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"Holistic Management of Brownfield Regeneration"

D 2.1: Early Indicators for Brownfield origination

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Summary

Managed land can be considered as being at a certain stage within a cycle: of allocation of building land, development, use, imminent end-of-use or even abandonment and re-use. Many of the urban and industrial areas that are reaching the end of their current life cycle, unless revived, are in danger of turning into brownfields (BFs). Though BFs are being redeveloped successfully, it is argued that at the current pace more BFs are coming into existence than are being redeveloped.

One of the first objectives of HOMBRE is to get a b*etter understanding of why, how, where and when BFs are formed,* in order to avoid future BFs as much as possible. To this end, 'early indicators' are identified, that can aid in anticipating BF formation and related problems in an early stage. Then, through managed intervention, this could be prevented from happening. Thus, the goal of the early indicators is to have a signalling function towards persons or organisations responsible for land management. The management level specifically considered is that of the municipality.

In total, around 40 early indicators have been identified through literature review, that are viewed to be generically usable. They have been grouped into clusters within the categories of economic, social and environmental indicators. As economic drivers were found to dominate BF formation, there is some emphasis towards economic indicators. Municipal land managers are envisaged to select from the list of suggested indicators the ones that are most relevant and convenient in their situation. Aspects of data availability, that are crucial in this choice, will be worked out in deliverable D2.2 on indicator monitoring.

Contents

1 Introduction

1.1 Brownfields

Brownfields (BFs) are sites that have been affected by the former use of the site and surrounding land, are derelict or underused, may have real or perceived contamination problems, are mainly in developed urban areas and require intervention to bring them back to beneficial use (CABERNET, 2005). Communities with BFs often face economic and social concerns, such as unemployment, substandard housing, outdated or faulty public infrastructure, and crime. The areas and communities affected also include abandoned mining regions, where lack of economic prospect and deteriorated landscapes force the population to move to new-built suburbs outside their region. Social and economic developments since WWII have triggered an unprecedented and on-going urban sprawl in all western countries among which most EU Member States. These developments could indicate that many of the urban and industrial areas that are reaching the end of their current life cycle, unless revived, are in danger of turning into BFs. Based on various definitions, the overall estimate amounts to near one million (potential) BF sites for the EU (Oliver et al, 2005) and to more than 450000 BFs in the US.

Clearly, BF regeneration remains a key to tackling urban sprawl and ensuring a more sustainable environment (Commission of the European Communities, 2006). Though BFs are being redeveloped successfully, it is argued that at the current pace more BFs are coming into existence than are being redeveloped (Ferber, in Ramsden, 2010).

1.2 HOMBRE WP2

Advances in the prevention and re-use of BF's are thus paramount to reducing our carbon footprint and increasing overall sustainability in land management, while at the same time enhancing the well being of the population. BF regeneration should not be considered as a stand-alone negative issue, but as part of a more positive perspective on land management. The HOMBRE projects' vision is to develop a HOlistic Management of Brownfield REgeneration (HOMBRE) to accomplish a 'Zero Brownfield' development. Part of the mission of HOMBRE is that, in future BF regeneration projects, sustainability aspects of both the regeneration process and of the projected resulting land use are integrally included in decision making. HOMBRE therefore focuses at strategies, technologies and solutions for BF management, that emphasize the positive value of available resources and potential social, economic and environmental benefits.

To do so HOMBRE has identified the following research objectives:

1. *Better understanding why, how, where and when BFs are formed* in order to avoid future BFs , in different areas in the EU and in three main fields: urban, industrial and mining areas,
2. *Better planning and more attractive communication technologies*, that allow more holistic appraisal of BF regeneration options and early stakeholder involvement,
3. *Better operations*, better implementation of state of the art technologies, and development of *innovative technology combinations* for more sustainable integrated BF regeneration,
4. Better and *more creative solutions for long-term land use* of current and potential future BFs.

The focus of HOMBRE WP2 “BF Roadmap for Zero Brownfields perspective” is on the first research objective. With further input from WP3-5 (research objectives 2-4), a framework for holistic BF management will be developed within WP2, which will be completed in WP6 and formalised in a CEN Workshop Agreement within WP7.

1.3 This report

This report of WP2 delivers one of the building blocks to reach the first objective: a discussion of early indicators of BF origination that could point out possible ways of prevention (Deliverable 2.1 “Early Indicators for Brownfield origination” and part of task 2.1 “Early indicators and key factors of brownfields origination”). It summarises the results of the first year of the HOMBRE project concerning the role and position of such indicators within the Zero Brownfield framework and the construction of a basic set of early indicators to identify if BFs are likely to come into existence. With this information the aim is to at least anticipate BF formation and related problems in an early stage and, through managed intervention, prevent this from happening. How this can be done will be further elaborated in a report addressing monitoring within the Circular Land Management Framework (D 2.2) and a report discussing and describing criteria and indicators for successful BF regeneration (D2.3).

