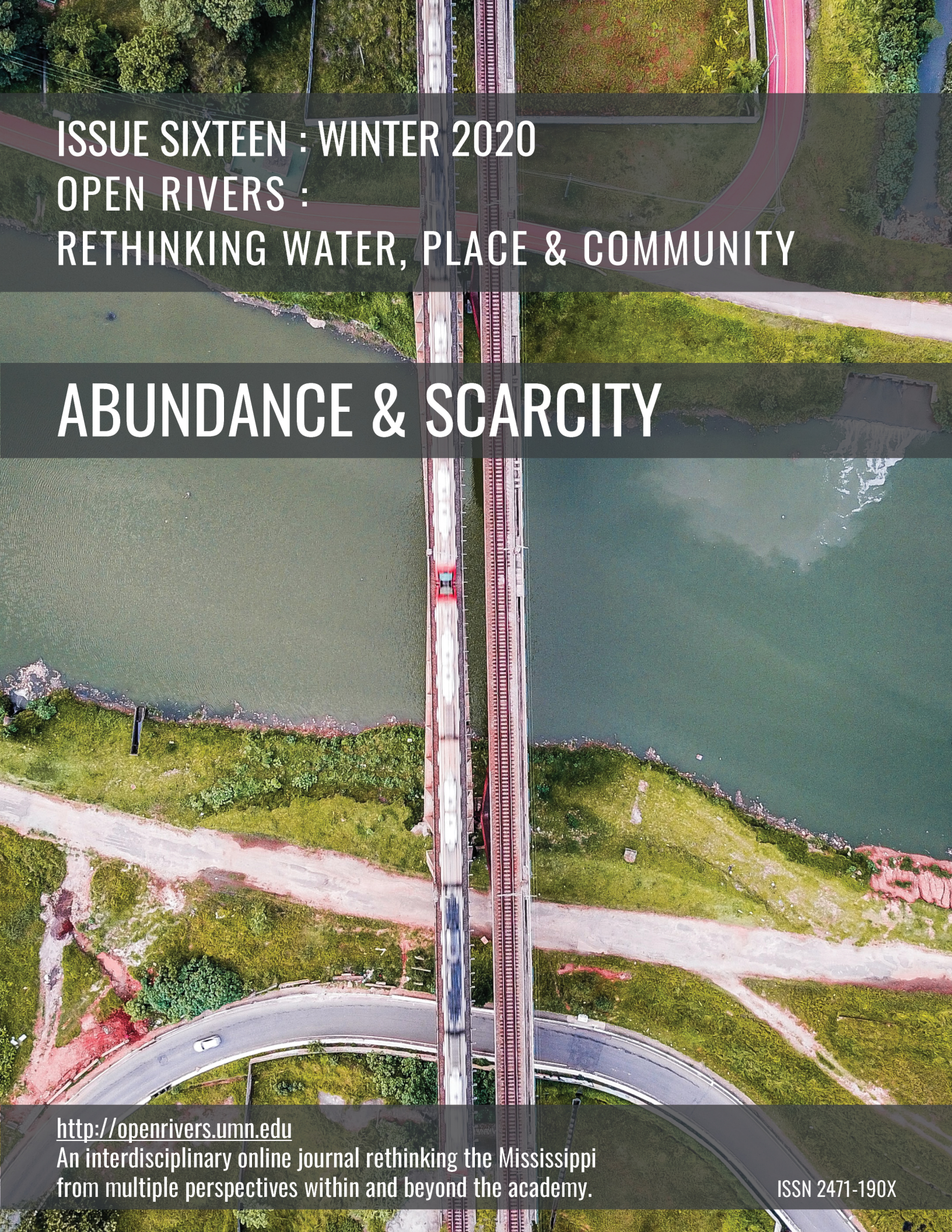

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Contact Us

Open Rivers
Institute for Advanced Study
University of Minnesota
Northrop
84 Church Street SE
Minneapolis, MN 55455

Telephone: (612) 626-5054
Fax: (612) 625-8583
E-mail: openrvrs@umn.edu
Web Site: http://openrivers.umn.edu

