laura Raskin (author) and Halkin Mason (photographer), “The Cows Come Home,” *Architectural Record*.

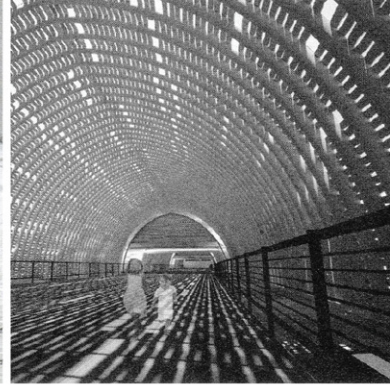
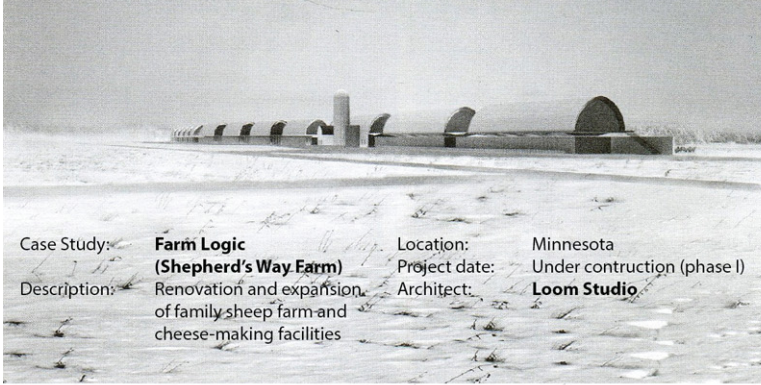
5. **Deepwater Woolshed -** Peter Stutchbury

All illustrations from Patrick Bingham-Hall, *Peter Stutchbury: Selected Works*.

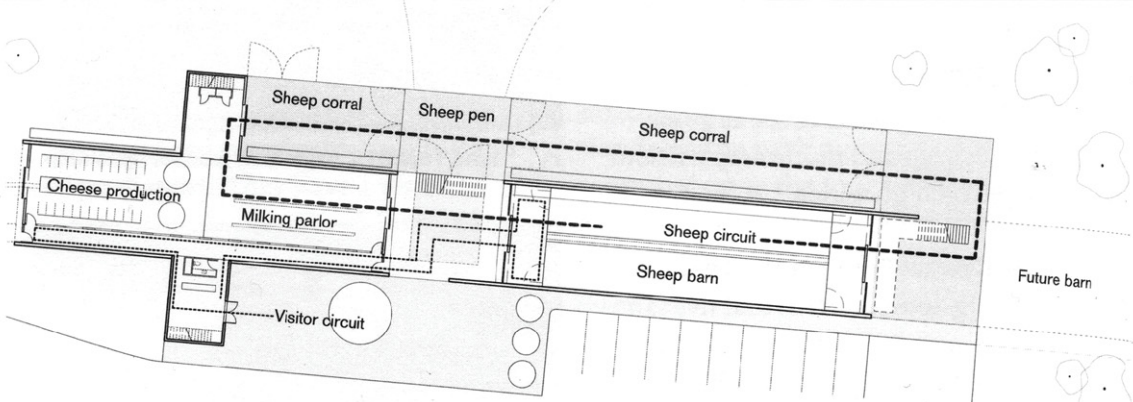


Case study: **Stone Barns Center**
 Location: Pocantico Hills, New York
 Project date: 1930s; 2004 renovation
 Architect(s): **Grosvenor Atterbury Machado & Silveti Assoc.** (renovation)
 Area: 80 acres

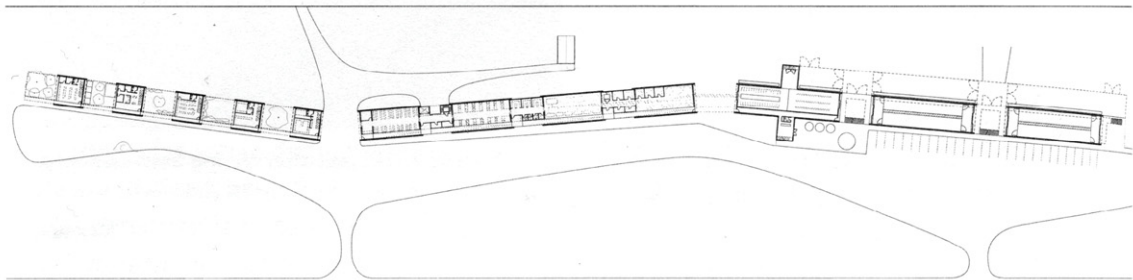
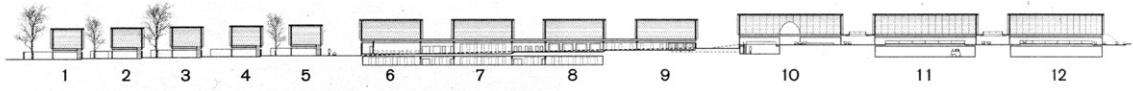