The report starts with a historic narrative (Section 2) and a short introduction of the land use cycle, which forms the context of BF formation and regeneration (Section 3). Here, also the use of indicators in the decision-making processes is briefly discussed. In Section 4 we describe the methodology that has been followed to construct the current basic set of early indicators. Section 5 presents the results: a list of early indicators.

2 Brownfields: a historical narrative

As is clear from the definition given in the introduction, BFs are sites that have been previously developed for industrial or urban use, but are now derelict. This dereliction is connected to two major historical developments of the past half century: deindustrialisation and suburbanisation (Tang & Nathanail, 2012).

Around the turn of the 18th century, the large mines and mills that emerged with the industrial revolution had led to a concentration of employment, and a concurrent migration of people from rural to urban areas. In the early 20th century, a development of mass production without mass employment had already set in. The late 20th century saw an out-migration of important industrial sectors, such as the closure of large sites from the coal and steel industries and the 1980s textile crisis. This development largely affected both urban economy and urban land use. In addition to loss of jobs, also previous industrial land became vacant, as the service sectors that replaced the industry usually require less land on which to operate. Of course, many of the former industrial sites suffered from contamination.

Not only industry out-migrated, also the population had turned their back on the cities, especially the more wealthy part. They moved to newly developed estates at the fringes of existing urban areas, that offered better quality of housing, air, and environmental conditions in general (Mieszkowski & Mills, 1993). As a result, also many residential properties in city centres became derelict. Dereliction further reduced the appreciation of both residents and potential investors for the inner cities, resulting in continued out-migration and more dereliction.

While the ”first generation” of BFs appeared in Europe with this deindustrialisation, military downsizing and abandoned transport infrastructures have added to the list of BFs since the 1990s (Ferber, 2010; Ramsden, 2010). On-going globalisation and economic change currently create BFs and “Greyfields” from abandoned social infrastructure, housing and commerce. CLARINET (2001) identified three main categories of BFs (Figure 1):

- in **traditional industrial areas**, where the massive loss of industrial jobs led to substantive structural urban change. Those BFs are often large, situated in urbanised areas and with a poor environment, have low land value, and require intensive recycling and rehabilitation intervention, linked with high costs.
- in **metropolitan areas**, where the land market turned into a dynamic model influenced by the service sector. Old industries were pushed outside the city in the periphery, and reinforced the urban sprawl, illustrated by business and industry parks at the fringe of cities. Also urban areas of old railways, military and harbours are included in this category. Land speculation on those areas, because their attractiveness near city centre, exacerbates the difficulties of cities to find good solutions for regeneration.
- in **rural areas**, where sites connected with primary economic activities (intensive agriculture and forestry, mining) were under strong transformation process, due to the abandonment of activities. Local authorities were often not able to develop instruments or strategies of revitalisation.

Picture 3: „First Generation of Brownfields from heavy industries, mining and textile industry

Picture 4: "Second Generation" from military conversion, traffic infrastructure

Picture 5: "Third Generation" for housing, social infrastructure, "Grayfields"

Figure 1. Examples of BF types (source: Ferber, 2010)

3 Early indicators and the land use cycle

In analogy to materials cycles, which link primary resources, product manufacturing, product use, waste generation and waste recycling, also managed land can be considered as being at a certain stage within a cycle: of allocation of building land, development, use, abandonment and re-use (www.Circuse.eu; Box 1).

Box 1: Early indicators in Circular Land Management

Circular Land Management (www.Circuse.eu) is an approach to land use planning that, in analogy to materials cycles, considers a cycle of allocation of building land, development, use, abandonment and re-use (Figure 2).

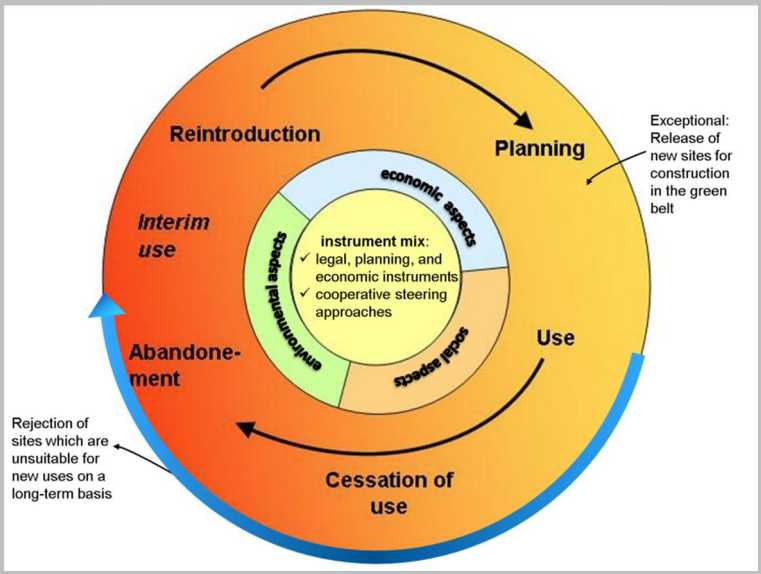

Figure 2. The land use cycle (adopted from www.Circuse.eu)

Circuse defines the following phases within this cycle (Phases C and D are were BFs exist):

A. Planning	Including all formal and informal activities on planning decisions for future land use.
B. Use	Phase of stable use and maintenance of land and buildings
C. Cessation of Use	Phase of underuse, neglected maintenance and closure of activities
D. Abandonment	Phase of dereliction without use.
E. Interim Use	Non permanent use based on a step-by-step approach for the revitalization of land. Interim uses can provide a smooth continuation from the traditional use into the future use of the area.
F. Reintroduction	Transition phase of land before being available for new uses and planning.

