

Designing with a systems approach

Assesing the BR2 tool for urban brownfield redevelopment by applying it on the urban design case of the Merwe-Vierhavens

Internship report

Guiding tutors

Linda Maring, Deltares

Sr. project leader urban land and water management

Fransje Hooijmeijer, TU Delft

Assistant Professor Environmental Technology and Design

Nirul Ramkisor

April - October 2014



SNOWMAN NETWORK
Knowledge for sustainable soils



Urban Brownfields are underperforming or not used areas within the urban context, mostly with an industrial background. Therefore most of these sites are contaminated and not economically viable (for market parties). But they can play a key role in stopping urban sprawl and the use of precious Greenfields. Because these sites are mostly not economically viable, there are no concrete plans for redevelopment. The Brownfield Remit Response tool (BR2) was developed within the European project HOMBRE at the University of Nottingham to assess different redevelopment options and compare them to find the best solution for the site. The tool has been tested on three location in the PhD-thesis of Leney (2008). This reports focusses on the use of the tool in the field of urban planning and design. The test location is Merwe-Vierhavens location in Rotterdam, the Netherlands.

Table of contents

Abbreviations and acronyms	4
1. Introduction assignment	5
2. Merwe-Vierhavens (M4H) location	
2.1 Introduction	8
2.2 Analysis	10
3. The BR2 tool	
3.1 Introduction	14
3.2 Applying BR2 on Hofbogen, Rotterdam	20
3.3 Applying BR2 on M4H - workshop	22
3.4 Applying BR2 on M4H - phases	30
4. The design	
4.1 Design process	40
4.2 Final design	46
5. Evaluation and conclusion	x
References	x
Appendices	
Appendix A	x
Appendix B	x
Appendix C	x
Appendix D	x

Abbreviations and acronyms

B4P	Balance 4P, a project about balancing decisions for brownfield regeneration and part of the SNOWMAN Network http://www.snowmannetwork.com/
BCM	Binary coded matrix
BE	Built environment
BIO	Biodiversity
BR2	Brownfield REMIT/RESPONSE, the method which is used in this report and developed by Leney (2008)
C,E-chart	Cause and effect graph derived from the interaction matrix
CABERNET network	Concerted Action on Brownfields and Economic Regeneration, the European Expert Network addressing the complex multi-stakeholder issues raised by brownfield regeneration
CIC	Central institutional controls
DEM	Demographics
ESQ	Expert semi-quantitative, method to value relations between elements
HOMBRE	Holistic Management of Brownfield Regeneration, EU project (2010-2014) http://www.zerobrownfields.eu/
IE	Individual economic
LIC	Local institutional controls
M4H	Merwe-Vierhavens site, Rotterdam, the Netherlands
NE	Natural environment
PrE	Private economic
PuE	Public economic
QoL	Quality of life
REMIT/RESPONSE	Rock engineering systems approach developed by Hudson (1992) SNOWMAN Network A transnational group of research funding organizations and administrations in the field of Soil and Groundwater in Europe

1. Introduction assignment

This report concludes an internship at Deltares, which has been done for a course about sustainable urban design at the faculty of Architecture at the Technical University of Delft. The assignment that led to this report is about the regeneration of urban brownfields and is part of the HOMBRE and Balance 4P projects.

Since the world's population keeps growing and evermore moving to urban areas, cities are rapidly covering more and more land. In order to prevent urban pressure on valuable land (urban sprawl), which can be used for cropping, energy resources, drinking water harvesting etc., available land within the urban tissues which is underused (brownfields) could be redeveloped. When we look at brownfields in a European context, we see that every country has its own (or no) definition of the term 'brownfield'. A list of the different definitions can be found in table 1 of the paper *The Scale and Nature of European Brownfields* (Oliver et al., not dated). In that same paper, a brownfield is defined as "sites that have been affected by the former uses of the site and surrounding land; are derelict and underused; may have real or perceived contamination problems; are mainly in developed urban areas; and require intervention to bring them back to beneficial use", according to the CABERNET network definition. We will use this definition in this report.

HOMBRE project

The HOMBRE project, Holistic Management of Brownfield Regeneration, is a Collaborative Project carried out under the Seventh Framework Programme THEME FP7 ENV.2010.3.1.5-2: Environmental technologies for Brownfield regeneration, Grant Agreement Number 265097. The project began on 1 December 2010 and has a duration of 48 months (HOMBRE, not dated). The main objective of the project is the 'zero-Brownfield' concept. Hombre is based on providing the scientific and technical backbone to support this. It all starts with the land-use cycle. Within the project land is described as the ultimate finite resource, underlining the urge for brownfield regeneration. A brownfield is part of the land-use life cycle; after losing its former function it is in an in-between stage before being developed again. According to the beliefs of the project it is important that future brownfield generation is prevented for many economic, environmental and social reasons. Land that already is brownfield should be redeveloped or used for intermediary use. These uses could contribute or coexist to the redevelopment and help the land to be gradually restored until it can be fully re-integrated into the land use cycle. By combining technologies great opportunities are offered to surmount the cost barrier by sharing

1. Introduction assignment

the land management costs with other services and opportunities for society such as renewable energy and urban green space and climate control. To reach the main objective HOMBRE developed practical, science based guidance to deliver the concept of a land cycle as a working system for planners and land managers by developing integrated stakeholder communication and decision support technology for the optimal selection of Brownfield regeneration options, approaches and technologies of decision making. One of the tools developed is the BR2 tool, which is assessed in this report.



Figure 1.1 HOMBRE project partners (HOMBRE, Holistic Management of Brownfield Regeneration, not dated)

Balance 4P project

The SNOWMAN Network is a transnational group of research funding organizations and administrations in the field of Soil and Groundwater in Europe. Balance 4P is a project with the SNOWMAN Network between partners in Sweden, The Netherlands and Belgium and is about balancing decisions for urban brownfield regeneration, with a focus on soil contamination. It is a spin-off of HOMBRE and covers aspects that were not fully addressed within that project. The overall aim of the proposed project is to deliver a holistic approach that supports sustainable urban renewal through the redevelopment of contaminated land and underused sites (brownfields). To reach this the project focuses, among others, on the application and assessment of methods for design of urban renewal/land redevelopment strategies for brownfields that embrace the case-specific opportunities and challenges (BALANCE4P, not dated). The application of methods by the target group “urban planners and designers” is an aspect that is missing within HOMBRE.

The assignment

The assignment that led to this paper is to, like described in the goals of B4P, assess one of the tools developed within the HOMBRE project - the BR2 tool - by the target group, which is planners and land managers. My own background is in architecture and urban planning and design. As a student at the Technical University of Delft I completed a Bachelor in Architecture and am currently a Master student in Urbanism. I will assess the tool by applying it on a test case in The Netherlands, the Merwe-Vierhavens in

1. Introduction assignment

Rotterdam, during the design process. The final outcome will be a spatial plan, developed by using the tool, and a reflection on how the tool works in practice. The reflection is built up in parts throughout different chapters in chronological order. This way it gives an idea about the process of working with and understanding the method. Therefore it is possible that questions posed in one chapter are answered in the next. The final findings and conclusions (and thus the total overview) are given in chapter 5. The location will be introduced in paragraph 2.1 and the BR2 tool in paragraph 3.1. The general build-up of the report is illustrated in figure 1.2.

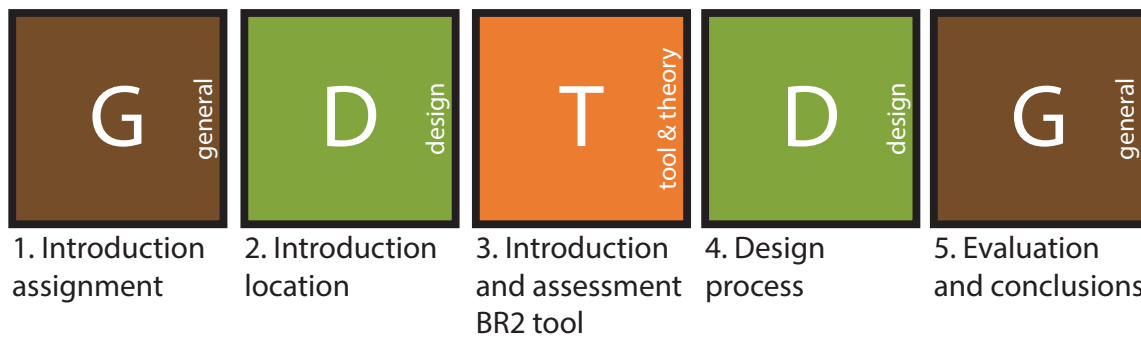


Figure 1.2 General build-up of the report (own illustration)

2. Merwe-Vierhavens (M4H) location

2.1 Introduction

The Stadshavens of Rotterdam are located in between the Beneluxtunnel and the Erasmus Bridge. It is a collection of harbour areas covering 1600 hectares. After the completion of the western extension of the harbour (Maasvlakte 2) in 2013, the port activities shift further and further towards the North Sea. The old harbours near the city center of Rotterdam become available for urban renewal. However, the transformation does not go as earlier foreseen. The aim was for the redevelopment to support both the port and the city by becoming a part of the Mainport of Rotterdam like nowhere else: the center of development and innovation, directly linked to daily businesses and urban labour force (Projectbureau Stadshavens Rotterdam, 2011, p. 8). The report also mentions the chances for revaluation of the harbour character of the city by building living and work environment that are 100% Rotterdam. The corporate identity of the city has been identified in 2001 as a young, international city at the water with a sober and decisive attitude. Ambition, change and involvement are important characteristics for the city (Rotterdam World Brand, not dated).

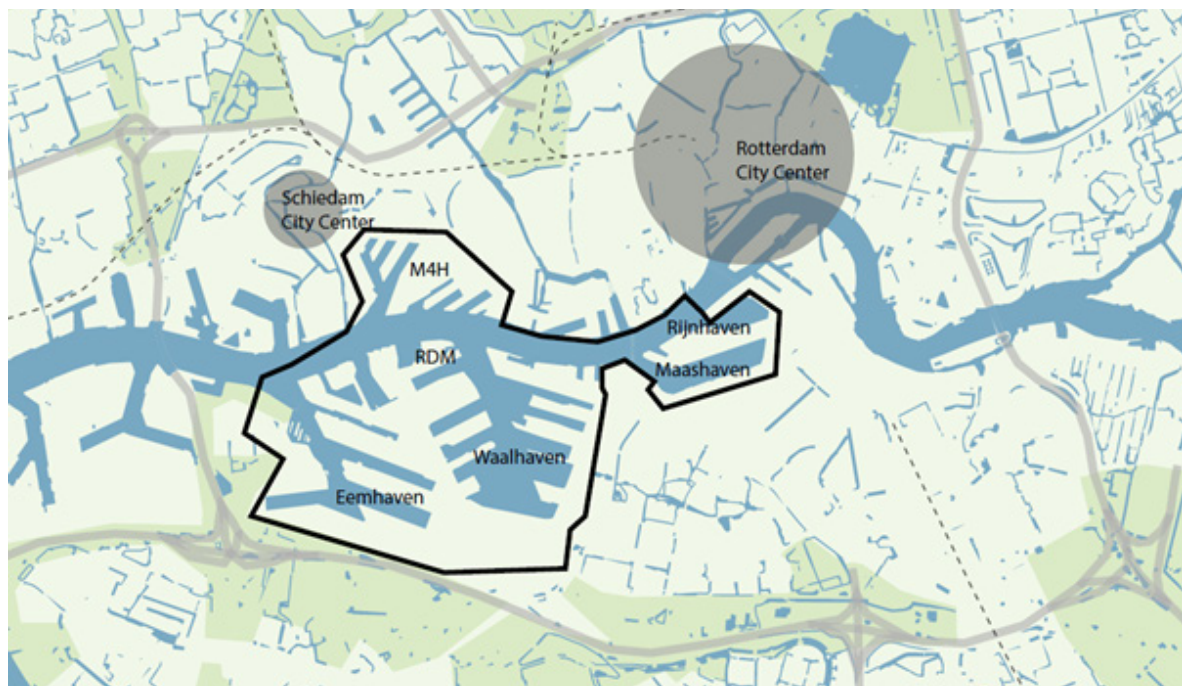


Figure 2.1 Stadshavens Rotterdam and sub regions (own illustration)

In this report we focus on the sub region Merwe-Vierhavens (M4H). The area is partly still active as an industrial area with port related activities. Because of this the area is not well accessible and the urban space is very open and anonymous. Along the water there are fruits and juices clusters focused on transshipment. Away from the water and more towards the road there are small businesses which are not related to the port. And in

2. Merwe-Vierhavens (M4H) location

2.1 Introduction

between there are vacant plots which are not yet financially attractive to redevelop. There is also a power plant from energy company Eon. This, together with the port activities prevents (re)development. Many plans and visions have been made for the area already, by the municipality, the Port Company (Havenbedrijf Rotterdam), project offices and students. The municipality has, together with the port company, created a vision for the area. It should transform into an innovative living and working environment that is complementary to and beneficial for surrounding neighbourhoods. The area should furthermore become an international testing location for innovative energy and water management (Projectbureau Stadshavens Rotterdam, 2009, p. 5). One of the plans was to create the clean tech delta, an area that would pilot delta related innovations, but the idea was postponed indefinitely, partly due to the financial crisis.



Figure 2.2 Aerial view over the Vierhavens (Projectbureau Stadshavens Rotterdam, 2011, p. 30)

The visions by the harbour company and the municipality are very broadly described and vague, so there is a lot of room for development solutions. Therefore the BR2 tool seems like a very suitable tool for this design case. This will be further elaborated in chapter 3.

2. Merwe-Vierhavens (M4H) location

2.2 Analysis

As mentioned before, multiple plans and studies have been done before. A short summary of the 2009 business case and the 2011 structural vision can be found in appendix A. In this paragraph the conclusions of the analysis will be discussed, additional maps, figures etc. can be found in appendix B.



Figure 2.3 Merwe-Vierhavens and sub regions (own illustration)

One of the main objectives of the redevelopment is to give the waterfront back to the city. Due to the large port-related activities the water is not accessible for inhabitants. Because we are dealing with a city along the river we must be aware that there are public riverfronts along the Maas. Most of them are better situated with beautiful views over the Erasmus and Hef bridges and the skyline of the Wilhelminapier. Map B1 (appendix B) shows the accessibility of the riverfront in the city of Rotterdam. There are long stretched boulevards near the city center, but not near the Merwe-Vierhavens. There are parks nearby, but they're mostly along residential areas and less attractive and less connected to the city. There's only one outer dike nature area at the eastern edge of the city. To be complementary to the current situation, the waterfront of M4H could be an outer dike nature area combined with an attractive boulevard providing facilities and which is well connected to the city via good transport links.

The area is well connected to the regional and national road system and the Marconiplein zone (zone 6 in figure 2.3) is well connected to the rest of the city via public transport, as shown on map B2 (appendix B). The accessibility by both car and public transportation and the proximity to both the center of Schiedam and Rotterdam make M4H an attractive location. This can further improve if the water net is extended. The main problem is reaching the inner parts of the area from the well accessible edges. There is no designated

2. Merwe-Vierhavens (M4H) location

2.2 Analysis

space for slow traffic. The streets that border the area also form borders for pedestrians and cyclists from surrounding areas. Street patterns and lay-out as well as transportation links need to be improved.

The location is on the border of the municipalities of Rotterdam and Schiedam (map B3, appendix B). The municipality wants to transform the area into a lively living and working environment. However, in the municipality of Schiedam to the west there is a large business park zone which is being further developed over time. Therefore it seems logical to adjust the spatial and functional lay-out of the west strip (number 1 in figure 2.3) to that. The west point (zone 9 in figure 2.3) seems attractive for residential or office high rise, due to the location along the water. There are some typical characteristic elements in the area which, if preserved, could aid the identity of the place. Old abandoned train tracks, cranes and warehouses can be re-used.

There are already a lot of facilities located in the immediate vicinity of M4H, as indicated on map B4 (appendix B). The development of dwellings would not require extra facilities and can be carried out from the start.

There are also a lot of challenges to face when thinking about redevelopment. One issue is that of flood protection and water management. Since the area is outer dike (map B6, appendix B) there is no pluvial problem, the water runs off to the river. But a rising water level of the river makes the land vulnerable for flooding. The current normative high water level is 3,6 m + N.A.P., which is already higher than large parts of the surface. The level for 2100 is predicted to be 4,7 m + N.A.P. according to the Veerman prediction (Slootjes et al., 2011, p. 21). There are multiple solutions to deal with this: we can heighten the surface of the area, build a new dike around the area, make a storm surge barrier or build amphibiously. Another problem is that the current dike which is protecting the hinterland is too low at one point.

Another problem is the building restriction for housing due to the noise nuisance of Citronas, zone4, and the safety zone of the Eon power plant, zone 5 (figure B8, appendix B). As long as these companies are active the development of dwellings is not possible. In this case we assume that transshipment firm Citronas will move to another harbour location due to vacancy elsewhere with the Maasvlakte 2 expansion. The Eon power plant

2. Merwe-Vierhavens (M4H) location

2.2 Analysis

is located above a hot water reservoir, so switching from steam and gas to geothermal energy becomes an option.

Because of the former and current uses the area is contaminated, at some point a lot more than others. The power plant is one of the sources of contamination but next to it used to be a paint and metal factory (Ferro). Besides those there were and are many more industries that served/serves as sources of contamination. Contaminants in the area are: PACs, heavy metals, chlorinated carbohydrates and others. There is also polluted groundwater (map B7, appendix B). Figure 2.4 gives an overview of remediation techniques (Khan, Husain, & Hejazi, 2004). The costs mentioned are for the U.S. context. There are highly variable costs between different countries and situations, but the overview by Khan et al. gives a good overview of techniques and a basic indication for variables per technique, such as cost, efficiency and duration. Based on the contaminants we can explore certain techniques such as soil washing, soil flushing and phytoremediation. The variables cost, efficiency and duration will determine which technique is best applicable on a certain location. For an overview of the Dutch context please refer to www.bodemrichtlijn.nl.

A comparative evaluation of soil remediation technologies

Technique	Development status	Contaminant	Soil type	Cost	Efficiency	Duration
Soil washing	F	B-F	F-I	A-B	A	A
Soil vapor extraction	F	A-B	F-I	C	A	B-C
Landfarming	F	B-C	A-I	C-D	B	B-C
Soil flushing	F	A-F	F-I	C-F	B-C	A-B
Solidification/stabilization	F	C, E-F	A-I	A-B	A	B
Thermal desorption	F	A-F, except C	A-I	C-E	A	A-B
Biopiles	F	A-D	C-I	E-F	A-B	A-B
Bioventing	F	B-D	D-I	C-E	A	A-B
Phytoremediation	P	A-F	Independent	D-E	C-D	D-E
Bioslurry system	F	A-D	D-I	A-C	A	A
Encapsulation	F	C-F	A-I	B-D	B	B-C
Aeration	F	A-B,D	C-I	E	B	C-D

Contaminant		Soil type		Cost	Efficiency		Duration		
Type	Rank	Type	Rank	Range, US\$/t of water treated	Rank	Range	Rank	Range	Rank
VOCs	A	Fine clay	A	>150	A	>90%	A	1-6 months	A
SVOCs	B	Medium clay	B	75-150	B	75-90%	B	6-12 months	B
Medium to heavy hydrocarbons	C	Silty clay	C	50-75	C	50-75%	C	1-2 years	C
Insecticides	D	Clay loam	D	25-50	D	<50%	D	2-5 years	D
Inorganic	E	Silt loam	E	10-25	E			>5 years	E
Heavy metals	F	Silt	F	<10	F				
		Sandy clay	G						
		Sandy loam	H						
		Sand	I						

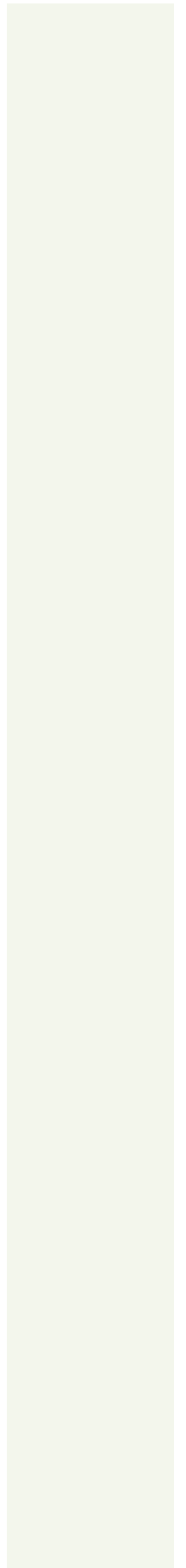
F, full scale; technology used in real site remediation; P, pilot scale; studies conducted in the field or laboratory to fine-tune the design of the technology.

Figure 2.4 Comparative evaluation of soil remediation techniques (Khan, Husain, & Hejazi, 2004, p. 116)

Because the area is still an active part of the harbour most of the plots are in possession of the harbour company or in leasehold. It is not financially viable to buy off the lease. The most opportune scenario is to redevelop plots when leasehold ends. That can be difficult when plots around the vacant spot are still active industrial areas. Also taken into consideration is the costs of remediation. Map B5 (appendix B) shows the duration of the leasehold and the remediation costs.

2. Merwe-Vierhavens (M4H) location

2.2 Analysis

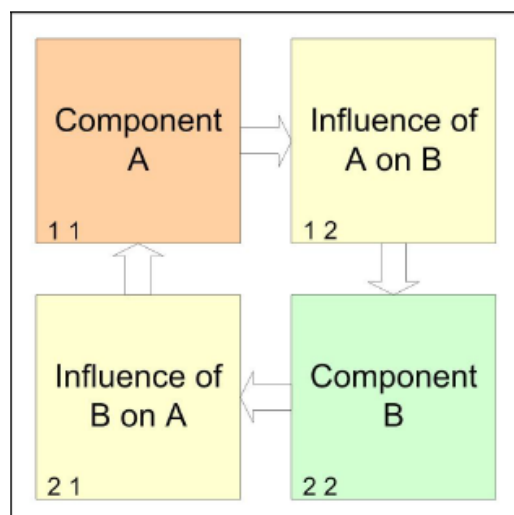


3. The BR2 tool

3.1 Introduction

The method will now be introduced briefly. For a full in-depth explanation please refer to the PhD-thesis of Leney (2008). BR2 is a method to “provide a means for exploring the impact that brownfield redevelopment will have on the urban system within which it takes place and the exploration of the consequences that will arise as a result of these impacts. Therefore, it can provide a means for selecting redevelopment options based on site specific analysis of the impact of redevelopment rather than relying on generic theories of redevelopment (i.e. building employment generating buildings will reduce local unemployment). In this way it provides a means to select redevelopment options using a robust evidence based approach” (Leney & Nathanail, not dated).

A system is a group of elements forming a connected or complex whole (Oxford English Dictionary (OED), 1989b). Traditional approaches that assess the impact of redevelopment assume that the urban system is a simple system and that causes and effects are directly linked. These ways of approaching redevelopment impacts exclude a lot of relations and indirect causes and effects. BR2 treats the urban system as a complex and interactive system that will respond in a dynamic way to change. Within a system like this simple changes can result in unexpected, and possibly undesirable, outcomes. By applying a systems approach, the planned redevelopment options can be assessed on site specific analysis of the impact of redevelopment using a robust evidence based approach rather than relying on generic theories of redevelopment (Leney, 2008, pg. 120-121). The method is based on REMIT/RESPONSE, a procedural approach to rock engineering that applies existing knowledge about a rock mass to develop a model of a rock engineering situation which can then be used to develop procedures to deliver stated objectives (Hudson, 1992; Nathanail et al., 1992).



How it works

The BR2 tool works via a matrix - an N2 chart - that models the urban fabric of the city. The matrix is build-up out of squares representing the fabric and its functioning (figure 3.1). The diagonals from the top left corner to the right bottom form the important elements e.g. housing stock, transportation, biodiversity etc. Each other

Figure 3.1 The concept of an N2 chart (Leney, 2008, p. 129)

3. The BR2 tool

3.1 Introduction

square is horizontally and vertically linked to two components and describes the relation between the first and the second one. So as square 1,2 is the relation between 1,1 and 2,2, so will 4,7 be the relation between 4,4 and 7,7.

