Unleveling the Land

On Sand and Lava

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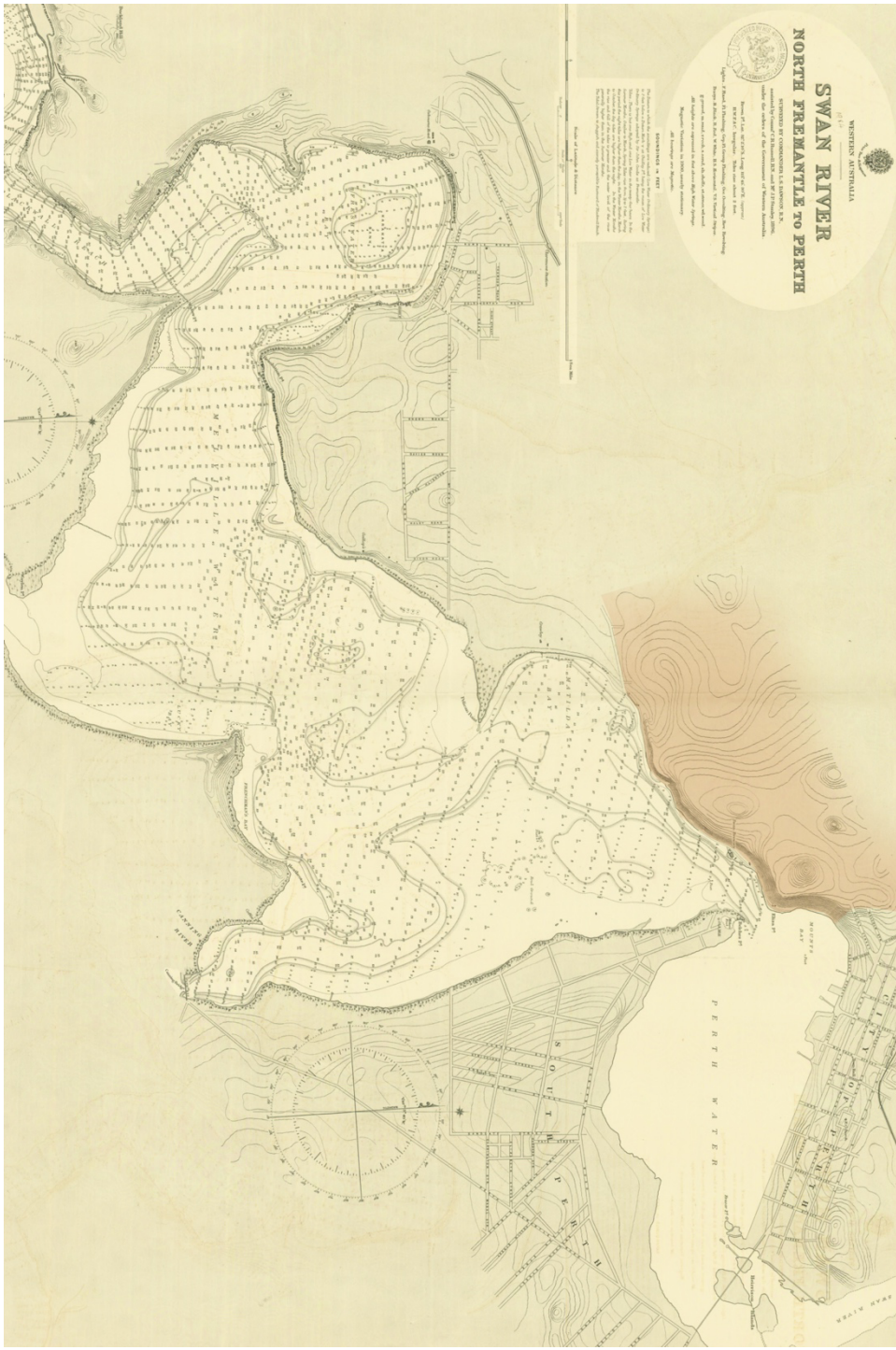
We tend to use the word *topography* as a synonym for *landform*, but topography as represented on a map usually includes other natural and cultural features also evident in the landscape. The term derives from the Greek: *topos*, for place, joins with *graphia*, to write, describe, or draw lines that capture a place, as does a map. To begin, I would like to draw some lines through the places that have influenced my topographic thinking as a background for the ideas that follow.

The field of landscape architecture is a bit off the main track of destination professions. Instead, it's a field you somehow find or somehow finds you. Three brief topographic origin stories will establish how it found me. The first landscape is Kings Park and Botanic Garden in Perth, Western Australia, which is situated in the traditional lands of the Whadjuk people. My father was superintendent of the park and my family lived on its 1,000-acre grounds for some 30 years. We lived in the gatehouse on the main avenue into the park, the only house on the highest hill, in the middle of the city [6-1].



6-1. Perth, Australia, 1896. Bathymetric and topographic map of Perth's Swan River and surrounds. [State Library Victoria].

As a recent immigrant who didn't speak English, my father began work at the park by digging holes. Modifying topography became basic to him. One could say that he dug his way up in rank, first to become head nurseryman and eventually the park's superintendent. By necessity he became an autodidact landscape architect with a drafting table set prominently in his office. Whenever some part of the park needed improvement, he would draw it up, take it to the site, and instruct the work teams on how to implement it. His style was unconsciously influenced by the woodturning that was his hobby, and his designs were reminiscent of the Beaux Arts. He definitely had not received the modernist memo. Although called a park 90% of the sandy terrain was—and remains—the natural remnant bushland originally reserved as a source of firewood—bushland that remarkably has survived in the heart of a sprawling city of two million people. As I grew up I drew my own lines through the bushland, with secret trails that followed the lay of the land and connected my home with the river, the city center, primary school, high school, and eventually university.

