A Comparative Analysis: Approaches to Sustainable Design in Housing Developments in the Netherlands and the United States Focusing on Water Management

Abstract: This study intends to give an overview of the implementation of sustainable design for housing developments in the Netherlands as compared to that of the United States through the lenses of government policy and local initiatives mainly focusing on water management. The housing developments in Leidsche Rijn, Almere, Lanxmeer and IJburg will provide case studies for practical comparison with the United States.

Erin Lilli GD1
Arch 5750
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Introduction

When one thinks of the Netherlands (NL), typically the mind conjurs up images of wooden shoes, tulips and especially windmills. The question for the later is, what were the windmills used for? Currently, in the orderly flatscape of the NL with it's perfectly lined trees and orthogonal ditches are found perfectly lined wind turbines. These thin, gracefully aerodynamic giants swoop their large blades, with the copious wind the NL has to offer, in order to generate electricity. This electricity along with solar power and ground source thermal heating provide 10% of the electricity for the entire country. These are the "new" windmills of the Netherlands, but the key to the country's existance and concerns for water lie in the purpose of the traditional windmills.

A Brief History of Water and the Netherlands

To begin an discussion of water in the Netherlands, a clear understanding of their historical ties to it is vital. Nearly 2/3 of the NL is under sea level so the Dutch have developed precision ways of reclaiming land from the sea (or other bodies of water) with the use of dykes, ditches and windmills to pump the water out. After a few years of draining, the new land, called a polder, is dry and can be developed with agriculture and towns. The first of these (which was actually reclaimed from a lake) was the Beemster created from 1609-1612 (Wikipedia) and further developed with the merchant trade monies until 1740 during the NL's Golden Years. Clearly defined 1800 m^2 plots were designed with drainage ditches running east to west every 35-50 m. Farming in Essex, England was used as a case study for development of Dutch agriculture. There was even a limitation to the population of certain types of farm animals allowed on agriculture land and since maintaining the windmills to pump out the water was essential, a strong cooperation amongst the farmers was initiated that is now known as the polder model. (Jan-Wouter Bruggenkamp) Alternatively, the Untied States (US) haphazardly claimed land, especially out west in the later half of the 19th century, and gave little thought to overall planning and organization of infrastructure. Where the Dutch create land from the sea and plan it meticulously to the last house for all aspects of living; the US is spoiled in the sense that there is so much land at its disposal. This coupled with a capitalistic/pioneering mentality has morphed the US into a country with little urgency for progressive planning, thoughts of the environment and cooperative attitudes. These shortsighted tendencies still exist today and are running rampant in the form of urban sprawl such as that exist in Los Angeles, California and Dallas/Fort Worth, Texas which in turn provide little positive planning for storm and rain water management.

The Dutch Mentality and Sustainability

As Voltaire stated, "God created the earth- except for Holland which was created by the Dutch.", which after spending any time studying urban planning in Holland, this quote becomes very true. Since the land is created, and not merely commandeered and developed, seemingly at will, great care goes into planning and progressive forward thinking in the NL. In this vein, sustainable design concepts are embedded in Dutch
planning to the extent that upon research it is referenced rather prevalently, but literature on specific implementation is not as easy to come by. The Dutch do not have a need to advertise sustainable design because it is already what should be done, whereas the US is selling “green” as the hottest new trend, but what is really changing with their overall planning is very little. Some common examples of Dutch sustainable concepts considered in new developments are; high density, the use of recyclable materials, low energy use rating systems, optional grey water recovery, separation of effluent from waste water stream for bio-gas fuels, green spaces and public transit availability to name a few.

