On the care of cottonwood

tending + attending
to our sentinel trees

Lindsay Mamchur

On the care of cottonwood: tending and attending to our sentinel trees.

by Lindsay Mamchur

A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF LANDSCAPE ARCHITECTURE

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Abstract

This is a project devoted to a tree. The tree is the Plains cottonwood, known for its superlative growth rate, size, and longevity in the Great Plains. Well attuned to local growing conditions, cottonwood are among the tree species that define Winnipeg, a city of 750,000 people located in Manitoba, Canada. I call these trees sentinels because those that reach maturity witness much change in their 200+ year lifespan.

Winnipeg's urban cottonwood population is composed of mature declining trees; a small number of planted trees; and self-seeded trees growing in leftover land, unlikely to survive to middle age. The mature declining class is the most ecologically, spatially, and, I argue, culturally significant of the population. As things are, no near-future population of mature cottonwood will be as numerous or widespread. Shifts in the regional hydrological system and in patterns of human settlement and interaction result in fewer opportunities for natural cottonwood propagation. This, coupled with their largeness, perceived ill-suitedness for urban spaces and enduring image as a seedy, short-lived nuisance tree, has led to chronic underplanting.

What, then, I see as a design response is clear: plant more cottonwood. But rather than simply plant trees, I propose establishing distinct cottonwood configurations that we can tend and attend to over time as we do our current sentinels and in new ways that celebrate the tree, our shared histories, and the processes critical to a cottonwood's lifecycle, being, and meaning.

Acknowledgements

To Kamni, Leanne, and Nathan; thank you for your time, encouragement and enthusiasm.

To Mom, Dad, Jordyn and Meagan.

And to all others who viewed drawings, shared stories and walked with me in McBeth Park.

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I call these trees sentinels
because those that reach maturity
witness much change in their 200+ year lifespan.

I am drawn to these trees for these reasons and
because I think they are special and beautiful.

Chapter 1: Portrait

Names

Common	Plains Cottonwood[1]
Cree	Tasékátik[2]
	Písowayánáhtik[3]
Dakota	Wagha chan[4]
Lakota	Waga can (“rustling tree”)[5]
Français	Peuplier deltoïde de l’Ouest[6]
Kingdom	Plantae (plants)[7]
Subkingdom	Tracheobiota (vascular plants)
Superdivision	Spermatophyta (seed plants)
Division	Magnoliophyta (flowering plants)
Class	Dilleniidae (unique tissue)
Order	Salicales (willow)
Family	Salicaceae (willow)
Genus	*Populus* Linnaeus
Species	*Populus deltoides* Bartram ex Marshall (Eastern Cottonwood)
Subspecies	*Populus deltoides* Bartram ex Marshall subsp. *monilifera* (Aiton) Eckenwalder
Scientific	*Populus deltoides* subsp. *monilifera* (Ait.) Eckenw.
	Populus deltoides var. *occidentalis* Rydb.[8]
	Populus sargentii Dode[9]

Definition

A Plains cottonwood is a large, deciduous tree who grows along streams and rivers in the Great Plains.[10] It is the largest tree of our prairie landscape, in favourable conditions reaching ages upward of two hundred years.

The tree is one of eight native cottonwood found across North America (i.e. Black, Fremont, Lanceleaf, Narrowleaf, Rio Grande, Swamp, Plains, Eastern),[11] species who hybridize freely where their ranges overlap.[12] Plains cottonwood is the predominant cottonwood species in the Great Plains region. The tree's latin binomial, *Populus deltoides* subsp. *monilifera*, denotes that it is considered a subspecies or close relative of Eastern cottonwood, *Populus deltoides*. While the two trees share many characteristics, Plains cottonwood can be distinguished by its slightly shorter and wider stature and deeply furrowed gray-brown bark.[13] The Plains' leaf is another identifier; it has a straight or inwardly-curving bottom margin and a longer tapered point, as compared to Eastern and other cottonwood leaves.[14] Each spring, cottonwood trees produce great quantities of cottony seed, which drift in the wind and blanket the ground - a spectacle so noticed that it gave the tree its common name.

Fig. 1.1. A single cottonwood portrait.

1 As it is the widest known name, I most frequently refer to the tree as a "Plains cottonwood" or, simply, "cottonwood" in this text.
2 École Provencher and Winnipeg Trails, "Identification des peupliers à feuilles deltoïdes," (infographic poster).
3 École Provencher and Winnipeg Trails, "Identification."
4 iNaturalist, "Cottonwood," accessed December 4, 2023, https://www.inaturalist.org/guide_taxa/873098#ref8.
5 Jeffrey Zelitch, "The Lakota Sun Dance," *Expedition Magazine* 13, no. 1 (Fall 1970): 19.
6 "Plains Cottonwood," Natural Resources Canada, last modified August 4, 2015, https://tidcf.nrcan.gc.ca/en/trees/factsheet/443.
7 For all classification items: Kathleen Cain, *The Cottonwood Tree: an American Champion* (Denver: Bower House, 2007), 8.
8 "Plains Cottonwood," Natural Resources Canada.
9 "Plains Cottonwood," Natural Resources Canada.
10 Cain, 9.
11 Cain, 9.
12 Reinhard F. Stettler, *Cottonwood and the River of Time* (Seattle: University of Washington, 2009), 71.
13 Cain, 23.
14 Cain, 22.

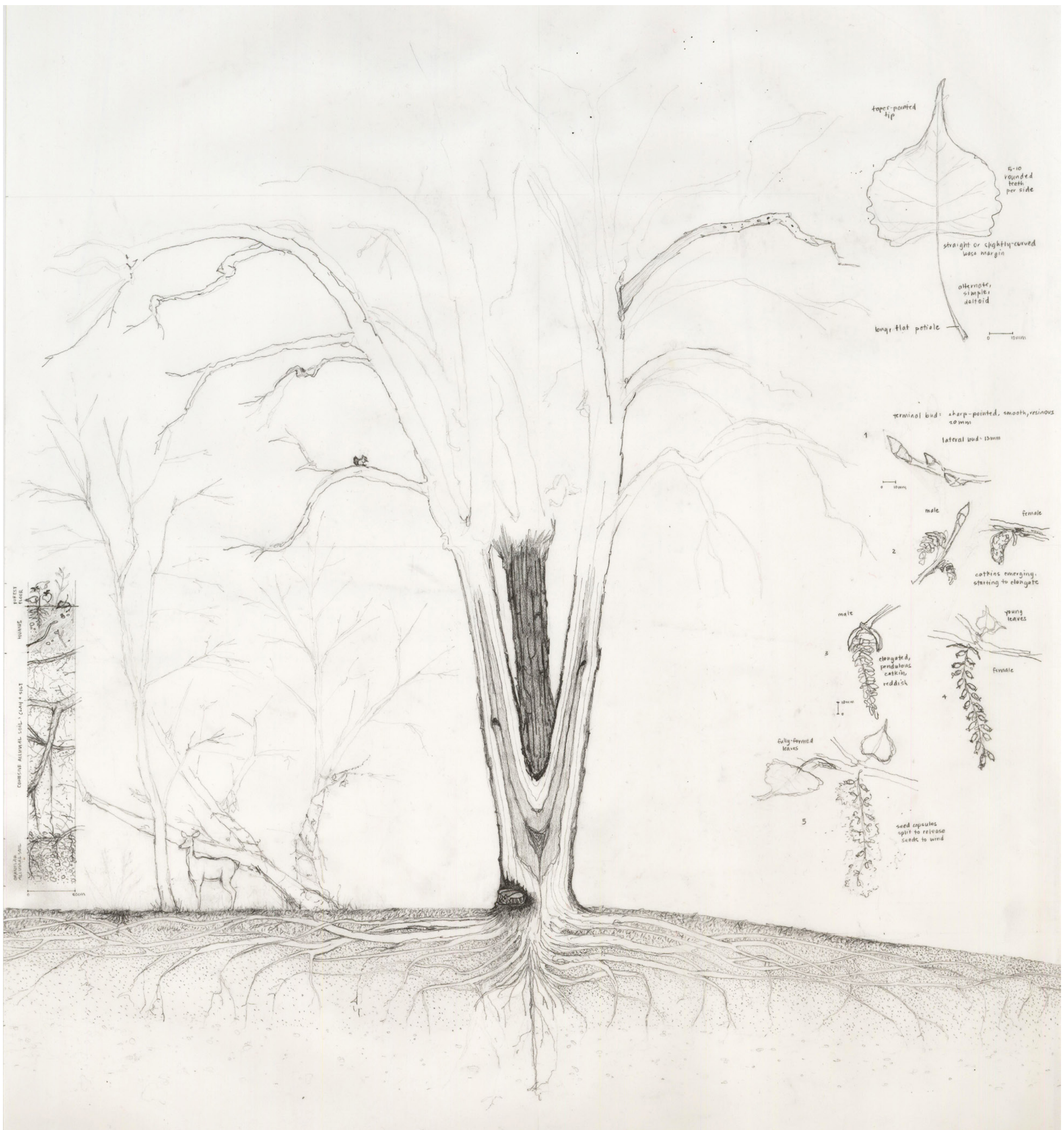
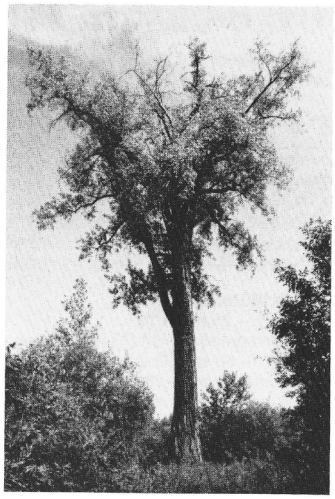

taper-pointed tip
5-10 rounded teeth per side
straight or slightly-curved base margin
alternate, simple, deltoid
long, flat petiole
0 10mm
terminal bud: sharp-pointed, smooth, resinous 20mm
1
lateral bud - 13mm
0 10mm
male
female
2
catkins emerging, starting to elongate
male
3
elongated, pendulous catkin, reddish
10mm 0
young leaves
female
4
fully-formed leaves
5
seed capsules split to release seeds to wind

Fig. 1.2. Riparian habitat.

Fig. 1.3. Plains cottonwood distribution.

RECORD TREES



Meanings

Fig. 1.4. Manitoba's Largest Tree, *Heritage Trees of Manitoba* (Winnipeg: Manitoba Forestry Association, 1987): 30.

In Winnipeg, the Plains cottonwood is known for its superlative growth rate, seediness, size and longevity. Several individuals are celebrated "Heritage Trees," nominated and profiled in a 1987 publication by the Manitoba Forestry Association (fig. 1.4) and online in the Manitoba Tree Register. Other cottonwood trees receive acknowledgement from immediate neighbours, who name, measure, climb, harvest from, and revere them - different forms of tending and attending.

Though they are not the most common or widespread tree in our city, cottonwood seem to express, through their stature and age, a rootedness and comfort growing in local conditions. They are a riparian species and this is, after all, a river city. Of course, cottonwood grew here long before a city existed.

Cottonwood trees have invited relationships to humans over time and across their native range (fig. 1.3.). Indigenous peoples have long tended and attended to cottonwood. The tree was, to most, of great practical importance. Wood was a source of fuel and construction material.[15] Yellow, aromatic bud resin was concentrated into medicines and dyes.[16] Some parts, like catkins or soft inner cambium, were food for people in hard times.[17] In sparsely wooded plains, cottonwoods indicated water and shelter, and marked distances along seasonal movement paths.[18]

15 Cain, 24.
16 Cain, 24.
17 Cain, 24.
18 Gerald A. Oetelaar, "Indigenous stewardship: lessons from yesterday for the parks of tomorrow," (paper presented at the Canadian Parks for Tomorrow: 40th Anniversary Conference, University of Calgary, Calgary, AB, May 8 to 11 2008), 9.

Early trappers and traders learned the uses of cottonwood from Indigenous peoples and devised other applications.[19] The tree's harvest for fuel continued.[20] Farmers later built homesteads from cottonwood lumber fenced with cottonwood posts and sheltered by planted cottonwood windbreaks.[21] The wood is known for its relative weakness and indistinct cream-coloured grain, and it can be uncooperative in attempts to manipulate it.[22] Despite this, cottonwood has been used in making products like boxes, crates, pallets, plywood, pulp, and furniture framing.[23] Though perceived commercial value is limited, skilled craftspeople appreciate working the better quality wood – straight-grained and knot-free – by hand and carvers prize the dried bark for its softness.[24]

Beyond cottonwoods' utility is its cultural significance. As do many Plains nations, Lakota people share a special relationship to cottonwood, which they call waga can or the "rustling tree," so named for its sound in the wind - prayer and song for Wakan Tanka, Grandfather.[25] A specially chosen cottonwood is felled for Sun Dance ceremonies, during which the trunk is erected as the centre pole of the altar, a sacred link between the earth and sky.[26] By many Peoples, the tree is associated with the sky and with stars, a relationship strengthened by the five-pointed star revealed in the pith of a cottonwood stem. To the Lakota, the form represents the morning star of light and wisdom.[27] Dakota storytellers narrate the star's origin, how it descended from the sky and

19 Cain, 24.
20 G.B. MacDonald, *The Growth, Returns and Uses of Planted Cottonwood in Iowa* (Ames: Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts, 1924), 169.
21 MacDonald, *The Growth*, 170-171.
22 Harvey E. Kennedy, *Cottonwood: An American Wood* (Washington, D.C.: U.S. Department of Agriculture, Forest Service, 1985): 7.
23 Cain, 19.
24 Cameron Turner, "Misunderstood & Maligned: Rethinking the Cottonwood," *Mortise & Tenon Magazine*, May 24, 2021, https://www.mortiseandtenonmag.com/blogs/blog/misunderstood-maligned-rethinking-the-cottonwood.
25 Zelitch, 19.
26 Zelitch, 19.
27 Zelitch, 19.

took shelter in a cottonwood tree in order to hear the sounds of people living nearby.[28] Other variations tell of how the stars are born deep in the earth and brought up through cottonwood roots and into branches, which, when broken by wind, release the stars into the dark night.[29]

To many Indigenous cultures, the practical and spiritual value of the trees are inseparable. Notably, the Niitsitapi of the northern Great Plains understand the cottonwood groves that grow across their homeland as both a rich supply of resources and a sacred place cared for by their ancestors, even after they passed on.[30] In an important death ritual, bodies of the deceased were laid to rest on platforms in the trees' canopies so that the Sun could release their spirit, which thereafter became an intermediary between the living and other beings.[31] So where the groves established, they were raised by the Niitsitapi. They attended the trees seasonally to remember their ancestors and to fulfill their responsibility in maintaining the grove, and by extension other beings and the broader balance of nature, by clearing the understorey through harvest and low intensity burning.[32] The Niitsitapi know the cottonwood groves as living products of their multi-generational tending practices.

In a way, the city is an unfit frame with which to explore the history of local cottonwood, since for all but a few centuries of the species' existence they have grown

28 Mary Louise Defender Wilson, "The Star in the Cottonwood Tree," YouTube, November 13, 2001, video, 4:56, https://www.youtube.com/watch?v=WPVvIKEi_d8&t=70s.
29 "stars in cottonwoods," University of Washington, accessed December 4, 2023, https://depts.washington.edu/hortlib/pal/stars-in-cottonwoods/.
30 Oetelaar, 10.
31 Oetelaar, 10.
32 Oetelaar, 9-10.

differently, alongside people whose interactions with the trees were guided by more sensitive understandings of natural systems.

Upon the arrival of European colonists, timeworn relationships to cottonwood were severed or readapted,[33] as Indigenous peoples across the continent were displaced from traditional territories and land practices. Human relationships to cottonwood changed in scale and consequence, even unintentionally. New disruptions were initiated in regional hydrological and agricultural systems that, still today, challenge and hinder cottonwood populations. Settlements grew around or over the trees. In less than a single tree's lifespan, the city of Winnipeg developed and incorporated.[34] Today's mature individuals bore witness to much change.

More than any other trees, these cottonwood are our sentinels, our watchful guardians whose crowns top all others to scan the most distant horizons.

The sentinels will continue to see change in their already repressive urban conditions. The city, as it is, does not nurture cottonwood. While they are not dependent on human nurturing, cottonwood benefit from our attention - our tending and attending - just as we have long benefitted from their practical and spiritual resources.

Fig. 1.5. McBeth Park cottonwood, before falling, September 26, 2020.

33 How precontact relationships to cottonwood transformed vary greatly. One example, related to the legality of Sun Dance ceremonies, is described by Zelitch, 18.

34 J. M. Bumsted, "Winnipeg Time Line (1812-2000)," Manitoba Historical Society, last modified December 2, 2023, https://www.mhs.mb.ca/docs/features/winnipegtimeline/index.shtml.

Role in Riparian Ecosystems

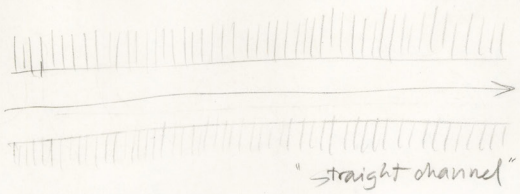
Fig. 1.6. Mature cottonwood towering over riparian successors.

Cottonwood are reliably found in floodplain and riverbank habitats. In these environments, they are a keystone species, an organism with significant influence on their ecosystem, disproportionate to their number.[35]

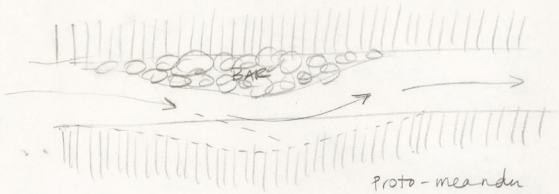
Once mature, cottonwood tower over boxelder, ash, and elm, successors who rise from understorey shade. The abundance of debris shed seasonally by a single cottonwood helps build the soil layer upon which succeeding species rely.[36] Their debris - branches, logs, driftwood, whole trees - that falls into a watercourse helps shade the channel, catch sediment, and provide cover for aquatic species.[37] Cottonwood stabilize banks with sprawling root systems, slowing erosion thereby protecting water quality.[38] They regulate ambient air temperature and humidity levels, establishing a microclimate that helps support understorey organisms.[39] They provide cover and habitat for an array of microbes, insects, birds, and mammals.[40] A declining cottonwood, prone to hollowing, can host many cavity-nesting animals like woodpeckers, owls, tree-nesting ducks, raccoons, and skunks.[41]

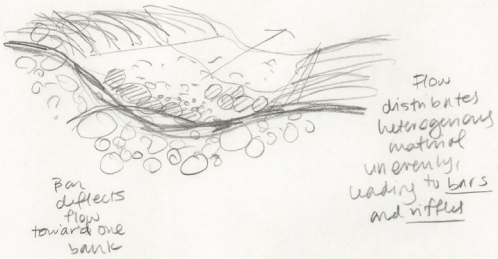
Many ecological functions performed by a cottonwood tree become more productive with age.

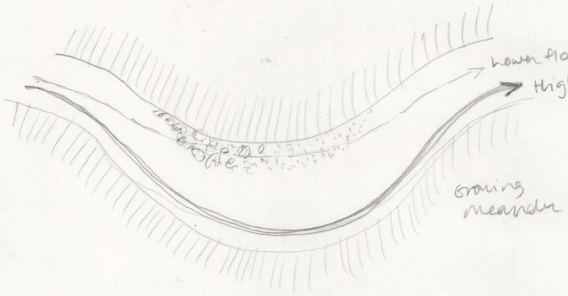
35 Karen Allen, "Colorful cottonwoods help our streams and rivers," Deschutes Land Trust, October 16, 2019, https://www.deschuteslandtrust.org/news/blog/2019-blog-posts/cottonwood-benefits/.
36 Stettler, 9.
37 Allen, "Colorful cottonwoods."
38 Allen, "Colorful cottonwoods."
39 Stettler, 9.
40 Stettler, 9.
41 Candace Savage, Prairie: *A Natural History of the Heart of North America* (Vancouver: Greystone Books, 2011), 361; Cain, 92.

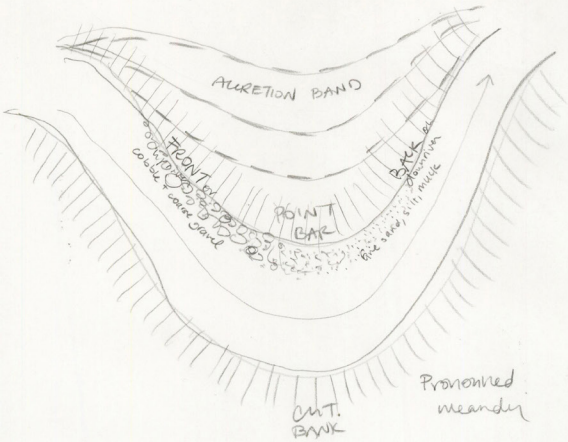

"straight channel"

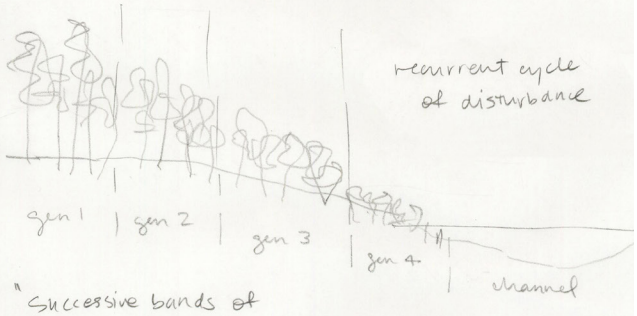

Heterogeneous material

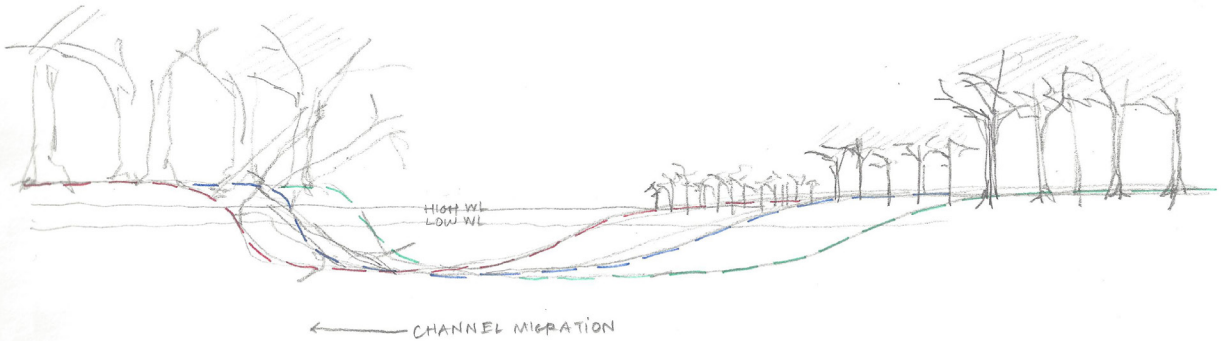

BAR
Proto-meander


Bar deflects flow toward one bank
Flow distributes heterogeneous material unevenly, leading to bars and riffles


lower flow velocity DEPOSITS
higher flow velocity CARVES bank
Centrifugal force
Growing meander


ACCRETION BAND
FRONT
POINT BAR
BACK
Prominent meander
CUT. BANK


recurrent cycle of disturbance
gen 1
gen 2
gen 3
gen 4
channel
"Successive bands of seedling cohorts"


High WL
Low WL
CHANNEL MIGRATION

Stand Development + the River

Fig. 1.7. River meander dynamics.
Fig. 1.8. Channel migration.

As a riparian species, cottonwood processes are closely linked to those of the adjacent watercourse. In fact, in a free-flowing river, cottonwood stand development is driven by river meander and flood dynamics (fig. 1.7).

Before a river has begun to meander, the bed of a straight channel is composed of stones and sediment of various size and mass.[42] A proto-meander forms when the flow of water distributes the heterogenous material unevenly, creating bars and riffles that deflect waterflow toward one bank.[43] As the river moves around the meander, it is subject to centrifugal force.[44] Near the inside bend, or point bar, water velocity falls and sediment carried in the water is deposited.[45] Near the outside bend, or cut bank, water velocity rises and carves sediment from the bank.[46] The meander grows as the erosion-deposition cycle continues, aided by flooding. The point bar extends seasonally, building increments of land still highly susceptible to disturbance and wash out by strong currents or flooding. The new land, an exposed bed of coarse, heat-holding, nutrient-deficient gravel,[47] has little to offer most living things. Cottonwood seedlings, however, are uniquely adapted to take root in this harsh environment. Full sunlight, access to water, and a lack of competition are key factors that allow the seedlings to establish as an even-aged band parallel to the channel.[48] Successive bands develop as the point bar extends, while at the same time growth on the opposite bank is undercut (fig. 1.8).[49]

42 Stettler, 13.
43 Stettler, 13.
44 Stettler, 13.
45 Stettler, 13.
46 Stettler, 13.
47 Stettler, 15.
48 Stettler, 15, 21.
49 Stettler, 16.

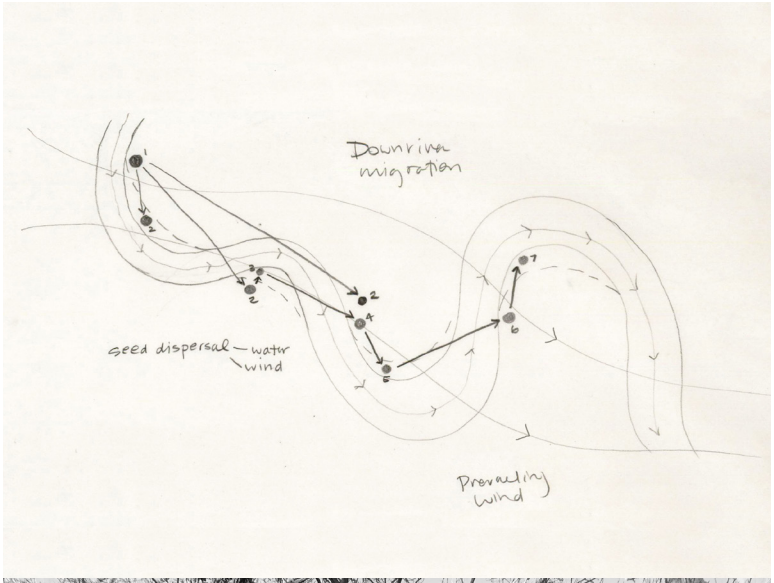
Flooding + Disturbance

Seasonal flooding and disturbance are environmental processes cottonwood has evolved to endure. For instance, cottonwood growing in floodplains have adapted to frequent flooding by extending shallow root systems.[50] Sometimes visible in mature riparian stands, cottonwood roots remain close to the soil surface, where oxygen first becomes available when floodwaters recede.[51] Further, certain biological mechanisms of cottonwood are genetically programmed by the timing of seasonal cycles and events, such as how seeds gestate over a relatively short eight to ten week period to disperse before other species and in time to root in fresh flood deposits.[52]

In even more finely tuned ecosystem interactions, cottonwood have evolved to rely on certain forms of disturbance for stand regeneration. As an early-successional species, cottonwood are among the first trees to appear on disturbed land, like a riverine point bar, where meager resources keep less adaptable competitors away.[53] Once enough cottonwood debris has decomposed and openings in the canopy allow sunlight to reach the new soil, succeeding species start their ascent, crowding out any future cottonwood regrowth.[54] Instead, as cottonwood declines, their offspring must find a new bed in which to root - downslope, downstream, or downwind (fig. 1.9).[55] If wind or waters do carry them to a silted bar or scoured gap, the succession cycle begins anew. In this way, cottonwood hinges on migration and disturbance.

Fig. 1.9. Downriver migration.
Fig. 1.10. McBeth Park, flooded, May 3, 2023.

50 Cain, 9.
51 Cain, 9.
52 Stettler, 19.
53 Stettler, 6.
54 Stettler, 23.
55 Stettler, 36.


Downriver
migration
seed dispersal — water
wind
Prevailing
wind

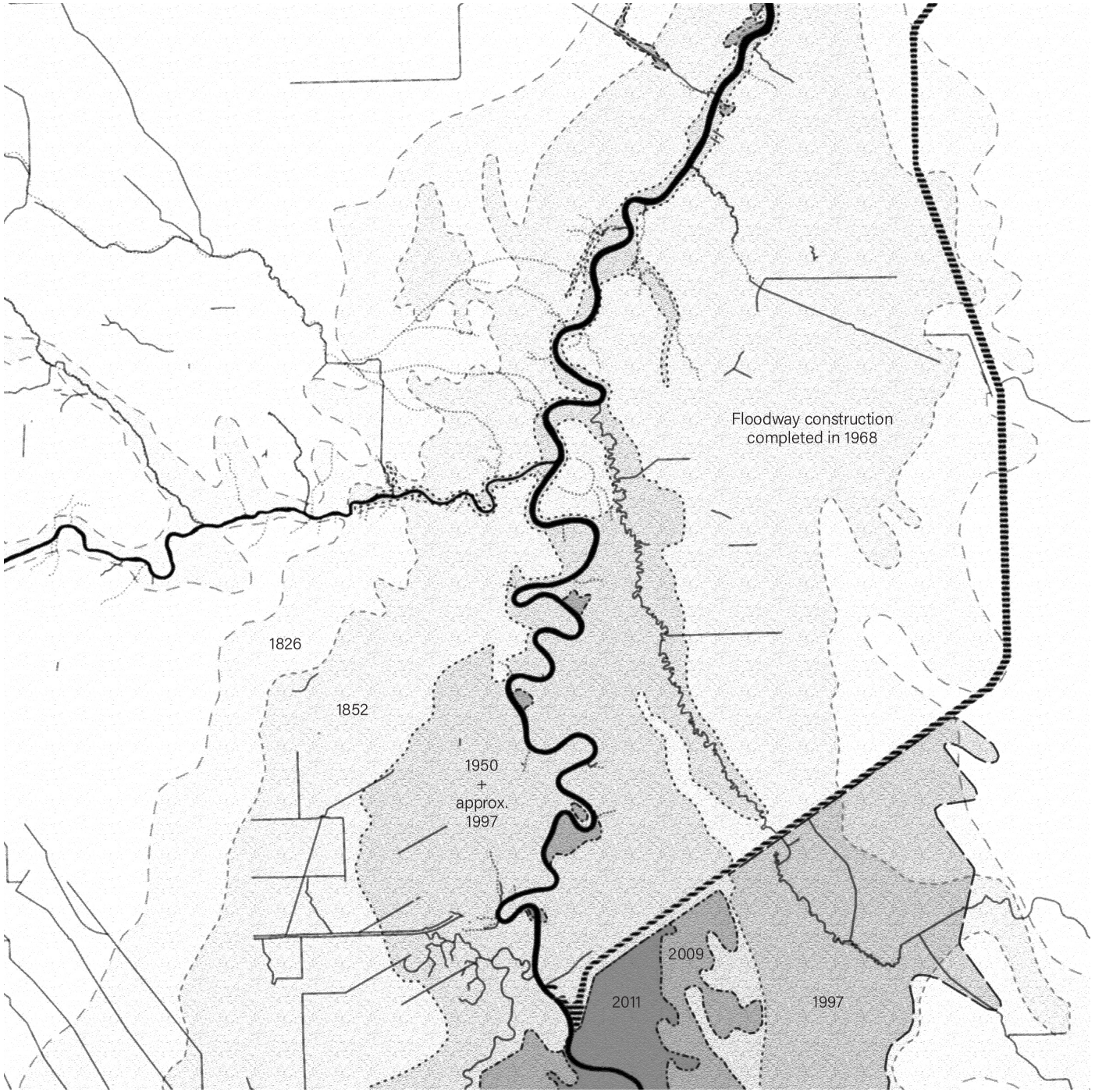


Fig. 1.11. Historic flood extents, map.

This map shows flood extents in the Winnipeg area from 1826, suspected to be around the time that older trees in the city were taking root. Change in flood extents after the construction of the Red River Floodway reflect an altered hydrological regime.

Hydrological History

Since cottonwood have come to depend on riverine disturbances to regenerate, human interventions into the hydrological regime affect the species' regrowth. In 1826, when current sentinel cottonwood were young, major flood events covered much of what is now Winnipeg's urban area. As the city developed, flooding threatened widespread damage, as witnessed during the 1950 flood, setting in motion an extensive flood response program.[56] Completed in 1968, the Floodway was designed to control the flow of the Red River by receiving floodwater diverted at an upstream control structure, carrying it around the city, and discharging it back into the river downstream.[57] What results from the Floodway is a more stable flow regime and reduced risk of damage to urban property. Weakened are the variable flow rates and erosion-deposition cycle that precipitate channel migration in free-flowing rivers. Instead, the watercourse shifts only slightly, an almost static channel whose banks erode into steep, dry faces less suitable for emergent and riparian vegetation like cottonwood.[58]

56 Robert W. Passfield, "'Duff's Ditch': The Origins, Construction, and Impact of the Red River Floodway," *Manitoba History*, no. 42 (Autumn/Winter 2001-2002): 3.
57 Passfield, "'Duff's Ditch," 5-6.
58 Stewart B. Rood and John M. Mahoney, "Collapse of Riparian Poplar Forests Downstream from Dams in Western Prairies: Probable Causes and Prospects for Mitigation," *Environmental Management* 14, no. 4 (1990): 459.

Fig. 1.12. Cottonwood in the public tree inventory, map.

This map shows the public tree inventory, data points (lightest gray) representing about a third of the urban forest. *Populus* trees are emphasized with a darker shade of gray and *Populus* trees with a DBH equal to or over 100cm are marked with a large gray dot. It should be noted that the public tree inventory does not include trees in forested parks and on some public riverbanks. Unsurveyed cottonwood is certain in areas, like McBeth Park, and likely in others. Cottonwood on private land is unexplored in this study.