Case Study: **Farm Logic (Shepherd's Way Farm)** Location: Minnesota
 Description: Renovation and expansion of family sheep farm and cheese-making facilities Project date: Under construction (phase I)
 Architect: **Loom Studio**

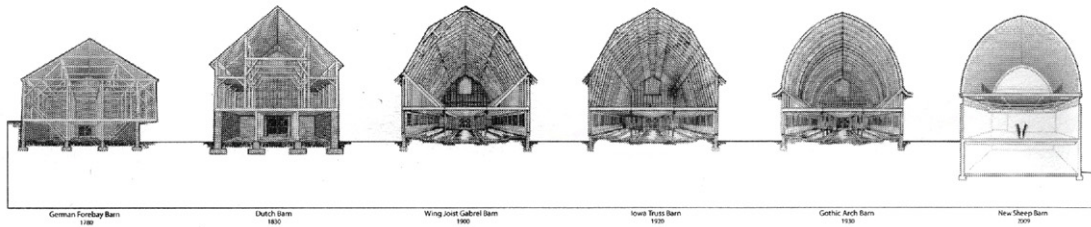


▲ Plan showing visitor and sheep circuits.



- 1. Weaver's studio and shearing court
- 2. Veterinarian's clinic and animal court
- 3. Cheese shop and tasting court
- 4. Butcher's shop and slaughter yard
- 5. Farm office and flower garden
- 6. Raw milk cheese aging barn—cheese caves below, loft above
- 7. Cheese packing barn—cheese caves below, workshop below, loft above
- 8. Cheese processing barn—loft above
- 9. Milk pasteurization barn—hay loft above
- 10. Milking and feeding barn—hay loft above
- 11. Lambing barn and nursery—hay loft above, workshop below
- 12. Sheep barn—hay loft above, tractor garage below

▲ Five-family farm, plan and section.



▲ Pragmatic evolution.