The cycle is influenced by social, environmental and economic drivers (and vice versa), this in turn can be influenced by legal regulation, economic incentives, and other instruments). The primary focus of the Early indicators is from phase B through C-D, as indicated by the blue arrow.

Although, phase C and D often still include care and maintenance -responsible site owners put in place provisions to protect the environment and the public from hazards-, BFs in this

analogy compare to waste. Minimising waste as a contribution to sustainability, in this context means that abandonment needs to be avoided. Thus, managing land within this cycle involves taking responsibility for the prevention of BF formation and/or counteracting its negative effects, and the direction or facilitation of BF regeneration processes. The goal of an 'early indicator' within this framework is to have a signalling function towards persons or organisations responsible for this land management in the early stages of the process of BF formation.

The use of indicators in policy and decision making has a long history. Without going into the details of the environmental debate on the use of indicators, in general terms indicator use started in the mid 20th century from economics (Box 2).The term indicator has since been used in various contexts, like industry (e.g. key performance indicators), finance (e.g. market indicators) and environmental sciences and social sciences (see e.g. the International Society of Environmental Indicators Journal). Literature (OECD, 2008; Hemphill et al. 2005; Martin and Sauvageot, 2011) shows that the word is given different meanings in different contexts and is sometimes used as a synonym for data, targets, standards for evaluation, or modes of data collection.

Box 2: Use of indicators in decision and policy making

According to Wong (2004), the use of quantitative indicators to guide policy action began in the 1940s in the United States, with a view to measuring economic questions. Based on the success of these indicators and their use in policy processes, indicators began to be applied to other areas as well, for example in the mid 1960s to measure social changes. Wong (2004) describes this as the first large wave of how the use of indicators spread. The second large wave - according to Wong -, was in the 1990s. In a context of the emergence of environmental questions, indicators would be constructed in order to measure the sustainability and quality of life on its different scales. They should be able to form a solid base for taking policy decisions. The emphasis of this new wave of indicators was much more pragmatic and with a wider policy angle than the previous moment.

The OECD (2008), describe an indicator as *a quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions in a given* (thematic) *area. When evaluated at regular intervals, an indicator can point out the direction of change across different units and through time (p.13)*. According to the European Commission (EC, 2001), indicators are used to *describe a project's objectives in operationally measurable terms (quantity, quality, time).* What these definitions have in common is that the indicator is linked to a *change in time* and used to monitor an on-going process, be it autonomous development or a managed intervention. These indicators may therefore also be termed monitoring indicators (see World Bank, 1996).

A wider definition, in the context of sustainable remediation of contaminated land, is adopted by NICOLE, SuRF-UK and REJUVENATE and RESCUE. They define an indicator as *a single characteristic that can be compared between options to evaluate their relative performance towards specific sustainable development concerns. Indicators need to be measurable or comparable in some way that is sufficient to allow this evaluation* (REJUVENATE, 2009). Here, the indicator is not restricted to measure a change with time, but may also assess a difference between situations. These could be real situations separated in time (= monitoring indicator), different locations, but also projected results under different management scenarios.

The HOMBRE early indicators for BF origination are intended to be monitoring indicators that should follow the part-managed, part-autonomous process of land use degeneration and BF origination. By degeneration of land use we understand a more or less gradual process whereby costs and benefits (be it economic, environmental or social) of current land use run out of balance. Early indicator monitoring should provide information on whether a site is shifting from phase B (use) towards phase C (cessation of use/underuse) and D (imminent abandonment).

Evidently, such early indicators could also apply for the long term monitoring of successfully regenerated BFs, helping to identify the extent of project success and overall sustainability as defined in the planning phase A. As such they might be used in all stages of the land use cycle, providing clear signals if, when, and what type of intervention is required, thereby contributing to the HOMBRE 'Zero-Brownfields' ambition. In this sense, early indicators can be viewed as 'red flags' in circular land management, signalling that intervention is required.