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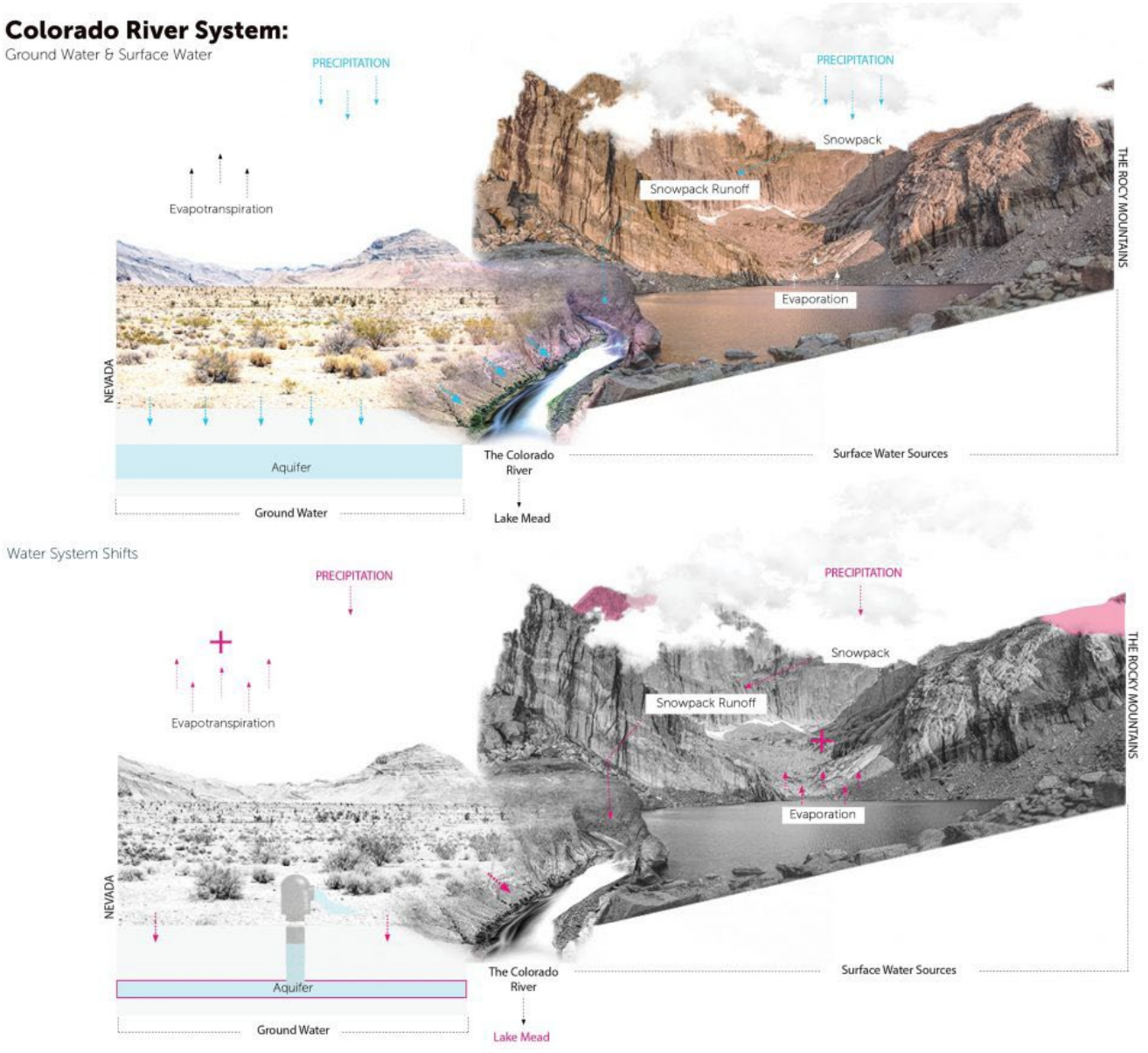
INVISIBLE INFRASTRUCTURE: DOCUMENTING THE HIDDEN FLOOD CONTROL INFRASTRUCTURE IN LAS VEGAS