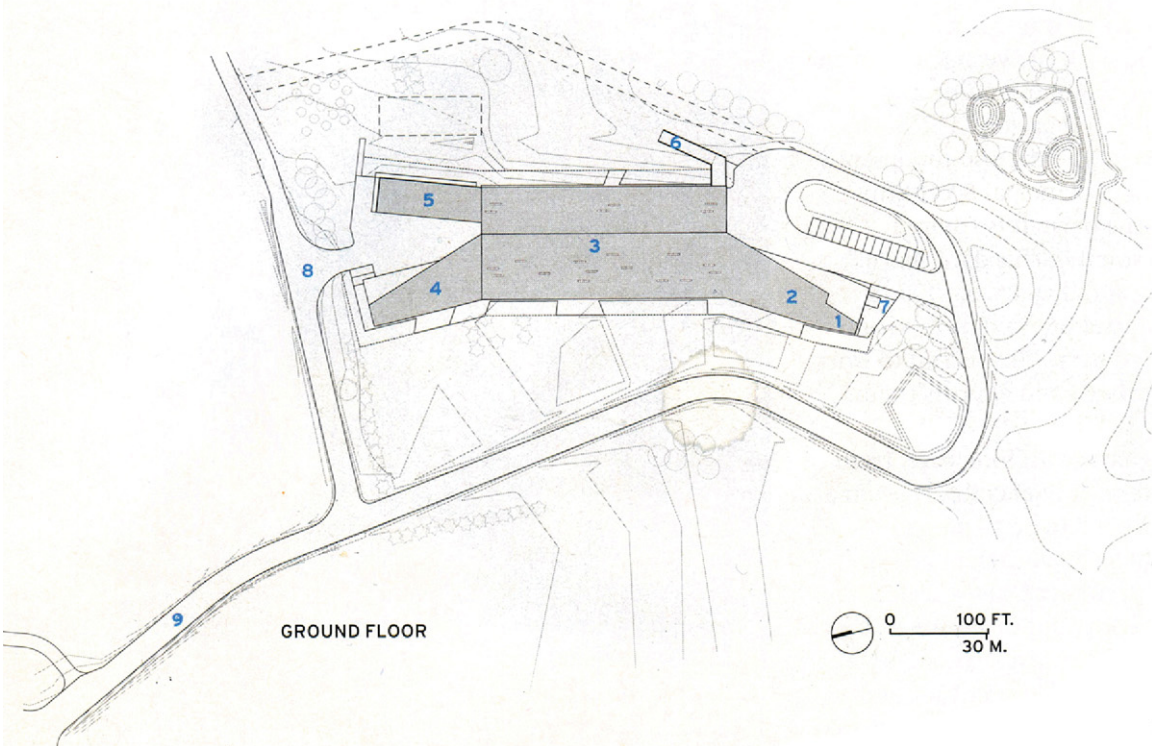
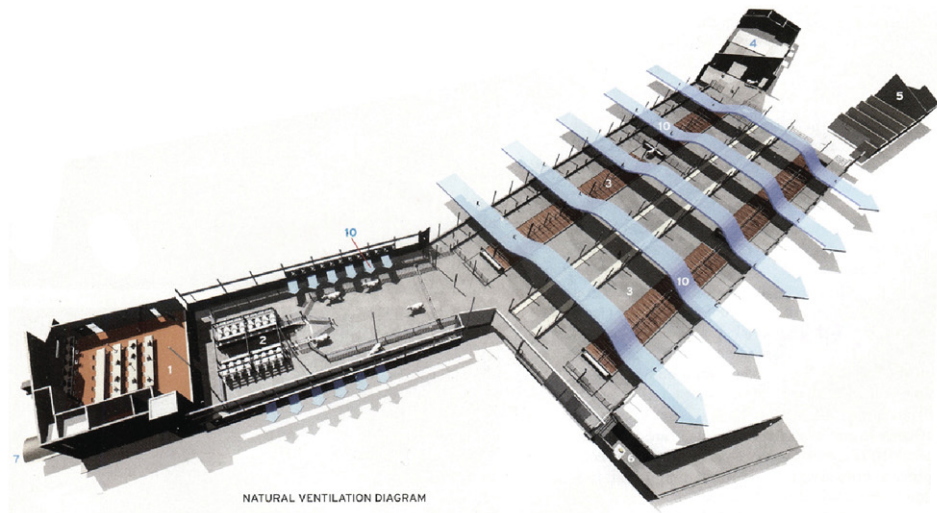
Case Study: **Cornell University Teaching Dairy Barn**

Location: Ithaca, New York

Project date: 2012 (completion)

Architect(s): **Erdy McHenry Architecture**

Area: 43,000 SF





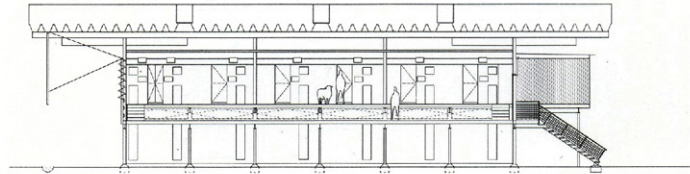
Case Study: **Deepwater Woolshed**

Location: Wagga Wagga, NSW
Australia

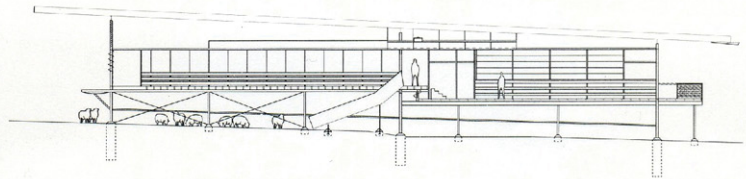
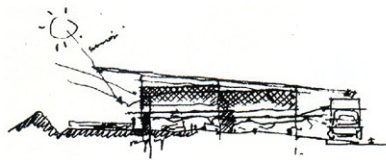
Project date: 2003 (completed)

