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# High Fidelity

Drone mapping fills a missing link in site representation

Karl Kullmann

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In many ways, the satellite has been instrumental for landscape architecture. As the apex of two centuries of progressively higher aerial reconnaissance, the satellite's view reveals landscape associations and patterns that remain concealed at lower altitudes. Through these revelations, satellite imagery played a key role in the reinterpretation of cities as complex ecological systems instead of mere assemblages of buildings. Ultimately, online satellite mapping applications confirmed that the entire planet is comprised of landscape. Through the convenience of GPS-equipped mobile devices, we now seamlessly integrate the satellite's landscape into our everyday lives.

A world tuned in to the synthesizing role of landscape is undoubtedly empowering for landscape architecture. But as enlightening and convenient as the satellite's encompassing gaze may be, the tyranny of distance coupled with the downward viewing angle also undermines its potency. As landscape architects are abundantly aware, the nuances and details that enrich the landscape are often camouflaged from 700 kilometres above Earth within shadowed, interstitial, and underneath spaces. Even with familiarization and steadily improving image resolutions, abstract planimetric forms routinely fail to resonate with an individual's perception of his or her place in the world. The recurring popularity of more immersive angles such as the archaic bird's-eye view is probably a reaction to this lingering apprehension.



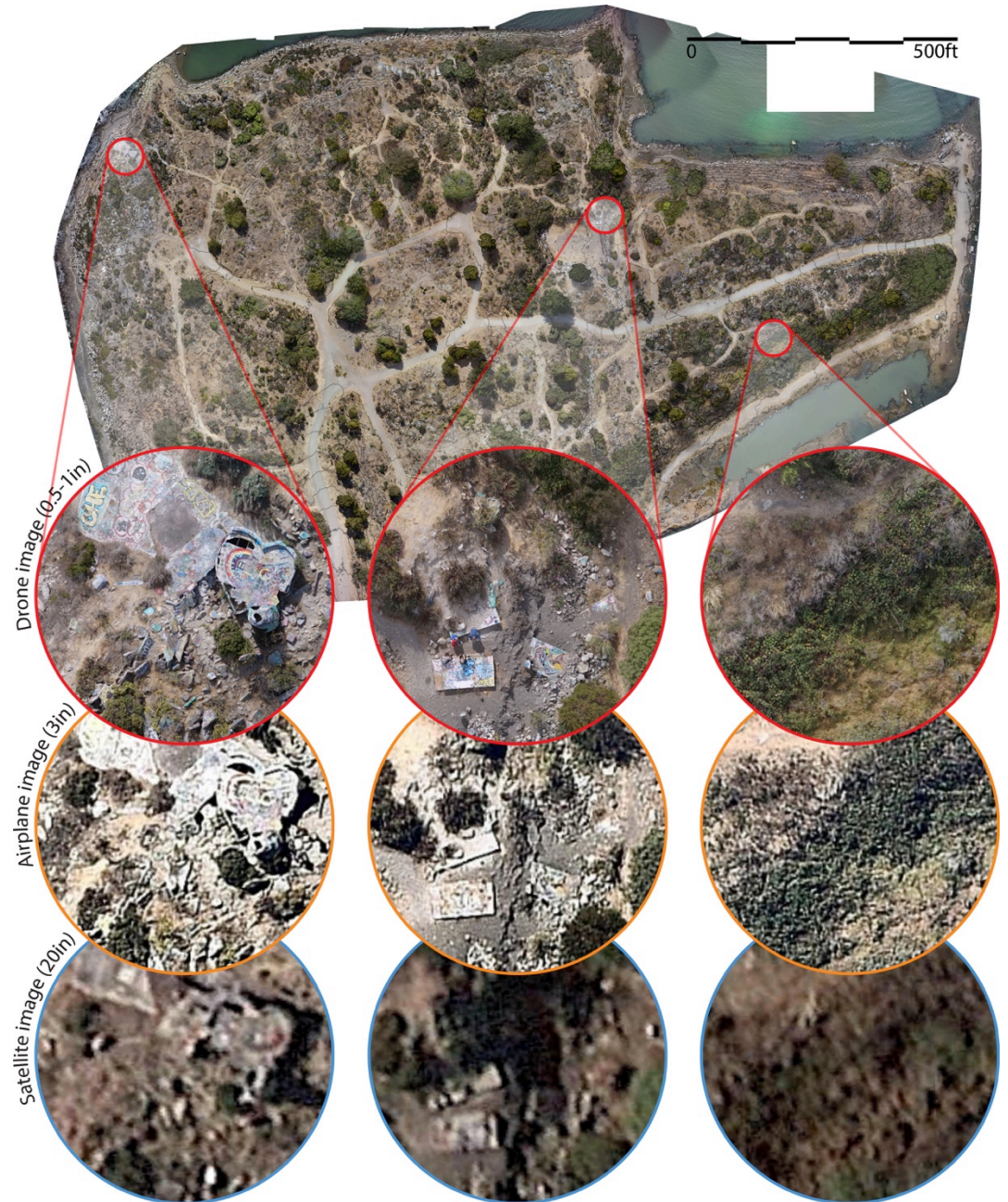
The satellite's view: San Francisco Bay (© 2015 Landsat 8, USGS/ESA)