The second topographic influence derived from my family's extensive journeys into the Australian interior, the Outback. Taking one of Kings Park's Land Rovers we would brave the dust, heat, and incessant flies in search of what I understand now to be remoteness. Looking to the endless horizon through the window of the Land Rover, I would imagine that we were headed to some place marked by dramatic topography and more evident signs of civilization. That we'd been going down the same dirt track for a week and hadn't encountered another vehicle—let alone a mountain or a townsite—should have been a clear sign that this was not the case. In this vast, ancient, worn-down landscape the topographic rewards came in extremely small portions. Surrounded by a thousand miles of scrub in every direction, a small dry gully, or a lonely outcrop is all you get for your prolonged efforts. But while the terrain at first appears to be featureless, in time one learned to appreciate and read its nuances and understand the forces that produced them.

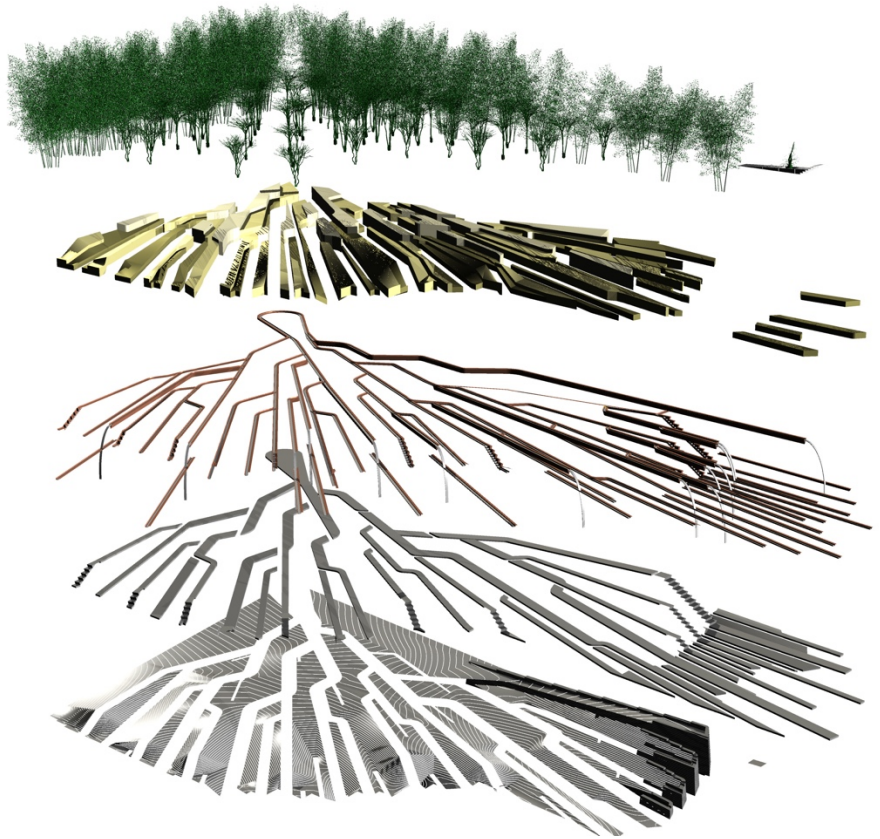
My third formative topographic line involves the conversion of terrain-reading the Outback and Kings Park into a sport. From about age six I competed in orienteering, an athletic sport involving "analogue navigation" unaided by Global Positioning Systems, whose epicenter lies in the Nordic countries. When orienteering one reads the map, uses the compass, and interprets the lay of land to traverse the terrain in minimum time. The sandy topography of Kings Park itself was itself an orienteering map; that is to say, for most of my life I had lived in an orienteering map. To know the logic of one's own terrain is the ultimate home field advantage. But on the flip side, when orienteering in other parts of the world, one must quickly find one's bearings in new terrain. I competed, with some success, on sand dunes, complex granite shelves, Karst limestone, alpine slopes, and the most challenging of all, the post-glacial terrain of Scandinavia.

These topographic experiences were formative to my understanding the land, and in particular, they heightened my interest in complex and nuanced terrain and how human activity has shaped the land—and how landform has shaped behavior. The capacity of landform to shape behavior is wonderfully demonstrated by Gas Works Park in Seattle, where landscape architect Richard Haag reshaped a former industrial site into an unprogrammed topography open for varied uses and interpretations. These are the "uncommitted plastic forms" that Kevin Lynch felt to be a necessary aspect of public space, although the landform provides subtle clues to behavior on site.[1] In that sense Gas Works Park is a free and liberated landscape that allows us to perform as if on a stage, in this case a stage with a rather grand view. Subtle landform that guides behavior through motion is also found at Park Rabet in East Leipzig, Germany. Derived from the desire lines worn over the years, the park's cross-paths are simply imprinted down into a ground elevated above the rubble remaining after the war [6-2]. Setting the path slightly below grade reinforces the weight of human passage, with the contours themselves indicating where people move, much in the manner of a watercourse.