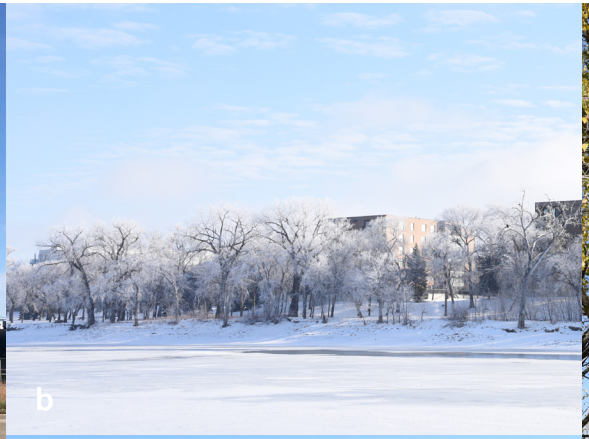
Cottonwood in the Urban Forest

Our current cottonwood population, shaped by past and present hydrological patterns, represents but one species in a larger urban forest. In Winnipeg's public tree inventory, cottonwood and hybrid poplar account for 2.5% of trees.[59] Within this fraction, trees with a diameter at breast height equal to or over 100cm, speculative mature cottonwood, make up only 3.6%.[60] The inventory is otherwise outweighed by ash, at 33%, and elm, 25%.[61] Given that ash and elm's dominant biculture is under threat by invasive pests and disease, cultivating species diversity in the urban forest is critical. According to the city's Urban Forest Strategy, underrepresented species like linden, maple, hackberry, and poplar are being planted in higher proportions.[62] However, some poplars, excluding *Populus tremuloides*, are noted as "less preferred" planting options.[63]

Further, poplar species compose 15% of dead trees, second after ash at 23%, and 2% of the poplar population is removed annually.[64]

59 City of Winnipeg and Diamond Head Consulting Ltd, *Winnipeg Comprehensive Urban Forest Strategy* (Winnipeg: City of Winnipeg, 2022), 54.
60 City of Winnipeg, *Tree Inventory Map using New Visual Experience*, shapefile, last modified December 4, 2023.
61 *Winnipeg Comprehensive Urban Forest Strategy*, 53.
62 City of Winnipeg and Diamond Head Consulting Ltd, *Winnipeg Comprehensive Urban Forest Strategy: State of the Urban Forest* (Winnipeg: City of Winnipeg, 2021), 15.
63 *Winnipeg Comprehensive Urban Forest Strategy*, 54.
64 *Winnipeg Comprehensive Urban Forest Strategy*, 54; *Winnipeg Comprehensive Urban Forest Strategy: State of the Urban Forest*, 17.


a


b


c


d


e


f

Cataloguing Cottonwood

Many forms of cottonwood are present in Winnipeg: (a) Planted saplings are present but uncommon, evidence of the tree's status as a "less preferred" planting option. Often, cottonwood varieties and hybrids are favoured over "wild" cottonwood for their selectively cultivated traits related to growing form and seeding behaviour.[65] (b) Riverbanks are good places to find older cottonwood, remnants of once thicker riparian corridors. (c) Pure, even-aged stands, products of healthy river disturbances, are rare in our city. Such a stand grows in Lagimodière-Gaboury Park on the floodplain of the Red and Seine Rivers. (d) Seedlings spring up in disused or disturbed land. Though they may have enough moisture and nutrient supply for germination and early growth, these self-tended seedlings are usually shortlived. And then there are the more anomalous instances of cottonwood: (e) a small group of trees of ambiguous origin; (f) a single tree stood alone, distant from signs of water, or growing within or near a forest of different ecological character.

Fig. 1.13a. A planted cottonwood tree near Fort Rouge rapid transit station, September 30, 2023.
Fig. 1.13b. Riverbank cottonwood on east side of Red River behind Rivergate Estates, January 9, 2021.
Fig. 1.13c. An even-aged cottonwood stand in Lagimodière-Gaboury Park, September 30, 2023.
Fig. 1.13d. A cottonwood seedling near Chevrier Blvd, September 30, 2023.
Fig. 1.13e. A small group of young cottonwood, behind Mulvey Market, September 30, 2023.
Fig. 1.13f. A mature lone cottonwood, near the intersection of Argue St and Rosedale Ave, January 4, 2023.

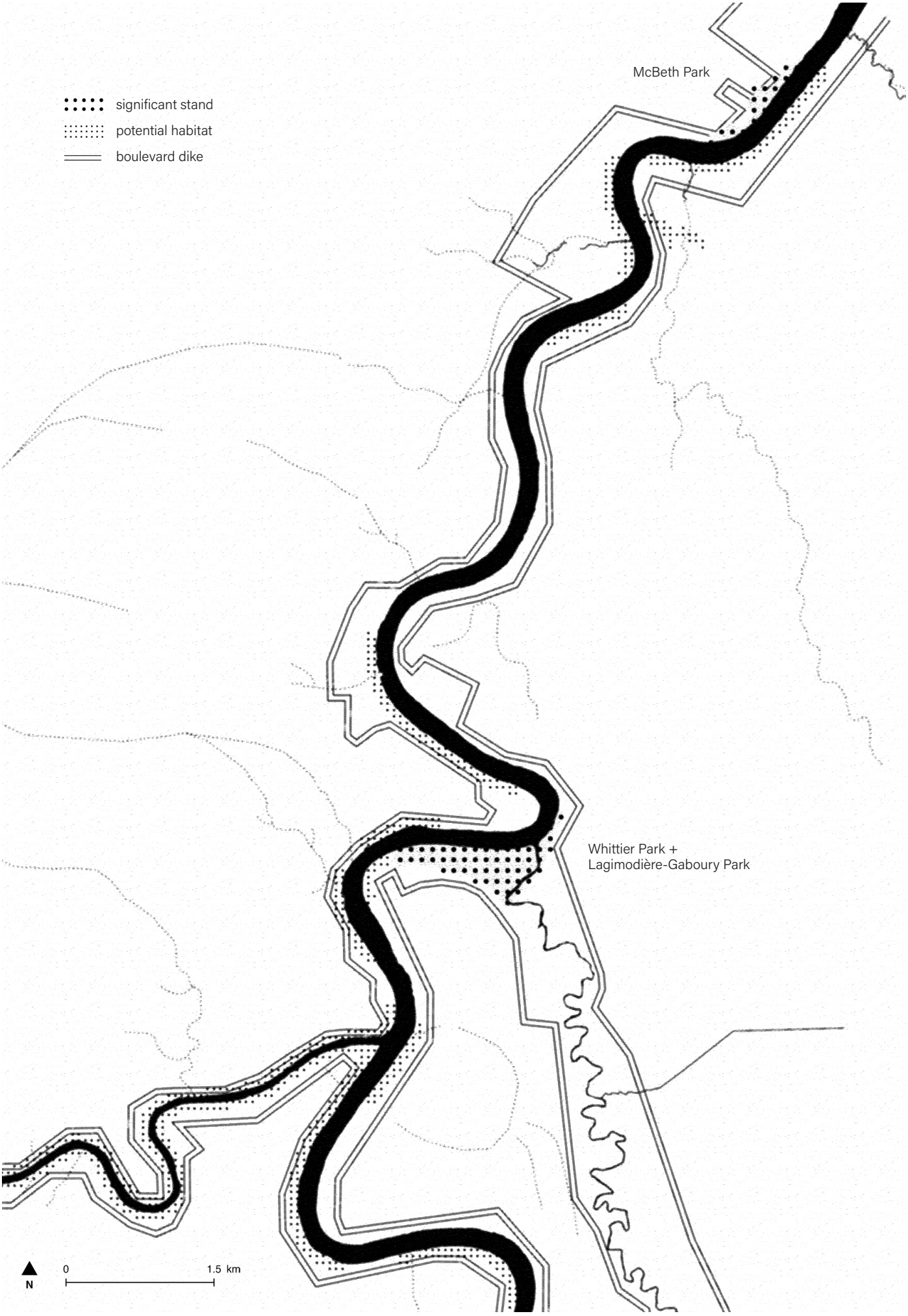
65 Mike Allen, "They're popular, but poplars not suited to the city," *Winnipeg Free Press*, June 8, 2003.

Significant Stands

Since flood infrastructure restricts where and how cottonwood stands can establish, it should be no surprise that the most significant urban stands are found in floodprone riverbottom ecosystems. These stands are large, intact groups of healthy trees. Three are identified in the map opposite: in McBeth Park, Whittier Park and Lagimodière-Gaboury Park. The first two are mature stands mixed with boxelder, ash, and elm. Lagimodière-Gaboury Park features a dense, even-aged stand of mostly cottonwood, broken up by shrubby clearings. All three stands grow in the floodable space between the riverbank and the nearest boulevard dikes, elevated roads running adjacent to the rivers that were built in coordination with the Floodway.[66]

Fig. 1.14. Significant stands, map.

66 Passfield, "'Duff's Ditch'," 3.


significant stand
potential habitat
boulevard dike
McBeth Park
Whittier Park +
Lagimodière-Gaboury Park
N
0
1.5 km


a
b
c
d

Challenges for Cottonwood

Fig. 1.15a. Assiniboine River at Main Street Bridge, Google Street View, 2019.
Fig. 1.15b. Assiniboine River at Main Street Bridge, 2021.
Fig. 1.15c. Assiniboine River at Main Street Bridge, 2022.
Fig. 1.15d. Assiniboine River at Main Street Bridge, 2023.

A city exerts unique forces on a cottonwood population. Where and how we reshape our urban environment can be powerful among these forces. Our intervention is felt particularly along rivers, where old cottonwood anchor riparian banks and where new cottonwood are meant to regenerate. Combined with the rivers' altered flow patterns, riverside development can supplant existing trees and degrade potential habitat.

Growing room is a broad difficulty for city cottonwood. The few trees who grow in tight urban spaces, like yards or boulevards, may suffer discomfort and poor health. These are also the trees who are susceptible to conflict with more hostile neighbours. A Free Press story from 1969 describes the effort of a few West End residents in securing the "execution" of nearby cottonwood, whose seed one claimed was responsible for "soil[ing] his wife's washing" and, said another, "his cup of coffee if he drank it outside".[67] Similarly, a 1983 article recounts a dispute between two neighbours over the removal of a boulevard cottonwood. One of the neighbours planted the tree nearly forty years earlier, while the other urged its felling on the basis, later disproven, that the tree's roots caused water backflow in her basement and that she was allergic to the seed,[68] a common but mistaken belief, as the seed has little allergenic value.[69]

There are, for better reasons, places in a city where cottonwood should not grow, revaluing the fewer good sites as critical habitat.

67 Bill Leader, "Cottonwood Trees Get Stay of Execution," *Winnipeg Free Press*, August 6, 1969.
68 Val Werier, "The fight to save a tree," *Winnipeg Free Press*, March 30, 1983.
69 "In Defense of Cottonwoods," Novi.org, published June 23, 2022. https://novi.org/News/In-Defense-of-Cottonwoods.aspx.

Observations on our Urban Population

In Winnipeg, cottonwood are most commonly found along the Red and Assiniboine rivers and near remnant creeks and streams. Large mature stands exist in McBeth Park in West Kildonan and Whittier Park in St. Boniface, though these aging trees are succeeded not by more cottonwood but by species, like boxelder and ash, who can rise from dense understory shade.

Displaced from riparian forests, new cottonwood must establish elsewhere.

Cottonwood also take root in drier, disturbed areas, where resources are scarce and inter-specific competition is weak. Seedlings spring up on the edges of rail lands, in vacant industrial lots, in sunny, gravelled environments that simulate a coarse riverine point bar, their natural propagation site. The seed from which these new trees sprout arrives by wind from unknown distances, likely blown from nearby riverbanks where older trees reside. The young trees who survive these harsh conditions long enough to begin seeding themselves will beget more trees, if and where there is land left over.

Self-seeded and -tended cottonwood, along with the small number of trees planted annually, comprise the next generation of cottonwood in our city, much reduced from the historic populations that thrived in a dynamic hydrological system of seasonal floods and disturbance, and benefitted from more sensitive patterns of human interaction and settlement.

Fig. 1.16. A self-seeded and -tended cottonwood sapling.

Chapter 2: Lifecycle

Taking Root

A cottonwood's lifecycle can begin in two ways: from seed or as a clonal propagule.

Seed is released after sexual reproduction and gives rise to a new genetic individual who shares the DNA of two parent trees.[70] Clonal propagation, on the other hand, is asexual or vegetative, and produces a genetic copy of a singular parent.[71]

Seed Germination:
Once seeds, wrapped in a wind-catching "cotton" envelope, make contact with wet, recently flood-scoured soil, they immediately take up water and initiate germination within the first 24 hours.[72] Germination results in a *germinant*, a 2-3cm seedling with a set of small leaves.[73] The germinant's root grows 1cm/day to follow the receding water horizon.[74] At a month old, the seedling is 5cm tall with 5 small leaves and a thin root extending as long as 30cm.[75]

Clonal Propagation:
Vegetative reproduction can occur in a variety of ways but the growth mechanism remains consistent. Sprouting is initiated by meristems, or undifferentiated cells located at the tips of buds and in the cambium of stems.[76] Meristematic cells can replicate into any type of tissue.[77] As one example, a broken twig that comes in contact with wet soil can redirect its stored energy into resprouting from meristems, resulting in a new shoot.

Fig. 2.1. A cottonwood's first month of growth, from seed or as a clonal propagule.

70 Stettler, 53.
71 Stettler, 34.
72 Stettler, 19.
73 Stettler, 20.
74 Stettler, 21.
75 Stettler, 21.
76 Stettler, 27-28.
77 Stettler, 28.

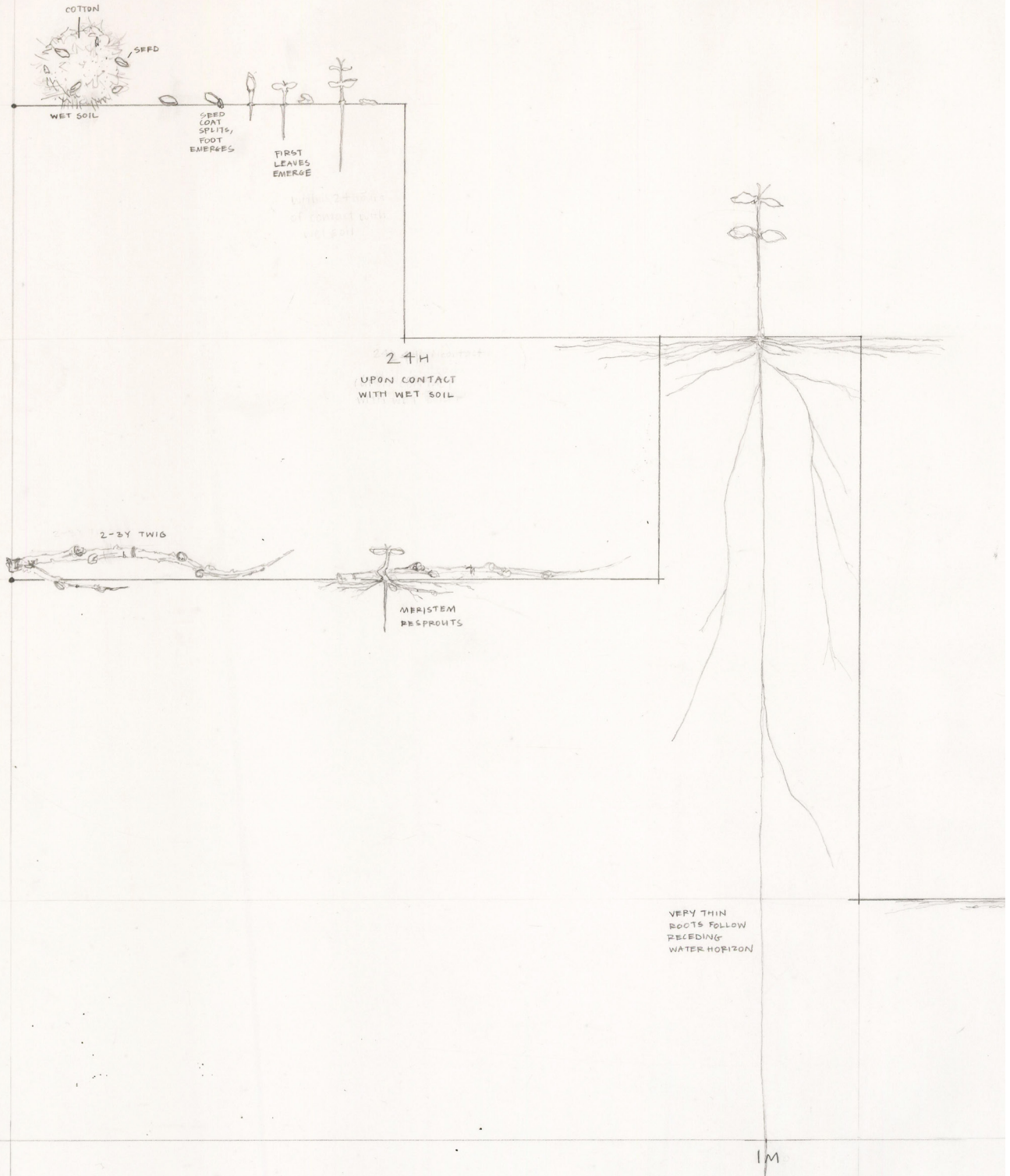
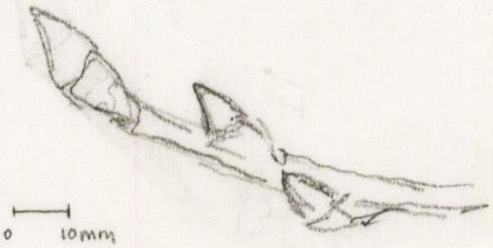

COTTON
SEED
WET SOIL
SEED COAT SPLITS, FOOT EMERGES
FIRST LEAVES EMERGE
24H
UPON CONTACT WITH WET SOIL
2-3Y TWIG
MERISTEM RESPROUTS
VERY THIN ROOTS FOLLOW RECEDING WATER HORIZON
1M

Fig. 2.2. A seedling courageously grows in the part shade and leafy debris of its fully-grown relatives.

Fig. 2.3. Vigorous young shoots sprout from the exposed roots of a toppled tree.

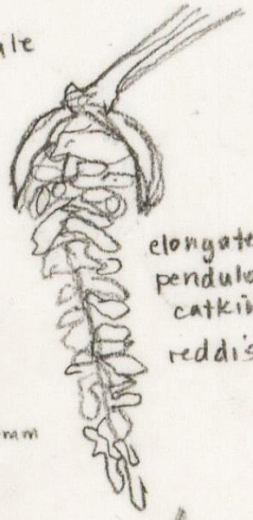
1



2

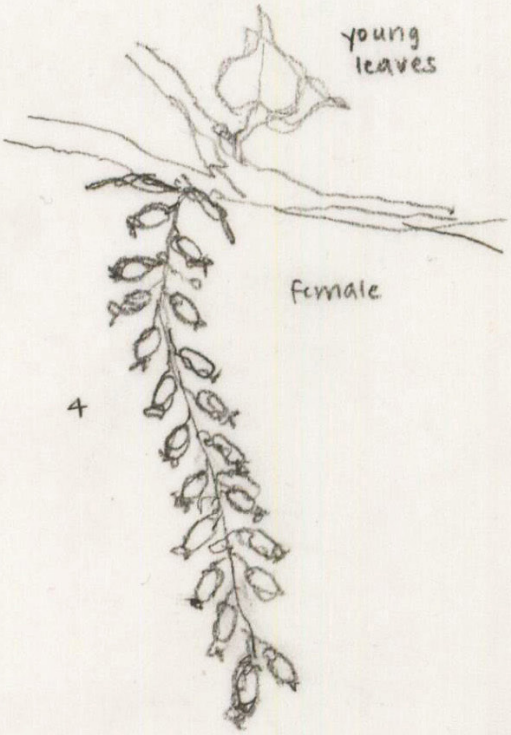
catkins emerging, starting to elongate

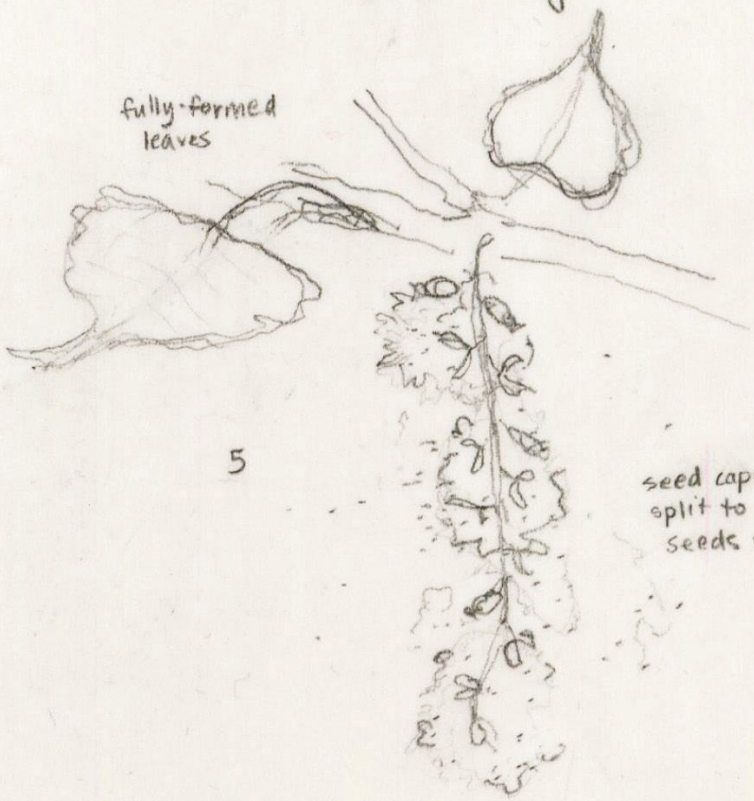
3



elongated, pendulous catkin, reddish

4





5

seed capsules split to release seeds to wind

Flowering + Seed Dispersal

Fig. 2.4. Flowering and seed dispersal.

For there to be seedlings, there must be flowering.

A cottonwood begins to flower around 10 years of age.[78] As a dioecious species, staminate (male; pollen-bearing) and pistillate (female; fruit-bearing) flowers are borne on separate trees.[79] Both trees produce catkins, cylindrical flower clusters, that emerge from axillary buds and elongate into pendulous red (male) or light green (female) structures.[80] Pollinated pistillate catkins transform into long strings beaded by oval capsules that break open and release cotton-wrapped seeds to the wind.[81]

Seed dispersal can extend across two to three weeks for a single tree and three to four weeks for a stand, usually starting in mid-May.[82]

Seeding peaks in vigour at thirty years of growth but continues into old age.[83]

78 Kennedy, 4.
79 Cain, 9.
80 Cain, 19.
81 Cain, 19.
82 Stettler, 20.
83 Kennedy, 4.

Lifecycle

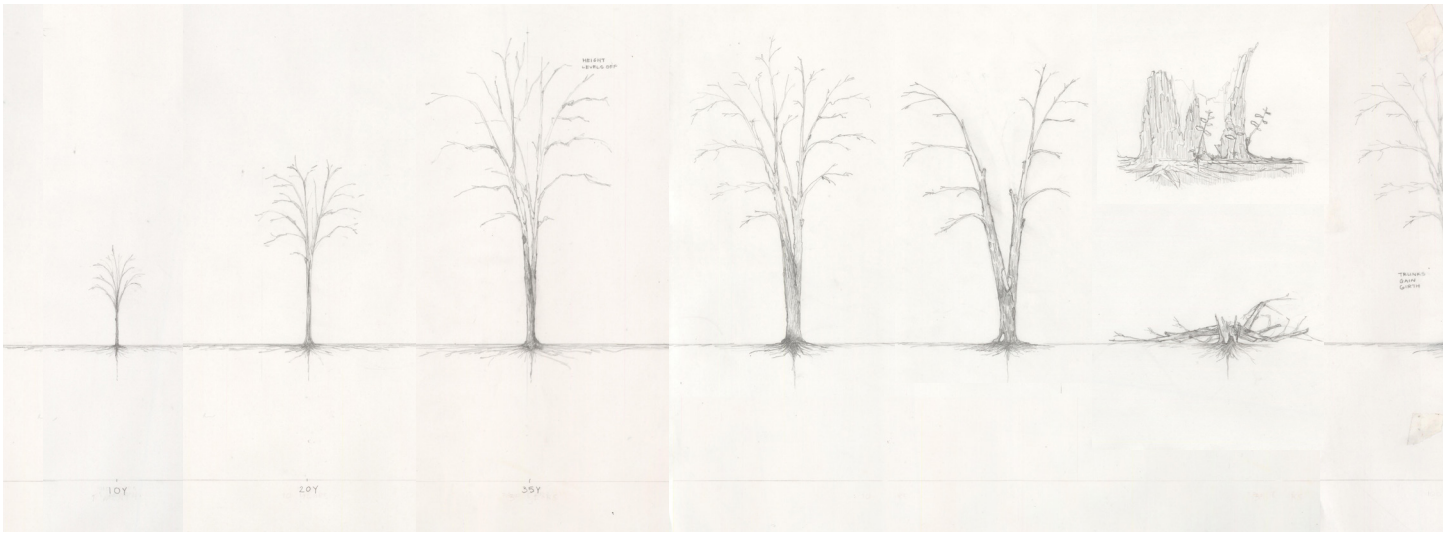
At 10 years old, a cottonwood begins producing seed. After rapid early growth, the tree reaches a mature height of 25 to 30m at 30 to 40 years of age. Its diameter at breast height continues expanding to upward of 2m.[84] In ideal conditions, a cottonwood tree can live over 200 years.

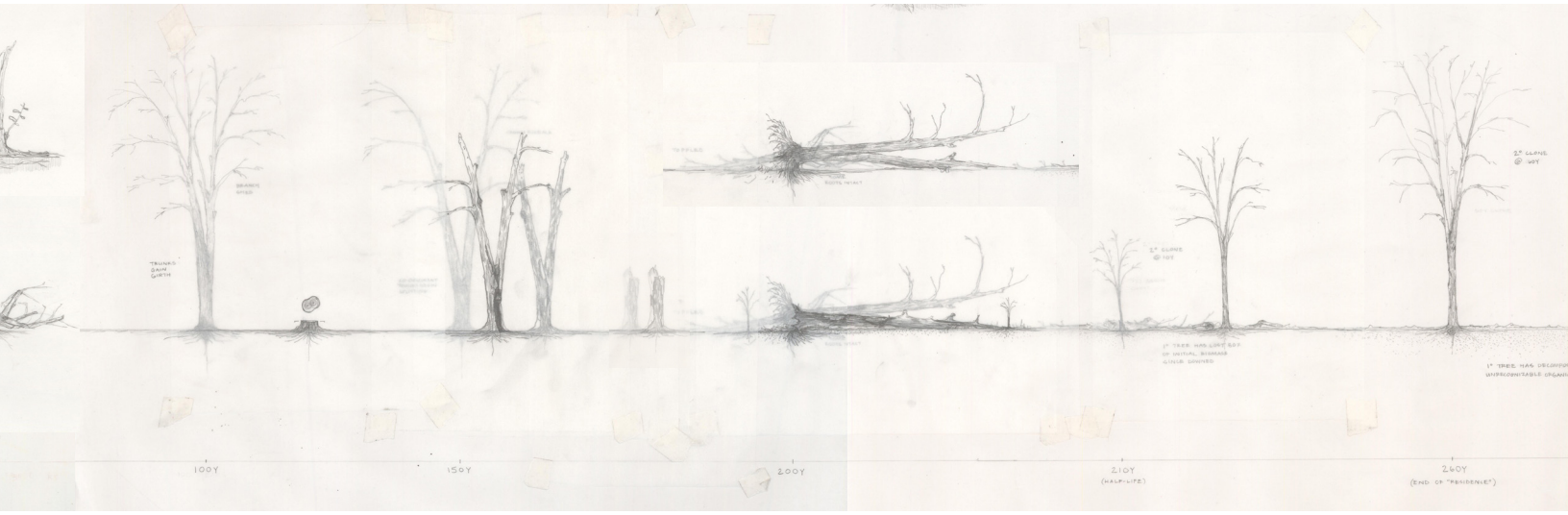
As a consequence of its tremendous growth rate, which compromises wood strength and longevity, cottonwood is highly susceptible to structural damage like breaking and splitting, and to the associated bacterial and fungal invasions of exposed sapwood.[85] Cottonwood often develop wounds at trunk forks or crotches, where moisture and infection collect.[86] Hollowing is common in cottonwood, a process which sees the spread of decay beyond compartmentalized wounds and the total decomposition of heartwood, leaving only outer rings of wood and bark.[87]

Though predisposed to a variety of decay processes, a cottonwood has adapted to respond with resilience. Damage and disturbance to the tree during decline sometimes trigger regeneration attempts, such as resprouting from the stump base or torn roots, that lead to a new tree, a genetic identical that extends the tree's lifecycle.

Fig. 2.5. A cottonwood timeline.

84 Stettler, 23.
85 Allen, "They're popular."
86 "Elm," Texas Plant Disease Handbook, Texas A&M Agrilife Extension, accessed December 7, 2023. https://plantdiseasehandbook.tamu.edu/landscaping/trees/elm/.
87 Paul D. Manion, *Tree Disease Concepts* (Englewood Cliffs, N.J.: Prentice-Hall, 1991), 226.


HEIGHT LEVELS OFF
10Y
20Y
35Y


TRUNKS GAIN GIRTH
100Y
150Y
200Y
210Y
(HALF-LIFE)
260Y
(END OF "RESIDENCE")

Beautiful Decline

From top to bottom:
Fig. 2.6. A red-bellied woodpecker perched near cavities on decayed upper branches.
Fig. 2.7. A cottonwood window.
Fig. 2.8. Walking beneath a bridge of collapsed bark.

88 Stettler, 8.

As single old trees, declining cottonwood offer a variety of special moments, richness, beauty, delight, meaning.

In their deterioration, we see texture, patterns, weathering, time, impermanence - the processes, which invite sustained attention and close interaction. Such processes draw me to these trees repeatedly and sharpen my eyes for change, usually subtle, like the gradual disintegration of bark on a fallen tree, but other times dramatic, like the collapse of a sheath of bark over a familiar trail (fig. 2.8).

What looks like disorder and dysfunction is really the good work of many visible (fig. 2.6) and invisible organisms and interactions stimulated by the decline of a cottonwood. It is as *Populus* expert Reinhard Stettler wrote in his book *Cottonwood and the River of Time*:

> "[cottonwood] seem to emphasize the *process* over the *product*. Its fleeting existence draws attention to the ever-changing process of ecosytem evolution and reminds us of the underlying forces at work. After all, the seeming permanence of an oak, as comfortable as it makes us feel, is an illusion, a mere delay of the inevitable change to come."[88]

Chapter 3: Design Strategy

Design Position

Our urban cottonwood population is composed of:

- mature declining trees
- a small proportion of planted trees
- self-seeded and self-tended trees in leftover spaces, likely shortlived; inconveniently sited in vacant or "developable" land; not intentionally planted

The mature declining class is the most ecologically, spatially, and culturally significant of the population. As things are, no near-future population of mature cottonwoods will be as numerous or widespread.

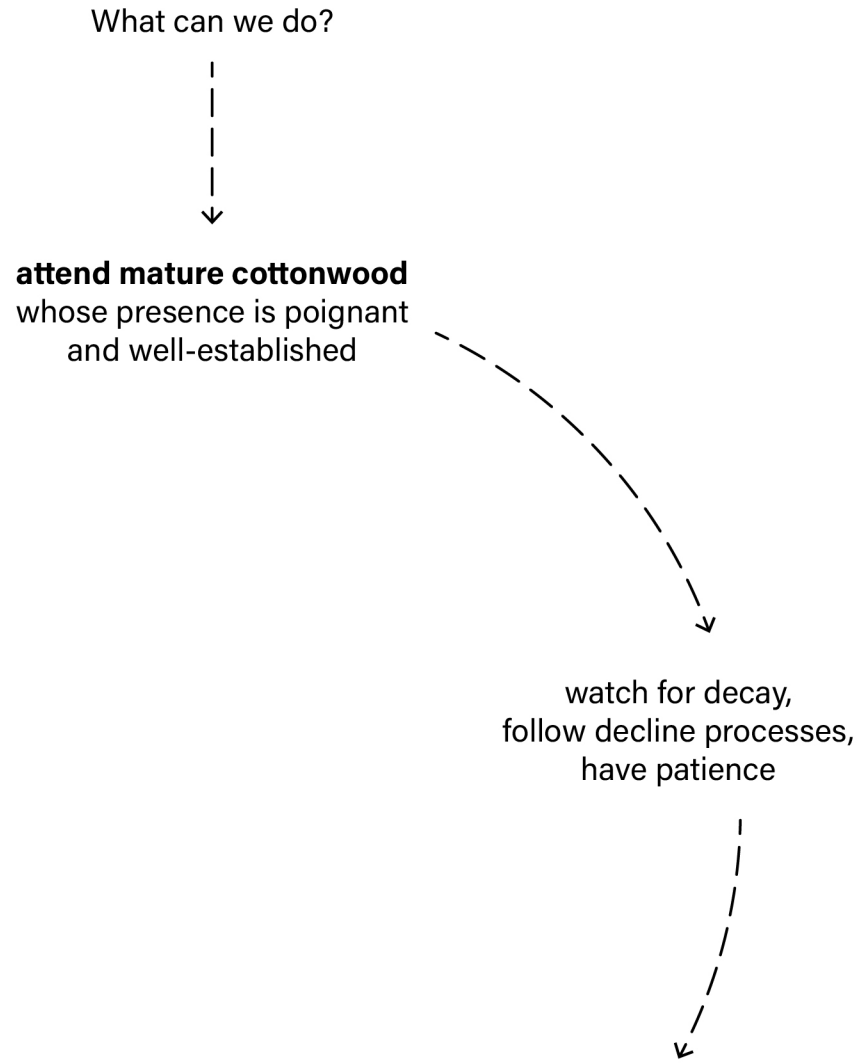
Shifts in the regional hydrological system and in patterns of human settlement and interaction result in fewer opportunities for natural cottonwood propagation. This, coupled with their largeness, perceived ill-suitedness for urban spaces and enduring image as a seedy, short-lived nuisance tree, has led to chronic underplanting.

