

**WHERE DRAGONFLIES RETURN:
TOWARDS AN ENTO-METROPOLIS**

A Thesis Submitted to the Department of Landscape Architecture,
Harvard University Graduate School of Design

by

ANNE TONG

In Partial Fulfillment of the Requirements for the Degree of

MASTER IN LANDSCAPE ARCHITECTURE

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Thesis Advisor

An aerial photograph of a lush, green wetland landscape. A winding waterway, possibly a stream or canal, flows through the center of the image, bordered by dense, vibrant green vegetation. The water reflects the surrounding greenery. In the upper right corner, a small, dark, rectangular structure, possibly a building or a small bridge, is visible. The overall scene is a mix of natural and man-made elements, suggesting a focus on environmental design or urban planning.

Where Dragonflies Return

Towards an Ento-Metropolis

Anne Tong MLA II Advisor: Chris Reed



Acknowledgement

Thank you to my incredible thesis peers—Leslie Ponce-Díaz, Carlo Raimondo, Tingyue Tan, Emily Kim, and Garrett Craig-Lucas—for your constant feedback, encouragement, and camaraderie throughout the year. From long nights to shared moments of laughter, I truly couldn't have finished this project without you all.

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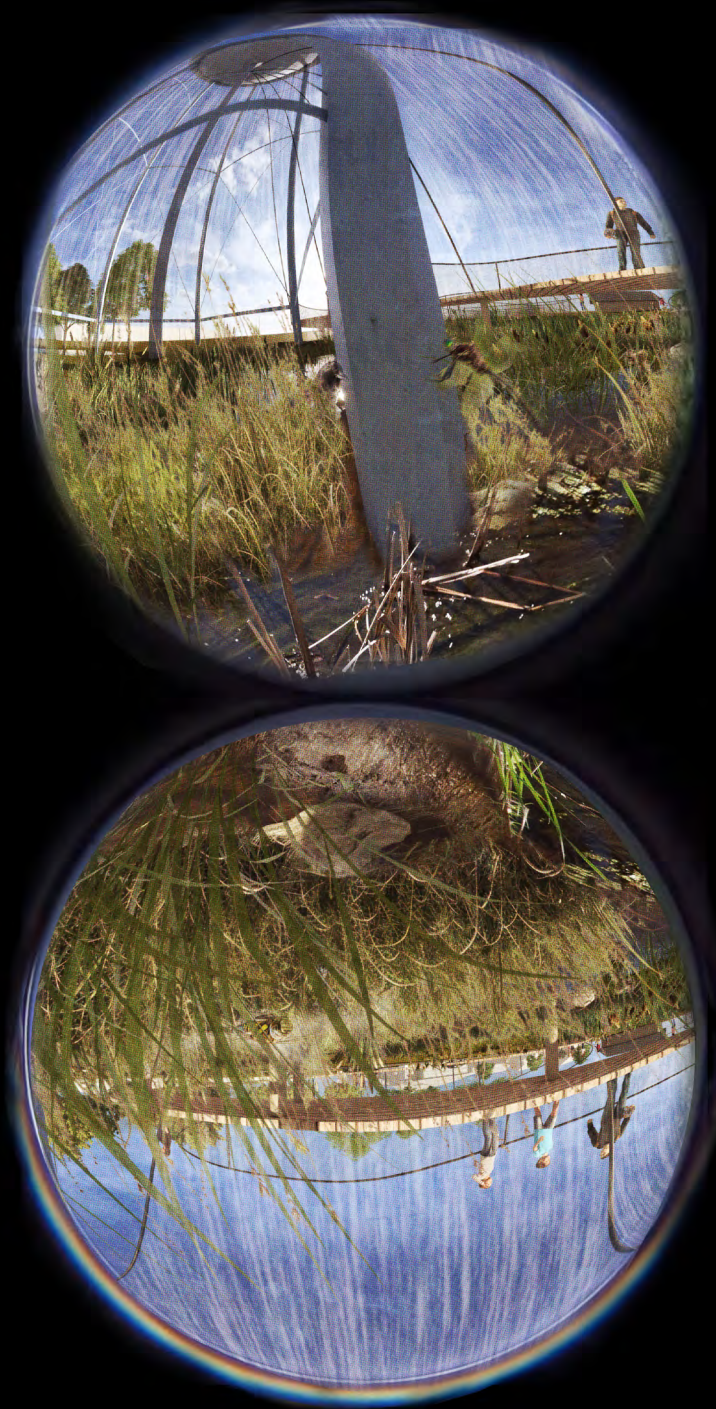
My deepest thanks go to my advisor, Chris Reed. Your ongoing guidance, thoughtful feedback, and genuine understanding of my interests have been invaluable. I found my voice in design through the option studio I took with you, and I'm profoundly grateful to have continued exploring and evolving my ideas of the small creatures under your mentorship.

Lastly, to my parents—thank you. None of this would have been possible without your unwavering support.

Abstract

The Hine's Emerald Dragonfly, a key ecological indicator of groundwater-based ecosystems, faces extinction in the United States. Its most genetically diverse remaining habitat - the Des Plaines River watershed in Illinois - is experiencing significant groundwater depletion and encroachment through urbanization, thereby threatening the species' survival. This proposal reimagines single-purpose infrastructure easements as shared commons for people and wildlife, and operates at three layers: point, repurposing groundwater wells into dragonfly habitats; line, transforming transmission corridors into flight pathways; and field, integrating these elements into a systemic urban framework for long-term coexistence.

Over time, the return of the dragonfly would mark the site's transformation into a new kind of public space, offering a cultural identity shaped by confronting insect agency. Each summer, swarms of dragonflies would become a celebrated spectacle, signaling restored balance between human infrastructure and the natural world. By centering more-than-human perspectives, this vision challenges conventional infrastructure design, advocating for landscapes as adaptive commons—spaces of ecological reciprocity rather than extraction and control.



Why is this important?

"If all mankind were to disappear, the world would regenerate back to the rich state of equilibrium that existed ten thousand years ago. If insects were to vanish, the environment would collapse into chaos"

--E.O Wilson, Half Earth: Our Planet's Fight for Life

"Endangerment is a question of both scale and value. Only the humanities and social sciences, transformed though they will be through their engagement with science, can fully articulate what we may lose."

-- Julia Adeney Thomas, History and Biology in the Anthropocene:
Problems of Scale, Problems of Value

Insects are the most numerous and widespread class in the animal kingdom, accounting for up to 90% of all animal species. Yet, as human activity rapidly transforms the planet, global insect populations are declining at an alarming rate—by up to 2% each year—with an estimated 45% drop over the past four decades. Deforestation, pesticide use, artificial light pollution, and climate change have pushed these essential creatures to the brink—along with the crops, flowers, and animals that depend on them.

In many design projects that involve insects or other small organisms, the focus has often been on restoration—rebuilding habitats, reintroducing species, repairing damaged ecologies. But as biodiversity loss accelerates and ecosystems unravel, I have come to question whether this approach alone is sufficient. As landscape architects, we must think beyond survival. We need to design for coexistence—systems that not only allow insects to persist, but also recognize their agency and embed their presence within the everyday life of our shared environments.

This requires more than ecological fixes. It calls for a shift in perception—one that challenges the cultural hierarchies that have rendered insects invisible, disposable, or even repellent. Our landscapes reflect our values, and the marginalization of insects reveals a deeper discomfort with disorder, decay, and forms of life that cannot be neatly

controlled. Yet it is precisely these small, often overlooked creatures that stabilize our environments, pollinate our food systems, decompose waste, and maintain the delicate balances upon which all species—including humans—depend.

We inhabit a world shaped by grids, boundaries, and infrastructure—a landscape organized around efficiency and human utility. Within such a framework, the return of insects may appear unruly or chaotic. But the patterns they bring—seasonal rhythms, trophic interactions, underground networks—are not disruptions. They are expressions of a deeper order that underpins the functioning of ecosystems. To embrace these patterns is not to lose control, but to recalibrate our understanding of what control should mean in the age of ecological crisis.

This also means rethinking how we define and respond to endangerment. The disappearance of insects is not just a loss of biomass; it is a loss of ecological function, of cultural connection, of planetary stability. The value of insect life cannot be measured by scale alone—by numbers or size—but by the complex interdependencies they sustain. Recognizing this value requires us to work across disciplines, combining ecological science with the insights of the humanities and social sciences to fully grasp what we are losing, and what it would mean to live differently.

To begin this shift, we must also reconsider our methods. Rather than applying traditional landscape frameworks from the top down, we must start from the ground up—literally and metaphorically. We must observe from the perspective of other species, design with their life cycles in mind, and build environments where multiple worlds—human and more-than-human—can intersect. This is not only a technical challenge, but a cultural and ethical one. To restore insect life is to restore a world where difference is not managed, but honored.

HINE'S EMERALD DRAGONFLY
(Somatochlora hineana)



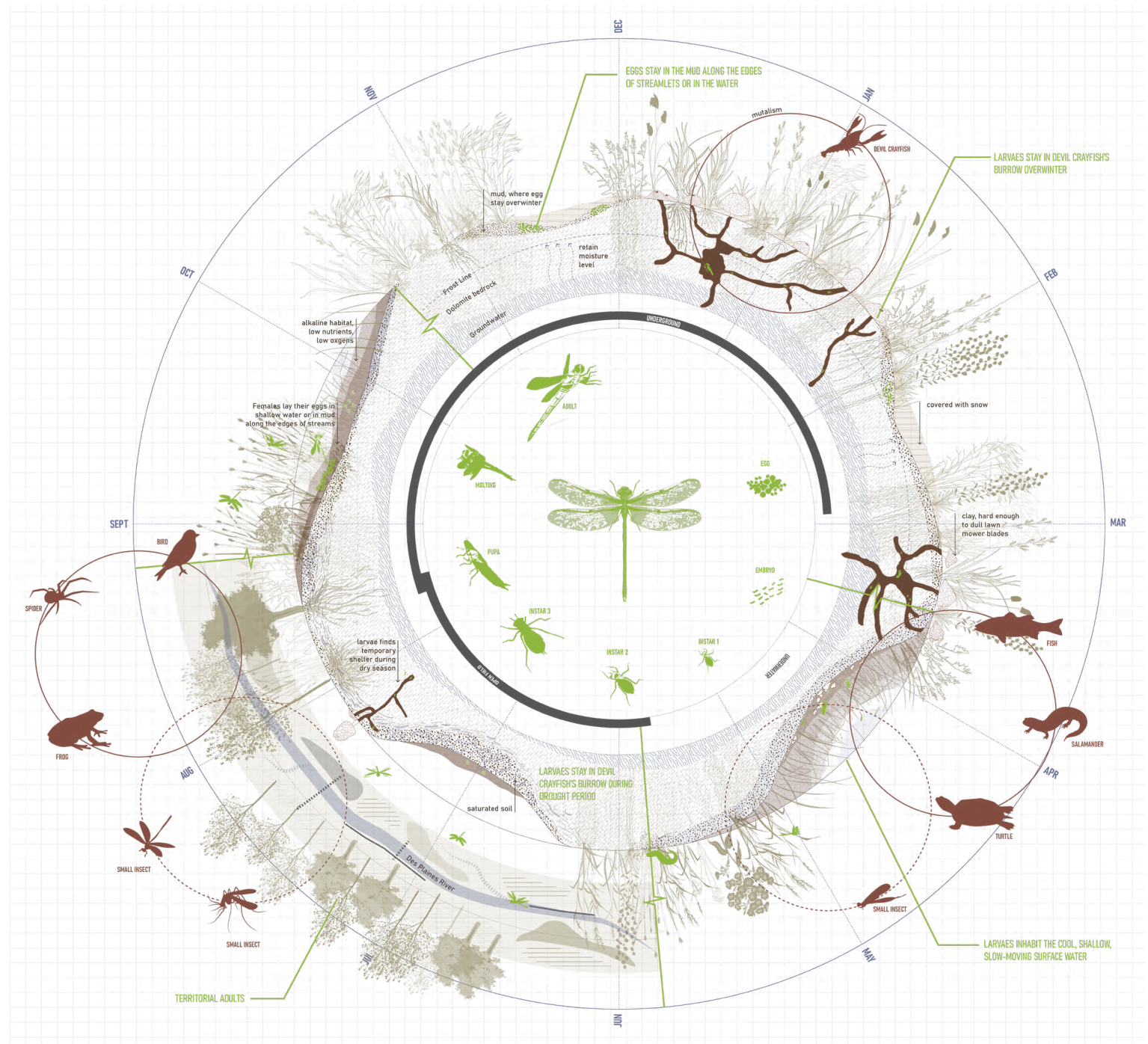
Adult Dragonfly, Forest Preserve of Cook County

This thesis centers on Hine's emerald dragonfly (*Somatochlora hineana*), the only dragonfly species currently listed as endangered in the United States. With a life cycle spanning four to five years, it spends the majority of its life in the larval stage, emerging as an adult for only the final three months.



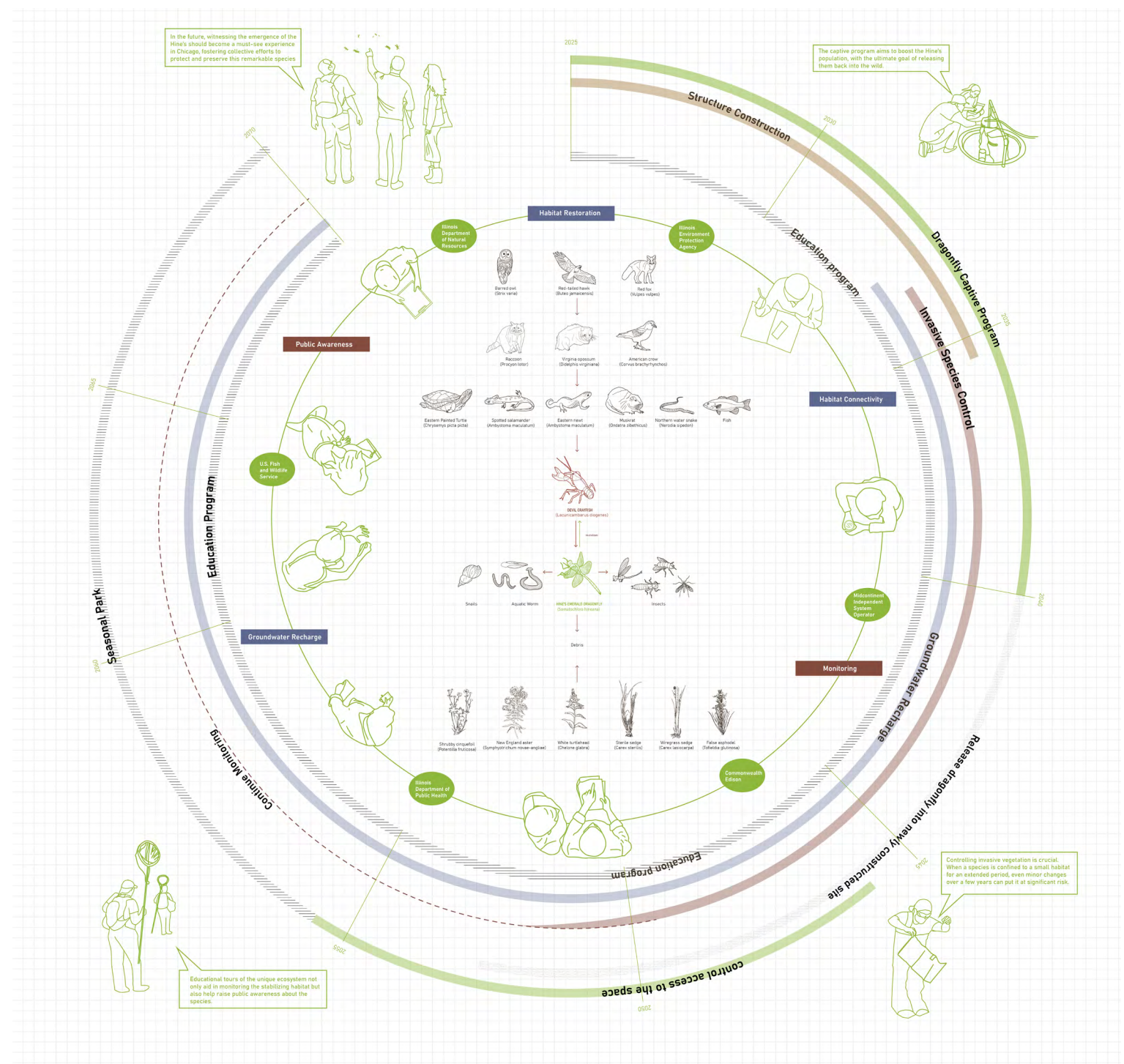
1,2,3,4 year larvae dragonfly, U.S. Fish and Wildlife Service

Both the egg and larval stages are aquatic. Hine's emeralds spend the majority of their lifespan in the larval stage, which lasts 2–4 years. The specific length of this stage varies with food supply, water depth, and temperature. While in this stage, Hine's emerald nymphs live within streamlets and mature by undergoing a series of molts.



Lifecycle diagram of Hine's Emerald Dragonfly

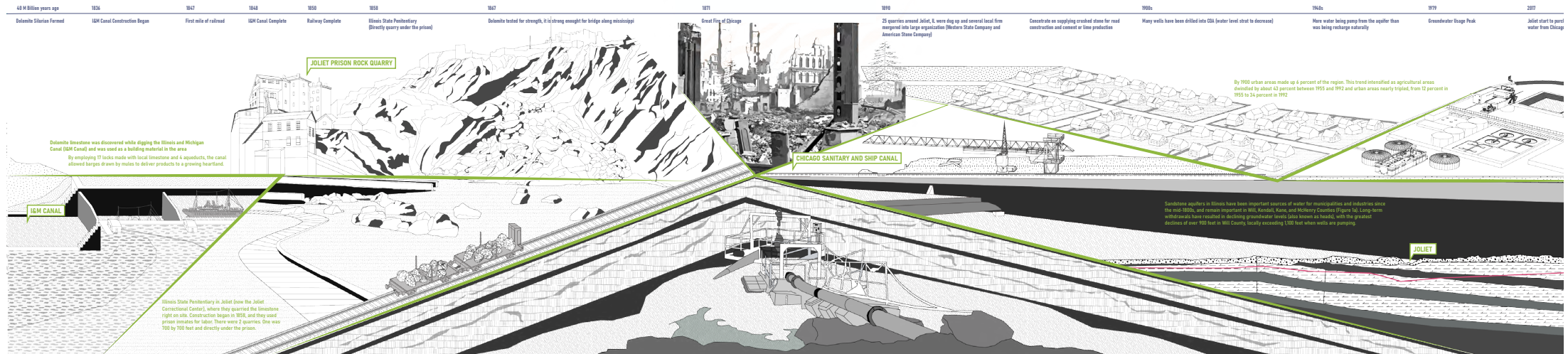
As a larva, the dragonfly depends on groundwater-fed habitats and forms a mutualistic relationship with the devil crayfish, using its burrows as overwintering shelters. When snow melts in spring, the larvae return to the surface and inhabit shallow, slow-moving streams known as rivulets. Increasing climate variability and drought have made the crayfish burrows even more critical to the dragonfly's survival. In its brief adult stage, the dragonfly follows open, sunlit flight corridors—preying on small insects, seeking mates, and reproducing to sustain the next generation.



The Hine's emerald dragonfly, as a critical indicator species, is the only federally listed endangered dragonfly species, activating collaboration across federal, state, and local agencies. Its protected status creates a framework for coordinated conservation efforts and funding. As a charismatic invertebrate tied to rare groundwater-dependent habitats, it offers a unique opportunity to raise public awareness and reshape ecological priorities. Its decline signals systemic hydrological stress, but its recovery could serve as a visible, compelling symbol of ecological restoration and multispecies coexistence.