6-2. Lützow 7 Landscape Architecture. Park Rabet. Leipzig, Germany, 2000. Cobbled desire path subtly impressed into landform. [Karl Kullmann]

And if we think in terms of water, and how and where it flows to, the projects and terrains discussed above all represent *non-dendritic* landform that lack the converging branching structure formed by moving water. We are more familiar with the *dendritic* landforms that emerge where rills merge with creeks, creeks with rivers, and rivers that merge with the sea. Without the organizational structure of surface water flows non-dendritic landform is more variable and unpredictable. It is a kind of landform usually associated with the porous substratums such as limestone and landfill, but also sand and lava, as addressed below. But first I will briefly discuss a garden project that used dendritic flow, although literally and figuratively reversing it.

The Garden of the Forking Paths was created for the International Horticultural Exposition in Xi'an, China in 2011.[2] In the collective Chinese imagination rivers flow from west to east, from the plateau to the sea, but the Chan-Ba River, upon whose floodplain the garden is situated, appears to flow in reverse—from east to west. In the garden the hydrological mythology was conceptually amplified. The natural



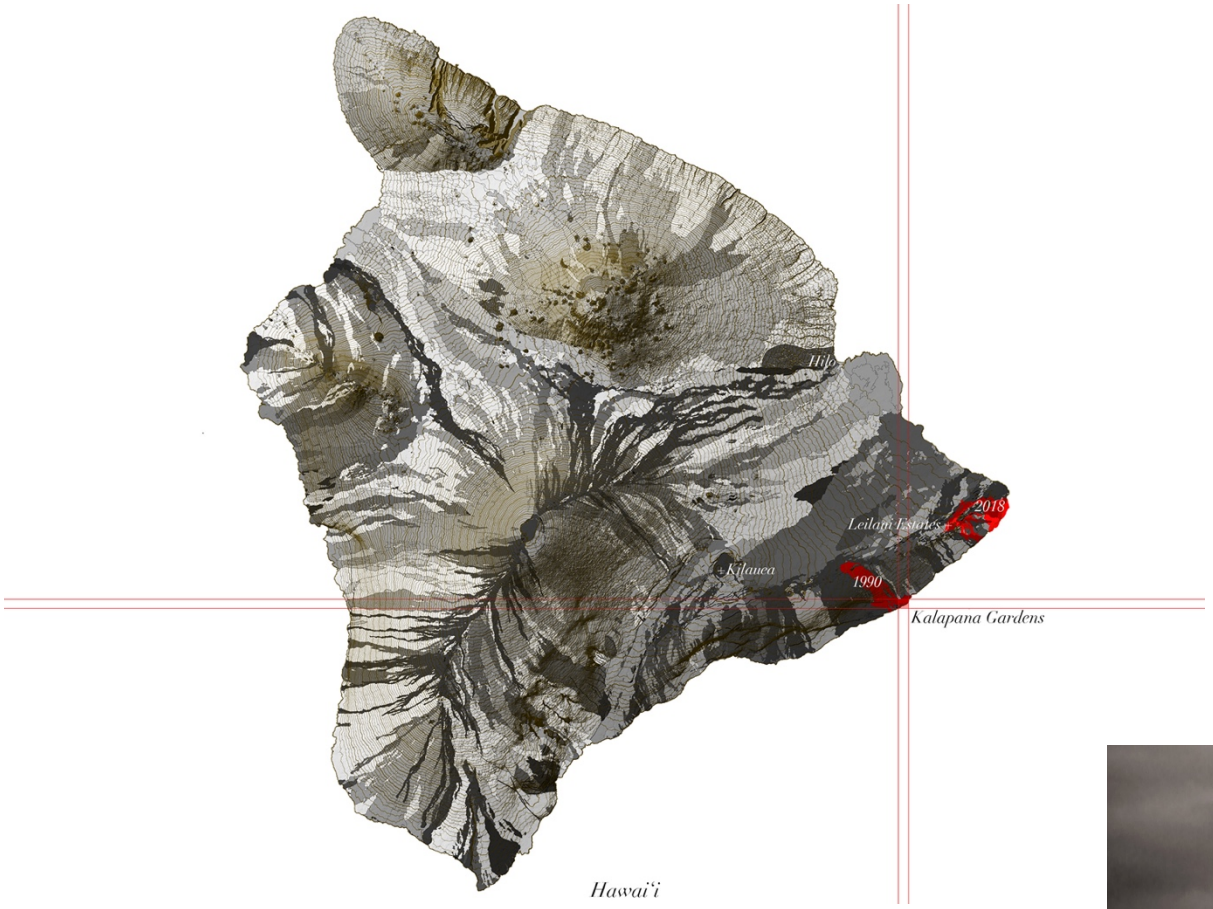
6-3. Karl Kullmann. The Garden of the Forking Paths. Xi'an, China, 2011. Exploded axonometric. Layers from bottom to top: landform, paths, runnels, planting, trees.

tendency of water to converge was reversed through a system of divergent flows of both paths and runnels [6-3]. Read metaphorically as an allegory for life, the bifurcating flows question a world view in which history converges to form a meta-narrative. The garden was entered through a single aperture in a bamboo grove, from which a series of choices escalated as one path metamorphosed into thirty [6-4]. Each path was accompanied by bifurcating water channels that fanned out and finally emptied into a lake. As we learned, it's quite difficult to divide paths of water because water molecules want to stick together and follow the path of least gravitational resistance. In response, and quite on their own, visitors found stones to use as makeshift sluices with which to rearrange the courses of the water.