These shortcomings are revealed at the site scale, at which a significant portion of landscape practice occurs. At this scale, the substitution of feature surveys or commissioned aerial imaging with freely available satellite-derived GIS data often lowers the quality of spatial information. GIS mapping data interpolated from much larger data sets trades off site specificity for expansive coverage, and its accuracy typically has not been verified on the ground. Given that landscape architecture relies on maps in one form or another to interpret, abstract, conceptualize, and ultimately reconfigure the ground, this demotion of ground proofing is highly significant to the discipline.

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Enter the drone. Initially introduced to the public as enigmatic appliances of remote warfare, drones rapidly became synonymous with the multi-rotor camera-equipped consumer devices that increasingly permeate the sky. Despite unresolved privacy concerns, civilian drones now fulfill everyday roles ranging from flyovers of photogenic landmarks to promotional real estate bird's eye views. Likewise, many landscape architects routinely deploy drones for site overviews, design visualization, and completed project documentation. And, as previously reported in *LAM*, drones are also being fitted with experimental payloads that include seed dispersal and fire ignition for forest fuel load management.

Whereas this first generation of civilian drones required active piloting, the next generation of the technology incorporates automated navigation. By integrating GPS with onboard avionic sensors, automated navigation enables pre-definition of virtual flight paths and autonomously tracks the ground-dwelling operator from the sky. Automated navigation also streamlines and systematizes the process of landscape imaging. Georeferenced drone imagery is digitally composited into extremely high-resolution orthomosaics, and converted through a sophisticated form of



The drone's eye view: orthomosaic of the Albany Bulb landfill in comparison with satellite and aerial imagery (drone image captured with 3DRobotics Solo drone equipped with Sony UMC-R10C camera flown at 60m)

