SANDPIT LAKES: INDEXING A NEW TYPOLOGY

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ABSTRACT

The city of Grand Island, Nebraska has embraced both the sand and gravel extraction process and a new urban form, with most of its residential development occurring near the sixty-eight industrial-scale sandpit extraction sites within and surrounding the city. These industrial-scale networks form new development patterns no longer reliant on the dominant Jeffersonian grid, but instead on the operating procedures of material extraction and resultant lakes. It is vital to balance urban expansion in these decommissioned material extraction sites throughout the Great Plains to frame a new pattern and design opportunities for these post-industrial sites. This paper will present an in-depth historico-geographical approach taken through the graphic indexing of the changes to Grand Island's sandpit lakes over time, animating a new development process from manufactured sites to new spatial typologies. By analyzing aerial photographs, a series of indexed spatial drawings was generated to record the size, shape, material, development, and program of the sandpit lakes over time, visualizing the evolution of urban growth. Understanding these new spatial typologies within traditional growth patterns will reveal a new urban morphology as Grand Island continues to expand, balancing the new with the old and serving as a critical cultural-natural nexus.

Keywords: urban morphology, landscape, post-industrial, historico-geographical

INTRODUCTION

Nebraska is a landlocked state without any significant bodies of water, making former sand and gravel sites, reclaimed as recreational and residential lakes, the prevailing lake type in the state. However, unlike historic landscape-scale sites such as urban brickyards and cement plants that pose enormous difficulties for brownfield redevelopment, Nebraska's rural sandpits are post-industrial sites with value-changing capacity for emerging recreational- and architectural-scale interventions that alter the currency of sand by creating new, untapped spatial and environmental configurations. The city of Grand Island, Nebraska has embraced both the sand and gravel extraction process over the years to produce a morphology of urban repair, with most of its residential development occurring near the sixty-eight industrial-scale sandpit extraction sites within and surrounding the city. These extraction pits have generated a spatial typology, which brings the process of urbanism into manufactured sites, thus providing a unique opportunity for further investigation. It is vital to balance urban expansion in these decommissioned material extraction sites throughout the Great Plains for the purpose of framing new and more responsible design opportunities for these post-industrial sites.

CONTEXT OF URBAN GROWTH

Centered around the idea that an infinite supply of sand and gravel exists in central Nebraska, sandpit extraction is helping to facilitate growth in Grand Island, the state's second fastest-growing city. Grand Island has a population of over 50,000 people and is the third-largest city in Nebraska behind Lincoln and Omaha. Located in close proximity to the Platte River, Grand Island is also located six miles north of Interstate 80. The city's sand and gravel demand figures to be about 388,450 tons per year based on population estimates from the Regional Planning Department, with the majority being used for streets, highways, and buildings (Overstreet, 2005).

As of 2020, the sixth-eight post-industrial sandpit lakes within and surrounding the city are helping to facilitate population growth in Grand Island. The city has embraced both the sand and gravel extraction process and a newfound appreciation for the value of water and sand, with most of its development happening near these sandpit extraction sites. These sites are typically mined for as little as a single season or as long as multiple decades, with the majority currently out of production. Likewise, the shapes and forms of these sandpits are often irregular and based around machine mining until they are no longer economically viable.

Several of the sixty-eight extraction pits in Grand Island have been decommissioned, but the addition of new social programs to these lakes allows them to be viewed through the lens of what Alan Berger describes as a "reclaimed landscape." According to Berger, "reclaiming landscape is the creation of a new condition in which land is rescraped in accordance with a new program (subdivisions, grazing fields, ponds, etc.) (Berger, 2001, p. 151). The resultant form occupying the land consists of the co-existence of the previously abandoned old sites and the new amenity-based programs. The reclaimed ground or space for programming among the sixty-eight extraction pits is changing the process of city expansion in Grand Island.

The industrial-scale networks are forming new development patterns that no longer rely on the dominant Jeffersonian grid or architecture's historic role as the basic building block for organizing space, but instead rely on the operating procedures of material extraction and the resultant lakes. These sites are an example of what Nina Marie Lister describes as "complex and dynamic cultural-natural systems [resulting in] a multi-scaled and multi-layered urbanism involving cultural, social, political, economic, infrastructural, and ecological conditions that are layered, tangled, and mutually dependent" (Lister, 2010, 525-526). In Nebraska, this multi-layered urbanism consists of vertically layered groundwater where ecologies concealed below ground are revealed to the surface. While sites that have been decommissioned more recently have not been reclaimed, several older sites have been redeveloped with new amenity-based programs consisting of residential housing, and a smaller number have been reclaimed as public parks in the urban core.