4 Methodology

4.1 General mind-set

An interesting proposition was made by Rittel and Webber (1973), who state that *"the information needed to understand the problem depends on one's idea for solving it…the process of formulating the problem and conceiving a solution…are identical, since every specification of the problem is a specification of the direction in which 'treatment' is considered"*. With this quote we want to point out that the issues we want to address in the HOMBRE project – or any other societal, policy or planning issues- are not given facts that stakeholders or policy makers simply must accept. The issues may be defined in various, quite different ways, each way containing the seeds for a different solution. For example, if we agree the problem is a hungry population, then providing food is the answer. But we might decide that the problem is low-income and if so, we look for ways to supplement income (Innes, 1989). The point we want to make here is that indicators are not exact science and building them is a part subjective, part consensual process, in which questions and interests of different natures are involved (Wong, 2004). This being said, does not imply that finding relevant indicators is fully context dependent and case specific. In the example given above, abolishing hunger would be a common goal, and monitoring the nutritional value of the average diet a means to evaluate the success of the solution approach chosen.

This report aims to identify "early indicators of BF origination", that are to be used for "early recognition of why, how, and when BFs come into existence" and to "better understand why, how, where and when BFs are formed". Although many of the processes leading to BFs are more or less autonomous and operate at global scales, the managed adaptation to these processes *can* be influenced (how to react but also when to react).

The early indicators should be useful tools to enable local governments to develop a strategic policy on BF regeneration and land development. They will also help to identify what triggers BF formation. Thirdly, a good understanding of early indicators of BF origination could create windows of opportunity for using BFs for adaptation to natural or man-induced (extreme) events (e.g. climate change). The spatial scale that has been used as focus for this report is the municipal level. This does not rule out some more global trends and developments, as they could also have an impact on a municipal level and are thus taken into account for the identification of early indicators.

4.2 Literature study on BF origination

To identify early indicators of BF origination, a literature review was executed. The literature review is mainly based on UK, US, Dutch, French and German research and case studies (amongst others www.flaeche-im-kreis.de, www.refina.de, www.rescue-europe.eu, SurfUK; see also Appendix 1).

As it turns out, most literature focuses on what facilitates successful or sustainable BF regeneration (Silverthorne, 2006, Doick et al., 2009, Pediati et al., 2010). There is very little literature on how to prevent certain areas currently in phase B of the circular land management framework from moving towards phase C and develop into a BF site. The only exception found is Taylor et al. (2009), who present a system methodology for identifying,

characterizing, and evaluating engineering solutions and policies that prevent the formation of BFs which are contaminated.

The literature on BF regeneration is nevertheless useful to determine early indicators of the deterioration of sites, as they often depict the opposite of early warning signs. What constitutes success in BF redevelopment identifies indicators that could point out either success or decline. One definition of success in this context is given by the former UK Department of the Environment, Transport and the Regions (DETR): 'if an area no longer experiences economic, social housing and environmental problems, other than the average of the country'. Hence, several articles (e.g. van der Toorn and Vrijthoff, 2006, Villella et al., 2006), project results (RESCUE, SURF-UK) have been used to identify indicators of success which after adaptation are presented here as early indicators. These are for example infrastructure and accessibility and surrounding land value.

Also, literature on indicators of sustainable land management has been taken into account, as its aim is to minimize environmental effects and promote social cohesion and a stable economy. The disregard of these elements could inherently lead to BFs coming into existence. Furthermore, more heterogeneous (global) trends and developments are considered, such as the change from industrial based economy to tertiary activities, namely deindustrialisation (Rowthorn & Ramaswamy, 1997), as a cause of BF origination (Alker, Joy, Roberts, & Smith, 2000; Oliver et al., 2005; Ganser & Williams, 2007; Adams, De Sousa, & Tiesdell, 2010).

Lang and McNeil (2004) point out that the success of BF redevelopment is not solely due to environmental factors, and success cannot be achieved by just addressing the environmental issues (such as tackling contamination issues). For many redevelopment projects, success is directly measured against the original objectives of the project – such as realising real estate - where focus is often more towards economic, rather than social and environmental aspects. According to Doick et al. (2009), success in BF regeneration has been described generically as economic benefit (De Sousa, 2008), or as civil infrastructure renewal, tax-based development, economic development and neighbour-hood revitalisation (Amekudzi and Fomunung, 2004). In more specific terms, success has been described as local community involvement, job creation or relative to environmental remediation (Amekudzi and Fomunung, 2004). A classification into economic, social and environmental costs is often used to refer to the cost of BF sites (Burnham-Howard, 2004), hence success of BF regeneration should also be measured along these three axes, that are commonly understood to be the pillars of sustainable development. As Silverthorne (2006) stresses, '*it is now of vital importance when formulating a definition of success of redevelopment projects to include factors relating to the success of the social objectives with regard to the original stakeholders and the local communities*'.

It becomes apparent from the literature that there is neither a benchmark standard nor a list of indicators by which success (or the opposite: degeneration) is measured or defined in absolute terms (Silverthorne, 2006). From the above, a first classification into economic, social and environmental indicators appears essential. Additionally, these three main categories can be subdivided into themes or issues that are considered to be most relevant or urgent (see SuRF-UK).