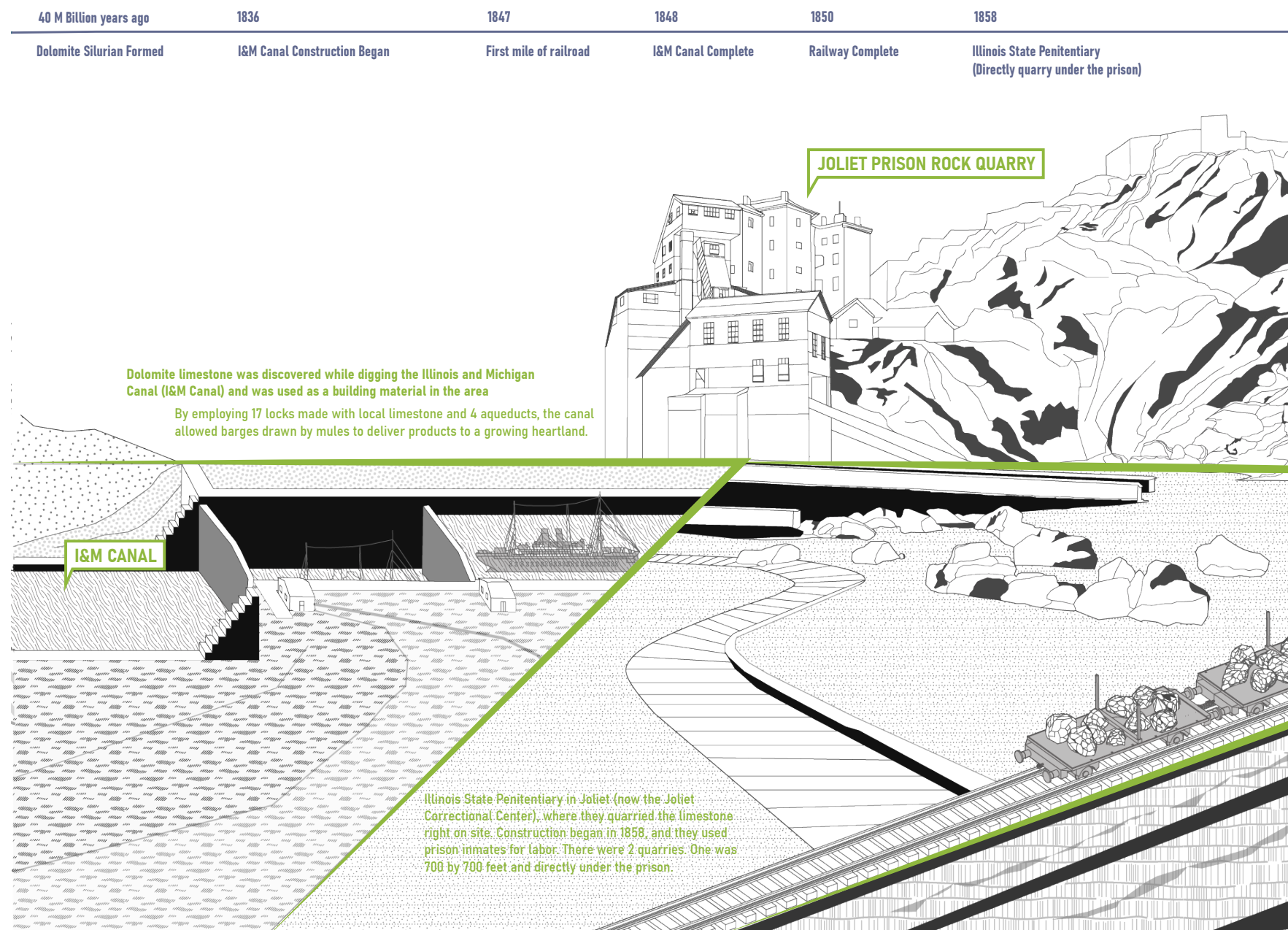
Hine's Emerald Dragonfly as an critical indicator species

Hine's vs. Human: Contesting Uncommon Ground



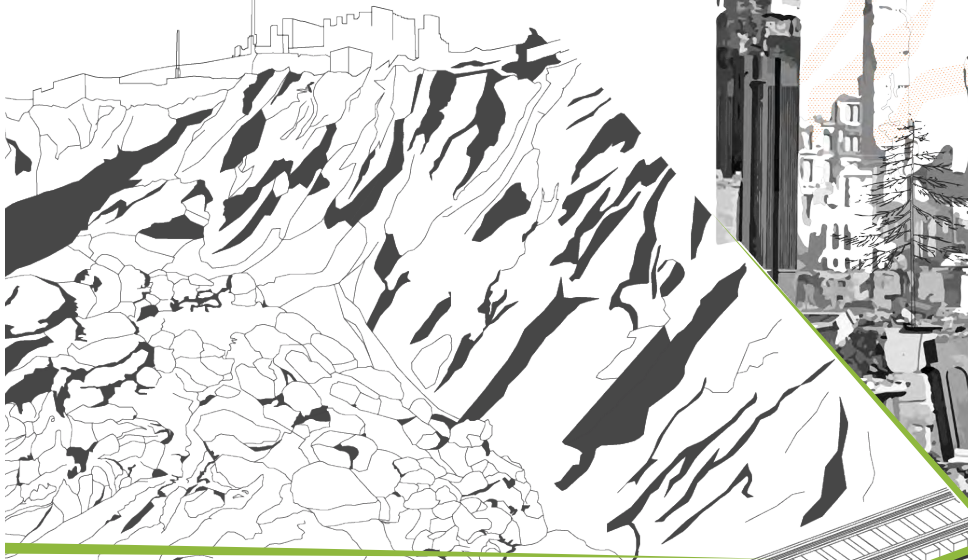
Hine's Emerald Dragonfly as a critical indicator species

The destruction of Hine's emerald dragonfly's habitat is closely tied to the founding and expansion of the city of Chicago. The dragonfly depends on rare dolomite bedrock habitats, first uncovered during the construction of the Illinois & Michigan Canal. After the Great Chicago Fire of 1871, demand for dolomite surged, as the city turned to fire-resistant materials like the limestone that had preserved the iconic Water Tower. This boom in quarrying, combined with urban expansion and industrial growth, led to widespread groundwater depletion and fragmented habitats, pushing the dragonfly toward the brink of extinction.



1867

Dolomite tested for strength, it is strong enough for bridge along mississippi



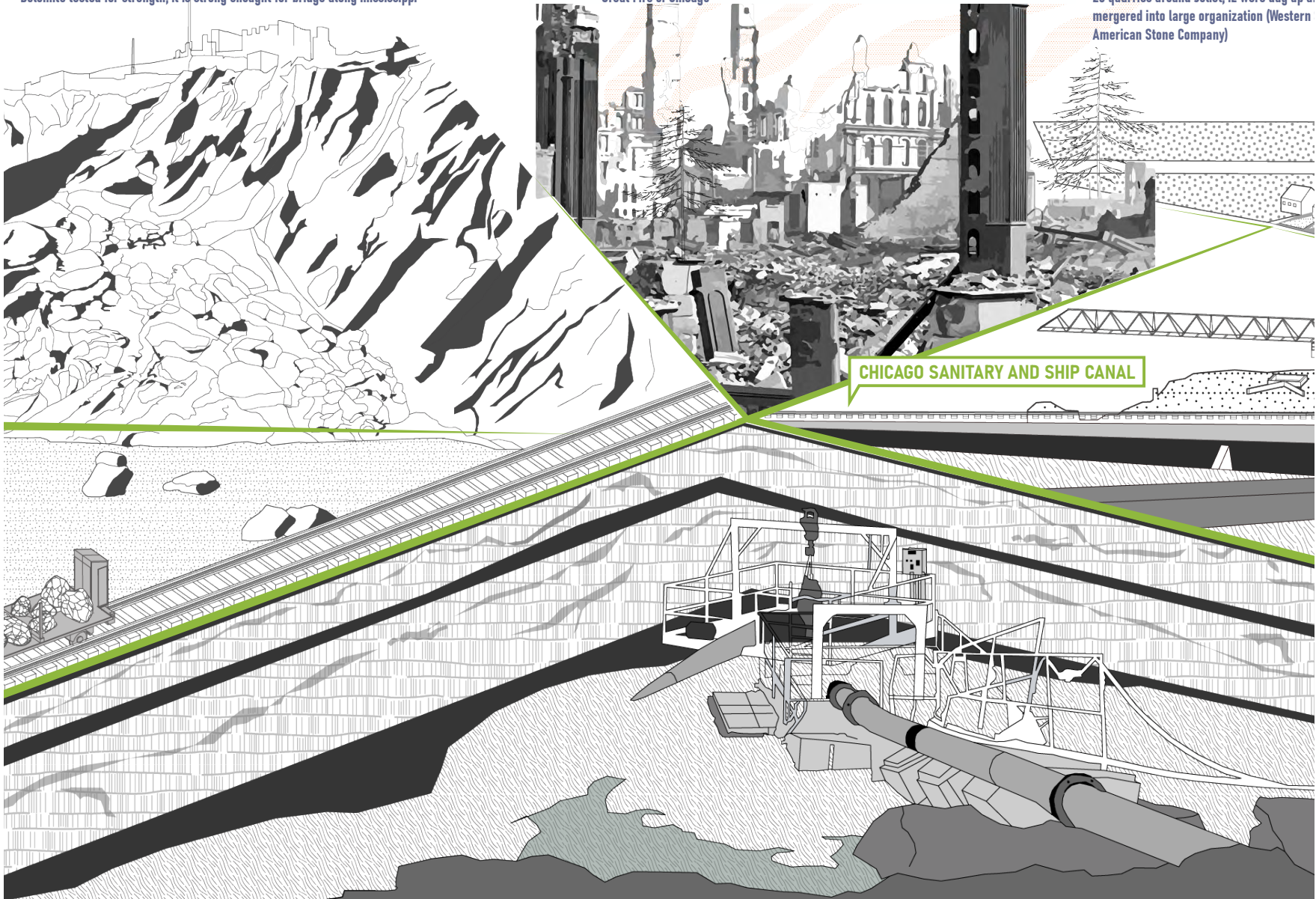
1871

Great Fire of Chicago



1890

25 quarries around Joliet, IL were dug up and merged into large organization (Western American Stone Company)



1900s

Concentrate on supplying crushed stone for road construction and cement or lime production

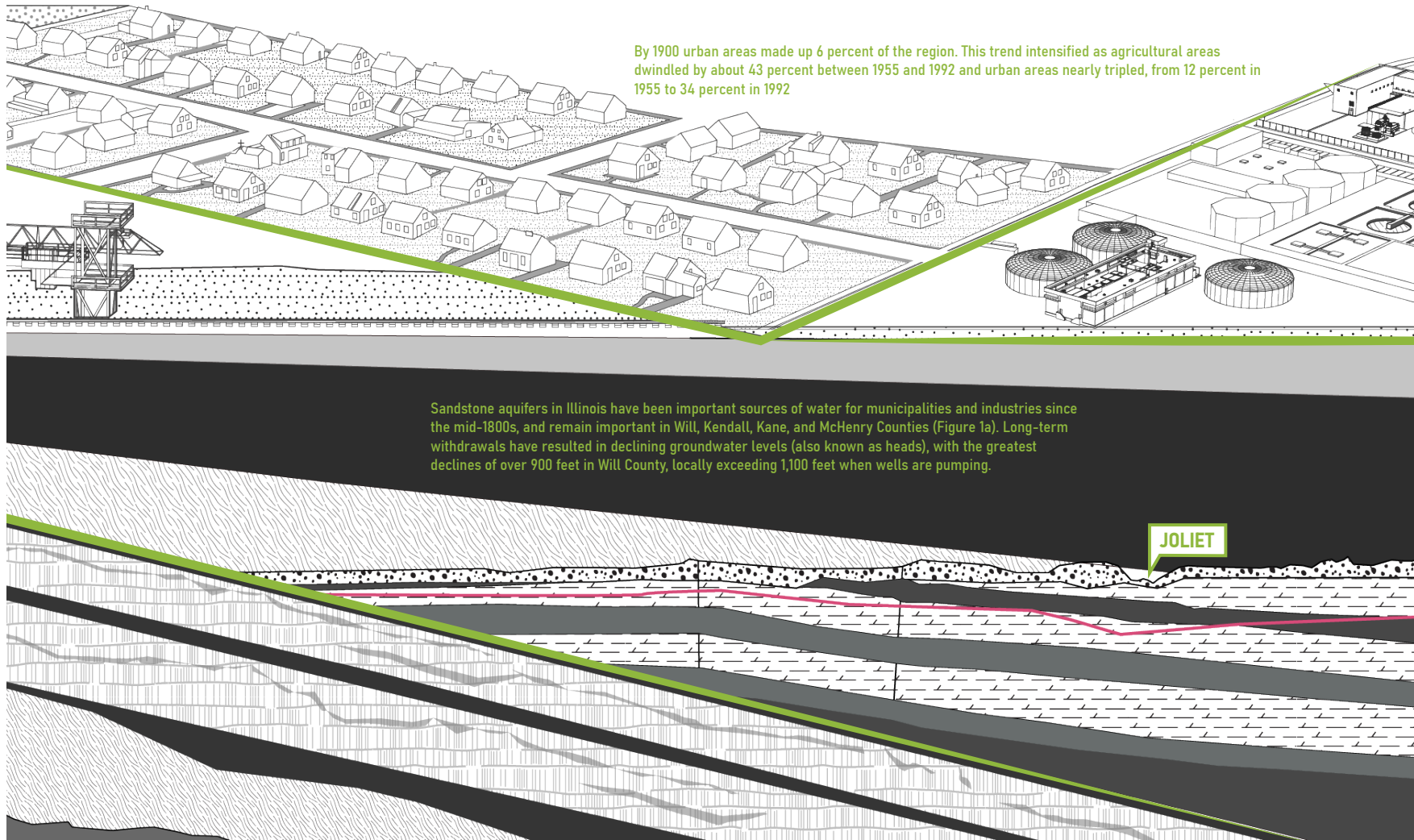
Many wells have been drilled into COA (water level start to decrease)

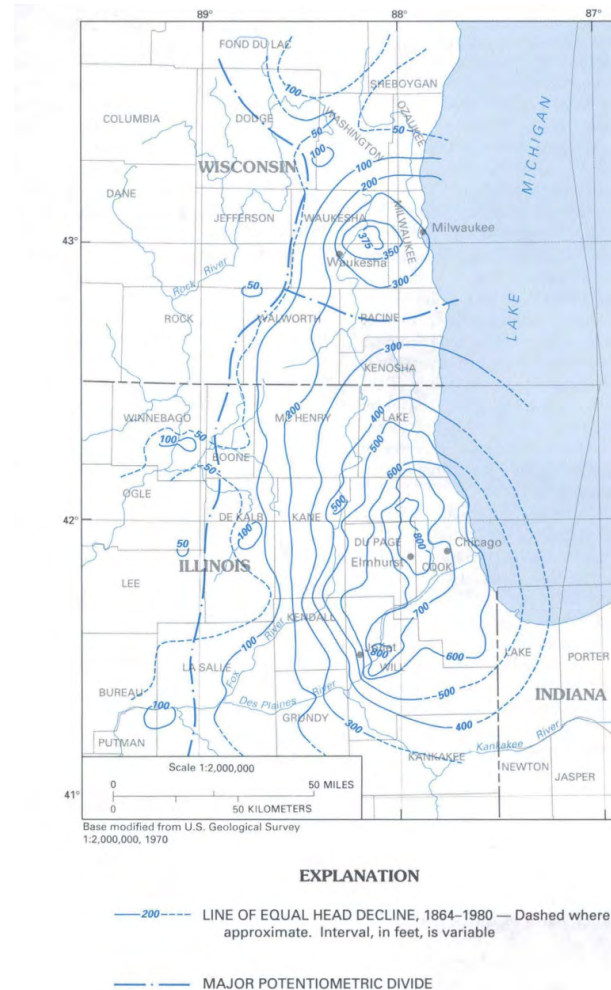
1940s

More water being pump from the aquifer than was being recharge naturally

1979

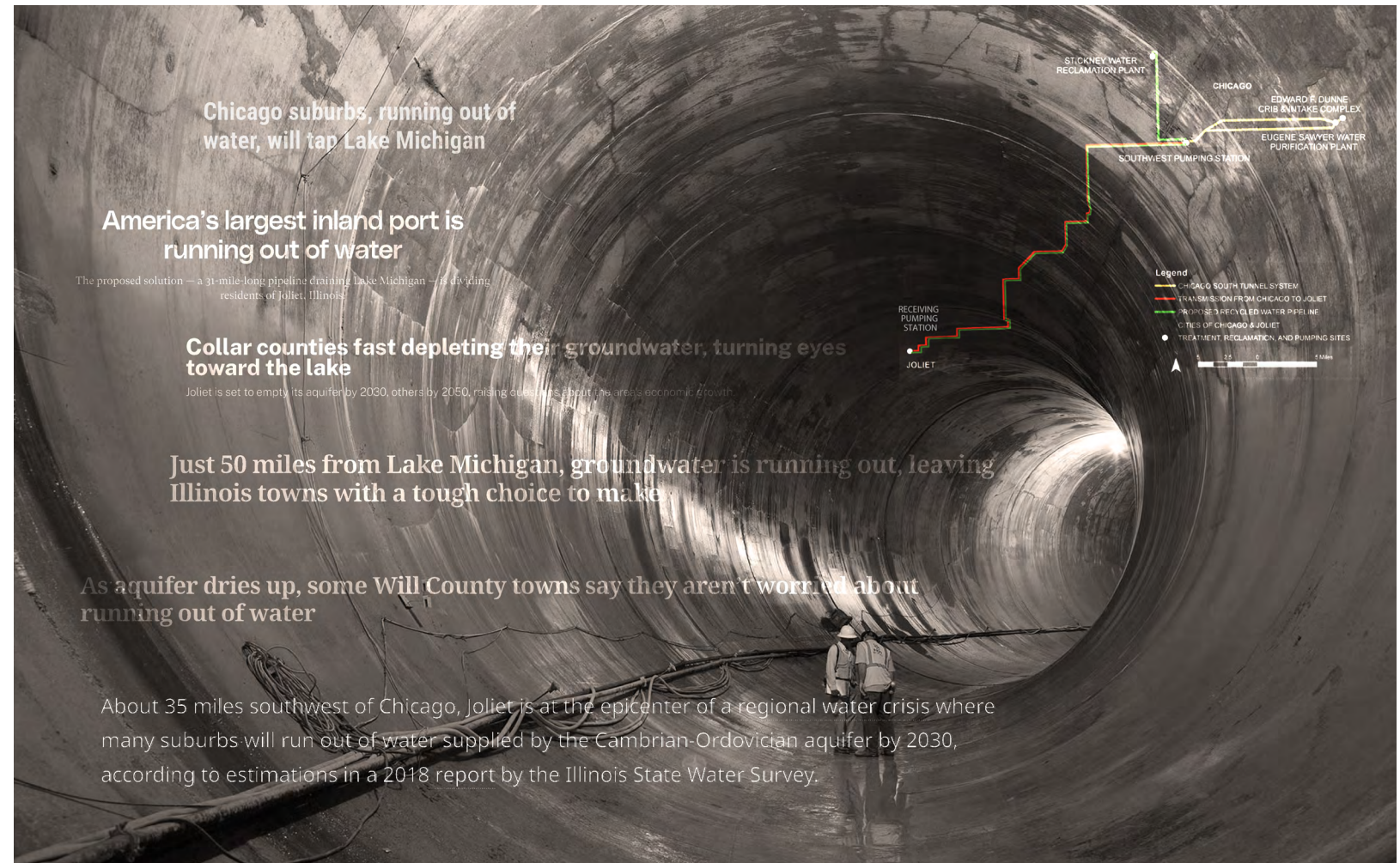
Groundwater Usage Peak





Illinois Groundwater Study, Prairie Research Institute, 2019

The Cambrian-Ordovician aquifer system is a major water resource in Northeast Illinois, but these aquifers have experienced declining water levels since the first deep well was drilled in Chicago in 1864. In modern times, groundwater supplies in the southwest suburbs are at the highest risk, where water levels have reached historic lows, exceeding 1,100 feet of drawdown when wells are pumping. That's equivalent to water levels having fallen by 88 floors of Willis Tower, and by 2040, the regional trend suggests that drawdown will have reached the top floor.