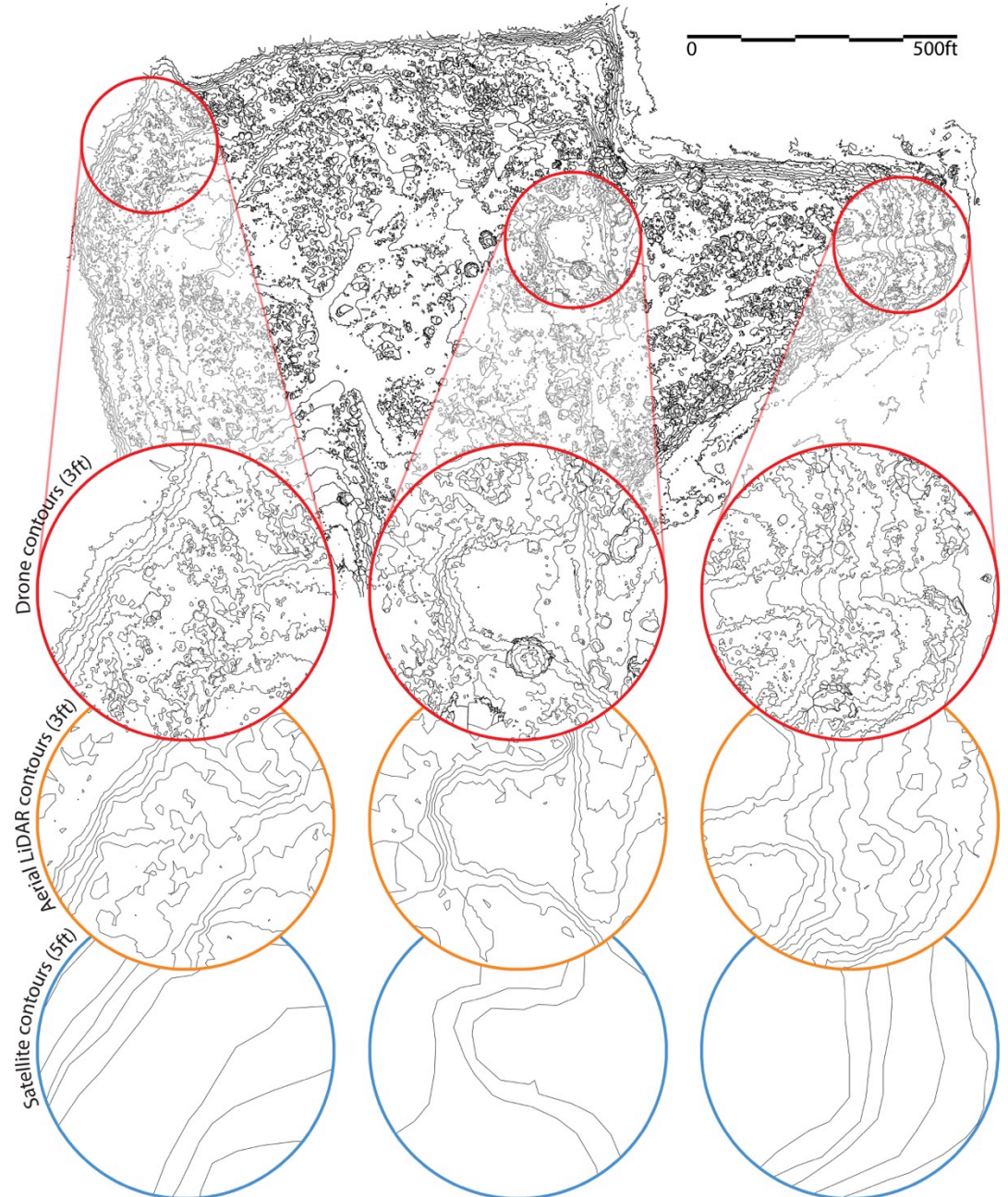
photogrammetry into three-dimensional topographic models. From these models, detailed contour elevation maps are generated.

Based on current battery technology, areas of up to 40 hectares can be captured in optical, near infrared, or thermal formats. Flying at practical altitudes of 60 meters with high-definition cameras results in image pixel resolutions of under 2 centimetres. To place this in context, imagery at this resolution is more than 600 times sharper than typical online urban satellite imagery, and where available, about 15 times sharper than aerial imagery captured and hosted by aircraft-based imaging vendors. Compared to the fidelity of Google Earth and GIS maps, the results are astounding. For the first time in cartographic history, topographic features are mapped down to a level of clarity comparable to the world that we perceive from on the ground.

In practice, the various features of next-generation drones are intended for different user groups, with topographic mapping principally calibrated for commercial use, and self-tracking primarily directed at the consumer market. But befitting of its diverse identity, landscape architecture straddles both of these professional and consumer domains. The applied aspects of drone mapping are most directly relevant to landscape architecture's ongoing search for new methods with which to represent the complexities of landscape. And as a social art, landscape architecture also has a vested interest in the cultural implications of the more consumer-oriented drone features.

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How might this technology impact landscape architecture? First off, the useability of automated drone navigation is primed to increase the prevalence of the bird's eye view in landscape design visualization. Once prominent in landscape architecture before falling out of favor in the latter part of the 20th century, this oblique angle is



Drone mapping: contour map of the Albany Bulb landfill in comparison with GIS and LiDAR contour data (drone map captured with 3DRobotics Solo drone equipped with Sony UMC-R10C camera flown at 60m)



The bird's eye view: contemporary landscape architectural visualization of the Salton Sea (Richard Crockett)

already enjoying a digitally propelled resurgence through applications such as Google Earth (with terrain and 3D buildings activated), Google `Maps 45° and Bing Bird's Eye. Combining a structural overview with close range immersion in the landscape, the cyclical allure of the bird's eye is a product of its capacity to communicate design visions to a general audience. Insofar as we imagine the future to arrive from over the horizon, there is something inherently aspirational about looking at, over, and through the landscape.