6-4. Karl Kullmann. The Garden of the Forking Paths. Xi'an, China, 2011. Garden entrance with diverging paths visible in the foreground and diverging landform in the background.

From the divergence of water, the story now shifts to the divergence of lava on the Big Island of Hawai'i, most of which rests below the ocean as the accumulation of a million years of lava flow [6-5]. Sited above a "hot spot" the island is in continual evolution, evidenced by the 1990 eruption above the residential neighborhood of Kalapana Gardens. As the lava flowed downward from the volcano to the sea it was stopped by an existing ridge that caused it to pool laterally. Eventually the entire neighborhood was buried beneath 50 feet of lava while the coastline was extended by a thousand feet. Although almost all its buildings were wiped out of existence Kalapana Gardens as a community wasn't wiped off the map. The original topography of the homesites had been completely effaced but on paper the boundaries that marked land tenure survived [6-6]. What resulted was a radical superimposition of the old lot lines upon this newly formed and unruly topography. As the residents slowly returned to retake their property, vestiges of the old street lines were bulldozed through the lava. People have even reoccupied the land in a way that at first appears completely indiscriminate—but actually complies with the lot lines established by law.

A new wave of homesteading followed mixing tiny homes, converted shipping containers, old buses, and flat-pack huts, landlocked boats—anything that could be repurposed for habitation [6-7]. As the lava continues to cool, crack and settle, each of these structures functioned as a life raft. Everyone and everything was self-sufficient because utilities were non-existent. And it's all self-made because no agency will insure structures on the site; it takes a particular kind of lava pioneer to inhabit this basalt desert. Everyone builds light, ready to leave at a moment's notice when the lava flows inevitably return. The pull of the ground is compelling, however, and if they stay long enough



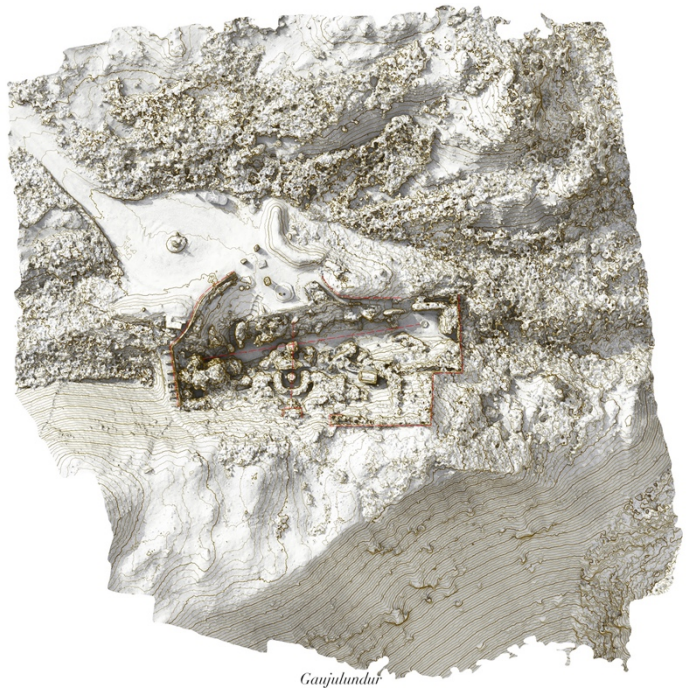
6-5. Accumulated lava flow map. Big Island, Hawai'i. The 1990 flows at Kalapana Gardens and more recent flows at Leilani Estates are shown in red. [Karl Kullmann]

6-6. Kalapana Gardens. Hawai'i, 2018. Topographic relief map. Original property boundaries are shown in red. [Karl Kullmann]

6-7. Kalapana Gardens, Hawai'i, 2018. Reinhabiting the lava. [Karl Kullmann]

the residents step off their life rafts and begin to modify and interact with the igneous terrain. They start by scraping, levelling, and reshaping the lava to form useful spaces on its surface. When they start fashioning gardens, you know these re-pioneers are really putting down new roots.

6-8. Erlendur Stefánsson and Guõfinna Ólafsdóttir. Gaujulundur. Heimaey, Iceland, circa 1980 to present. Sheltered lava garden with Dragon Rock visible in the background. [Karl Kullmann]



6-9. Erlendur Stefánsson and Guõfinna Ólafsdóttir. Gaujulundur. Heimaey, Iceland, circa 1980 to present. Topographic relief map of Gaujulundur. Constructed windbreaks to the east and west shown in red. [Karl Kullmann]

Halfway around the world, on a volcanic island in the North Atlantic, the work of two dedicated gardeners showed just how to put down roots in lava. Situated just off the southern coast of Iceland and blessed with a magnificent natural harbor, the tiny island of Heimaey is home to one of Iceland's most important fishing ports. It also straddles the highly seismically active mid-Atlantic Ridge, which in the middle of one night in 1973 erupted without warning and opened a one-mile-long lava fissure across the island. Within about five hours all of the island's 5,000 inhabitants were safely evacuated by the boats of the local fishing fleet. Within a week, a cinder cone—later named Eldfell, or fire-mountain—grew in height to over 500 feet. As the eruption progressed lava advanced at a rate of twenty feet per day and threatened to inundate the town and seal off the entrance to harbor and render it a lake.