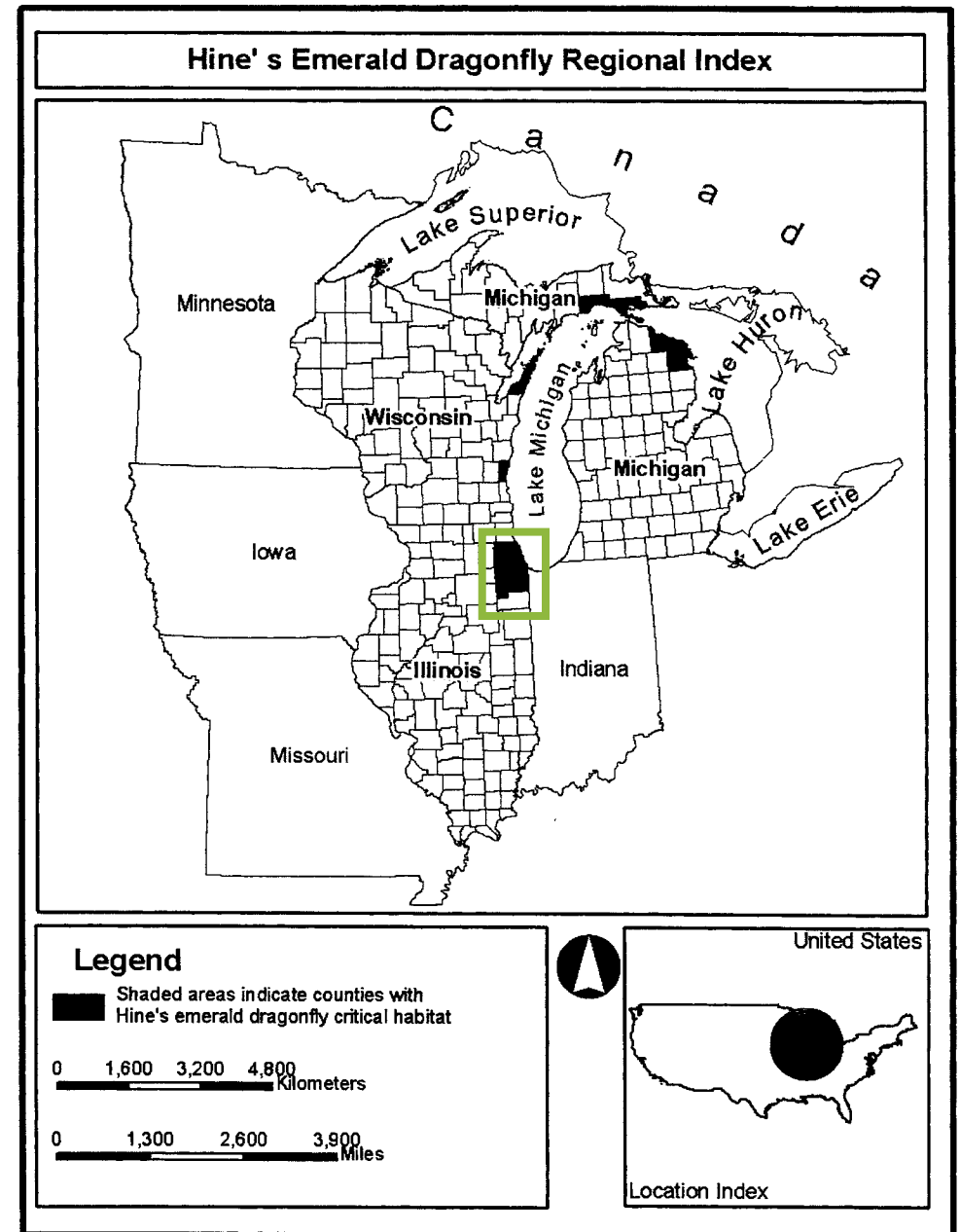
Chicago tribune, 2025

Joliet, a suburban city about 35 miles southwest of Chicago, is at the center of a looming regional water crisis. A 2018 report by the Illinois State Water Survey projected that many communities drawing from the Cambrian-Ordovician aquifer, including Joliet, will face severe groundwater depletion by 2030. In response, Joliet has announced plans to source water from Lake Michigan. Construction of the new pipeline—funded by the Grand Prairie Water Commission, which includes Joliet and the towns of Channahon, Crest Hill, Minooka, Romeoville, and Shorewood—is scheduled to begin next month.

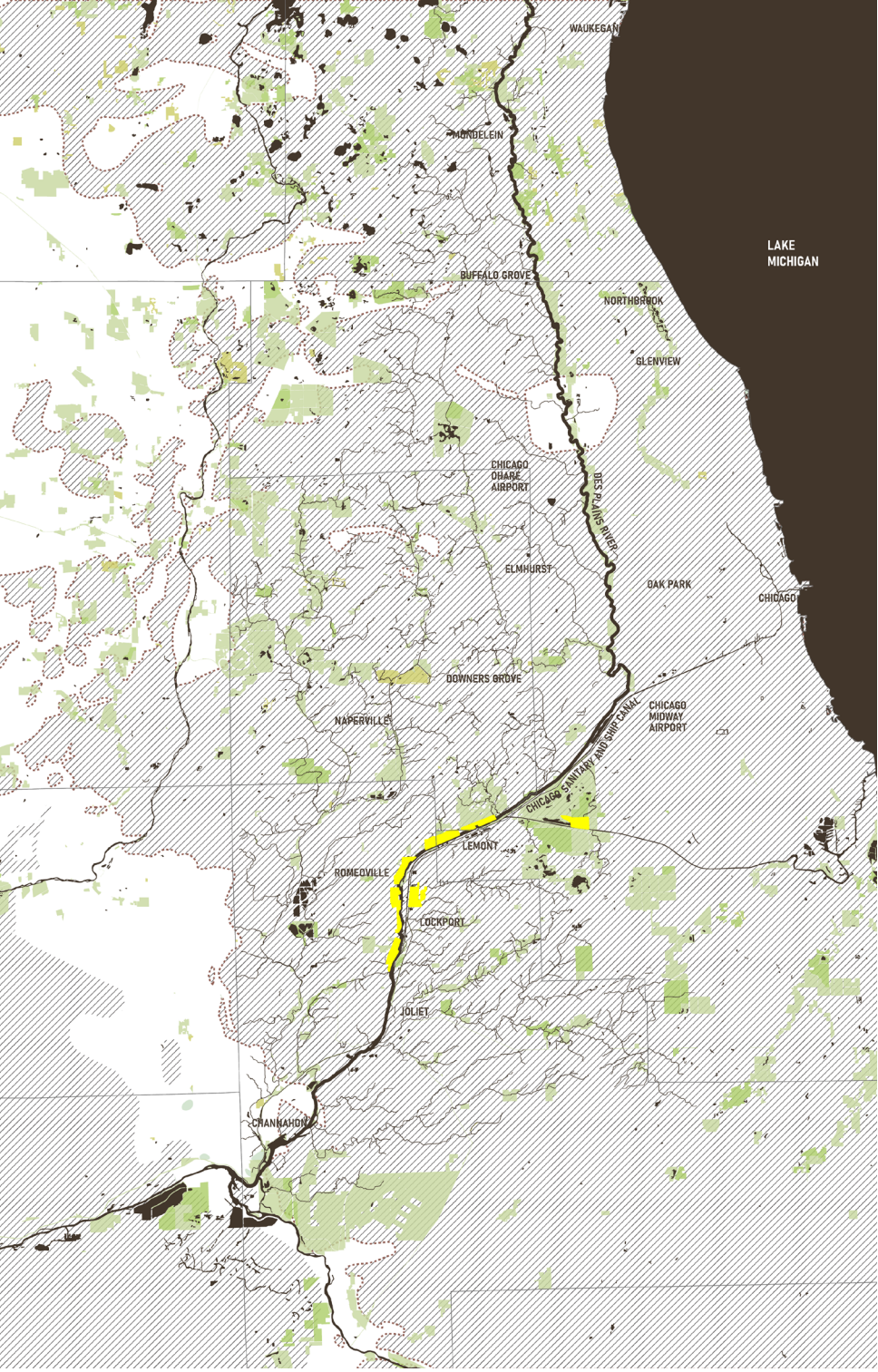


Interstate 355 bridge

Habitat fragmentation and barriers to movement can reduce population sizes and diminish genetic diversity. For the Hine's emerald dragonfly, such barriers include closed-canopy forests and infrastructure like bridges. In the Des Plaines River Valley, the Interstate 355 bridge was elevated by 3 meters during construction to allow safe passage for dragonflies. However, post-construction observations indicate a decline in adult Hine's emerald dragonfly activity beneath the bridge. Adults were frequently seen approaching the bridge, then abruptly increasing their flight height to cross at deck level, often near the height of traffic, while avoiding the area below. In a study by Soluk et al., of eleven potential Hine's emerald dragonflies observed, three flew directly over the bridge, none passed underneath, and the remaining individuals did not attempt to cross at all.



Therefore, the project is taking place at the hines emerald dragonfly's most genetically diverse remaining habitat in northeastern Illinois.

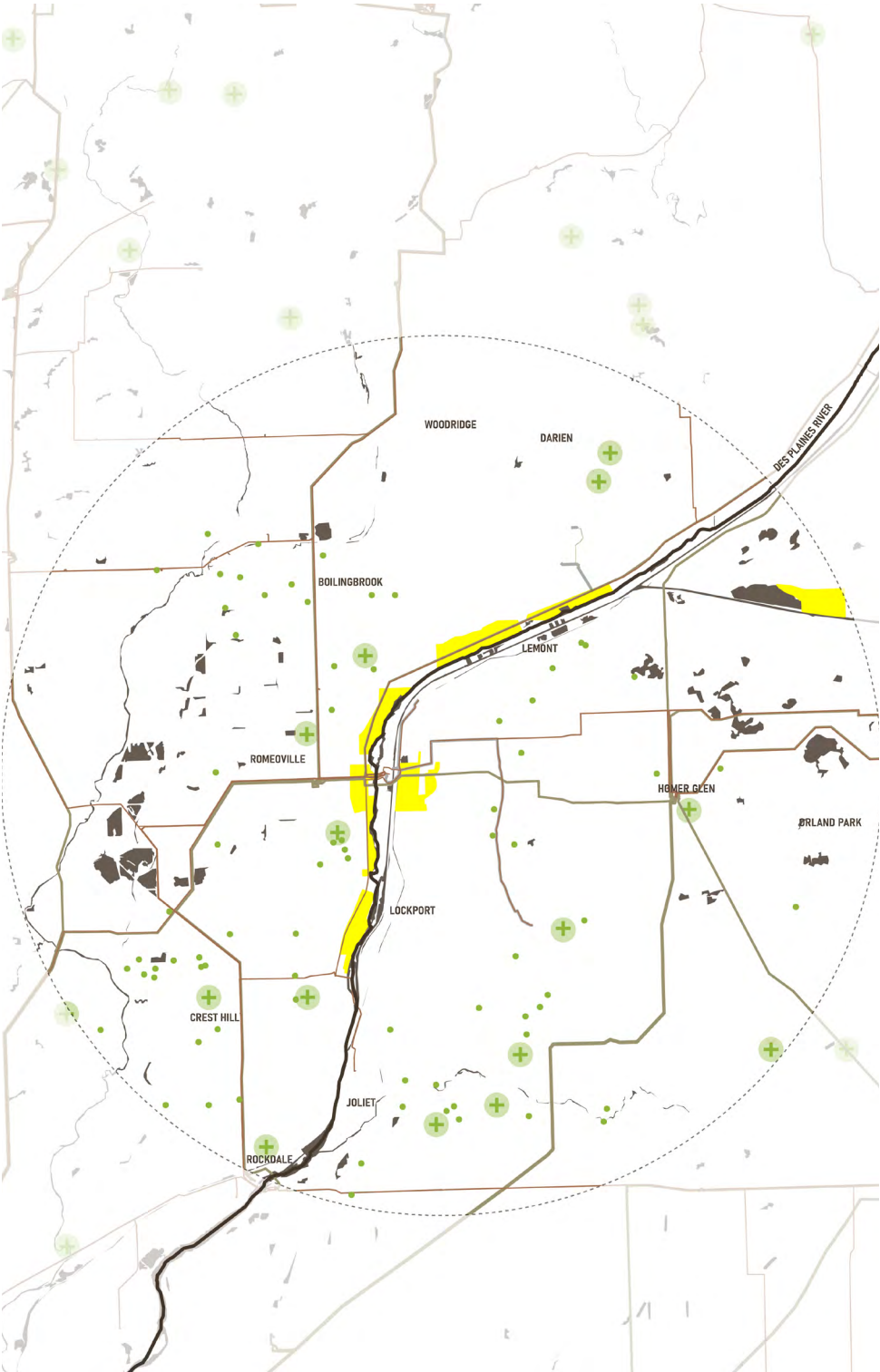


The Des Plaines River flows southward for 133 miles (214 km) through southern Wisconsin and northern Illinois, eventually joining the Kankakee River west of Channahon to form the Illinois River—a major tributary of the Mississippi. Alongside the unique underlying bedrock aquifer, the Des Plaines River corridor supports several designated critical habitats for the Hine's emerald dragonfly.

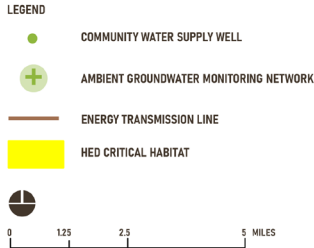
CRITICAL HABITAT FOR HINE'S EMERALD DRAGONFLY



By rethinking single-purpose infrastructure—specifically groundwater supply wells, which are directly linked to the groundwater crisis, and transmission corridors, which intersect wildlife pathways—the design proposes a three-part framework: points, lines, and field.



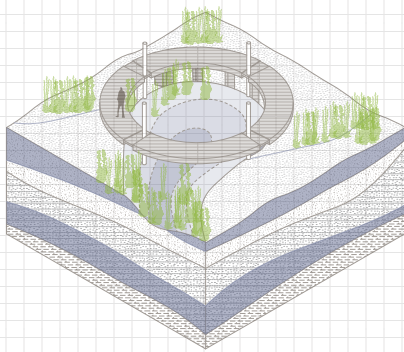
INFRASTRUCTURE SYSTEM



Design Framework

POINT

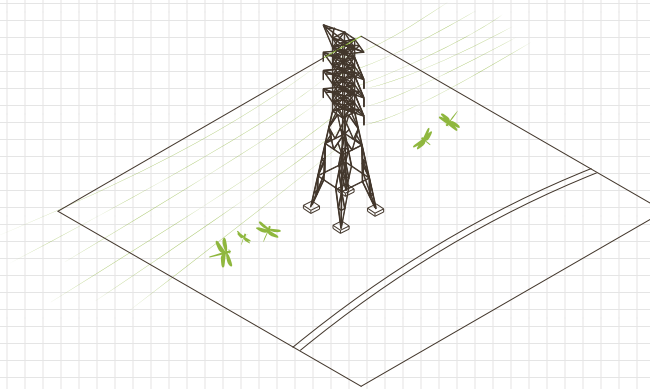
WATER WELL



LARVAL STAGE

LINE

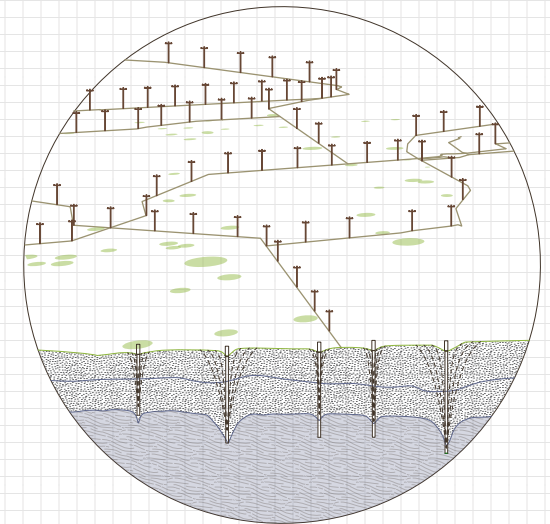
TRANSMISSION LINE



ADULT STAGE

FIELD

URBAN FRAMEWORK



THE ECOSYSTEM

Design Framework

Using the existing critical habitat as a foundation, the project increases larval habitat around water well sites and enhances the transmission corridor as a flight path, together forming a multi-scalar urban system. Ultimately, the return of Hine's emerald dragonfly would signify a restored, resilient ecosystem.



Existing critical habitats

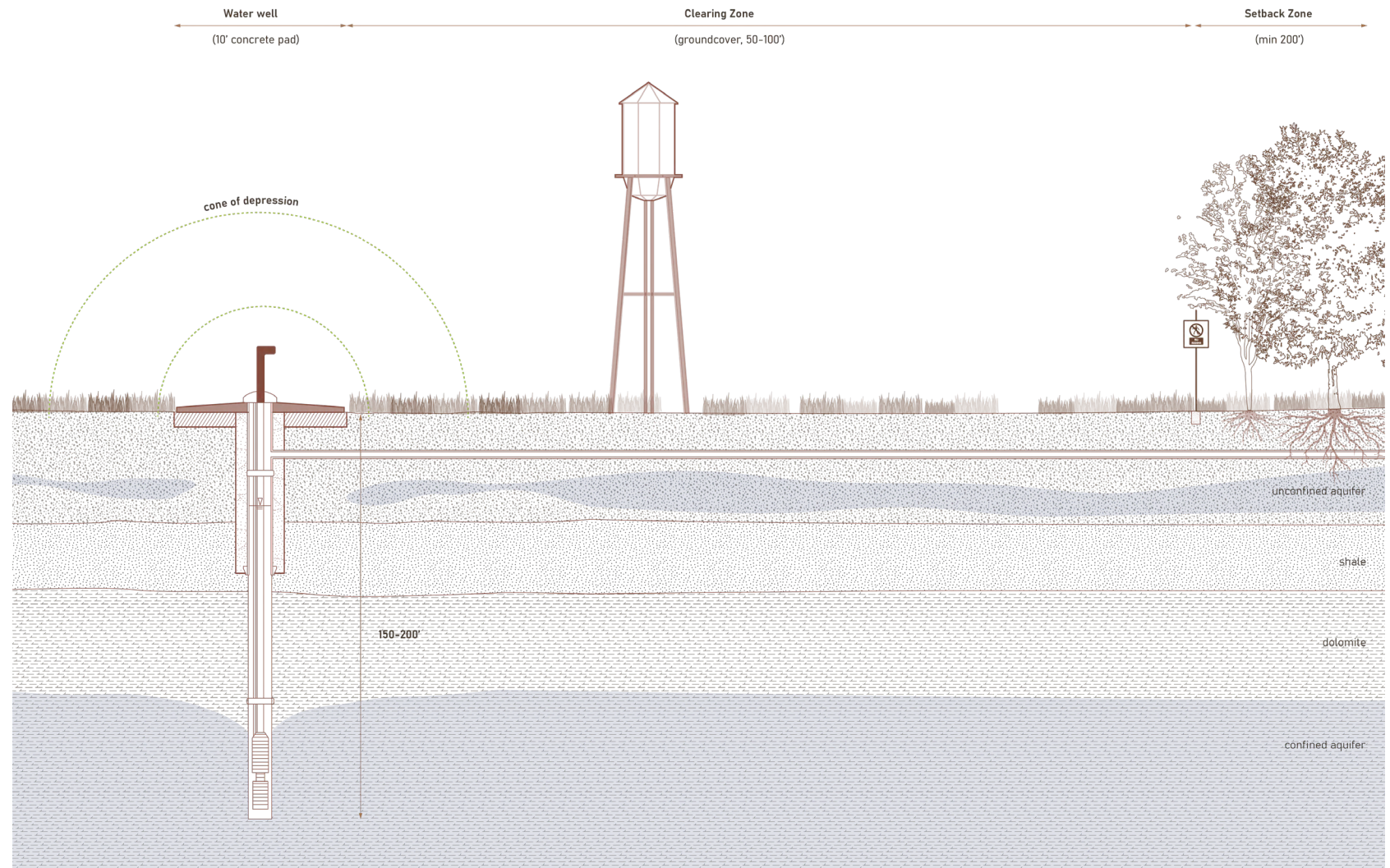


Groundwater well sites



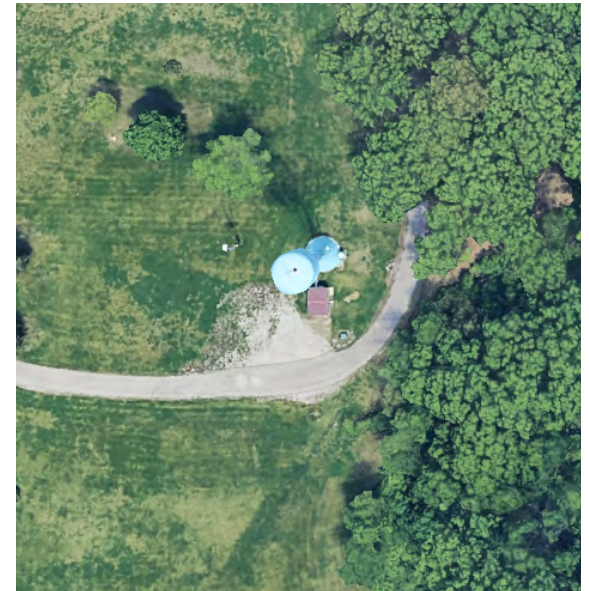
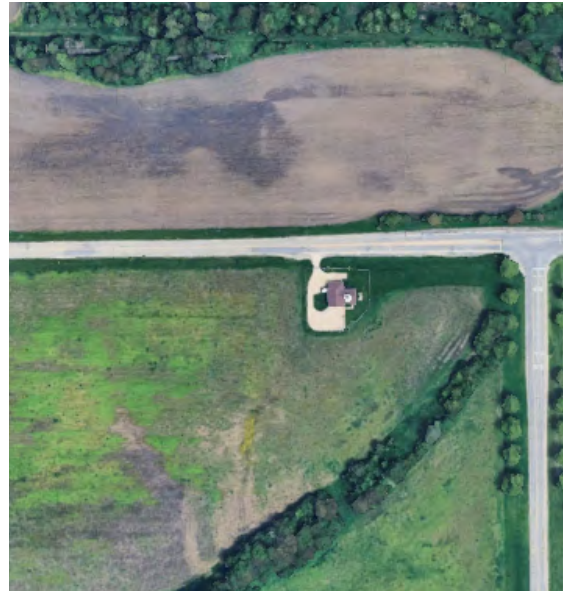
Transmission line corridors