By Jessica Rossi-Mastracci

Las Vegas. A city branded by sin, vice, and extravagance. A city where "anything goes," including gambling, the Strip, partying, strip clubs, and more recently, legal marijuana. Visitors rarely venture outside of the Strip, Fremont Street, or perhaps out to the Hoover Dam, and see only green, lushness, opulence, and a portrayal of paradise in the desert. The many fountains, lawns, and golf courses seem to defy nature in a place where the average summer temperature is 100° F. In addition, the sprawling gated suburbs look like they should be in the Midwest, and reinforce a vision of the American dream with single family homes, green lawns, and white picket fences. Despite appearances, however, water is scarce in Las Vegas. Located in the Mojave Desert, there are few local water resources and the city relies almost entirely on

Detail from original image with a view along the Flamingo Arroyo Wash and Bike Trail where the wetland is fed primarily by urban runoff. Image courtesy of the author.

water from the Colorado River that is imported over hundreds of miles. As well, infrequent but severe storms cause widespread flooding, which sometimes turn deadly. To combat this, the region has built a complex network of flood control water infrastructure to collect and move flood water swiftly out of the urban area. Further digging into policy, built form, and land use highlights the complexity and contradictions in the region around water.



Graphic describing current water system and impacts due to climate change projections. Image courtesy of Erin Schregardus, Yungui Cai, and Collin Wenberg.

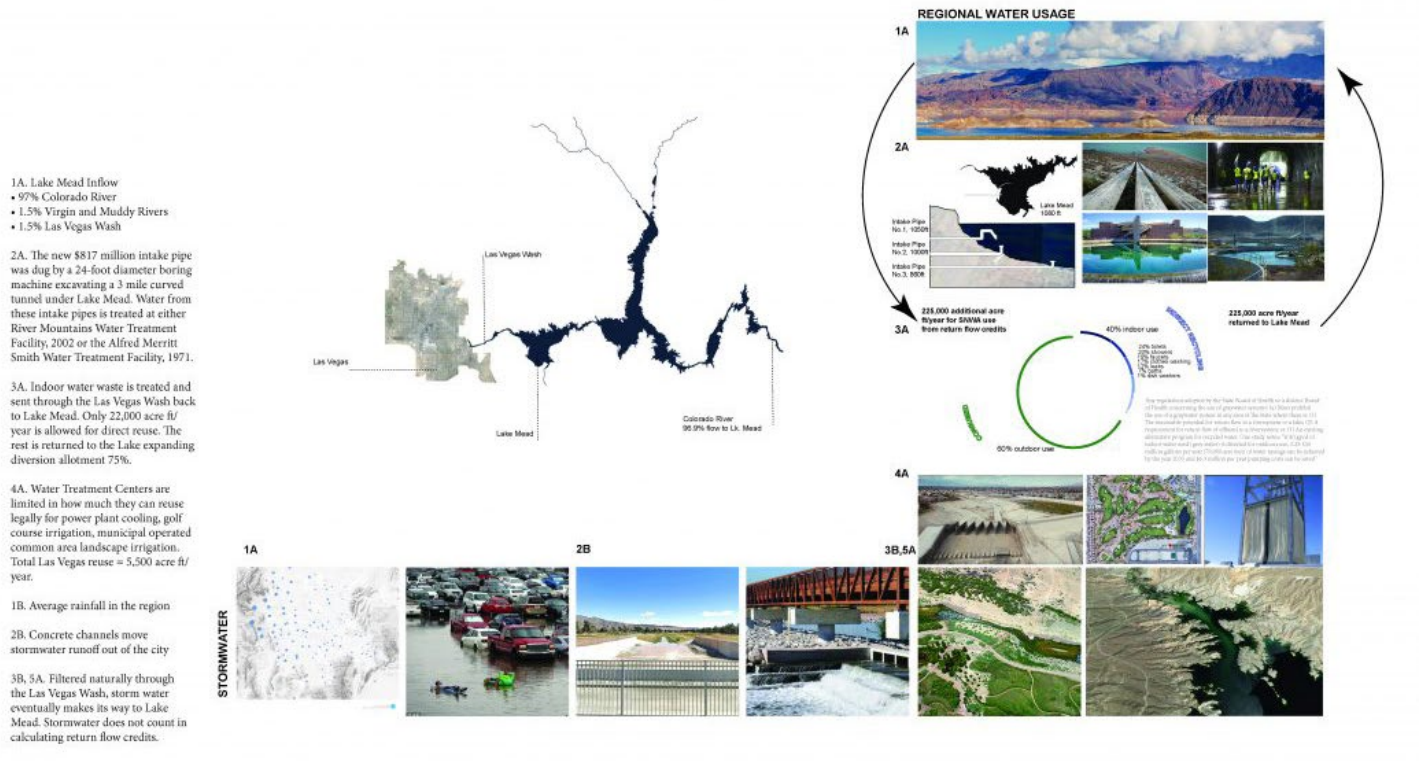
Context

During the Fall of 2019, I developed and taught a master of landscape architecture design studio at the University of Minnesota. The course brief charged students with developing innovative urban and landscape forms that address water scarcity and future uncertainties due to climate change in the rapidly growing desert city of Las Vegas, Nevada.