An interaction matrix can be tailor-made for every specific site. The methods used to do so are expert judgement and winnowing. With the first method a group of expert and stakeholders can determine which elements are relevant and important enough to be a leading diagonal. The second method is a more systematic process. Winnowing, in this context, means discarding the irrelevant. The theoretical process is to start with a coarse matrix with 3 or 4 very general elements, e.g. natural environment, built environment, policy and finance. Then the elements which do not seem relevant are winnowed out (unlikely in the first stage). Next each element is expanded into several sub-elements, followed by winnowing out any of these that are not relevant to the site and surrounding area. This process is continued until the user is content with the matrix. When done alone this can make the matrix subjective. I therefore recommend to combine both methods to create a tailor-made interaction matrix.

There is also a generic interaction matrix (figure 3.2).

Biodiversity									
	Natural environment								
		Built environment							
			Demographics						
				Quality of life					
					Public economic				
						Private economic			
							Individual economic		
								Local inst. control	
									Central / E.U. inst. control

Figure 3.2 The generic interaction matrix (own illustration, based on Leney, 2008, p. 187)

3. The BR2 tool

3.1 Introduction

The matrix resembles the urban context of the redevelopment site. The different options are tested by putting them in the matrix as a perturbation of the system. The following steps have to be taken for all the different scenarios. The first step is to identify all the relevant relations in the system. This is also called BCM, or binary coded matrix. Every site is different and so are the relations between different elements. In the BCM relations are marked with a zero when the relation is irrelevant or non-existing or with a one when the relation is relevant. The matrix will be coded with zeros and ones (figure 3.3). These values are summed and plotted in a graph. The graph shows which elements are either dominant or subordinate in the system and if they're active or inactive.

After the relevant relations have been identified, it is necessary to appoint them with a numerical value according to the impact on the system. This is done according to the ESQ method, or expert semi quantitative. There are two ESQ matrices, one with values between $-n$ and n (in the generic matrix -2 to 2 is used) and one with only positive values (0 to 4 in the generic matrix). These values indicate the impact of the redevelopment on the urban system. The horizontal rows in the matrix are the values of the influence the element has on other elements (cause). The vertical columns are the values of the influence other elements have on the element (effect). These numbers are summed up and plotted (this is done the same way for the BCM). The resulting graph shows whether an element is either dominant or subordinate in the system and if it's active or inactive (figure 3.4).

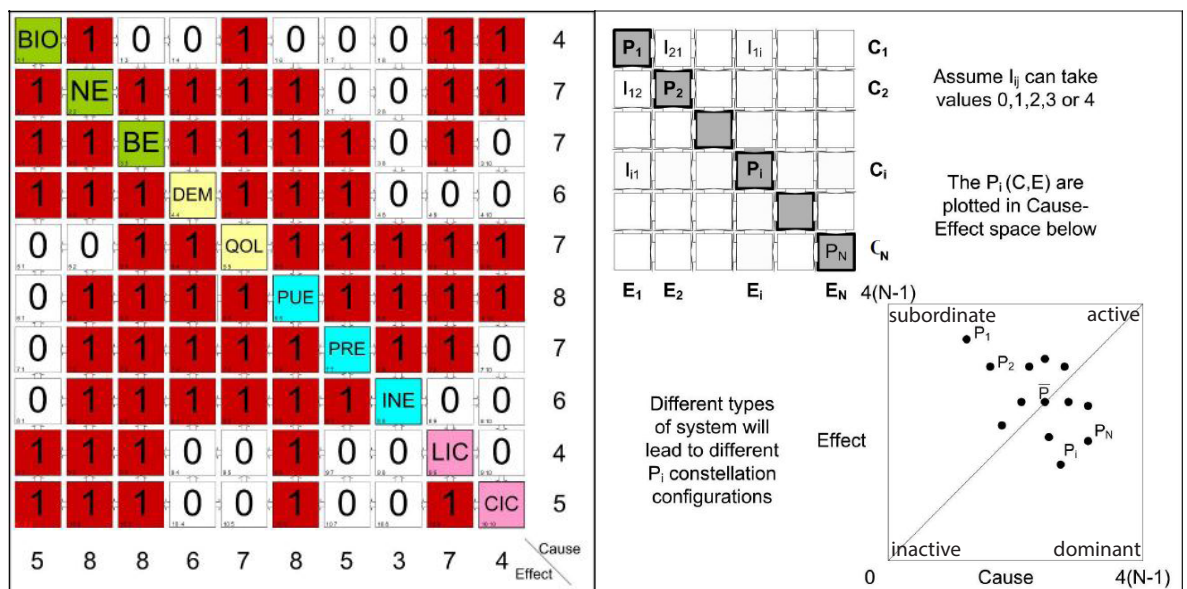


Figure 3.3 Binary coded matrix - BCM (Leney, 2008, p. 188-189)

Figure 3.4 ESQ matrix and graph (Leney & Nathanail, unknown)

3. The BR2 tool

3.1 Introduction

Based on these outputs, the different redevelopment options can be assessed according to the impact they'll have on the urban context and whether that impact is positive or negative. The best option can be selected for redevelopment.

The generic interaction matrix comes in an excel file (figure 3.5) in which you can insert the BCM and ESQ values per relation and which then generates the graphs.

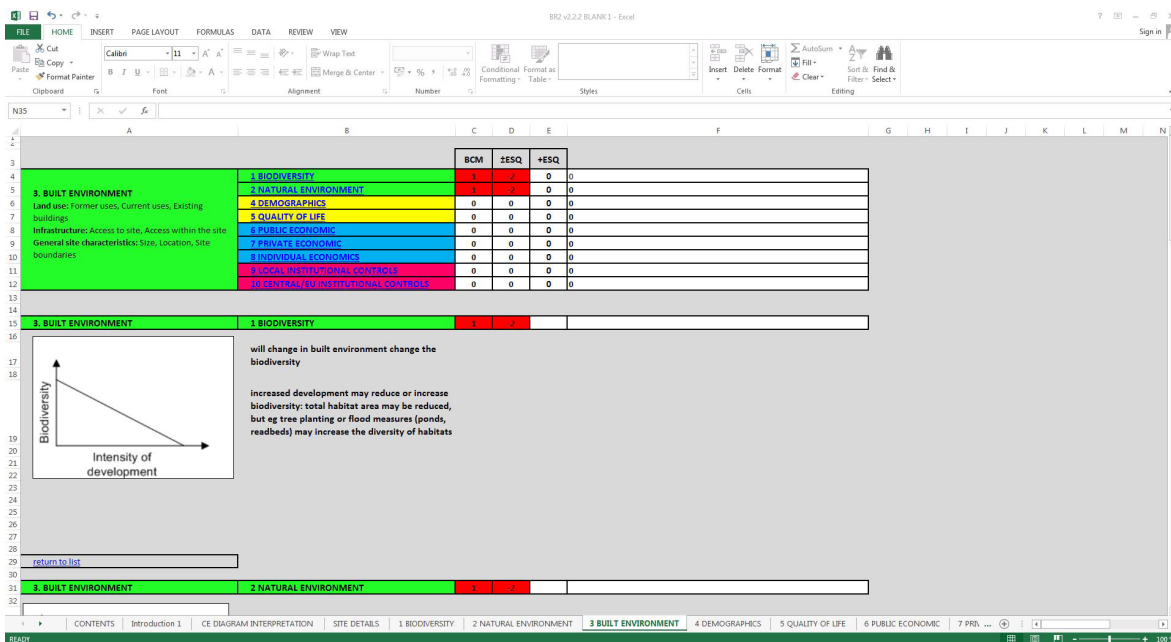


Figure 3.5 Generic interaction matrix excel file (BR2 excel file)

How to apply it

After the theoretical understanding of the method, some questions may arise. It might seem that the method is an objective way to determine what effects changes on a plot have on the urban fabric surrounding it. In some ways it is and in some it's not. Since there is no coherent body of theory for the redevelopment of brownfields (Leney, 2008, p. 139), a lot of decisions regarding the matrix have to be made based on expert knowledge. When done alone or in a small group the outcomes may be subjective. The answer to this would be using the tool with a good cross-section of stakeholders and experts.

Another question that may arise is about the scale of the redevelopment. The tool seems very applicable when there is a mono-functional site surrounded by the affected urban context. But what if the site itself forms a part of the context? That challenge will be elaborated further by looking at the M4H case.

3. The BR2 tool

3.1 Introduction

A full list of questions I personally had after reaching a theoretical understanding of the tool, together with the answers provided by the University of Nottingham, can be found in appendix C.

The original aim of the method is to analyse the impact of different redevelopment options for an urban brownfield site on the urban system. The results can be compared and evaluated, and the best option can be selected for redevelopment. The tool is meant for use by urban development project teams. They are the leading party; however, a good cross section of all stakeholders of the project is needed for valid results and conclusions.

The tool is always applied in an interactive meeting. There is no coherent body of knowledge for urban brownfield regeneration (yet) and all sites are different. Therefore expert judgement is needed to use the tool, but within a transparent process: stakeholder participation. The approach of the method is covering all steps in the process. It helps to find the best suitable option for brownfield redevelopment. This includes financial aspects, economic aspects, technical aspects, social aspects etc. and relates all these different fields to each other by exploring the effects they have on each other. The urban environment is a very complicated thing. Cause and effect is not always easy to determine. To try to define what kind of relations between important aspects in that environment are present and relevant, knowledge about all fields has to be present and stakeholder/expert participation is needed, which also makes it a communicational tool.

It takes some time to understand the tool and to get familiar with it. When the generic matrix is used, the tool is easy to use. It is presented in an excel sheet and is very user friendly. Defining the relations and defining whether or not they are present and relevant (and valuing them if they are) is the difficult part. If a site specific matrix is being produced, it becomes a bit more complex and good knowledge about the site and the surroundings is needed. The difficulty is then medium, since the most important aspects of the site need to be defined in cooperation with stakeholders/experts. Experts and stakeholders are essential, so costs will be made to hire experts and to facilitate workshops.

The method is meant for use in the second part of the initiative stage and the design/planning stage. In the first part of the initiative stage, information is gathered. In the second part, this information is used to model the urban context and define relations

3. The BR2 tool

3.1 Introduction

between them (or, when the ready-to-use generic matrix is used – see figure 2 – instead of producing a site specific matrix, the active relations are defined). Then, in the design and planning phase, different scenarios are developed and assessed with the tool. Comparing the outcomes can contribute to selecting the most suitable option for further development. The ideal process would require 2 workshops (figure 3.6). In the first one the current context is discussed (and modelled) and the relevant relations are defined. The potentials for the area are explored. Multiple options for redevelopment are defined. Then, after the workshop, the project team develops the scenarios further. In the second workshop the different plans are assessed and the results are being compared. The most suitable option is chosen for further development by the project team. Depending on whether or not a site specific matrix is being made, the first workshop can last from half a day up to three days; in the exercise of Leney (2008, p. 186) the generic matrix took three days to produce. The second workshop would take at least one full day. All other aspects, such as data collection, design, desk study etc. are also present in the design process when the BR2 tool is not being used and therefore not calculated in the time span of the tool.



Figure 3.6 Process of designing with the BR2 tool (own illustration)

3. The BR2 tool

3.2 Applying BR2 on Hofbogen, Rotterdam

After the theoretical understanding, the first step was to apply the tool on a design case. In order to get a grip on the generic interaction matrix and its content, I chose to apply it retrospectively on a project I had already done for the Bergpolder neighbourhood in Rotterdam. This way the project was merely a tool to understand the matrix rather than using the matrix to develop a plan. The project focusses on improving the air quality and urban environment of the location, which is situated along one of the busiest highways of the country. It entails the introduction of pine trees in the public space, which can bind much more particulate matter (PM10) than deciduous trees. Beside that TiO₂ is implemented in the road surface of the highway to bind particles out of the exhaust gasses. However, the run-off water would contaminate the local water system, so the water is redirected into the neighbourhood where it is purified in constructed wetlands. A system to store pluvial water is also integrated. Visual representation is provided in appendix C.

When using the excel file, the first notable thing was that it was well structured and navigable and user-friendly. A small detail is that the use of colours can be adjusted, both for functional and aesthetic reasons. The bright colours can be very distracting. In the BCM the cells turn red if that cell is active (when you enter "1"), but red is commonly linked to negative values, whilst here we just mean active or inactive.

The most interesting observation was that identifying the relations is very difficult, especially when done alone. It also shows that without proper knowledge of the subjects the results are meaningless; there were no surprises with the outcomes of the BCM. Built environment (Hofbogen structure and street), Public economics (public space), Private economics (businesses) and Natural environment (trees and wetlands) are dominant. The values for the BCM and the reasoning can be found in appendix C.

As mentioned before, without sufficient knowledge it's hard to determine whether a relation is active, let alone put a value to it. In the examples in the thesis of Leney (2008) a lot of mechanisms or relations are inactive because they're not significant enough. But how to establish this? For example: are changes in natural environment (addition of wetlands and more trees) significant enough for an increase in biodiversity? And if so, is it rated +1 or +2?

3. The BR2 tool

3.2 Applying BR2 on Hofbogen, Rotterdam

The lack of knowledge can be supported with many more examples. An increased Quality of life (QoL), in this case a livelier street, leads to less crime and anti-social behavior and degradation of the built environment (BE); $QoL > BE$. This also greatly depends on the demographics and social situation, though. How can we predict the change in the amount of crime or anti-social behaviour? We need figures and facts for mechanisms like these.

Another thing was to avoid circle reasoning. It is hard to establish what effects what, for example: does biodiversity affect natural environment? Change in biodiversity (BIO) requires change in natural environment (NE). Does it work two ways? It then also brings us to the problem of direct and indirect relations. For example: quality of life is increased through natural environment. Is QoL then also an active influencer?

Indirect relations combined with insufficient knowledge can lead to difficult questions. For example: the mechanism between QoL and BIO. The question posed in the excel sheet is whether QoL may increase volunteering (nature conservation) or gardening (which can increase BIO). In this case, QoL is enhanced by NE. Does QoL then indirectly influence BIO? It also depends on the type of people living in the neighbourhood. Better QoL does not directly result in an increase in BIO. In our case, demographics (DEM) doesn't change in quantity, but the changing of the urban area (removing cars from the street and using the space for a constructed wetland) might result in people moving away and other people moving in. Will the old population engage in volunteering or gardening? And how about the altered population? And how many people will actually move? This shows a very complicated issue which seems hard to solve, so assumptions have to be made, which is contradictory to the idea of this being an evidence based approach.

This leads to the necessity of using the tool in a workshop with a group of stakeholders who have expert knowledge about the area and the mechanisms. This is simulated in the next paragraph.

3. The BR2 tool

3.3 Applying BR2 on M4H - workshop

The workshop to simulate stakeholder participation took place on 29th of July 2014. The aim of the workshop was to assess multiple options for redeveloping the Merwe-Vierhavens (M4H) site in Rotterdam with a group of people that could function as stakeholders and experts. A list of participants and additional information can be found in appendix C.

Introduction to the workshop

The M4H site is still an active harbor area. However, plans are already being made for when the port related industries cease activities on their current location. The leasehold of the plots will not end simultaneously. In the first steps of redevelopment, the plot lies within the context of the active harbor area (figure 3.7). The figure shows the difference between the example cases described in the thesis of Leney (2008) and the M4H case. In the examples the plot was always surrounded by non-industrial context and the effects of redevelopment on the context could be modelled. In the case of M4H, the plot is still surrounded by an industrial context. The effects of redevelopment do not have a direct influence on the neighbourhoods surrounding the harbour area, but the industrial context has more influence on the redevelopment itself. Since the first phase is situated on a plot alongside the water and on only light contaminated ground, the plan seems commercially viable - the only restraint is the operating Eon power plant. Therefore using the BR2 tool is not very apparent. In a later stage, the area around this power plant (phase 4, figure 3.8) will be redeveloped within the context of the earlier developed phases – dwellings, offices and businesses. The location is heavily polluted and costly to remediate and is located less favourable if Eon stays (but switches to geothermal energy). Therefore multiple options for redevelopment are assessed (figure 3.9). In this workshop, only the park option, scenario C, is assessed. The park will be a cultural park. As a reference we can use the Emscher park in Germany.

Emscher park

The Emscher Landscape Park is a regional park in the northern Ruhr area in Germany. The goal: urban, social, cultural and environmental measures as a basis for economic change in an old industrial region, the largest industrial region in Europe. The concept of the plan was the creation of a new type of park that connects different spaces together: preserved areas of the pre-industrial cultural landscape, industrial landscapes and post-industrial landscapes. The Rotterdam harbour area is the largest port area in Europe and under constant transformation. The Emscher Park can prove to be a good

3. The BR2 tool

3.3 Applying BR2 on M4H - workshop

example for the redevelopment of contaminated ex-harbour plots by improving the image to provide for an economic basis and by using the old industrial identity to do so.

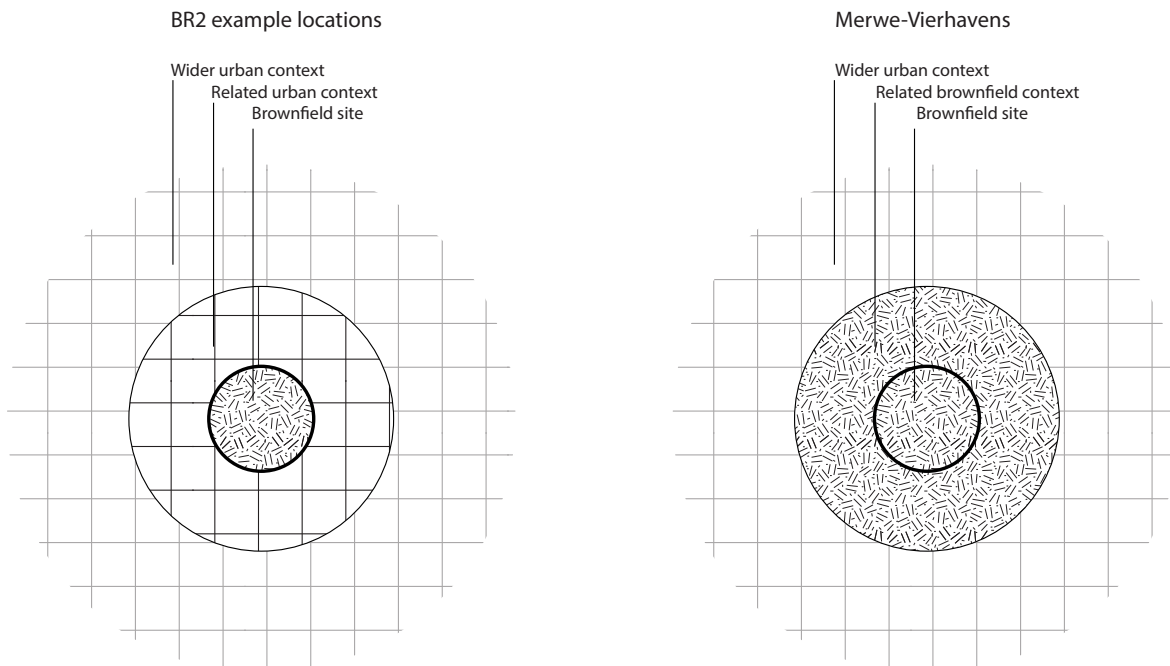


Figure 3.7 Comparison between tested sites in the PhD thesis and M4H (own illustration)



Figure 3.8 Phasing of the redevelopment of the M4H area (own illustration)

3. The BR2 tool

3.3 Applying BR2 on M4H - workshop

Scenario	A	B	C	D
Function	Housing	Industry	Park	Mix housing/industry
Dwellings M4H	4800	3180	3180	3990
Dwellings M4H if phase 5 = industry	4160	2540	2540	3350
Inhabitants	10.560	7.000	7.000	8.780
Inhabitants if phase 5 = industry	9.150	5.590	5.590	7.370
Eon power plant	Moves or transforms	Moves or transforms	Moves or transforms	Moves or transforms
Bridge to Schiedam	Yes	No	Yes	Yes
Amount of Remediation needed	High	Medium	Low	High/medium

Figure 3.9 Redevelopment options for the eon power plant site (own illustration)

Results and reflection

On a general note, the participants of the workshop had some trouble defining the boundaries of the site when using the matrix. Sometimes they included the context and sometimes they excluded it. When talking about demographics for example, the conclusion was that there would be no inhabitants living on the site, but the inhabitants of the immediate context weren't taken into consideration. Relations as natural environment on individual economy were defined as value of housing, but was left out (when it actually shouldn't have been) because there was no housing on the site. The on/off site considerations can be confusing. When talking about jobs the participants tend to talk about employment in the area. However, information about where the workforce comes from isn't available. There can be more jobs in the area, but it could also be that it doesn't affect the local population; in this case the relation would be irrelevant. More jobs could increase traffic, what would indeed affect local population (and environment). Next time the method is used, there should be more awareness of these, sometimes confusing, relations.

The excel file itself is very user friendly and well organized. When identifying and valuing the relations, there was some confusion about the colouring. Red triggers the idea that something has a negative value, whereas green usually means positive (value). It is confusing that the binary coded column turns red when a relation is active, as if it implies a negative relation.

Another thing was that built environment is sometimes defined as quantity and sometimes as quality (the relation between natural environment (NE) and built environment (BE) is

3. The BR2 tool

3.3 Applying BR2 on M4H - workshop

about quantity where the relation about BE and quality of life (QoL) is about quality). The expert semi quantitative (\pm ESQ) values turn red (or orange) when negative and green when positive. When talking about quality that makes sense, but the relation between quality and quantity is not always equal. When more natural environment leaves less space for built environment, that is negative for the amount of built environment. It doesn't say anything about the quality of that built environment, though. There could have been a lot of low quality buildings there before, whilst the few that remain after the intervention become of high quality. The direct relation would be negative (less BE) but that could also mean something positive, so the numerical values about BE are hard to compare or sum when some are about quality and other about quantity. Overall, the definitions should be unambiguous (e.g. quality and quantity is ambiguous).

The example questions in the excel sheet can sometimes have a limiting or confusing effect. When taking institutional controls as an example, we can see that the relations with the first elements (biodiversity, natural environment, built environment) are defined as protection, which were interpreted as laws during the workshop. Later on (with other elements) the relations are defined as effects on planning as well. In this case, the effect of quality of life on local institutional controls (LIC) is indirect. Quality of life is for a big part due to the change in natural environment, so to value this relation positively would be double, since it should already be valued as NE on LIC. But since LIC was only being considered as laws, the relation was said to be inactive. The example questions are very helpful, but can sometimes also be confusing.

There are more double relations in the method. This could be because it is hard to define what is leading and what is indirect. For example, more natural environment (NE) leads to more space for biodiversity (BIO) and less built environment (BE) could lead to more space for biodiversity (unless it is only an empty field). The second one is indirect; more BIO due to more NE and less BE due to more NE. Another example is between NE and BE. More space for NE leads to less space for BE. Less space for BE also leads to more space for NE. However, the intervention is a park which makes the first relation relevant and the latter indirect. Biodiversity and natural environment are in general very closely related, which makes it sometimes hard to avoid double relations (however, we always defined that biodiversity increases due to natural environment and didn't consider that BIO can also increase in a more urban environment).

3. The BR2 tool

3.3 Applying BR2 on M4H - workshop

At the relation between central institutional controls (CIC), e.g. the relation between CIC and NE and BE, the participants talk about the effects of existing policies on the intervention. For all the other elements only what is changed in the intervention is being regarded. If the same would apply here, then existing policies would have no influence on the intervention in the matrix (which makes sense since it is about the effects of the intervention on the urban context). If not, then the relation between LIC and private economics would not be inactive because there are subsidies.

A note about the relation between public economic (PuE) and institutional controls; tax revenue is PuE, so the relation is defined the wrong way around in the question (how would development affect tax revenue?).

The reasoning of the participants was not always consistent and clear during the workshop. At the relation between private economic and natural environment for example, it was stated that the relation was double and already mentioned at public economic and natural environment. But PuE is about more public money so more potential for biodiversity. Private economic is about more private money, so more development and less potential for biodiversity (even though these cultural companies/activities will benefit from the park and thus biodiversity, they will still need parking etc. which gives less room to biodiversity). More specific questions in the excel file of the generic matrix could be one way to guide the user through complex issues.

Another example of inconsistent reasoning is between private economic (PrE) and public economic and vice versa. Between PrE and PuE the participants stated that more companies leave the area than companies that settle there, though the other way around the balance is claimed to be equal. After filling in the matrix, it would be good to review everything one more time to rule out inconsistencies etc. (perhaps not immediately after the session though).