What, then, I see as a design response is quite simple: plant more cottonwood. But rather than simply plant trees, I propose establishing distinct cottonwood spaces in new configurations, built from materials and methods grounded in cottonwood decline and regeneration dynamics. These new spaces can be tended and attended to over time like current sentinels and in new ways that celebrate the trees, our shared histories, and the processes critical to a cottonwood's lifecycle, being, and meaning.

Prompts

1 how to celebrate the processes critical to a cottonwood's lifecycle, being, meaning

2 how to participate in cottonwood regrowth, at a scale that encourages close interaction and sustained attention


What can we do?
attend mature cottonwood
whose presence is poignant
and well-established
watch for decay,
follow decline processes,
have patience

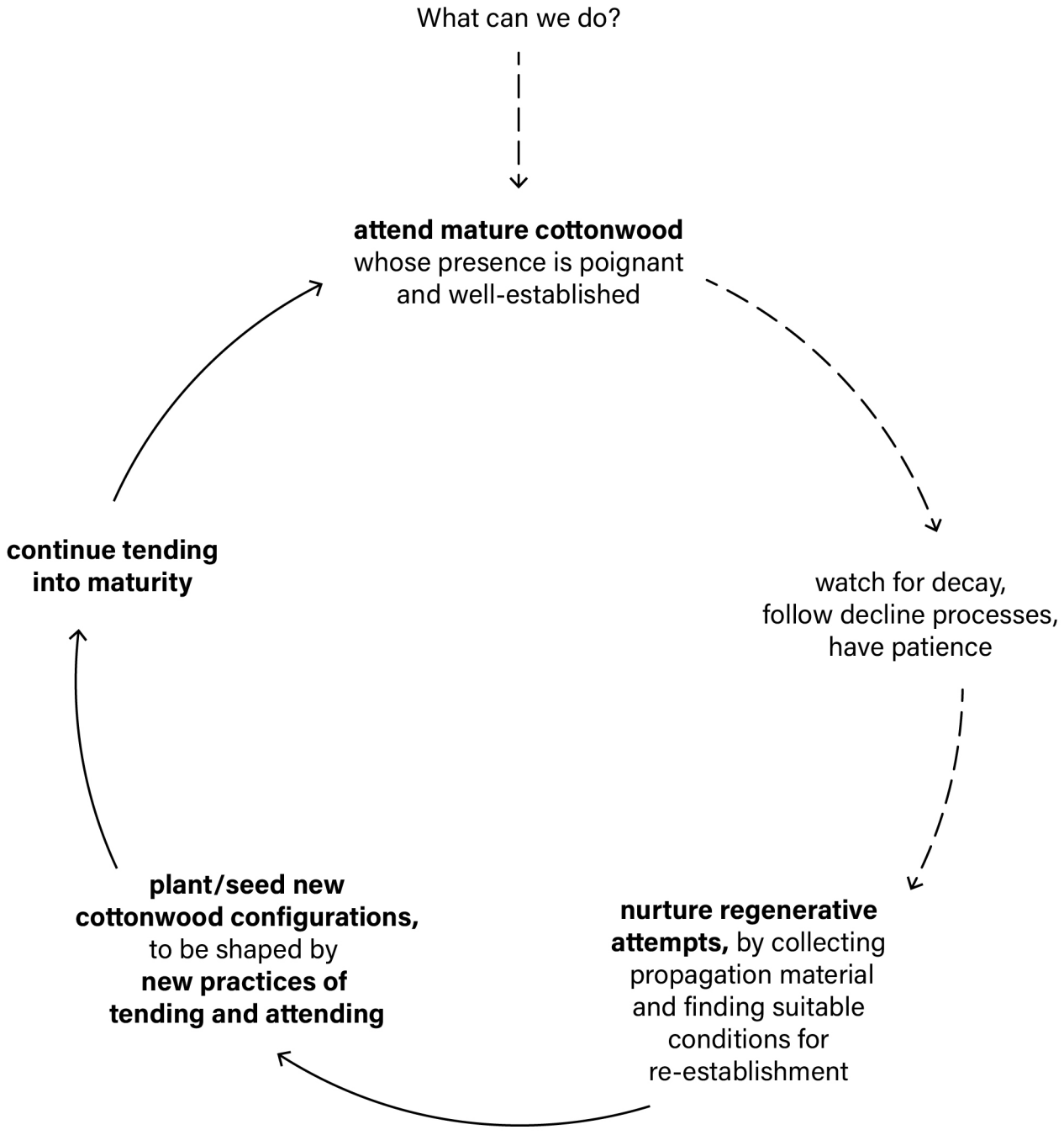
Design Actions

A cottonwood regrowth effort starts with existing trees, those we already know and care for. These cottonwood may be Heritage Trees, neighbourhood landmarks, or beloved community members. As the trees decline, they may attempt to regenerate, as dicussed in the previous chapter. Regrowth, and the establishment of new cottonwood spaces, can begin to follow the tree's ecological direction and timing.

The cycle diagram opposite outlines the initial big-picture actions for a cottonwood regrowth model, which build on the first design prompt to observe and engage the tree's significant processes:

- **attend mature cottonwood whose presence is poignant and well-established:** an action that we already perform with sentinels and one that forms the basis of our attachment to the trees.

- **watch for decay, follow decline processes, have patience:** an action that will require understanding what cottonwood decline processes look like and how and why they vary amongst individuals.


What can we do?
attend mature cottonwood whose presence is poignant and well-established
watch for decay, follow decline processes, have patience
nurture regenerative attempts, by collecting propagation material and finding suitable conditions for re-establishment
plant/seed new cottonwood configurations, to be shaped by **new practices of tending and attending**
continue tending into maturity

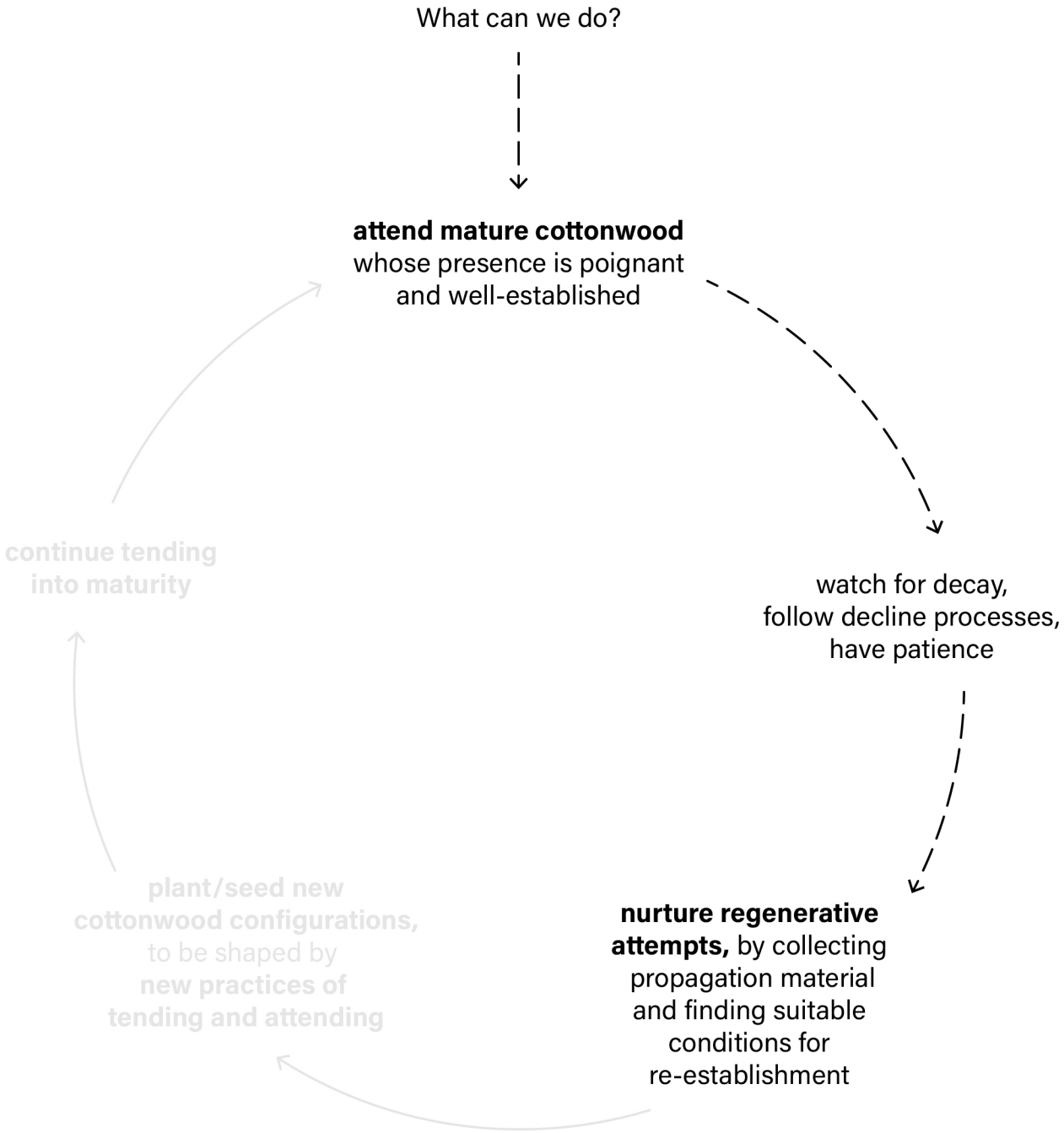
The cycle is completed, outlining the remaining actions, which build on the second design prompt to actively assist in planting and caring for the new cottonwood spaces over time:

- **nurture regenerative attempts, by collecting propagation material and finding suitable conditions for re-establishment:** an action that will require understanding what regenerative attempts are made during decline processes, and what propagative materials may result.

- **plant/seed new cottonwood configurations, to be shaped by new practices of tending and attending:** an action that will require understanding key siting parameters, and detailing the new spaces and ways of shaping them.

- **continue tending into maturity:** an action that will require understanding the lifecycle of the new spaces and defining their long-term tending schedules including when and how tending should ease so as to return to the first action.

Chapter 4: Sentinel Studies


What can we do?
attend mature cottonwood whose presence is poignant and well-established
watch for decay, follow decline processes, have patience
nurture regenerative attempts, by collecting propagation material and finding suitable conditions for re-establishment
plant/seed new cottonwood configurations, to be shaped by **new practices of tending and attending**
continue tending into maturity

Prompts

1 how to celebrate the processes critical to a cottonwood's lifecycle, being, meaning

2 how to participate in cottonwood regrowth, at a scale that encourages close interaction and sustained attention

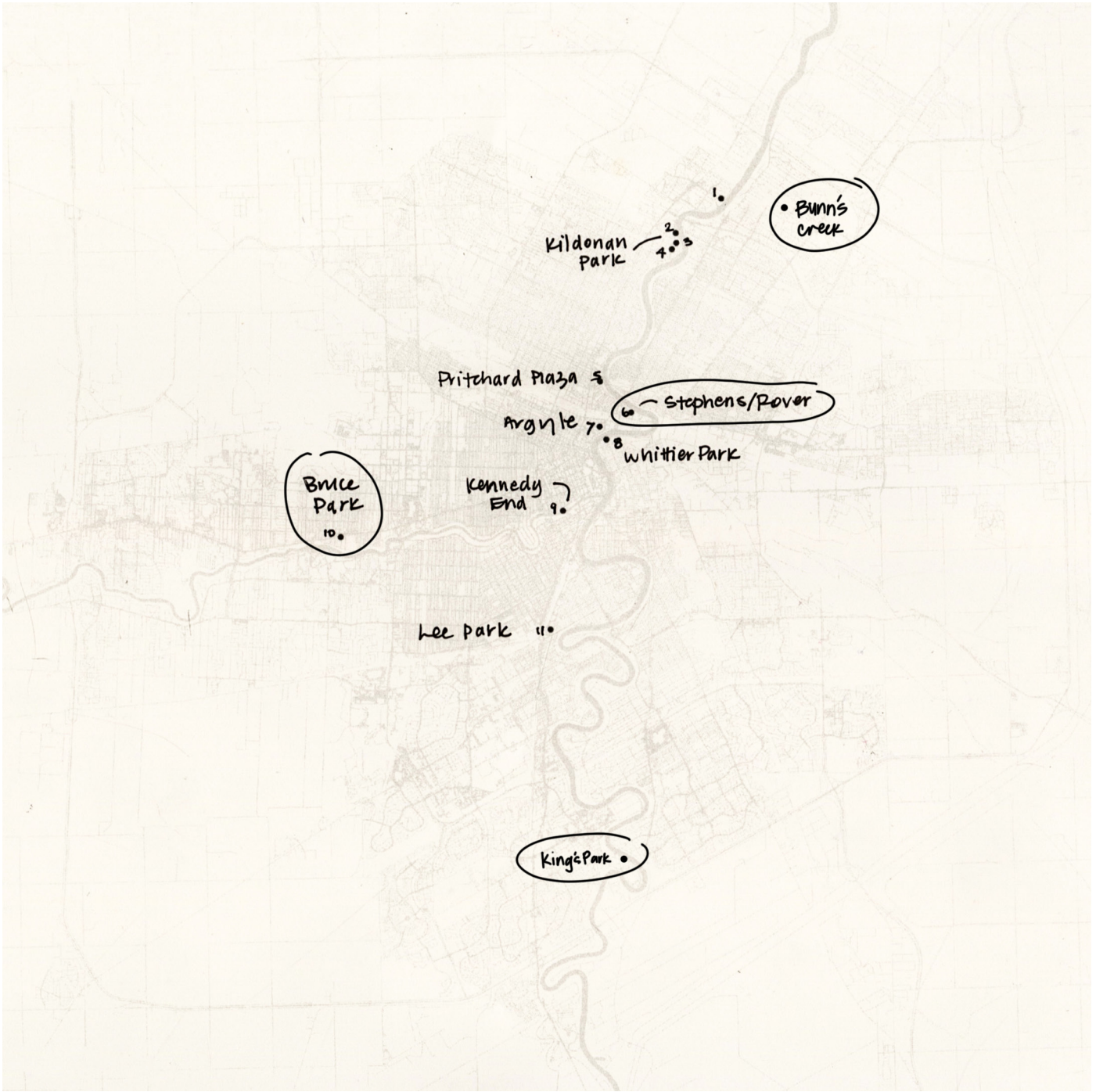


Fig. 4.1. Sentinel survey, map.
(below) Fig. 4.2. Sentinel survey profiles.

To examine differences in culture and growing environments among Winnipeg's mature cottonwood, a city-wide survey was conducted of thirteen trees chosen for their largeness (as an indicator for age), location on public land, and presence or relationship to context. Each tree was visited and documented (fig. 4.2). Four trees (circled on map) were chosen for further study.


FOREST
fell sometime in summer 2022
riparian forest (park)
new light conditions
before it fell, one could stand inside the tree, here
lays in "undisturbed" area of park (no paths were created)
forest path
hollow trunk
PARK
riparian forest off city park
PARK
park
the largest tree in the vicinity, among other mature elms
parkroad
visible from surrounding area
URBAN
downtown streetside
SEMI URBAN
quiet residential park, peripheral to downtown
might be the oldest cottonwood in the city
SEMI URBAN
park near residential
SEMI URBAN
mature residential park
SEMI URBAN
urban leftover (park) near residential
encroaching condo development
construction site fence
impending doom
bulbous growths on branches and trunk cracks
drift
canopy within reach
soccerfield
Transitway
Jubike
unusually wide, arching, low canopy
relatively short tree but wide trunks

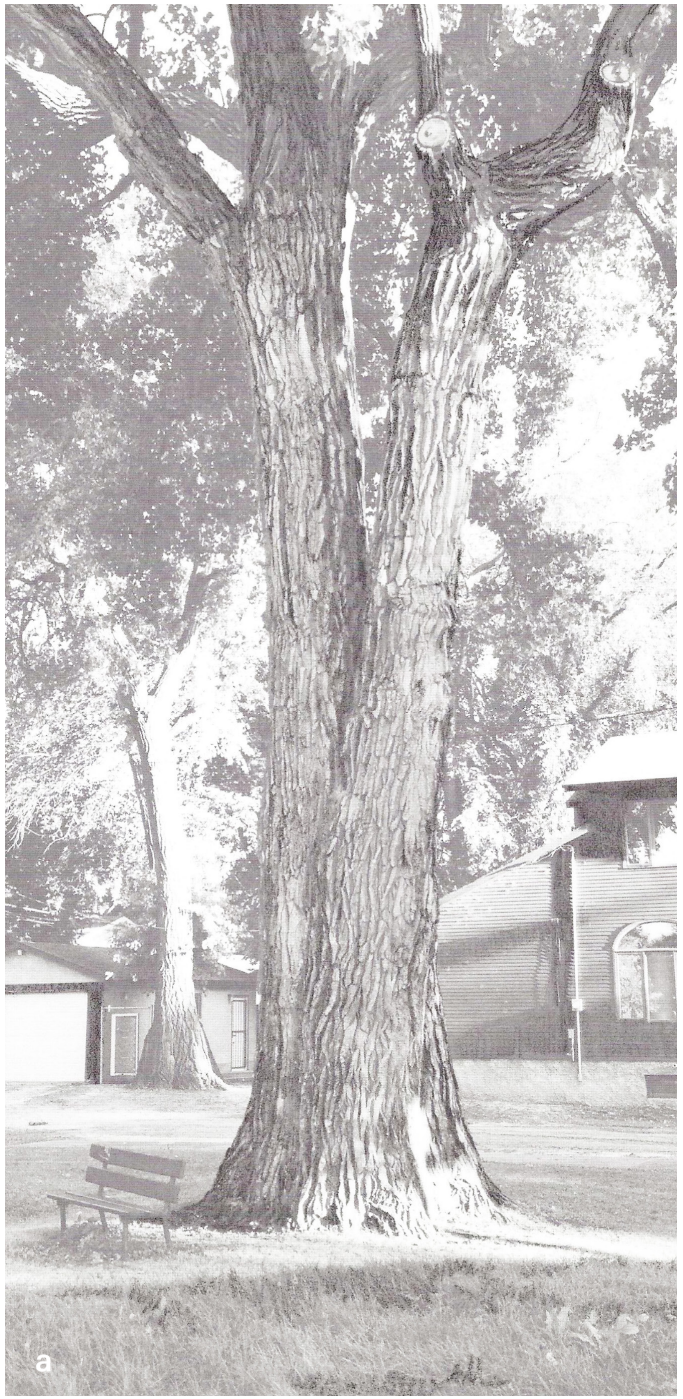
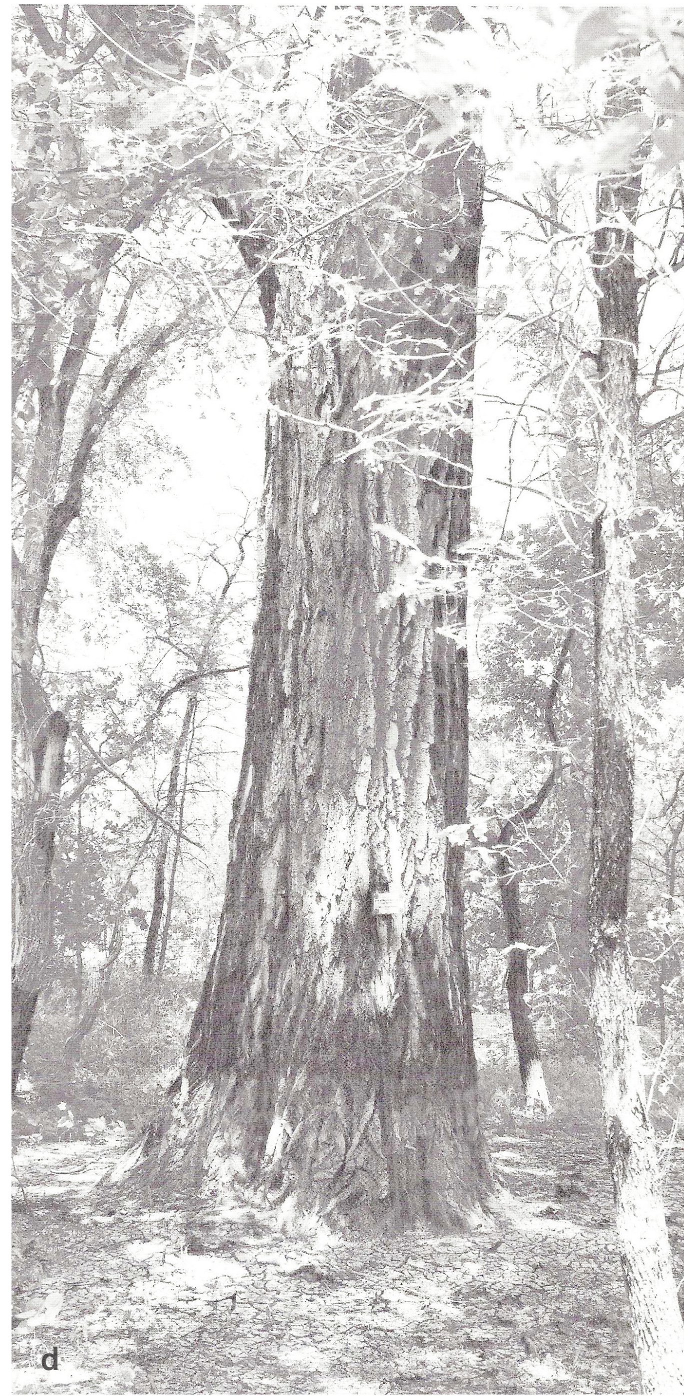


Fig. 4.3a. Point Douglas Sentinel.
Fig. 4.3b. Bunn's Creek Sentinel.
Fig. 4.3c. Bruce Park Sentinel.
Fig. 4.3d. King's Park Sentinel.

Of thirteen surveyed, four sentinels were chosen for further study, for their even distribution across the city and because they grow in and are shaped by different environments. The four trees distinguish themselves through their orientation, relationship to water, exposure/enclosure (i.e. presence of shelterwood, or sheltering stand of trees), groundplane character, and level of tendedness.


c


d


a
b
c

Point Douglas Sentinel

Fig. 4.4a. Strong vertical axis.
Fig. 4.4b. Exposure.
Fig. 4.4c. Elegant branching.

Below:
Fig. 4.5. Point Douglas Sentinel, aerial plan, Google Earth Pro.

89 V. Hidahl and M. Benum, *Heritage Trees of Manitoba* (Winnipeg: Manitoba Forestry Association, 1987), 19.

The first sentinel is located near the Red River in Point Douglas. The tree was nominated as a Heritage Tree in 1987, whereby it was acknowledged as a long-standing community landmark.[89] Today, the tree is likely to be around two hundred years old. The tree sits centrally in a small, wedge-shaped lawn (fig. 4.5) at the corner of Rover Avenue and Stephens Street. From Rover, the ground slopes down toward the tree. A bench waits expectantly at the tree's base for a tired passerby. Three major branches support an elegant, arched canopy. The tree's spatial presence is defined by its openness, both in terms of exposure and canopy structure (b), strong vertical axis (a), and relationship to the sky (c).

The Point Douglas Sentinel is situated in the most urban conditions of the four cottonwood. It grows near built infrastructure in a tended lawn as a highly visible focal tree with limited protection from wind and storm damage.


a
b
c
d

Bunn's Creek Sentinel

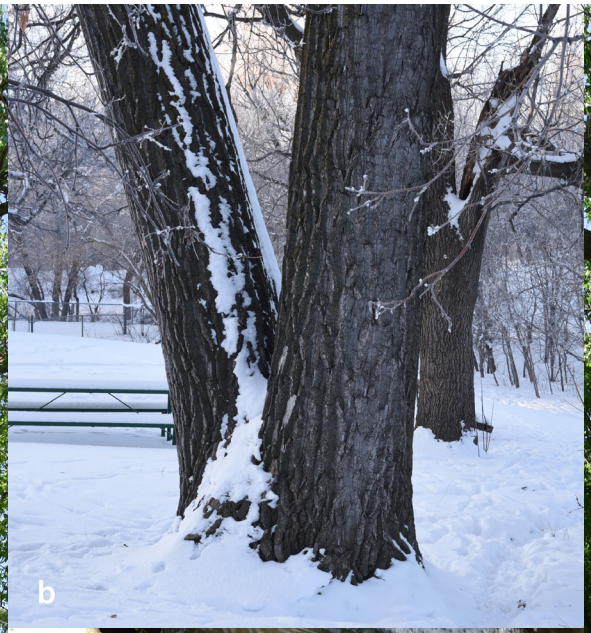
Fig. 4.6a. Forest-meadow edge.
Fig. 4.6b. Informal path.
Fig. 4.6c. Undergrowth.
Fig. 4.6d. Beacon.

Below:
Fig. 4.7. Bunn's Creek Sentinel, aerial plan, Google Earth Pro.

The second sentinel is located in Bunn's Creek Park. It is the only cottonwood in the area. It is the smallest and youngest of the four sentinels, though likely between 75 and 100 years old. The tree grows on the border between a creekside meadow and an oak forest (a), metres off of an informal path (b). The tree's stature surpasses the oaks' easily; its tall crown is visible from many places in the park (d). The tree's spatial presence is defined by its position at the transition of two conditions and as a beacon or visible marker distinct from its surroundings.

The Bunn's Creek Sentinel grows away from built infrastructure, adjacent to a protective shelterwood, and in conditions that receive little to no tending.


a


b


c


d

Bruce Park Sentinel

Fig. 4.8a. Co-dominant trunks.
Fig. 4.8b. Trunk juncture.
Fig. 4.8c. Truro Creek.
Fig. 4.8d. Shrubby understorey.

Below:
Fig. 4.9. Bruce Park Sentinel, aerial plan, Google Earth Pro.

The third Sentinel is located in Bruce Park. It is a co-dominant or two-trunked tree (b) of likely 125 to 150 years. Similar to the Bunn's Creek Sentinel, the tree in Bruce Park is situated on the upper bank of a watercourse, Truro's Creek (c), and is a lone cottonwood in a sparse scattering of oak. Though otherwise surrounded by lawn, the tree is ringed by an assortment of groundcover plants and shrubs (d). The tree's spatial presence is defined by its self-containment, and informal habit and appearance.

The Bruce Park Sentinel is the only co-dominant tree of the four. It grows away from built infrastructure in an open area without shelterwood protection, and with a moderately tended, garden-like groundplane.


a
b
c

Fig. 4.10a. A sense of length.
Fig. 4.10b. Flood-washed clay.
Fig. 4.10c. Riverbank shelf.

Below:
Fig. 4.11. King's Park Sentinel, aerial plan, Google Earth Pro.

King's Park Sentinel

The fourth and final sentinel is located in King's Park. The tree resides in a floodplain forest of mainly boxelder and ash. In near ideal conditions for a cottonwood, the tree has reached an impressive size with a long straight bole (a), likely at least 150 years old. At eye level on two sides of its wide trunk is posted a small sign that reads: "Please respect THE KING OF KING'S PARK He's lived longer than all of us". The tree is, as a seed-producing female, more accurately the "Queen" of King's Park and well-deserving of a royal title since it is, by far, the largest tree in the park. Thick clay (b) underlies a shrubby understorey, worn by foot traffic around the tree and in the direction of adjoining paths. Not far from the tree, the riverbank has eroded into an unstable shelf (c). The tree's spatial presence is defined by its sense of length, enclosure and relationship to the river.

The King's Park Sentinel grows distant from built infrastructure in a shelterwood, on a floodprone, eroding riverbank that receives little to no tending.

Mapping Cottonwood Decline

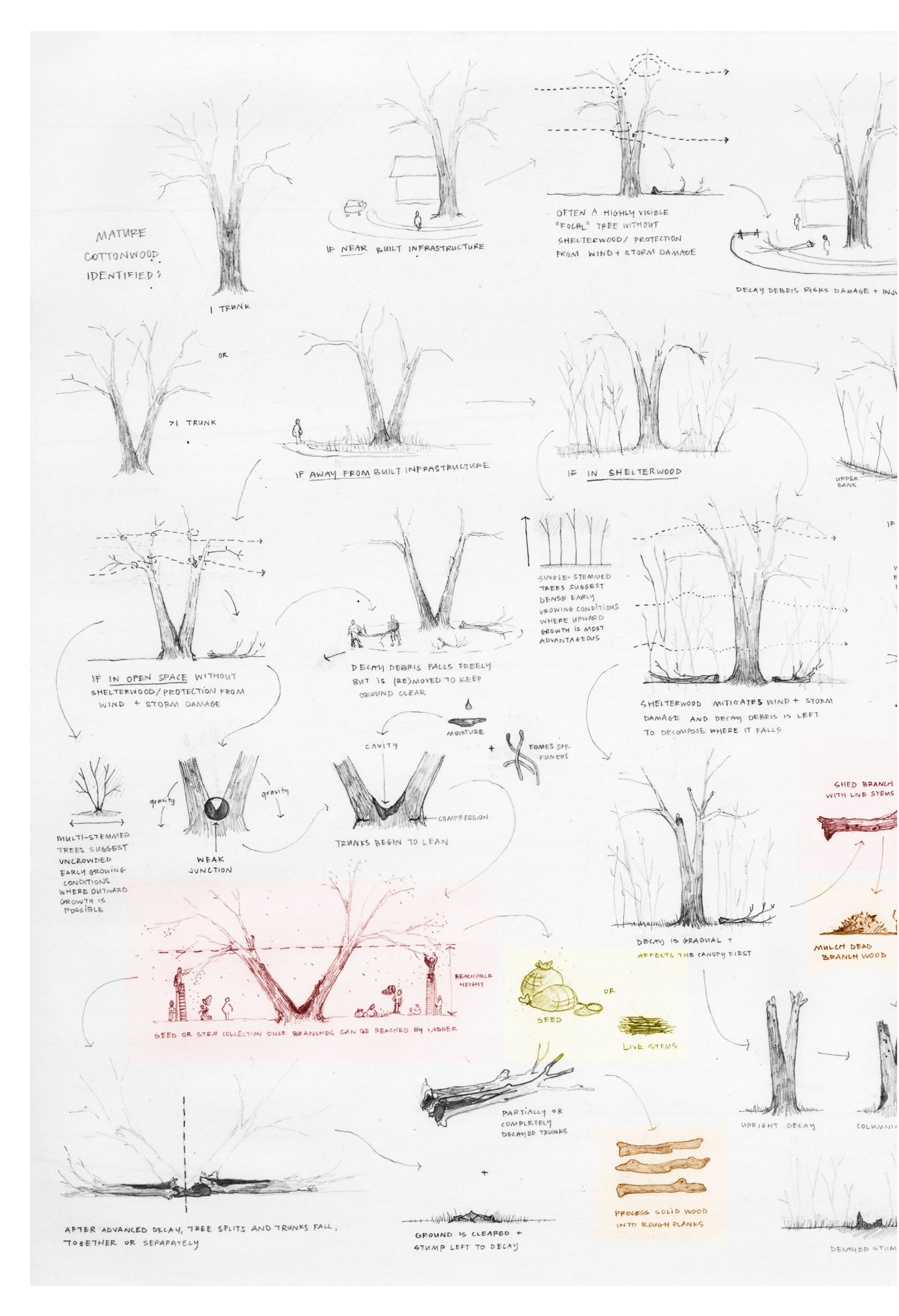
The four sentinels vary in measurable ways through their orientation, exposure or enclosure, relationship to water, groundplane character, and level of tendedness. Each sentinel can be understood as a representative for others that share their characteristics and influences. With the information gathered on their growing habit and conditions, it is possible to speculate how each might decline, so that the processes of tending and attending the trees can be identified and followed. The way each sentinel declines also indicates possible modes of regeneration.

In reality, cottonwood decline can be complex and unpredictable. There are certainly more factors involved than can be reasonably discussed in this study. In formulating representative "types," decline processes are isolated and simplified for the sake of more straightforward design responses later in the proposal. This noted, decline processes are detailed with as much care and accuracy as possible for a research exploration of this kind.

The map on the next spread (fig. 4.12) outlines four decline pathways, one for each sentinel. The Bruce Park Sentinel's co-dominant trunks weaken and **split**. The Bunn's Creek Sentinel, protected from severe wind and storm damage, decays upright into a crumbling **column**. The King's Park Sentinel is destabilized by bank erosion and **topples** downslope. And the Point Douglas Sentinel, too large a threat to surrounding property and people, is **felled** before it can significantly decay.

Each pathway also indicates how the tree might try to regenerate. A regeneration mechanism (pink) produces or makes available material for propagation (yellow). Secondary materials, other by-products of decline that cannot be propagated (orange), are indicated for harvest and processing for use later in the construction and tending of the new plantings.

Before a tree splits, it **leans**, bringing its canopy closer to the ground and within reach of tenders who come to **net seed and cut stems**. After splitting, the trunk and branch wood is processed into **planks**. As a tree columns, it **sheds branches** with **live stems**. The stems are harvested and the dead branch wood is made into **mulch**. After a tree topples, buried stems spontaneously propagate by **layering**, producing **new shoots**. The toppled tree eventually weathers into driftwood, later salvaged for **logs and woodchips**. After a tree is felled, its root system will **sucker**, producing **new shoots**. The felled tree is processed into **fenceposts**.