Over the years the functional and social value of Grand Island's mining sites has changed, and as of 2017 the existing function of the older extraction pits consisted of 28 residential, 14 undeveloped, 9 ag/business, 8 public parks, and 9 currently active. Few pits are located near the urban center while the remainder are located in the first ring of residential development and the agrarian edge of the city parallel to the Platte River. The overall size of the pits ranges from several hundred feet to a half mile in length. The resultant lakes generally have steep banks and dramatic changes in depth (Nebraska Game and Parks, 2013), and some smaller lakes have microtopography ranging from 15-30 feet deep with larger lakes reaching depths of 70-plus feet (Pekraek, 2019). Currently the sandpit lakes are owned by homeowners' associations, engineering companies, private owners, and sand and gravel extraction companies. In an attempt to understand this evolution of pit size and program type, a series of visualizations for each lake was assembled to index the changing landscape by documenting the presence of water and sand over the last forty-five years.

METHODOLOGY

Using an in-depth historico-geographical approach provided a graphic indexing of the changes to Grand Island's sandpit lakes over time, animating a new development process from manufactured sites to new spatial typologies. This study investigates the relationship of urban form development via the Jeffersonian Grid, waterbodies, sand, roads, parcels, and architecture relative to two residential lakes in Grand Island, Ponderosa Lake and McMahon Lake. These lakes present distinct conditions in terms of their planning and their relation to the city, thus providing appropriate opportunities for comparison. Both lakes are currently programmed as residential, but Ponderosa Lake is one of six sites originally planned for residential development during excavation, with eighty-eight homes on the property and a location within the city limits, while McMahon Lake is one of twenty-two sites unplanned for development during excavation, with one home on the property and a location outside the city limits. Analysis of varying layers revealed meaningful and significant relationships between the Jeffersonian Grid, water, roads, parcels, and architecture of Ponderosa Lake and McMahon Lake (see Figure 1).

FINDINGS –LAYERS OF URBAN MORPHOLOGY

The Jefferson Grid preceded the

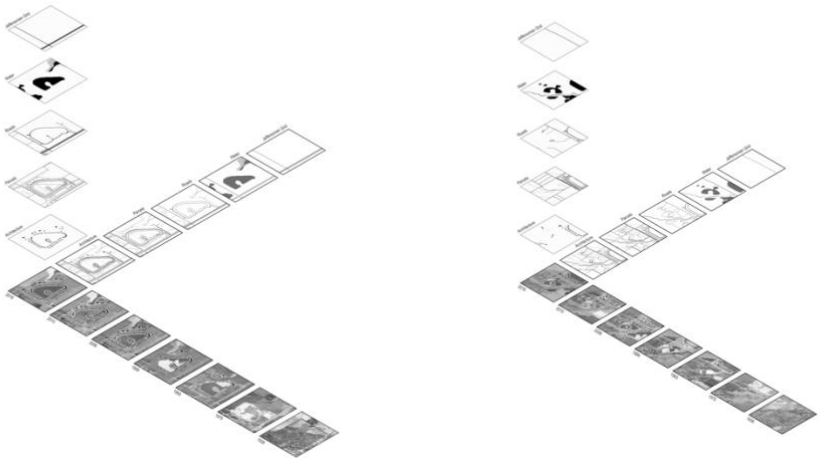

Figure 1. Plan analysis of Ponderosa Lake (left) and McMahon Lake (right) indicating influential layers (Jeffersonian Grid, water bodies, sand, roads, parcels, and architecture).

development of both lakes and thus partially determined the lakes' forms based on street frontage, access, drainage, and infrastructure. Ponderosa Lake backs into the corner of the Jeffersonian Grid and informed two orthogonal sides (south and east) of the lake while the remaining sides (north and west) of the lake seemingly disregarded the grid. McMahon Lake, on the other hand, is not influenced by the Jeffersonian Grid, suggesting an alternative driver to the lake's final form. The machine-based operations implied by the irregular form and unplanned nature of the lake leaves it essentially free to assume an open-ended shape free from the orthogonal grid.