Architect: **Peter Stutchbury**

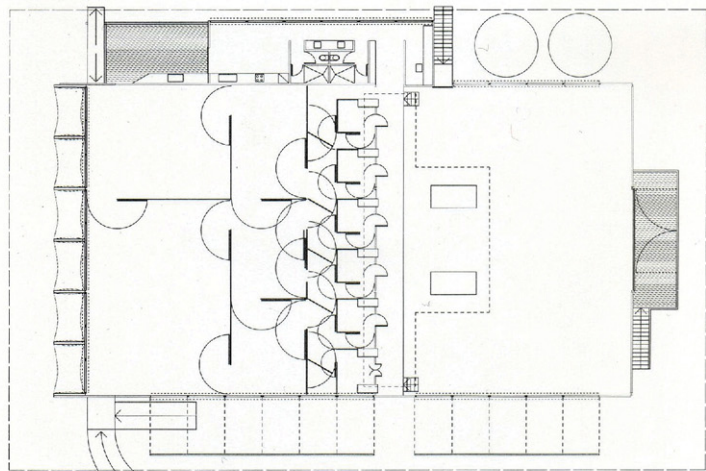
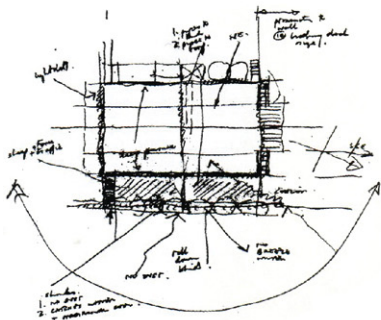
Area: 9,700 SF



section from south



section from west



plan

0 2 5 10m



APPENDIX IV: GIS DATA

David Westlake and Crawford Macpherson of the Municipality of the County of Colchester were kind enough to extract, compile and share a number of geographic information systems (GIS) datasets for this project. The original sources of the datasets are as follows:

1. Agriculture - GIS data on the activity and type of agriculture was created by the NS Department of Agriculture in 1997-1998.

2. Buildings - GIS data was created by the Municipality of the County of Colchester (2011). The County's building footprint layer was generated by digitizing the 2011 High Definition Aerial Photography (15cm resolution) and the Nova Scotia Topographic Database (NSTDB) building footprint data layer.

3. Ecological Land Classification - GIS data was created and compiled by the Nova Scotia Department of Natural Resources

4. Flood Plain - GIS data was generated and compiled by the Town of Truro in 1996, from 1:2400 maps that were compiled by Environment Canada, Inland Waters/Lands and the Nova Scotia Department of the Environment, March 31, 1988. The data layer has not been verified by the Town of Truro or the Municipality of the County of Colchester and is treated as a graphical representation only.

5. Marshes (fresh water, salt water, protected) - GIS data was created and compiled by the Nova Scotia Department of Natural Resources and the Nova Scotia Department of Agriculture.

6. Soils and CLI - GIS data was created by the Nova Scotia Department of Agriculture. The layer was generated from the 1:50,000 map sheets found in the Soils of Colchester County, Nova Scotia (Report 19, Nova Scotia Soil Survey, 1991). The CLI (Canada Land Inventory) information was compiled from the same report.

7. Road Centreline - GIS data was extracted from the Nova Scotia Civic Address File (NSCAF). This layer is maintained by Service Nova Scotia and Municipal Relations.

8. Property Boundaries - GIS data was extracted from the Nova Scotia Civic Property Records Database (NSPRD). This layer is maintained by Service Nova Scotia and Municipal Relations.

9. Contours - GIS data was created by the Municipality of the County of Colchester using LiDAR data. The contours of 1m and 2m were generated by utilizing the software Global Mapper 15.

10. Aerial Photography - High Definition Aerial Photography (15cm resolution) was collected and compiled in 2011 by Leading Edge Geomatics, Lincoln New Brunswick.