MATURE COTTONWOOD IDENTIFIED
1 TRUNK
OR
>1 TRUNK
IF NEAR BUILT INFRASTRUCTURE
IF AWAY FROM BUILT INFRASTRUCTURE
OFTEN A HIGHLY VISIBLE "FOCAL" TREE WITHOUT SHELTERWOOD/ PROTECTION FROM WIND + STORM DAMAGE
DECAY DEBRIS RISKS DAMAGE + INJ
IF IN SHELTERWOOD
UPPER BANK
IF IN OPEN SPACE WITHOUT SHELTERWOOD/ PROTECTION FROM WIND + STORM DAMAGE
DECAY DEBRIS FALLS FREELY BUT IS (RE)MOVED TO KEEP GROUND CLEAR
SINGLE-STEMMED TREES SUGGEST DENSE EARLY GROWING CONDITIONS WHERE UPWARD GROWTH IS MOST ADVANTAGEOUS
SHELTERWOOD MITIGATES WIND + STORM DAMAGE AND DECAY DEBRIS IS LEFT TO DECOMPOSE WHERE IT FALLS
MOISTURE
CAVITY
FOMES SPP. FUNGUS
COMPRESSION
TRUNKS BEGIN TO LEAN
MULTI-STEMMED TREES SUGGEST UNCROWDED EARLY GROWING CONDITIONS WHERE OUTWARD GROWTH IS POSSIBLE
gravity
gravity
WEAK JUNCTION
DECAY IS GRADUAL + AFFECTS THE CANOPY FIRST
SHED BRANCH WITH LIVE STEMS
MULCH DEAD BRANCH WOOD
REACHABLE HEIGHT
SEED OR STEM COLLECTION ONCE BRANCHES CAN BE REACHED BY LADDER
SEED
OR
LIVE STEMS
PARTIALLY OR COMPLETELY DECAYED TRUNKS
UPRIGHT DECAY
COLUMNI
AFTER ADVANCED DECAY, TREE SPLITS AND TRUNKS FALL, TOGETHER OR SEPARATELY
GROUND IS CLEARED + STUMP LEFT TO DECAY
PROCESS SOLID WOOD INTO ROUGH PLANKS
DECAYED STUM

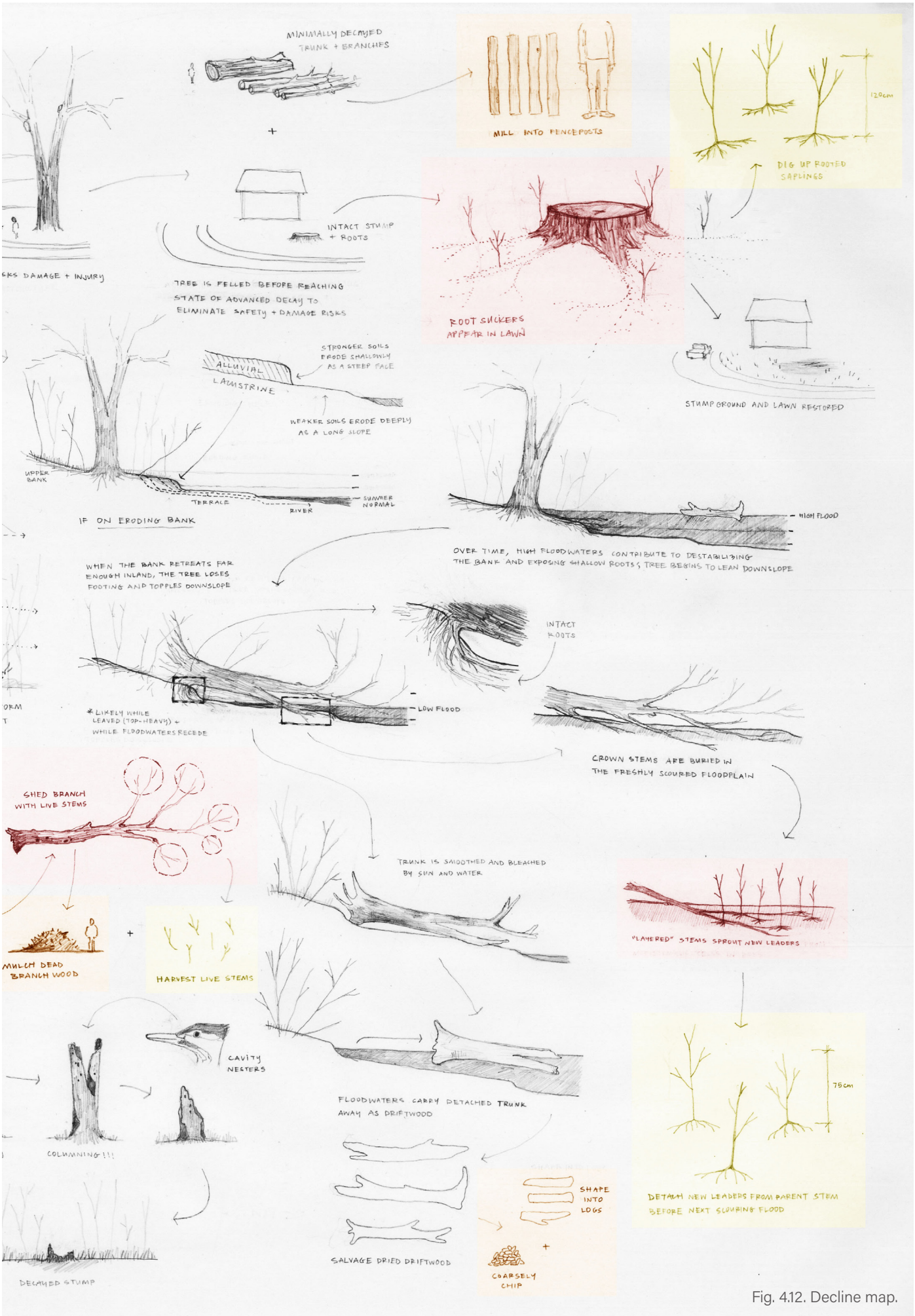


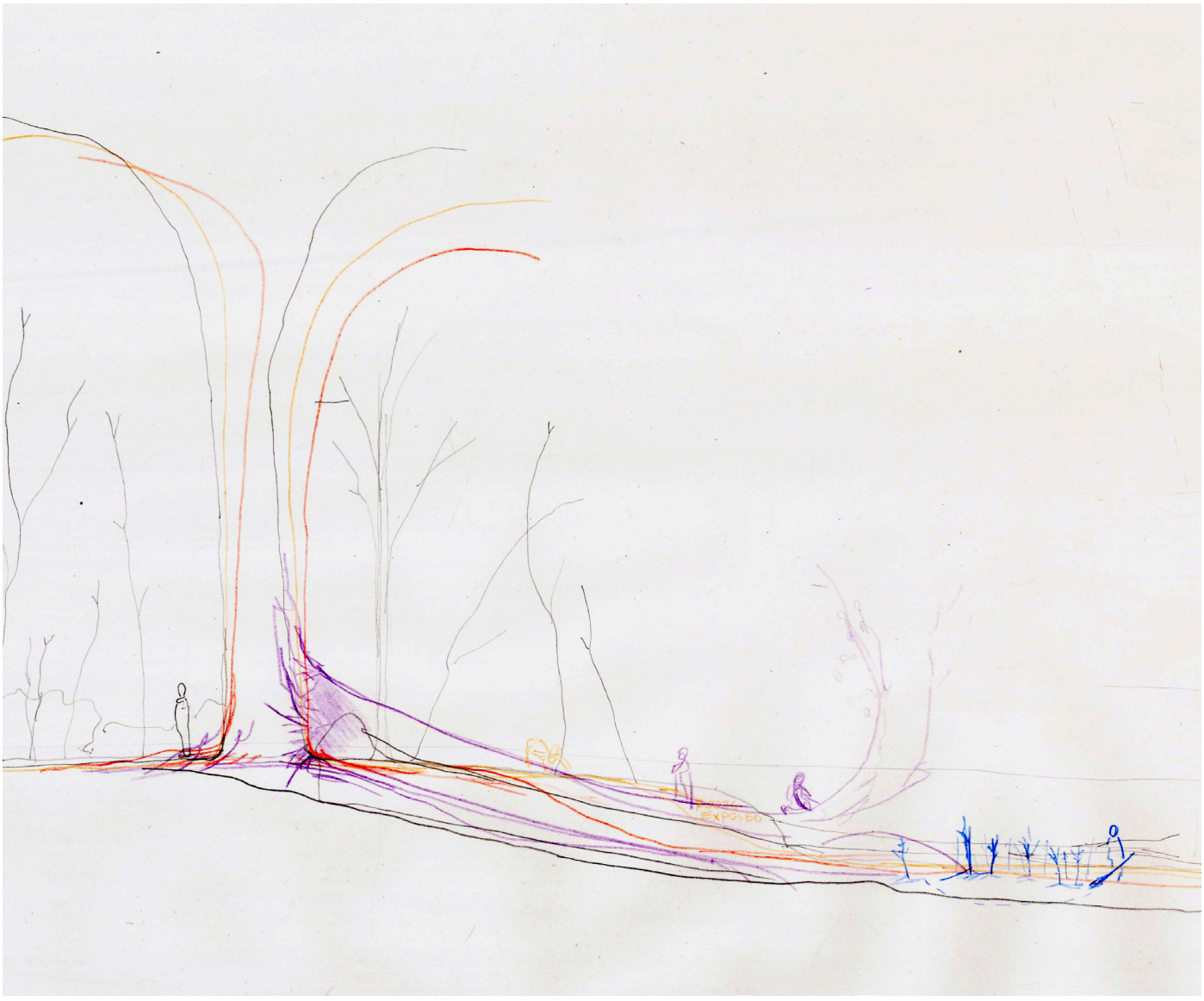
Fig. 4.12. Decline map.

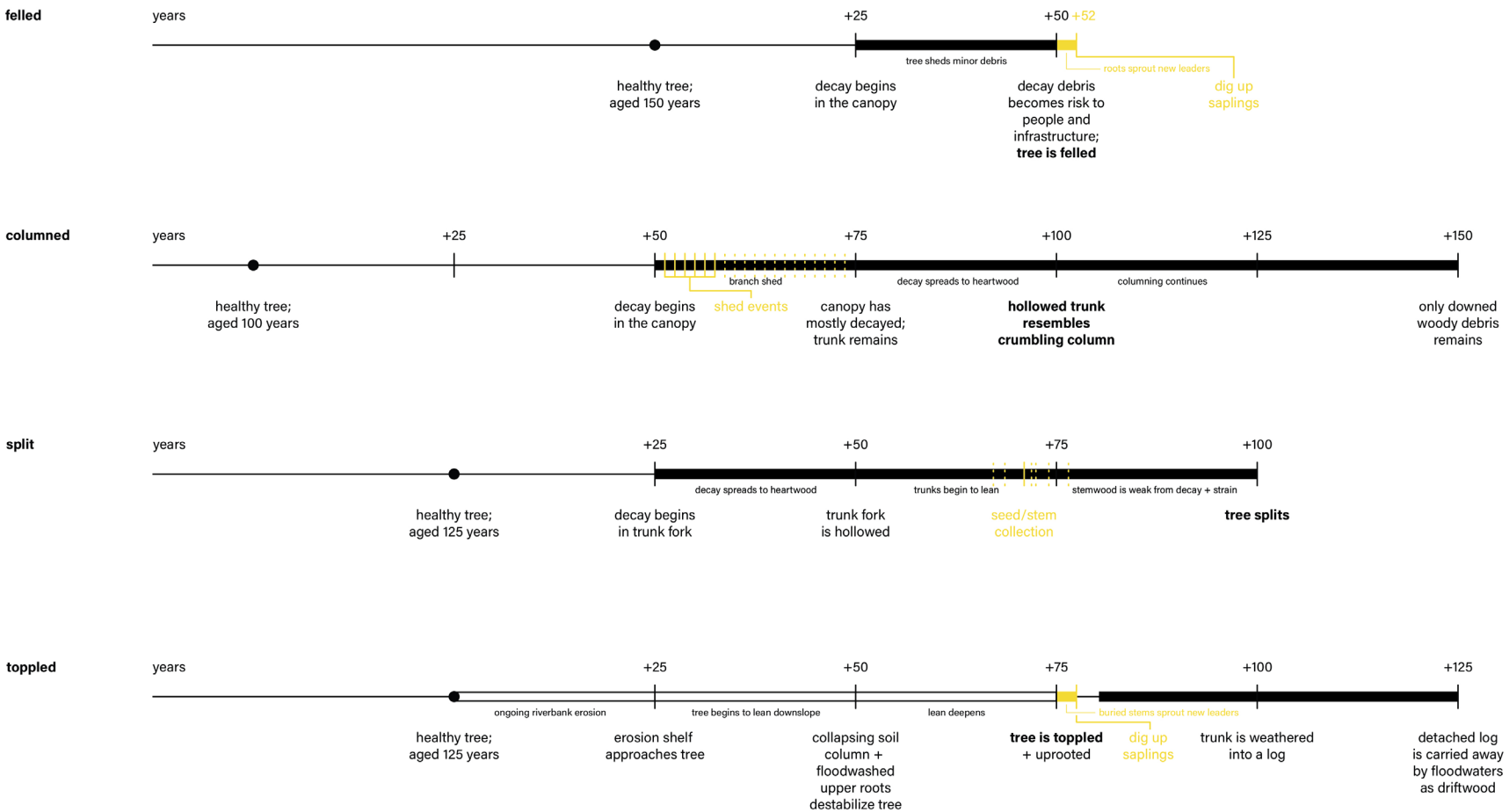
Fig. 4.13. Felling.

Fig. 4.14. Columning.

Fig. 4.15. Splitting.

Fig. 4.16. Toppling.




felled
years
+25
+50 +52
tree sheds minor debris
roots sprout new leaders
healthy tree;
aged 150 years
decay begins
in the canopy
decay debris
becomes risk to
people and
infrastructure;
tree is felled
dig up
saplings
columned
years
+25
+50
+75
+100
+125
+150
branch shed
decay spreads to heartwood
columning continues
healthy tree;
aged 100 years
decay begins
in the canopy
shed events
canopy has
mostly decayed;
trunk remains
hollowed trunk
resembles
crumbling column
only downed
woody debris
remains
split
years
+25
+50
+75
+100
decay spreads to heartwood
trunks begin to lean
stemwood is weak from decay + strain
healthy tree;
aged 125 years
decay begins
in trunk fork
trunk fork
is hollowed
seed/stem
collection
tree splits
toppled
years
+25
+50
+75
+100
+125
ongoing riverbank erosion
tree begins to lean downslope
lean deepens
buried stems sprout new leaders
healthy tree;
aged 125 years
erosion shelf
approaches tree
collapsing soil
column +
floodwashed
upper roots
destabilize tree
tree is toppled
+ uprooted
dig up
saplings
trunk is weathered
into a log
detached log
is carried away
by floodwaters
as driftwood
pre-decay process
decay process

Decline Timelines

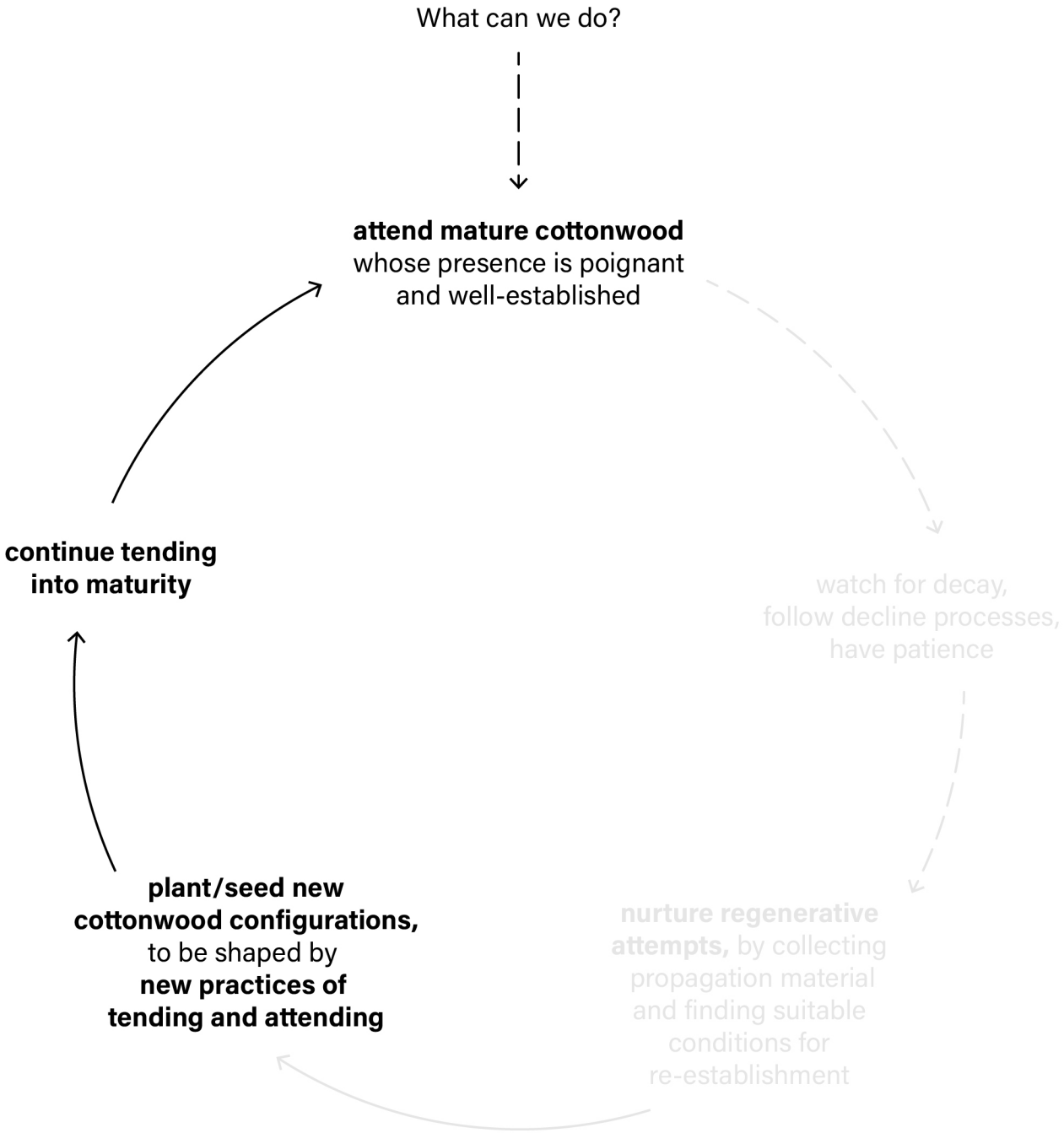
Fig. 4.17. Decline timelines by type.

Timelines for each decline process vary in length and level of decay. These factors determine when propagation material can be harvested - the opportune moments or periods (yellow) to intervene so as to extend the lifecycle of the tree.

Felling is abrupt whereas columning, splitting, and toppling are gradual. A felled tree experiences minimal decay whereas a columned tree decays entirely into woody debris. For felled, split, and toppled trees, there is one harvest event, while for columned trees there is a harvest period made up of multiple seasonal harvest events.

In the chapter to follow, these timelines will expand to include the coordination between a parent sentinel's decline and their propagules' establishment.

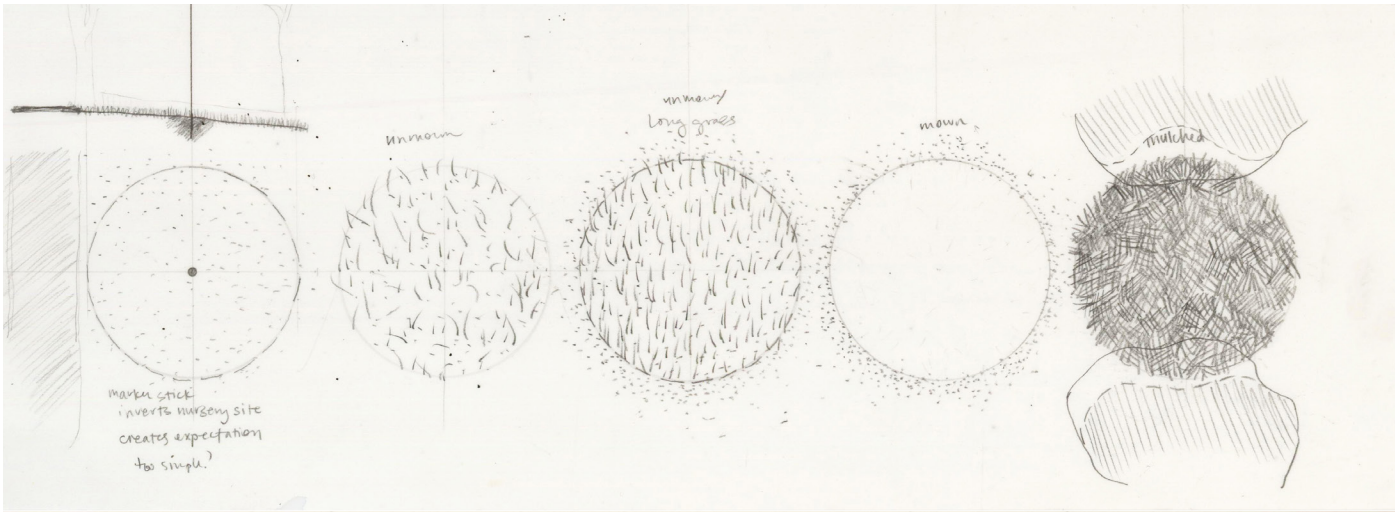
Chapter 5: Regrowth

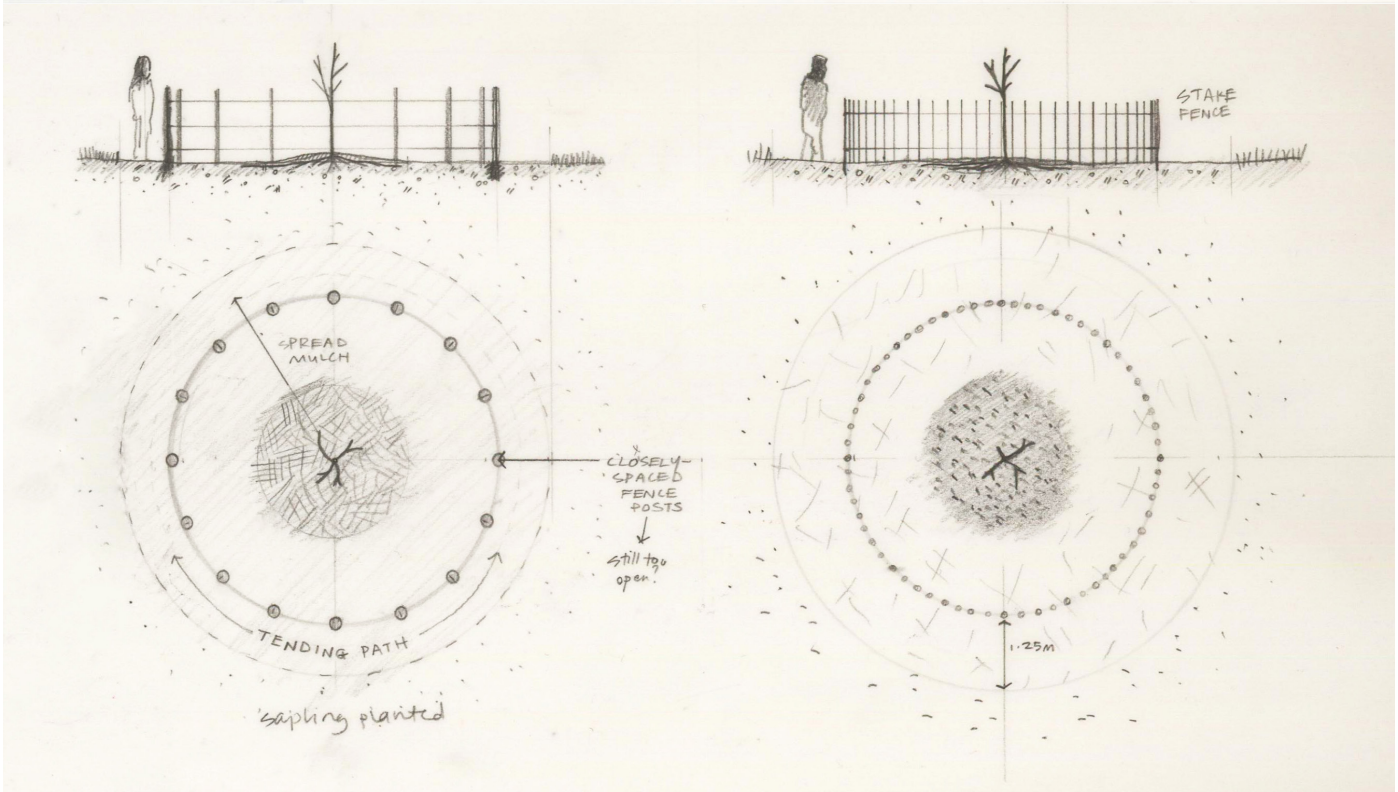

What can we do?
attend mature cottonwood whose presence is poignant and well-established
watch for decay, follow decline processes, have patience
nurture regenerative attempts, by collecting propagation material and finding suitable conditions for re-establishment
plant/seed new cottonwood configurations, to be shaped by **new practices of tending and attending**
continue tending into maturity

Prompts

1 how to celebrate the processes critical to a cottonwood's lifecycle, being, meaning

2 how to participate in cottonwood regrowth, at a scale that encourages close interaction and sustained attention


unmown
unmown/
Long grass
mown
mulched
marks stick
inverts nursery site
creates expectation
too simple.)


STAKE
FENCE
SPREAD
MULCH
CLOSELY-
SPACED
FENCE
POSTS
still too
open
TENDING PATH
sapling planted
1.25M

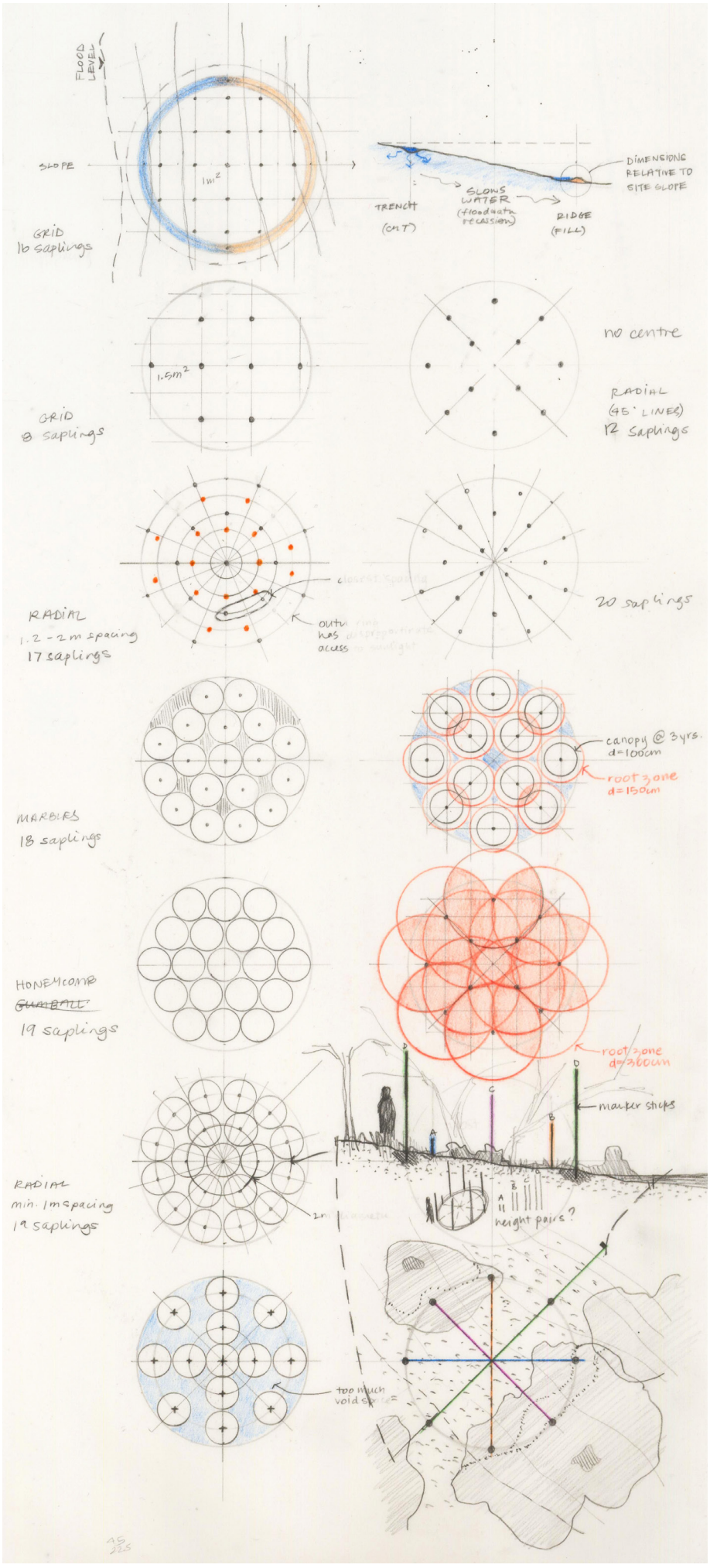


Fig. 5.1., 5.2., 5.3. Early drawings for model configurations explored site preparation methods (opposite, top); possibilities for fencing, framing, and marking (opposite, bottom); and planting geometries (right). Later drawings diverged from or built on these explorations, further informed by the design considerations outlined on page 85.

Parent Decline Type	Regeneration Mechanism	Inheritance	
		Propagative Material	Secondary Material
felled	suckering	root sprouts	trunk + branch wood
columned	branch shed	stem cuttings	dead branches
split	leaning / canopy lowering	seed or stem cuttings	trunk + branch wood
toppled	layering	crown sprouts	driftwood

Design Considerations

Complementary to the model's design prompts, below is a list of key considerations that guide the design of the four new cottonwood spaces.

The configurations should be simple, small-scale, and tendable:

- limited number of propagules
- living and minimally processed construction materials (chart, opposite) with their own material qualities and parameters
- replicable form and scale that a small group of people can reasonably establish and tend; dimensions that can be adjusted relative to a chosen site
- simple, impactful form that reveals process

The configurations should relate to their parent sentinel type and to each other:

- parent's presence translated into new space
- uniformity in character, variety in dimension

The configurations should engage time, change, and indeterminacy:

- dynamic geometries that make time visible and measurable
- tending + attending practices evolve
- initial structure and tending defined but the spaces should shape themselves

Opposite, a chart summarizes processes and products for each decline type.

Felled Configuration:
Court

Key Spatial Qualities
openness vertical axis a relationship to the sky

Spatial Concept
a quadrangle enclosed at its perimeter, marking out an interior space or a COURT

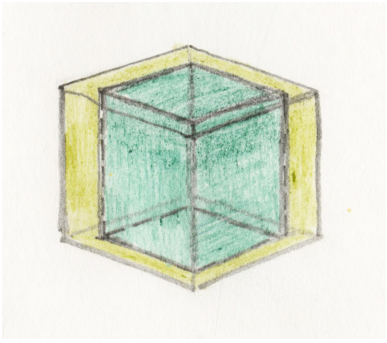
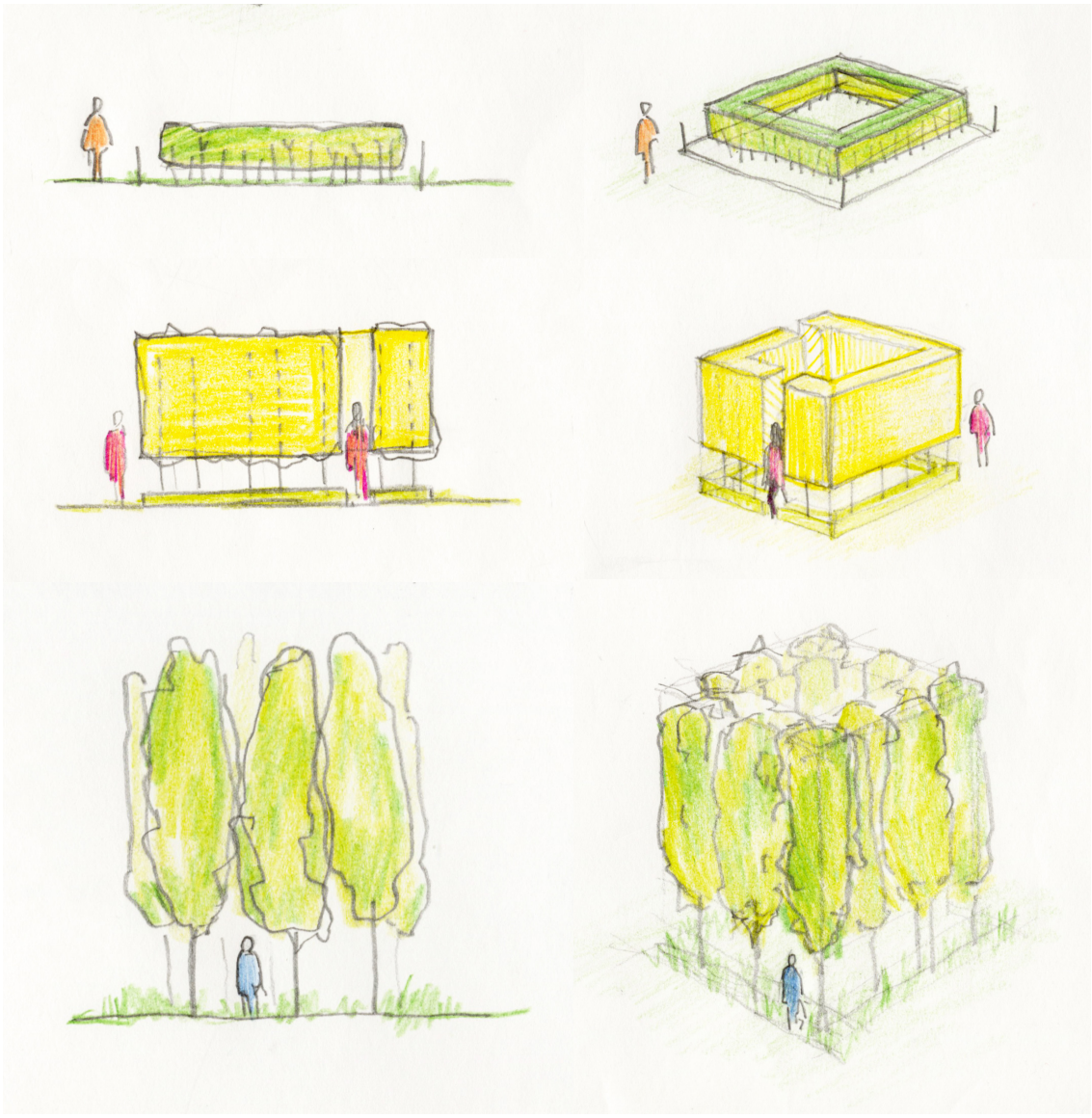
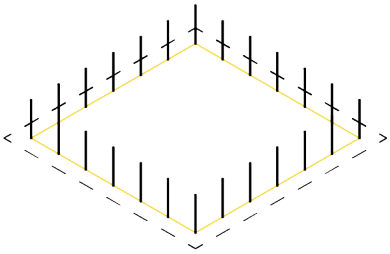
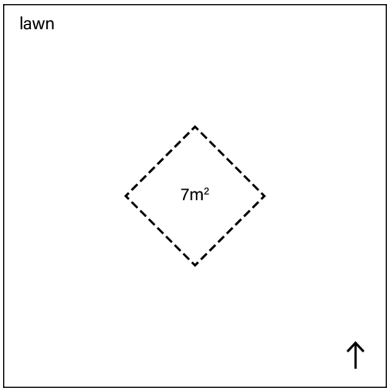


Fig. 5.4. Court, solid-void diagram.
(opposite) Fig. 5.5. Court spatial concept sketches.