Another aspect that is quite arbitrary is to determine the impact of a relation (whether it was ± 1 or ± 2). The positive and negative values in the concluding \pm ESQ table are still a bit confusing. When there are 4 positive and 4 negative relations about an element the sum is zero which makes it seem that it is not influenced. The negative and positive relations are still visible though when you look closer at the

3. The BR2 tool

3.3 Applying BR2 on M4H - workshop

matrix, but it is not visible in the graph (e.g. in figure 3.11 PuE in the graph is extremely dominant and not at all subordinate since it is on the x-axis, though we can clearly see in the matrix that is indeed effected by two other elements, PrE and NE). An idea would be to split the positives and negatives instead of summing.

The participants completed the assessment in just over an hour. There was no fact checking, nor did anyone check any figures or statistics about jobs, taxes, population etc. Therefore it stays very general. To make it really work, all the facts and figures are needed. That would require that the plans for the different scenarios are detailed enough and that the time and effort for the assessment increases. But it is necessary to end up with valid conclusions. An example is the element individual economics. The question in the excel sheet regarding the relation to natural environment is: will changes in individual economics affect spending on e.g. private open space? How can one know if the plan changes individual economics? If it is related to jobs created, it is unknown where the employees will come from. Without any statistics valid assumptions can't be made.

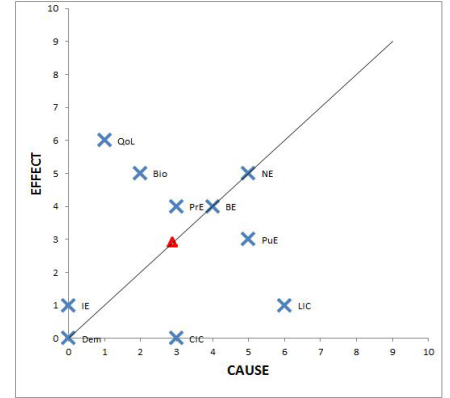
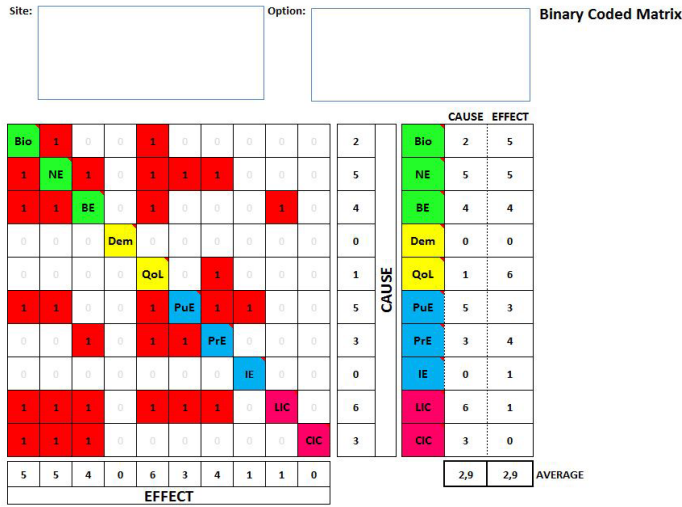
The conclusions about M4H resulting from applying the BR2 tool in the workshop are very general. In the BCM (figure 3.10) we see that local institutional controls and public economic are dominant, which seems logical since a park function is being planned which is publically funded. The biggest influenced element is quality of life, which also seems logical since an industrial area with a closed waterfront becomes a public park. Also biodiversity is influenced, also due to the major function change.

In the ESQ (figure 3.11) we see local institutional controls and public economic again as dominant factors. However, built environment also suddenly becomes dominant. That could be because we indirectly link changes in natural environment to built environment. The new park is to make more NE. That results in less BE. In this figure BE influences NE, which means less BE leads to more NE. It doesn't work both ways, the intervention is to do one or the other.

Another conclusion is that the method can also be used to get a better understanding of the urban system. We only assessed one redevelopment option, so the scenarios can't be compared now. However, we did see which factors are dominant or subordinate and less or more interactive in this particular scenario. This could be helpful if we want to realize this plan but didn't know where or how to start the transformation.

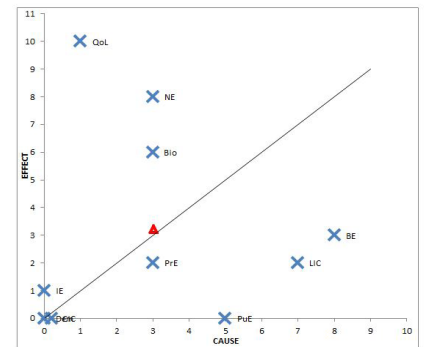
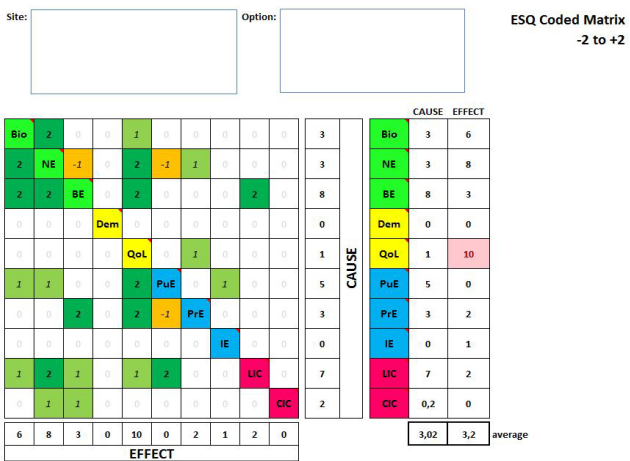
3. The BR2 tool

3.3 Applying BR2 on M4H - workshop



set max extent of C-E line	min	0
	max	9

Figure 3.10 Results workshop, BCM (BR2 excel sheet)



set max extent of 1:1 line	min	0
	max	9

Figure 3.11 Results workshop, ESQ (BR2 excel sheet)

Additional notes

For the plan of the area, instead of assessing the alternatives as separate elements, they could be considered as subsequent land use functions in different phases of a plan (variant C, followed by D and A). It is a possibility to look at the opportunity to use the tool for sequence modelling. This could be done by assessing the situation after every phase of the plan. A mixed park/industry function can be planned to boost the image of the location before redeveloping it for housing. An example is the location of the old airstrip Valkenburg where currently the success musical Soldaat van Oranje is performed and positively brands the area for future housing developments (Smit, 2012). This will be further explored in paragraph 3.4.

3. The BR2 tool

3.3 Applying BR2 on M4H - workshop

The Merwe-Vierhavens site is a difficult case, since it is not a brownfield following the definition in chapter 1 (p. 5). It is a combination of brownfield sites, and sites that are currently in use, but that will be redeveloped in the future (different time spans). The size of the study area is therefore larger than the average European brownfield (Oliver et. al., unknown, p. 7) - the size is over 100 hectares. The BR2 tool was not specifically developed for brownfields, so the fact that M4H isn't a brownfield shouldn't matter for applying the tool. It might be hard to compare results of this case to results of the use of BR2 on the brownfield sites mentioned in the thesis of Leney (2008), since those are smaller in size and could therefore be redeveloped in one go. In this case, the tool can be used to understand urban systems and to see which factors are dominant when considering redevelopment. These factors can be starting points for the execution of the plan.

3. The BR2 tool

3.4 Applying BR2 on M4H - phases

In this paragraph I applied the BR2 tool to assess subsequent phases with different land use functions for the redevelopment rather than different scenarios.

Applying the tool on the location generated several questions, especially concerning the scale of M4H and whether subsequent phasing due to the complexity that that large scale entails, will be a problem for the use of the tool. The answers to these questions are discussed at the end of this paragraph.

1. On what scale is the BR2 tool applicable?

In the examples in the thesis of Leney (2008), only single plot or single function interventions are tested in the BR2 tool. The M4H area is substantially larger and will therefore not be occupied by a single function. The context of the intervention must be modelled to test the action as a perturbation of the system. If the intervention is made on a plot in the larger area of M4H, is then that area modelled as context, or the surrounding neighbourhoods? The M4H area is after another part of the brownfield, and we want to test the effect on the urban surroundings.

2. Is phasing included in the BR2 tool?

This question is relevant for larger projects with different stages. In the thesis of Leney (2008) only small scale interventions are considered. When we talk about a first intervention, it is clear what the context is. In a second, third or next step however, that context is not so certain. We can only model the context when we assume all previous phases are executed as planned. The retrieved conclusions are then not very flexible; they are based on the assumption that the previous intervention is successful. The more stages there are, the more inflexible it is. (The urban environment is very dynamic and changes a lot). Should we then make variants for different urban contexts per phase? That would mean that how further the stage is, how more variants there are.

3. To what extent of detail is the BR2 tool applicable?

The leading diagonals seem very generic. And they have to be, in order to model the context. But until what extent does that condition limit detail? Is the BR2 tool meant for the determination of the most suitable function of the area? The way that function is designed has also an impact on whether the intervention works. Is that past the tool, or can variants of the design on that level also be modelled?

3. The BR2 tool

3.4 Applying BR2 on M4H - phases

Aim and introduction to the context of the assessment

The aim was to apply the BR2 tool in a “series approach” rather than a “parallel approach”. There are no different options assessed, but different phases within the redevelopment process to understand the dynamics of the urban environment within every phase. This way we attempt to get a better understanding of what the leading or dominant elements are in a specific redevelopment.

The different options for redevelopment as addressed in the workshop in paragraph 3.3 have formed the basis for the plan. For the entire location there is a phasing, consisting of phases I – V (see figure 3.13). Phase IV is the phase where the Eon/Citronas location is redeveloped and the phase on which we focus and apply the BR2 tool. For this there are 3 sub phases: IV-1, IV-2 and IV-3. An overview is also given in figure 3.12.

Phase	IV-1	IV-2	IV-3
Function	Industrial park	Cultural park	Inhabited park
Dwellings location	0	0	1200
Dwellings M4H	2540	2540	3740
Inhabitants	0	0	2.640
Inhabitants M4H	7.000	7.000	9.640
Eon	Switches to geothermal	Old building turned into cultural inst.	-
Amount of Remediation needed	Low	Low/Medium	High
Remediation techniques	Phytoremediation	Phyto & soil flushing	-

Figure 3.12 Redevelopment phases for the eon power plant site (own illustration)

Phasing

Figure 3.13 on the next page provides a step by step overview of the different phases discussed. In phase I the Merwehavens will be developed into a residential area and the Marconizone will become a cultural strip in cooperation with the initiative Artpark. Phase II will focus on the strengthening of businesses around the Marconitowers. Also the infrastructural node Marconiplein will be redeveloped. In phase III housing will be developed on the peers of the Vierhavens. In phase IV-1 gentle remediation will be started on the empty Citronas plot and the park along the riverside will be developed together with the main green infrastructure in the neighbourhood. At this stage an inflatable dike will be developed to protect the new residential areas. In phase IV-2 the vacant plots will be demolished en remediated. The old Eon and Ferro buildings will be turned into cultural institutions. Phase IV-3 will focus on housing developments on the remediated plots and the terrain next to Eon and Ferro will become a permanent



Figure 3.13 Phasing of the M4H location (own illustration)

3. The BR2 tool

3.4 Applying BR2 on M4H - phases

park. In phase V the most western strip of the area will be developed further in cooperation with the municipality of Schiedam. If the area proves to be attractive and in demand, new residential towers can be developed along the water.

Results and reflection

One of the first matters that were encountered when applying the tool on subsequent phases of a project is the problem to determine when certain relations or elements become significant enough to have an impact on the system. Figure 3.14 illustrates this matter. In the first graph we can see that by the time phase 1 reaches a level where relations and elements become of a certain level that they influence the system, phase 2 has already started. Should at that point the effects in the matrix be taken into account for phase 1 or for phase 2? There is a need to define at what point in time the BR2 is applied, as shown in the second graph. If it is applied before a next phase starts, the effects of the previous phase might be tangible in the next phase. If chosen to apply at the end of a phase, than some effects of the beginning of the next phase might be tangible in the previous phase.

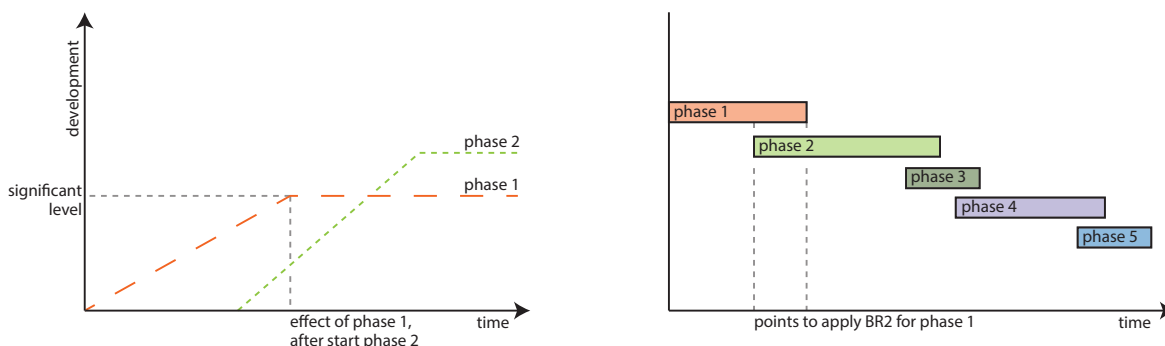


Figure 3.14 When to apply the BR2 tool during a phased project? (own illustration)

Crucial information which should already be part of the plans would be when the leasehold of certain plots end, what parts will be developed when and the development times of vegetation. To look at the plan and the relations between elements more detailed, the entire site could be divided into sub-plots. This would require extra time to apply the tool to every sub-plot. What also needs to be taken into account and what might be less obvious to include in planning is for example the development time of biodiversity or social influences. These elements are less predictable but very important in the urban system. It is hard to predict what the final outcome of these aspects will be, let alone the process. An example in this case is the relation between NE and PrE in phase IV-1. At this stage, the main green infrastructure in the neighbourhood is developed, but it needs time to develop and is therefore not yet significant enough to attract new businesses to the area.

3. The BR2 tool

3.4 Applying BR2 on M4H - phases

Another point remains that of double relations, as explained in paragraph 3.3. As an example we can take natural environment (NE) and built environment (BE). In what way does the relation work? The plan is to implement more green as a main infrastructure through the neighbourhood and as a park. The result of this is less space for BE. But when we have vacant plots which can temporarily be used for recreation functions it seems to be the other way around (BE influences NE). The relevant question here would be if we plan NE on vacant plots or if vacant plots provide space and opportunity to use it for NE.

It is also related to where we place our park, under NE or BE. NE is described as green open space among others and BE as land use (which could both apply to our park function). There is a need to have a clear definitions for the elements.

Another example for double relations is related to the questions provided in the excel sheet to guide the user of the tool. The development of a park is a public investment and costs public money. The relation is between NE and public economic (PuE), which is defined as more public open space, more public spending. The question between local institutional control (LIC) and PuE states that LIC determines the level of public intervention, so more intervention leads to more spending. More intervention in this case is equal to more public open space, as defined at NE. It is clear that LIC has influence on the plans and thus the PuE, but isn't the effect on PuE now double?

Also when we look at biodiversity (BIO) and NE and BE there is some confusion. The questions are: will the change in NE/BE lead to a change in BIO? In phase IV-3 we plan more BE but it also changes the NE which is already there at that point. It is clear that BE is the leading factor but the formulation of the question suggests that the change in NE is also active.

For some elements it is not clear whether specific outcomes are positive or negative. For example with institutional controls we could say that more LIC is positive because there is more protection for certain elements. We could also say that more LIC takes more effort and money to deal with certain protected elements which is negative. Therefore the interpretation of the stakeholders is vital.

The time duration of the application of the tool decreases after the user has applied it multiple times. Although the same reasoning is being applied for certain relations after

3. The BR2 tool

3.4 Applying BR2 on M4H - phases

multiple assessments. This raises the question whether all aspects of the relations are being covered and if important relations aren't being forgotten. In this case the questions in the excel sheet can be very useful. But to prevent them from being limiting they should be applicable for different types of interventions, or there should be different sets of questions according to the type of intervention being assessed. An example of that limiting factor is that energy has not been considered during the entire exercise until coincidentally in phase IV-3 at the relation between DEM and NE.

Sometimes questions at a certain relation trigger effects at another relation. For example, between quality of life (QoL) and BE it is about crime. Crime can also decrease due to social control, which is a relation between demographics (DEM) and BE.

Another example is about local car journeys. The question is asked between private economic (PrE) and Ne, but in our case it is not commercial activity that increases car journeys, but residents driving from and to their houses. This question could be formulated at the relation between DEM and NE when there is an intervention that includes housing.

Figures 3.15 to 3.18 on the next pages show the outcomes (BCM and ESQ) of the three assessed phases. In figure 3.15 we see that in the first phase NE, BE and PuE are dominant. That is no surprises because at this stage the demolition and remediation of the Citronas plot is started which is quite large and the implementation of the main green infrastructure is started which is publically funded. QoL is the most subordinate, since the mostly concrete and privately owned land starts to get publically accessible and greener.

In figure 3.16 we see that both PuE and BE generate a lot of positive effects. It would also be expected that NE would do the same, but the positive and negative effect of this element level each other out. The negative effect on PuE is logical because it costs a lot of money, but the negative effect on BE seems not logical (as mentioned before at in paragraph 3.3). More NE results in less BE, which is negative for BE, but it improves the overall quality of the area. QoL receives a lot of positive effects.

Figure 3.17 shows that in phase IV-2 PrE and NE are most dominant. That can be explained due to the fact that the planned green infrastructure in phase IV-1 is now developed to such an extent that it has effects on the system. The dominance of PrE can be explained

3. The BR2 tool

3.4 Applying BR2 on M4H - phases

Site: Option: Binary Coded Matrix

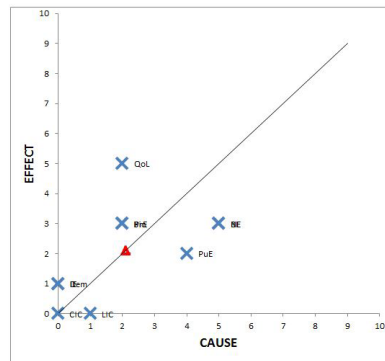
CAUSE	EFFECT								
Bio	1	0	0	1	0	0	0	0	0
1	NE	1	1	1	1	1	1	1	0
1	1	BE	0	1	1	1	1	1	0
0	0	0	Dem	0	0	0	0	0	0
0	0	1	1	QoL	0	0	0	0	0
1	1	0	0	1	PuE	1	0	0	0
0	0	1	1	1	PrE	0	0	0	0
0	0	0	0	0	0	IE	0	0	0
0	0	0	0	1	1	LIC	0	0	0
0	0	0	0	0	0	0	CIC	0	0
3	3	3	1	5	2	3	1	0	0
EFFECT									

CAUSE	EFFECT		
Bio	2	3	
NE	5	3	
BE	5	3	
Dem	0	1	
QoL	2	5	
PuE	4	2	
PrE	2	3	
IE	0	1	
LIC	1	0	
CIC	0	0	
AVERAGE			

2,1	2,1
-----	-----

set max extent of C-E line	min	0
	max	9

Figure 3.15 Results of phase IV-1, BCM (BR2 excel sheet)



Site: Option: ESQ Coded Matrix
-2 to +2

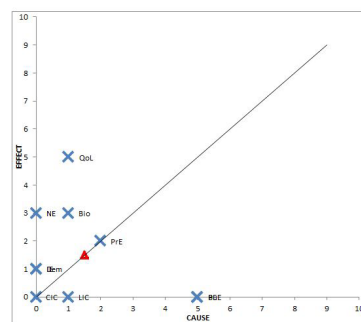
CAUSE	EFFECT								
Bio	1	0	0	0	0	0	0	0	0
1	NE	-1	0	1	-1	0	0	0	0
1	1	BE	0	1	1	1	1	0	0
0	0	0	Dem	0	0	0	0	0	0
0	0	1	1	QoL	0	0	0	0	0
1	1	0	0	1	PuE	1	0	0	0
0	0	1	1	1	PrE	0	0	0	0
0	0	0	0	0	0	IE	0	0	0
0	0	0	0	1	1	LIC	0	0	0
0	0	0	0	0	0	0	CIC	0	0
3	3	0	1	5	0	2	1	0	0
EFFECT									

CAUSE	EFFECT		
Bio	1	3	
NE	0	3	
BE	5	0	
Dem	0	1	
QoL	1	5	
PuE	5	0	
PrE	2	2	
IE	0	1	
LIC	1	0	
CIC	0	0	
average			

1,5	1,5
-----	-----

set max extent of 1:1 line	min	0
	max	9

Figure 3.16 Results of phase IV-1, ESQ (BR2 excel sheet)



Site: Option: Binary Coded Matrix

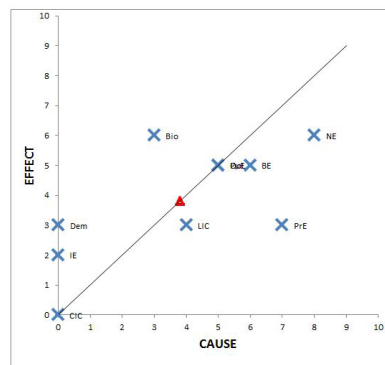
CAUSE	EFFECT									
Bio	1	0	0	1	0	0	0	1	0	
1	NE	1	1	1	1	1	1	1	0	
1	1	BE	0	1	1	1	1	1	0	
0	0	0	Dem	0	0	0	0	0	0	
1	1	1	1	QoL	1	0	0	0	0	
1	1	1	1	1	PuE	1	0	0	0	
1	1	1	1	1	1	PrE	1	0	0	
0	0	0	0	0	0	0	IE	0	0	
1	1	1	0	0	1	1	LIC	0	0	
0	0	0	0	0	0	0	0	CIC	0	0
6	6	5	3	5	5	3	2	3	0	
EFFECT										

CAUSE	EFFECT		
Bio	3	6	
NE	8	6	
BE	6	5	
Dem	0	3	
QoL	5	5	
PuE	5	5	
PrE	7	3	
IE	0	2	
LIC	4	3	
CIC	0	0	
AVERAGE			

3,8	3,8
-----	-----

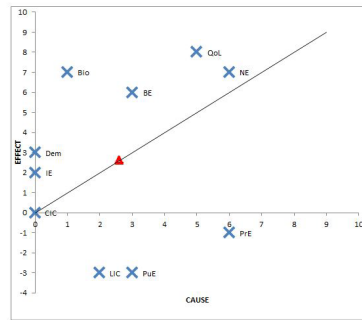
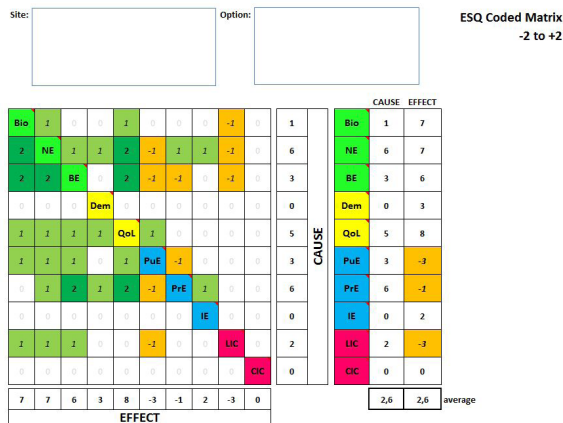
set max extent of C-E line	min	0
	max	9

Figure 3.17 Results of phase IV-2, BCM (BR2 excel sheet)



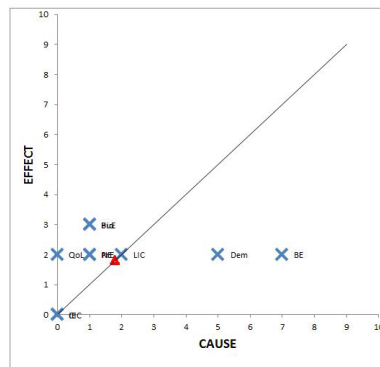
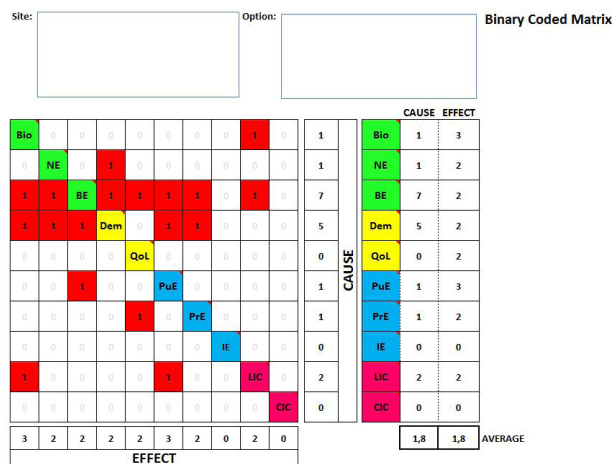
3. The BR2 tool

3.4 Applying BR2 on M4H - phases



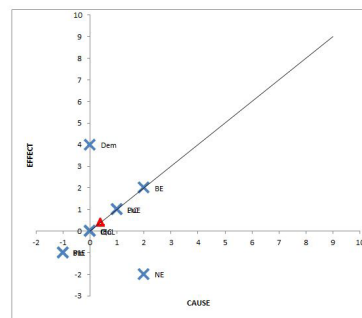
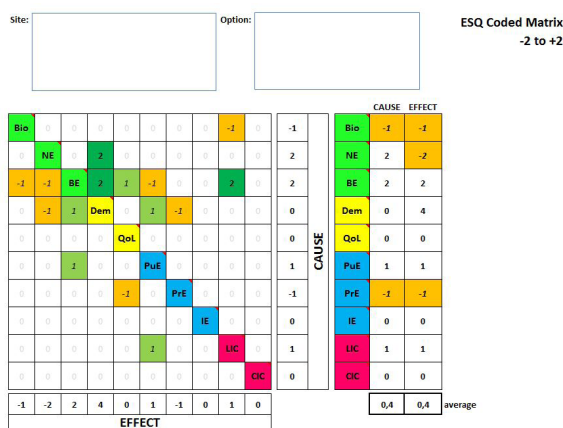
set max extent of	min	0
1-1 line	max	9

Figure 3.18 Results of phase IV-2, ESQ (BR2 excel sheet)



set max extent of	min	0
C-E line	max	9

Figure 3.19 Results of phase IV-3, BCM (BR2 excel sheet)



set max extent of	min	0
1-1 line	max	9

Figure 3.20 Results of phase IV-3, ESQ (BR2 excel sheet)

3. The BR2 tool

3.4 Applying BR2 on M4H - phases

by the attractive force of that developed NE and by the transformation of the old Eon and Ferro building into cultural facilities and institutions, which are (partly) privately owned. BIO is the most subordinate, probably mostly due to the development of NE. Figure 3.18 shows that even though PrE is dominant, it is being influenced negatively. This can be explained by looking at the (large) companies which are leaving the site. Also PuE and LIC are influenced negatively, mainly due to the costs of the development of public space and due to lost tax incomes of leaving companies. BIO, BE, QoL and NE are being influenced very positively.