APPENDIX V: GLOSSARY

abattoir	A slaughterhouse; a facility where animals are slaughtered for food.
<i>aboiteaux</i>	A one-way gated sluice/culvert which permits drainage of fresh water from behind a dyke.
<i>affinage</i>	The process of maturing/curing cheese, which can involve washing, brushing, patting and/or turning.
agricultural urbansim	An emerging planning, policy, and design framework for integrating a wide range of sustainable food and agriculture system elements into a community.
bulk tank	A large storage tank for cooling and holding milk at a cold temperature.
butchery	A building where animals are butchered; although butchering includes slaughter and the initial preparation of carcasses, the butchery is distinguished here from the processes of the abattoir as a place for the preparation of standard cuts of meat for sale or for further processing.
charcuterie	The branch of cooking devoted to preparation meat products, such as bacon, sausage, terrines, <i>galantines</i> , <i>pâtés</i> , and <i>confit</i> , through traditional preservation methods such as salting, smoking and curing; although pork is most commonly used, it also applies to other meats including lamb.
cheese cave	A specialized facility, either a cellar or an actual cave, with cool temperatures and consistent, high relative humidity, traditionally used for the aging process in cheese making.

CIP system	Clean-in-place system; a method of cleaning the a closed system, such as the interior surfaces of pipes, vessels, process equipment, filters and associated fittings, without disassembly.
dry-curing	A common technique for meat preservation in which a cut of meat is rubbed with a mixture of salt and other ingredients and aged for months to years, during which time curing, fermentation, drying and ripening take place; used in the preparation of prosciutto, sausages, and other charcuterie.
dykelands	Coastal salt marsh which has been drained and dyked to create productive agricultural land; Acadians settlers were the first to practice this landforming in Nova Scotia.
ewe	A full-grown female sheep.
farm-to-table	Reference to the various processes in the food chain from agricultural production to consumption. Also refers to a movement concerned with producing food locally and delivering that food to local consumers.
feedlot	An animal feeding operation used in factory farming for finishing livestock, where livestock are confined and fed carefully mixed, high-concentrate feed to fatten them.
fleece	The wool from a single sheep in the shorn grease state.
food hub	Facilities that manage the aggregation, storage, processing, distribution or marketing of locally and regionally produced food.
forage	Grasses, small shrubs and other plant material that can be used as feed for livestock; edible parts of plants.

galvalume	Metal roofing and siding product comprised of a steel sheet coated with a corrosion-resistant aluminum-zinc alloy.
lairage	A place where livestock may be rested during transit to a market or abattoir.
lamb	(1, noun) A young sheep. (2, verb) To give birth to a lamb. (3, noun) The meat from an animal less than one year old.
lanolin	Natural wool “grease;” byproduct of wool processing.
locavore	A person whose diet consists only or principally of locally grown or produced food (not moved long distances to market), such as the 100-mile diet.
milk house	A specialized area on the dairy farm used expressly for the purpose of isolating fresh milk from the smells, dust, and microbes of the barn environment.
milking parlor	A specialized area on the dairy farm where the milking process is performed.
paddock	An enclosed area for grazing animals.
peri-urban	Immediately adjoining an urban area; between suburbs and countryside.
ram	Uncastrated adult male sheep.
salt marsh	The coastal ecosystem in the upper intertidal zone, between land and open salt water or brackish water, which is regularly flooded by the tides and dominated by dense stands of salt-tolerant plants, in particular grasses. The soil of these wetlands is typically composed of deep mud and peat.
slow food movement	A movement to defend biodiversity in the food supply, spread taste education and connect producers of food with co-producers.

- surface run-off The water flow that occurs when the soil is infiltrated to full capacity and excess water from rain, meltwater, or other sources flows over the land, where it can pick up soil contaminants such as pesticides, fertilizer, and manure.
- terminal sire A ram that has the desired genetic traits for offspring that are intended to be slaughtered (as opposed to offspring for breeding).
- terroir* The combination of local factors, including soil, climate, geology, hydrology, and culture, that gives an agricultural product (for example, wine, cheese or meat) its distinctive character.
- weaning Removal of young mammals from their source of milk (mother).