Furthermore, the early indicators can be divided among predictable (homogeneous) and complex (heterogeneous) processes. The complex processes can be seen as more long-term

trends that cause BFs to develop, such as land-use changes which create “locked-in” situations, or shifts from industrial economy to a service-oriented economy, which makes certain activities obsolete. Other example of complex processes are global trends which may cause investments to move elsewhere. CABERNET for example concluded that some mobile phone companies chase the growing markets and once a market is saturated they move to the next country, thus using land as a disposable commodity. Although these processes in themselves cannot be influenced, their mere recognition helps decision-makers to be aware of these trends and were possible respond and react in the best possible way, which can counteract BF development (Couch, et. al. 2011).

Finally, certain institutional conditions are potentially high determinants for BF origination or successful regeneration. For example investment capacity, governance, type of legislation (rigid or flexible) and presence of soil remediation/regeneration policies for old industrial sites (Couch, et. al. 2011).

5 Results: Basic set of early indicators

As mentioned before, the management level on which the early indicators apply is that of the municipality level, and not on the level of a specific site or project. Rather, the early indicators should signal whether or not initiation of a project is called for, to intervene in an otherwise undesired development along the land use cycle.

Comparative studies between European countries showed that there are diverse causes of BF formation and distributions among countries and cities (Olive et. al. 2005; Couch, Leontidou and Petschel-Held, 2007; Couch, Sykes and Borstinghaus, 2011). Because of the demographic differences and life-style differences, the demand of land use could vary. Thus, no unified quantitative standards to evaluate the potential of dereliction is envisaged. However, the quantitative indicators may help municipalities to assess the trend of urban development within their administrative areas and therefore, help to evaluate the probability BFs may appear. At minimal, this should allow the comparison of the same indicators between different observation periods in a municipality. This is also the approach of WP3 of the HOMBRE project in developing the Brownfield Navigator.

In total, around 40 early indicators have been identified through the literature review, that are viewed to be generically usable. This does not mean that they will be equally valuable in all situations, but that they can be relevant in most cases. Also, the size of and capacity available at municipalities varies considerably (see Couch et al., 2011), including their capability to collect and interpret the necessary indicator data. We therefore propose that municipalities select, from the list of suggested generic indicators, the ones that are most relevant and convenient in their situation.

It should further be noted that no one single indicator can precisely predict the emergence or increase of BFs, given the complexity of their origination. When more, and more varied, complementary types of indicators are used, more accurate result can be obtained from the evaluation. Yet, from a practical point of view, in an actual management context the number of indicators selected probably needs to be limited based on past experiences from the project team we advise to use a maximum of about 15 indicators.

The indicators have been grouped into clusters within the categories of economic, social and environmental indicators, as reasoned above. As it turns out, there seems to be an emphasis towards the economic cluster of indicators, in line with the historic analysis as presented in section 2, where economic drivers were found to dominate. As discussed above, the selection of indicators is a part consensual process, be it for a specific case, where consensus should be reached among the case stakeholders, or for a generic list as presented here, where consensus is derived by the scientific community through exchange of ideas in literature.

The full rationale behind each of the indicators listed, and their specific suitability as Early indicators for BF generation at the municipality level is to be worked out within Task 2.2 on monitoring, as data availability is expected to be a crucial factor for the usefulness of early indicators. However, some examples of rationale behind the indicators are presented (Box 3).

5.1 Economic indicators

It is generally believed that most of past and existing BF cases were the results of deindustrialisation and urban sprawl (Alker, Joy, Roberts, & Smith, 2000; Oliver et al., 2005; Ganser & Williams, 2007; Adams, De Sousa, & Tiesdell, 2010). Following this line of thought, the economic parameters that changed during the process of deindustrialisation and suburbanisation may be useful in predicting an increase in BF land. Overall, it can be deducted that when a major restructuring of society occurs (for example, the change of major economic activities in the area, the out-migration of population of specific classes, or withdrawing investments), it is likely that BFs would appear because the designated land use in certain locations becomes out of date. Thus, the indicators that help predict the changes or estimate the speed of the restructuring may be useful early indicators. Here the economic indicators start to coincide with the social indicators.

As described in section 4.2, a second approach is to consider solutions developed or demonstrated in the research and case studies on BF regeneration projects, to retrieve the factors that delay BF redevelopment (for example, the indicators derived from the case studies of Silverthorne, 2006; Van der Toorn Vrijthoff, 2006). This approach has limitations, as BF regeneration as a means to achieve sustainable development does not equate to restoring the site back to its original conditions. For example, re-introducing the mining and textile industries to Northern England may not be feasible or appropriate. Therefore, the solution to the urban dereliction in northern part of England may not be directly relevant to the origin of the BFs. This limitation has been taken into account when choosing the indicators.

Box 3. Example rationales for early indicators

'change of the percentages of areas under industrial land use'
The industrial sectors generally need larger areas of land for production compared to the service sectors. During the process of the deindustrialisation, a location needs to attract more service sectors to occupy the original space used by the out-migrated industry in order to prevent dereliction. This is not often possible. From the speed of changes of percentages of industrial land use in a municipality, the municipality may sense whether the out-migration of the industry is happening and evaluate the possibility of dereliction. Thus, the changes of the percentages of areas under industrial land use may be good early indicators for brownfield.