Court:
Inventory





Inheritance from Parent Sentinel

36 x rooted saplings, 2 years old
about 120cm tall

trunk + branch wood, milled into:
8 x 10x10x125cm corner posts
92 x 5x10x125cm fence posts
+ more for replacement, if supply allows
scrapwood mulch

Dimensions

total area including 0.5m no-mow border = $7m^2$
planting perimeter = $6m^2$
trunk spacing = $1m^2$

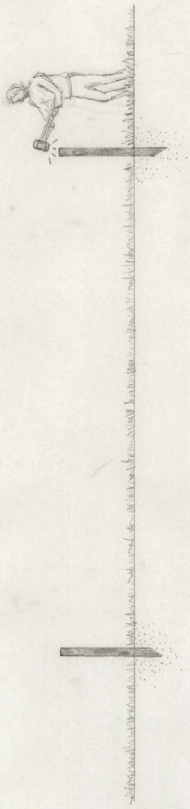
Site Selection

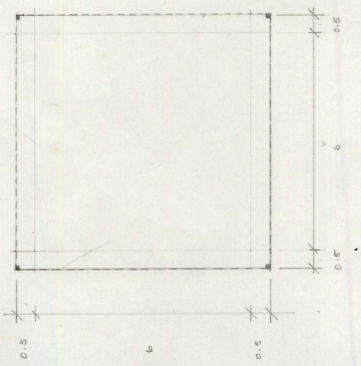
an open lawn
adequate soil moisture

Siting + Orientation

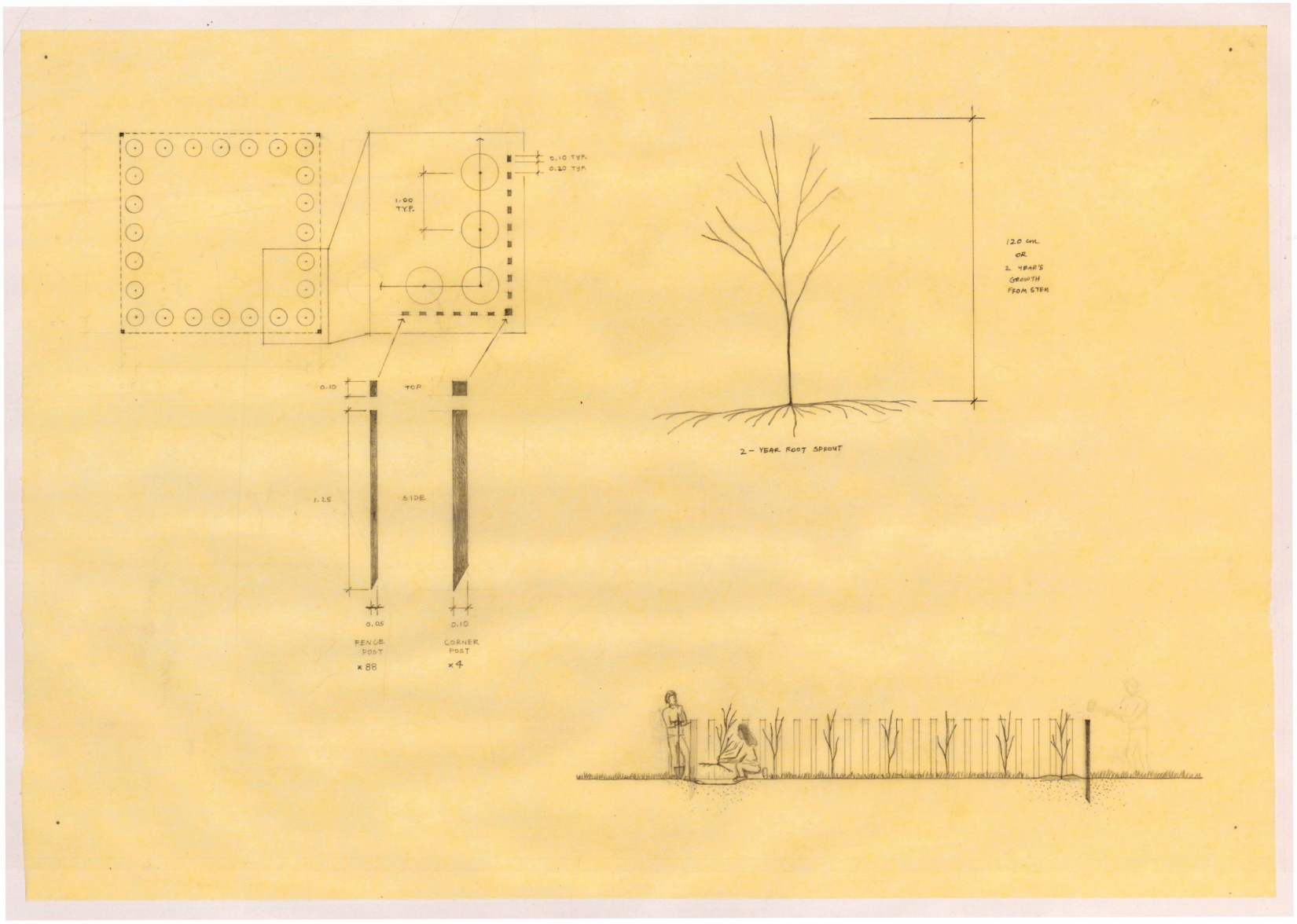
full sun
lawn or clear, mown groundplane
corners aligned to cardinal directions, for even light distribution

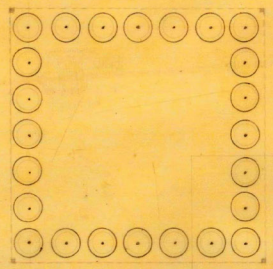
(opposite) Fig. 5.6. Court vignette.
(top) Fig. 5.7. Court planting diagram.
(bottom) Fig. 5.8. Court site diagram.



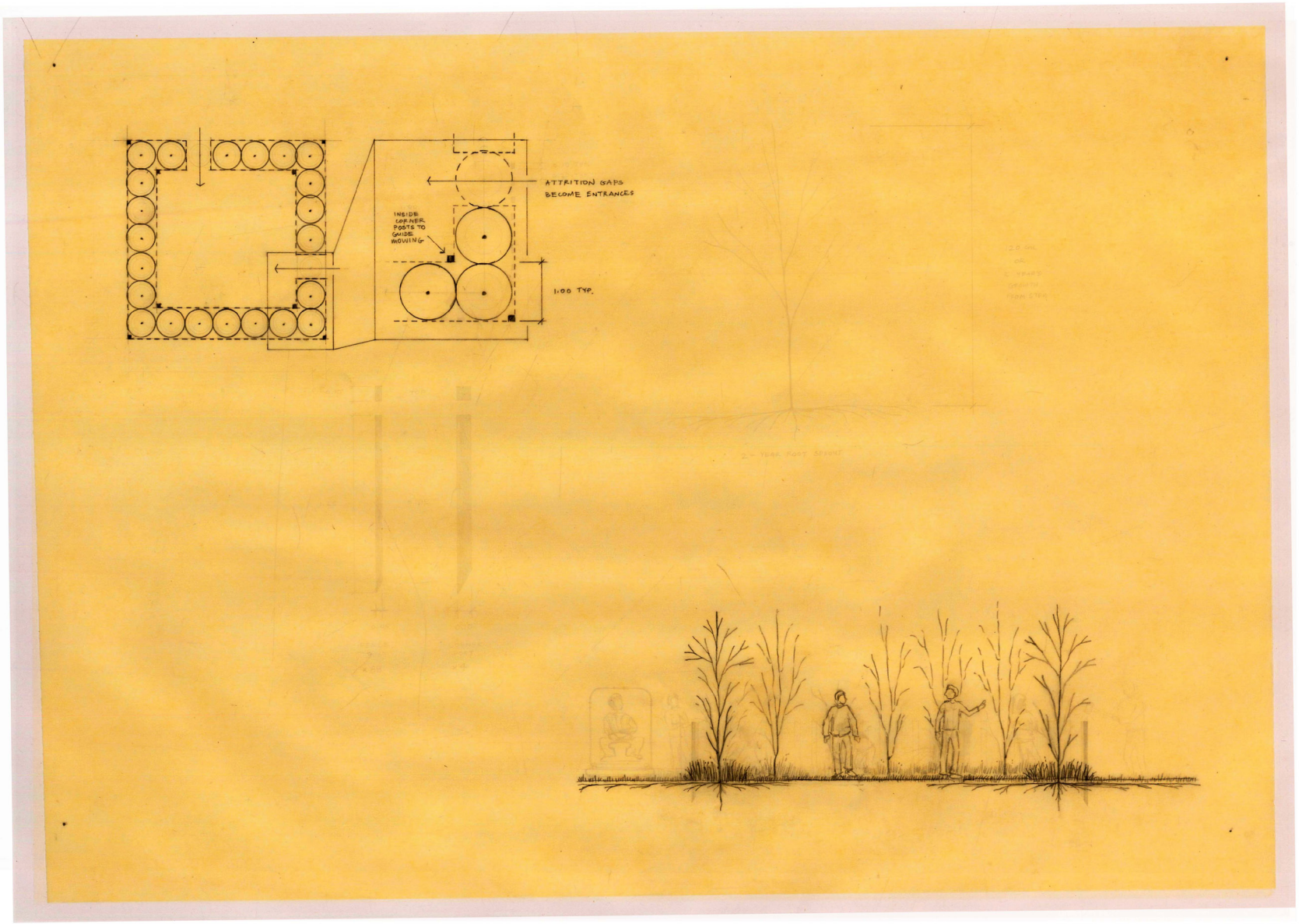

0.5
6
0.5
4
0.5

(above) Fig. 5.9. Court: Y1, site work.
(below) Fig. 5.10. Court: Y2, planting.





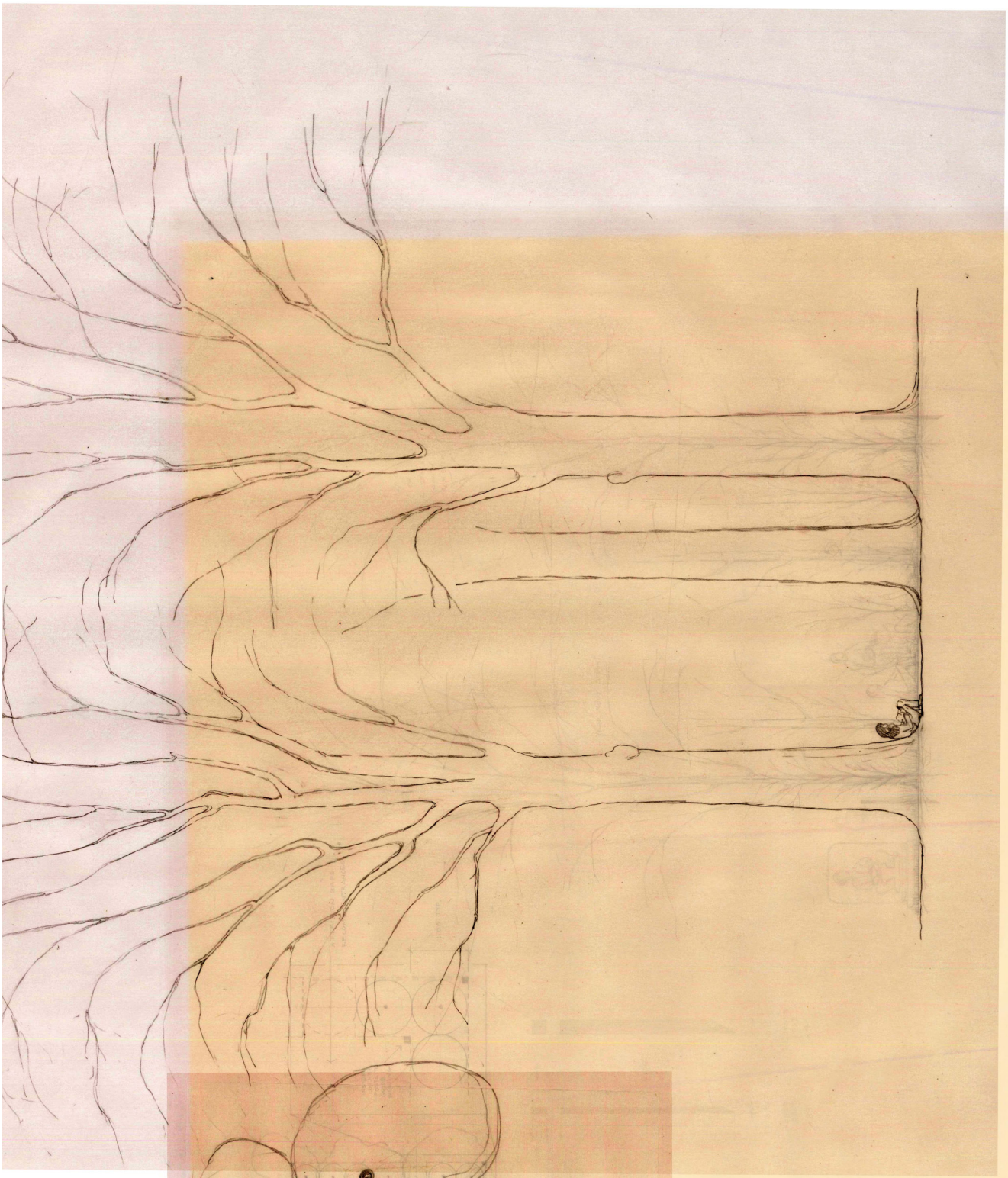
(above) Fig. 5.11. Court: Y3, 1° tending.
(below) Fig. 5.12. Court: Y8, after court opening.




ATTRITION GATES
BECOME ENTRANCES
1.00 TYP.

Fig. 5.13. Court: after Y15, cloudgazing through canopy opening.

Next spread:
(top) Fig. 5.14. Court: Y150, quiet reading.
(bottom) Fig. 5.15. Court: Y175, picnic table chats.



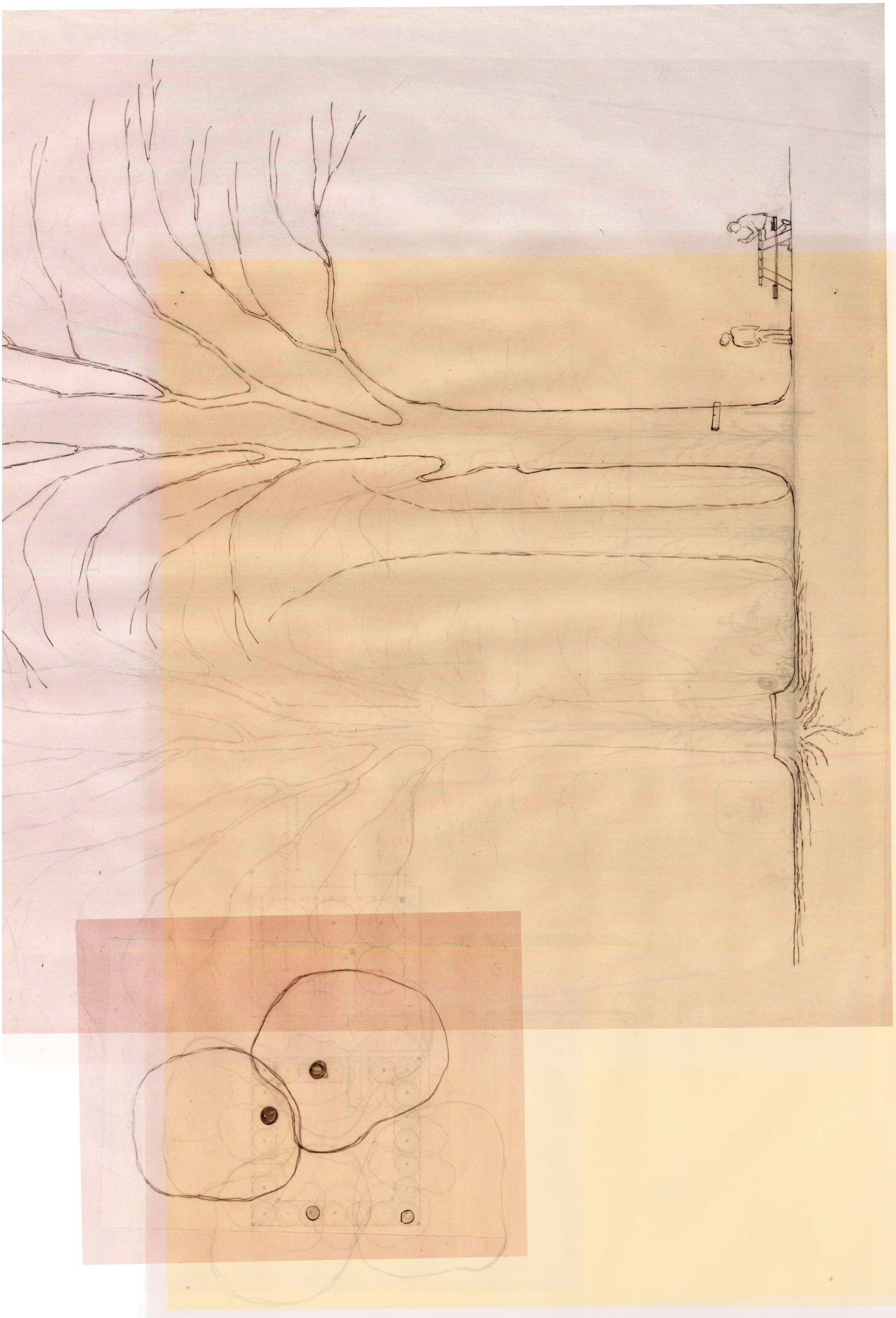
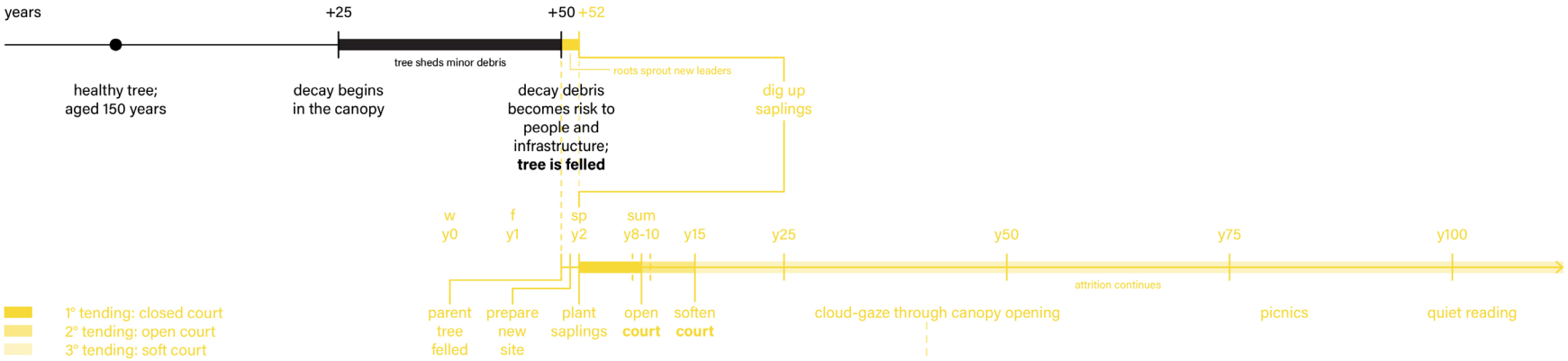


Fig. 5.16. Felled/Court timelines.



Court Tending Schedule

	TIMING	ACTION	NOTES
felling	winter Y0	parent tree felled stump left unground wood milled	
	as root sprouts emerge	weeding mowing	as needed, hand pull as needed, carefully around sprouts
site work	fall Y1	select site dimension COURT area ($7m^2$) drive in corner posts	using criteria (see pg. 89) 10x10x125cm posts
planting	early spring Y2, before budbreak	stake out spacing dig planting holes transplant saplings amend soil with compost water thoroughly mulch install fenceline	100cm o.c. 5-10cm layer, away from trunk 5x10x125cm posts, 20cm spacing to deter browsers and foot traffic
1° tending		watering weeding fencepost replacement mowing around fenceline re-mulching structural pruning (from Y6 on)	as needed as needed, hand pull as needed using corner posts as guides as needed for: *narrow canopy, low-branching form*
court opening	summer Y8-10 or once an attrition gap forms	remove fenceline; leave corners clear debris (e.g. thinned trees) dimension COURT interior ($5m^2$) drive in interior corner posts mow interior mow gap as "path" into COURT	chip/mulch posts chip/mulch debris 10x10x125cm posts using inner corner posts as guides
2° tending		mowing new paths as gaps form leaf collection watering weeding fencepost replacement pruning debris removal	using outer and inner corner posts as guides after leaf drop in dormant months
court softening	Y15 or once lowest branches spread overhead	remove all fenceposts mow site evenly	chip/mulch posts to clear groundplane between + below trees
3° tending		mowing weeding debris removal pruning damage	

Columned Configuration:
Hall

Key Spatial Qualities
transition beacon

Spatial Concept
a threshold; a roofed space in which to meet or a HALL

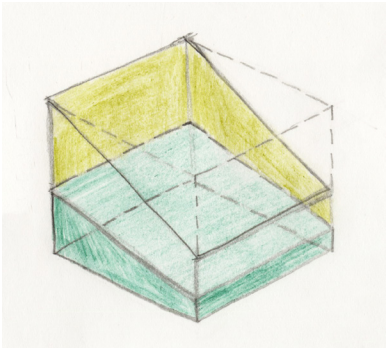
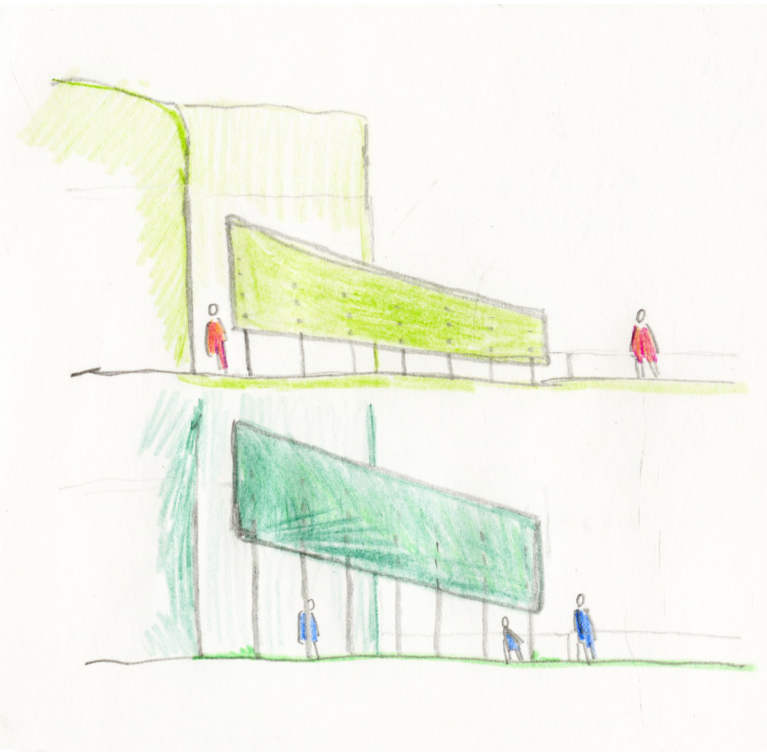
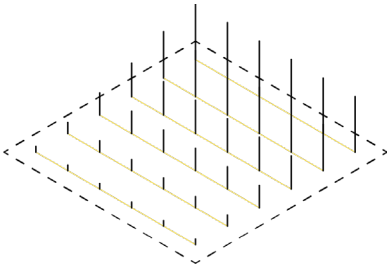
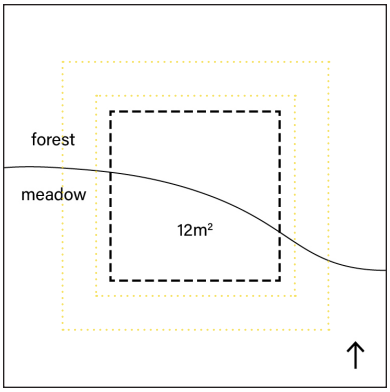


Fig. 5.17. Hall, solid-void diagram.
(opposite) Fig. 5.18. Hall spatial concept sketches.



Hall:
Inventory





(opposite) Fig. 5.19. Hall vignette.
(top) Fig. 5.20. Hall planting diagram.
(bottom) Fig. 5.21. Hall site diagram.

Inheritance from Parent Sentinel

min. 6 live stems/shed event for 6 shed events
collected in early spring from freshly shed branches
to be rooted in growing medium before planted
1 or 2 year wood with at least two viable buds

decayed branch wood, mulched

Dimensions

*total area = min. 12m^2
*planting row length = min. 10m
trunk spacing = 2m^2

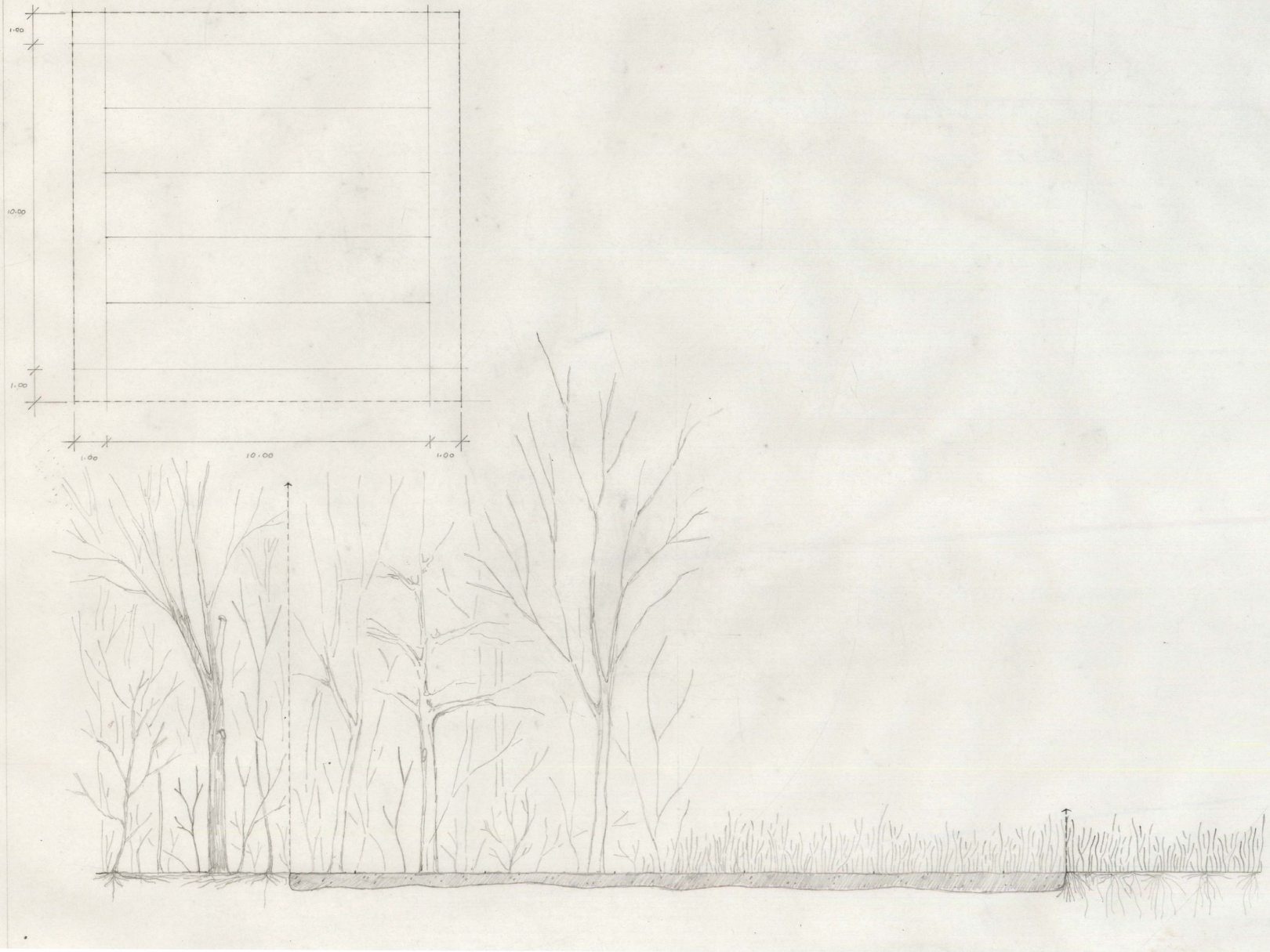
*HALL area and row length may be modified on site
(see dotted dimensions in fig. 5.21):
if total area = xm^2, row length = (x-2)m
x is an even number
x/2 = # of rows and shed events
(row length/2)+1 = # of stems per row

Site Selection

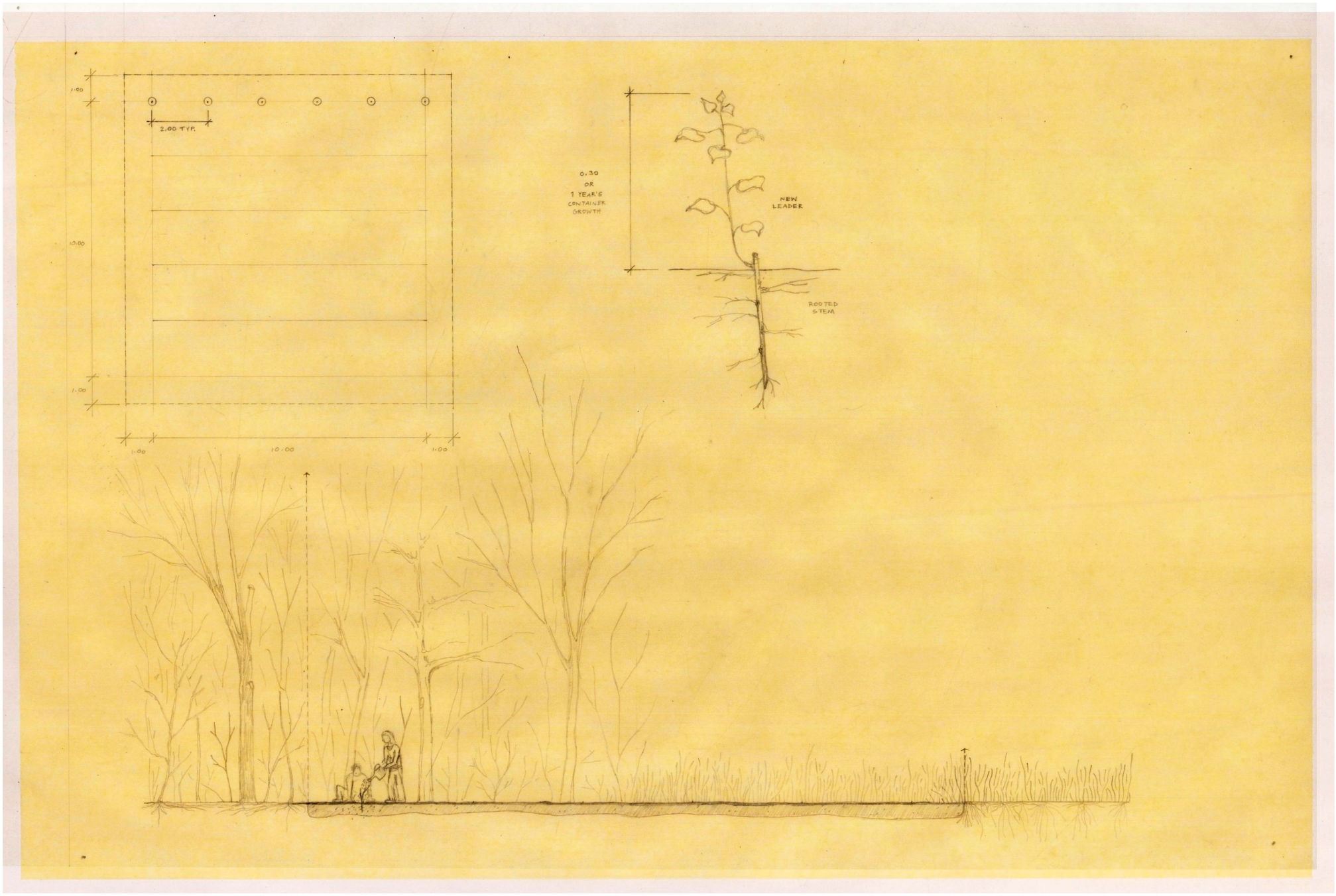
south-facing forest-meadow edge
manageable shelterwood and understory vegetation