Instead of sailing away for good a team of industrious "geological agents"—of the term is Ann Winston Spirn's—dared to return and fight fire with water.[3] In what at first appeared quixotic, a plan was hastily hatched to hose down the advancing front of the lava with vast volumes of seawater to cool and redirect its path. Incredibly, it worked. By the time the eruption ended six months later the island had expanded in surface area by one fifth; the harbor had been saved, its amenities actually improved by a new lava breakwater that now sheltered the port's entrance from Arctic storms.

As displaced residents began returning to Heimaey the question became just what to do with all this new ground: a still-cooling and menacing black mass of twisted topography. To help reestablish their sense of place the residents were invited to adopt a patch of lava. After much searching across difficult ground, a local couple Erlendur

(Elli) Stefánsson and Guõfinna (Gauja) Ólafsdóttir found a sunken dell flanked by a distinctively animistic rocky protrusion that they named Gaujulundur [Gauja's Grove]. Elli and Guaja spent the next twenty years digging and reshaping the lava bed, propagating about a hundred species of plants, and introducing various garden features that included paths, a gnome, a fishpond, a gabled wooden shed, several follies, and picket fences [6-8]. While the recessed shape of the dell offered some shelter from the incessant northern and southern gales, Elli and Guaja augmented this natural protection by constructing windbreaks to the east and west. Together, these features created a semi-permeable frame around the garden, in part topography, in part fence.

6-10. Mid-Levels neighborhoods. Hong Kong, 2016. Slope engineering database. Stabilized slopes are shown as dark grey areas and retaining walls as red lines. [Karl Kullmann]

The idea of the garden has expanded over the eons with varied degrees of enclosure that ranged from the cloistered garden of the medieval period to the open horizons of the seventeenth-century French formal garden. One of the beautiful things about Gaujulundur is that it combines both internal and external orientations, despite being to a certain degree carefully framed on all sides [6-9].

A garden, as opposed to just a rock, confirms a human commitment to a place. Once the gardener plants a garden he or she must stay and shepherd its growth or it will soon go rogue or die. And yet, gardens always seem to get away from the gardener, never quite developing according to plan—often for the better. As geological agents gardeners are always modifying the topography of their place, reshaping hills and sculpting depressions. Much of the distinctive character of the Gaujulundur and Kalapana Gardens derives from this topographical manipulation that evolves over time, the product of hardy individuals working at a human scale on a labor of love.

When we get organized and start planning—and there is no threat of the lava's return—our geological labor reshapes landforms on an industrial scale, which is not necessarily a bad thing. Consider San Francisco, where the city's grid famously contrasts with the unruly topography below it. Florence Lipski observed how the urban quality of San Francisco resides precisely in the basic incompatibility of the grid with the hills.[4] Or Hong Kong, where through sheer necessity construction continues even on severely steep slopes; exceptionally steep slopes are engineered to ensure their stability against landslides and mapped in a database [6-10].

This apparent equilibrium between nature and culture is an exception rather than a norm, however. Many cities have breached the natural limits of reason in their quest for level or stable land. In Central and

South America it is often the people of the lowest socioeconomic stratum who are relegated to the steepest slopes, while closer to home it's often the reverse: enabled by “mountain cropping” terracing techniques, the wealthy retreat to the hills and look over those in the flat lands [6-11].[5]

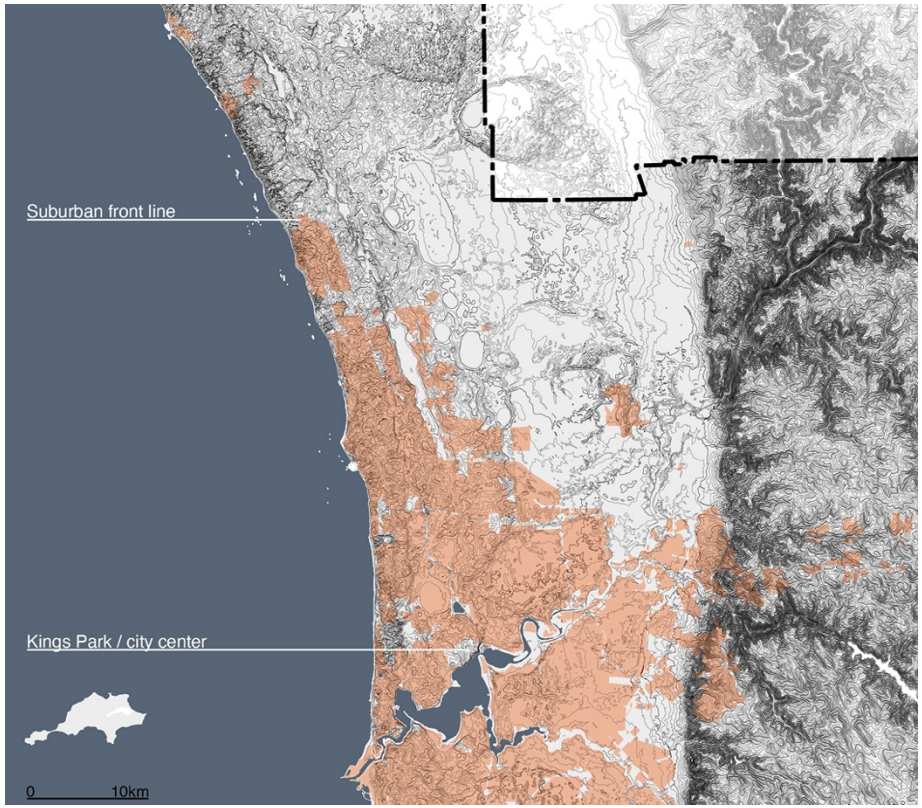
While the conspicuous excess and flat/steep dualism of terracing characterizes many landscapes in the American West, elsewhere in the world it's not so clear. In Nagasaki, for example, low-density suburban terraces have actually taken over preexisting terraces formerly used for agriculture. The case of Nagasaki also illustrates how suburban terracing is not simply solved by urban densification. Even as the city’s aging and shrinking population moves downtown from the surrounding hills, new terraced suburbs continue to be created on the periphery. These newer developments use massive terraces that hardly encourage a chat with your neighbor without a cell phone [6-12].