BIBLIOGRAPHY

- AgraPoint. *Maritime Pasture Manual*. 2009. http://www.perennia.ca/pasture_manual.php.
- Aguayo, Mauricio I., Thorsten Wiegand, Gerardo D. Azocar, Kerstin Wiegand, and Claudia E. Vega. "Revealing the Driving Forces of Mid-Cities Urban Growth Patterns Using Spatial Modeling: a Case Study of Los Angeles, Chile." *Ecology and Society* 12, no. 1 (2007):13. URL: <http://www.ecologyandsociety.org/vol12/iss1/art13/>.
- Animal Architecture. "Stone Barns Center." Last modified May 25, 2009. <http://www.animalarchitecture.org/stone-barns-center/>.
- Arxio.bak. "Agricultural City, Kisho Kurokawa." Last modified March 24, 2013. <http://arx-iubak.blogspot.ca/2013/03/agricultural-city-kisho-kurokawa.html>.
- Bing Maps. Aerial maps of Halifax, the Annapolis Valley, and Truro. 2013. <http://www.bing.com/maps/>.
- Bingham-Hall, Patrick. *Peter Stutchbury: Selected Works*. Sydney, Australia: Pesaro Publishing, 2010.
- Blue Hill at Stone Barns. "Courtyard, Blue Hill at Stone Barns Center." Digital photograph. "On Location: Blue Hill at Stone Barns." *Bowen & Company*. Accessed November 24, 2013. <http://www.bowenandco.com/blog/on-location-blue-hill-at-stone-barns>.
- Bohn & Viljoen Architects. Middleborough Opportunity Map (extract). 2007. Kent School of Architecture. <http://www.kent.ac.uk/architecture/research/centres/create/openlectures/andreviljoen.html>.
- Burke, Ellen. "Farm Plus: Hybrid Agricultural Landscapes." In *Bracket—Almanac 1: On Farming*, edited by Mason White and Maya Przybylski, 88-91. New York: Actar, 2010.
- The Canadian Sheep Foundation. *Virtual Tool Box*. Accessed January 16, 2014. <http://can-sheep.ca/cms/en/Resources/VTBox/VTBox.aspx>.
- Cockrall-King, Jennifer. *Food and the City: Urban Agriculture and the New Food Revolution*. Amherst, NY: Prometheus Books, 2012.
- Colville, Alex. *Seven Crows*. 1980. Digital copy of acrylic polymer emulsion on hardboard, 60 x 120 cm. "Colville: A look at his iconic work," *Chronicle Herald* online. <http://thechronicleherald.ca/novascotia/1142673-colville-a-look-at-his-iconic-work>.
- De La Salle, Janine, and Mark Holland, ed. *Agricultural Urbanism: Handbook for Building Sustainable Food & Agriculture Systems in 21st Century Cities*. Winnipeg: Green Frigate Books, 2010.

- Environment Canada. "Canadian Climate Normals 1971-2000 Station Data." Accessed November 13, 2013. http://climate.weather.gc.ca/climate_normals/index_e.html.
- Fraser, Bud. "Integrated Infrastructure for Local Food and Agriculture." In *Agricultural Urbanism*, edited by Janine de la Salle and Mark Holland, 103-14. Winnipeg: Green Frigate Books, 2010.
- Glase, Nick. "Seasoned Pasture: A Demonstration Range and Public Park." In *Bracket—Almanac 1: On Farming*, edited by Mason White and Maya Przybylski, 122-126. New York: Actar, 2010.
- Global Footprint Network. "Measuring the Footprint of the 'World's Greenest City'." Last modified July 12, 2010. http://www.footprintnetwork.org/en/index.php/GFN/blog/measuring_the_footprint_of_the_worlds_greenest_city.
- Google Maps. Map of greater Truro, Nova Scotia. 2013. <http://maps.google.ca>.
- Henner, Mishka. "Coronado Feeders, Dalhart, Texas." 2013. Digital copy of archival pigment print, 150x180cm. <http://www.mishkahenner.com/Feedlots>.
- Karlin, Mary. "Ripening and Aging Guidelines." From *Artisan Cheesemaking at Home*. Ten Speed Press, 2011. <http://www.artisancheesemakingathome.com/cheesemaking-ripening.html>;
- Ladner, Peter. *The Urban Revolution: Changing the Way We Feed Cities*. Gabriola Island, BC: New Society Publishers, 2011.
- Lillooet Sheep Pasture Golf Course. "Golfing in Lillooet." Last modified 2012. <http://www.lillooetgolf.com/>.
- Loom Studio. "Farm Logic." In *Bracket—Almanac 1: On Farming*, edited by Mason White and Maya Przybylski, 204-207. New York: Actar, 2010.
- Lorenzetti, Ambrogio. *Allegory of Good Government*. Fresco painting, 1338-9. From Imgarcade, *Gallery for the Effects Of Good Government In The City And Country* (website). Accessed March 25, 2014. <http://imgarcade.com/1/effects-of-good-government-in-the-city-and-country/>.
- Machado and Silvetii Associates. *The Rockefeller Stone Barns, Pocantico Hills, New York 2004*. Accessed February 6, 2014. http://www.machado-silvetti.com/projects/stone_barns/index.php.
- Machrihanish Dunes. "Scottish Links Golf Courses in Kintyre." Last modified 2014. <http://machrihanishdunes.com/golf/>;