In addition to the major Jeffersonian Grid there are several repeating patterns and alignments between the roads, parcels, and architecture. Examination of the residential roads around both lakes revealed that the service roads follow each of their forms. The residential roads were constructed after the extraction process was completed, suggesting that they were meant to complement the parcels surrounding each lake. Similar to the roads, the parcels align to the lake's final form, with homes oriented outward toward the surrounding street and vehicular accessibility to the individual parcels.

Both lakes represent typical urban conditions of sprawl, creating a dispersed development pattern near the southeastern edge of the city. Although the lakes are desirable places to live, their development patterns significantly impact the city's growth through annexed low-density developments, reduction in productive agrarian landscape, and compromised wildlife habitats. Ponderosa Lake replicates the traditional suburban model with front and back yards for each house, forming a continuous yard of grass in the front and back of each house and a strip of sand following the perimeter of the lake. Properties around Ponderosa Lake illustrate a highly subdivided area with relatively little size variation between the property acreage. Each home sits perpendicular to the water offering a 180-degree view across the lake to neighboring residents with an attached garage in front and front doors facing the street. The average square footage per house around Ponderosa Lake was 4,300 sq. ft.

Ponderosa Lake encompasses one full row of housing surrounding the entirety of the lake and a partial second row offset from the first. While some homes within the second row sit staggered to the first row, the remainder are aligned. Had the development been better planned, the staggered homes directly across from the first row could have a better view of the lake rather than of the neighboring homes. The lake contains six housing duplexes but additional housing types for lease, rental, or purchase should have been considered to accommodate a wider variety of residents. Additionally, most planned residential lakes operate as homeowners' associations and could have considered public open space or additional community amenities, including parks, playgrounds, or sports fields for use by residents. A good example of this can be seen in the horseshoe-shaped Kuester Lake, which contains a restaurant/bar at one end of the lake and a large park with tennis courts on the peninsula (see Figure 2). Water surface acreage of Ponderosa Lake (42.42 acres) is nearly three times larger than that of McMahon Lake (13.15 acres), and although a significant scalar difference exists between the surface acreages, coincidentally, each lake contains also a peninsula. The peninsula of both lakes is believed to have been formed by the geometric position of the radii of sand extractor equipment and beneficially expands the lakes' perimeter, thereby increasing accessibility to the water, water surface area, and offering a wider degree of views.

The twenty-eight planned and unplanned sand extraction pits reclaimed as residential developments

Figure 2. Timeline analysis of planned Kuester Lake (left), decommissioned/undeveloped Firethorne Lake (middle), and an active mining site by the J.T.L Asphalt Paving Co. (right).

are a desirable typology in Grand Island creating opportunities to reclaim the fourteen inactive and undeveloped sites, in addition to the eighteen active sites at a later date. Most of the twenty-two extraction pits likely sought to create a unique and desirable residential experience during the developmental planning process, most often aimed at higher-end clientele. McMahon Lake is a 40-acre estate and an extreme but often typical example of a desirable unplanned low-density typology, with one 5,300 sq. ft. single home perched on the lake's peninsula. The home is situated with a grassy front yard, side yard, and backyard along with a generous beach. The front door faces away from the access road, offering an uninterrupted 270-degree view. As reclaimed residential lakes are mined or considered for future redevelopment the city should take a proactive stance and require best practices for redeveloping the sites by considering density, housing types (market rate vs. affordable), and open space amenities. To aid in this process a timeline comparison of the lakes was created and it reveals several correlations across the different stages of both sites' transformations (see Figure 3).