Point: Water Well

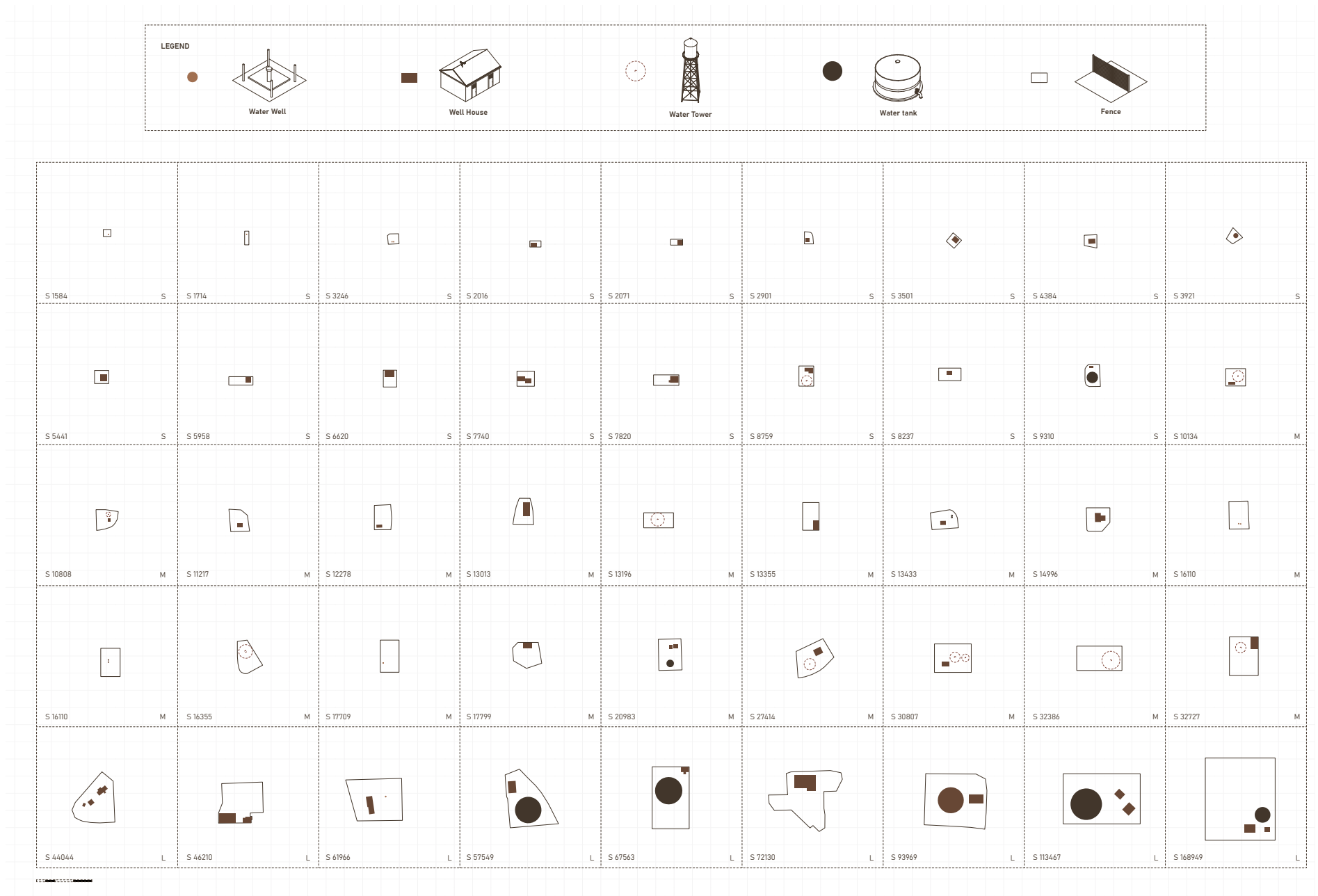


Typical water well site easement area

The design begins at the point scale, focusing on water well sites. Typically located on individual lots ranging from 50 to 100 feet in cleared easement, these sites contain varying infrastructure—from a single wellhead to monitoring houses, water towers, and large storage tanks. As the region faces groundwater depletion by 2030, many wells are slated for decommissioning—sealed off and fenced to prohibit public access. This project reconsiders their afterlives.



Existing groundwater well sites in the area , Google Earth

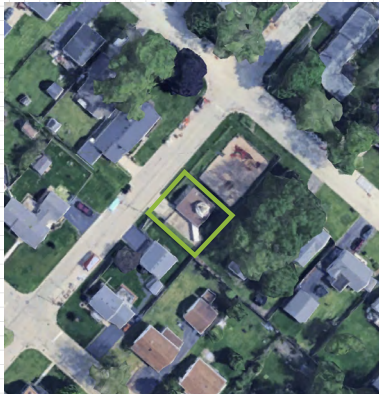


Catalog of the existing water well sites

SMALL



S 3501



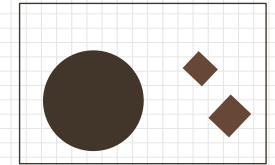
MEDIUM



S 8759



LARGE



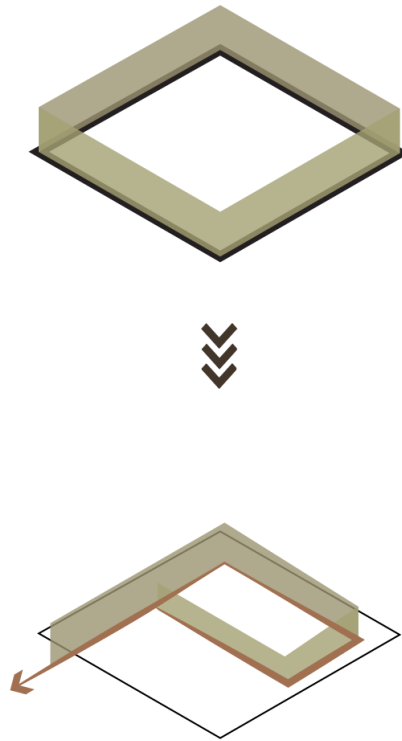
S 113467



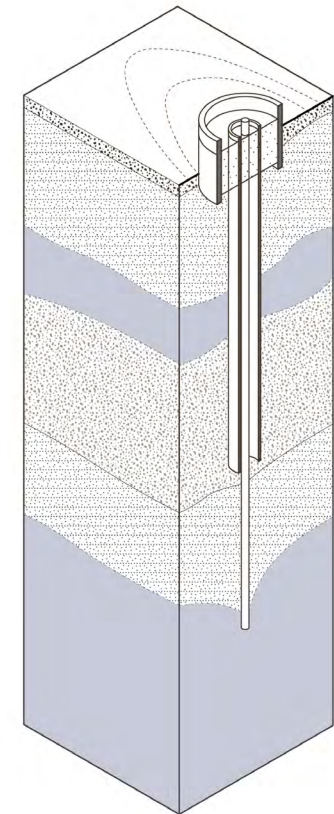
3 typologies of the existing water wells

Based on size and structure, three prototypical site types are identified:

- Small sites with a standalone water well
- Medium sites that include a water tower and monitoring house
- Large sites incorporating a water tank and expanded infrastructure

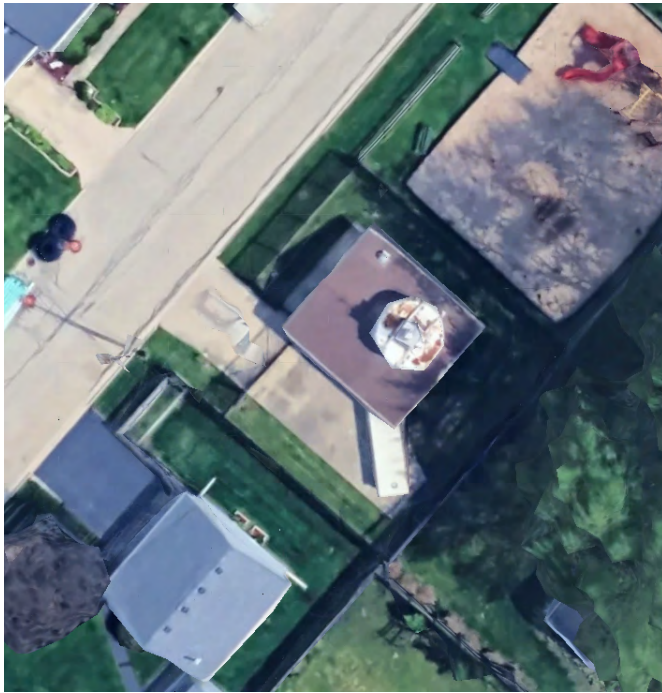


Invert the fence



Invert the well

All are currently fenced off, but the project asks: Why not invert the fence inward—to guide rather than exclude human presence—while protecting and restoring delicate ecosystems? In doing so, the well becomes a recharge site rather than a point of extraction.

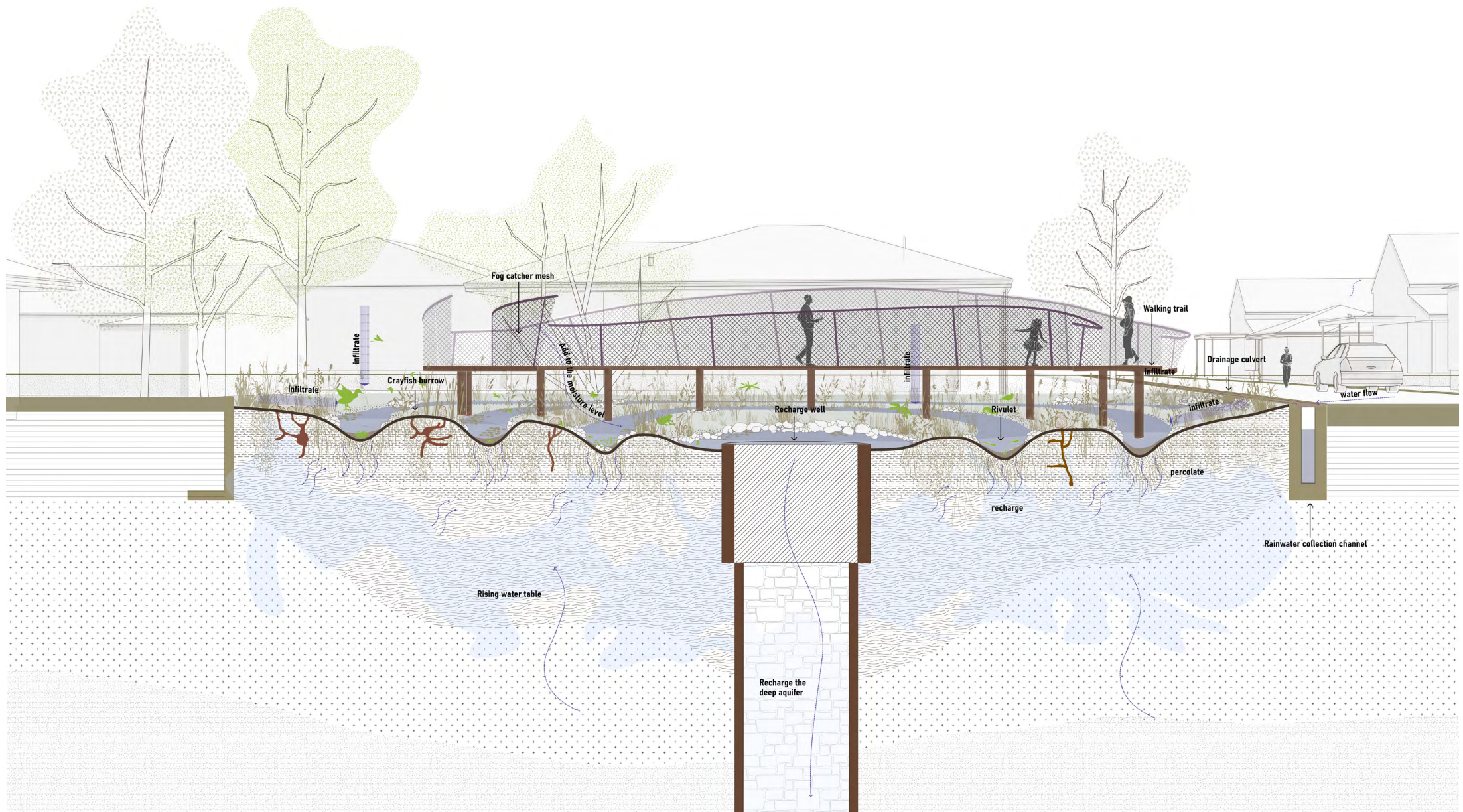


Existing condition of the small site



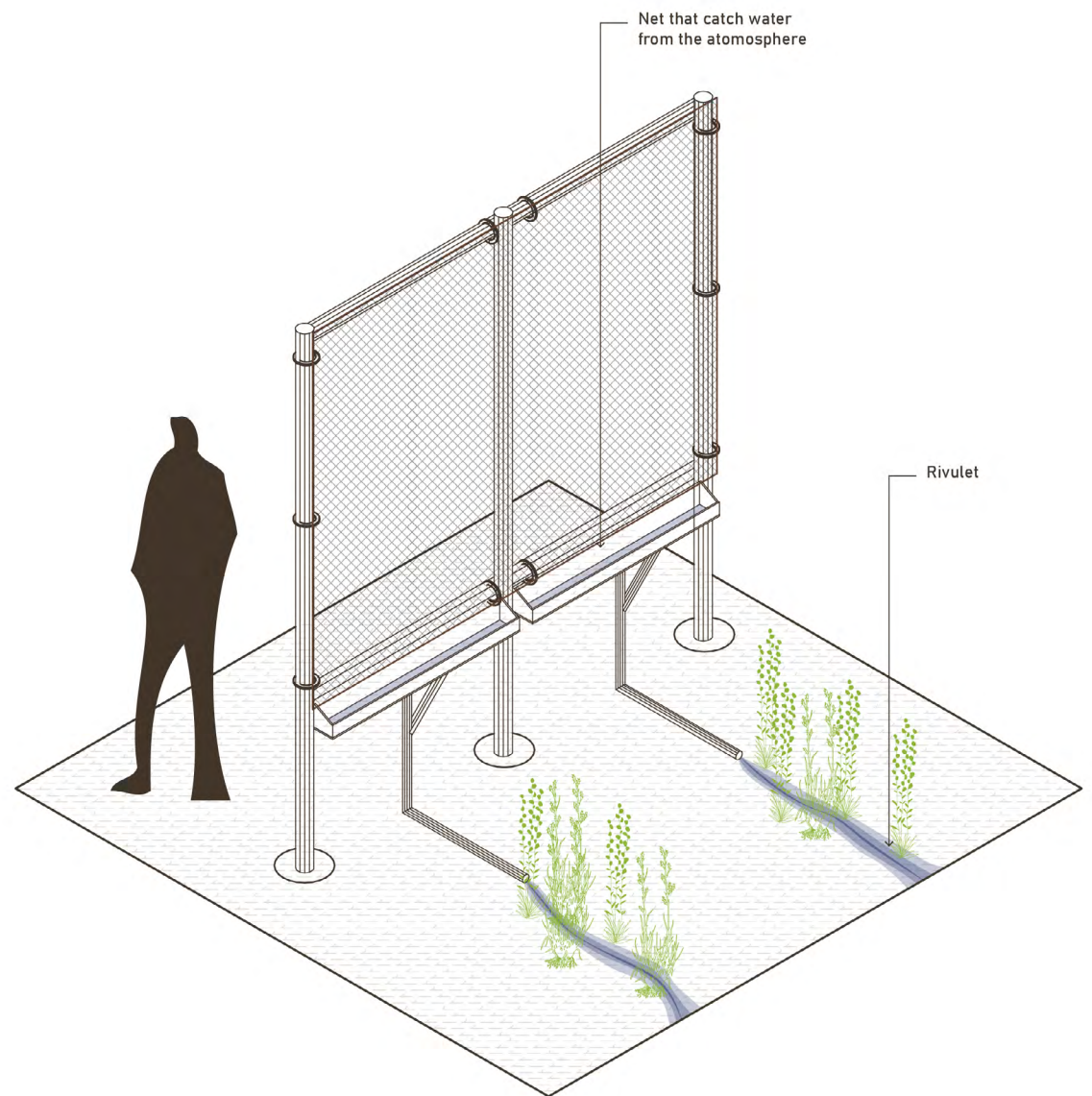
Small Site – Site Plan

At this small site, stormwater from surrounding streets is collected and redirected onto the lot, ultimately flowing into a recharge well.



Small Site – Site Section

Through subtle grading and microtopographic interventions, the water is slowed, infiltrated, and directed into a recharging well. The resulting shallow, slow-moving rivulets are critical for the larval stage of the Hine's emerald dragonfly. DeWvil crayfish are introduced to cohabitate, while carefully selected plants support percolation and stabilize the moisture balance.