To return to Perth, where the underlying sandy terrain is continuously undulating, it's a similar story. There’s no clear mountainous frame, no flat versus sloped land, just sand dunes of varying ages and varying topographic complexity. And due to population growth and uninhibited suburban sprawl over the decades, the city has extended a hundred kilometers up and down the coast from the center in Kings Park where I grew up [6-13]. Much of that expansion has been achieved by stripping away all the native coastal heath and re-modelling the land into megalithic terraced earthworks of retaining walls and perfectly flat building lots. Termed “land benching” by the local industry, this mining-derived practice clears the way for standardized tract housing to be laid out irrespective of the local topography.

The contours that are ironed out of the terrain end stacked up within the retaining walls that border each parcel, isolating each residence as a stone fortress. The streetscapes that result fail basic urban design standards for livable neighborhoods, and moreover fail to create any sense of place. And yet the act of levelling itself is not necessarily the

6-11. Las Vegas, Nevada, 2016. Terraced earthworks prepared for suburban development. [Karl Kullmann]

6-12. Nagasaki, Japan, 2015. Extreme suburban terracing in a new neighborhood on the outskirts of the city. [Karl Kullmann]



6-13. Perth, Australia, 2014. Topographic map of the northern half of the city. The sandy coastal plain is bounded by the Indian Ocean to the west, and an ancient granite escarpment to the east. [Karl Kullmann]

problem, since seeking or making level ground is a primal act of inhabitation. Throughout history we have actively levelled the ground to sleep for the night, to grow crops, or to found settlements. Viewed through this lens level building pads still have a place in architectural site works. As Noman Booth has observed, a building often appears most "stable and comfortable" when situated on level ground. In contrast, buildings set on columns to touch the ground lightly may appear to cling precariously to the hillside.[6] The catch is that while this may hold true for one-off dwellings on large lots, the impact of site levelling quickly escalates when repeated across many dwellings at suburban densities.

Suburban-style development in Perth predates the practice of land benching, which really began only about two decades ago. Until then it was normal for housing parcels to retain their natural unlevelled topography and even to retain some native vegetation. So, what changed? First, as land values increased the city expanded into areas of more rugged topography where development had hitherto been prohibitively expensive. Second, coupled with standardized construction techniques the popularization of the modernist concept of indoor-outdoor continuity reconstituted the garden as an extension of the house floor plate. And third, Perth has witnessed a significant increase in plot ratios, that is, the relationship of the size of the building footprint to the area of the plot.[7]

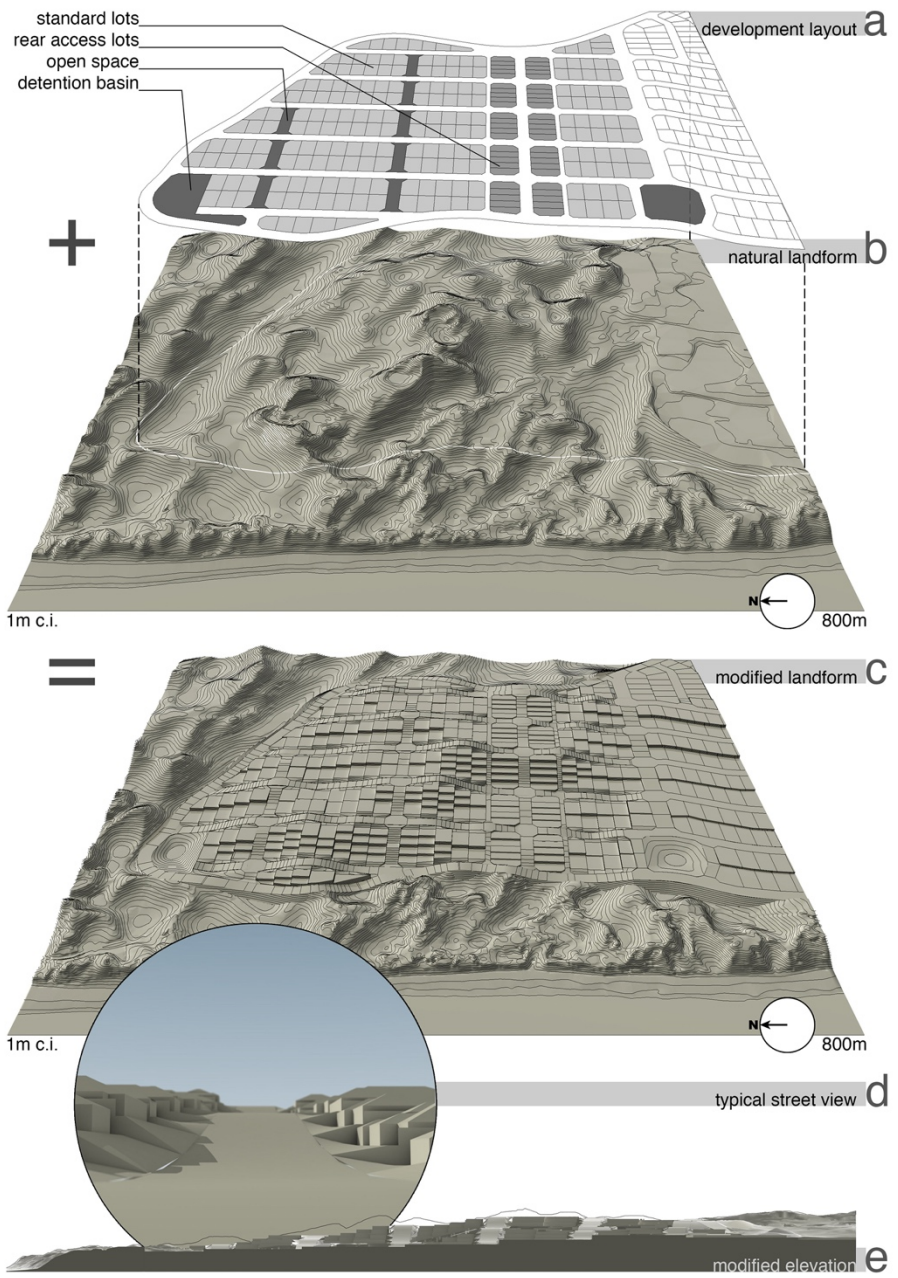
Up until mid-twentieth century a small house of roughly one thousand square feet occupied a large lot with plenty of room for its stone foundation to accommodate any topographic nuance. By the seventies houses were growing and the lots were getting smaller, although the adoption of split-level residential plans absorbed some topographic differences. The functional yard of the past suburbia, with its place for drying clothes, chickens, and perhaps a well for water, became a yard for entertaining and other social activities. Since the 2000s, houses have grown to occupy up to 80% of the parcel. That is to say, building footprint and lot size have been rendered almost congruent, with the retaining wall around the parcel boundary essentially serving as the foundation for the house.