FINDINGS – TIMEFRAME

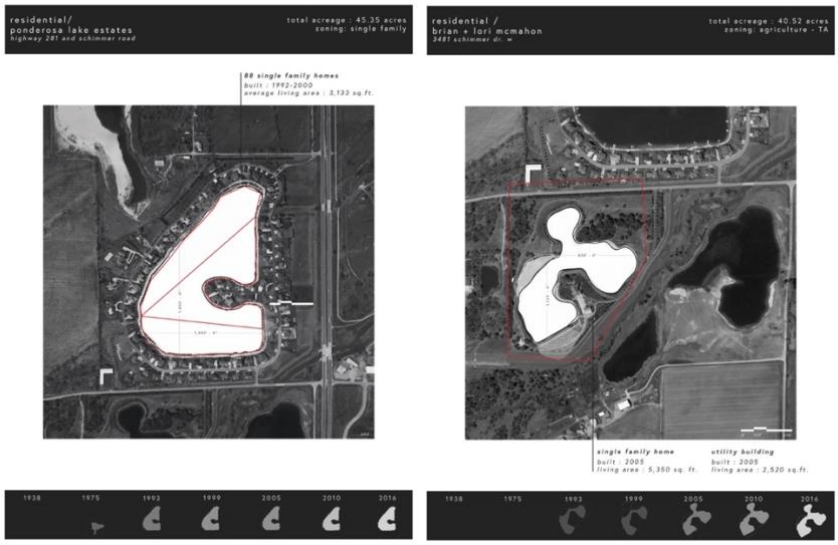

Figure 3. Timeline analysis of Ponderosa Lake (left) and McMahon Lake (right). The aerial images show current status and indexing lake forms (1938, 1975, 1993, 1999, 2005, 2010, 2016) at the bottom.

Timeline analysis of Ponderosa Lake reveals the site's transformation from forest and agricultural land in 1938 to a shifting boundary of sand extraction between the 1960s and 70s. After twenty-plus years of sand extraction, Ponderosa Lake found its final form around 1991 when the Ponderosa Lake Estates housing development was established. Housing was built around the lake starting with duplexes on the north side, and since 2010 the architecture, roads, and sand surrounding the lake have remained relatively unchanged.

Timeline analysis of McMahon Lake reveals a gradual transformation from forested area to agricultural plots beginning sometime between the years 1938-1975 (the two years during this period for which aerial photos are available), prior to the start of material extraction sometime between 1975-1993. The timeframe analysis also revealed fluctuations of surface area of sand and water due to sand extraction over time. After several years of extraction, McMahon Lake reached its final form in the early 2000s followed by the completion of the home in 2005. Since 2006, the lake's surrounding architecture, roads, and sand have changed very little.

While the exact depth of either lake has not yet been accurately measured, it can be inferred based on the period of extraction and the surface acreage. Ponderosa Lake is likely deep (upwards of 75 feet), due to the larger surface acreage and several decades during which it was mined. In contrast, McMahon Lake could be relatively shallow (15-30 feet) because it was likely mined over a shorter period and encompasses less surface area. Examining the timelines of sandpit lakes both planned and unplanned will reveal further opportunities to shape and form lake geometries in terms of length, width, and depth to produce spatially and environmentally responsible lake forms.

FINDINGS - CHALLENGES

While waterfront residential subdivisions are in high demand throughout Nebraska, they often mask the undiscussed negative impacts of their development: challenges include issues with settling house foundations; lack of awareness; and disagreements among residents regarding best water management practices, temperature and thermal stratification, and chemistry and chemical stratification. Such issues may partly stem from the reclamation of these lakes, since, as Katie Pekarek, Extension Educator on Water Quality, stated in 2019, "sandpits and stormwater ponds are marketed to homeowners as an amenity, but are not developed with the primary intention of being an amenity and are therefore not designed to serve the purposes that they are sold for." Consequently, over time these land use transformations are likely to trigger small-scale environmental changes leading to the displacement of native wildlife, the introduction of new species, and vegetation change, among other ecological consequences. Moving forward, if active mining sites are designed in a

responsible way by considering factors from machine mining to architectural buildings, future lakes could provide better amenities to people, animals, and the regional ecological network.

CONCLUSION

Post-industrial site development has seen landscape and ecology become primary vectors in contemporary urbanism (Lister, 2010, 525). This can most prominently be seen throughout the countryside, where these systems are inherent to water usage, land use, and settlement patterns. In Grand Island alone, nine active and fourteen inactive and undeveloped extraction sites exist, all of which have the potential for stakeholders (developers, the city of Grand Island, architectural planners, and extraction companies) to consider long-term impacts while balancing the value of water as a developer-driven amenity. Considering the relationship between global resource extraction and urban development further suggests the need for design innovations that reconsider the impacts of the 28 current and 31 potential future residential lakes as reclaimed landscapes. Responsible design solutions must be forged through architecture, landscape architecture, urban design/planning, and ecological thinking as a result of this relationship between post-industrial sites and cultural-natural systems.

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