Fences also trap and retain humidity

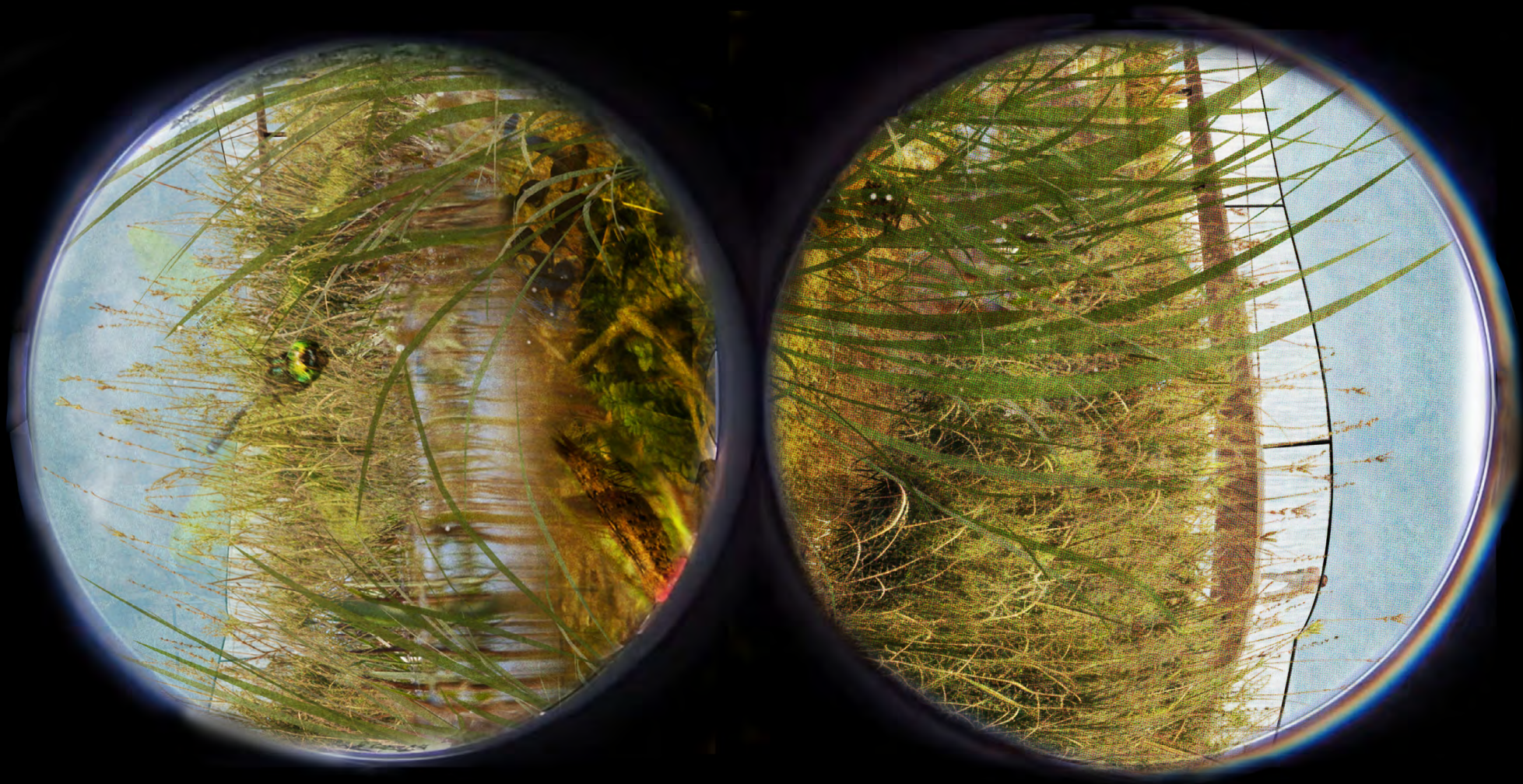
The fence transforms into more than a barrier—it acts as a humidity catcher, helping retain moisture during increasingly frequent droughts.



In summer, neighborhood children might walk along the trail and peer through the mesh to glimpse the microhabitat within.



For the dragonfly—its 360-degree vision surveying a rivulet teeming with life—the site becomes a complete world, where human traces recede into the periphery. One can imagine a baby dragonfly poised on the water's surface, preying on tiny insects in the glow of filtered light.



Dragonfly larvae rest in the rivulet
within the redesigned water well
site, quietly preying on passing food.

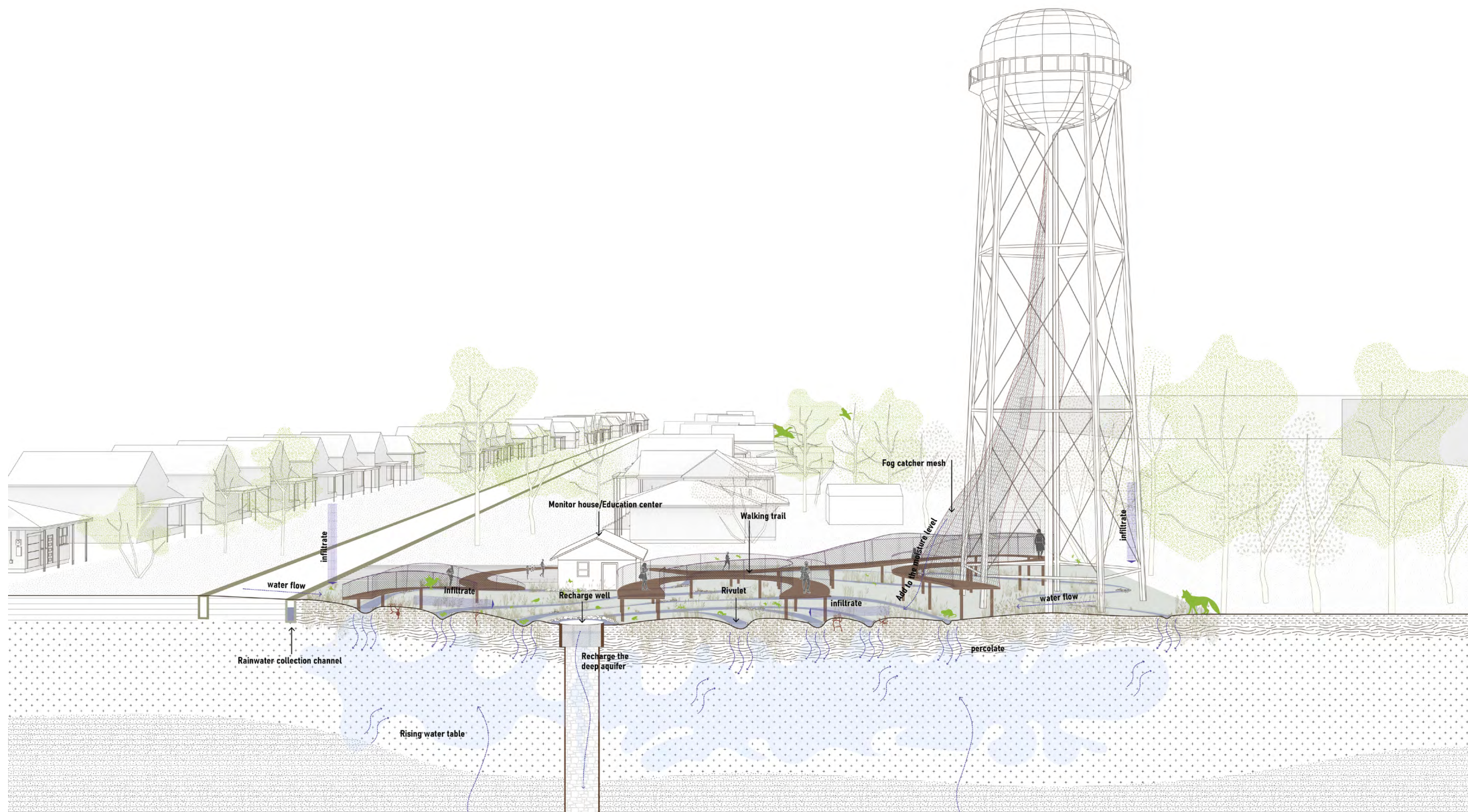




Existing condition of the medium site



Medium Site – Site Plan

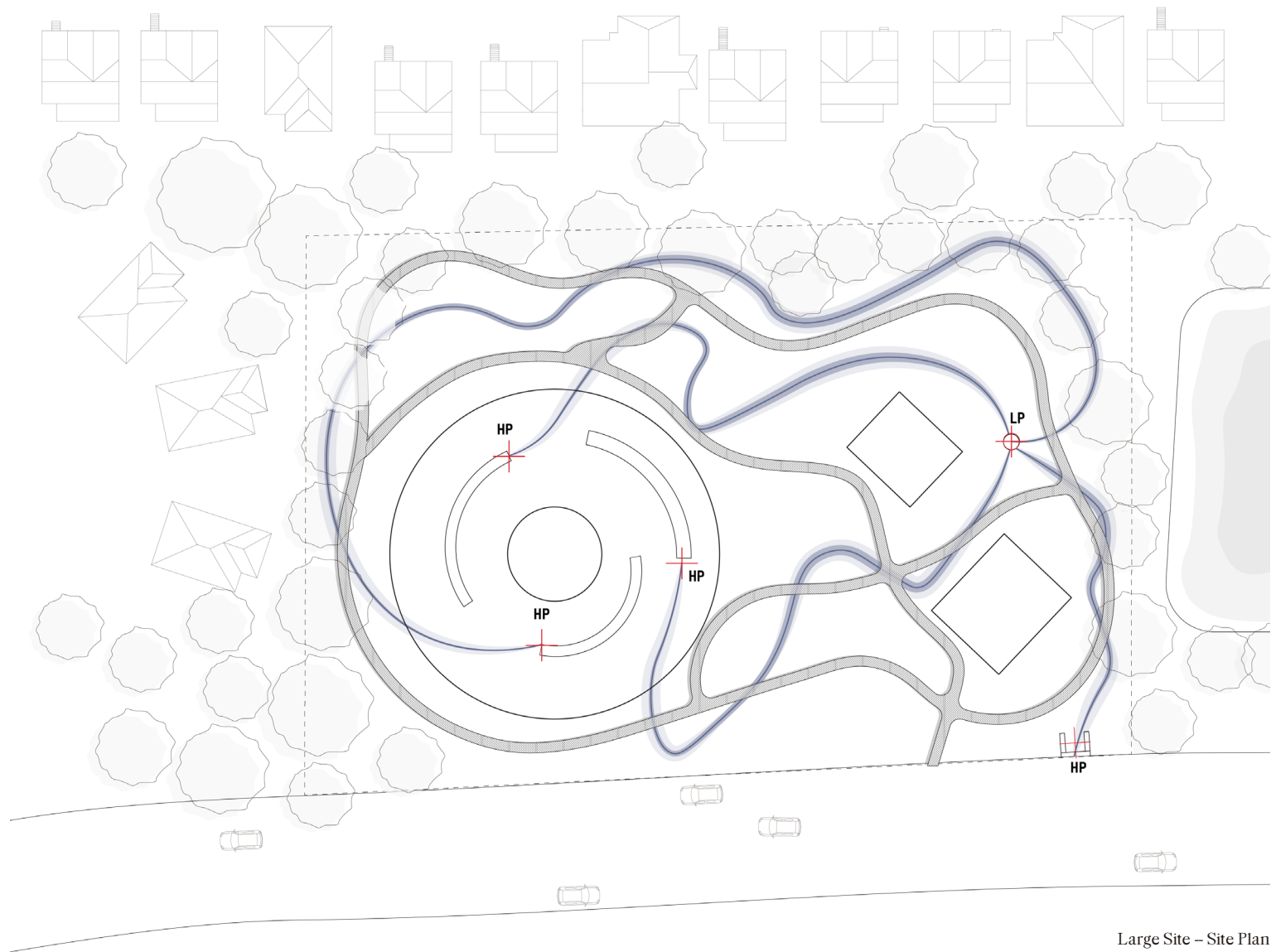


Medium Site – Site Section

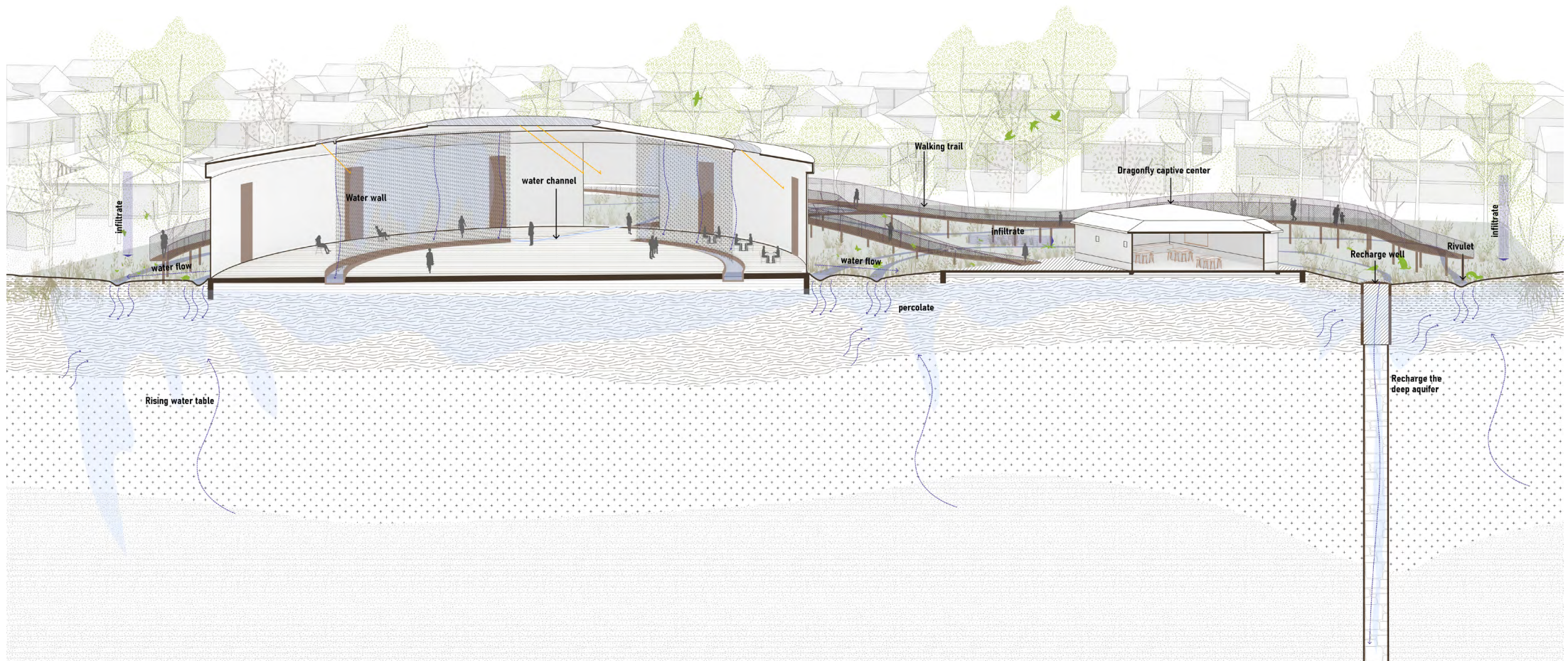
In the medium site, the water tower is reimagined as a passive water collector. A long draping mesh attached to its structure channels condensation and rainwater into the restored ground. The monitoring house retains its original utility but is augmented with ecological education elements, providing interpretation of the species and systems it now supports.



Existing condition of the large site

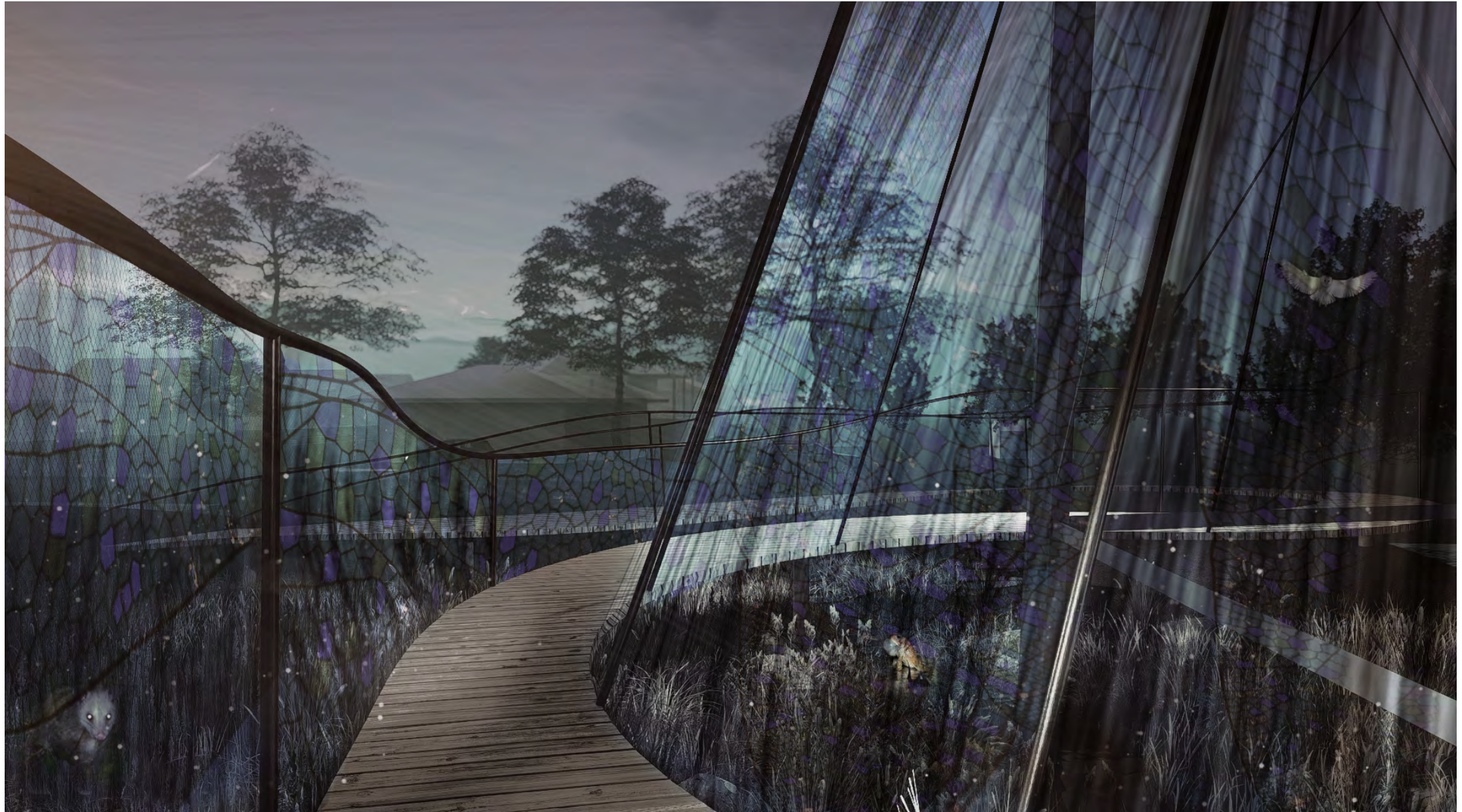


Large Site – Site Plan

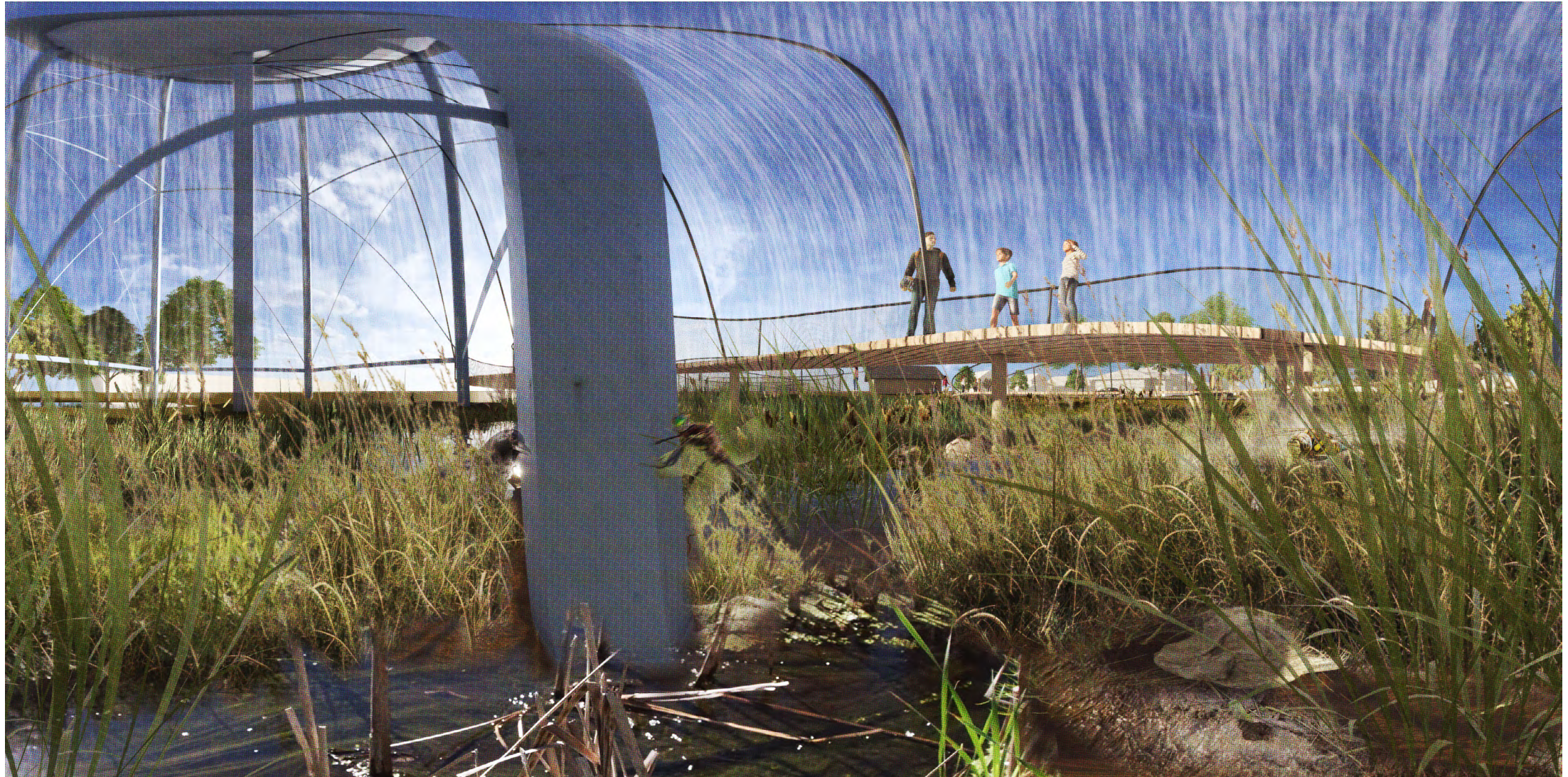


The large site transforms the water tank into an indoor water incubator. Openings are cut into the roof, allowing light and air to enter. Mesh “water walls” control moisture and provide habitat surfaces. Inside, the space becomes a hybrid between a public pavilion and an ecological museum, hosting community events that celebrate the area’s hydrology, biodiversity, and cultural history.