In addition to reviving the bird's-eye view, the drone heightens the landscape architect's interaction with the site. Current regulations and technologies require drone operators to escort their equipment to (or nearby) the mapping target. The act of launching the drone upward from the ground reverses the downward zoom of satellite imagery,

and places the landscape architect on the site and in the frame of the map. Granted, future developments in long-range drone dispatching may well dilute the practice of physically planting the operator's feet on the site. But for the time being, a sweet spot exists between the technique and the technology. Landscape architecture is likely to be enriched by this return to the field from which it became progressively insulated in digital age.

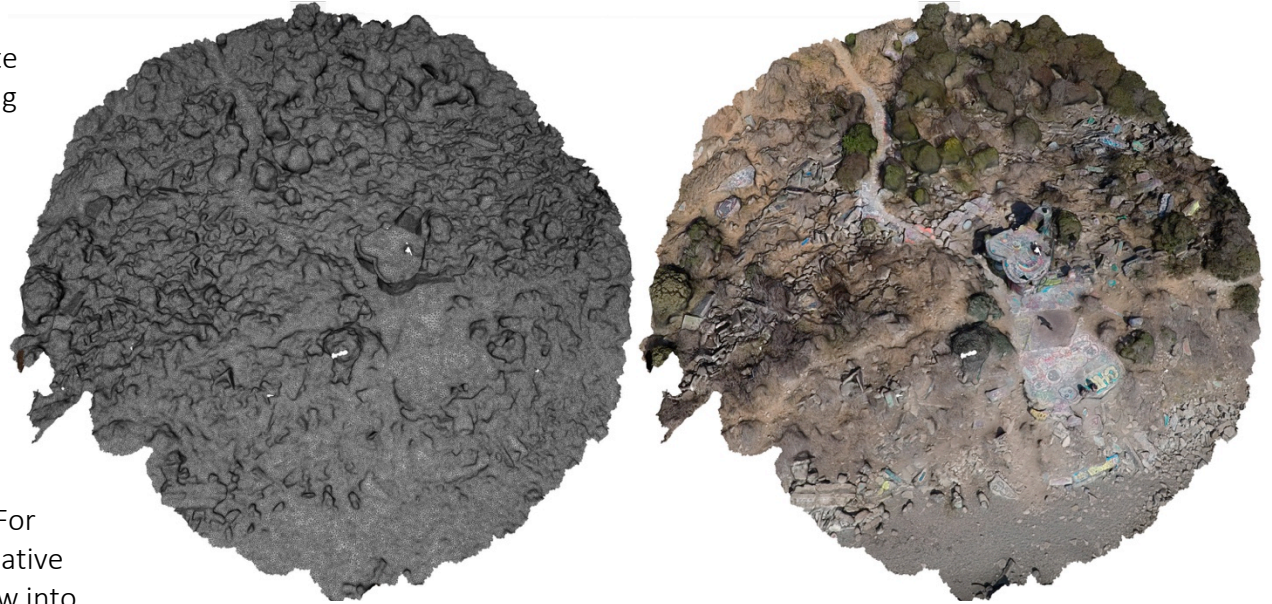
Even in the advent of remote drone dispatching (or the assimilation of drone imagery into Google Earth), the drone's close relationship with the ground reintroduces a form of fieldwork to the site mapping process. From a near-ground aerial perspective, this thickened fieldwork fulfills the original terms of site surveying, whereby an overview of a landscape is established by working from the inside out (as opposed to from the top down). In rediscovering the role of

surveyor—as opposed to mapper—the landscape architect is embedded into the whole process of site delineation. Whereas designers engaged in mapping typically mine satellite, aerial, and spatial data provided by agencies and corporations, drones facilitate unfiltered on-site engagement in the creation of content.

