

A greener tomorrow: Water management in urban redevelopment

Dortmund has transformed from a major industrial city into the “green metropolis” of Germany’s Westphalia region. Following World War II and the closure of major coal mines and steel plants, the city undertook a major sustainable redevelopment project which led to marked improvements to municipal water management and sustainable design.

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Summary

In the late 19th to 20th century, Dortmund was known worldwide as a center for brewing, coal, and steel industries. In 1990, looking to remain out of history books and into the future of urban design, Dortmund began a major redevelopment project which focused on the establishment of pleasant living and working environments through the promotion of sustainable practices. The project included building a large man-made lake, restructuring municipal wastewater flow, improving ecological habitats, and increasing the number of nature reserve areas in the city. The project also prioritized attracting cutting-edge technological industry to the city and advancing Dortmund as a logistics hub. Through the project, Dortmund sought to be known as a “green metropolis” in Germany and has succeeded in many ways. With greater infrastructure for flood prevention, a completed river revitalization projects, a number parks and gardens throughout the city, and a major lake serving as a center of residential, technological, and touristic life – Dortmund has used its need for redevelopment to jumpstart its future as a leader in sustainability.

The importance of water management

With millions moving into cities globally each month, urbanization implies a necessity to increase water supplies. However, according to a global study by McGill University in 2014, one in four major cities is water-stressed currently. Global watersheds are overused and overstretched with 504 billion liters of water moving across 27,000 km in order to provide adequate amounts of water to their inhabitants.

This means that managing water resources in cities across the globe is pressing. In order to counter climate change, it is necessary to have healthy ecosystem services, which rely on adequate water supplies. Therefore, a local government devoted towards improved water management provides its inhabitants with a possibility of a future with greater resiliency, safety, and quality of life.

Dortmund’s restructuring of its water sources in their redevelopment has proven successful. The polluted Emscher River, contaminated from years of industrial output and an outdated sewage system, underwent major flood prevention as well as ecological restoration. The creation of Lake Phoenix carried a great impact for climate change mitigation because of its water retention and cooling system. This case study focuses on the city’s water management, in particular the building of a major lake and the cleaning of the river system, which increased Dortmund’s resilience.



Facts & Figures

Population / Land area

600,000/ 280.7 km²

Municipal budget

\$2.23 billion

Greenhouse gas inventory

Yes, since 1990. As of 2012 Dortmund has reduced its CO₂ emissions by 25% relative to its 1990 baseline.

Looking ahead

Dortmund is a center for future oriented sectors such as IT, micro and nano-technology, logistics, e-commerce and increasingly also for biomedicine and robotics.

More than 37,000 people are employed by over 1,400 companies in these sectors, and Dortmund is also Germany's biggest producer of software.

Dortmund in context

Dortmund is located in the State of North-Rhineland Westphalia and is one of the major cities in the Metropolitan Ruhr Area, the former coal mine area of Germany. Comprised of 12 distinct districts, Dortmund is the eighth largest city in Germany and boasts strong technological, academic, and tourism sectors.

Industry gave context to much of Dortmund's infrastructure prior to the redevelopment. Since 1875, with the rise of the industrial revolution, until 2001, with the closing of the final major steel mill in Dortmund, the coal, steel, and beer industry dominated Dortmund's economy. Approximately 80,000 of Dortmund's employees worked in one of the industrial branches. However with the industrial decline in the 1990s, steel plants and coal mines began to close, and Thyssen Krupp, the final owner of Dortmund's industrial sites, closed most of their Dortmund sites in 2001. It was not until this end of the steel industry that a pressing need for a "New Dortmund" arose.

"New Dortmund": Sustainable redevelopment in the Dortmund District of Hoerde

Establishing a "New Dortmund" required a major restructuring of the abandoned industrial parks and the wastewater river. In the District of Hoerde, the government acquired all 200 hectares of land from the steel mill Phoenix to build a technological park, artificial lake, and renewed wastewater management system. The redevelopment project was led by the Dortmund administration sector and the newly established development agency through the Stadtwerke Dortmund. Mayor Ullrich Sierau took considerable initiative in strategizing and rallying for the project. The goal was to establish Dortmund as a leader in creative arts and business, with excellent living and working conditions.

Broadly, the project can be split into three main parts: first, the repurposing of Phoenix East, focusing on the creation of a public lake to increase quality of life, housing, and tourism. Secondly, the emergence of a cleaned Emscher River System from the restructuring of the city's wastewater system. Lastly, the transformation of Phoenix West into a Technology Park focused on increased jobs and innovation in the ICT and MST industries. This transformation also included increasing green spaces in the south. Overall, the "New Dortmund" redevelopment project hoped to increase job opportunities and quality of life through sustainable practices.