'% change in income groups in certain period'
The change of land use within an area – going from heavy industry towards more service oriented activities – also has an impact on the society that supplies the labour force for these new service industries. A similar line of reasoning applies for a housing site as potential BF. If companies are moving away from an area, this will also be visible in the change in income groups over a certain period

'm2 of green area per inhabitant'
According to Silverthorne (2006) green areas in urban areas increases the overall liveability and contributes to the quality of life in the locality. In this sense, a lack of green areas of a certain quality can be a warning sign for a negative development of a site. Although it may not have a direct impact, it can be expected to be a negative influence in the long term.

The basic set of economic indicators considered relevant to evaluate the potential for BF formation are listed in table 1. As an example of rationale, the indicator '*change of the percentage of areas under industrial land use*' is discussed in Box 3.

Table 1. Basic set of economic early indicators for BF formation

ELEMENT	CATEGORY	ISSUES INDICATORS MIGHT NEED TO CONSIDER	SUGGESTED INDICATORS	Effect on short/long term <10 years >	Scale Local/Regional/ National/Global	Source for data/info
	deindustrialisation or restructuring of the economic activities	Land use	the change of the percentages of areas under industrial land use	Short term	Local and National	EUROSTAT
			floor spaces for industrial, retail and office use	Short term	Local	Local/national statistics For example: http://www.communities.gov.uk/planningandbuilding/planningbuilding/planningstatistics/previouslydevelopedbrownfield/
		Composition of employment	percentages of employment in industrial sector and service sector within municipalities	Short term and long term	Local and national	EUROSTAT Local/national statistics
		Composition of GDP	percentages of GDP in industrial sector and service sector within municipalities	Short term and long term	Local and national	EUROSTAT national statistics
		Employment	long term unemployment	Long term	Local national	EUROSTAT Local/national statistics
		Real estate market	property price	Short term	Local	Local/national statistics Online directories Property assessment cooperation
	transportation	Accessibility, mobility, operational efficiency	average time from facility to major highway network/train facility	Short term/ Long term	Local	Local infrastructure plans
			bridge weight limits	Short term/ Long term	Local	Local infrastructure plans
			lost time due to congestion	Short term/ Long term	Local	Local infrastructure plans
			volume/capacity ratio	Short term/ Long term	Local	Local infrastructure plans
		Safety	Number of accidents	Short term/ Long term	Local	Local statistics
		System Preservation	Percent of roadway/bridge system below standard condition	Long term	Local	Local infrastructure plans
			Age distribution of infrastructural elements	Long term	Local	Local infrastructure plans
	Urban Sprawl	Property Price	ratio of the property price in a municipality to the adjacent municipalities	Short term/ Long term	Regional	
	Recession	Withdrawing investment from regions experiencing recession	National real GDP	Short term/ Long term	National/Global	National Statistic Eurostat
			Real income	Short term/ Long term	National	National Statistic Eurostat
			Employment rate	Short term/ Long term	National	National Statistic Eurostat
			Industrial production	Short term/ Long term	National/Global	National Statistic Eurostat
			Wholesale-retail sales	Short term/ Long term	Local	Chamber of commerce

5.2 Social Indicators

The approach towards the identification of social indicators is similar to that for the economic indicators. Hence, also the social parameters that changed during the process of deindustrialisation and suburbanisation may be useful in predicting an increase in BF formation. Likely, BFs would appear when the designated land use in specific locations becomes less attractive from a social perspective. Thus, the indicators that help predict the changes or estimate the speed of the restructuring may be useful early indicators.

Aspects considered of importance for generating community support in BF regeneration projects might, when absent, may signal risks for the emergence of BFs.

The basic set of social indicators considered relevant to evaluate the potential for BF formation, as based on the literature review, are listed in table 2. As an example of rationale, the indicator '*% change in income groups in certain period*' is discussed in Box 3.

Table 2. Basic set of social early indicators for BF formation

ELEMENT	CATEGORY	ISSUES INDICATORS MIGHT NEED TO CONSIDER	SUGGESTED INDICATORS	Effect on short/long term <10 years >	Scale Local/Regional/ National/Global	Source for data/info
Social	Societal development	Population wealth	% social rent dwellings % of uniform houses versus diversification of houses % change in income groups in certain period	Short term	Local	Local statistics
		Education level	% of university/higher education in certain period	Short term/ Long term	Local	Local and national statistics
		Available services	Average distance to schools / shopping areas / restaurants etc (specific to case)	Short term	Local	Local statistics
	State of the social system	Crime	# of vandalism incidents reported in certain period compared to regional statistics # of criminal incidents reported in certain period compared to regional statistics	Short term	Local/Regional	National Databases For example in the Netherlands: http://www.ad.nl/ad/nl/1401/home/integration/nmc/frameset/nieuws/misdaadmeter.dhtml
		Health	Average age of death	Long term	Local/National	Local and national statistics
		Social cohesion	Change in the distribution of age groups in area.	Long term	Local	Local and national statistics
			% of people feeling some sort of commitment with area		Local	

5.3 Environmental Indicators

Early indicators from an environmental perspective are less easy to define as from the economic and social perspectives. The main reason for this is that especially aspects such as quality of soil/subsurface, water, and air nowadays are often known and – if EU regulation is implemented – will not deteriorate very much over time. We have added them to the list of early indicators none the less, because in some areas they still are relevant. Probably when it comes to biodiversity, ecology and hindrances, the changes over time can be more substantial. Table 3 lists the basic set of environmental indicators considered relevant to evaluate the potential for BF formation, as based on the literature review.