**Sustainability and Dutch Politics**

To further exemplify the integrated nature of sustainable design a brief inspection of the political system is necessary. Just as in the US there are three main branches, but in the NL there is a constitutional monarchy with the queen and ministry (whom answer to Parliament) comprising the executive branch. It is important to note that there is no ministry for sustainable design and it is not mentioned specifically in their constitution, nor is there national income for it (just as is the case in the US). State secretaries (junior ministers) are appointed that have individual portfolios they are responsible for, however they are not part of the cabinet. In the case of sustainable design the Secretary of Housing, Spatial Planning and the Environment is accountable. Sustainable design is developed and managed in the government as a broad policy initiative that includes many aspects of government all working together in a comprehensive and well integrated approach. (Hans van Zijst, 2006) This model, which is entirely opposite to that of the US is based on the previously mentioned 12th century polder model developed by farmers and, as we can see, is a mentality that is very much alive in the NL as is the decentralized water board. There is an effort to shift more of the responsibility to the municipal level in order to better streamline implementation of water management techniques. Currently, Dutch Provinces are responsible for formulating the policy in water management plans, granting licenses for groundwater abstractions, regulating the management of water levels and supervising the policy of water boards. The water boards manage the surface water while the municipalities construct and maintain the sewer systems. Recently the government has focused on the lack of water in areas, this is known as dessication. The majority of the causes for dessication are: intense drainage for urban developments, increased evapotranspiration due to high crop yields and increased foreign water. Groundwater levels are also maintained in peat and clay soils since drying out could lead to land subsidence and seepage of brackish water. (GE Arnold)

In the US housing developments must follow certain building codes that vary somewhat by climates zone, but there are no governmental laws for many of the issues that will be mentioned in the case studies. The EPA has a set of regulations in order to minimize point source pollution from stormwater to groundwater, but in the vast majority of housing developments in suburban sprawl, runoff in channeled out into ditches untreated.

**Housing Developments in the Netherlands**

Upon observation in the NL, the most outstanding difference in planning for cities and housing developments compared to the US is boundaries. The Dutch have definite boundaries either natural (which in the NL is still manmade, ie. canals, dykes, greenspace, or even motes) or built like highways that contain cities and communities such as Almere, Leidsche Rijn (LR), and especially Java Island. Population growth in the NL is expected to increase until 2035 and level off at 18 million inhabitants. Currently the average Dutch household has 2.31 people and is expected to decrease to 2.17 creating a higher demand for housing. (Rutger De Graaf) With this influx of people, it is vital to have a well planned infrastructure of
water management within new housing developments, especially with the dryer summers expected due to climate change (Rutger De Graaf) and the shallow water table in the deltaic regions. (GE Arnold) Currently, according to Graaf & Van, 2005 (as noted in Delta Sync 04), local rainfall can fulfill residential water requirements for new developments in an average year, harvesting it would be a huge advantage.

Until the 1970s water management was sectoral with little communication between neighboring communities for joint efforts. Additionally, it wasn’t until 1989 with the Third National Policy Document on Water Management that the quality and quantity of groundwater and quality of surface water were brought together under one formulated policy. (GE Arnold) The focus for this paper will be with four case studies and their approaches to water management and sustainability which differ depending on their location.

**Liedsche Rijn**

To the west of Utrecht, NL in the area previously known as De Meern is Leidsche Rijn (LR). This suburb of Utrecht came to fruition due to a housing shortage and a deficit incurred during urban renewal of the 1970s which resulted in governmental funding that created LR. (Utrecht, 2008) In summation, LR is based off three original villages and is a series of individually designed neighborhoods that were not preplanned, but follow the VINEX\(^1\) set of laws for housing that were developed by the ministry for housing, spatial scheduling, and environment management otherwise known as VROM. (Mieke Bosse) This is the largest of many VINEX projects in the NL at 2,560 ha with plans to house 80,000 people.

In this large development water plays a role for recreation, décor and ecology. At LR’s center is a 300 ha green space that connects the autonomous neighborhoods together. In this “natural” region rainwater is collected and stored for future use. Additionally surface water is of high importance and goals have been set to keep the top meter of surface water clear. With the density of people, pets

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1 VINEX laws essentially deal with how to build houses. Issues such as density, quantity and location of schools and shops, and matters of sustainability like energy efficiency ratings and materials used in construction are key in VINEX developments. VINEX has had some negative effects on development. Since they had developers buy land beyond what the municipalities could afford; the government’s role in development was weakened. A deal was struck where the developers sold the land to the municipality at a “friendly” price on the condition that the builders could build the houses in a specific scope. This in turn leaves little competition with builders which can drive down quality as was seen with several apartment complexes in LR. (Arch 5750 student Presentation)
and unexpected high car use\textsuperscript{2}, a pilot plant of 13 processing sections utilizing sand, iron and calcium carbonate with vertical flow reed beds has been established to help filter out pollutants such as phosphorous. (Blom and Verhoeven, 2006) Lastly, water in LR comes from two main places; 80\% from rainwater and 20\% from seeping ground water. (Blom and Verhoeven, 2006) Much of the green space allows for rainwater to seep slowly into the ground and allow some natural filtering much like the mote around the fortified medieval city model of the newly designed Brandevoort which will be briefly discussed later.