Left: Phoenix in 1961 (Photo by Willi Garth); right: Future Location Phoenix West" (Photo by Frank Vincentz)

Creation of Lake Phoenix

In 2010, the site of what was once one of the largest steel factories in Europe was flooded to create Lake Phoenix. In line with the goals of a “New Dortmund”, the lake would be the trademark of the city’s pleasant working and living conditions, setting it apart from other cities. The lake sits on the eastern side of a barren industrial site close to the city center of Dortmund, covering roughly 24 hectares of land. It is 1,230 m long, 360 m wide, and 4.6 m deep in maximum, situated near Hoerde, the newly attractive suburb. Dortmund City Council’s urban planning and building development department began construction in 2004, finishing by March 2010.

The creation of the lake has brought greater tourism, residential communities, and technological institutions to the area. The lake itself boasts a promenade and harbor area used for boating, water sports, concert performances, and fine dining. During heavy storms, the lake acts as a flood prevention, providing an additional 360,000 m³ to its normal capacity of 600,000 m³ of retention volume of rain water or overflow from the Emscher. This holding guarantees flood prevention for up to a 100-year flooding event. However, it was designed so that naturally, the river does not flow into the lake in order to preserve their differing natural ecosystems.

Re-naturalization of Emscher River

The Emscher River is an 85 km long tributary of the Rhine River. It flows from the east of Dortmund through the Metropolitan Ruhr Area up to the City of Duisburg. It forms the central axis of the river system in the City of Dortmund. During the era of industrialization, the river served as an underground sewer known as “Hoeschkanal”, running below the steel works site in Phoenix East. Much of the river’s natural biodiversity growth and ecosystem was destroyed from the repercussions of industry. The water undrinkable and the river beds and banks concreted for better drainage, the whole river system was in need of a major redevelopment. The re-naturalizing of the Emscher focused on reallocating wastewater, increasing flood prevention, and restoring natural flora and fauna to the area, while attracting recreational activities along the river.

Reallocating wastewater: As part of the redevelopment, the Emscher drainage and wastewater management system transformed into a natural open water system. The new Emscher catchment area in the Metropolitan Ruhr area contains more than 240 km of waste-water channels parallel to the river system, focused around a large main drain. In Dortmund, this main drain serves as an axis for the sewage, leading the sewage to the Dortmund-Deusen treatment plant, one of four treatment plants in the Emscher System of the Metropolitan Ruhr Area. The new wastewater sewer will run to the south and the west of Lake Phoenix. The Emscher will now flow freely along the northern edge of the lake. The Dortmund government has focused on transforming the water system fully by 2020 to reduce peak discharge into the Emscher River.



Lake Phoenix
(Photo by Frank Vincentz)



Renaturalized river Emscher running parallel to Lake Phoenix
(Photo by S. Baer)



Urban integration of natural River Emscher at Lake Phoenix
(Photo by Wirtschaftsfoerderung Dortmund)

Flood prevention: In Dortmund there are three floodplain locations along the Emscher River. In the District of Hoerde, Lake Phoenix serves as a huge rain water retention system. Its design offers protection from flooding for the downstream populated areas. In the northern districts of Dortmund, Mengede and Ellinghausen, the Emscher has been restructured to “natural” meander widths of 200-300 m. The river flows downstream through four weirs, roughly 5 m in length, into one outlet, which dams and stores the water flow. The weirs control the flow and speed of water movement and aid in the prevention of flooding. The plains surrounding the Emscher have been designed to weather a ten-year flooding event.

Ecological Restoration: A great focus was held on natural regrowth and sustainable construction along the River Emscher. The redeveloped floodplains have been constructed to maximize the natural growth in the area. The upstream floodplain in Ellinghausen, stores water at regular, smaller flood intervals to have constant flow downstream which allows for natural flora and fauna to live longer in the area. The downstream floodplain in Mengede, covers larger floods and controls water flow into the basins to allow for new wetland restoration and continual irrigation of surrounding land. These wetlands will allow for natural vegetation, eventually reaching half of its growth to be native trees and half native plant life, along the banks.



Renaturation of the Emscher system: Demolition of concrete borders in the Rüpingsbach in Dortmund-Schönau (Photo by Stefan Kunzmann)

Results and impact on community

- **Growth in jobs and industry:** Today, 70% of Dortmund's economy belongs to small to medium sized businesses focused in the service sector. The City of Dortmund acts as the service center for the surrounding regional manufacturing economy. Main industries in Dortmund now include IT technology, micro and nanotechnology, and production and information technology innovation. There has been a rise in GDP per capita from the start of the redevelopment in the 1990s. Much growth in new technology sectors comes from the growth of technological parks and technical universities in Dortmund. The number of employees has grown steadily, and has expanded by 5,900 in 2015. However the unemployment rate is still high but on a slide downwards trend of 11.8% in June 2016. The main unemployment group is old industrial workers who have found difficulty learning skills in new sectors. The unemployment agency, local government, associations and institutions are dealing with the problem and trying to find solutions for this problem.
- **Increase in leisure and quality of life:** Many residents were skeptical especially of the Phoenix project in its early stages, in particular of the rising real estate prices of property surrounding the lake. However, multiple aspects of the redevelopment focused on using resilient practices to improve the livelihood of Dortmund's

population. The creation of the lake established room for recreational sports such as windsurfing, sailing, boating on the lake itself and cycling, walking, skating on the shores of the lake. Also along the Emscher River newly created footpaths and cycling lanes made from recycled soil encourage nearby inhabitants to exercise outdoors. The outpouring of clean water, natural flora and fauna, and beautiful parks and gardens in the city bring great enjoyment to visitors and residents.