Table 3. Basic set of environmental early indicators for BF formation

ELEMENT	CATEGORY	ISSUES INDICATORS MIGHT NEED TO CONSIDER	SUGGESTED INDICATORS	Effect on short/long term <10 years >	Scale Local/Regional/ National/Global	Source for data/info
Environ-mental	Pollution	Soil	Contamination amount/density; soil quality assessment	Short term/ Long term	Local	Local/National statistics
		(Ground)Water	EBI index	Short term/ Long term	Local/Regional	Local/National/EU statistics
		Air	NOX/pm10 concentrations	Short term/ Long term	Local	Local/National/EU statistics
	Green areas	The presence of green area at site and its quality	m2 of green area per inhabitant	Long term	Local	Local/National statistics
	Ecology	Biodiversity	Number of species per m2	Short term	Local	Local/National statistics
	Hindrances	Amount of hinder due to noise	amount of dB at different sites throughout the area	Short term	Local	Local/National statistics

6 Concluding remarks

Based on a review of literature related to de-industrialisation, urbanisation, urban regeneration and BF regeneration, a basic set of indicators relevant to evaluate the potential for BF formation is presented here. However, the relative contribution to BF origination of the individual developments represented by the different indicators may vary from country to country or from region to region, depending on its history, culture, and social, political and economic structure. As such, the list is a generic advice regarding issues worth looking at, but interpreting the indicator trends in terms of low, moderate or high risk for BF origination is context dependent and requires local insight and commitment.

The early indicators for BF origination are intended to provide management information in the phase before sites become abandoned and derelict, preferably already in the initial stages of current land use decline (phases B-C-D in Figure 2). As explained in Section 3, they should signal whether or not specific action is required. This implies that monitoring early indicators needs to be part of "business as usual", as no specific project –focussed on a specific site or on counteracting an undesired development within the area– has yet been initiated.

Thus, two important aspects for the practical use of the early indicators emerge:

- Local relevance (local socio-economic characteristics).
- Data availability and ease of access

We intend to evaluate these aspects, both from a more generic perspective in deliverable D2.2 that will address monitoring approaches for BF indicators, and in the context specific situations of a number of Hombre cases[1]. Other aspects that could be evaluated are generally recognised criteria for 'good' indicators (Martin and Sauvegot, 2011):

- Capacity to summarize information without distorting it.
- Structured and multifaceted nature, allowing it to be linked to other indicators resulting in an across-the-board analysis of the system.
- Precision and comparability.
- Reliability and accuracy.

The basic list of early indicators will be included within the Brownfield Navigator (BFN, HOMBRE WP3, see also HOMBRE deliverable D 3.2, Maring et al., 2013), together with tools to weight and prioritise among indicators and come to an overall assessment of the indicator information. These assessment tools, of course, will also apply to the criteria and indicators for successful BF regeneration that will be addressed in D2.3.

From the fact that not all indicators listed in the basic set are expected to be equally relevant in different contexts, it may also be concluded that some indicators, that would be specifically relevant within a certain case or context, are missing. This requires that the HOMBRE framework, via the BFN, also provides insight in methodologies and practical tools how to derive/construct case-specific indicators[2]. Again, such tools will also be relevant to other phases of Circular Land Management.

[1] Initial case testing has already been done for the Genoa and Terni cases (Italy), primarily in connection with the development of the BF Navigator in WP3. Other cases that will be used are Solec (Poland), Jiu (Romania), and possibly Markham Vale (UK)

[2] This has already been addressed in previous versions of this deliverable, but will now be included in D2.2.

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Appendix 1: Review on French indicators for brownfield origination

1. Introduction

The aim of this review was to give an overview on French existing indicators of BF origination. BF definition was taken from the CABERNET network. Therefore, BF stands as a site which:

- have been affected by former uses of the site or surrounding land;
- are derelict or underused;
- are mainly in fully or partly developed urban areas;
- require intervention to bring them back to beneficial use; and
- **may** have real or perceived contamination problems.