Other sustainable features in LR include the goal of a low Energy Performance Ratio (EPR)\textsuperscript{3}. Where the current legal EPR is 1.4, LR houses must be 1.1 and soon only .7 or less then 50kWh/(m\textsuperscript{2}yr). (Energie-Cités, 1999) In addition, LR is backed by the European Union's "Thermie" program which awards a subsidy of 800,000 Euros to investors to encourage them to bear their share of environmental responsibility by using construction materials that are eco-sensitive, solar energy and proper insulation to name a few. Indoor air quality pertaining to paints and finishes is also considered. LR also has an underground sustainable trash collection system available that keeps the streets free of debris that could potentially harm the groundwater and storm runoff. (Mieke Bosse) Lastly the use of the hot water from the district heating network can be used for dishwashers and washing machines which allows that water to serve more than one function without the energy intensive process to make it potable. (Energie-Cités, 1999)

Almere

In 1967 the polder that is now Almere was created. Today this booming city houses a new city center and has plans in its future to be tied to Amsterdam, (to its west) as one metropolis with two distinct sides. Unfortunately, Almere’s new city center with housing, by Rem Koolhaas, is rather inflexible and may need to have drastic revisions in the next 30 years in order to make way for changes such as new big stores, light rail and internet. (Ria van Dijk) This is not very sustainable, but none the less, Almere does have many good ecological qualities. All of this is done under

\textsuperscript{2} LR was designed with smaller roads and parking with the expectation that public transportation would be utilized. Unfortunately the government could not provide this fast enough and now LR is more dependent on individual cars with an infrastructure that is not accommodating. (Arch 5750 student Presentation)

\textsuperscript{3} The EPR is the Netherlands’ way of measuring the energy performance of a building. It takes into account thermal insulation, passive solar and heating systems and gives the building a numerical rating and in turn increases communication between the architect, administration and builder. The present legal standard is 1.4, or about 120kWh/(m\textsuperscript{2}yr). The US is beginning to become more concerned with their building’s energy consumption and has the LEED point system from the US Green Building Council, but this itself is not the law of the land and has issues such as the weight of importance of certain green factors as well as the fact that owners get wrapped up in points and how things look on paper and not what is actually benefiting the environment.
the pressure of fast population growth with 5000 new inhabitants each year, seven new homes per day and three new schools per year. By 2030, the population is expected to sprout from the present 185,000 to 400,000, bringing in people from Utrecht, Amsterdam and other parts of Europe. (Ria van Dijk) Sustainability and clean water are vital when you are dealing with the fastest growing part of the NL.

Almere has two water systems, the waste water from houses is taken to the sewers for purification (just as in the US) and the rain water is channeled into the canals where it is filtered there on its way to the pumping stations that maintain the polder. The canals running through the polder receive frequent maintenance to remove debris and other pollution that are present. The majority of the water in the Almere travels in two main canals which are in a constant balancing act to keep them clean and level. (Ria van Dijk) Water treatment does have positive attributes in Almere, but they are not as progressive as those found in IJburg, which will be mentioned next. There are also no hard and fast rules as towards green roofs and rain water catchment, however some neighborhood communities such as the ecohouses took rainwater catchment on themselves. A community like that would be rather difficult to get passed code in the US.

One observation noted, while visiting Almere and studying the model of the city center, was the slope of the terrain towards a large body of water. Storm runoff could follow the path straight towards the rocky “beach” front and carry pollutants towards that water on its way. Fortunately there is little more than foot traffic on this route, however, the fact that the beach is rather impermeable and not allowing any pre-filtering of water before entering the lake could be an issue.

Lastly, a few more sustainable topics are worth mentioning for Almere. According to one of the city planners, Ria Van Dijk, Almere uses a rating system for sustainability (DPL) that factors in 40 different variables and gives a score from 1(good) to 10(best), and in Almere all housing must rate a six or better. Additionally, renewable energy is utilized with a goal of each home having 25% of its energy from sustainable sources by 2010. On that same token, a goal of 100% electricity and 80% of the heat needed for 1000 homes would come from a plant powered by biomass augmented by photovoltaics. A 30% energy savings is achieved with the use of a central heating system much like that in LR and Almere plans to achieve 20% CO2 reduction by 2010 as well. (Crrescendo)