That said, the optical basis of drone mapping is no substitute for the precision of the surveyor’s theodolite. But although inappropriate for design documentation and construction, drone mapping is relevant to many of the other roles in which landscape architects are routinely invested. For preliminary design, community advocacy, or speculative work, the technology provides an accessible window into spatiality and materiality at the scale of the landscape site.

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Can this newfound fidelity actually be harnessed in the design process, or does it lead to a form of design determinism? It is possible that drone mapping delivers an information overload at the site scale that mirrors the critiques leveled at Ian McHarg’s regional mapping method of the 1960s. Although the new wave of GIS-based creative mapping sought to reconcile this “analysis paralysis” of too much data with the “fantasy fatigue” of whimsical design, an inflection point remains between the gathering of information and projecting of ideas. At this decisive moment, landscape architects may become transfixed by site-mapping fidelity that surpasses the fidelity at which they are able to conceptualize form. Mesmerized by ephemeral and variable landscape phenomena that are freeze-framed in high definition, a designer may be tempted to trivialize this information into mere pattern making.



Drone modeling as fieldwork: 3D mesh of rough terrain and vegetation at the Albany Bulb landfill (captured using 3DRobotics Solo drone equipped with GoPro Hero4 camera)

These consequences remain possible, though my initial observations from coordinating a graduate design studio project over several iterations suggest more constructive outcomes. This design studio challenge involves transitioning an overgrown dumpsite situated on the eastern shore of San Francisco Bay into a public park. Named the Albany Bulb, the site comprises a highly complex topography of concrete-and-rebar outcroppings interspersed with self-seeded thickets. Over the Bulb’s short history, these features supported clandestine off-grid encampments and inspired creative activities.

In earlier iterations of the studio, the students’ aspirations to engage these physical and cultural characteristics sensitively through design were curtailed by the coarse fidelity of available site data. With off-the-shelf satellite imagery, GIS data, and feature surveys all failing to systematically capture the topographic “texture” of the site, students tended toward over scaled and overbearing design interventions. With this site texture now represented in high fidelity, the design proposals

Site-specific design at the Albany Bulb landfill empowered by high fidelity drone mapping (Yiping Lu, with permission)



are noticeably more specific in their engagement with the complex qualities of the site. Moreover, much as landscape architects have always done, intermittently placing the detailed mapping aside and simplifying the site into key features and tectonics avoids any risk of data overload.

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The capacity to spatialize nuanced landscape characteristics evidently affects the designer's ability to engage these qualities through design. If we extrapolate this and assume widespread participation drone-based fieldwork, an increase in landscape design strategies that focus on retaining and incorporating the pre-existing qualities of a given site is a likely consequence. This is particularly relevant to the integration of culturally appropriated urban wasteland sites (such as the Albany Bulb) into the public realm.

But this is not to suggest that a renewed focus on site specificity will or should displace the past two fruitful decades of emphasis on large-scale associations, systems, and infrastructures. Rather, the drone and the satellite are most productive coexisting as overlapping scales of engagement with landscape. This is particularly relevant to addressing the persistent division within the discipline between site design and regional planning, cities, and regions, and between gardens and landscape. Moreover, the drone's eye is potentially instrumental in grounding the satellite approach to urbanism that has prevailed over the past 15 years and that arguably overlooks the placemaking aspects of dwelling.

Hypothetically, aerial access to the scale at which humans interact with the public realm also creates a platform for other innovations within landscape architecture. The reinvigoration of the human behavioral side of landscape architecture is one such possible by-product. When coupled with recent advances in mobile technology