The students and I visited for a week in September and met with University of Nevada-Las Vegas landscape architecture students and faculty, residents, ecologists, planners, hydrologists, and Southern Nevada Water Authority representatives. We interviewed local residents and water experts to gain a perspective on their relationship with water and to understand policy, planning, and decision-making frameworks. We visited sites around the city to understand impacts of these policies on the built and natural environments. The photographs, drawings, diagrams, and site research in this article came out of the work produced by students and studio site visit.

Water + Las Vegas

Water is by far the largest challenge in the region, both too much and too little. Located in the Mojave Desert, Las Vegas has limited local water sources and relies on the Colorado River water infrastructure to provide 90 percent of its water. This begins as rain and snowmelt in the Rocky



Graphic describing the regional domestic water system and flood control infrastructure in Las Vegas and Clark County. Image courtesy of Sonali Devarajan, Christopher Ototo, Sheng Dong, and Tyler Smith.

Mountains, imported over thousands of miles through a series of channels, reservoirs, and aqueducts, and ultimately distributed to approximately 40 million people across seven western states and the country of Mexico.[1] Each state manages, imports, sells, and distributes their legally determined water allocation or budget. Locally this is done by the Southern Nevada Water Authority.

It rains on average a meager four inches over about 20 days a year. Half of that is in winter as gentle rain over the entire valley, and is welcomed by residents. The other half happens in summer monsoons where short but intense rain events scatter the valley unevenly, and heavy rain in one place could cause flash flooding downstream.

Topographically, the Las Vegas Valley is surrounded by mountains on three sides and acts like a bowl, capturing rainwater from the adjacent mountains through a series of washes and alluvial fans, with the Las Vegas Wash and Lake Mead at the end. During the summer monsoons, flooding often happens suddenly and severely since both urban runoff and rainwater from the mountains are directed through the city.

Since 1991, the Clark County Flood Control District has spent $1.9 billion to construct flood control infrastructure to intercept, slow, and move flood water efficiently out of the urban areas. Currently there are 650 miles of flood channels and 100 flood control basins built with another 25 years of projects anticipated as the

A flood control channel within the city, collecting trash. Image courtesy of the author.

Edge of residential community, bike trail, and ephemeral wetland in the Las Vegas Wash. The wetland is fed by discharged reclaimed wastewater, groundwater, and urban runoff. Image courtesy of the author.

urban area continues to grow.[2] The infrastructures are located both within the urban fabric as detention basins, streets, and flood control channels, and on the edges of town as flood diversion infrastructure. While construction began prior, most of this has been built in response to the 1999 storm where a 100-year storm event caused widespread flooding. Two people died and thousands more needed to be rescued when parking lots, streets, and first floors of casinos flooded with fast moving water. All in all, the storm caused $20 million in damages.[3]

To gather and channel urban runoff from streets, adjacent parking lots, and building roofs, a network of earthen, rock riprap, and concrete flood control channels crisscross the region. Often located in between neighborhoods, most have eight-foot tall concrete masonry unit walls lining each side. The channels collect large amounts of garbage and feel as if the city ignores them. Some are dry most of the year, while others are continuously wet and receive treated water from adjacent wastewater treatment plants.

Detention basins are the largest piece of infrastructure, which average 100 acres each and can be as large as 240 acres. Water is moved through streets and flood channels to the basins, which fill up and release the captured rainwater slowly to not overwhelm the downstream system. At least 20 feet deep, the basins are engineered to be large enough to capture an extreme rain event, yet empty within 24 hours to be prepared for the next storm. Many are in the middle of neighborhoods, with fences and gates to keep most people out, and look like empty dirt pits or lots waiting to be developed. Occasionally some have parks, among the few public spaces in Las Vegas, which are mainly lawn and passive open spaces that can flood without needing repair. On the edge of town, flood diversion infrastructure intercepts water moving off of the adjacent mountain ranges and diverts around neighborhoods located in the water's path. As a landscape architect, this infrastructure is fascinating as it creates a secondary network through the city dictated by topography, urban development, and remnant space.