So, why is terracing a bad thing? For one, is it does not permit keeping remnant vegetation. Some new developments have tried to retain some trees, commonly species like the locally endemic Jarrah (*Eucalyptus marginata*). As they don't like their roots trod upon, however, the trees often survive only about five years and have usually been retained only for marketing purposes. Also lost from terracing is the biotic layer that has required hundreds of years to accrue, even if it's only very thin. And there's also a loss of the phenomenological value of rough terrain converted to terraces, a loss of what Kevin Lynch called the "topographical gradients" by which we navigate and create a sense of place and identification.[8]

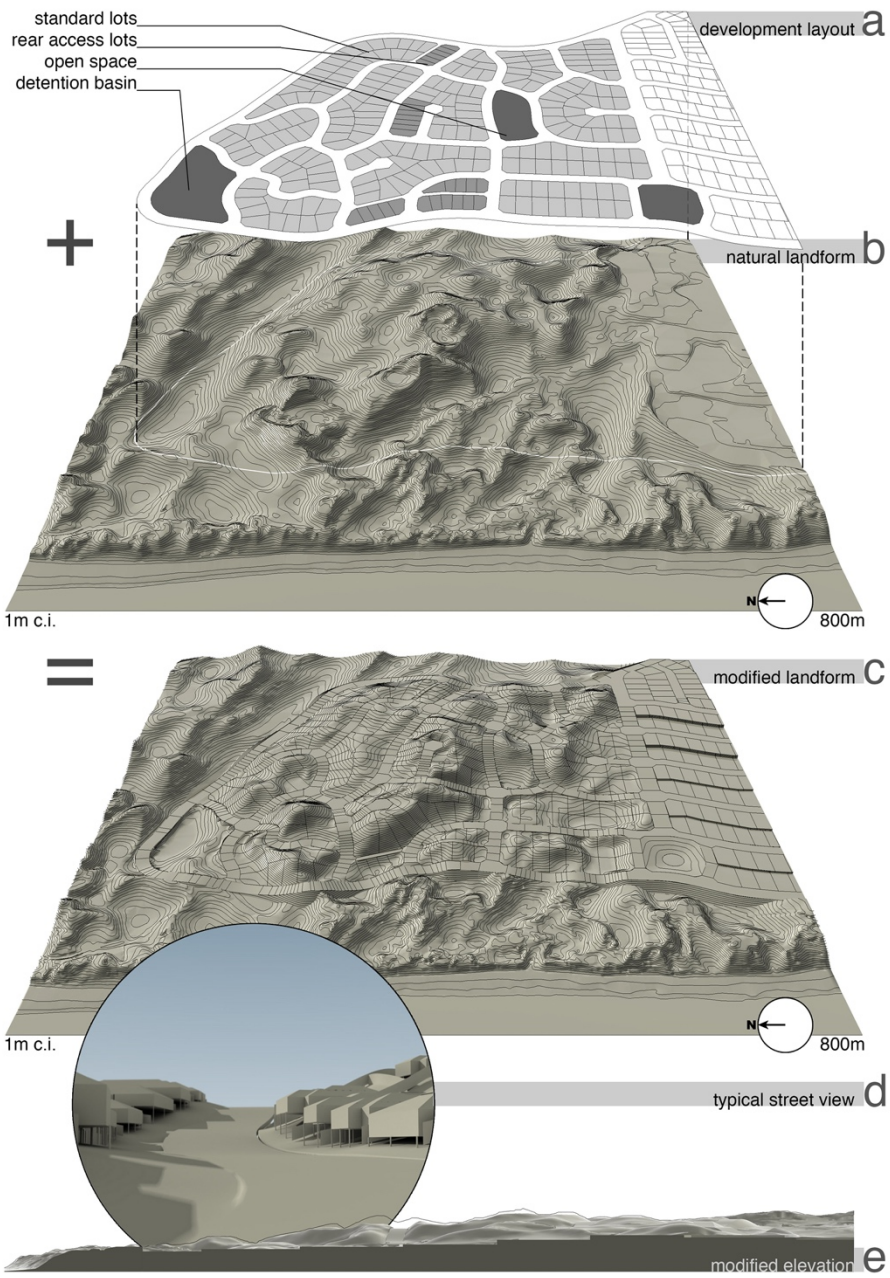
6-14. Perth, Australia, 2014. Aerial view of coastal suburban development. The site for the case studies for future development is outlined in red. [Karl Kullmann]