- MacLean, Alex S. "Housing Tone Shift - Seaside Park, NJ." 2011. Digital capture photograph, ref # 110715-0715. <http://www.alexmaclean.com/#/portfolio/dwelling/110715-0715>.
- . "Wheat Strips Run Perpendicular to the Prevailing Wind, Conrad Area, Montana." Digital version of film photograph, ref# LS_4734_07. Accessed March 25, 2014. <http://www.alexmaclean.com/#/portfolio/growing/1052-166rF2>.
- McCully, Richard. Aerial photographs of Truro, Nova Scotia and surrounding area, 1931. From Nova Scotia Virtual Archives, McCully Collection. Accessed October 5, 2013. <http://www.novascotia.ca/nsarm/virtual/mccully/>.
- Menzel, Peter, and Faith D'Aluisio. "The Melansons of Iqaluit, Nunavut Territory, Canada" and "The Ahmed family of Cairo, Egypt," Digital photographs. From "Hungry Planet: What the World Eats." *Time* online. Last modified September 20, 2013. http://world.time.com/2013/09/20/hungry-planet-what-the-world-eats/photo/can_061005_150_f1x/.
- Misra, R.V., R.N. Roy and H. Hiraoka. *On-Farm Composting Methods*. Rome: Food and Agriculture Organization of the United Nations, 2003. Accessed online January 24, 2013. <http://www.fao.org/docrep/007/y5104e/y5104e07.htm>.
- Municipality of the County of Colchester. "Agricultural Planning for the Clifton District Federation of Agriculture." Accessed November 19, 2013. <http://www.colchester.ca/planning>.
- . Map of Area of Interest in Lower Truro, Nova Scotia. Geographic Information Systems (GIS) datasets compiled December 27, 2013. Using ArcGIS [GIS software] and AutoCAD Map 3D 2012 [CAD software]. For list of original dataset sources, see Appendix IV.
- Nova Scotia Agricultural Land Review Committee. "Preservation of Agricultural Land in Nova Scotia." 2010. <https://www.novascotia.ca/agri/elibrary/nsalrc/>.
- Nova Scotia Department of Agriculture. *Environmental Regulations Handbook for Nova Scotia Agriculture*, 2nd Edition, 2004. http://www.novascotia.ca/agri/rs/envman/env_handbk.pdf.
- Nova Scotia Department of Agriculture. *Manure Management Guidelines*, 2006. http://www.novascotia.ca/agri/rs/envman/manureguide_2006lowres.pdf.
- Nova Scotia Department of Agriculture. *Sheep Industry*. Accessed November 20, 2013. <http://growingnovascotia.ca/opportunity-profiles/sheep-industry>.
- NSW Department of Primary Industries. "Grazing the Coastal Floodplain: Meet the graziers who are farming the floodplain sustainably." State of New South Wales, 2008. http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0017/405701/Grazing-the-coastal-floodplain-case-studies.pdf.
- O'Hara, Finn. "Jackson-Triggs Niagara Estate Winery, Niagara-on-the-Lake." Digital photograph. March 27, 2012. From "Jackson-Triggs Winery for *re:porter*, the journal of Porter Airlines." <http://finnohara.com/blog/?p=2568>.