Large Site – Site Section



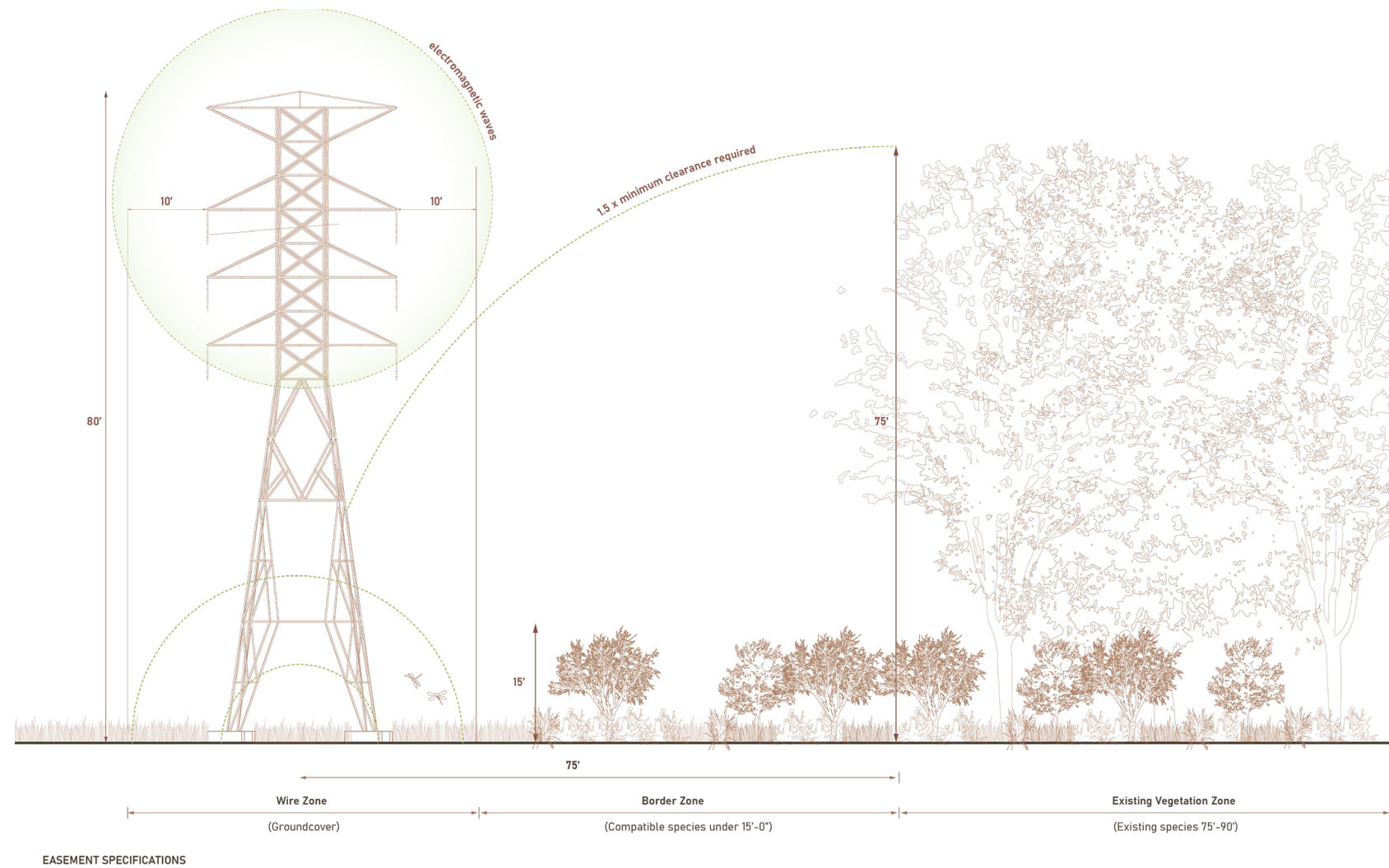
At night, the mesh glows with illuminated patterns inspired by dragonfly wings, embedding cultural identity into the landscape.



Dragonflies perch on the tower beams to molt, using the infrastructure as scaffolding for their transformation.

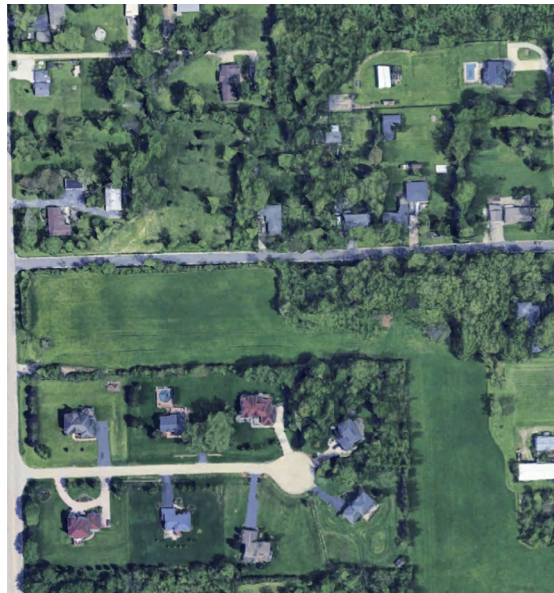
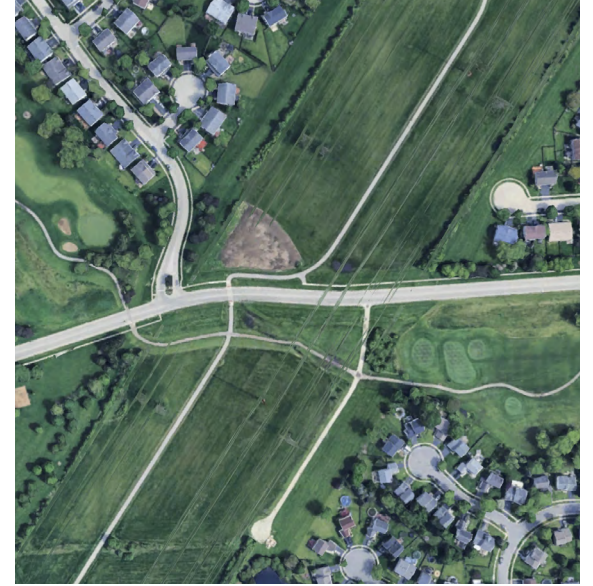


Line: Transmission Line

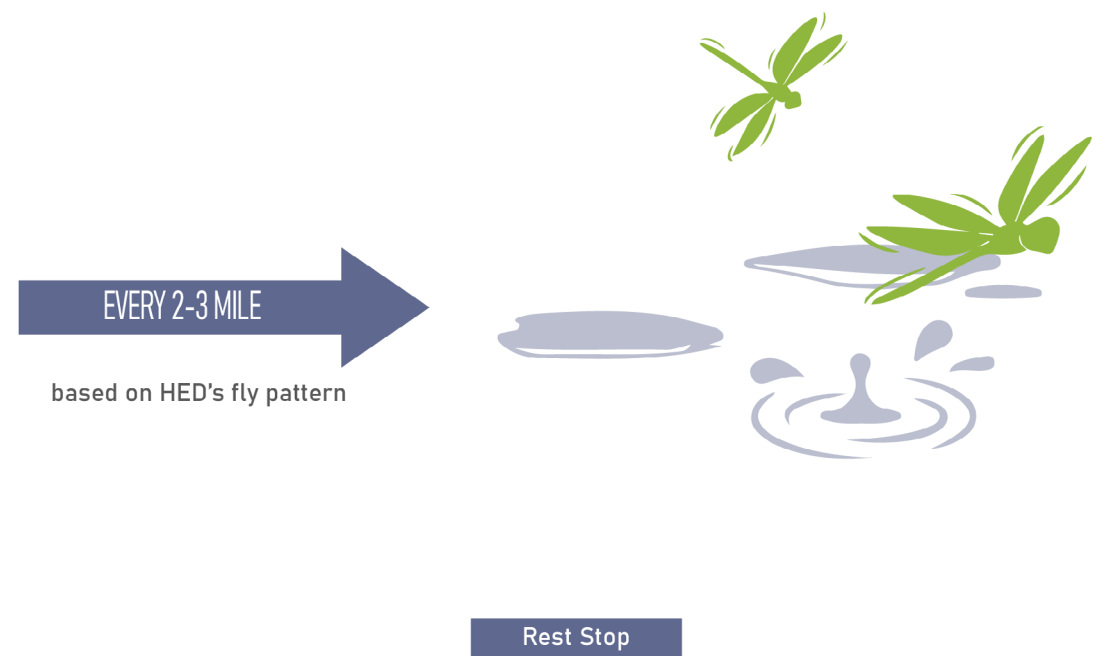


Typical transmission line corridor site easement area

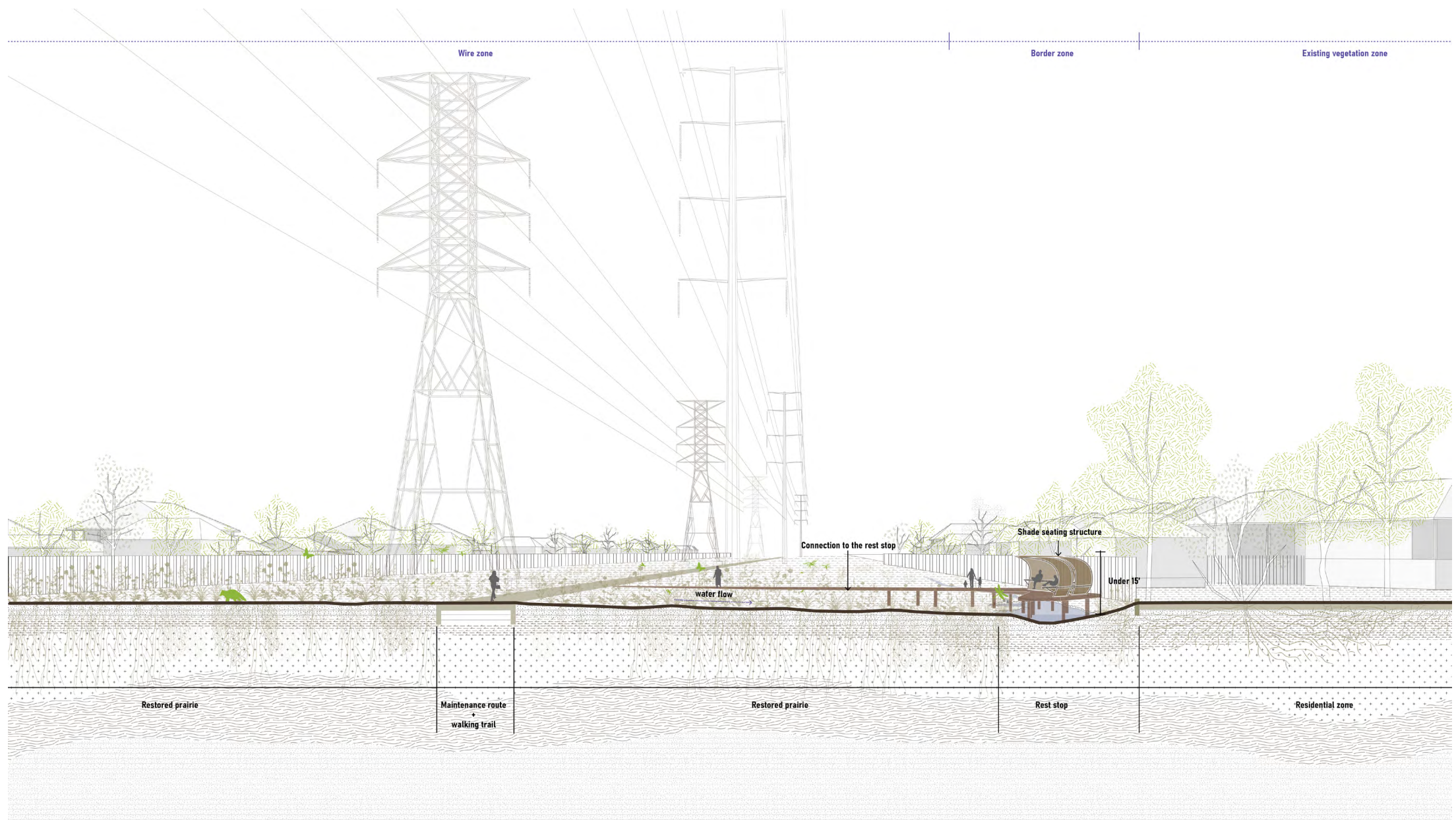
Electricity transmission corridors span over 9,000 miles of rights-of-way in Illinois, with widths ranging from 100 to 500 feet and strict vegetation height requirements for maintenance. According to a Hine's emerald dragonfly expert from the U.S. Fish and Wildlife Service, recent observations show that the adult dragonfly actually prefers flying along these corridors due to their openness. The species actively avoids shade during flight, making transmission lines an unlikely but ideal habitat axis.



Existing transmission line corridor in the area , Google Earth

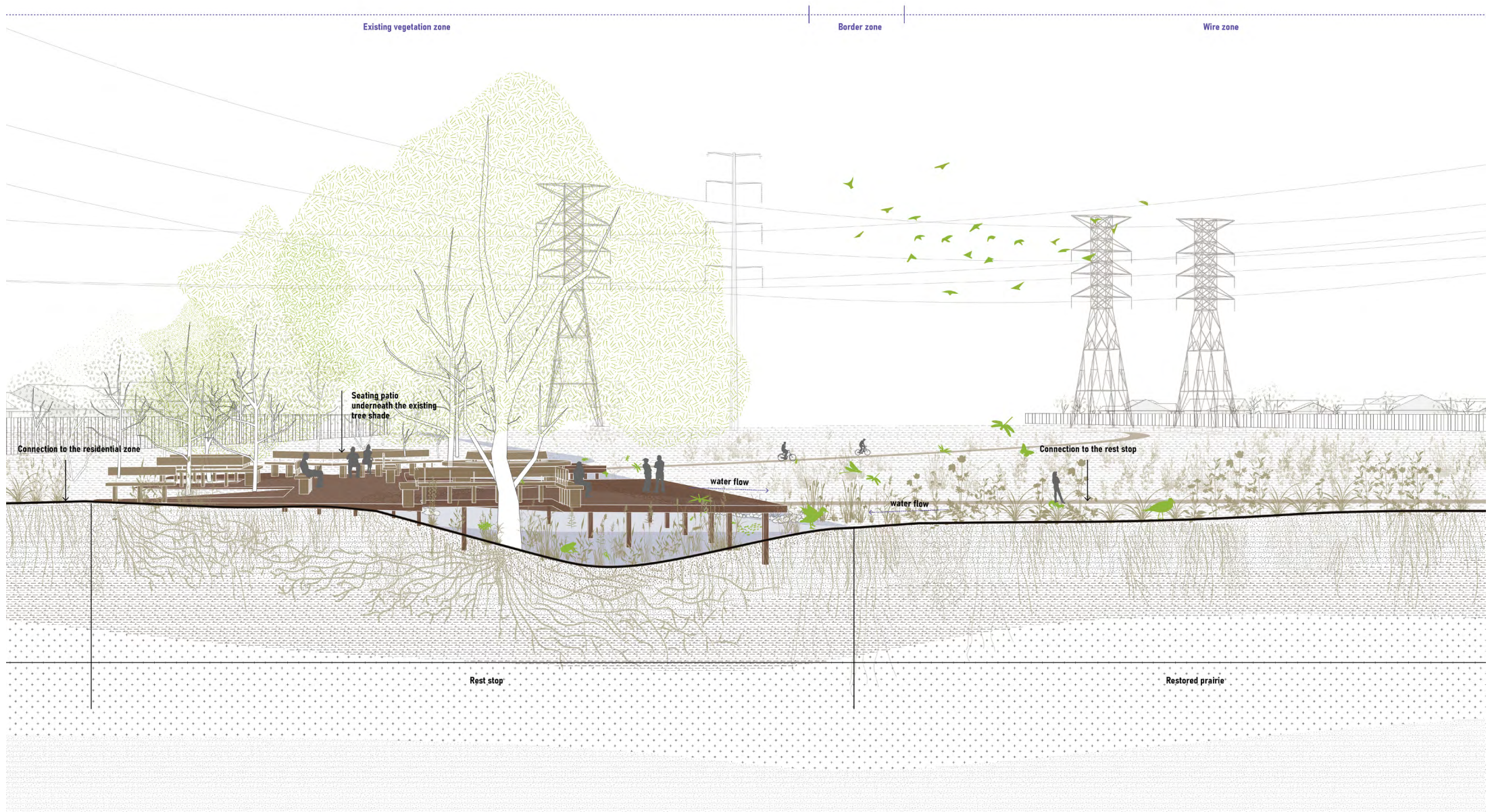


Dragonflies are highly sensitive to heat and risk overheating during extended flight. In natural settings, they cool themselves by perching at forest edges or dipping their wings into water. Inspired by this behavior, the design proposes installing rest stops every 2–3 miles, based on existing transmission infrastructure and clearance regulations.



Located at the edge of the right-of-way, this first type of rest stop diverts surface water into a bioswale, creating shallow, slow-moving water bodies where dragonflies can cool down. The existing maintenance road is opened to the public as a walking trail, connecting to a shaded seating pavilion situated just above the bioswale. The structure adheres to the maximum 15-foot height limit set by utility regulations. Beneath the towers, native prairie vegetation is restored to support biodiversity and provide food sources for the dragonflies.

Rest Stop 1 - Site Section



Rest Stop 2 - Site Section

In areas where transmission corridors intersect with remnant woodland or tree groves, rest stops use existing shade to their advantage. By redirecting water to form a biobasin and installing a small patio, the space becomes both a cooling site for dragonflies and a gathering space for people.



As visitors walk the trail, they may see a dragonfly flying alongside them, its emerald eyes glinting in the sun. A net structure inspired by dragonfly wing patterns serves as a wayfinding marker—and a cultural signature.



Look closely at the water, and you might catch a dragonfly performing its dunk-and-spin maneuver to regulate its body temperature.

An adult dragonfly performs its
dunk-and-spin maneuver to
regulate its body temperature
at the rest stop.



Fly at a height of 5.9 ft



Safe passage

Transmission corridors often intersect with roads and highways—zones of high risk for the Hine's emerald dragonfly, which typically flies at an average height of 5.9 feet. Road mortality remains a critical threat.