Photo study of the textures at the edge of a detention basin. Image courtesy of Sheng Dong.

Red Rock Detention Basin at the northwest of Las Vegas, which intercepts flood water coming off of La Madre Mountains and Red Rock Canyon National Conservation Area. Image courtesy of the author.

The inlet of the Tropicana Detention Basin, where a public park sits within a piece of flood control infrastructure. Image courtesy of the author.

Looking into the Tropicana Detention Basin, where a public park sits within a piece of flood control infrastructure. Image courtesy of the author.

Water infrastructure at the eastern edge of Las Vegas that intercepts flood water coming off of Frenchman Mountain. Image courtesy of the author.

Opportunities + Challenges

Within this engineered landscape, there are signs of life where vegetation has started to take over. Cracks in the concrete-lined channels, gaps in between rock riprap, or space at the edges of earthen berms create the perfect niche for willows, sunflowers, cattails, sage varieties, and cottonwood trees to find just a little bit of water and soil to grow. These linear channels have become habitat corridors for birds; between the draw of the Clark County Wetlands Park and flood control channels, the network attracts 300 species of migratory birds including many that are endangered or threatened. A novel urban ecosystem, the channels host colonies of released pet turtles and goldfish as well as carp and crappies that have found their way upstream from Lake Mead. In a brief period, the channels have become a critical ecological and infrastructural corridor for the region and beyond.

The region has begun to build bicycle and walking paths in some of the channel corridors. While minimal now, they have the opportunity to create a city-wide connected pedestrian network. There are many opportunities to enhance this network by creating shade, seating, and wayfinding. This is a critical piece of public space network in a city where most residents must drive to access park or open space.

The flash flooding events often catch residents by surprise, including the growing homeless population that lives at the edges of detention basins or in the channels. Throughout these areas, the presence of people is highly visible through informal camps, large amounts of garbage and debris, and furniture both left by people and carried from upstream during a storm. This has been documented in great detail in popular

Ephemeral wetlands along the Las Vegas Wash fed by discharged reclaimed wastewater, groundwater, and urban runoff. Image courtesy of the author.

Along the Flamingo Arroyo Wash and Bike Trail, where the wetland is fed primarily by urban runoff. Image courtesy of the author.

media, including a 2014 article in VICE and a 2019 article in HuffPost.

With the lack of a larger regulatory framework or land-use plan, many developers have built within natural washes, which has interrupted historic water flow movements, produced more flooding, and increased the need for additional flood control infrastructure. Also, developers are not required to build stormwater infrastructure or manage flood waters. As a result, the Regional Flood Control District "fits" the infrastructure in the spaces in between communities.[4] To connect the pieces, channels often make strange turns, some almost at 90 degree angles, and then dip under urban areas into a culvert or pipe, reappearing miles later. Each turn or culvert increases the potential for overflow and flooding. More infrastructure is under construction today, trailing behind the rapid and sprawling urban development.

Development in the Valley has pushed almost to the edges of the bowl, constrained by natural features and federally owned land. The exception is at the southern edge where Las Vegas is continuing to sprawl south unrestrained, merging with the nearby towns of Henderson and Enterprise. This situation has created a clash between urbanized areas and natural systems. However, in this battle, urbanization wins when natural systems can be disrupted, controlled, and altered for the sake of urban and economic growth, creating tensions between natural and built environments and exacerbating vulnerabilities.

A brief glimpse at future projections outlines the instability and vulnerability of the Colorado River as a water source. Due to climate change and increased urban and agricultural demand, recent projections show that Lake Mead will fall below 1000 feet in elevation a quarter of the time by 2040 and almost half of the time by 2060.[5] This elevation is too low to withdraw water from and for the Hoover Dam to generate hydroelectricity, and it will trigger severe mandatory water cuts to all of the basin states. Las Vegas is hedging its bets and in 2015 finished an $817 million construction project to build a lower pipe (referred to as the Third Straw) from Lake Mead at 860 feet in elevation.[6] In effect, the Southern Nevada Water Authority will have the ability to extract and sell water long after Los Angeles, Phoenix, Tucson, and San Diego will have either found an alternate water source or will have disappeared entirely.