Figure 3.19 shows that DEM and BE are dominant, which is because in phase IV-3 new residential developments are realized. Figure 3.20 shows that NE, BIO and PrE are affected negatively. The first two lose space due to the new development and the latter (in the context) suffers from competition from new businesses which are attracted by the new housing developments.

There are no real surprises in the outcome of these assessments. The question is whether that is due to the generic information and the lack of details or due to the fact that the assessment is done by the same person who developed the plan and (unconsciously) influences the reasoning. Both have already been argued to be true. Another factor could be that the questions in the generic matrix excel file are steering reasoning and limiting the exploration of other and more relations.

A practical note is that when multiple elements have the same value and thus the same place in the C,E-chart, the name of the elements overlap and become unreadable.

Now, the questions at the the beginning of the paragraph will be addressed.

1. On what scale is the BR2 tool applicable?

During a phased project of a large scale, we're looking at one plot (or one area) at the time within the context of its immediate area, which in this case is the rest of the M4H area. This area is still an active industrial site. The redevelopment will in the first phases not affect the urban context outside the industrial context and therefore the BR2 tool will probably not be useful during those phases. The tool could be applied during further stages of the plan.

3. The BR2 tool

3.4 Applying BR2 on M4H - phases

2. Is phasing included in the BR2 tool?

The tool can be applied for a phased plan. The comments regarding the first phases are stated at the previous question. For the further stages (we want to redevelop the entire area) there are different options. We can use the tool to look at the plan at certain time intervals, or per phased area (subareas that are delineated in a phased plan), or look at the entire site before and after. This poses difficulties. When we look at time intervals, different phases overlap. It might be hard to tell when a relation becomes relevant and when it affects what (figure 3.14). The same occurs when we look at the plan per phased area. Looking at the entire site before and after has both advantages and disadvantages. It skips everything what is happening in between, so the effects during the entire process (which will probably be at least 20 years) are not taken into account. On the other hand, when finished, the effects of the redevelopment on the context can be seen clearer. Depending on the project it has to be decided what is the best solution for that specific case.

3. To what extent of detail is the BR2 tool applicable?

The method is already hard to use as it is, trying to add more layers of detail in it (more detailed leading diagonals) will make things much more difficult. On the other hand, they also might make thing easier, since the relation between more distinguished things are much clearer than when the terms are very broad. This needs further testing.

4. The design

4.1 Design process

In this chapter the design for the M4H area will be presented (paragraph 4.2). The design process is not a structured and streamlined one. Firstly, some idea sketches will be presented as a continuation of the analysis, followed by some additional ideas. After that, the different ideas will be chronologically ordered to have an overview of the actual process. In this timeline we can see where and if there is a link with the BR2 tool. The subzones of the area are identified in paragraph 2.2 (figure 2.3, p. 10).

First idea sketches

The sketches below follow the analysis from paragraph 2.2. They present challenges and opportunities and form guidelines to steer the final design.

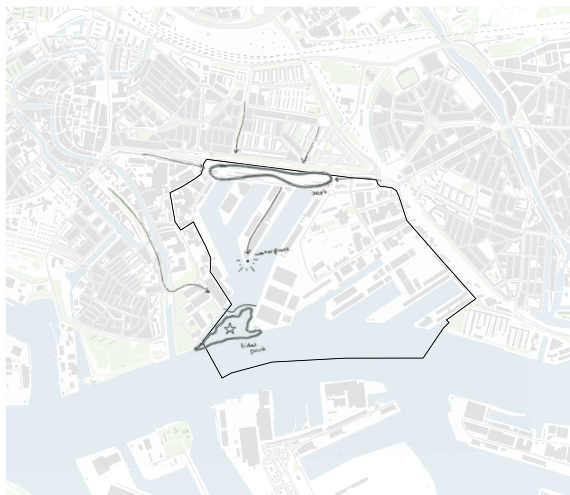


Figure 4.1 Waterfront back to the city (own ill.)

The idea was to give the waterfront back to the city. To give the waterfront a greater attractiveness to the rest of the city and region it can be combined with a tidal park. A park in the Marconi strip could be the bridge from surrounding neighbourhoods towards the tidal park between the West point and the Citronas point.

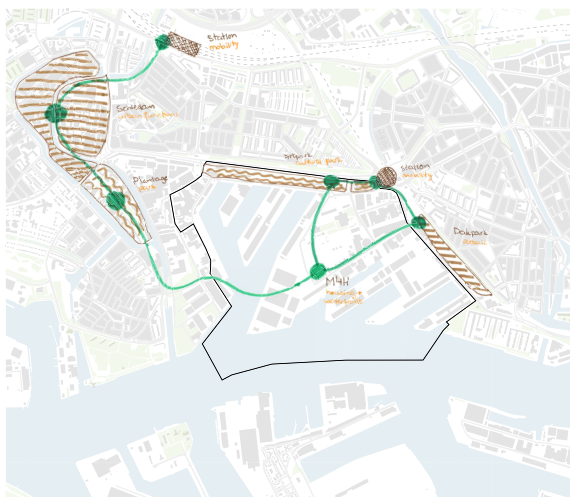


Figure 4.2 Slow traffic connections (own ill.)

In order to create better accessibility for slow traffic, the borders that the edges form need to be crossed. This way the area will be better reachable from the surrounding neighbourhoods as from the public transport hub Marconiplein. Main facilities and key locations need to be easily connected in this new slow traffic network. De Plantage is a nice park to bridge the gap to the facilities of Schiedam.

4. The design

4.1 Design process



Figure 4.3 Different areas in M4H (own ill.)

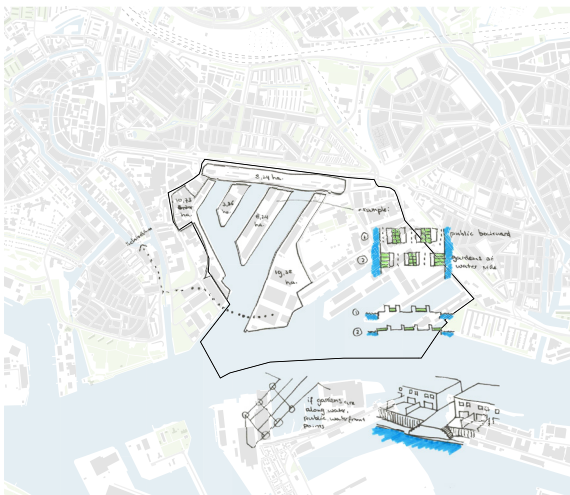


Figure 4.4 Housing Merwehavens (own ill.)

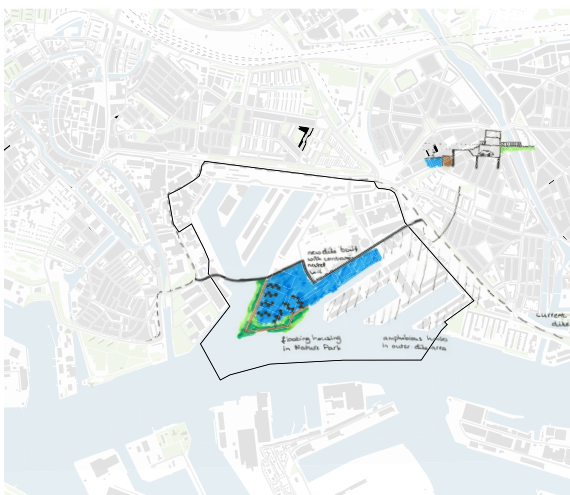


Figure 4.5 New dike and water safety (own ill.)

The area can be divided according to location characteristics and redevelopment opportunities. The west strip remains a business park next to the Schiedam business park. The Marconi strip can transform into a cultural park initiated by Artpark. The Marconiplein zone remains an office and facilities zone fed by the transport hub Marconiplein. The piers of the area are suitable for residences and the challenge is to redevelop the Citronas point and the Eon zone.

The piers of the Merwehavens can be redeveloped from the start, since leasehold, soil contamination and current facilities in the neighbourhood permit it. The piers have good dimensions for low-rise row housing. The waterfront can either be the backyard of the buildings or the street side.

To protect the area from high water, a new dike can be created. It could use the highly contaminated soil of the Citronas point and create a floating community on the former point. This dike is a short line between parts of the current dike, making the total length shorter and thus the risk of a breach smaller. The new dike creates an inner dike and an outer dike area which needs adjusted buildings and public space.

4. The design

4.1 Design process

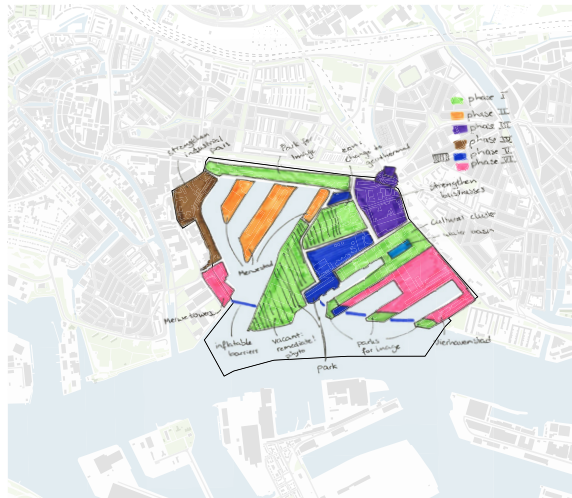


Figure 4.6 Phasing (own ill.)

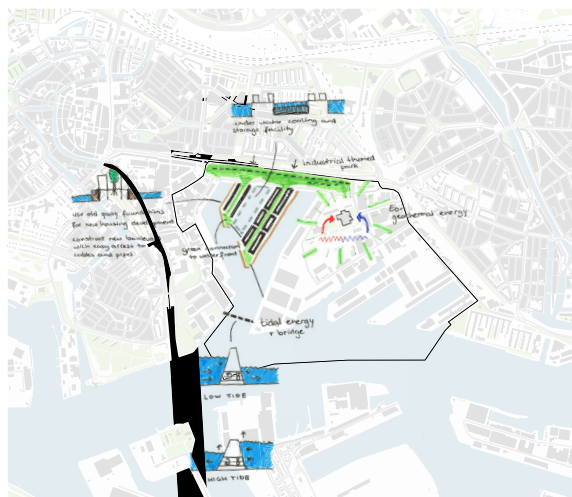


Figure 4.7 Workshop municipality (own ill.)



Figure 4.8 Eon site transformation (own ill.)

Soil contamination and leasehold of the plots are two important factors for the order of development through time. Plots which are available and only little contaminated can be developed almost immediately. More contaminated plots can be remediated (softly) and developed in a later stage.

A workshop for the redevelopment of the area at the municipality of Rotterdam led to a housing plan for the Merwe piers. The old foundations could be used for new housing blocks and a new floating or lightly constructed boulevard could be built to also accommodate cables and pipes, separated from trees and vegetation. The idea was based on the idea that Eon would switch to geothermal energy and tidal energy could form an additional power source.

The workshop with the BR2 tool led to the idea to focus on the Eon zone and the Citronas point. The rest of the area has clear potential but for the highly contaminated area of the Eon/Citronas there is not an obvious plan. The idea is to use the industrial heritage as a catalyst to upgrade the area by forming a cultural park. The transformation goes slowly and is a combination of soft remediation and temporary use.

4. The design

4.1 Design process

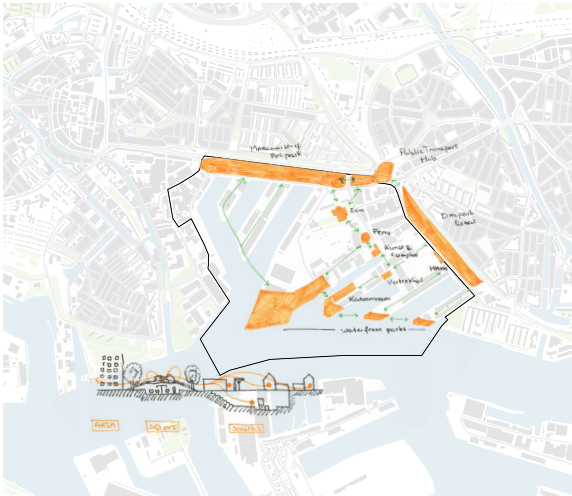


Figure 4.9 Different areas in M4H (own ill.)

The concept is to build a green infrastructure (which also provides room for slow traffic) from the first stage. It forms a network between key locations through the area. These locations will be developed in different stages and slowly but surely the entire network becomes more vast. When the image of the area is improved more housing can be developed.



Figure 4.10 New water barrier and concept (own ill.)

To ensure flood protection in the area the tips of the piers can be formed into dikes, with mobile barriers in the water between the piers. This is easier to integrate into the phasing of the plan than a new dike on land.

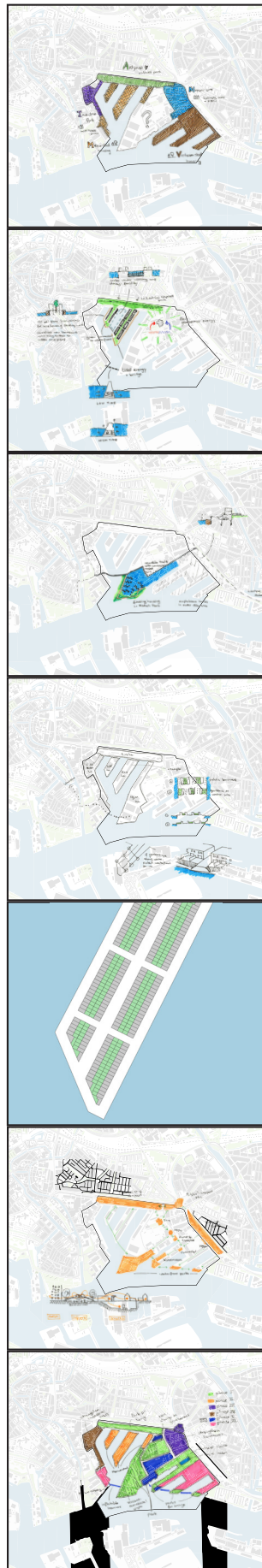


Figure 4.11 Tidal park and canal structure (own ill.)

In order to experience the water more, canals can be laid through the area which fill up with water during high tide. This way the tidal movement will become a part of the identity of the area and symbolize the connection between the city and the water. In case of extreme high water, the barriers mentioned before will close and the tidal movement will in that case no longer be visible in the canals.

4. The design

4.1 Design process



Basic phasing

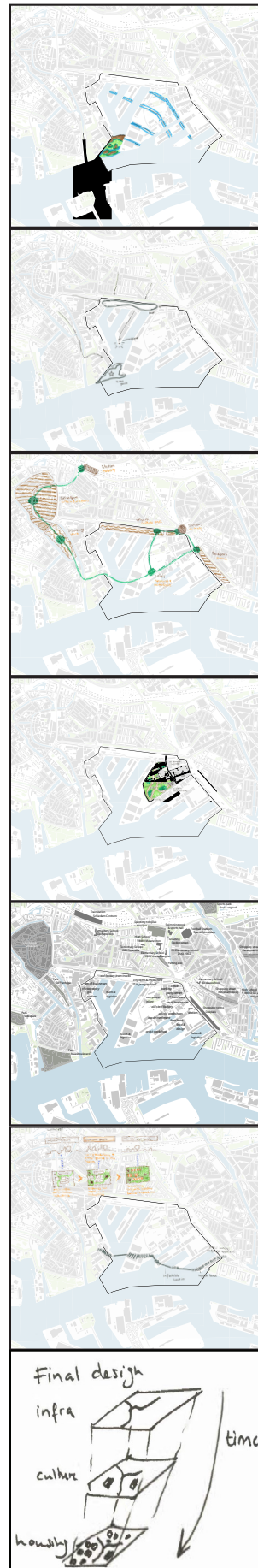
Workshop
municipality

Move dike /
inner dike v.s.
outer dike

Merwestad

Marconi hub

Phasing 2



Public
waterfronts

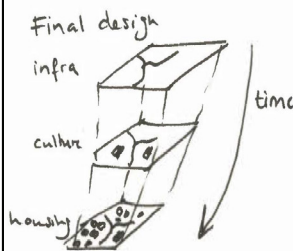
Artpark and
tidal park

Routing slow
traffic

Workshop,
focus on Eon
site

Service cluster

Workshop
parallel v.s.
serie



4. The design

4.1 Design process

The timeline on the left page shows the progress of the design and in what stage the BR2 tool played a role. After analysis some first design ideas were formed. They led to the conclusion that a large part of the area has potential for redevelopment. The design stagnated due to the urge to apply the BR2 tool to the process. Different land-uses spread over the entire area and implemented on different moments in time made the combination of BR2 and M4H difficult. The challenge of both applying the tool to a large project and making a redevelopment plan for the Eon/Citronas zone led to the decision to apply the tool to only that specific location. The different options considered during the workshop were eventually applied as subsequent phases of land-use instead of evaluating them as alternative plans. In that respect the tool (coincidentally) formed the basis of the design plan.

Left page

Figure 4.12 Chronological order of the design process (own ill.)

4. The design

4.2 Final design

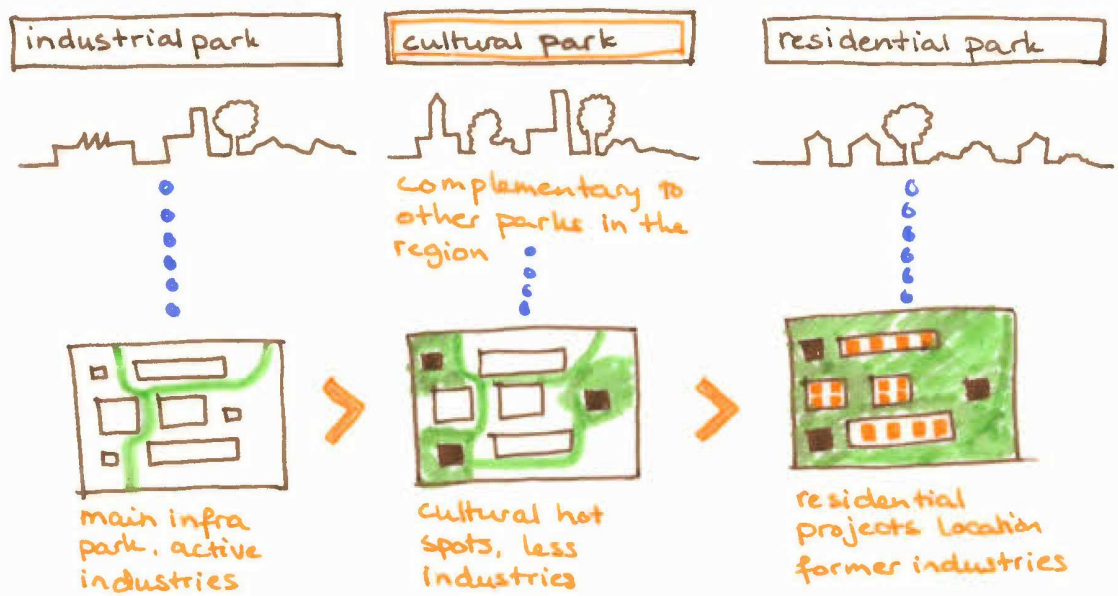
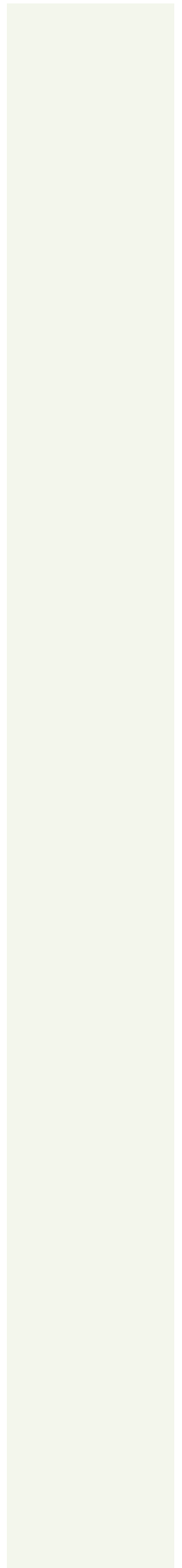


Figure 4.13 Design concept (own ill.)

4. The design

4.2 Final design



5. Evaluation and conclusion

This chapter forms the conclusion of applying the BR2 tool in the field of urban planning and design by testing it on the urban design case of the Merwe-Vierhavens in Rotterdam.

Applicability in the field

Getting acquainted with the tool was a long process of reading and doing research. However, in order to use the generic matrix the tool can be understood in a short time frame (during the workshop described in paragraph 4.3 the tool was explained to the participants in ten minutes). The excel sheet of the generic matrix is well organized and easy to use. Identifying and valuing relations between elements is based on expert knowledge and needs to be done in a group of stakeholders and expert with knowledge about the location and subjects in order to get valid results. It forms a way of communication between disciplines which makes it a communicational tool. If applied by a single person or a small group of people (with limited interests and/or limited knowledge) the method would be subjective. The most ideal situation would be to have two workshops, one to create a site specific matrix and one to assess different options for redevelopment. Creating a custom made matrix in the field of urban planning and design has not been done in this report and needs further research.

While understanding the generic matrix is easy to do, applying it poses some challenges. When applying the tool, there is a strong need for a discussion leader whom understands the tool very well and can make sure the reasoning is consistent throughout the exercise. There are small details that can aid that cause. One is to set a strict boundary for the site and the context. If the situation of the context is being taken into account in one mechanism, it also should be in others. There also need to be set boundaries for external influences. In the workshop for example, some relations were being considered as a result of the intervention, whilst others were considered as a result of existing laws. The reasoning should be ambiguous, that way results of different relations can be better compared to each other. In the current generic matrix however, unambiguous definitions of elements and mechanisms between mechanisms also impede that. In the current situation there are relations defined as a quantity whilst others are defined as a quality. The definitions should be changed in the tool or the discussion leader has to make sure strict agreements are made regarding this. There also need to be made agreements about to what extent indirect relations can be taken into account. A lot of situation indirect relations lead to circle reasoning, which needs to be avoided.