Fig. 2 Simulated 12 m wide roadway in a meadow at Toft Point State Natural Area in Door County, Wisconsin. The *lower photo* shows the diversion nets raised, and the *upper photo* shows diversion nets removed. The *arrows* indicate location of poles along simulated roadway edges. Height of diversion netting, length, and orientation of the roadway were the same as in Fig. 1

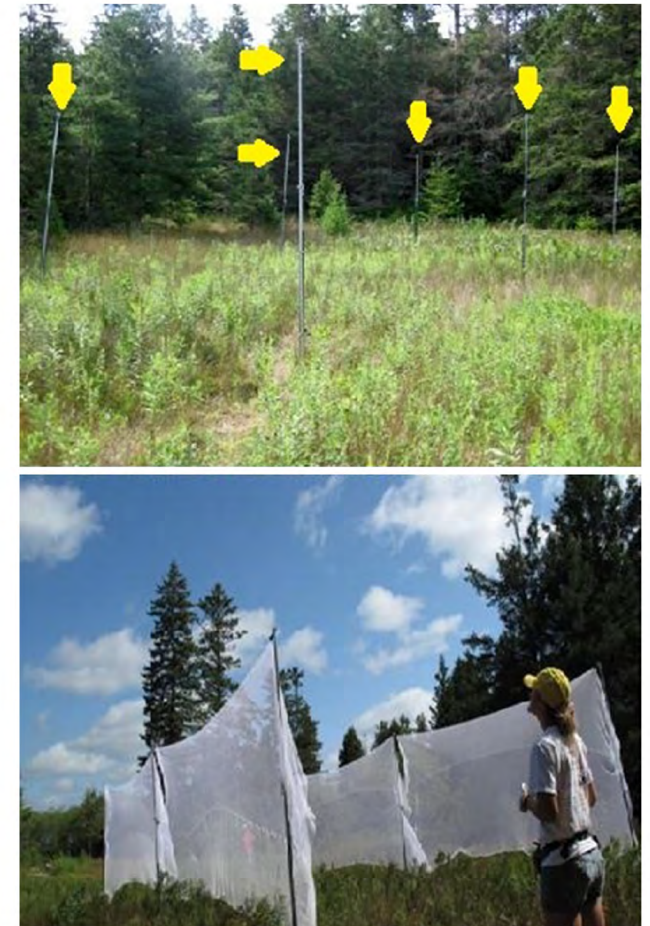
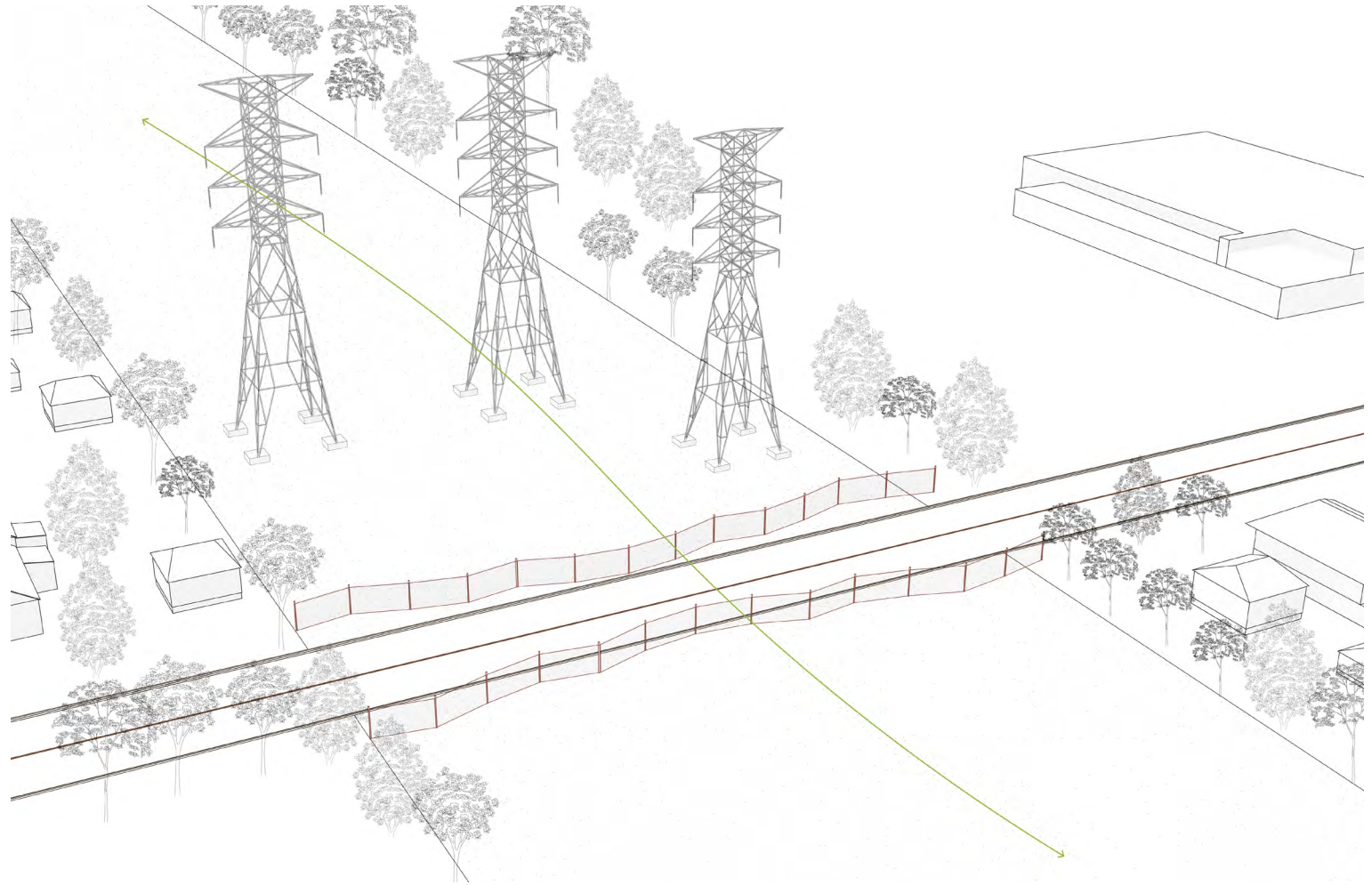


Fig. 1 Simulated 6 m wide roadway in a meadow at Toft Point State Natural Area in Door County, Wisconsin. The *lower photo* shows the 3 m high diversion nets raised, and the *upper photo* shows diversion nets removed. The *arrows* indicate location of poles along simulated roadway edges. The roadway was 20 m long and in a north to south orientation

The potential of diversion structures to reduce roadway mortality of the endangered Hine's emerald dragonfly 2015

Research has shown that diversion nets successfully guide dragonflies to fly above vehicular traffic, especially on narrower roads.



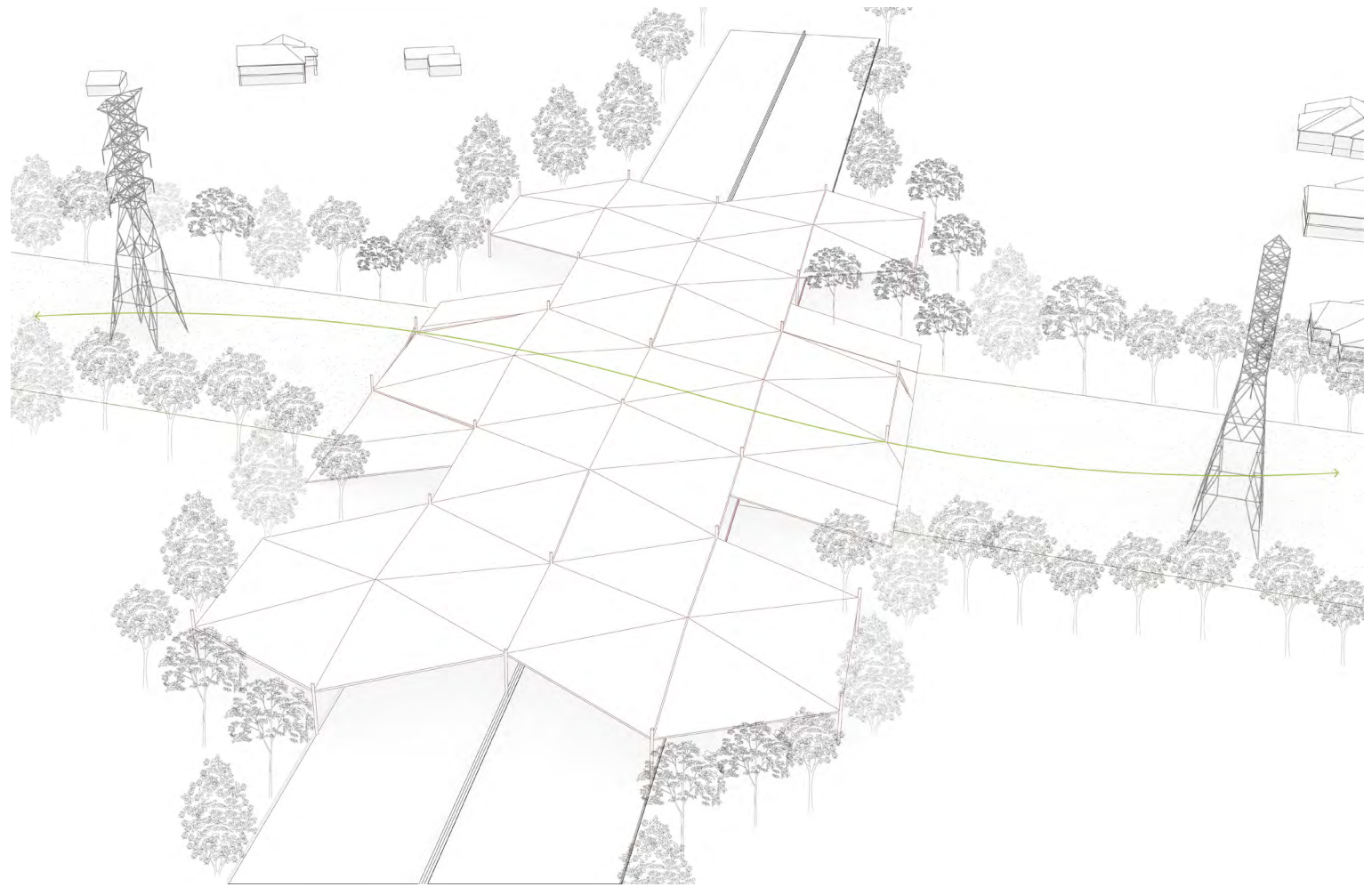
Crossing 1 – Site Plan



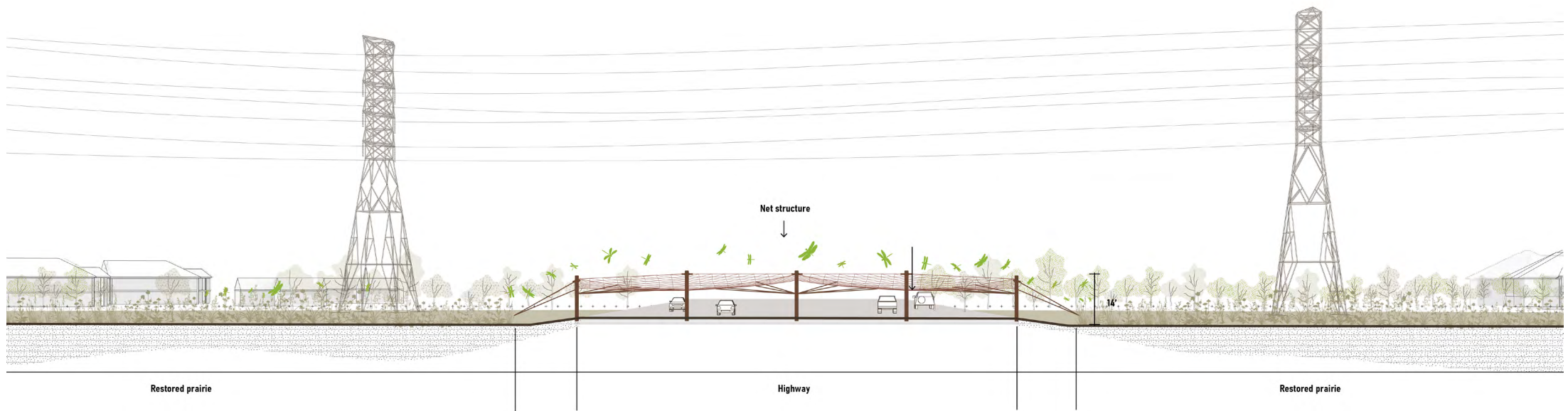
Crossing 1 – Site Section

This design adopts a zig-zag arrangement of netted structures across four-lane roads to create a flipbook effect as vehicles pass. The shifting frames depict dragonflies in flight, advocating for insect agency while functioning as visual speed cues.