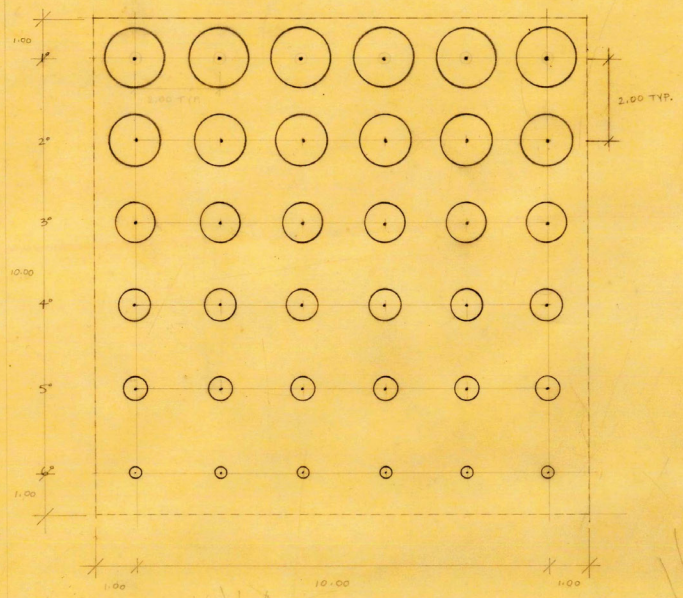
Siting + Orientation

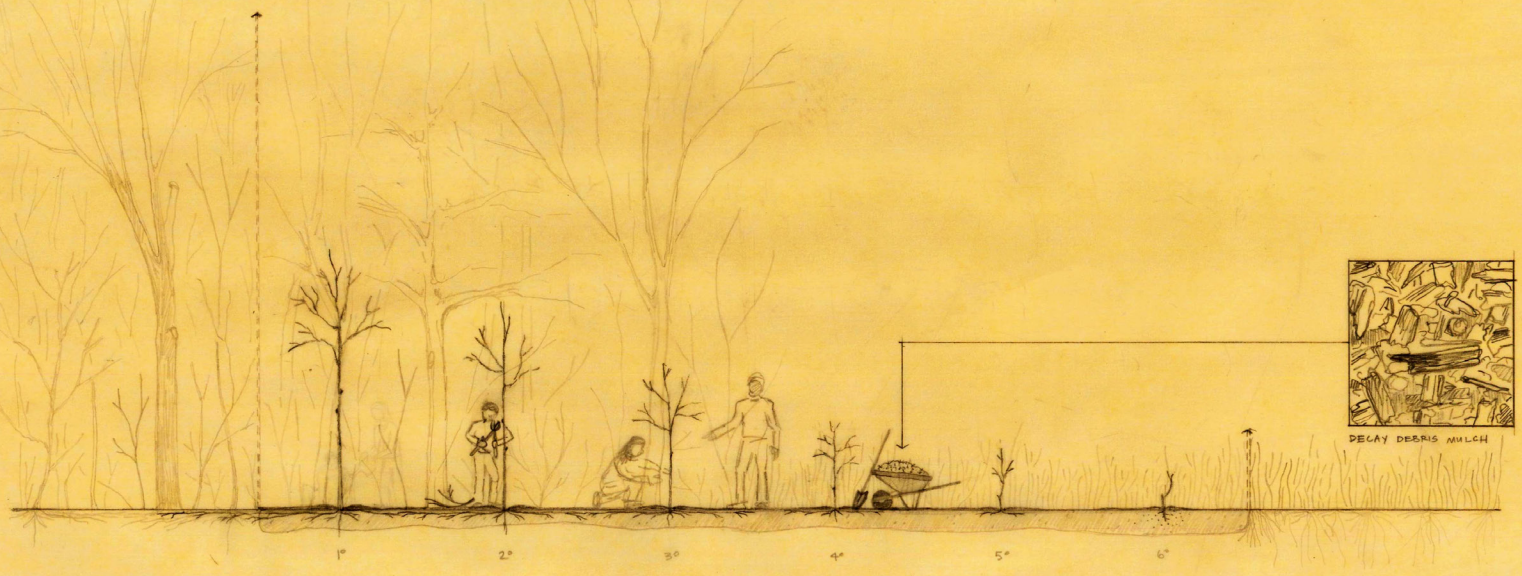
full sun
rows aligned to an east-west axis
rows planted on a north-south axis
forest-meadow edge bisects the site so that 6m of
both forest and meadow are cleared outward from
the midline


1.00
10.00
1.00
1.00
10.00
1.00

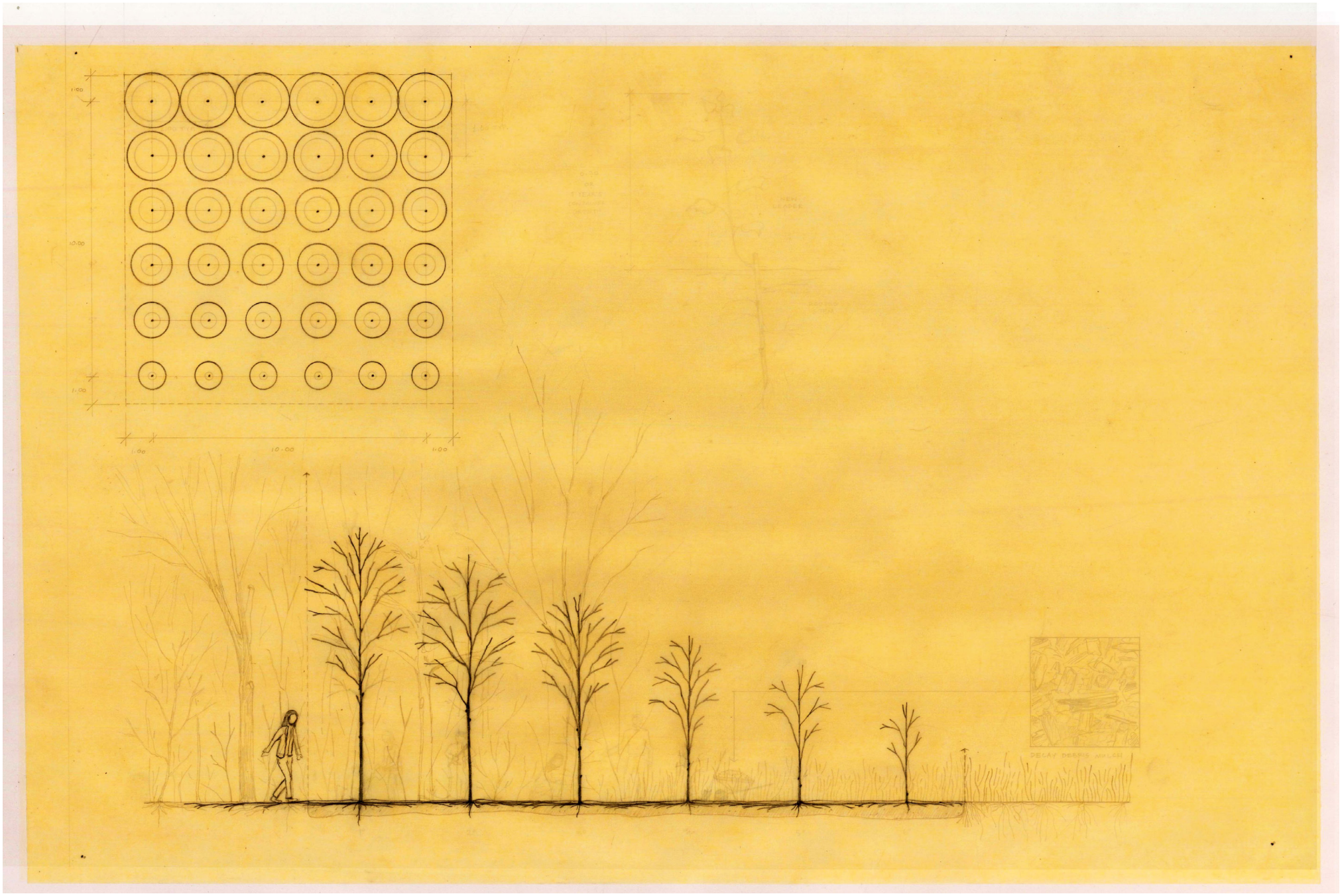
(above) Fig. 5.22. Hall: Y0, site work.
(below) Fig. 5.23. Hall: Y1, 1st row planting.




1.00
1°
2°
3°
10.00
4°
5°
6°
1.00
2.00 TYP.
1.00
10.00
1.00


DECAY DEBRIS MULCH
1°
2°
3°
4°
5°
6°

(above) Fig. 5.24. Hall: Y6, 6th row planting.
(below) Fig. 5.25. Hall: Y8, 1° tending.



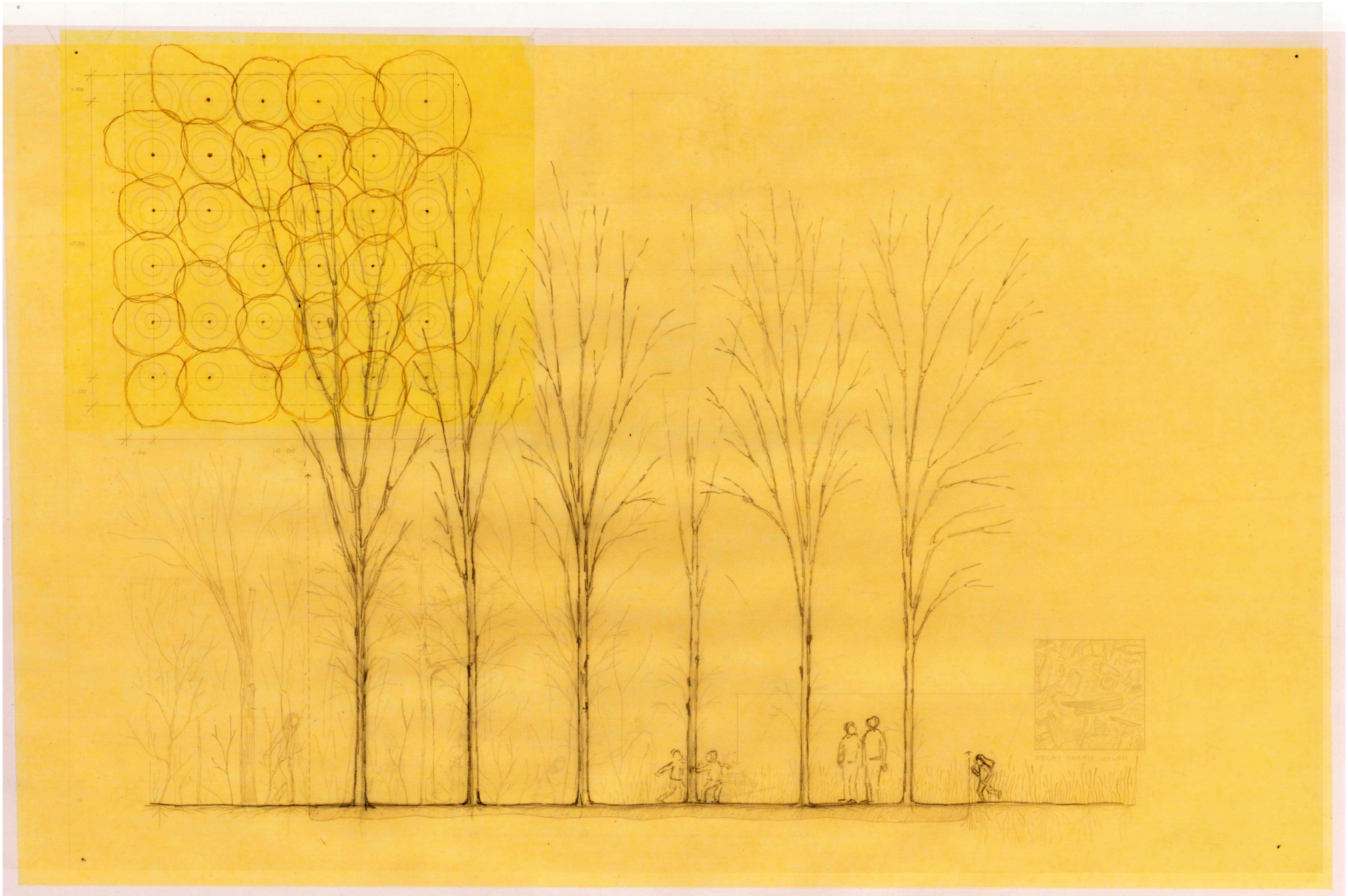
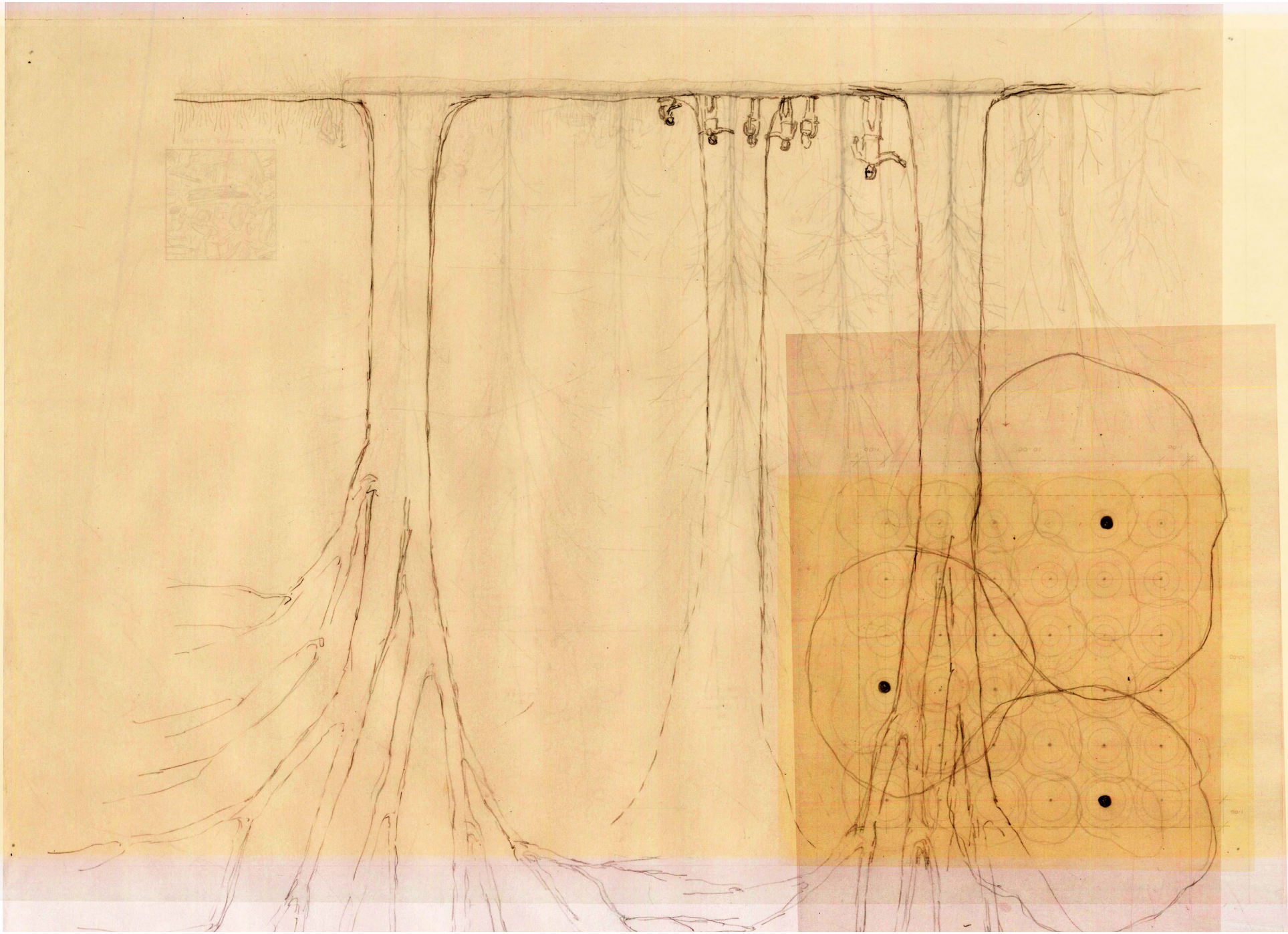


Fig. 5.26. Hall: Y20, after hall clearing.

Next spread:
(top) Fig. 5.27. Hall: Y150, school field trips.
(bottom) Fig. 5.28. Hall: Y200, bark harvesting.



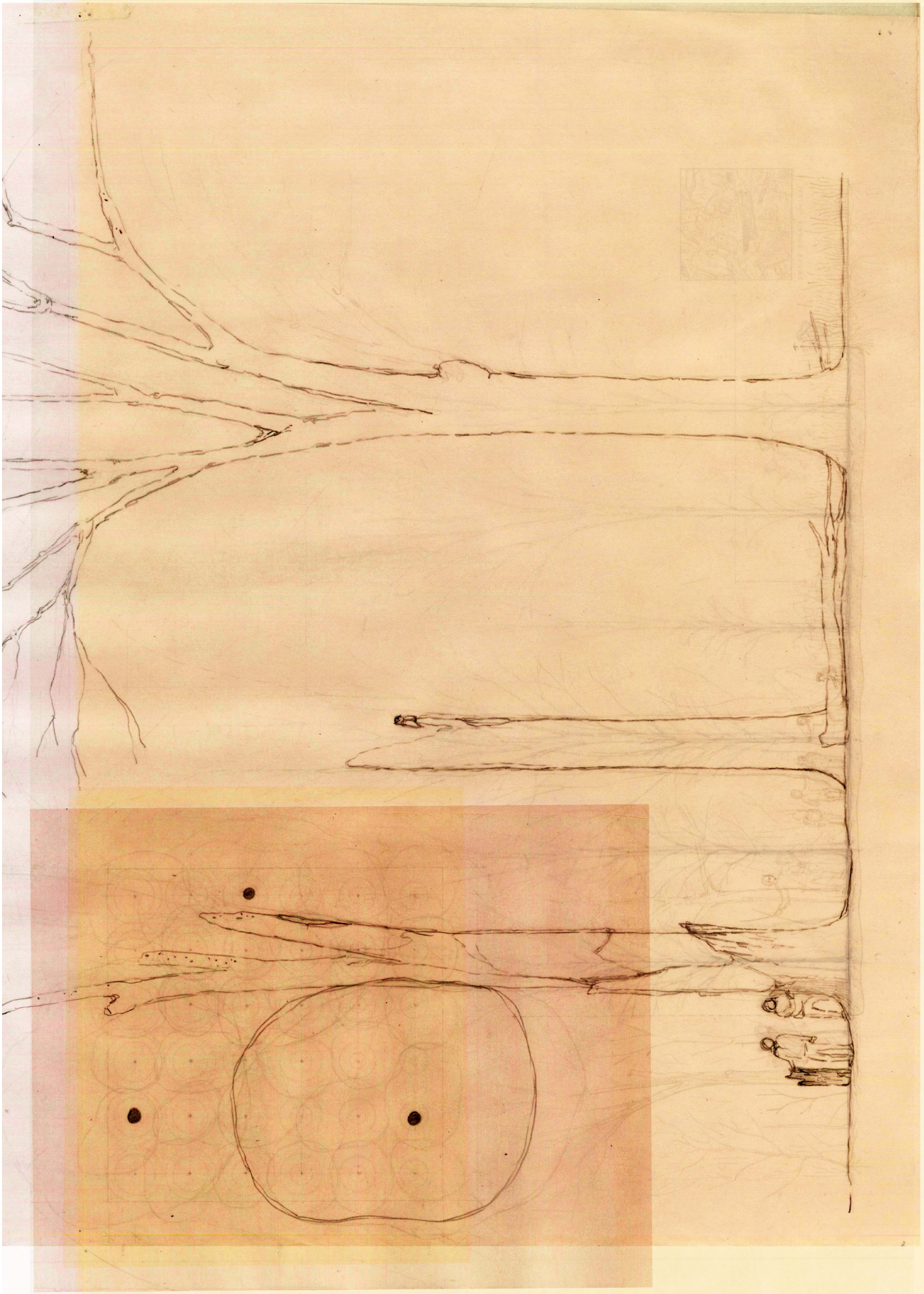
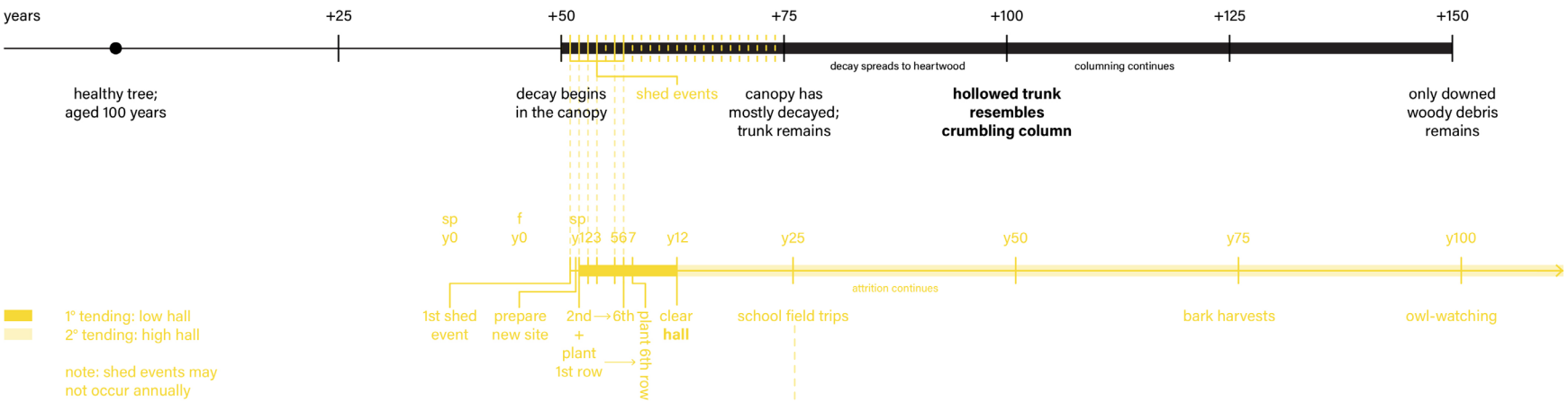


Fig. 5.29. Columned/Hall timelines.



Hall Tending Schedule

	TIMING	ACTION	NOTES
1st SE	early spring Y0	1st shed event (SE) collect 6 live stems mulch dead branchwood	 plant in growing medium to root
site work	fall Y0	select site dimension HALL area ($12m^2$) clear area of forest + grass till and mulch lightly mow tending path thin shelterwood edges stake out planting rows	using criteria (see pg. 103) through meadow, from nearest adjoining path to manage light obstruction
2nd SE	early spring Y1	2nd shed event	
planting 1st row	early spring Y1, before budbreak	stake out spacing dig planting trench plant rooted stems water thoroughly mulch	200cm o.c. 5-10cm layer, away from trunk
	annual spring shed events and row planting repeat until 6th shed event and row planting		
1° tending		watering re-mulching weeding mow tending path structural pruning (from Y4 on)	as needed especially site edges, to suppress creeping growth as needed, hand pull biweekly, during warm months for: *straight trunks, slanted canopy ceiling (variable branching height: highest at forest edge, lowest at meadow edge)*
hall clearing	Y12 or once lowest branches spread overhead	mow site evenly ease mulching ease shelterwood thinning	between rows
2° tending		mowing tending path leaf collection pruning damage debris removal (shed branches)	mown debris composted or scattered in forest weekly, during warm months after leaf drop in dormant months as needed to keep groundplane clear

Split Configuration:
Copse

Key Spatial Qualities
self-contained informal

Spatial Concept
a small, densely-spaced wood or a COPSE

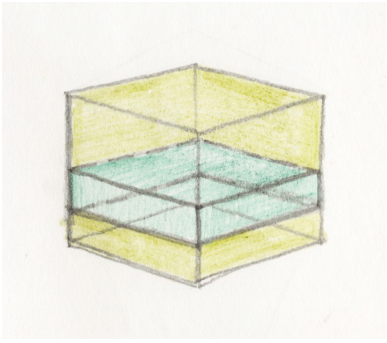
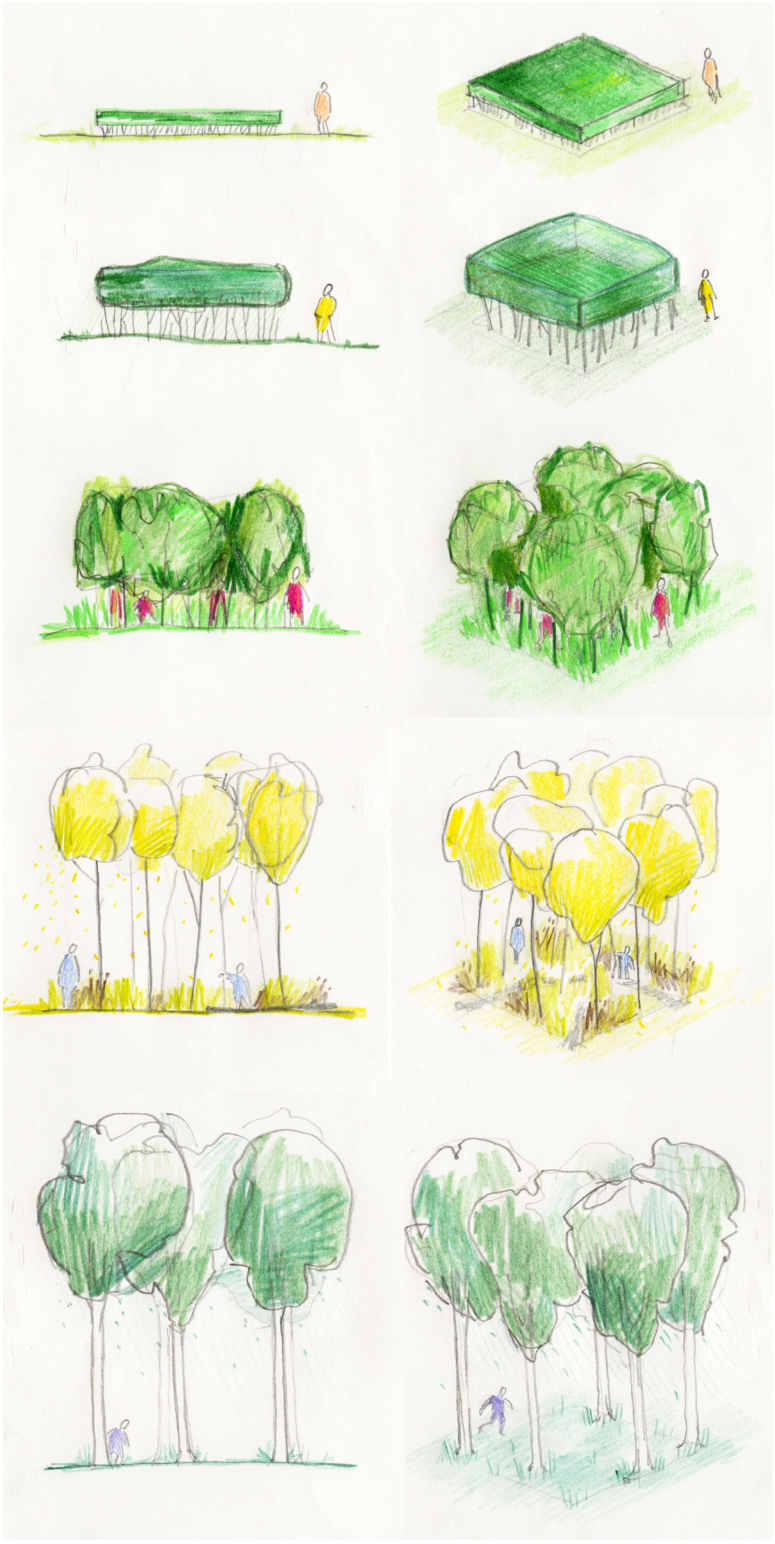
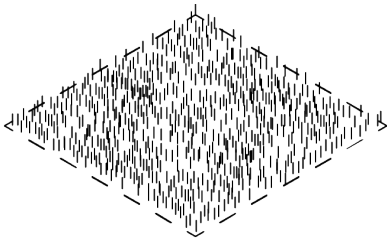
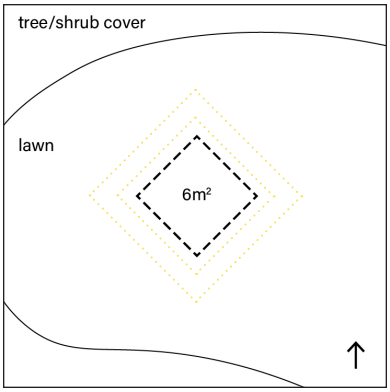


Fig. 5.30. Copse, solid-void diagram.
(opposite) Fig. 5.31. Copse spatial concept sketches.



Copse:
Inventory





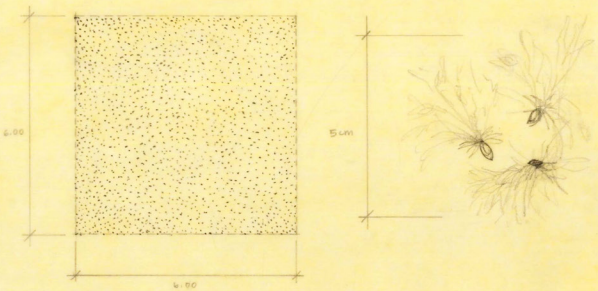
(opposite) Fig. 5.32. Copse vignette.
(top) Fig. 5.33. Copse planting diagram.
(bottom) Fig. 5.34. Copse site diagram.

Inheritance from Parent Sentinel
seed, collected as free cotton or in capsules and dispersed on new site immediately OR live cuttings, collected from canopy to be rooted in growing medium before planted 1 or 2 year wood with at least two viable buds trunk + branch wood, milled into rough planks

Dimensions
*total area = min. 6m^2 spacing uncontrolled *COPSE area may be modified on site (see dotted dimensions in fig. 5.34)

Site Selection
a sheltered lawn open clear groundplane adequate soil moisture

Siting + Orientation
full sun corners aligned to cardinal directions, for even light distribution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5cm
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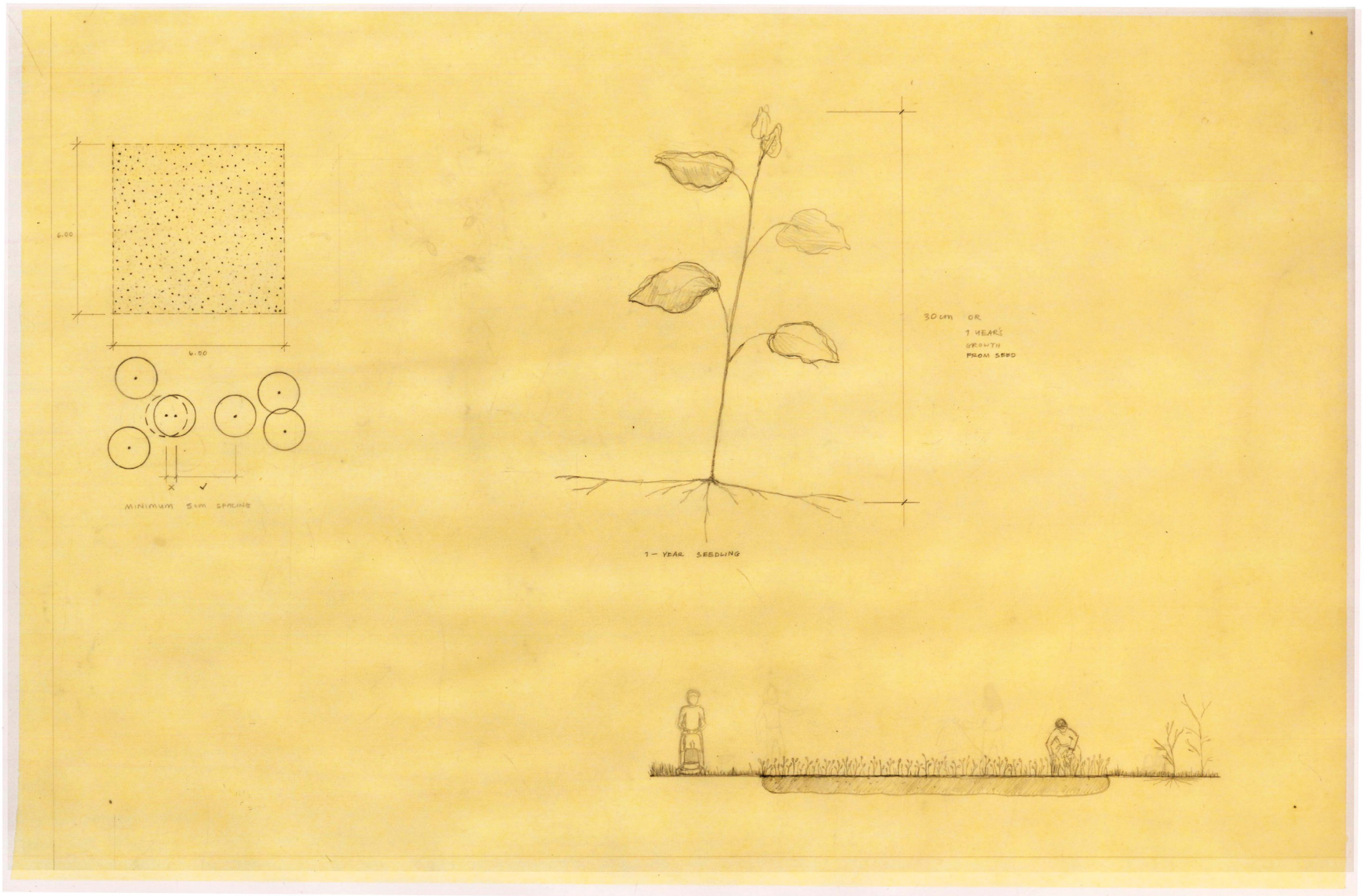
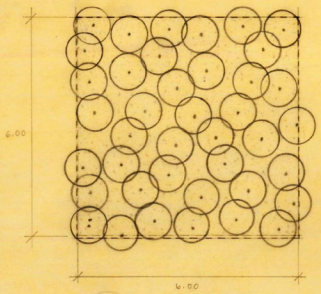
(above) Fig. 5.35. Copse: Y1, seeding.
(below) Fig. 5.36. Copse: Y2, 1° tending.