5. Evaluation and conclusion

The excel sheet itself provides questions to guide the user when identifying relations. These questions are sometimes limiting participants in thinking about the relations. It is also confusing since there are a lot of different types of land-use in redevelopment plans. The tool could provide different sets of questions according to the type of redevelopment being assessed. The colouring of the tool is also confusing at times and would work better if adjusted. For some elements it is not clear whether specific outcomes are positive or negative. This needs to be agreed on by the stakeholders.

After filling in the matrix, it would be good to review the exercise one more time to rule out inconsistencies. When there are no detailed facts and figures about the redevelopment plans the results of the assessment remain very general. In order to obtain valid and useful conclusions, the plans need to be worked out to a detailed scale before they're assessed with the BR2 tool. It still remains an exercise of doing assumptions and predictions, but expert knowledge and sufficient information can provide a solid reasoning.

The results of the valuing (ESQ chart) can sometimes be misleading. When an element has both negative and positive influences on other elements the summing can result in a value of zero influence. In the ESQ matrix the separate values are visible but in the ESQ chart they are not. A solution would be to split the result into positive influences and negative influences.

Applicability on large scale projects

The Merwe-Vierhavens is a very large area which is partly still active as an industrial area. The complexity of the area poses a big challenge. The site cannot be redeveloped at once, due to the size and economic situation, the market, the leaseholds, contamination etc. The plan will be implemented in different stages. During the first phases the redevelopment will not affect the urban context outside the still active industrial zone and therefore the BR2 tool will probably not be useful, since there is no need of assessing the influences of the redevelopment on the industrial zone. It could however be possible to use the tool the other way around, by testing the influences of the industrial site on different redevelopment options. This needs further testing.

We can use the tool to look at the plan at certain time intervals, or per phased area (subareas that are delineated in a phased plan), or look at the entire site before and

5. Evaluation and conclusion

after. This poses difficulties. When we look at time intervals, different phases overlap. The effects of an intervention in one phase could be tangible in a later phase. In order to prevent relations to be taken into account in multiple phases the phases need to be delimited. The point in time where the tool is applied also needs to be defined carefully. To be able to delimit phases, crucial information like when the leasehold of plots end, what parts will be developed when and the development times of vegetation should be known and part of the plan. The same occurs when we look at the plan per phased area. It also means that the tool needs to be applied many times and a lot of stakeholder workshops are needed for that. Looking at the entire site before and after has both advantages and disadvantages. It skips everything what is happening in between, so the effects during the entire process (which will probably be at least 20 years) are not taken into account. On the other hand, when finished, the effects of the redevelopment on the context can be seen clearer. Depending on the project it has to be decided what the best solution for that specific case is.

Another challenge for a site like M4H is to determine what the context is for a certain intervention. In some phases (when the redevelopment is in the middle of the site) the larger site itself forms (part of) the context, while in a later stage (more to the edge of the area) also the surrounding neighbourhoods are part of the equation. To avoid confusion and inconsistencies the context per phase needs to be determined.

Personal reflection

For me, it took a lot of time to understand the tool. This was partly because I focussed on making a specific tailor-made matrix for the M4H location. This posed a lot of questions and further research, which, in hindsight, delayed the process of the research as a whole. When I finally got to use the generic matrix for the first time on the Hofbogen case (paragraph 3.2), I realized that using the generic matrix on my own was already a huge challenge. A lot of questions arose during this and it became apparent that the tool had to be applied during a (simulated) workshop with stakeholders and experts (paragraph 3.3). The workshop presented new questions and challenges, which all have been discussed before, but it also steered the design (accidentally). Working with the tool made it clear that it would be too complex to apply BR2 to the entire site, and therefore the decision was made to focus on the Eon/Citronas zone, since this was the area which was least obvious for redevelopment (due to contaminations etc.) Also the proposed alternative plans of the workshop could be combined into one plan, implemented in different stages

5. Evaluation and conclusion

through time. So the tool contributed to the design even though it is not meant to. I made the mistake of wanting to design with the tool which led to a delay in the process. Looking back, it is clear that BR2 is a decision making tool and should be applied on certain moments in the design process. The design itself has no connections to the tool, other than the decision of which plan will be developed further, which is made with BR2.

Given these findings, the BR2 tool itself can be improved and the guiding of the user needs to be improved. There is a manual being developed at the University of Nottingham. Hopefully this will lead to a clearer process and a better use of the BR2 tool.

References

BALANCE4P. (not dated). Retrieved August 12, 2014, from Snowman Network:
<http://www.snowmannetwork.com/main.asp?id=255>

HOMBRE. (not dated). Holistic Management of Brownfield Regeneration. Retrieved August 12, 2014, from Zero Brownfields:
http://www.zerobrownfields.eu/quicklinks/HOMBRE-2nd_Flyer_Final_PRINT.pdf

HOMBRE. (not dated). Project Overview. Retrieved August 12, 2014, from Zero Brownfields:
<http://www.zerobrownfields.eu/projectoverview.aspx>

Hudson, J. A. (1992). *Rock Engineering Systems: theory and practice*, Ellis Horwood, Chichester.

Khan, F., Husain, T., & Hejazi, R. (2004). An overview and analysis of site remediation technologies. *Journal of Environmental Management*, 71, 95-122.

Leney, A.D. (2008). A systems approach to assess the redevelopment options for urban brownfield sites. PhD Thesis, University of Nottingham, Nottingham.

Leney, T., & Nathanail, C. P. (not dated). A systems approach to assessing and comparing redevelopment options for urban brownfield sites. Unpublished manuscript.

Nathanail, C. P., Earle, D. A. and Hudson, J. A. (1992). Stability hazard indicator system for slope failure in heterogeneous strata. In: *EUROCK'92 Symposium*, Chichester, UK, Thomas Telford. pp. 111-116.

Oliver, L., Ferber, U., Grimski, D., Millar, K., & Nathanail, P. (not dated). *The Scale and Nature of European Brownfields*. Retrieved August 12, 2014, from Cabernet:
<http://www.cabernet.org.uk/resourcefs/417.pdf>

Oxford English Dictionary (OED) (1989b). "system 4." Oxford University Press. Available at <http://dictionary.oed.com/cgi/entry/50245663> [Accessed 02 October 2006], Oxford.

Projectbureau Stadshavens Rotterdam. (2009). *Pionieren aan de Maas. Krimpen aan den IJssel: Efficiënta*.

Projectbureau Stadshavens Rotterdam. (2011). *Stadshavens Rotterdam Structuurvisie*. Rotterdam: TDS.

Rotterdam World Brand. (not dated). Retrieved September 30th, 2014, from Rotterdam World Brand: <http://www.rotterdamworldbrand.nl/merkaanpak/merkstrategie/>

Slootjes, A., Jeuken, A., Botterhuis, T. and Gao, Q. (2011). *Resultaten MHW berekeningen t.b.v. probleemanalyse en verkenning hoekpunten voor het Deltaprogramma Rijnmond-Drechtsteden*. Deltares.

References

Smit, M. G. J. (2012). RVOB Café gebiedsbranding: Gebieden beleven. Retrieved October 5, 2014, from Gebiedsontwikkeling.nu: <http://www.gebiedsontwikkeling.nu/artikel/1169-rvob-cafe-gebiedsbranding-gebieden-beleven>



Appendices

Appendix A

Summary 2009 business case Stadshavens

- Sub regions:
- Vierhavens
 - Marconistrip
 - Merwehavens

Vierhavens

Characteristics: Image is inspiring, free and rough. Monumental buildings with cultural historic value. Warehouses and harbor related functions. Unused buildings, feeling of insecurity; closed off image and lack of liveliness.

Landowner: Largely municipality (OBR, Ontwikkelingsbedrijf Rotterdam). Mostly in leasehold until 2025 or later.

Challenges: Nuisance limits and other restrictions prevent transformation. There is soil, water and ground contamination. Some private, non-accessible roads. A lot of cargo transport and no separate room for bicycles and pedestrians. Several quays are outdated. Energy transition and sustainable (urban) water management.

Intended transformation: Mix of harbor related functions and urban functions. Location for companies related to delta technology. Water for demo floating structures and energy extraction out of river water. Room for small companies to start transformation. Suitable companies to settle are:

- Focused on water, energy and sustainability
- Innovative, leader firms
- Added value to Rotterdam Climate Campus (RCC) network
- Sustainable in image
- Able to create jobs
- Able to fit within the mixed, green urban character of the neighbourhood

In the northern part of the area, and the southeastern corner, high quality residential areas will arise with 1300 to 1400 dwellings. A direct link between dwellings and the campus is intended.

Appendix A

Summary 2009 business case Stadshavens

More space for pedestrians and bicycles. Condition for this intensive transformation is that existing harbor activities are moved (to the Waal- and Eem-harbor).

Policy goals:

Transformation must contribute to secure the position of the Mainport Rotterdam as a vital economic settling area. Also add to the image of the attractive working city. Local small businesses as a connection with surrounding neighborhoods. Reconnect the city to the water.

New development must be sustainable:

- In mobility: waterbus, electrical transport over land, structured public transport, room for bicycles and pedestrians.
- CO2 neutral, H2O neutral, zero waste, climate proof building.

Intended result:

Attractive and high quality living and working environment. RCC as central party. International study area for energy transition and water management. Sustainable dwellings. Accessible area that reconnects city to the river.

Transformation strategy:

Heavy involvement of the market. Short term program should fit long term goals. Short term: innovative leisure economy, food, catering and limited workshops. Around Keilehaven: innovative businesses and leisure economy. Use the development of new dwellings in Tussendijken neighbourhood and the Dakpark mall to extend development to the Keilehaven. In transition area, shopping and leisure.

Infrastructure, route over Dakpark to waterfront at the Katoen veem building, where a waterbus stop will be realized.

From 2015 until 2037, movement of juice cluster to (presumably) Waal-harbour. In this period 1335 apartments will be built. Expansion of room for offices and businesses. Remediation needed for the entire area. Most contaminated is the old gas factory, sanitation until 2029. Investment in infrastructure, bridge over the Vierhavensstraat.

Appendix A

Summary 2009 business case Stadshavens

Sustainability: Reuse of building materials (also decreases transport) and “recycling boulevard” around Keilehaven to test street lighting etc. Connecting chocolate melter to rest heat of eon. Connect warehouses to the heat net so they don’t have to use ammoniac for cooling any longer.

Amphibiotic building, raising ground level (on building level) to ensure water safety. Raising the entire area is not an option, nor is moving the dike.

Phasing:

2010 – 2011	Redesign of Marconiplein.
2010 – 2014	Leisure realization.
2010 – 2016	Sustainability investments (noise measures eon etc.).
2011 – 2034	Offices (most part until 2014), remediation necessary for: NSI terrain, Ferro, Katoenveem, Haka, Chefaro, Juice warehouses, Rotterdam retail center.
2012	Start remediation of gas factory. Largest part between 2020 and 2029.
2013 – 2014	Social facilities.
2014	Pedestrian boulevard and public space Keilehaven.
2016	Accessibility improved.
2016	Bridge over Vierhavensstraat.
2023 – 2032	1335 apartments realized.
2033 – 2034	Social facilities and leisure.
2034 – 2036	Shopping.

Marconistrip

Characteristics: Small strip of land, should be seen together with Merwehavens to form Merwestad (Merwe city) in the future. Old shunting area Warehouses, partly empty, partly rented (also artists’ workshops). Long vistas towards the river and RDM terrain on the south bank.

Landowner: Municipality, Real estate by OBR/Havenbedrijf.

Challenges: Neglected area. Social insecurity. Criminality. Polluted soil.

Appendix A

Summary 2009 business case Stadshavens

Intended

transformation: Together with Merwehavens 3000 dwellings. Until 2015 catalyst in transformation from harbour to urban space. Free zone for businesses. Transform into a modern urban area, related to the Merwehavens. Until 2015, temporary functions to improve the image of the area and the branding. Temporary use will expose the intrinsic quality. The area will be lively and safe.

Policy goals &

intended result:

To secure the area won't be any more neglected, short term interventions are needed.

On the short term (until 2015) the long term transformation will be initiated by improving the image and branding. The theme 'nature and culture' will be leading in the short term interventions. Businesses in creative sector and urban farming will be facilitated.

On the long term (2015 – 2040) this area together with the Merwehavens will become a high quality residential area (partly floating). Sustainability is a key precondition. The dwellings must be self-sufficient on energy. Green facilities will be realized. Dwellings will be in the middle and higher segment to bind more highly educated people to the city.

Transformation

strategy:

The rough image will be kept and (minimally) redesigned as free zone. The area will be made accessible and safe. The east and west part will be used first. Old warehouses can serve as exposition space, workshops, space for catering industry.

The middle part will be used for urban farming and glasshouses. This part will also be the connection between the neighbourhood north of the dike and Merwestad.

Six themes in the transformation to free zone:

1. Culture and nature and crossing borders

Temporary functions without a strict urban plan. Dynamo functions, temporary activities attract long-term functions (energy transition and climate adaptation). Use of cultural heritage as strength.

Appendix A

Summary 2009 business case Stadshavens

2. Improve accessibility

The outer dike area will be made better accessible, but safe.

3. Environment and sustainability

The users and inhabitants of the outer dike area will be self-sufficient on water and energy.

4. Changing zoning plan

Current plan only allows business and industry parks.

5. Cost effective leases to temporary functions

Temporary functions will only get a short lease to ensure long-term development. These short term leases must be cost efficient.

6. Removal of harbour related functions

After 2015 harbour related functions will be moved to the Waal and Eem harbour to create room for residential areas.

After 2015, the long-term (permanent) redevelopment together with the Merwehavens will be realized. 3800 floating and non-floating houses will be developed. There will be a mix of living and working in a high density. The necessary heightening of the Schiedamsedijk gives opportunity for innovative dike strengthening in combination with an urban program.

Sustainability: The possibility to place second-hand wind mills (40m).
Integrate the dike in the area.

Phasing:

2010 – 2011	8000m ² business park Marconi free zone will be realized. Operated for 8 years.
2010 – 2011	Reconstruction of 369m quay.
2012	Two separate transport systems Marconistraat.
2016	Accessibility altered.
2019 – 2020	Demolition of 6 buildings.
2020 – 2024	Construction of 1000 apartments.

Appendix A

Summary 2009 business case Stadshavens

Merwehavens

Characteristics:	Typical harbour area. Warehouses. Three harbour basins. Peers used for fruit cluster. Inaccessible area. Fruit cluster, gas station, distil cluster (Schiedam), glass factory (Schiedam).
Landowner:	46 hectares, mostly Havenbedrijf. In leasehold (biggest users are Van Uden [4,3 hectares] and Seabrex [29 hectares]). When leasehold ends, ownership goes to municipality.
Challenges:	Nuisance from fruit cluster are a problem for redevelopment.
Intended transformation:	The most important part is after 2020. A high quality urban environment with 3000 houses in the middle and higher segment. Seabrex wants to modernize and intensify. The Waal and Eem harbour are more suitable for this (also close to A15).
Policy goals & intended result:	Create an urban area that connects to the Vierhavens and the Marconistrip, but more importantly, forms a connection with surrounding neighbourhoods. By implementing a high quality residential area in a current harbour, the entire district will get a quality impulse. With high quality, sustainable housing in the middle and higher segment is meant. The 3000 houses are to be realized in a mix of apartments and low-rise. The peers will be connected with bridges, also to form an important new bicycle connection along the river. For facilities, the city center of Schiedam is nearby. Merwestad can provide other facilities for the entire district, such as docking places for boats and water sports clubs.
Transformation strategy:	Realize Merwestad from 2020 on together with the definitive transformation of the Marconistrip. The strategy is to take measure before that to make sure it will be possible. The fruit cluster is an obstruction, not only for the area itself, but also to the Vierhavens due to nuisance. The leasehold of some grounds are until 2050, so early termination is necessary. Movement of Seabrex in 2014 if possible.

Appendix A

Summary 2009 business case Stadshavens

Sustainability: Part of the dwellings will be floating. Heightening of ground for dwellings on land. These two may contradict, a higher ground level increases distance to the water.

Phasing:

2009	Acquisition of Seabrex plots.
2010 – 2029	Reconstruction of 7650m quay (most in the last 4 years).
2013	Public facilities on the water of Merwehavens.
2020	Collision protection for floating houses.
2020 – 2023	Remediation of west side.
2021 – 2030	Houses on land developed. Grounds need to be remediated.
2021 – 2030	Houses on water.
2021 – 2030	Businesses. Remediation.
2022 – 2030	Social facilities. Merwehavenkade remediation.
2025 – 2026	Slow traffic bridges.

Appendix A

Summary 2011 structural vision Stadshavens

Stadshavens in general

Center of development and innovation, linked to daily activity and the urban labour market. Building climate proof and climate neutral working and living environments that can help with the revalue of the character of the harbour city.

Strong economy. To broaden the activities of the mainport functions from a classical harbour economy to a knowledge intensive economic complex. Sustainability is an essential characteristic, social, economic and ecologic. Clean Tech Delta: an international representative network of companies, focused on innovative solutions for water, climate and energy issues. The own region will be the living lab and the rest of the world the market.

Attractive city. The city and the region want to enhance their attractiveness by offering a larger variety of work and living environments. The Stadshavens can play a key role in this. This also fits the ambition to realize at least 80% of expansion within city limits.

For Merwe-Vierhavens this means:

Development in 20 to 30 years into new water oriented city district with 4500 to 6500 houses and businesses and services related to the Clean Tech Delta. High sustainability ambitions and trendsetting temporary uses for plots which are waiting to be redeveloped.

- Sustainable Stadshavens:
1. Building energy neutral
 2. Building climate proof
 3. Development on and around the water
 4. Reuse of existing materials and products
 5. Producing the least possible amount of pollution, for example through sustainable mobility
 6. A green environment
 7. Human scale as starting point
 8. Developing from a cultural historic perspective
 9. Sustainable operation en management of real estate
 10. Knowledge about sustainability as economic engine

Appendix A

Summary 2011 structural vision Stadshavens

Stadshavens has three focus groups: Pioneers (innovators), trendsetters (early adopters) and trend followers (early majority). Pioneers are starting entrepreneurs, artists' collectives and clients for building their own home. They make and create conditions themselves. They need space and freedom. Facilities need to be mobile and flexible. Trendsetters are new communities, small enterprises and volunteers from surrounding neighbourhoods. They need the first part of the (small scale) facilities. Private and collective parties are initiators for real estate development on appealing locations. A combination between working and living is attractive. Accessibility needs to be sorted at basic level. Most important is perspective on better accessibility in the future. Trend followers are service focused and status sensitive civilians and entrepreneurs, and active young people looking for an attractive working, learning and leisure environment. They want to board in an area that is prepared for them. The image is clear and appealing, houses can be built on a big scale. Facilities reach the level planned. Accessibility and parking need to be in order.

Stadshavens is meant for companies that:

- Produce clean
- Contribute via their products and services to a sustainable harbour city
- Have sustainable added value for the logistic flows within the harbour
- Contribute to the shift from a fossil fuel powered economy towards a renewable energy based economy

Merwe-Vierhavens

International experimental garden for innovative energy supply and water management, for both residential areas as working areas. Scientists, advisors and engineering firms integrate their knowledge and expertise here. There is enough space in the harbour to experiment with new concepts. Also other pioneers, such as artists, urban farmers and entrepreneurs in manufacturing are attracted by the inspiring environment where the harbour is still functioning. A new water focused district arises which allows experimenting for sustainable urban redevelopment. Retrieving an urban waterfront.

Phasing: Until 2015 The first ground rights are being transferred from the harbour to the municipality. Necessary investments are made to attract pioneers to the area. Marconistrip is transformed into free zone.

Appendix A

Summary 2011 structural vision Stadshavens

- Conditions:
- Slow traffic connection from metro station Marconiplein and Park & Ride towards Keileweg (urban economy).
 - Implementation of charge facilities for electronic transport.
 - Building a peer to make public transport over water possible.
 - Upgrade Vierhavensstraat to lane with 4 lanes and space for a tramline.
 - Make noise plan.
 - Upgrade Marconiplein.
- 2015 – 2025
- The peers in the Merwehaven become available for development. Investment in innovative housing, such as floating homes in the Merwehaven, slow traffic connections and quality of public space.
 - Conditions: Slow traffic routes towards Bospolder and Rotterdam city center, linked to public transport stops and daily facilities.
 - Slow traffic routes towards Oud Mathenesse, linked to public transport stops and daily facilities.
 - Slow traffic routes towards Nieuw Mathenesse and Schiedam city center, linked to public transport stops and daily facilities.
 - Park & Walk facilities to Merwehaven (living and urban economy).
 - Upgrade Keileweg to city road.
 - Slow traffic routes and park & walk facilities, with public transport stops Schiedamseweg and Keileweg. Implementation of peer for water transport.
 - Public boulevards Merwehavens.
 - River park at top Merwehavens.
 - Gas pipes Eon moved or deepened.
 - Remediation old gas factory linked to area development.
- After 2025:
- The transformation process continues. Terrain Van Uden strip becomes available and therefore also the harbour basins (for floating program). More investment

Appendix A

Summary 2011 structural vision Stadshavens

in housing, focus on quiet, urban environment. Pioneers are followed by trendsetters and trend followers.

Further investments in public space, accessibility and facilities. New bridge Merwehaven to connect to Schiedam center.

Conditions: Upgrade Benjamin Franklinstraat to city road.

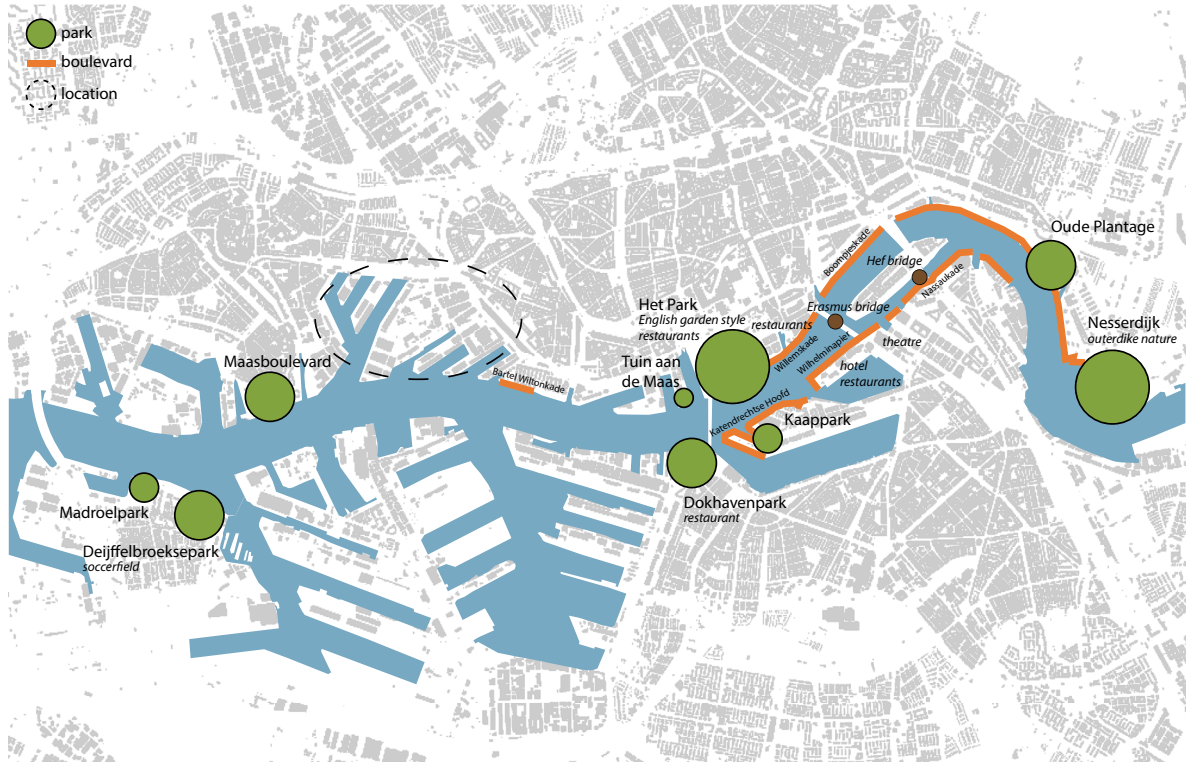
Public boulevards along Vierhavens.