Southern edge of Henderson, Nevada where development lines a wash coming down from Black Mountain and Sloan Canyon National Conservation Area. Image courtesy of the author.

Perceptions of Water, Infrastructure, and Society

Through our meetings, locals acknowledged they live in a region that does not have enough water and that shortages have increased in recent years. The policy and regulatory responses have focused on water conservation through conversion to low-flow fixtures and drought tolerant vegetation, while still maintaining pools, golf courses, and water fountains. The responsibility for water conservation falls primarily on residents, where tiered pricing for domestic water imposes steep costs for using above what is deemed "appropriate." Conversely, the Strip still appears to operate how they want to, with lush tropical plantings, expansive lawns, and extravagant fountains. The business-as-usual mentality, even in the face of extreme weather, increased drought, and decreasing water resources ignores the dramatic effects of climate change on the region and larger territory. There is a perceived fragility of the economy—as it is almost wholly dependent on tourism and related services—and a quiet fear of what would happen if visitors' perception of the city or behavior had to change.

With this in mind, there are opportunities to rethink our relationship with water, whether it's too much or too little. Through the coursework, I asked students to question our role as designers, using the city of Las Vegas as a test site. We considered:

- What would Las Vegas look like if it embraced its identity as a desert city rather than trying to convert it to a green and lush landscape?

- How can embracing natural patterns and flows inform how we could live, consume resources, and develop new patterns of urbanism? What if regional or territorial differences were determined based on resource availability, reconceiving of floodwater as an asset?

- How can Las Vegas' DNA as a place that embraces speculation, takes chances, and attracts people from all over inform a new form of urbanism for arid cities?

Student work in response ranged from reimagining detention basins as tourism and spectacle, deconstructing walls along neighborhoods and flood control channels, creating public space in the channel corridors, reconceiving the urban fabric as an ecological bird corridor, reducing impermeability in streetscapes and parking lots, to rethinking the water infrastructure and urban framework to reduce dependence on the Colorado River as a water source. The students then quantified the impact of their design: amount of runoff reduced by increasing permeability on all of the urban streets and parking areas in Clark County; access to public space increased by breaking or removing the walls in all of the stormwater channels; and increased density and attraction by programming the 50 largest detention basins. Within this experimental and speculative work, we see the potential for landscape architecture, design, and urban planning to reimagine how our cities look, function, and adapt to future changes.

While we may not experience weather fluctuations as extreme as the West specifically, the weather in the Midwest is predicted to become more extreme with climate change: increasing precipitation will increase flooding, decrease agricultural productivity, increase runoff and

pollution, and decrease the quantity of clean water due to pollution from runoff and groundwater contamination.[7] Worldwide water scarcity and climate change impacts will increase pressures in ways we don't know yet: from increasing global agriculture pressures, to water scarcity, to flooding, to future climate change refugees. Our role as citizens is to ask probing questions and to push designers, planners, and policymakers to think innovatively and speculatively on the form and function of our built environment.

Footnotes

[1] Pat Mulroy, ed., *The Water Problem: Climate Change and Water Policy in the United State*s (Washington, D.C.: Brookings Institution Press, 2017).

[2] Max Michor, "Looking back at 1999 Las Vegas Flood 20 years later." *Las Vegas Review-Journal* (July 8, 2019). Retrieved October 20, 2019, from https://www.reviewjournal.com/local/local-las-vegas/looking-back-at-1999-las-vegas-flood-20-years-later-1701236/.

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[5] David G. Groves, Jordan R. Fischbach, Evan Bloom, Debra Knopman, and Ryan Keefe, "Future Vulnerabilities to Colorado Basin Water Deliveries," in *Adapting to a Changing Colorado River: Making Future Water Deliveries More Reliable Through Robust Management Strategies*, (Santa Monica, CA: RAND Corporation, 2013), 31-42.

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About the Author

Jessica Rossi-Mastracci teaches in Landscape Architecture at the University of Minnesota. Her work investigates new ways of adapting to future unknown water conditions in extreme landscapes.