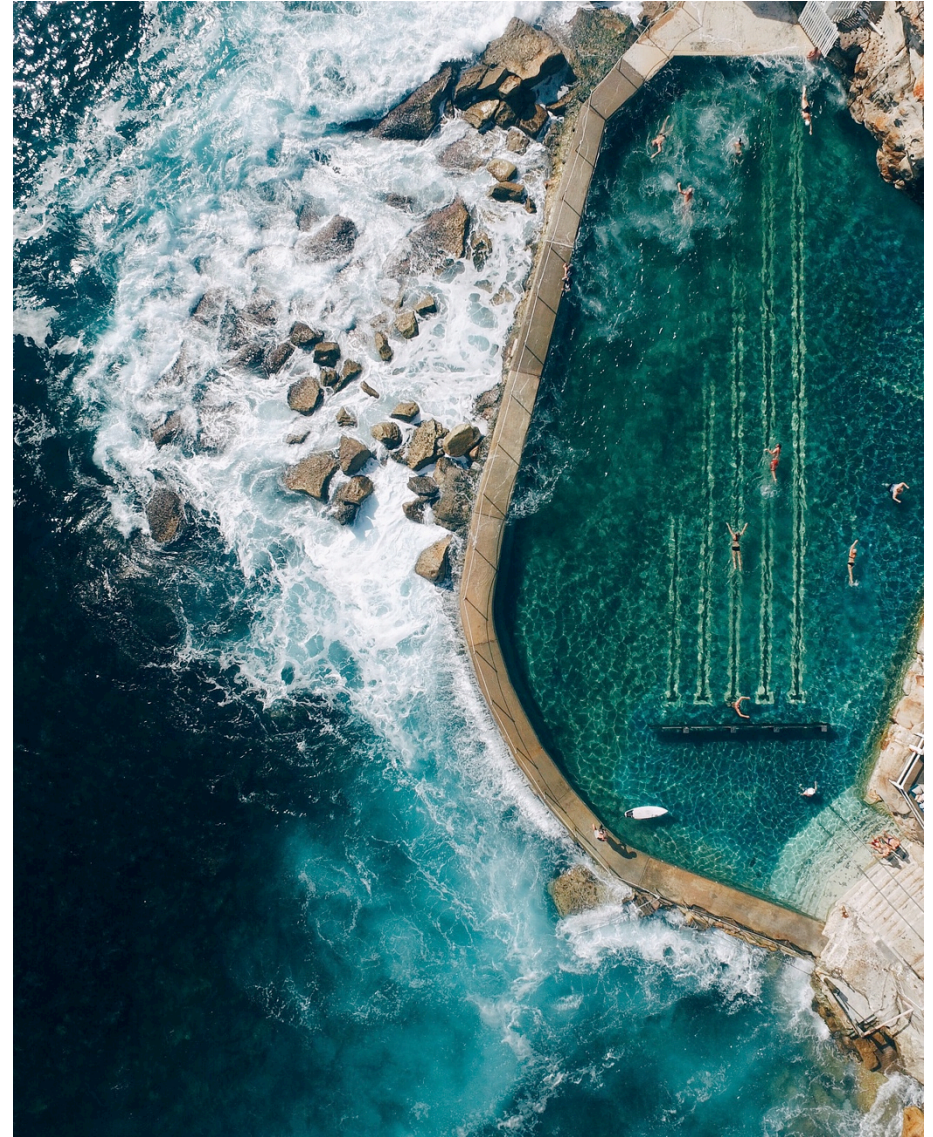
and the social sciences, it is conceivable that behaviourally based design would undergo a similar digitally propelled renaissance as occurred with ecologically based design a decade and a half ago.

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Intentionally capturing the natural and cultural landscape in high fidelity is only one half of the drone story for landscape architecture. The other aspect is the wider cultural assimilation of the drone's near-ground perspective. Clearly, our distaste at being visibly surveilled remains fervent. But in the same manner that individuals turned the cameras in smartphones back onto institutions of power and eventually back onto themselves, the use of drones as appliances of personal vanity is likely to outstrip the use of drones as deliberate instruments of surveillance and cartography. Whether we agree with it or not, drones are destined to become personal mirrors in the sky, enabling operators to witness (and share) themselves in the third person, positioned within the surrounding landscape.

But there is potentially a silver lining to this looming aerial narcissism. Once the drone operator's personal vanity is satisfied, attention invariably turns to the surrounding landscape that fills out most of the scene. Landscape architecture has a vested interest in how this circumstantially imaged landscape is utilized and interpreted. It is unlikely to remain inert, since by its very nature, the drone's-eye view implies a certain degree of envisioning of alternative futures. It also provides a degree of instrumentality for enacting those visions. Given that imagining and actuating landscapes is traditionally the task of landscape architects, everyday participation in drone mapping injects core landscape ethics into the existing culture of image sharing. With their horizons extended to include the near landscape, creators and consumers of drone imagery and mapping inadvertently advocate for landscape architecture.

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Drone image of Sydney sea pool on social media (Gab Scanu © 2016)

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