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4 The citadel in the city center is a mixed use building with shops on the bottom and mainly housing on the upper level. An extensive green roof covers this area, but is only for aesthetic reason, to provide a mock, typical Dutch landscape to those in good view of it. There were little other observable green roofs in the area.
IJburg and Lanxmeer

The last of the two case studies will be briefly mentioned for their innovative approaches to water management and sustainability. IJburg is a newly created island off of Amsterdam containing high density mixed income houses with different blocks designed by different architects. Water management is handled in three ways: roof water is filtered before entering the ground, waste water and rain water are separated with the rain water treated before it is returned to the environment (this is not done in the US) and sewers handle the household waste. Some houses even have an option for grey water recovery that owners can request from the architect. Local architect and planner Han de Hein lives in the Vrijburgcht development which is essentially dense apartment units on the waters edge that form a courtyard around a beautiful green space that the inhabitants use. Rainwater, in this instance, is channeled off the roof and filtered through the sandy subsoil of the green space. Lastly, and rather alarming, is the use of PVC pipes in IJburg as opposed to copper! According to Jurriaan van Stigt, copper is unsafe, but PVC has been known to leak cancer causing dioxins into water and even skin and is even forbidden to be used in some hospitals due to the high amounts of toxins released when it burns.

Lanxmeer, in Culemborg, is a community that was granted special permission to build partly in a so called 25 year zone (no build) water catchment area. This opened the door for a unique and necessary perspective towards sustainable design. Two main concepts are to be briefly addressed here, first is the public green space with community gardens that adjoin the back of the houses’ gardens. This space is not only for aesthetics, recreation and interconnection of inhabitants, but it is also used to store and purify rainwater, an excellent example of permaculture. Lastly to be mentioned is the Sustainable Implant that is part of the energy regulations for the urban design. Here, black water from household sewage and organic waste from the park are processed and the biogas they produce is harnessed to produce electricity for the district. (Adriaens, Femke, 2005)

The Netherlands, the US and the Future...

After studying several housing communities in the NL two thoughts come to mind; the US has a long way to go before they approach the imbedded Dutch mentality of progressive design and sustainable concepts, and the Dutch might begin to take the current American mentality of more space, less density.

In the US the sprawling cities and suburbs have some undeveloped, natural areas, but they are just that, undeveloped. There is a kinetic potential with in the concrete jungle scape that it is just a matter of time before those “green spaces” are developed with little thought for what is next to them. Some progress has been made such as LEED for New Homes, but it is by no means a government implemented standard. There are many grass roots initiatives in the United Stated from Minnesota Green Star to Energy Star, but most of these are up to the builder and very few of them are subsidised by the government.

One of the newer communities in the Netherlands, Brandevoort, is based on a fortified medieval city with a mote surrounding a solid exterior ring wall of housing and is designed in typical Dutch brick style. What an American, who has grown to appreciate Dutch design, might find alarming is the “suburb” area created outside the “fortified” city center. Here the houses look like typical American suburban housing with individual
yards and larger homes. Currently many Dutch designs are leaning towards the market desires of more and personal space. Proximity to green space is still important to the Dutch as is the historic personal garden, but instead it has morphed into a paved patio.

While the fears of climate change and sea water levels rising plague the Dutch they still need to continue to focus on matters within their borders such as the shrinking of the Green Heart and issues with agriculture and pesticides. From the US they can learn from our preparedness, or lack of, in situations such as Hurricane Katrina and from the Dutch the US can learn how they once properly farmed their land and how floods can be better managed. A perfect case of this is the recent flooding happening along the Mississippi River, running through the center of the US, and the amount levees that have breeched and caused the developed flood planes to flood people out of their homes because of improper control of water. In addition, the US “farms” have been transformed into places that mass produce meat for consumption at risk to the environment. These CAFOs (Concentrated Animal Feeding Operation) many times allow solid waste to be buried in manure ponds which in turn seep into the groundwater with little thought to using this waste a way to create power. In closing both countries have their challenges and goals that need to be achieved and we can only hope that the current world state will be the big turning point.


Bosse, Mieke is one of the original founding principals of SCALA architects Den Haag, NL.

Bruggenkamp, Jan-Wouter is a city planner working in the Netherlands.

Crrescendo. Almere, NL. Extended Project Summary

Dijk, Ria van is one of the city planners of Almere

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Stigt, Jurriaan van in an architect and principle of Loof & van Stigt located in Amsterdam, NL.


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