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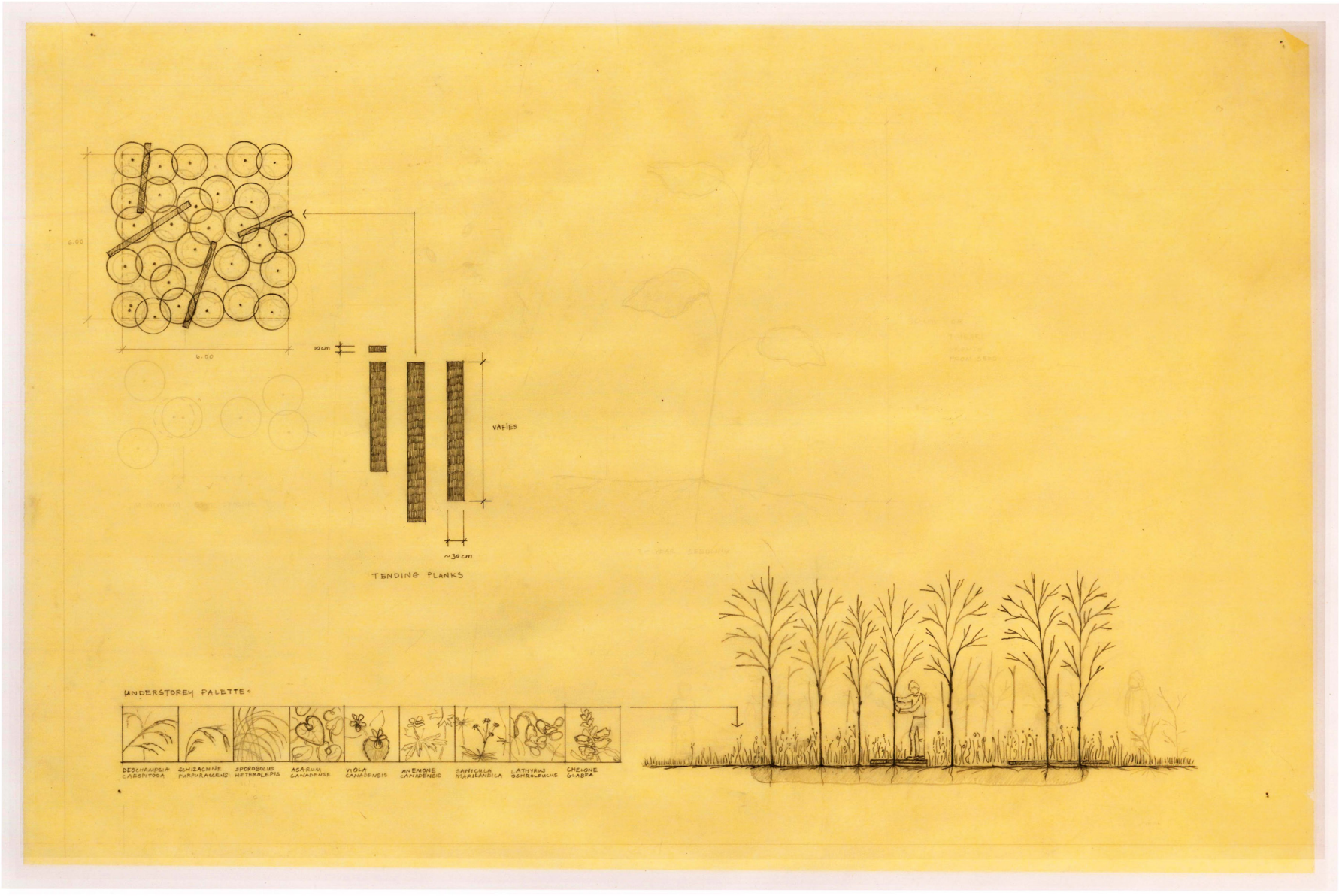
(above) Fig. 5.37. Copse: Y6, perennial planting.
(below) Fig. 5.38. Copse: Y8, 2° tending.



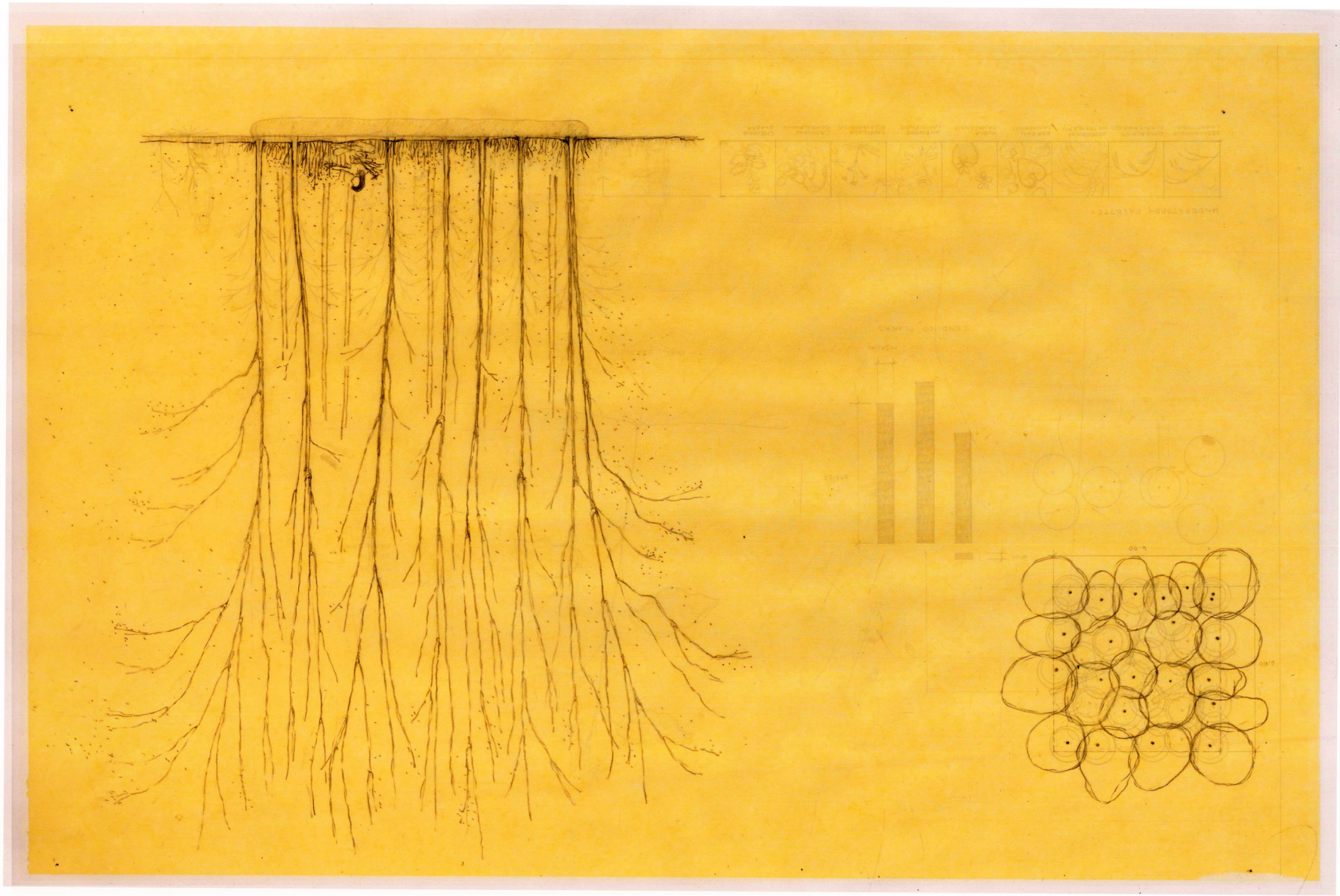
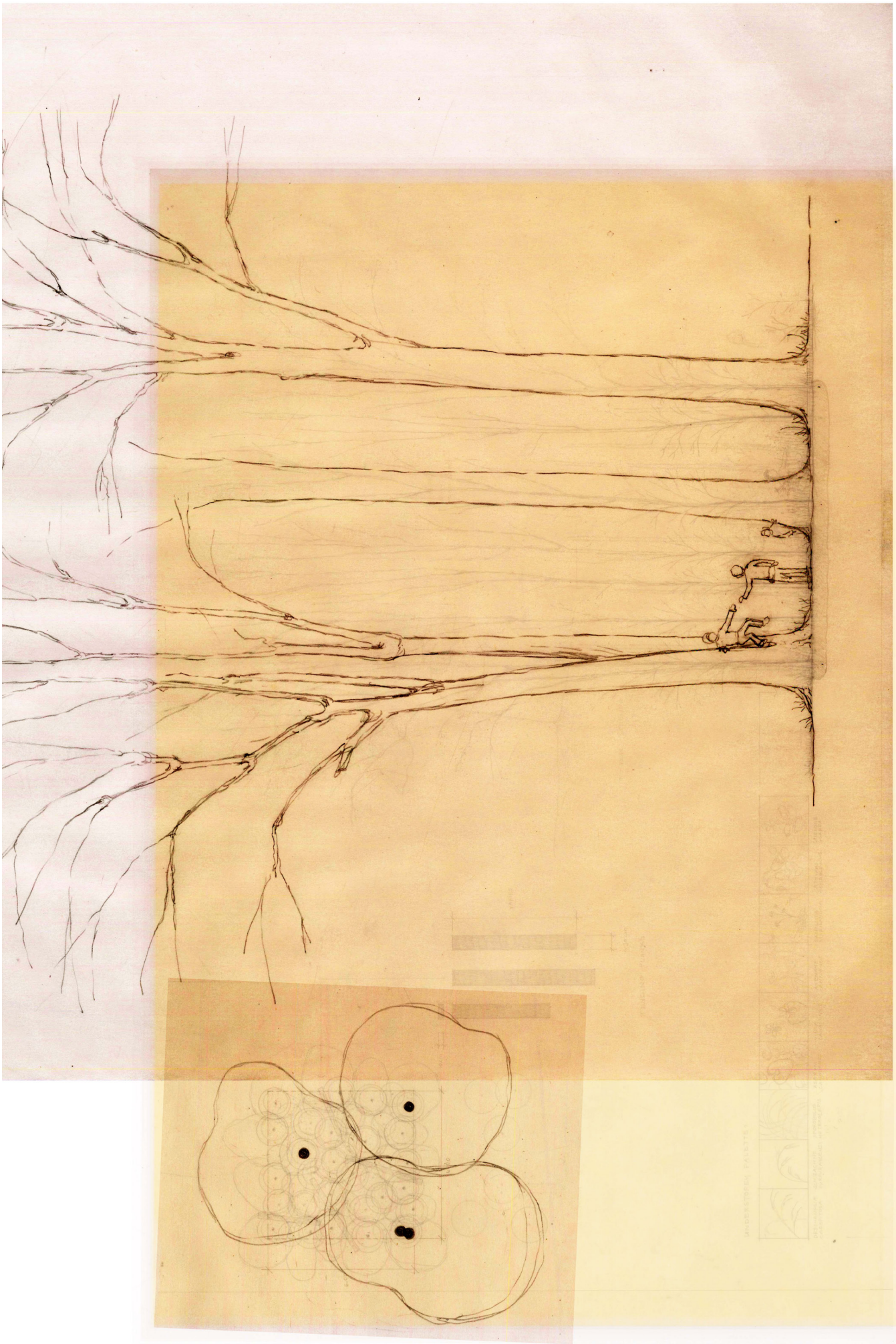


Fig. 5.39. Copse: Y15, flower collection.

Next spread:
(top) Fig. 5.40. Copse: Y125, trunk climbing.
(bottom) Fig. 5.41. Copse: Y175, log-sitting.



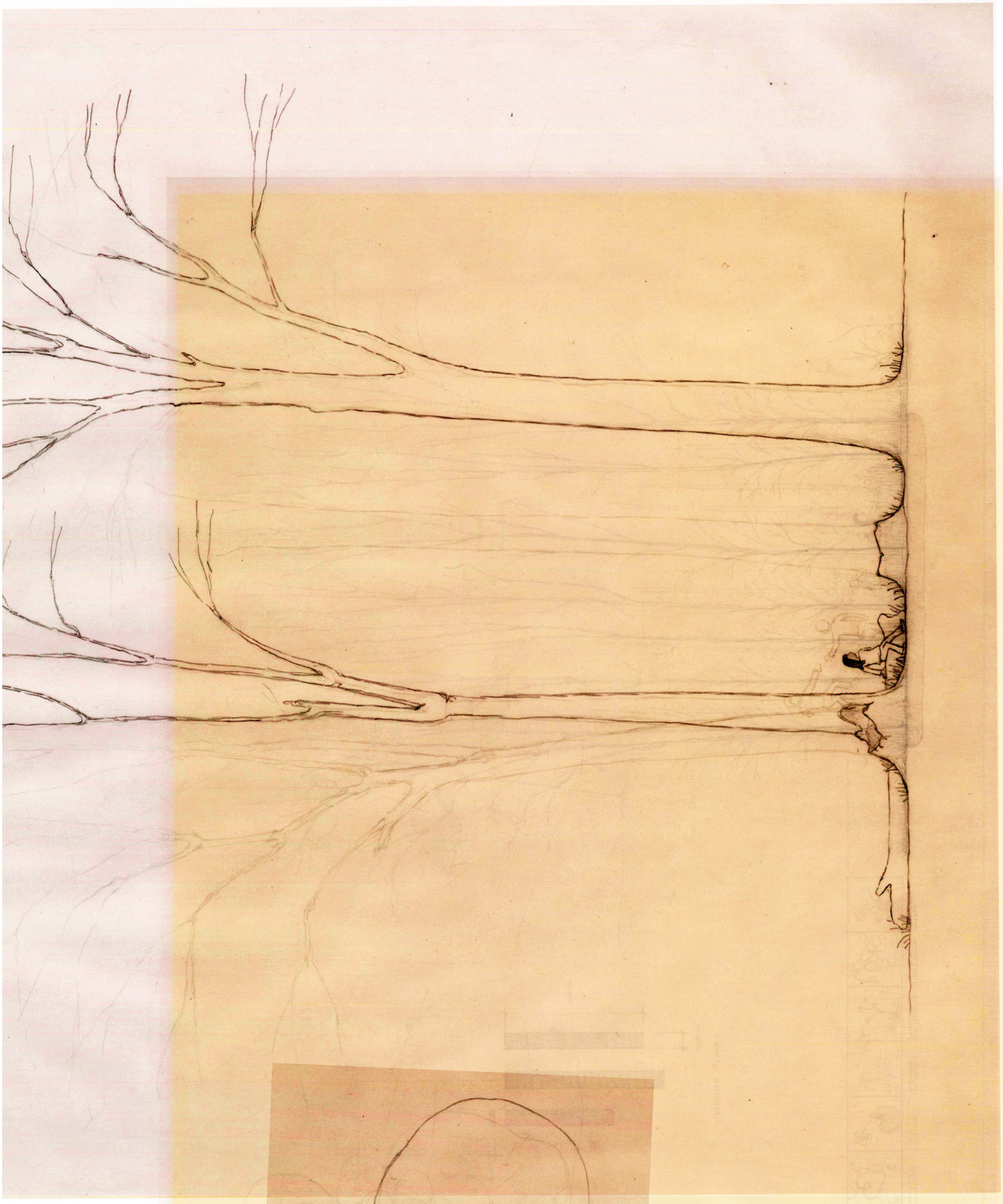
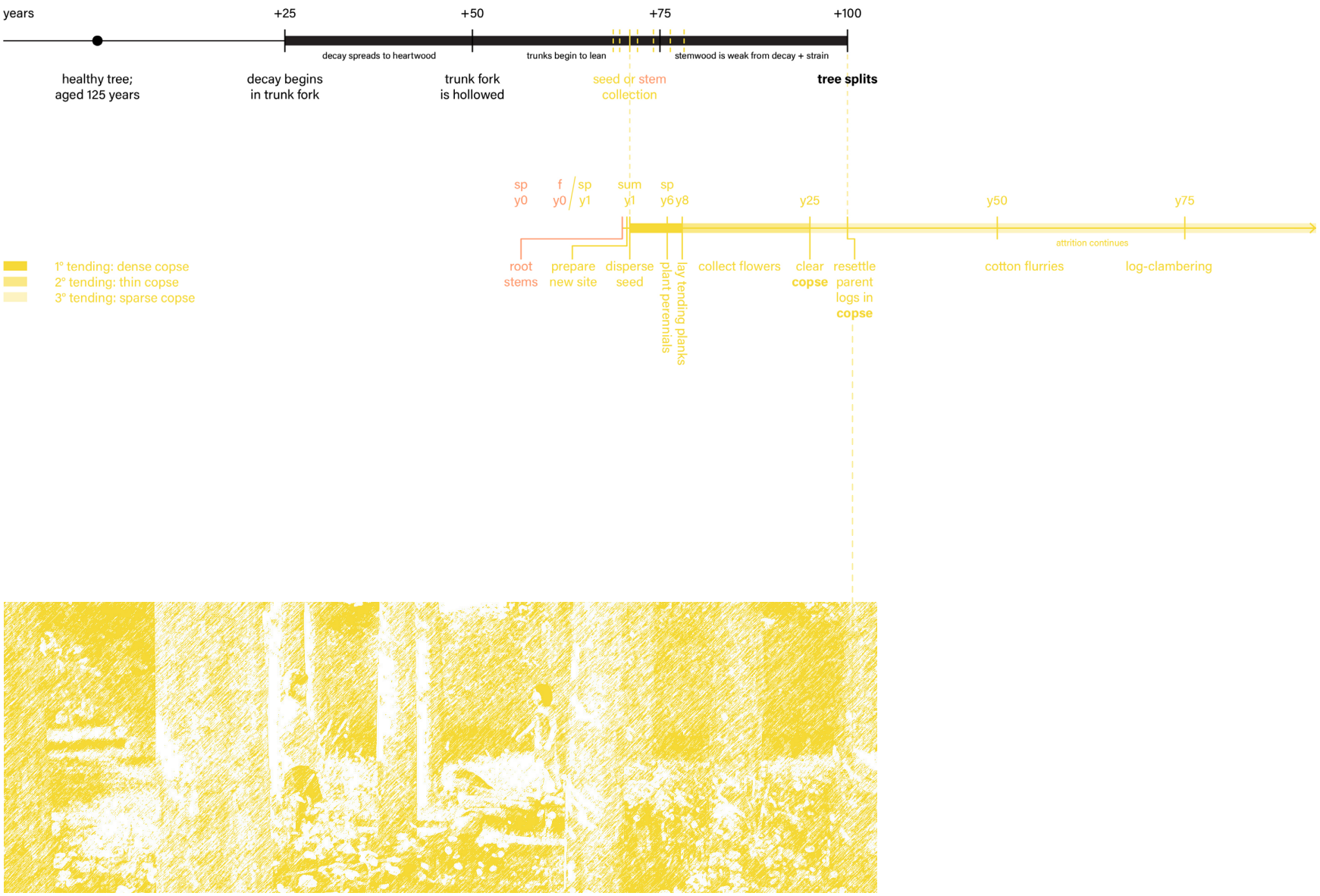


Fig. 5.42. Split/Copse timelines.



Copse Tending Schedule

	TIMING	ACTION	NOTES
stem harvest	early spring Y0, before bud break	collect stem cuttings	plant in growing medium to root
site work	fall Y0 (stem); early spring Y1 (seed)	select site dimension COPSE area ($6m^2$) clear, mow, till, grade evenly	use criteria (see pg. 117)
planting	early spring Y1, before bud break	plant rooted cuttings water thoroughly	densely; minimum 5cm spacing
seeding	early summer Y1	collect seed disperse seed over site settle seed scatter with loose soil water thoroughly	on still day; from canopy, ground, air as soon after collecting as possible
1° tending		watering mowing weeding thin leave debris	often around bed around bed once in summer Y2 minimum 5cm spacing to prevent overcrowding unless obstructive
perennial planting	spring Y6 or once canopy gaps allow light to understory	clear debris plant perennial plugs	compost/mulch debris carefully, without damaging tree roots placing sun-loving plants below canopy gaps or on COPSE edges
	1° tending as above		
plank laying	Y8 or once perennials are established	lay treated tending planks	
2° tending		replant perennials allow spillage beyond bed structural pruning watering mowing weeding debris removal	if damaged by plank laying mow around for: *straight trunks, branching overhead* as needed around bed within understory, hand pull
copse clearing	Y25 or once trunk spacing widens and garden has dissolved	ease debris removal leave large debris	for interaction and to decay in place
3° tending		resettle parent logs in COPSE mowing + weeding pruning damage	once split around bed in dormant months

Toppled Configuration:
Colonnade

Key Spatial Qualities
length enclosure a relationship to the river

Spatial Concept
a corridor with regularly spaced vertical elements supporting an overhead cover or a COLONNADE

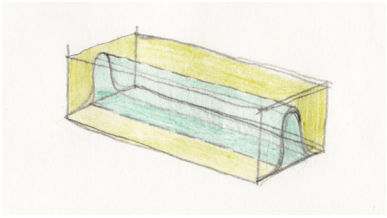
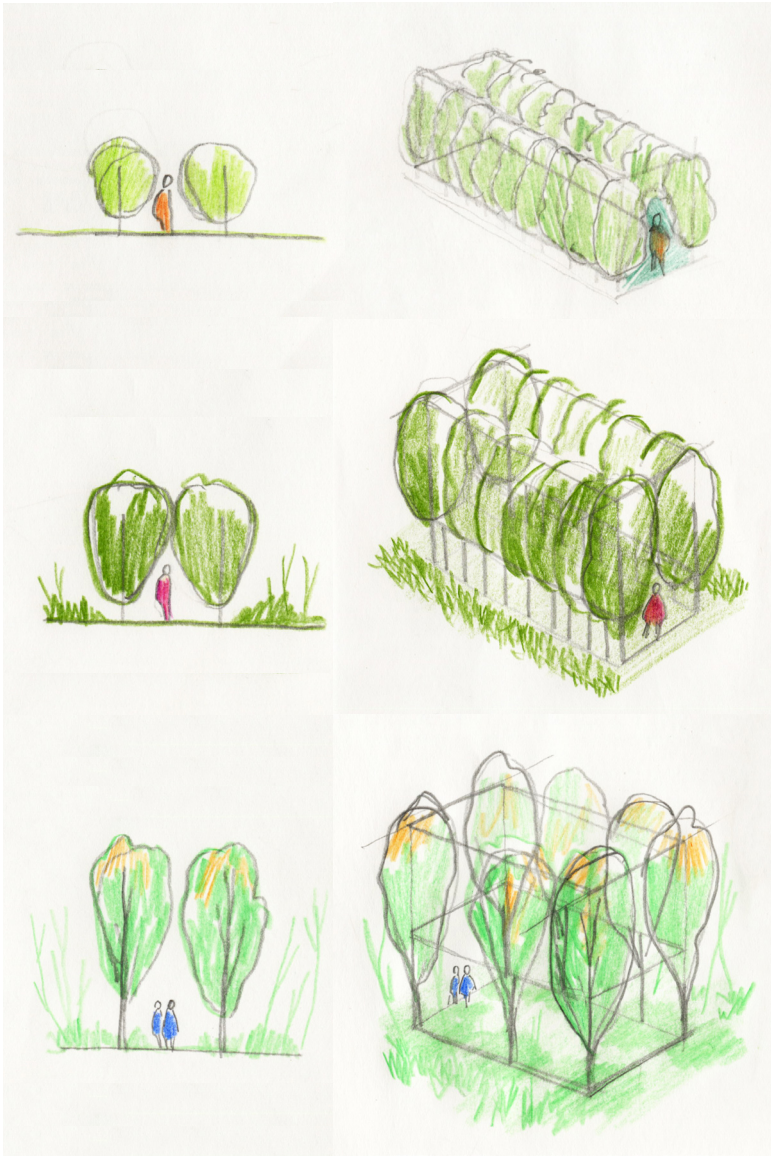
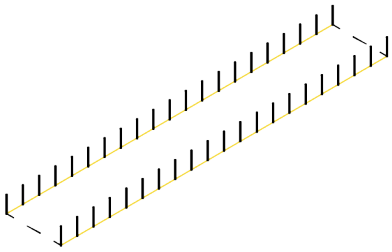
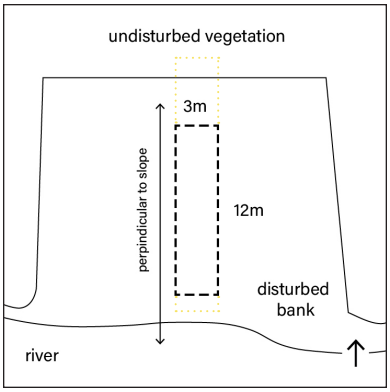


Fig. 5.43. Colonnade, solid-void diagram.
(opposite) Fig. 5.44. Colonnade spatial concept sketches.



Colonnade:
Inventory





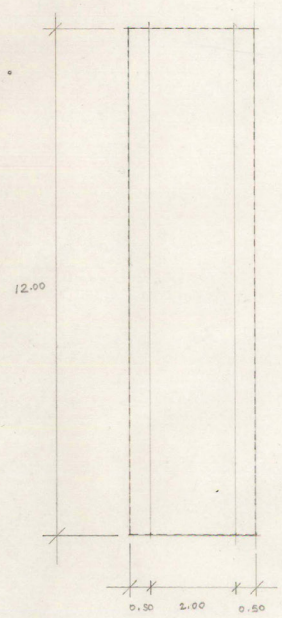
(opposite) Fig. 5.45. Colonnade vignette.
(top) Fig. 5.46. Colonnade planting diagram.
(bottom) Fig. 5.47. Colonnade site diagram.

Inheritance from Parent Sentinel
min. 42 x rooted saplings, 1 or 2 years old about 75-120cm tall driftwood logs, salvaged from shore, some cut to 2m lengths and some coarsely chipped

Dimensions
*length = min. 12m width = 3m trunk spacing = 0.6x2m *COLONNADE length may be modified on site (see dotted dimensions in fig. 5.47): if length = xm x is divisible by 0.6m (x/0.6)+1 = # of saplings per row

Site Selection
a disturbed riverbank area open, south-facing manageable competitive vegetation

Siting + Orientation
full sun planted perpindicular to slope to resist erosion away from undisturbed vegetation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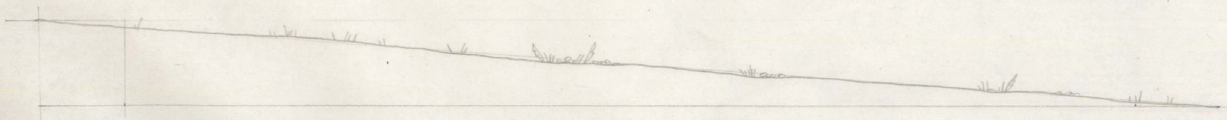
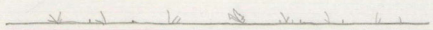
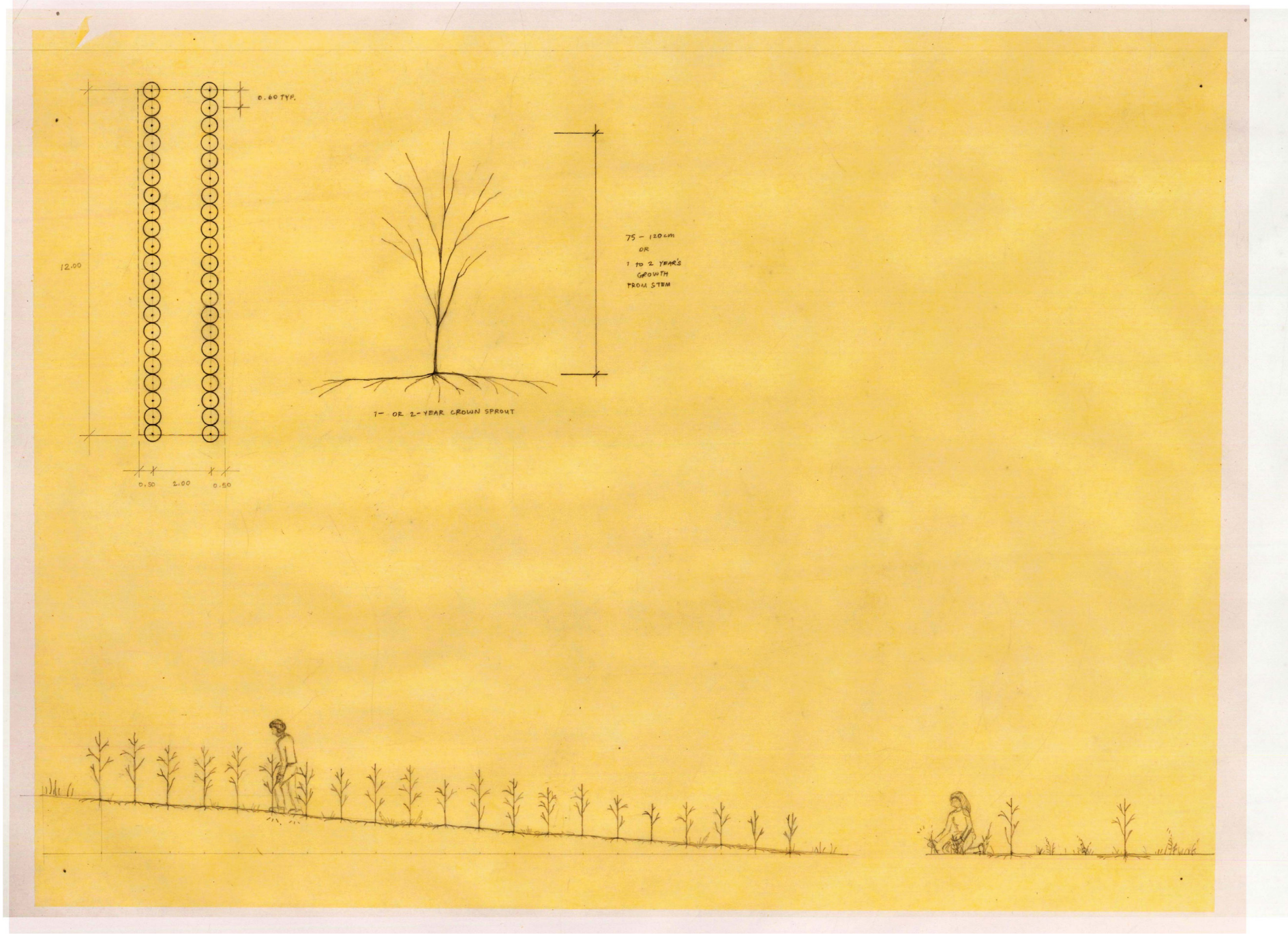
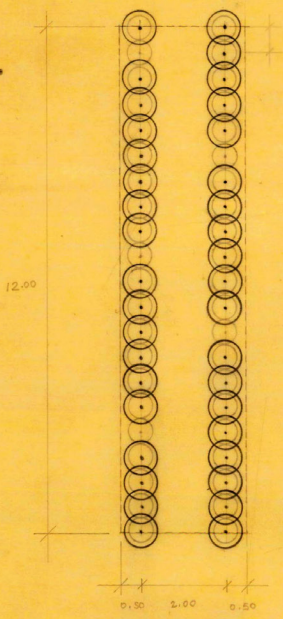
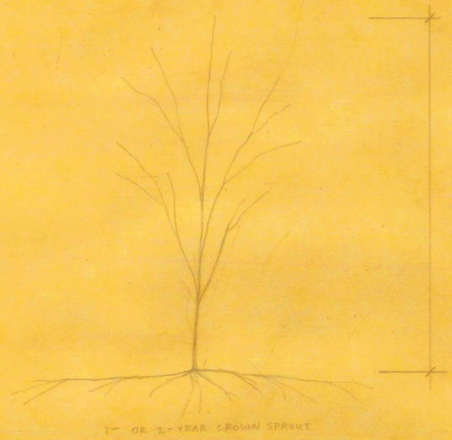




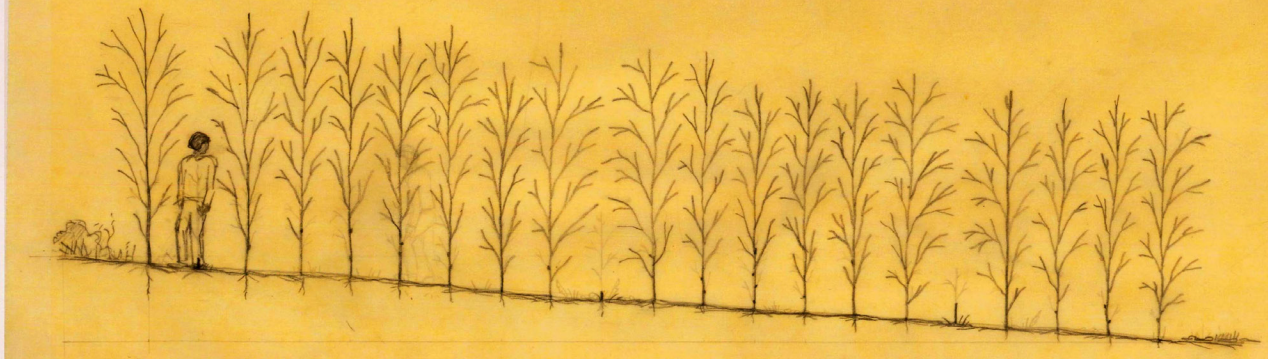
(above) Fig. 5.48. Colonnade: Y1, site work.
(below) Fig. 5.49. Colonnade: Y2, after planting.