New public transport connections.

Further upgrading Keileweg, including bridge towards Schiedam.

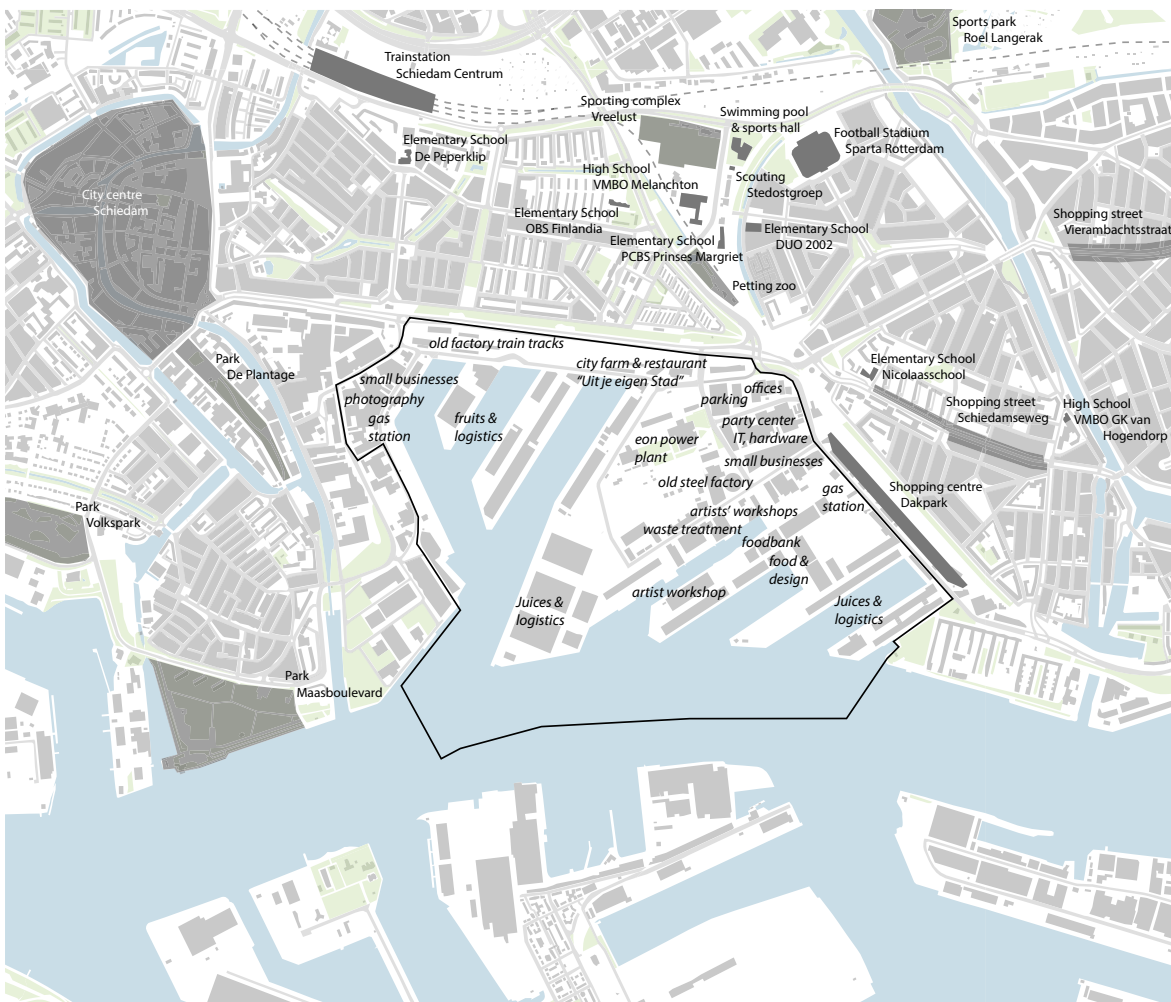
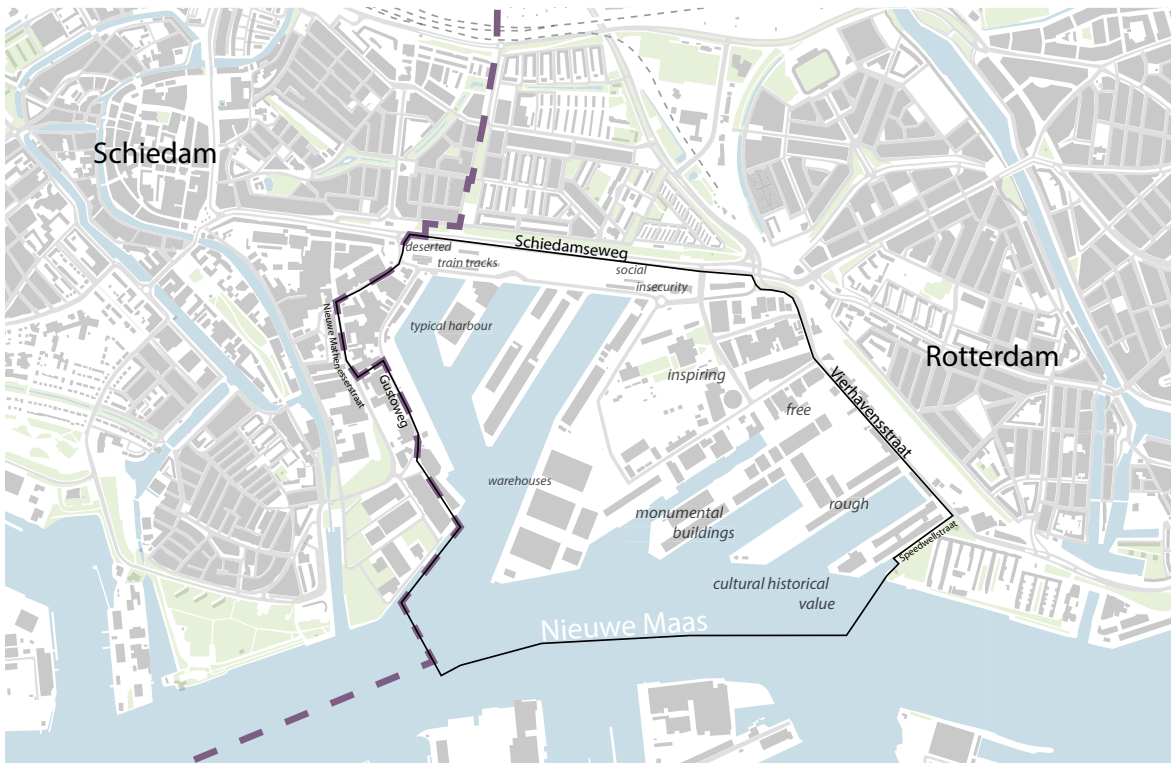
Appendix B

Analysis maps: (B1) Waterfront Parks & Boulevards, (B2) Public Transport



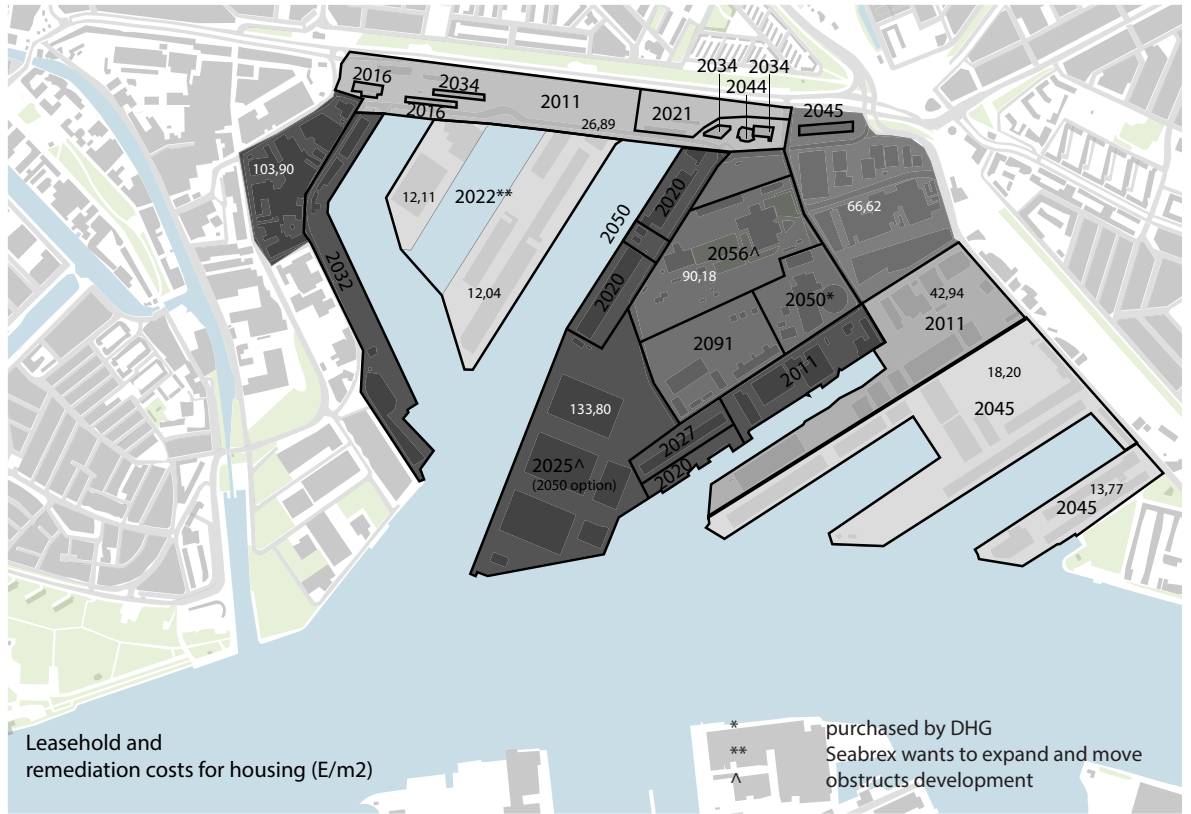
Appendix B

Analysis maps: (B3) Borders & Identity, (B4) Facilities



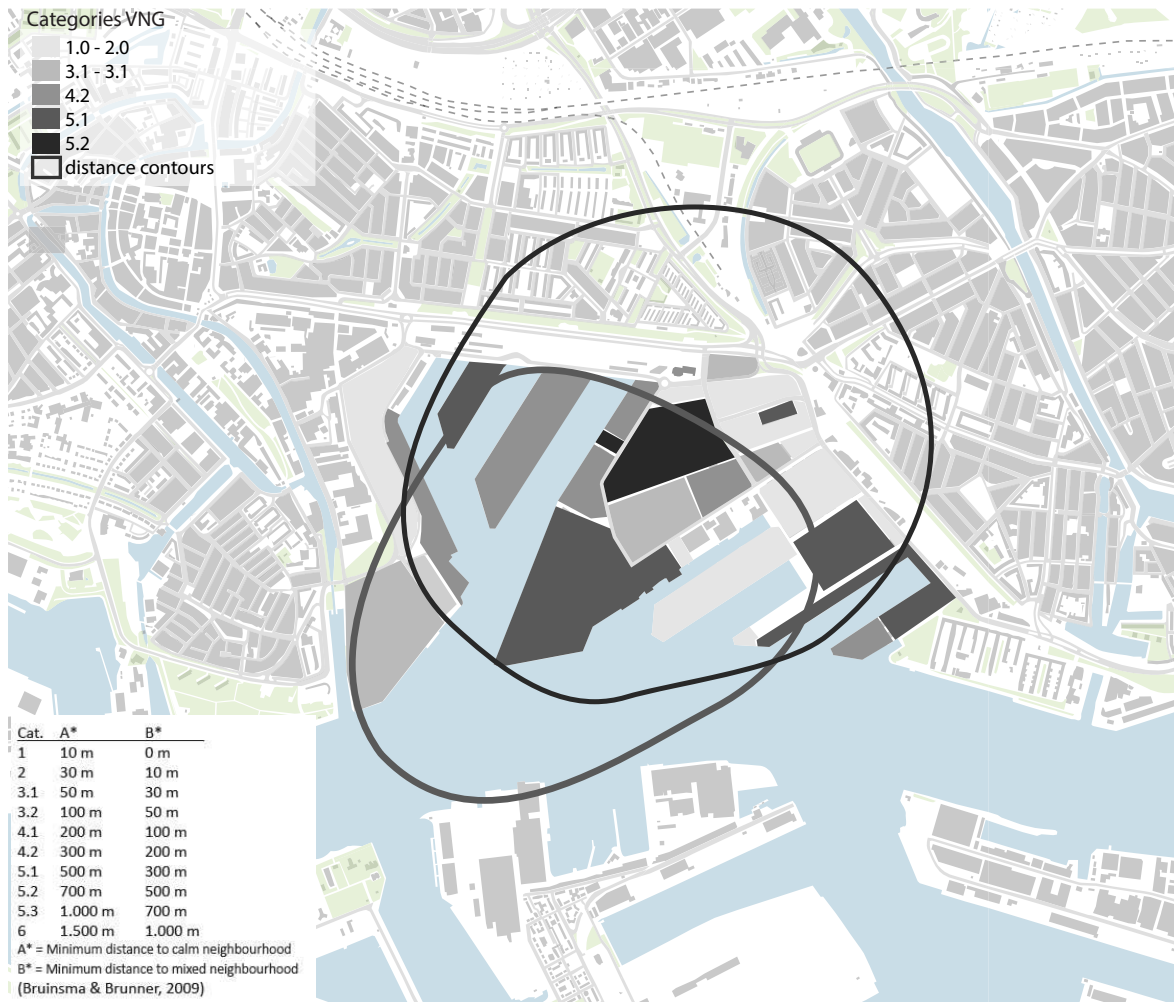
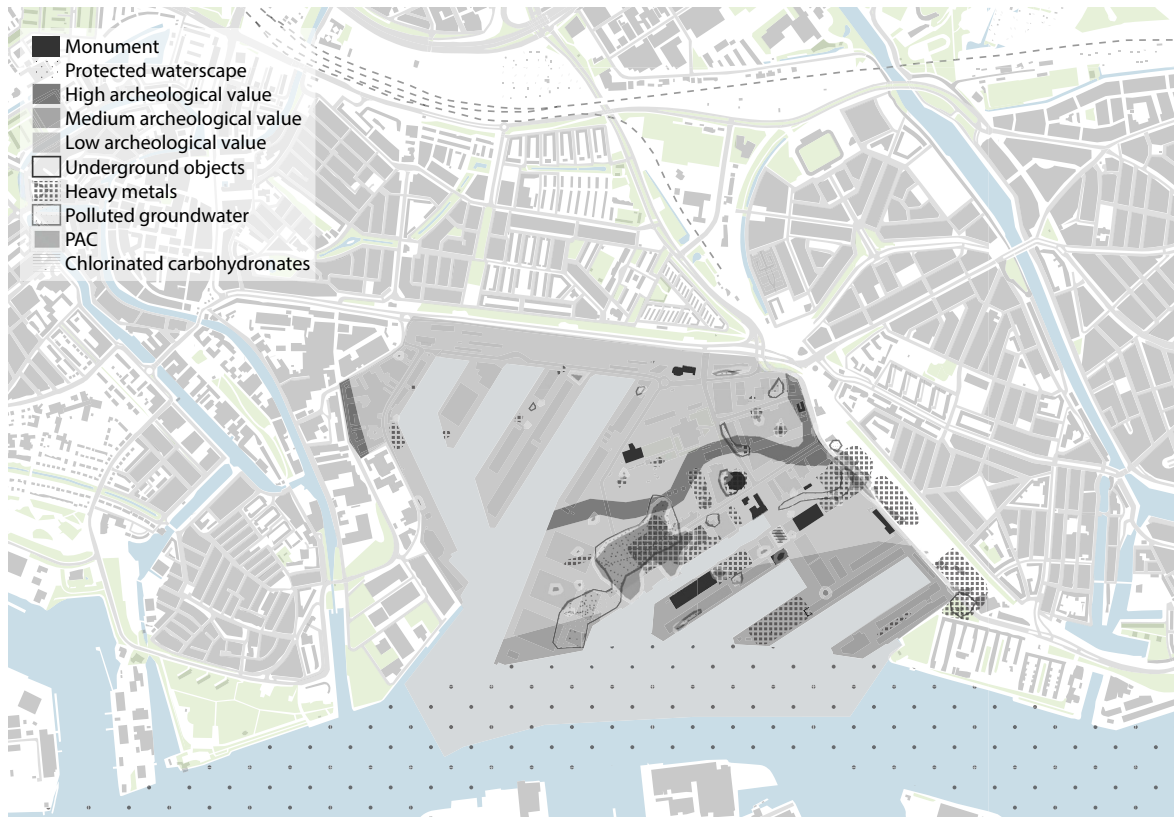
Appendix B

Analysis maps: (B5) Leasehold & Remediation; (B6) Water, land & dike heights [m]



Appendix B

Analysis maps: (B7) Subsoil, (B8) Risk contours



Appendix B

Analysis: Facts & Figures, sources

Location	Merwe-Vierhavens, Rotterdam 3,01 km to central station (as the crow flies) 3,36 km to central station (8 minutes by car, 12 minutes by bike, 22 minutes by public transport)
Transport links	3,36 km to central station Good public transport connections at Marconiplein: <ul style="list-style-type: none"> - Tram 4, 8, 21, 23, 24 - Metro A, B, C - Bus 42 (38 at 650m, 9 minutes walking) 1,47 km to A20 highway (city ring road)
Local authority	Rotterdam municipality
Gross area (hectares)	123,60
Ownership	Municipality, Havenbedrijf (Harbour enterprise), private investors
Site boundaries	Nieuwe Maas river, Schiedamseweg, Vierhavensstraat, Speedwellstraat, Gustoweg, Nieuwe Mathenesserstraat
Current uses	Fruit handling, juice handling, energy plant, offices, waste processing plant, gas station, small enterprises, art galleries
Previous uses	Metal factory, coal plant (currently gas)
Surrounding land uses	Residential areas (Oud-Mathenesse, Schiemond), Mixed-use residential and commercial areas (Spangen, Tussendijken, Bospolder), mixed-use commercial and service area (Vreelust)
Fit with context of larger area development	A zoning plan is being made by the municipality for the area. The area is part of the Stadshavens for which a vision has been realized.
Contamination	Heavy metals, PAC, chlorinated carbohydronates, polluted groundwater
Water management	Outer dike area, immediate flood risk
Other	Monuments in the area and potential archaeological sites

The information to compose all the material in Appendix B is from:

AHN.nl

EduGIS.nl

Freemaptools.com

GISWeb Rotterdam

Google Maps

MWH Nieuwe Maas, Deltares, 2011

Projectbureau Stadshavens Rotterdam, 2009

Sanne Mooij (own made risk contours map, intern municipality Rotterdam, 2014)

Appendix C

Q&A about BR2 tool

After reading about the method, some questions arose. These questions are formulated in this paragraph, as are the answers provided by Matthew Ashmore. The regular text refers to the PhD-thesis of Leney (2008) and the text in italics are the posed questions. After the questions some general comments are mentioned.

[page 126, paragraph 2] The challenge is to ensure that everything relevant within that boundary is present within the model.

1. *How can you best handle or manage this? Consequences of perturbations on aspects which were not indicated as relevant are not included; these could also indirectly influence aspects within the boundary.*

2. *A relation between components is filled in in the matrix. What if there are multiple relations? What if the relation is positive AND negative? How can this be modelled in the matrix? Example: re-use of brown water > a lot of nutrients that could enhance biodiversity (positive), but it can also make strong species more dominant over others (negative for biodiversity).*

[page 139, last paragraph] Within brownfield redevelopment, although there is no coherent body of theory on brownfield redevelopment and regeneration, theory does exist but is spread throughout the literature of many disciplines and is generally not readily available to those who redevelop brownfield sites. A REMIT/RESPONSE based approach provides a means of synthesising this disjointed body of theory into a form that is readily available to those involved in the redevelopment of brownfield sites, the generic interaction matrix.

3. *Who will synthesize this? Will the generic matrix be suitable for all brownfield redevelopment plans? If not and the matrix has to be created for each project, will there be a coherent body of theory created along with the BR2 tool? Or does it have to be synthesized by each person using the tool?*

[page 212] Example Basford Food Superstore. An increase in traffic has been shown to have a significant systemic effect on urban areas which can result in loss of flora and fauna, adverse health effects, the creation of 'fresh food deserts', increased carbon dioxide emissions, adverse economic impacts and even flash flooding.

4. *Where do these systemic effects show in the matrix (figure 88, page 214)? Is it in the value of the relation (-2 in this case)? If so, is a scale from +2 to -2 sufficient then? The table*

Appendix C

Q&A about BR2 tool

in the appendices [page 300, cell 3,4] only states: Significant increase in traffic due to people driving to the new supermarket. But not why it's valued as -2, should the table be extended?

[page 175, figure 67] Example Radford

5. *All conclusions, like those of the critical interactions, are based on the leading terms that are defined. When critical terms are missing, conclusions may not be valid, they only reflect on the relation between the chosen terms. Site can be dominant when assessed with urban area, economics and policy, but might be subordinate when another aspect is added. How to best deal with this? (Related to first question)*

6. *The examples talk about mono-functional interventions/perturbations. Is the tool applicable for mixed-use interventions?*

7. *The leading diagonal terms are very broad or general. Is it possible to define more detailed terms in a later stage of designing? Till what extend of detail is the BR2 tool applicable?*

[page 223, second paragraph] Advantage: BR2 tool does not require the same level of knowledge about each aspect of the brownfield redevelopment system.

8. *Why not? Is that not needed to determine the relations and especially to value the relations?*

[page 224, second paragraph] Similarly information about the impact of brownfield redevelopment is not necessarily easily available to those managing or assessing redevelopment projects. Brownfield REMIT/RESPONSE could help to overcome this problem by making the relevant aspects of urban theory available to brownfield redevelopment practitioners in the form of generic interaction matrices.

9. *If the generic matrix is there to guide planners and to synthesize the disjointed body of theory into a form that is readily available, and doesn't require the same level of knowledge about each aspect, wouldn't these matrices then create very black and white ideas? Does "demographics" always have a negative relation on "quality of life"? How do you prevent the user from blindly taking the outcomes as facts?*

10. *On what scales is the tool applicable? The examples show one building or one-function perturbations. What if there is an urban ensemble with multiple functions? Do you then*

Appendix C

Q&A about BR2 tool

need different models with different context?

11. *The object to be redeveloped is related to the urban context. But what if the brownfield is larger than the object itself (for example one factory in an old harbour area; Merwe-Vierhavens Rotterdam)? Is the industrial harbour context then modelled and the surrounding residential not relevant? And what if the rest of the area will also be redeveloped, outcomes might be uncertain. How do we deal with that regarding our plans for the factory? What context to use?*

General comments

Relations seem sometimes very general: Development has positive impact on individual economic (new jobs and increased incomes) [page 209]. We need to know if educational level and aspirations of residents match the new businesses. This determines till what extend the population will benefit (employees from outside of the region might be attracted, which leads to an increase of traffic).

A lot of questions arise when reading about BR2 tool and trying to understand it. But slowly it becomes clearer. Not always very apparent, though. Perhaps a manual focussed on spatial planners? Or one that is easily understood by all stakeholders?

Answers by Matthew Ashmore

1. I think my answer to many of your questions will be “by having a good cross section of stakeholder involvement”. I think it’s the only way that the majority of potential issues can be anticipated, though a knowledgeable local regulator would be the first on the list.

2. You could try to identify a particular factor that is most dominant, or give some kind of composite answer for the relationship – in your example, if you’ve constructed a wetland to deal with it then the area will have at least one more species in the area. Ideally in a more developed tool, if it seems in important/intractable issue, then the component should be split into the separate aspects that produce the different responses (I’m considering how I might put this in a future iteration of the tool now).

3. Again, initially at least, it will be down to the stakeholders and their experience. The idea behind a generic tool I guess is partly to begin this process and perhaps include

Appendix C

Q&A about BR2 tool

increasing depth and experience with future updates.