A series of case studies on a sandy coastal development site at Perth's northern suburban frontier explored how historical ways of developing suburbs might be adapted to mitigate or reduce the impact of retaining walls and improve topographic expression in these suburban developments [6-14]. After modeling the existing layout on the current topography, I speculated on different ways to plot a community based on different historical models, only two of which can be illustrated here. The studies matched the same yield as the developer and worked with industry-standard low and medium density housing types. And while it would have been easier to simply propose housing everyone in a single residential tower, or to curtail urban expansion altogether, the aim of the study was to be relevant to current practices.

One scenario adapted the grid-iron layout common in prewar suburbs and draped it over the terrain. While admittedly requiring more retaining walls, the use of split-level lots expressed the terrain as a pixelated form, while maintaining good urban legibility and



6-15. Perth, Australia, 2014. Grid-iron design scenario utilizing split-level development parcels. [Karl Kullmann]



6-16. Perth, Australia, 2014. Swale design scenario with dwellings elevated on pillars. [Karl Kullmann]

connections [6-15]. Another scenario, referenced the earliest informal coastal fishing settlements and routed roads along the swale lines with dwellings set on columns on the surrounding slopes. This scenario exhibits a very high degree of topographic expression but necessitates rethinking housing construction methods as well as accepting a layout less orderly than the typical [6-16]. The final study retained a significant landform that bisected the site as a mix of public open space and very low-density rural lots. While this scenario enabled a tangible area of natural topography to remain, the tradeoff was the low topographic expression of the standard benching practices that were required elsewhere to reach the developer's total yield.

Several consistent themes emerged in the course of these case studies. The first is that standard-issue housing design and construction remain a significant hurdle for creating more topographically expressive suburbs. While several Australian architects have designed houses that lightly touch the earth, they remain, for the most part, custom-designed residences for wealthy clients on large rural or bush lots. Thus far, few solutions have proven applicable to the more compact suburb. The second is that topographic expression is often not entirely compatible with contemporary urban design doctrine that implicitly prioritizes orderly urban plans. This stance should be interrogated, and perhaps loosened, to allow a greater flexibility for planning streets, lots, and building types and forms. There's a compelling demographic reason for doing this as well: today, we live in far more diverse arrangements than standard-issue three-bedroom bungalows with 2.3 people per household. Designs that connect a diversity of housing types and sizes to a diversity of landforms would benefit both suburban life and topographic expression.

In this regard, sand could learn from lava. While the sandy suburbs of Perth are geologically and geographically half a world away from the lavascapes of Hawaii and Iceland, they nevertheless offer transferable lessons. The eclectic tiny homes of Kalapana Gardens and sunken garden at Gaujulundur demonstrate what is possible when communities are incorporated into unruly topographies rather than

land that has been ironed out. And while both exemplify frontier exceptionalism they offer a tantalizing insight into how we might reimagine the historical relation between the building of cities and the process of clearing and leveling ground. In the unlevelled city topography becomes a medium through which to invest in one's urban environment—and be inspired. That is, to shape a sense of place, individually and collectively.

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Notes

[1] Lynch, Kevin (1972) "The Openness of Open Space", in György Kepes (ed) *The Arts of Environment* (New York: Braziller), 108–124. p.112.
[2] Although designed with graduate students as a speculative exercise that was not intended to be built, miraculously, it was realized. Although the complex grading and hardscape were very well executed, sadly, the planting was never finished.
[3] Spirn, Anne Whiston (1984) *The Granite Garden* (New York: Basic Books, 1984), p.91.
[4] Lipsky, Florence (1999) *San Francisco: The Grid Meets the Hills* (Paris: Editions Parentheses).
[5] "Mountain cropping" was a term used by William Bronson to describe the earliest suburban terracing in California, which he viewed interpreted as emblematic of environmental wastefulness in post WWII industrialized society. Bronson, William (1968) *How to Kill a Golden State* (Garden City NY: Doubleday).
[6] Booth, Norman K. (1983) *Basic Elements of Landscape Architectural Design* (New York: Elsevier), p. 65.
[7] These are Perth examples, but US data is similar, given that Australian suburbanism is largely imported from the US with local adaptations.
[8] Lynch, Kevin (1960) *The Image of the City* (Cambridge, MA: MIT Press), pp.96–97.