1– OR 2–YEAR CROWN SPROUT



(above) Fig. 5.50. Colonnade: Y5, 1° tending.
(below) Fig. 5.51. Colonnade: Y10, after path-building.

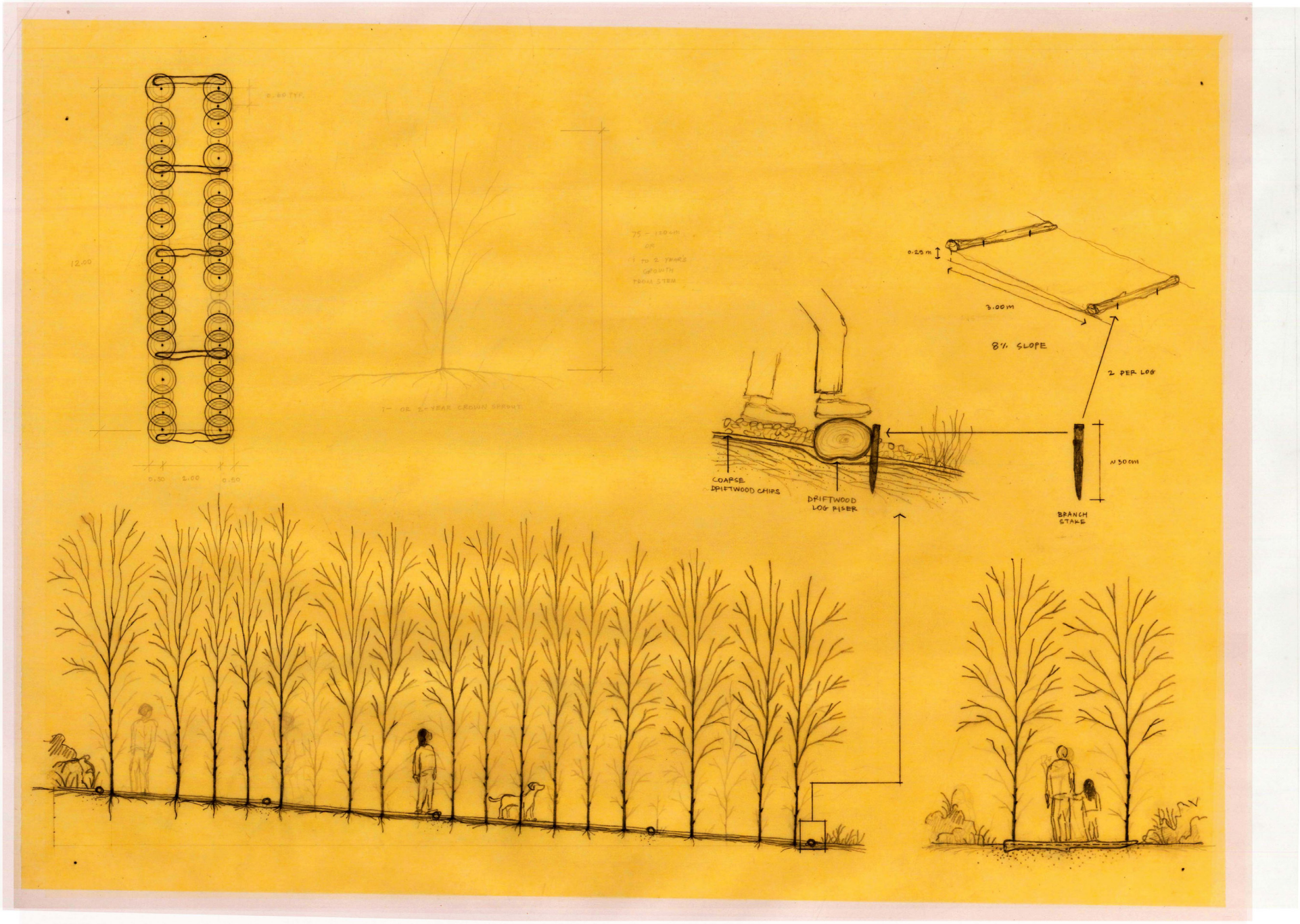
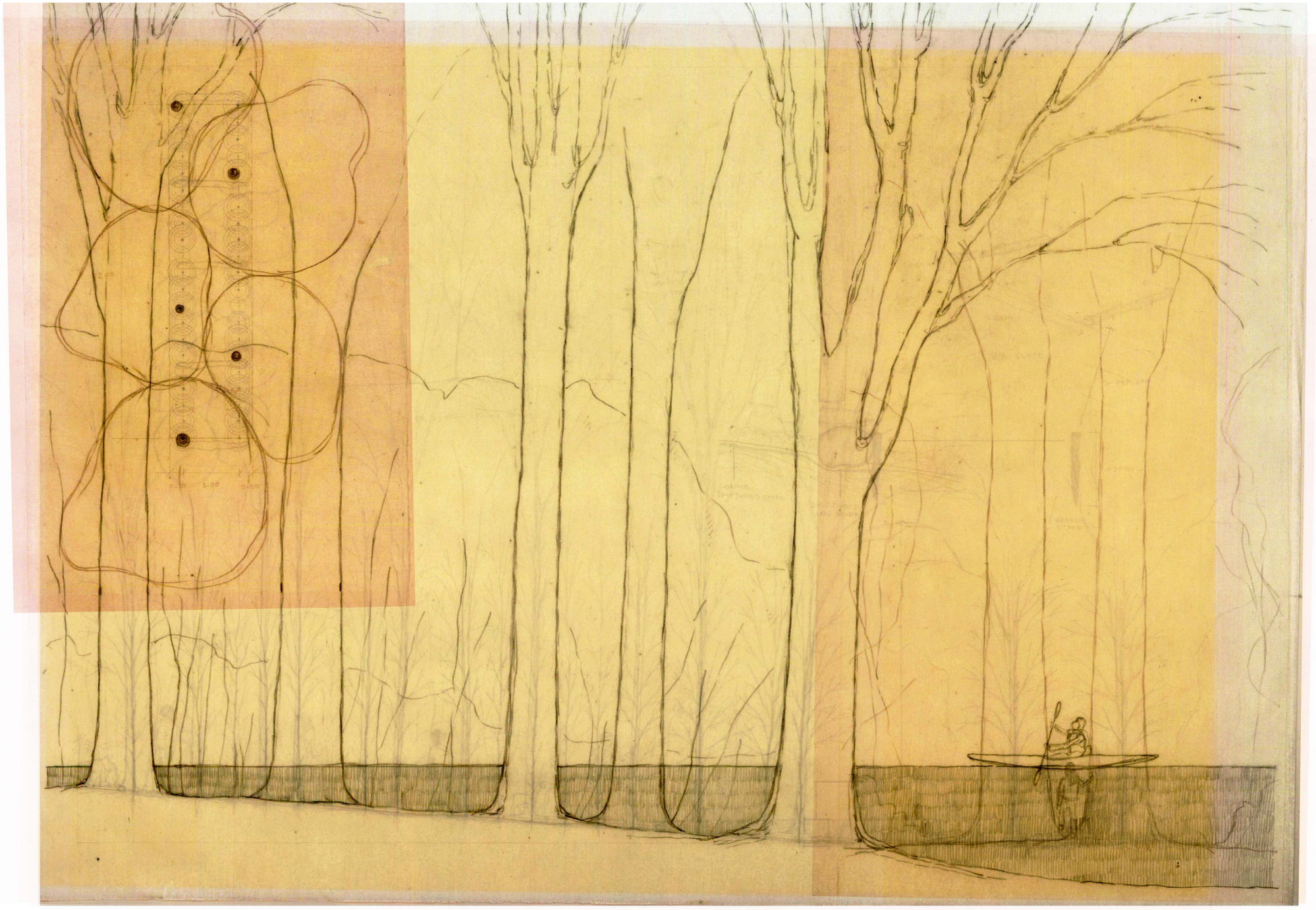


Fig. 5.52. Colonnade: Y20, measuring floodwater.

Next spread:
(top) Fig. 5.53. Colonnade: Y175, paddling through.
(bottom) Fig. 5.54. Colonnade: Y225, log-walking.



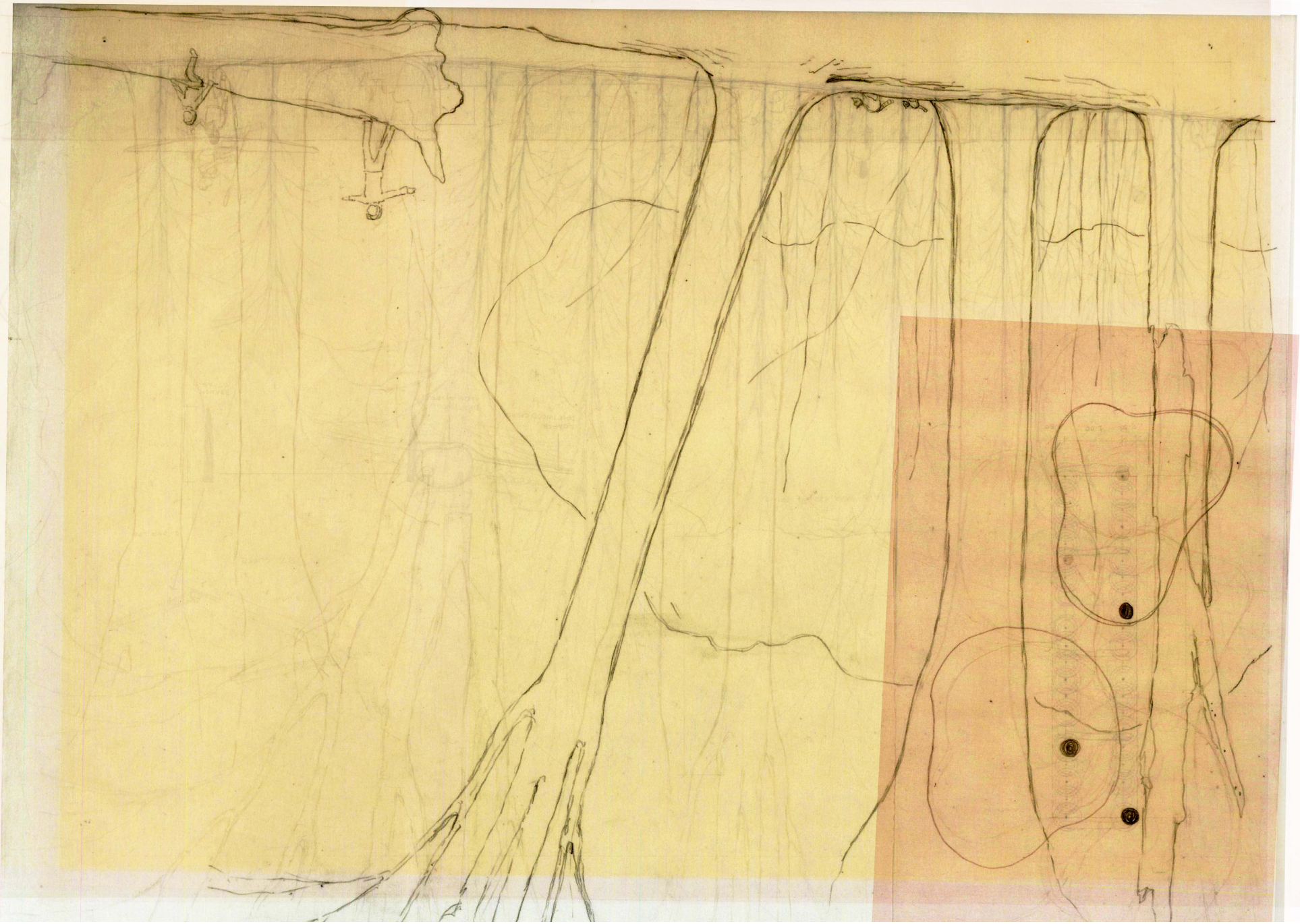
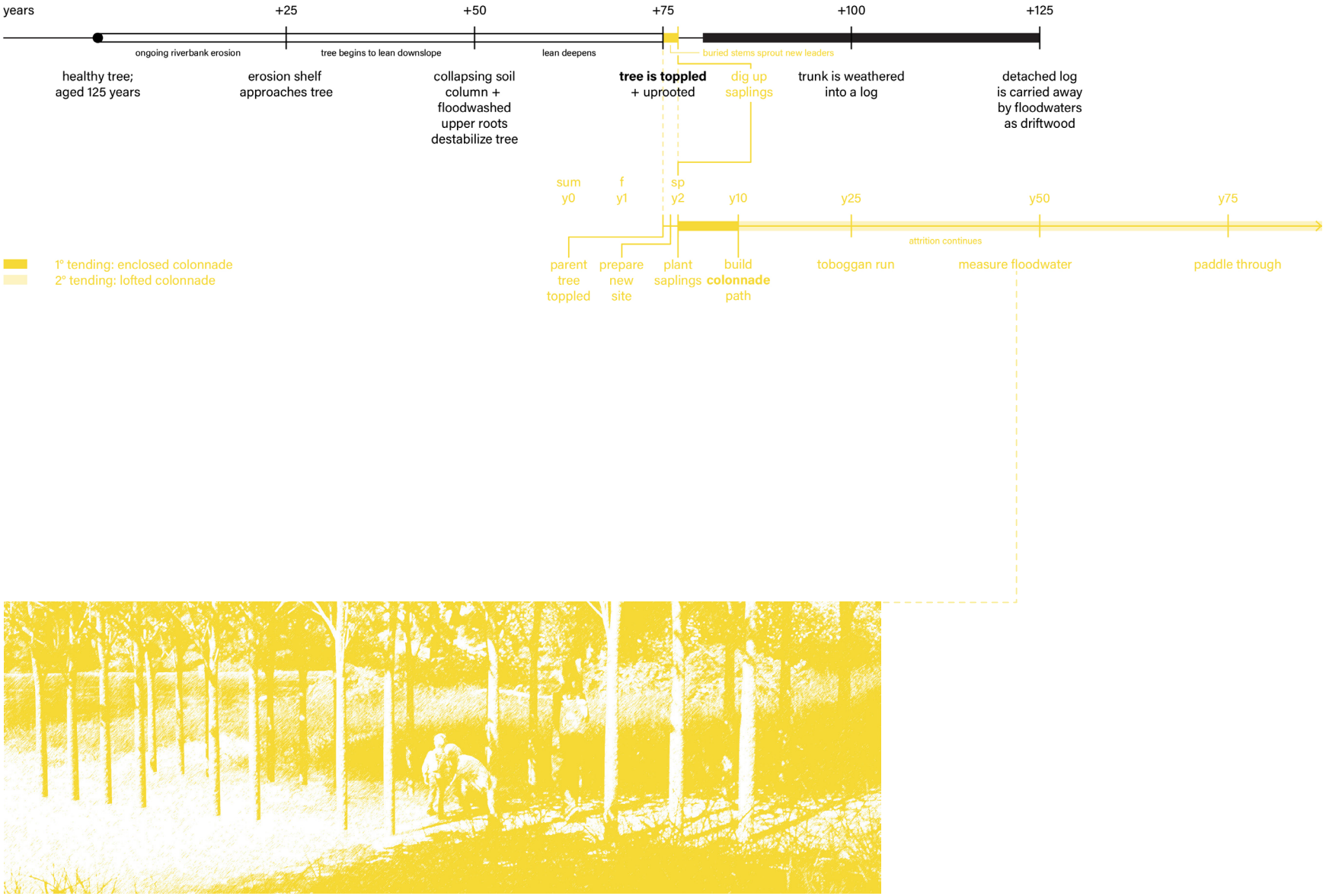


Fig. 5.55. Toppled/Colonnade timelines.



Colonnade Tending Schedule

	TIMING	ACTION	NOTES
toppling	summer Y0	parent tree toppled	
	as layered sprouts appear	weeding assist layering	as needed, hand pull if necessary, cover crown stems with disturbed soil to promote sprouting
site work	fall Y1	select site dimension COLONNADE area (12x3m) clear debris, till, compact evenly stake out planting rows	using criteria (see pg. 131)
planting	early spring Y2, before budbreak	stake out spacing dig planting trench transplant saplings water thoroughly	60cm o.c.
1° tending		watering weeding debris removal (thinned trunks) structural pruning (from Y5 on)	as needed often, mow if slope allows prioritize keeping inside path clear mulch debris and apply to rows for: *enclosing, low-branching form*
path-building	summer Y10	construct stepped path	to resist erosion; from salvaged driftwood log risers coarse chips as backfill
2° tending		weeding re-apply driftwood chips debris removal (branches) pruning damage	within COLONNADE as needed move to adjacent forest in dormant months

Model Procedure for Cottonwood Regrowth

A model is proposed as a replicable framework with a simple procedure that relies on self-organized community initiative, building on existing relationships to and care of neighbouring cottonwood.

1. The first sentinels are identified. These are located across the city for equitable distribution and should be considered the initiators of the Sentinel Cottonwood effort, which emerges as a branch of the Heritage Tree program. As dispersed as they are, the first trees are examples from which urban residents learn about the role of sentinel cottonwood. This knowledge ideally will spur the nomination of more trees in different neighbourhoods for an even greater, more representative distribution of sentinels.

    a. Sentinel cottonwoods are defined as mature individuals growing on public or private-partnered land, with poignant spatial presence (i.e. treated as focal point, relative size [dbh, height, spread], uncommon habitat) and the ability to produce seed or live tissue. Sentinels must be nominated by neighbours and accepted by the wider neighbourhood.

2. Once a tree is acknowledged as a Sentinel, a group of neighbours assembles to participate in the tree's decline and regrowth. To start, the carers monitor the tree, during their normal attending to the tree.

3. As the tree advances in age, it may become clear in what manner it will decline. Preparations will begin for the harvest and processing of the tree's propagative material. Re-establishment sites will be scouted and evaluated, using the site criteria for the expected configuration.

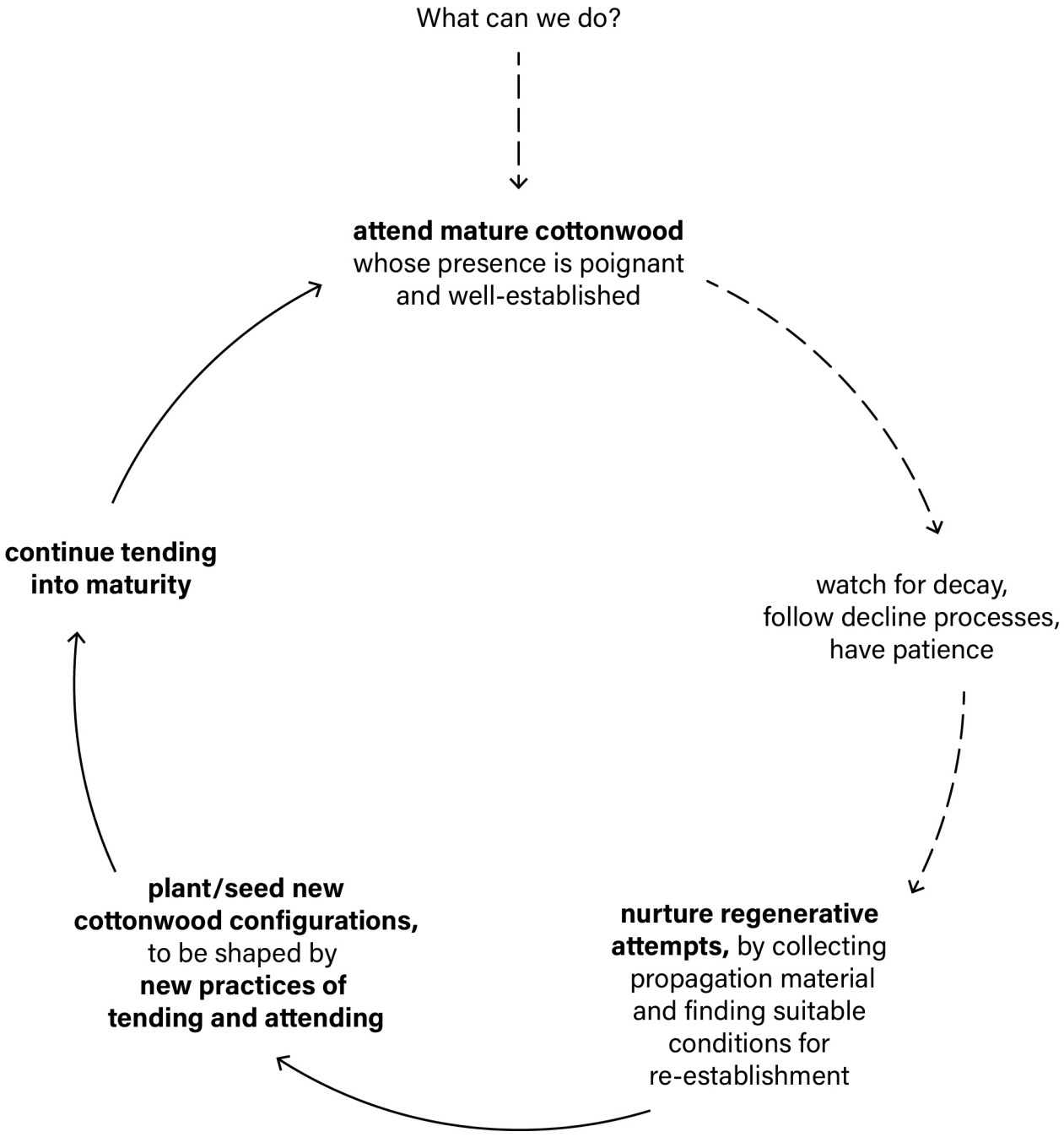
4. A re-establishment site is selected and prepared as specified in the configuration's tending schedule.

5. Once ready, the propagative material is planted or dispersed as specified by the configuration's tending schedule.

6. The new cottonwood space is tended and attended as specified by its schedule, until maturity (which varies in timing by configuration). Old neighbours pass on carer responsbilities to new neighbours.

7. Once the planting reaches maturity, tending practices will loosen.

8. As the configuration ages and new Sentinels are identified within it, the procedure begins again from Step 2.


What can we do?
attend mature cottonwood whose presence is poignant and well-established
watch for decay, follow decline processes, have patience
nurture regenerative attempts, by collecting propagation material and finding suitable conditions for re-establishment
plant/seed new cottonwood configurations, to be shaped by **new practices of tending and attending**
continue tending into maturity

Continuity

The regrowth model is meant to initiate a cycle of cottonwood care, with more tending when the trees are most vulnerable - as saplings and sentinels - and less in between when they are strong and healthy, but with attending, enjoying the trees, always.

In this model, one tree becomes a planting of many;
a planting with a specific shape and character;
a configuration that reflects tending hands and the influence of a parent tree;
a space that encourages interaction with the trees over time as they too become few and then many, again.

Fig. 5.56. Court evolution.

Fig. 5.57. Hall evolution.

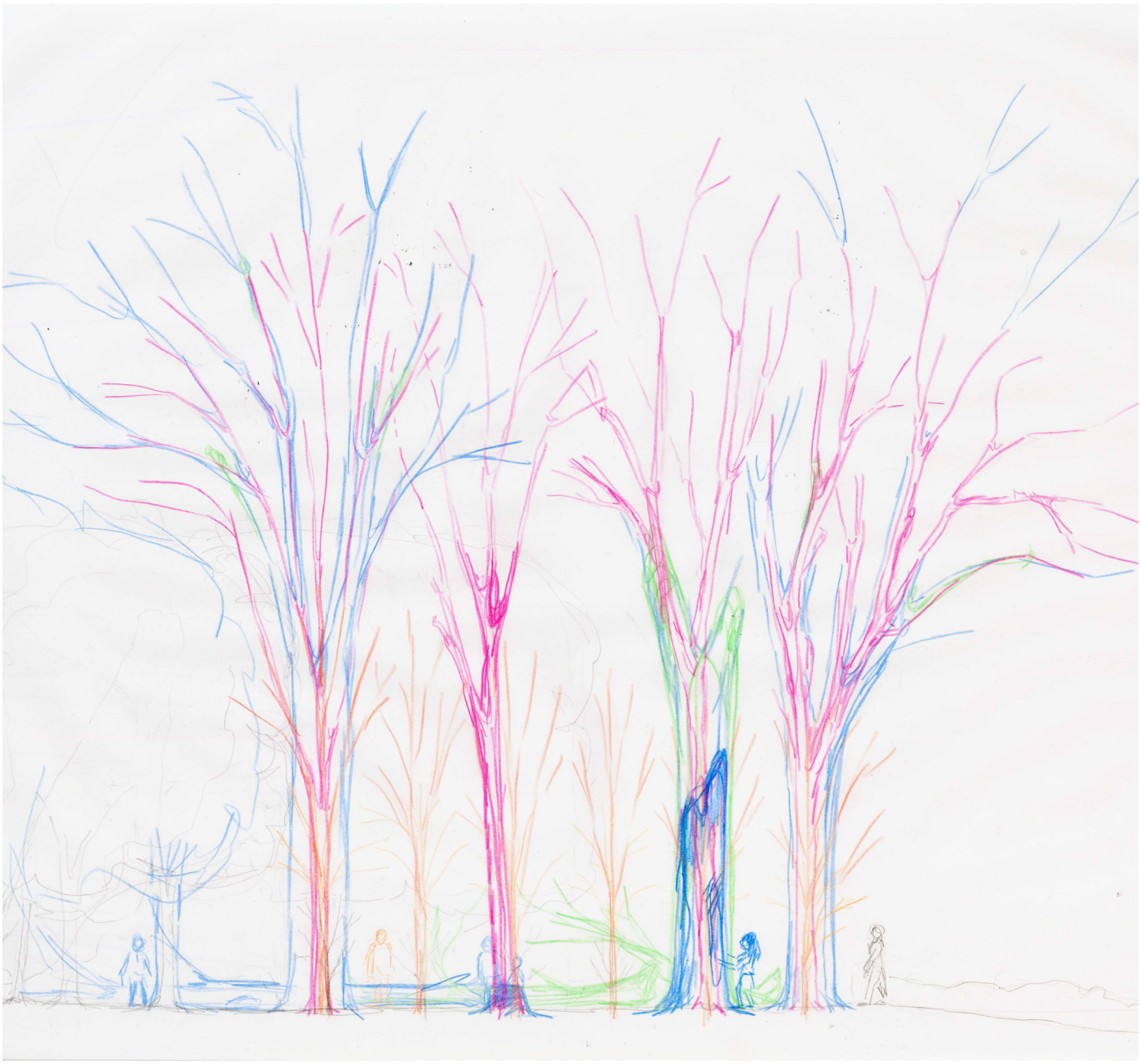


Fig. 5.58. Copse evolution.

Fig. 5.59. Colonnade evolution.

Chapter 6: Reflection

Reflection

I have spent much time with cottonwood trees over the course of this project. I walk in McBeth Park often. On my first visit several years ago, I was captivated by a hollow tree, pictured on page 13. One could enter its earthy room and stare up into burnt darkness, an indiscernible ceiling. Cracks around the "doorway" groaned in the wind. So precarious the tree stood and each visit I expected to see it fallen. And it did fall eventually. The hollow trunk now lays on its side, the room's ceiling illuminated, and the doorway open to the sky, the perfect platform from which to stand and peer around the forest (fig. 6.1). Once in winter, footprints atop the reposing trunk led to the mangled canopy, though much lower than before, still metres high. As my work for this project progressed, I searched for new leaders among the tree's broken crown, where sunlight entered a new clearing. This tree motivated my interest in cottonwood decline.

Fig. 6.1. Fallen cottonwood viewing platform.

From these firsthand experiences with the tree, I understood cottonwood to be a dynamic species. As the fastest growing hardwood on the continent,[90] it makes visible processes that in some trees occur over decades. In my reading, I came across Reinhard Stettler's comparison of cottonwood and oak. Stettler explains how oak favour stable growing conditions where they age slowly, investing much energy into strong, lasting wood and reproducing only after they are well-established.[91] Oaks, he claims, are the "antithesis" of poplars, who engage a metabolic strategy that

90 Cain, 9.
91 Stettler, 7-8.

Fig. 6.2. Light drawing 004, July 21, 2022, 20:00, soft.

prioritizes rapid growth in transitory habitats, therefore making minimal investment in wood strength and longevity, but reproducing early and prolifically.[92]

I thought it important to understand the cottonwood lifecycle in more detail, particularly how and in what variety of ways the trees decline, since decline processes represent a significant proportion of their ecological function. From this I learned how decline can induce a tree, readily and in numerous ways, to regenerate. It seemed a clear opportunity to ground a design strategy in these decline and regeneration dynamics. I had hoped in choosing to study cottonwood, a somewhat simple topic in the context of a landscape architecture practicum, that my work would build an ecological depth and specificity, engaging uniquely cottonwood cycles and timescales. Though a simple topic, the tree was a well-defined frame through which to examine time, process, and change.

These are ideas I first began to explore in my drawings of light on the bark of the Point Douglas Sentinel (fig. 6.2). The drawing procedure was a repeated, meditative practice of sustained attention toward light on the same patch of bark. The resulting drawings were of similarly simple purpose: to "hold" and measure light on the tree in moments over time. In this study, I observed certain material and environmental qualities of cottonwood through close, sustained engagement with a single tree, a process-oriented exercise that influenced later work.

92 Stettler, 8.

Another notion prominent in my early research was the single, old tree. The allure of these trees, I argued, had to be in part attributed to their iconic potential, to their personification as strong, wise characters in our collective imagination, and in our mutual trunk, limbs, and crown. We recognize ourselves in a single tree. Moreover, I was interested in the power and significance of single, old trees in human spaces, and the ways they have been tended and attended to. I studied examples of these trees from elsewhere in the world, specifically the spatial features, natural or cultivated, that contributed to their presence and reinforced their relationship to people. Though the spatial features were found to depend heavily on each tree's culture and context, consistent among all, and likewise with sentinel cottonwood, is scale. Each tree defines a comfortable, human-scale space.

The scale of a sentinel went on to inform the scale of my design responses, which seek to translate the spatial impact of a single tree before concentrating back into one. The dimensions and geometry of the configurations also reflect my intention for these to be compact legible spaces, their planted and tended forms noticeable, clear products of human care. Select dimensions of three configurations can be modified to better suit a chosen site, in specified proportions that preserve the configuration's legibility. Working on site with available space and material, tenders might realize grander halls, thicker copses, and longer colonnades than illustrated

in this proposal. I imagine someone happening across the trees, wherever they might have been established and in whatever modified form, and recognizing them as a planting made from a declined sentinel. And part of this interaction that I think is interesting is that the configurations can be planted wherever tenders choose. Proposed establishment sites are purposefully omitted from the model; instead, criteria list key site parameters and character, in a method of non-prescriptive site selection. Additionally, the decentralized, voluntary nature of establishment means that the configurations may be sporadic, their locations not widely known outside of a neighbourhood, and thus "found" through walking.

As each grows, the configurations will begin to participate in their own shaping. Their attrition is indeterminate, and my drawings show only one permutation of many. As they mature, the configurations will soften and become measures of time, quite like the bark drawings, perhaps revealing to those looking carefully their initial planting patterns, signs of tending, evidence they were raised by people.

Clockwise from top left:
Fig. 6.3. Point Douglas Sentinel, July 21, 2022, 20:00.
Fig. 6.4. Point Douglas Sentinel, October 20, 2022, 12:42.
Fig. 6.5. Point Douglas Sentinel, September 26, 2023, 16:42.
Fig. 6.6. Point Douglas Sentinel, January 4, 2023, 13:15.

Approaching a cottonwood is being drawn towards a soaring but steady figure. Standing beneath one is as standing in a wall-less cathedral. Often, sentinels are encircled, ringed by a path of trodden undergrowth, tended through circumambulation.

I have come to learn that many recognize the cottonwood's charisma. Attention, I think, the tree draws with its obvious attributes – its size and seediness – is sustained by those more subtle. People gaze in awe at the tree's elegant branching, floating cotton, and restless foliage, deep green and then golden. Change in the tree, across seasons, years, and decades, is distinct and beautiful. Though its solidity may give the appearance of permanence and slowness, the tree's very nature, as an early-successional species, embodies change.

Cottonwood is:

an old species (EVOLUTIONARY BIOLOGY)
a short-lived pioneer (FOREST SUCCESSION)
a sensitive, living system (ECOLOGY)
an ageless sentinel (HISTORY)

There is much to learn from this tree about time.

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