4. Remember e.g. -2 should not be viewed as a numerical value, more of a value judgement (I know this is exactly how it is used as in a C,E diagram, which is another reason why these diagrams, beyond the binary charts, should be used with caution). I think in this case, in the location discussed, a value judgement was made (by a single research student rather than a cross section of stakeholders) – I've heard at least one case in the US where residents wanted a supermarket in such a situation because the area already was a fresh food desert and this would actually cut traffic as people wouldn't have to travel as far.

5. See answer 1.

6. Yes if you include e.g. numbers of dwellings, jobs/types of employment which may be may be created. You could potentially create scenarios according to the proportion of each and look at the effects of each.

7. if the site is simple enough, these components may be enough, perhaps bigger/ more complex sites may require these to be expanded – I'm thinking about a more complex tool now.

8. Sorry, can't quite see what was being got at here.

9. This is a problem with all tools and methods in the field, many I see include different assumptions a fudge factors and these tend not to be easily seen in the outputs. The best you can hope for is a reasonably transparent process so all stakeholders have a say in how the decision was made. Any tool like this is open to misuse, again, it's about trust, transparency and having a good stakeholder cross section involved.

10. The UK we're trying it out on (retrospectively) is Markham Vale, a former coalmine now an industrial area which they're hoping will eventually provide 5000 jobs, and you could imagine using a similar methodology for e.g. comparing several sites in a country for a new international airport, say, so it should scale to any appropriate size, but obviously the complexity may also increase. Ultimately, the technique offers a way for all stakeholders

Appendix C

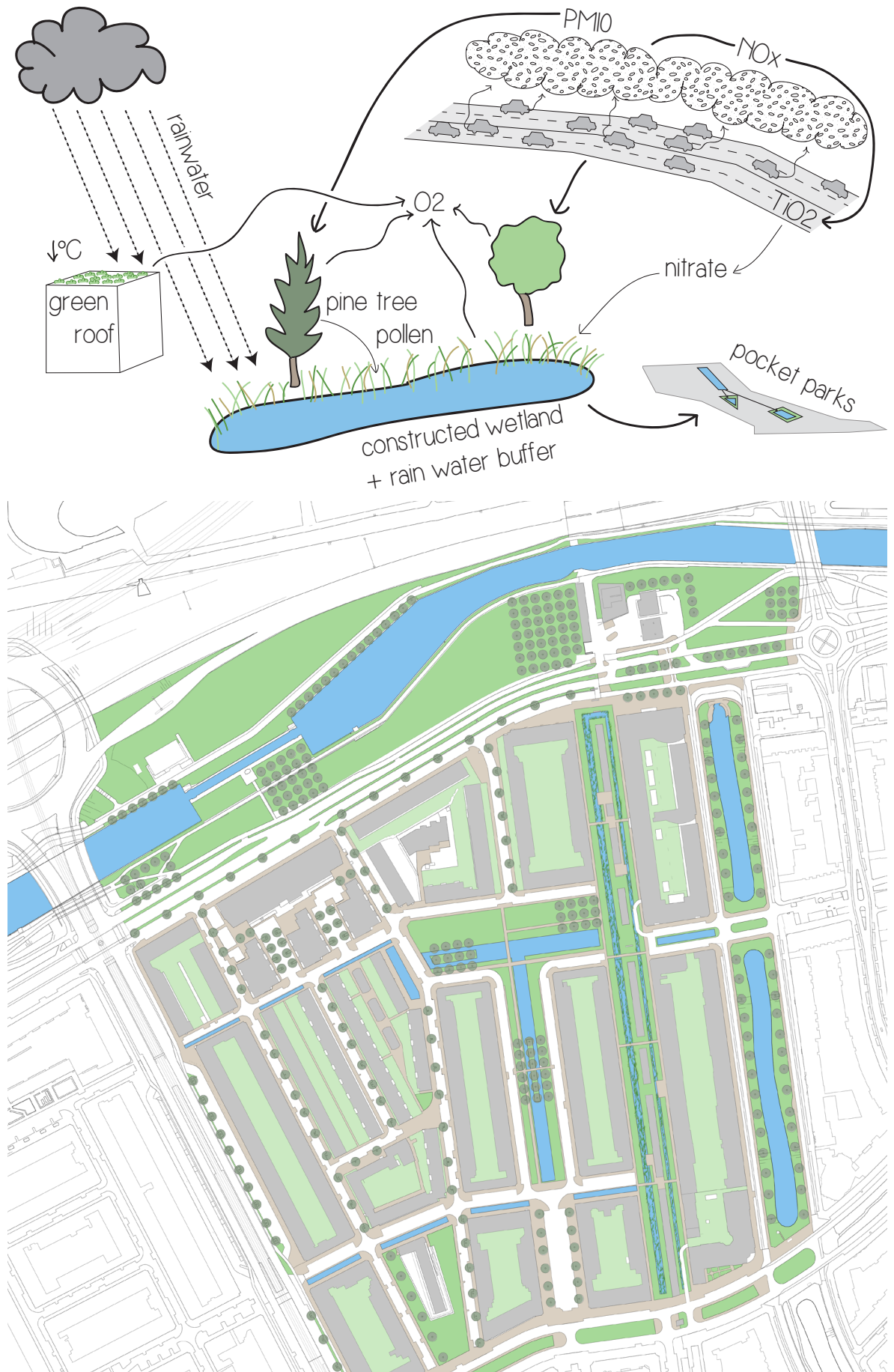
Q&A about BR2 tool

to get their views across, no method is ever going to be absolutely objective or complete.

11. You'll still need transport links, workforce etc., if you're looking at one plot within a bigger mega site say, then how the brownfield surroundings will affect the finished redeveloped may factor in the analysis. At Markham, I'm trying to set the system area as that within a commutable distance/time (given the nature of the likely jobs). If it's one site within a functioning industrial area then it might be one or two aspects of the site making it unattractive and a process like this isn't really warranted. You also have to look at how incentives for companies to take on the site affect similar sites nearby, eg Markham has a system of incentives for manufacturing companies to take up plots, but what if a company uses this merely to relocate a few miles?

Appendix C

Design drawings Hofbogen case: (C1) Design concept, (C2) Urban plan



Appendix C

Design drawings Hofbogen case: (C3) Impression constructed wetland



Appendix C

BR2 Hofbogen case: (C4) BCM and reasoning

When referring to the generic BR2 matrix, see figure 69 (p. 187) thesis Leney (2008).

1. Biodiversity on:	BCM	±ESQ	Motivation
2. Natural environment	1	+1	The plan includes new types of vegetation (increased biodiversity) which can attract new fauna and habitats (more increased biodiversity). This gives a higher value to the natural environment.
3. Built environment	0	0	According to the generic BR2 matrix.
4. Demographics	0	0	According to the generic BR2 matrix.
5. Quality of life	1	+2	More biodiversity can improve QoL (paper #2).
6. Public economics	0	0	According to the generic BR2 matrix.
7. Private economics	0	0	According to the generic BR2 matrix.
8. Individual economics	0	0	According to the generic BR2 matrix.
9. Local institutional controls	1	?	If biodiversity increases, the amount of traffic over the highway might be faced with measures to decrease emissions. Not only in this area, but also along the green strip to Midden Delfland.
10. Central/EU institutional controls	0	0	No relevant relation.

2. Natural environment on:	BCM	±ESQ	Motivation
1. Biodiversity	1		Different kinds of vegetation (pine trees and water filtering strip) attract different kind of species than currently in the area. The 'amount' of natural diversity will also increase, which can attract species which need a larger habitat.
3. Built environment	1		The space required for more natural environment (the water filtering strip) leads to less space for traffic and parking.
4. Demographics	0		The increase of natural environment is only in the public space, residential blocks will not be affected.
5. Quality of life	1		Pine trees together with TiO ₂ on the road surface will increase air quality. The streets along the Hofbogen will be car free and have a green environment were pedestrian can stroll through.
6. Public economics	1		The increase of natural environment will need a public investment. Afterwards, public costs will be made for maintenance.
7. Private economics	1		The increase of natural environment creates an attractive space for small functions, such as a neighbourhood café.
8. Individual economics	0		The increase of natural environment will not lead to local job creation.
9. Local institutional controls	1		If biodiversity increases, the amount of traffic over the highway might be faced with measures to decrease emissions.
10. Central/EU institutional controls	0		No relevant relation.

3. Built environment on:	BCM	±ESQ	Motivation
1. Biodiversity	1		Tree planting and flood measures can attract species from Midden Delfland.
2. Natural environment	1		The development is mostly natural environment; tree planting and creating flood ponds.
4. Demographics	0		The development is in the public space, the amount or type of dwellings is not altered.
5. Quality of life	1		The vacant Hofbogen structure will be visually more appealing with a roof garden and the wetland in front of it. Also, the building will house a selected number of small functions which inhabitants of surrounding plots can use.
6. Public economics	1		The development will need a public investment. Afterwards, public costs will be made for maintenance.
7. Private economics	1		The development might attract small businesses and thus a limited amount of jobs. Empty office space next to the plot might get a positive impulse.
8. Individual economics	1		The development will decrease transport links to the front door. The street will be made car free.
9. Local institutional controls	1		The Hofbogen is a national monument and redevelopment will need to be monitored and the structure must be protected.
10. Central/EU institutional controls	0		No relevant relation.

4. Demographics	BCM	±ESQ	Motivation
1. Biodiversity	0		There are no changes in population density. Type of people living along a street with no parking might change...
2. Natural environment	0		There are no changes in population density.
3. Built environment	1		There are no changes in population density. People might move away due to removal of car in the street. If no new people move in, this leads to vacancy.
5. Quality of life	0		There are no changes in population density.
6. Public economics	0		There are no changes in population density.
7. Private economics	0		There are no changes in population density.
8. Individual economics	0		According to the generic BR2 matrix.
9. Local institutional controls	0		According to the generic BR2 matrix.
10. Central/EU institutional controls	0		According to the generic BR2 matrix.

5. Quality of life	BCM	±ESQ	Motivation
1. Biodiversity	0		It is not likely that increased QoL leads to increased nature conservation etc.
2. Natural environment	0		It is not likely that increased QoL leads to increased nature conservation etc.
3. Built environment	1		An increased QoL (in this case means a livelier street) can lead to less crime and anti-social behavior (social control) and degradation of the built environment.

4. Demographics	BCM	±ESQ	Motivation
1. Biodiversity	1		Improved quality of life (air quality, natural environment, car free street, small functions) may lead to migration of new people to the area. This could decrease the level of segregation.
6. Public economics	1		There is room for small businesses in the area, like a neighbourhood café and a gym. How much of these businesses will be established and how much of them will be successful (and how relevant this cell is) is hard to establish.
7. Private economics	0		There is no increase in free time.
8. Individual economics	1		Space for businesses can be used by inhabitants, providing them an opportunity for personal development. However, how marginal this is, is yet to be shown.
9. Local institutional controls	?		Not enough information about the relation.
10. Central/EU institutional controls	?		Not enough information about the relation.

6. Public economics	BCM	±ESQ	Motivation
1. Biodiversity	1		The more money for tree planting and wetlands in the public space, the more room for biodiversity.
2. Natural environment	1		The more money for tree planting and wetlands in the public space, the more room for biodiversity.
3. Built environment	1		The more money for tree planting and wetlands in the public space, the more room for biodiversity.
4. Demographics	0		No relevant relation.
5. Quality of life	1		The more money for the wetland and the tree planting the better the results for air and water quality will be, and thus for citizens' health. Also the appearance of the space is affected.
7. Private economics	1		The new environment is more likely to attract small businesses.
8. Individual economics	0		No relevant relation.
9. Local institutional controls	1		The public spending leads to less parking spaces and thus to less cars, less motor taxes, less parking income and less parking permit income.
10. Central/EU institutional controls	0		No relevant relation.

7. Private economics	BCM	±ESQ	Motivation
1. Biodiversity	0		There will be less traffic on the small scale, but not due to private economics.
2. Natural environment	0		There will be less soil sealing, but not due to private economics.
3. Built environment	1		If successful, the Hofbogen will no longer be vacant, and the streets becomes livelier.
4. Demographics	0		The businesses are relatively small compared to the population.
5. Quality of life	1		A café/bar gives new opportunity to spend time outside but close to home, a gym can improve health conditions.
6. Public economics	1		The new businesses will have to pay taxes.
8. Individual economics	1		New development leads to more jobs. However, might not be so much compared to the population.
9. Local institutional controls	1		The development will contribute to measures on air quality.
10. Central/EU institutional controls	0		No relevant relation.

8. Individual economics	BCM	±ESQ	Motivation
1. Biodiversity	0	0	According to the generic BR2 matrix.
2. Natural environment	0	0	The plan doesn't affect private economics that much. All private open space is within building blocks.
3. Built environment	0	0	The plan doesn't affect private economics that much.
4. Demographics	0	0	The plan doesn't affect private economics that much.
5. Quality of life	0	0	The plan doesn't affect private economics that much.
6. Public economics	0	0	The plan doesn't affect private economics that much.
7. Private economics	0	0	The plan doesn't affect private economics that much.
9. Local institutional controls	0	0	According to the generic BR2 matrix.
10. Central/EU institutional controls	0	0	According to the generic BR2 matrix.

9. Local institutional controls	BCM	±ESQ	Motivation
1. Biodiversity	0	0	No relevant relation.
2. Natural environment	0	0	No relevant relation.
3. Built environment	0	0	No relevant relation.
4. Demographics	0	0	According to the generic BR2 matrix.
5. Quality of life	0	0	According to the generic BR2 matrix.
6. Public economics	0	0	No relevant relation.
7. Private economics	0	0	According to the generic BR2 matrix.
8. Individual economics	0	0	According to the generic BR2 matrix.
10. Central/EU institutional controls	0	0	According to the generic BR2 matrix.

10. Central/EU institutional controls	BCM	±ESQ	Motivation
1. Biodiversity	0	0	No relevant relation.
2. Natural environment	0	0	No relevant relation.
3. Built environment	0	0	No relevant relation.
4. Demographics	0	0	According to the generic BR2 matrix.
5. Quality of life	0	0	According to the generic BR2 matrix.
6. Public economics	0	0	No relevant relation.
7. Private economics	0	0	According to the generic BR2 matrix.
8. Individual economics	0	0	According to the generic BR2 matrix.
9. Local institutional controls	0	0	No relevant relation.

Appendix C

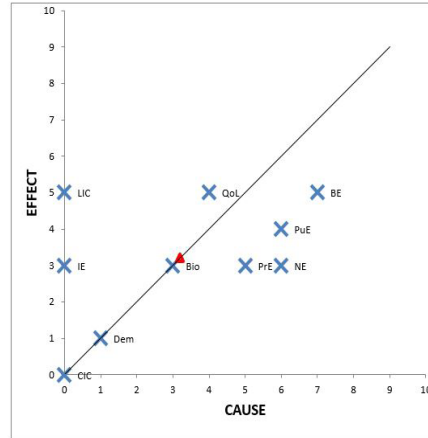
BR2 Hofbogen case: (C5) BCM results

Site: Hofbogen (elevated railline), Bergpolder part, Rotterdam, the Netherlands

Option: Pluvial storage and filtering and air quality improvement measures

Binary Coded Matrix

										CAUSE		EFFECT	
Bio	1	0	0	1	0	0	0	1	0	3	Bio	3	3
1	NE	1	0	1	1	1	0	1	0	6	NE	6	3
1	1	BE	0	1	1	1	1	1	0	7	BE	7	5
0	0	1	Dem	0	0	0	0	0	0	1	Dem	1	1
0	0	1	1	QoL	1	0	1	0	0	4	QoL	4	5
1	1	1	0	1	PuE	1	0	1	0	6	PuE	6	4
0	0	1	0	1	1	PrE	1	1	0	5	PrE	5	3
0	0	0	0	0	0	0	IE	0	0	0	IE	0	3
0	0	0	0	0	0	0	0	LIC	0	0	LIC	0	5
0	0	0	0	0	0	0	0	0	CIC	0	CIC	0	0
3	3	5	1	5	4	3	3	5	0	AVERAGE		3,2	3,2
EFFECT													



Appendix C

BR2 M4H workshop: introduction

The workshop to simulate stakeholder participation took place on 29th of July 2014.

Participants: Linda Maring (Sr. project leader urban land and water management, Deltares)
Ignace van Campenhout (Advisor Subsurface, GIS & 3D, Engineering office for city development Rotterdam)
Fransje Hooimeijer (Assistant Professor Environmental Technology and Design, TU Delft)
Sien Kok (Intern urban land and water management, Deltares & student MSc Earth Sciences and Economics, VU Amsterdam)
Jelle van Gogh (Intern urban land and water management, Deltares & student MSc Urbanism, TU Delft)
Myself, Nirul Ramkisor (Intern urban land and water management, Deltares & student MSc Urbanism, TU Delft)

Aim: The aim of the workshop was to assess multiple options for redeveloping the Merwe-Vierhavens (M4H) site in Rotterdam with a group of people that could function as stakeholders and experts.

Duration: The time for this workshop was 90 – 120 minutes.

Program:

- Introduction BR2 tool and generic matrix
- Introduction M4H location
- Assessing one option of redevelopment with the generic matrix

Context: The M4H site is still an active harbor area. However, plans are already being made for when the port related industries cease activities on their current location. The leasehold of the plots will not end simultaneously. In the first steps of redevelopment, the plot lies within the context of the active harbor area (figure C6) and the plot seems commercially viable - the only restraint is the operating eon power plant. Therefore using the BR2 tool is not very apparent. In a later stage, the area around this power plant (phase 4, figure C7) will be redeveloped within the context of the earlier developed phases – dwellings, offices and businesses. The location is heavily polluted and costly to remediate and is located in a less favourable area if eon stays (but switches to geothermal energy). Therefore multiple options for redevelopment are assessed (figure C8). In this workshop, only

Appendix C

BR2 M4H workshop: introduction

the park option, scenario C, is assessed. The park will be a cultural park. As a reference we can use the Emscher park in Germany.

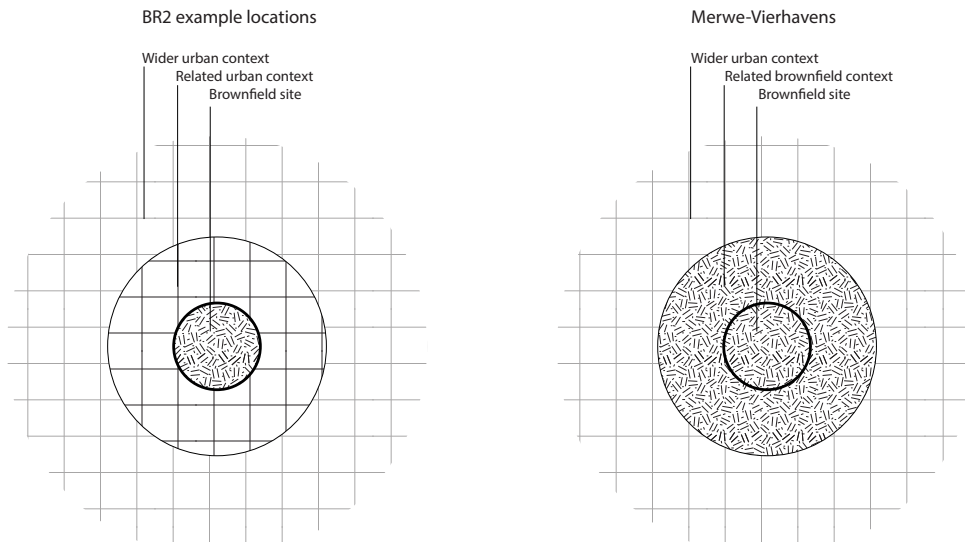


Figure C6 Comparison between tested sites in the PhD thesis and M4H (own illustration)



Figure C7 Phasing of the redevelopment of the M4H area (own illustration)

Scenario	A	B	C	D
Function	Housing	Industry	Park	Mix housing/industry
Dwellings M4H	4800	3180	3180	3990
Dwellings M4H if phase 5 = Industry	4160	2540	2540	3350
Inhabitants	10.560	7.000	7.000	8.780
Inhabitants if phase 5 = Industry	9.150	5.590	5.590	7.370
Eon power plant	Moves or transforms	Moves or transforms	Moves or transforms	Moves or transforms
Bridge to Schiedam	Yes	No	Yes	Yes
Amount of Remediation needed	High	Medium	Low	High/medium

Figure C8 Redevelopment options for the eon power plant site (own illustration)

Appendix C

BR2 M4H workshop: BCM, ESQ and reasoning

1. Biodiversity on:			BCM	±ESQ	Motivation	7. Private economics			BCM	±ESQ	Motivation
2. Natural environment	1	2			Commonly accepted that more biodiversity is positive for nature	1. Biodiversity	0	0			Only very indirect relations
3. Built environment	0	0			No identified interaction	2. Natural environment	0	0			Relation already mentioned at public (6>2)
4. Demographics	0	0			No identified interaction	3. Built environment	1	2			Yes, if there is a focus on quality, of course (the cultural facilities will blend with the park)
5. Quality of life	1	1			Support for services that enhance the ecosystem	4. Demographics	0	0			No population
6. Public economics	0	0			No identified interaction	5. Quality of life	1	2			Increasing (leisure) facilities
7. Private economics	0	0			No identified interaction	6. Public economics	1	-1			Less companies in total (more leave in comparison to new companies)
8. Individual economics	0	0			No identified interaction	8. Individual economics	0	0			No relation
9. Local institutional controls	0	0			Protection laws already exist, new laws are not needed, they're either applied or not	9. Local institutional controls	0	0			?
10. Central/EU institutional controls	0	0			Protection laws already exist, new laws are not needed, they're either applied or not	10. Central/EU institutional controls	0	0			?

2. Natural environment on:			BCM	±ESQ	Motivation	8. Individual economics			BCM	±ESQ	Motivation
1. Biodiversity	1	2			More species will inhabit the area if it changes from active industry to park	1. Biodiversity	0	0			No identified interaction
3. Built environment	1	-1			The amount of built environment decreases, but why is the relation only about quantity and not quality?	2. Natural environment	0	0			No changes in individual economic status due to plan
4. Demographics	0	0			No dwellings on site	3. Built environment	0	0			No changes in individual economic status due to plan
5. Quality of life	1	2			Obvious, more space, light, air, pleasant environment	4. Demographics	0	0			No changes in individual economic status due to plan
6. Public economics	1	-1			Maintenance costs	5. Quality of life	0	0			No changes in individual economic status due to plan
7. Private economics	1	1			Area becomes more attractive which provides opportunities for economic growth	6. Public economics	0	0			No changes in individual economic status due to plan
8. Individual economics	0	0			Value of houses and land, but not on site, in the periphery	7. Private economics	0	0			No changes in individual economic status due to plan
9. Local institutional controls	0	0			Protection laws already exist, new laws are not needed, they're either applied or not	9. Local institutional controls	0	0			No identified interaction
10. Central/EU institutional controls	0	0			Protection laws already exist, new laws are not needed, they're either applied or not	10. Central/EU institutional controls	0	0			No identified interaction

3. Built environment on:			BCM	±ESQ	Motivation	9. Local institutional controls			BCM	±ESQ	Motivation
1. Biodiversity	1	2			More space for biodiversity, but this effect was also taken into account as a result from more natural environment... Double?	1. Biodiversity	1	1			Yes, we're making a park
2. Natural environment	1	2			More space for natural environment	2. Natural environment	1	2			Yes, we're making a park
4. Demographics	0	0			No population	3. Built environment	1	1			The re-use of old harbour buildings, monuments. Needs protection
5. Quality of life	1	2			The remaining buildings' quality increases after getting a cultural function	4. Demographics	0	0			We can steer this (matrix says no identified interaction)
6. Public economics	0	0			Responsibility and maintenance was not of/by local authority	5. Quality of life	1	1			We can steer this (matrix says no identified interaction)
7. Private economics	0	0			Old jobs disappear and new jobs are created, balance?	6. Public economics	1	2			We're planning a park on formerly (or currently) private owned land, so yes
8. Individual economics	0	0			Location is already well connected	7. Private economics	0	0			Subsidies (matrix says no identified interaction)
9. Local institutional controls	1	2			Effects on spatial planning	8. Individual economics	0	0			No identified interaction
10. Central/EU institutional controls	0	0			No relation on central or EU level	10. Central/EU institutional controls	0	0			No identified interaction

4. Demographics			BCM	±ESQ	Motivation	10. Central/EU institutional controls			BCM	±ESQ	Motivation
1. Biodiversity	0	0			No population in the area	1. Biodiversity	1	0			No significant added value
2. Natural environment	0	0			No population in the area	2. Natural environment	1	1			E.g. policy says more green in cities
3. Built environment	0	0			No population in the area	3. Built environment	1	1			There is a structural plan for province Zuid-Holland
5. Quality of life	0	0			No population in the area	4. Demographics	0	0			No identified interaction
6. Public economics	0	0			No population in the area	5. Quality of life	0	0			No identified interaction
7. Private economics	0	0			No population in the area	6. Public economics	0	0			No relation
8. Individual economics	0	0			No identified interaction	7. Private economics	0	0			No identified interaction
9. Local institutional controls	0	0			No identified interaction	8. Individual economics	0	0			No identified interaction
10. Central/EU institutional controls	0	0			No identified interaction	9. Local institutional controls	0	0			?