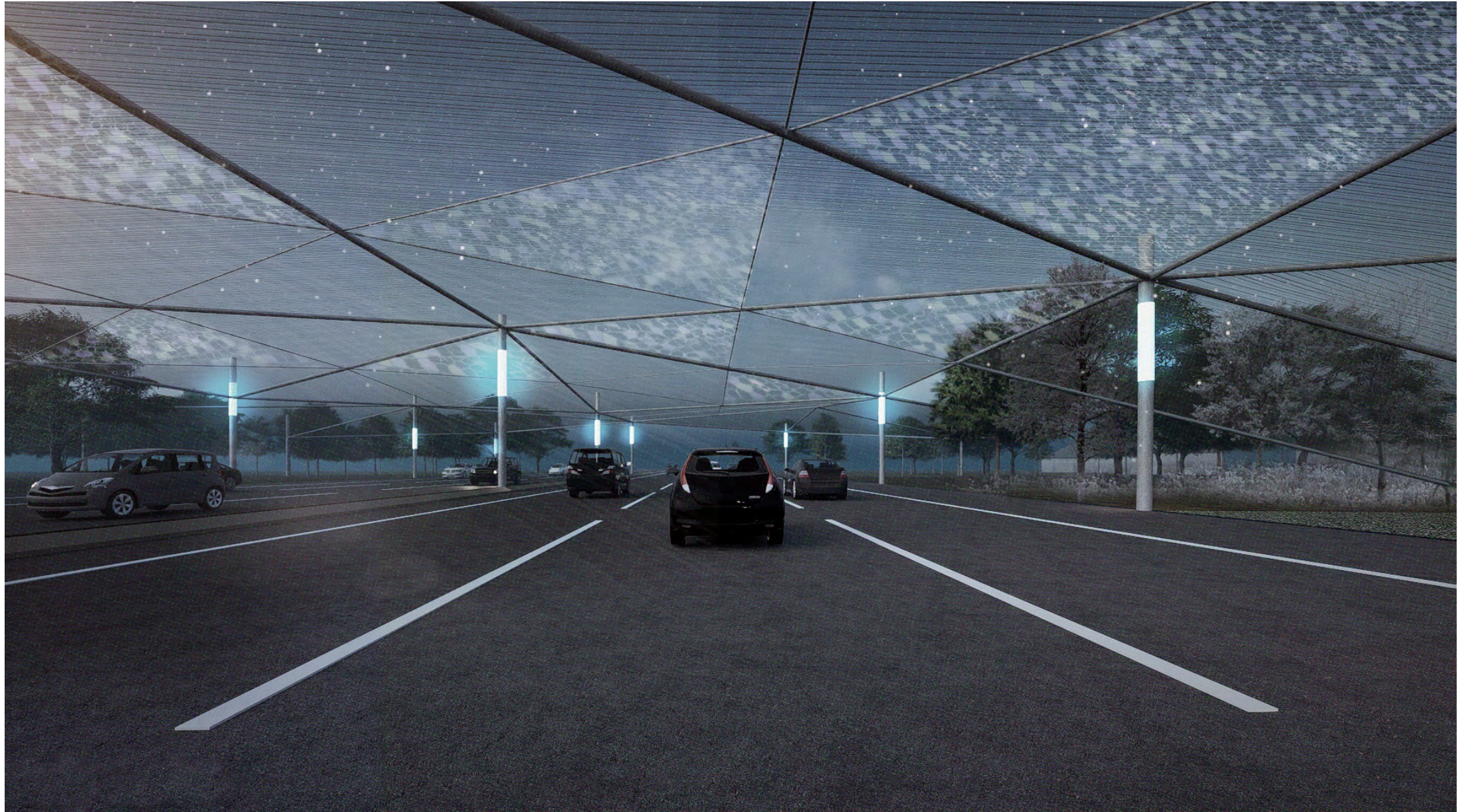


Crossing 2 – Site Plan

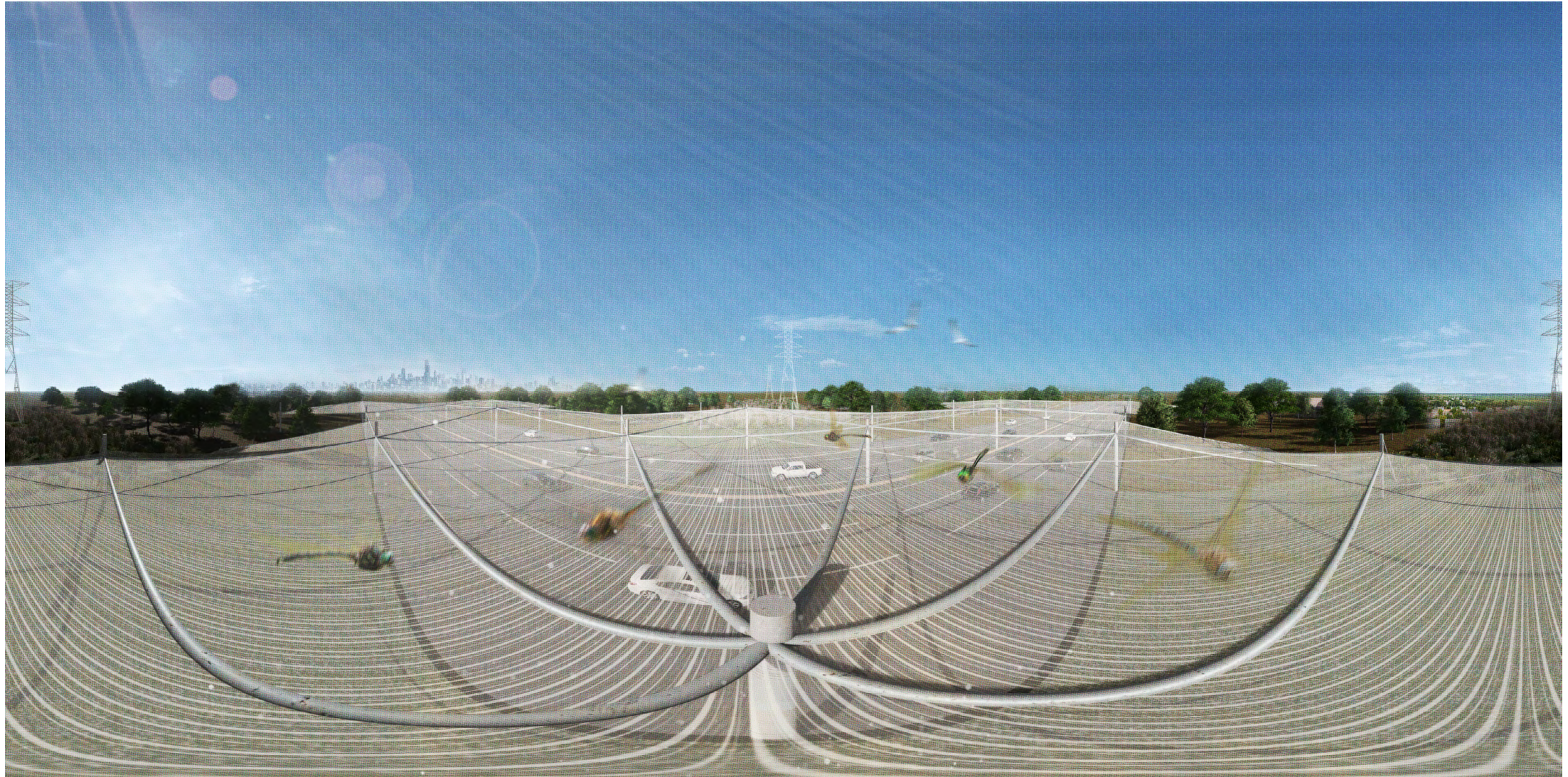


Crossing 2 – Site Section

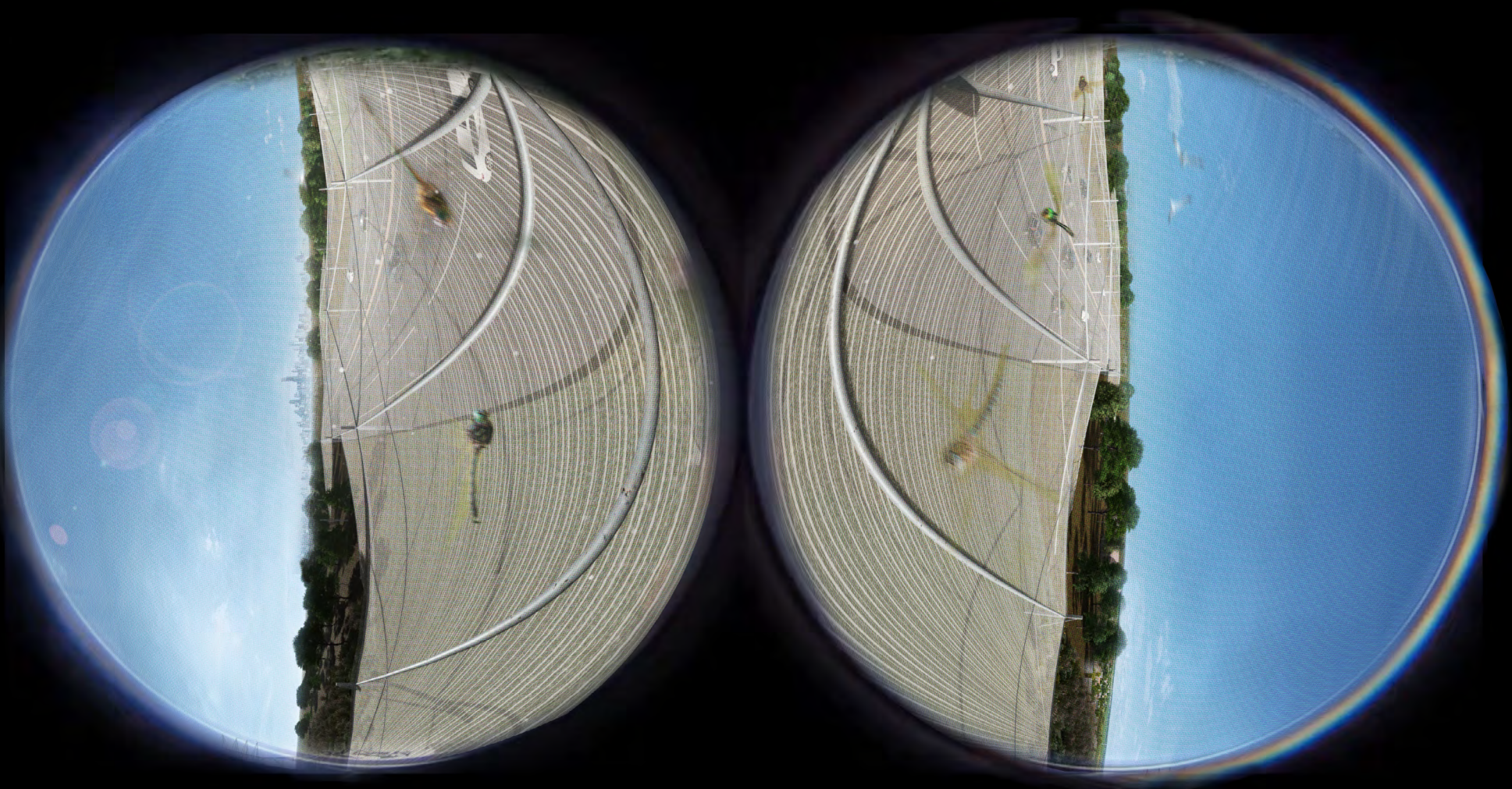
For major highways, where diversion nets are ineffective, the design borrows from anti-insect netting used in large-scale agriculture. A lightweight mesh canopy spans the roadway, encouraging dragonflies to ascend and sustain higher altitudes as they cross.



Since migration primarily occurs in June and July, this structure can serve dual purposes. Outside peak months, embedded light poles and portions of permanent netting contribute to a new visual identity for the region. For passing drivers, the illuminated mesh becomes a poetic landmark.



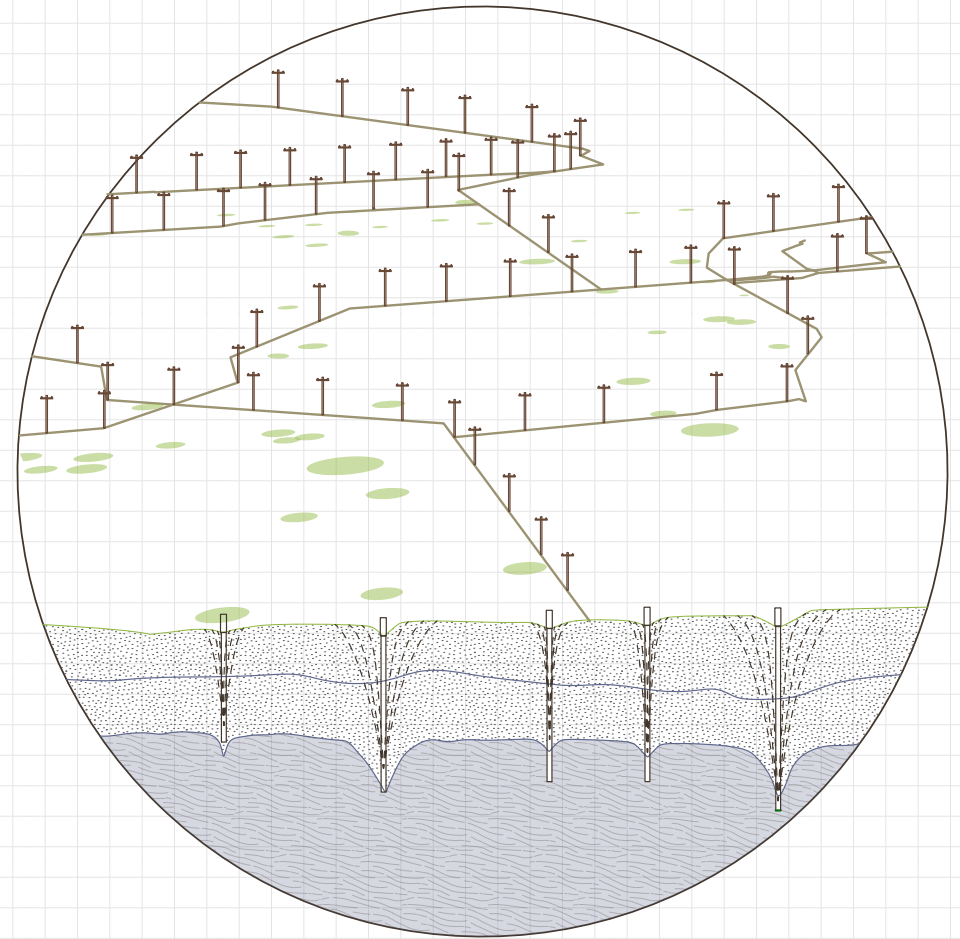
For the dragonfly, it becomes a safe, elevated highway.



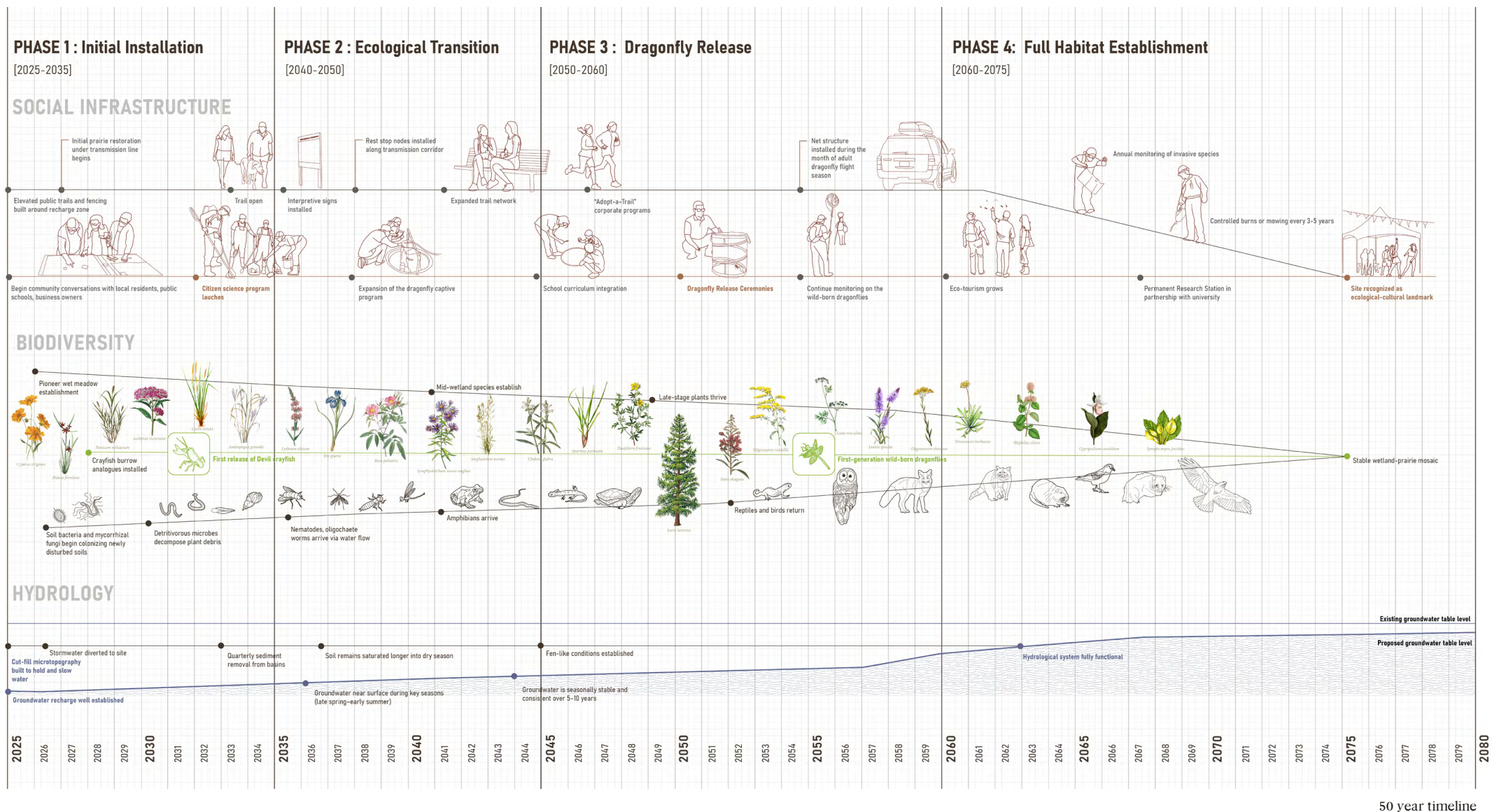
An adult dragonfly quickly shifts its flight direction and altitude as it approaches the net diversion structure.



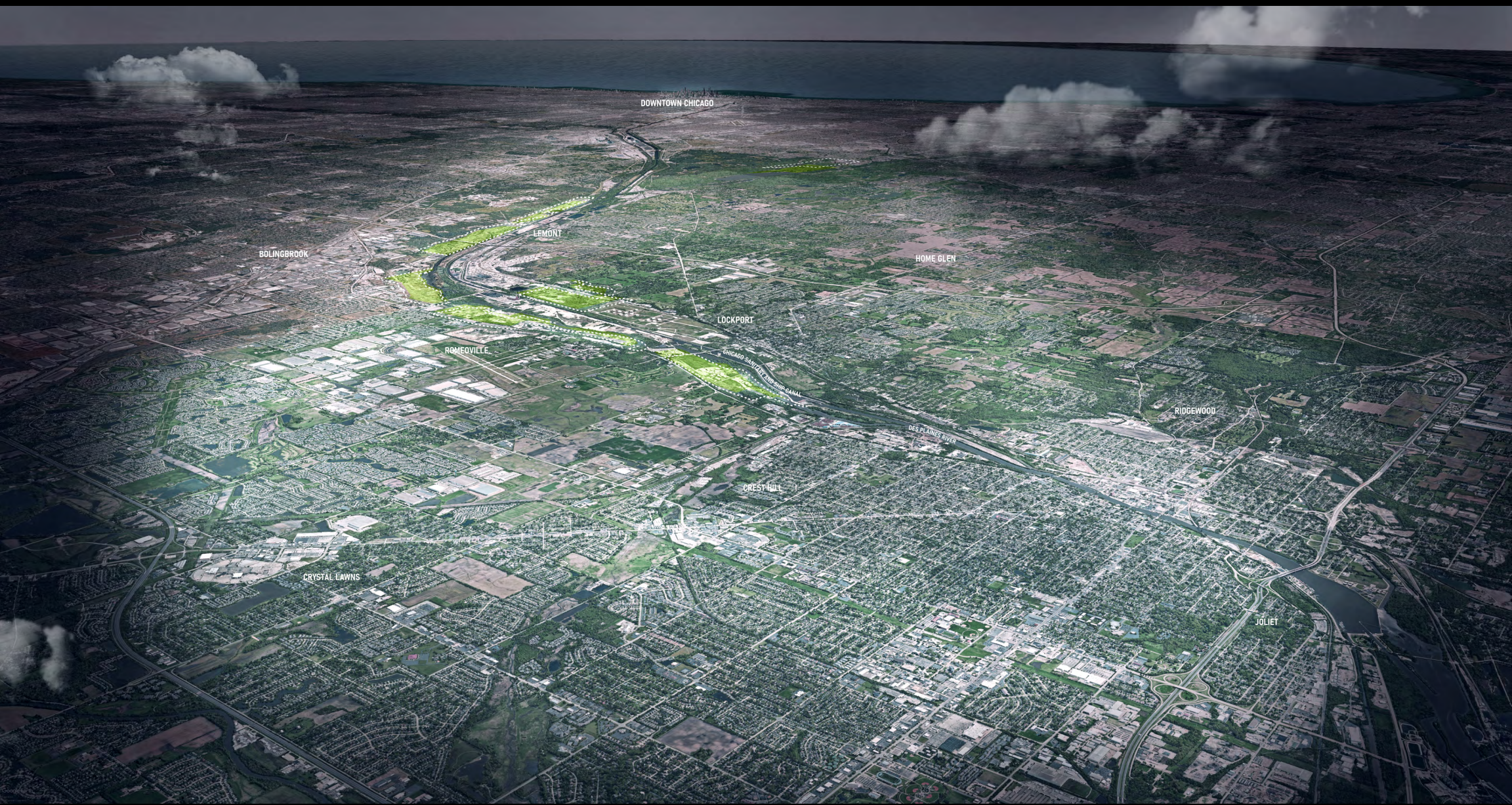
Field: Urban System



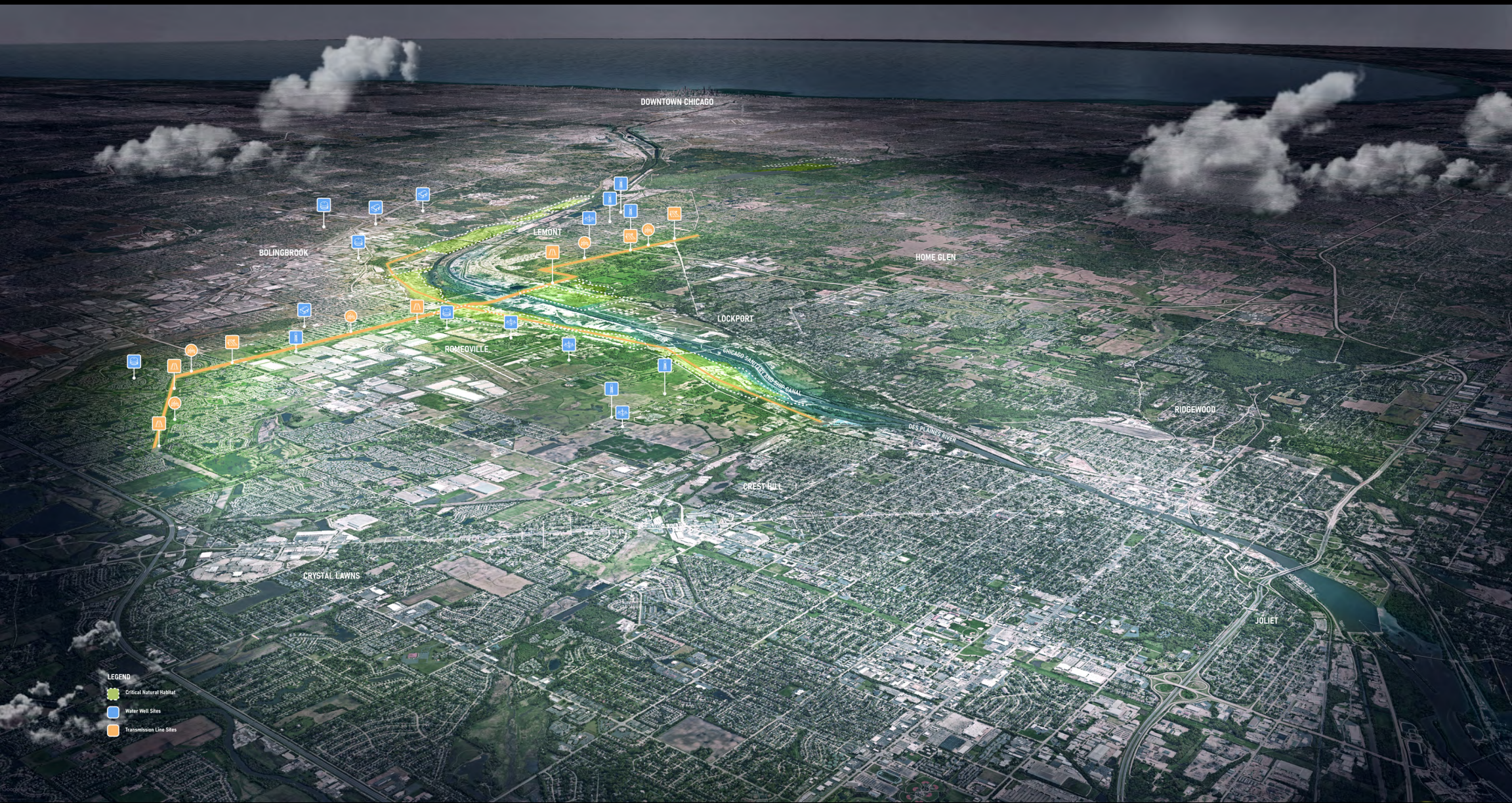
The last layer of the project is the field, brings together point and line into a larger urban ecological system.



This transformation won't happen overnight; instead, it unfolds through gradual adaptation, following the principles of ecological succession in both plant and animal communities, alongside the slow recharge of groundwater systems. Just as importantly, it relies on citizen participation to monitor, maintain, and care for these fragile but promising landscapes. With the growth of the community-based dragonfly captive program, dragonflies can be released into the sites once restoration is established and gradually becomes stable. Over time, more public spaces are added within reach of the community.



With the presence of pre-existing designated critical habitats, the Hine's emerald dragonfly has gradually begun to return to the landscape.



The process begins with the first stretch of transmission line and its adjacent water well sites, continuing to expand into surrounding areas.



Not all sites (as marked red) may successfully support dragonfly habitats, but they will still contribute to the long-term groundwater recharge of the region—an essential step toward restoring hydrological balance.



Through a network of citizen science initiatives and public engagement, the landscape evolves into one of coexistence. In time, the return of the Hine's emerald dragonfly becomes more than an ecological milestone—it marks the rebirth of a civic commons. Each summer, their swarming flight becomes a celebrated spectacle, signaling a restored balance between human infrastructure and the natural world.



At last, the Hine's emerald dragonfly can call this transformed suburbia home.