- OpenBuildings. "Perspective of Faustino Winery." Digital image. Accessed October 30, 2013. <http://openbuildings.com/buildings/faustino-winery-profile-1513>.
- Pasanen, Melissa. "For Temple Grandin, Changing Slaughterhouses Meant Long-Term Commitment." *Burlington Free Press*, Jan. 13, 2012. http://www.burlingtonfreepress.com/article/20120113/GREEN01/301130002/For-Temple-Grandin-changing-slaughterhouses-meant-long-term-commitment?nclick_check=1.
- Plummer, Henry. "Dominus Winery, California, USA | Herzog & de Meuron." Digital photograph. 2009. From Random House, *The Architecture of Natural Light*. http://www.randomhouse.com/catalog/promo_image/9781580932400_1389.jpg.
- Pollan, Michael. *The Omnivore's Dilemma: A Natural History of Four Meals*. New York: Penguin Press, 2006.
- Raskin, Laura, and Halkin Mason. "The Cows Come Home." *Architectural Record* 201, no. 7 (July 2013): 80-5.
- Richard Rogers Partnership. "Computer generated perspective view from the castle, Bodegas Protos." Digital image. Accessed October 30, 2013. <http://www.rsh-p.com/render.aspx?siteID=1&navIDs=1,4,23,424>.
- Savorelli, Pietro. "Archea Associati - Cantine Antinori in Bargino, San Casciano in Val di Pesa, Firenze, Italy." Digital photograph. June 11, 2012. From Google Images. <https://plus.google.com/photos/+FrancoDiCapua/albums/5881147675323451425/5881148744162839730?pid=5881148744162839730&oid=103439913885248954332>.
- Stanwick, Sean, and Loraine Fowlow. *Wine by Design*. Chichester, England: Wiley, 2006.
- Statistics Canada. "Census Profile: Truro, Nova Scotia." 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. <http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E>.
- Steel, Carolyn. "How Food Shapes Our Cities." Lecture, TED Conference, Oxford, July 24, 2009. http://www.ted.com/talks/carolyn_steel_how_food_shapes_our_cities.html.
- . *Hungry City: How Food Shapes Our Lives*. London: Vintage Books, 2009.
- . "Sitopia: How We Think Through Food." Lecture, TEDxDanubia, Budapest, March 25, 2011. <http://www.youtube.com/watch?v=aLOHsc86lkc>.
- Stone Barns Center for Food and Agriculture. *Stone Barns Center for Food and Agriculture*. Accessed February 6, 2014. <http://www.stonebarnscenter.org/visit/index.html>.
- Sustainable Cooperative for Organic Development. "Garden Cities by Ebenezer Howard." Accessed March 25, 2014. <http://scodpub.wordpress.com/2011/03/01/garden-cities-by-ebenezer-howard/>.

- Tenhour, Meredith. "The Architect's Farm." In *Above the Pavement—The Farm!: Architecture & Agriculture at P.F.1*, edited by Amale Andraos and Dan Wood, 166-88. New York: Princeton Architecture Press, 2010.
- Town of Truro. "Section 9: Environmental Management." In *Municipal Planning Strategy*. Amended October 2013. <http://www.truro.ca/municipal-planning-strategy.html>.
- U.S. Geological Survey. Landsat aerial photographs of Truro, NS. 1985 (May 25, June 28 & October 16) and 2013 (May 6 & June 23). <http://landsat.usgs.gov>.
- Viljoen, Andre, Katrin Bohn and Joe Howe. *Continuous Productive Urban Landscapes (CPULs): Designing Urban Agriculture For Sustainable Cities*. Amsterdam: Architectural Press (Elsevier), 2005.
- Waldheim, Charles. "Notes Towards a History of Agrarian Urbanism." In *Bracket—Almanac 1: On Farming*, edited by Mason White and Maya Przybylski, 18-24. New York: Actar, 2010.
- . "Notes Towards a History of Agrarian Urbanism." Online essay. From *Design Observer*. Last modified April 11, 2010. <http://places.designobserver.com/feature/notes-toward-a-history-of-agrarian-urbanism/15518/>.
- Webb, K.T., K.L. Thompson, G.J. Beke and J.L. Norvland. "Soils of Colchester County, Nova Scotia." Report No. 19, Nova Scotia Soil Survey. Ottawa: Research Branch, Agriculture Canada, 1991.
- Weisberg, Jackie. "Shorn sheep in a barn at Stone Barns Center for Food and Agriculture, Pocantico Hill, New York." Digital photograph. 2011. From Flickr. <http://www.flickr.com/photos/jackiew/5674037883/>.
- Windfinder. "Wind & weather statistics Debert/Truro." Accessed November 13, 2013. http://www.windfinder.com/windstatistics/debert_truro.
- Woschek, Heinz-Gert, Denis Duhme and Katrin Friederichs. *Wine and Architecture*. Munich: Edition Detail, 2012.
- Wright, Matt. "Meat Curing Safety." *Wrightfood*. Last modified February 24, 2011. <http://mattikaarts.com/blog/charcuterie/meat-curing-safety/>.