- **Greater green coverage:** Almost 50% of Dortmund is covered in green space, whether that be from forests, agriculture, parks, gardens, natural reserves or natural growth along the river system. Due to the restructuring of wastewater flow, the areas of Lake Phoenix and Phoenix West have become a part of the Emscher Countryside Park. It is now part of an 84 km stretch of green space in the Metropolitan Ruhr Area which runs from the start of the Emscher in Dortmund to its output into the Rhine. Parks of all sizes surround Dortmund. Westfalenpark, with the third largest rose collection in the world, with around 3,800 types of roses, holds three Federal Garden Exhibitions. Dortmund's botanical garden, Rombergpark, holds 4,500 different tree types and, with 65 hectares it is one of the largest botanical gardens in Germany. The protected nature reserves in Dortmund are steadily increasing. Between 1977 and 2016, almost 10% of the municipal area was taken under protection.

Lessons learned

Allowing for greater public participation in decision making more likely leads to excitement and interest in the Phoenix Project. In the beginning stages of the redevelopment, there existed uncertainty and fear among many inhabitants living nearby the project area due to the likely rising property prices and an influx of residents with an upper class social-economic background into the predominately working-class District of Hoerde, where Lake Phoenix would be constructed.

The integration of the resident population remains a challenge in the redevelopment, however establishing a platform for the voices of the residents allowed for greater excitement to be built and security to be felt. For example, in constructing the new flood plains surrounding the river, a workshop was held in 2006 on the design and construction of the river's ending outlet. They concluded that transparency in the redevelopment of the flood outlets is of great importance – adding an observation platform, bridge to cross the river, and walkway to the weirs.

Creating diversity of funding and leadership, where no single government member, developer, or investor holds a majority of the power in the project allowed for various funding and brainstorming to develop. The Mayor was extremely influential and charismatic in developing public support and acted as a point person and unifying figure for the public, yet many members' ideas and voices were valued and implemented into the project.

The mere scale of the project, quite large and complex for a city having lost its main form of economy, necessitated a collaborative, open-mind agency and team to successfully coordinate planning, marketing, and public participation. There were workshops held by the City of Dortmund, NRW.Urban, a major German developing agency, and ThyssenKrupp. These workshops integrated the ideas of other consultants, planners, knowledge institutes, developers, and architects into the larger concept of a "New Dortmund".



Concert in Dortmund (Photo by Roland Klecker)



Meeting with citizens (Photo by Michael Leischner)

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Stadt Dortmund



Clear, articulated goals lead to a more concrete and successful outcome.

Following the end of industry in Dortmund, most of the city's political leaders agreed that the city must undergo a major redevelopment if it wanted to stay a competitive urban metropolis. However the Phoenix redevelopment project resulted in being far more expensive than was anticipated in the budgeting and design. For example, due to an unpredictable evaluation of the sight, the cost to excavate the contaminated soil of the steel mill site increased. On the other hand, a large part of the project costs was borne by sale of land for buildings along the shore of the lake. Having clear, attainable goals from the beginning of the project, such as prioritizing a sustainable redesign, mitigated possible conflict that could arise from financial strains.

Prioritizing sustainable practices in redevelopment creates a long-term healthy impact on its community.

Dortmund focused its redevelopment around improving its resilience to climate change, with water management and greening as the main means of execution. It created ways to bring its citizens outside to stay active, increased its residential and tourist population, improved its water supply and flood prevention, and created more gardens and parks for its citizens to enjoy. By prioritizing improved water systems, the city is not only better prepared for heavy storms and flooding, it has also prioritized quality of life for its citizens, the biosphere, and the climate.

Replication

The results of this case study show that cities caught in antiquated infrastructure or modes of living may find success in adopting more sustainable practices. While aspects of Dortmund's project appear unique, there exist many possible ways to implement a more sustainable redevelopment plan on the local-level. Dortmund's redevelopment suggests that smaller scale projects such as increasing the number of parks and gardens or maintaining and restoring natural pathways for civilian use, can build resilience and improve quality of life for its inhabitants. By focusing on improving their water management, cities can work towards climate change mitigation, increased water supplies, and greater city-wide resiliency.

Further Reading

- Award winning documentary film about the history of Lake Phoenix: <http://www.goettliche-lage.de/>
- City of Dortmund: https://www.dortmund.de/en/about_dortmund/home_ad/index.html
- Conversion of the River Emscher System: <http://www.eglv.de/en/emschergenossenschaft/emscher-conversion/>
- 1989-1999 - International Building Exhibition in the Metropolitan Ruhr Area http://www.iba-emscherpark.de/pageID_2507086.html

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