5. Quality of life			BCM	±ESQ	Motivation
1. Biodiversity	0	0			(Happy people more caring for nature)
2. Natural environment	0	0			(Happy people more caring for nature)
3. Built environment	0	0			(Is there a relation with crime? Better QoL, less crime?)
4. Demographics	0	0			No population
6. Public economics	0	0			More costs, but due to more natural environment, this is just an indirect link
7. Private economics	1	1			Culture = QoL, more room for businesses
8. Individual economics	0	0			No relation
9. Local institutional controls	0	0			It goes from private to public, due to more natural environment, this is indirect
10. Central/EU institutional controls	0	0			No relation

6. Public economics			BCM	±ESQ	Motivation
1. Biodiversity	1	1			If more money is available, more potential for more biodiversity can be realized
2. Natural environment	1	1			If more money is available, more natural environment can be realized
3. Built environment	0	0			The surroundings of the built environment, but the built environment itself becomes privately owned
4. Demographics	0	0			No population
5. Quality of life	1	2			The higher quality the culture park gets (i.e. the more money there is available for it) the higher QoL is
7. Private economics	1	0			Old businesses will leave (negative) but others will settle (positive)
8. Individual economics	1	1			The more attractive the place is (linked to public spending) the higher chances are people will come to the place and spend (more) money there
9. Local institutional controls	0	0			?
10. Central/EU institutional controls	0	0			?

Appendix C

BR2 M4H phases: BCM, ESQ and reasoning (phase IV-1)

1. Biodiversity on:			BCM	±ESQ	Motivation
2. Natural environment	1	1			More biodiversity will increase the value of NE, but in the first phase of the transformation, NE still needs to develop and the effects will be moderate.
3. Built environment	0	0			No identified interaction
4. Demographics	0	0			No identified interaction
5. Quality of life	1	0			Support for services that enhance the ecosystem, but not yet significant enough.
6. Public economics	0	0			No identified interaction
7. Private economics	0	0			No identified interaction
8. Individual economics	0	0			No identified interaction
9. Local institutional controls	0	0			Increase in biodiversity not significant.
10. Central/EU institutional controls	0	0			Increase in biodiversity not significant.

2. Natural environment on:			BCM	±ESQ	Motivation
1. Biodiversity	1	1			More NE gives more room for BIO, in this phase the planned NE also provides green connections between green spaces (network). It still needs to develop though.
3. Built environment	1	-1			In this phase it is about the main green infrastructure, which means streets and some vacant plots will be transformed. The density of development will not decrease significantly. There will be a challenge where cargo transport on land (trucks) and the green infrastructure needs to be combined, therefore the relation is moderately negative. The quality of the space increases, though.
4. Demographics	0	0			The change in natural environment will not change the population density. Within earlier phases the green infrastructure is already considered and planned.
5. Quality of life	1	1			People will have a (more attractive) way to move through the area and they will have access to a green waterfront.
6. Public economics	1	-1			The realization and maintenance of green infrastructure is a publicly funded project.
7. Private economics	1	0			The area starts to get more attractive and better accessible, but it's a process that needs time (in this phase the groundwork is laid for the improvement of the image).
8. Individual economics	0	0			No local jobs are created. In time, by improving the area, the price of land houses will increase.
9. Local institutional controls	0	0			Increase in NE not significant.
10. Central/EU institutional controls	0	0			Increase in NE not significant.

3. Built environment on:			BCM	±ESQ	Motivation
1. Biodiversity	1	1			Vacant plots can already be used as green public space.
2. Natural environment	1	1			Vacant plots can already be used as green public space.
4. Demographics	0	0			The built environment does not change the population.
5. Quality of life	1	1			Vacant plots can already be used as green public space.
6. Public economics	0	0			The vacant plots are not fully developed as park function yet, more temporary, so public funding's are not significant.
7. Private economics	1	1			Vacant plots can already be used as green public space, where there is opportunity for (small) commercial activities.
8. Individual economics	1	1			It will improve connections between the area and surrounding neighbourhoods and make the PT hub Marconiplein better accessible.
9. Local institutional controls	0	0			No protection required.
10. Central/EU institutional controls	0	0			No protection required.

4. Demographics			BCM	±ESQ	Motivation
1. Biodiversity	0	0			There are no changes in population on site.
2. Natural environment	0	0			There are no changes in population on site.
3. Built environment	0	0			There are no changes in population on site.
5. Quality of life	0	0			There are no changes in population on site.
6. Public economics	0	0			There are no changes in population on site.
7. Private economics	0	0			There are no changes in population on site.
8. Individual economics	0	0			No identified interaction
9. Local institutional controls	0	0			No identified interaction
10. Central/EU institutional controls	0	0			No identified interaction

5. Quality of life			BCM	±ESQ	Motivation
1. Biodiversity	0	0			Happy people are more caring for nature, might be wishful thinking (changes not (yet) significant).
2. Natural environment	0	0			Happy people are more caring for nature, might be wishful thinking (changes not (yet) significant).
3. Built environment	1	0			Better accessibility leads to more people and more social control which decreases crime. However, the attractivity needs to develop in time.
4. Demographics	1	1			The increase of development to improve the area affects QoL which makes it a nicer place to live. Might attract new people. Significant, because plans are already in action and people might move before prices of housing in the neighbourhood increase.
6. Public economics	0	0			No increase in employment.
7. Private economics	0	0			No increase in free time.
8. Individual economics	0	0			No relation
9. Local institutional controls	0	0			No relation
10. Central/EU institutional controls	0	0			No relation

6. Public economics			BCM	±ESQ	Motivation
1. Biodiversity	1	1			If more money is available, more potential for more biodiversity can be realized.
2. Natural environment	1	1			If more money is available, more natural environment can be realized.
3. Built environment	0	0			The built environment (excluding the streets) is not yet transformed.
4. Demographics	0	0			More public spending does not change the population.
5. Quality of life	1	2			Yes, the more money available, the higher the quality of the space, which means a higher attractivity and a better atmosphere for people and more potential for new businesses and services etc.
7. Private economics	1	1			The more attractive and the better accessible the space is, the more attractive it is for new (small/temporary) businesses.
8. Individual economics	0	0			More PuE does not influence income or spending of IE.
9. Local institutional controls	0	0			It will not affect tax revenue. (Question formulated wrong way around?)
10. Central/EU institutional controls	0	0			It will not affect tax revenue. (Question formulated wrong way around?)

7. Private economics			BCM	±ESQ	Motivation
1. Biodiversity	0	0			No relation.
2. Natural environment	0	0			No relation.
3. Built environment	1	1			Yes, if businesses are more successful, the area becomes a livelier space.
4. Demographics	0	0			No significant relation.
5. Quality of life	1	1			Possible increase in facilities.
6. Public economics	0	0			New businesses are probably not big enough to make a significant change.
8. Individual economics	0	0			No.
9. Local institutional controls	0	0			No relation.
10. Central/EU institutional controls	0	0			No relation.

8. Individual economics			BCM	±ESQ	Motivation
1. Biodiversity	0	0			No identified interaction
2. Natural environment	0	0			No changes in individual economic status.
3. Built environment	0	0			No changes in individual economic status.
4. Demographics	0	0			No changes in individual economic status.
5. Quality of life	0	0			No changes in individual economic status.
6. Public economics	0	0			No changes in individual economic status.
7. Private economics	0	0			No changes in individual economic status.
9. Local institutional controls	0	0			No identified interaction
10. Central/EU institutional controls	0	0			No identified interaction

9. Local institutional controls			BCM	±ESQ	Motivation
1. Biodiversity	0	0			Current industries remain in this phase and protection is not (yet) altered.
2. Natural environment	0	0			Current industries remain in this phase and protection is not (yet) altered.
3. Built environment	0	0			No increased protection (yet) since old harbour building/monuments are not yet re-used.
4. Demographics	0	0			No identified interaction
5. Quality of life	0	0			No identified interaction
6. Public economics	1	1			We changing street profiles that consist solely of concrete and bricks into a green infrastructure which needs money for realization and maintenance.
7. Private economics	0	0			No identified interaction
8. Individual economics	0	0			No identified interaction
10. Central/EU institutional controls	0	0			No identified interaction

10. Central/EU institutional controls			BCM	±ESQ	Motivation
1. Biodiversity	0	0			No relation.
2. Natural environment	0	0			No relation.
3. Built environment	0	0			No relation.
4. Demographics	0	0			No identified interaction
5. Quality of life	0	0			No identified interaction
6. Public economics	0	0			No relation.
7. Private economics	0	0			No identified interaction
8. Individual economics	0	0			No identified interaction
9. Local institutional controls	0	0			No relation.

Appendix C

BR2 M4H phases: BCM, ESQ and reasoning (phase IV-2)

1. Biodiversity on:	BCM	±ESQ	Motivation
2. Natural environment	1	1	Commonly accepted that more biodiversity is positive for nature.
3. Built environment	0	0	No identified interaction
4. Demographics	0	0	No identified interaction
5. Quality of life	1	1	Support for services that enhance ecosystems.
6. Public economics	0	0	No identified interaction
7. Private economics	0	0	No identified interaction
8. Individual economics	0	0	No identified interaction
9. Local institutional controls	1	-1	Increase in BIO means more protection and results in restrictions concerning land-use.
10. Central/EU institutional controls	0	0	The relation is on local scale, not on central scale.

2. Natural environment on:	BCM	±ESQ	Motivation
1. Biodiversity	1	2	Green infrastructure is now more developed and old factories are transformed into cultural hubs which also extend NE onto their plots.
3. Built environment	1	1	The density of BE decreases, some plots are used for cultural and leisure facilities whilst others are not. The overall quality improves.
4. Demographics	1	1	The change in NE will not affect population densities. It might however have a change in the type of people who live there.
5. Quality of life	1	2	People will have a more attractive way to move through the area and they will have access to a green waterfront and cultural facilities.
6. Public economics	1	-1	The maintenance of green infrastructure was already publicly funded in phase 1. Some cultural facilities (and the NE on those plots) might also be publicly funded.
7. Private economics	1	1	The area is more attractive and better accessible, which attract businesses (cultural and leisure).
8. Individual economics	1	1	Prices of houses increase due to more natural environment instead of an active harbour.
9. Local institutional controls	1	-1	NE requires more protection (means more effort thus negative).
10. Central/EU institutional controls	0	0	The relation is on local scale, not on central scale.

3. Built environment on:	BCM	±ESQ	Motivation
1. Biodiversity	1	2	Plots are transformed to cultural and leisure uses with more NE which provides space for more BIO.
2. Natural environment	1	2	Plots are transformed to cultural and leisure uses with more NE.
4. Demographics	0	0	The built environment does not change the population.
5. Quality of life	1	2	Old businesses which weren't accessible to the public turn into cultural and leisure facilities; quality improves.
6. Public economics	1	-1	Some cultural facilities might be publicly funded.
7. Private economics	1	-1	New businesses are attracted to the area, but they do not compare (in size etc.) to the ones which are leaving.
8. Individual economics	0	0	Transport links were already improved in phase 1.
9. Local institutional controls	1	-1	Old buildings (monuments) will be used for new functions and need protection.
10. Central/EU institutional controls	0	0	No relation on central or EU level.

4. Demographics	BCM	±ESQ	Motivation
1. Biodiversity	0	0	There are no changes in population on site.
2. Natural environment	0	0	There are no changes in population on site.
3. Built environment	0	0	There are no changes in population on site.
5. Quality of life	0	0	There are no changes in population on site.
6. Public economics	0	0	There are no changes in population on site.
7. Private economics	0	0	There are no changes in population on site.
8. Individual economics	0	0	No identified interaction
9. Local institutional controls	0	0	No identified interaction
10. Central/EU institutional controls	0	0	No identified interaction

5. Quality of life	BCM	±ESQ	Motivation
1. Biodiversity	1	1	People who appreciate their environment tend to be aware/take care of it.
2. Natural environment	1	1	People who appreciate their environment tend to be aware/take care of it.
3. Built environment	1	1	Better accessibility leads to more people and more social control which decreases crime (no longer anonymous space).
4. Demographics	1	1	The improvement of QoL might attract new people to the neighbourhood.
6. Public economics	1	1	New jobs created (leaving companies move, so their jobs are not "lost"), less unemployment (if we assume people from the neighbourhood get hired).
7. Private economics	0	0	No increase in free time.
8. Individual economics	0	0	No relation
9. Local institutional controls	0	0	No relation
10. Central/EU institutional controls	0	0	No relation

6. Public economics	BCM	±ESQ	Motivation
1. Biodiversity	1	1	If more money is available, more potential for more biodiversity can be realized.
2. Natural environment	1	1	If more money is available, more natural environment can be realized.
3. Built environment	1	1	If there is more public money, the publicly owned plots might have a higher quality.
4. Demographics	0	0	More public spending does not change the population.
5. Quality of life	1	1	Yes, the more money available, the higher the quality of the space, which means a higher attractiveness and a better atmosphere for people and more potential for new businesses and services etc. This also already had an influence in phase 1.
7. Private economics	1	-1	The more attractive and the better accessible the space is, the more attractive it is for new businesses. The spending of these businesses however is probably lower than that of the businesses which are leaving.
8. Individual economics	0	0	More PuE does not influence income or spending of it.
9. Local institutional controls	0	0	It will not affect tax revenue. (Question formulated wrong way around?)
10. Central/EU institutional controls	0	0	It will not affect tax revenue. (Question formulated wrong way around?)

7. Private economics	BCM	±ESQ	Motivation
1. Biodiversity	1	0	Cargo traffic stops, but passenger traffic increases (in balance?).
2. Natural environment	1	1	Cargo traffic stops, but passenger traffic increases (in balance?). Car parks are needed, but there already were truck parks. The car parks can be greener.
3. Built environment	1	2	Yes, if businesses (cultural, leisure, and commercial instead of the leaving industrial) are more successful, the area becomes a livelier space.
4. Demographics	1	1	New jobs created (leaving companies move, so their jobs are not "lost"), less unemployment (if we assume people from the neighbourhood get hired).
5. Quality of life	1	2	Increase in facilities.
6. Public economics	1	-1	The new companies probably won't cover the collected business rates of the leaving companies.
8. Individual economics	1	1	Since the leaving companies are moving, those jobs are not lost. In total, there will be more jobs (spread over multiple location e.g. Waal and Eem harbour).
9. Local institutional controls	0	0	?
10. Central/EU institutional controls	0	0	?

8. Individual economics	BCM	±ESQ	Motivation
1. Biodiversity	0	0	No identified interaction
2. Natural environment	0	0	No changes in individual economic status.
3. Built environment	0	0	No changes in individual economic status.
4. Demographics	0	0	No changes in individual economic status.
5. Quality of life	0	0	No changes in individual economic status.
6. Public economics	0	0	No changes in individual economic status.
7. Private economics	0	0	No changes in individual economic status.
9. Local institutional controls	0	0	No identified interaction
10. Central/EU institutional controls	0	0	No identified interaction

9. Local institutional controls	BCM	±ESQ	Motivation
1. Biodiversity	1	1	Yes, we're making a park and former industries leave.
2. Natural environment	1	1	Yes, we're making a park and former industries leave.
3. Built environment	1	1	Re-use of old harbour buildings, monuments. Need protection.
4. Demographics	0	0	No identified interaction
5. Quality of life	0	0	No identified interaction
6. Public economics	1	-1	Some plots will be publicly owned whilst they used to be privately owned. This leads to more public spending.
7. Private economics	0	0	No identified interaction
8. Individual economics	0	0	No identified interaction
10. Central/EU institutional controls	0	0	No identified interaction

10. Central/EU institutional controls	BCM	±ESQ	Motivation
1. Biodiversity	0	0	No relation.
2. Natural environment	0	0	No relation.
3. Built environment	0	0	No relation.
4. Demographics	0	0	No identified interaction
5. Quality of life	0	0	No identified interaction
6. Public economics	0	0	No relation.
7. Private economics	0	0	No identified interaction
8. Individual economics	0	0	No identified interaction
9. Local institutional controls	0	0	No relation.

Appendix C

BR2 M4H phases: BCM, ESQ and reasoning (phase IV-3)

1. Biodiversity on:			BCM	±ESQ	Motivation
2. Natural environment	0	0			We cannot say if this part of the plan increases biodiversity.
3. Built environment	0	0			No identified interaction
4. Demographics	0	0			No identified interaction
5. Quality of life	0	0			We cannot say if this part of the plan increases biodiversity. Previous phases did do exactly this.
6. Public economics	0	0			No identified interaction
7. Private economics	0	0			No identified interaction
8. Individual economics	0	0			No identified interaction
9. Local institutional controls	1	-1			We cannot say if this part of the plan increases biodiversity. More BE thus less space for NE leads to less potential habitat for BIO, though we do not know till what extent.
10. Central/EU institutional controls	0	0			We cannot say if this part of the plan increases biodiversity.

2. Natural environment on:			BCM	±ESQ	Motivation
1. Biodiversity	0	0			It's about more BE (if we also consider less NE it's double).
3. Built environment	0	0			Housing is developed, which leads to less NE. This is the other way around.
4. Demographics	1	2			The more room available, at the cost of NE, increases population density.
5. Quality of life	0	0			The changes in NE will not affect the QoL.
6. Public economics	0	0			It's not the changes in NE that makes more costs.
7. Private economics	0	0			Changes in NE will not affect PrE.
8. Individual economics	0	0			Changes in NE will not affect IE.
9. Local institutional controls	0	0			No relation.
10. Central/EU institutional controls	0	0			No relation.

3. Built environment on:			BCM	±ESQ	Motivation
1. Biodiversity	1	-1			More BE leads to less NE. The natural environment that is lost in on the vacant plots. How much biodiversity is there is hard to tell. Could be moderately negative.
2. Natural environment	1	-1			More BE leads to less NE. The natural environment that is lost in on the vacant plots, which weren't (really) developed.
4. Demographics	1	2			A lot of housing is realized.
5. Quality of life	1	1			Green open spaces are developed into housing. What the value of these spaces will be to society is hard to tell. They were meant to be temporary, so there should be a balanced or even positive relation.
6. Public economics	1	-1			Vacant (formerly privately owned) plots will turn into public streets and parks.
7. Private economics	1	0			New dwellings will call for new small businesses. How much is hard to say, because the earlier developed housing in phases I - III will already have attracted businesses and there already are a lot of facilities nearby. New facilities here might affect others in the neighbourhood.
8. Individual economics	0	0			Connections are already there.
9. Local institutional controls	1	2			It contributes to densifying within existing tissue.
10. Central/EU institutional controls	0	0			No relation.

4. Demographics			BCM	±ESQ	Motivation
1. Biodiversity	1	0			The location goes from uninhabited to inhabited. But it was already a park with visitors, so it shouldn't have large effects on BIO.
2. Natural environment	1	-1			More inhabitants lead to more energy consumption. Though this is not (all/yet) produced on site so neither are the negative consequences. More car journeys per day which is negative for local air quality (but the air is already polluted in this part of the city).
3. Built environment	1	1			More BE leads to more DEM. It's the other way around. More demographics means more social control and less crime (which could have been there on vacant plots).
5. Quality of life	0	0			More DEM might attract some new small facilities, but there already are a lot of facilities in the neighbourhood and due to the cultural park. It will not affect the current population in the surroundings.
6. Public economics	1	1			More population will mean more tax income.
7. Private economics	1	-1			More DEM might attract some new small facilities, but there already are a lot of facilities in the neighbourhood and due to the cultural park. It will not affect the current population in the surroundings. New facilities here might affect others in the neighbourhood.
8. Individual economics	0	0			No identified interaction
9. Local institutional controls	0	0			No identified interaction
10. Central/EU institutional controls	0	0			No identified interaction

5. Quality of life			BCM	±ESQ	Motivation
1. Biodiversity	0	0			Happy people are more caring for nature, might be wishful thinking.
2. Natural environment	0	0			Happy people are more caring for nature, might be wishful thinking.
3. Built environment	0	0			No relation.
4. Demographics	0	0			No (obvious) relation.
6. Public economics	0	0			No increase in employment.
7. Private economics	0	0			No increase in free time.
8. Individual economics	0	0			No new opportunities for IE.
9. Local institutional controls	0	0			No relation
10. Central/EU institutional controls	0	0			No relation

6. Public economics			BCM	±ESQ	Motivation
1. Biodiversity	0	0			No relation in this phase.
2. Natural environment	0	0			No relation in this phase.
3. Built environment	1	1			Improves streets etc.
4. Demographics	0	0			No relation in this phase.
5. Quality of life	0	0			No relation in this phase.
7. Private economics	0	0			No relation in this phase.
8. Individual economics	0	0			No relation in this phase.
9. Local institutional controls	0	0			No relation in this phase.
10. Central/EU institutional controls	0	0			No relation in this phase.

7. Private economics			BCM	±ESQ	Motivation
1. Biodiversity	0	0			No relation.
2. Natural environment	0	0			More car journeys per day due to more DEM.
3. Built environment	0	0			The effect of success of local businesses will not (significantly) improve the BE. There already are businesses and facilities related to the cultural park.
4. Demographics	0	0			During building phase a contractor needs employees. Though most contractors already have employees and there is no telling whether they'll need more and if they do if they are from the neighbourhood.
5. Quality of life	1	-1			Facilities could even have a negative effect if they compete with the same kind of facilities in the neighbourhood.
6. Public economics	0	0			No significant change.
8. Individual economics	0	0			No relation.
9. Local institutional controls	0	0			No relation.
10. Central/EU institutional controls	0	0			No relation.

8. Individual economics			BCM	±ESQ	Motivation
1. Biodiversity	0	0			No identified interaction
2. Natural environment	0	0			New inhabitants move to the area, current IE doesn't change because there was none. Only new. And people in the neighbourhood, but nothing changes for them.
3. Built environment	0	0			New inhabitants move to the area, current IE doesn't change because there was none. Only new. And people in the neighbourhood, but nothing changes for them.
4. Demographics	0	0			New inhabitants move to the area, current IE doesn't change because there was none. Only new. And people in the neighbourhood, but nothing changes for them.
5. Quality of life	0	0			New inhabitants move to the area, current IE doesn't change because there was none. Only new. And people in the neighbourhood, but nothing changes for them.
6. Public economics	0	0			New inhabitants move to the area, current IE doesn't change because there was none. Only new. And people in the neighbourhood, but nothing changes for them.
7. Private economics	0	0			New inhabitants move to the area, current IE doesn't change because there was none. Only new. And people in the neighbourhood, but nothing changes for them.
9. Local institutional controls	0	0			No identified interaction
10. Central/EU institutional controls	0	0			No identified interaction

9. Local institutional controls			BCM	±ESQ	Motivation
1. Biodiversity	1	0			With new housing, local protection for BIO needs to be enhanced to secure habitats. It won't lead to an increase but to conservation.
2. Natural environment	0	0			It won't lead to improved NE.
3. Built environment	0	0			No relation in this phase.
4. Demographics	0	0			No identified interaction
5. Quality of life	0	0			No identified interaction
6. Public economics	1	1			The public space around the new dwellings can be either costly or less costly, depends on the way it's planned.
7. Private economics	0	0			No identified interaction
8. Individual economics	0	0			No identified interaction
10. Central/EU institutional controls	0	0			No identified interaction

10. Central/EU institutional controls			BCM	±ESQ	Motivation
1. Biodiversity	0	0			No relation.
2. Natural environment	0	0			No relation.
3. Built environment	0	0			No relation.
4. Demographics	0	0			No identified interaction
5. Quality of life	0	0			No identified interaction
6. Public economics	0	0			No relation.
7. Private economics	0	0			No identified interaction
8. Individual economics	0	0			No identified interaction
9. Local institutional controls	0	0			No relation.



Appendix D

D1

Appendix D

D2