The literature review was mainly based on French available sources of information (with the exception of one Swiss paper). Contaminated land management mainly focuses - to date - on managing existing BF and does not deal with trying to prevent creation of new BF. Therefore, BF origination is a relatively "new" concept in contaminated land management. Thus, we consulted documents on contaminated land management (including BF regeneration), but also on wider literature dealing with i) geography (industrial and land-use change and mutation, macro-economy), ii) industrial ecology, and iii) principles of sustainable land management which may be safeguard of BF origination. The results of this review is presented below

2. Contaminated land management literature

2.1 Technical literature

a. Mission d'information et d'évaluation FRICHES INDUSTRIELLES ET POLLUTIONS HISTORIQUES, Rapport de M. Christi and Decocq, avril 2010

In France, there are no "as such" existing indicators of BF origination in the BF and contaminated land (CL) literature. In introductory paragraph of BF regeneration or CL literature we found some elements of industrial history which may explained the origin of BF *on the last century in France*. BF origination comes from the concomitance of two phenomena 1) the likelihood of having activities which may have hindered pollution to the environment and 2) a land-use change which have yield to an underuse of the site(s).

Likelihood of having potential polluting activities

- Succession of activities: transformation of industrial activities over the years which yields to build new activities on older activities and potential existing pollution.
- Basic management of toxic product
- Firms which have or had boreholes at their sites (potential vector for pollution to groundwater).

Economic mutation and BF

- Lack of investment in an industrial sector
- Obsolesce of production equipment which does not allow to remain competitive on the market
- Competitiveness of (foreign) countries where the costs of production do not include social charges and use cheap labour
- Stop of activities or / and associated activities

- Localisation of the manufactures in the city centre and related difficulties to undertake industrial activities (such as manufacture access, renovation of old equipment or buildings)
- Need for liquidity, for financing and sometimes for compulsory liquidation which push the site owners to sell or to split their sites for the purposes of various smaller activities.
- Size (often large) and duration (often short) of the loss of activities: As the end of the activity is often very sudden, its instantaneous reconversion of the entire site is often impossible which yield to empty warehouse.

Existing database which may provide useful indicators for BF origination:

- Data bank on former and current industrial sites: **BASIAS** databank aims to draw up a wide-ranging and exhaustive list of all industrial sites, both abandoned and operational, that present risks of environmental pollution, to keep up a databank of these sites and to provide useful information to organisations and individuals involved in urban planning, land tenure issues and environmental protection.
- Databank **BASOL**: Database of contaminated sites which require an action from the administration for preventive or curative purposes.
- Local database on brownfield (industry based)
- Industrial heritage: Data base Mérimée, Protection zone of urban and landscape heritage, cultural heritage
- Local planning: Index n to specify the level of pollution (1=polluted or potentially polluted; 0=free of pollution)

b. Les friches, Coeur du renouveau urbain. Les communautés urbaines face aux friches : état des lieux et cadre pour agir, communautés urbaines de France, 2010

This report stresses the importance to switch from a BF management to a prospective view which enables to anticipate the origination of BF in order to optimise land management.
The urban space is in constant evolution, as it has to guarantee the adequacy of urban planning and its activities. Transition phase often lead to BF due to a lack of immediate reconversion caused by:

- The presence of “heavy structure” (such as buildings and infrastructures)
- Need for new urban architecture (structure, connectivity (means of transportation), space)
- Amount of investment associated with urban restructuration: depending on level of contamination, cultural heritage, conflict of interest, types of infrastructure
- Difficulty to assessment necessary investment

An increased level of anticipation, based on an improved knowledge in soil status, on more transparency from the owners and better taking into account of environmental externalities of owners or industries in LC of the industry.

c. ***Les friches industrielles, un potentiel foncier pour la ville : essai de classification dans le département des Yvelines Audrey Denise (1), Marie Hubert (2)***

Origination of BF depends on the types of land where the BF is likely to originate from. Several reasons can cause BF origination:

- Economic context and real-estate market
    - Land having an important concentration of activities, including industrial sites is generally more exposed to economic changes, especially in an economical context which tends to slow down. These sites can also be threatened by delocalisation.

    - Economic context may lead to abandon urban projects (such as residential areas, important development project),
    - General increase of greenland consumption.
- Characteristics of the land/ the area
    - Difficulty of accessibility to the area.
    - Obsolescence of the industrial zone, which cannot drag activities it was originally designed for.
    - Level of contamination of the land and associated high depollution costs.
- Stakeholders' strategy
    - Property and Heritage strategy of the institutional stakeholders can lead to abandon some of their sites
    - Change in land planning leading to change in more sensitive land-use
    - Failure of Urban Development (under the conditions of the Urban Redevelopment National Agency)

2.2 Legislative framework

Legislative framework, which changes continuously, set some conditions linked to site closure regarding the future land-use for which the site should be remediated. In absence of set future use, it is possible for the site owner to propose a remediation in compliance with industrial use. The remediation targets and the targeted use are important as they may be indicators for the creation of future BF through:

- Remediating the site at goals which does not fit potential coming stricter framework (corresponding to sensitive land-use).
- Setting land-use which is not compatible with future land development. The IPPC law of 2010 sets that the site must be remediated according to future use of the site which is a least comparable of the former land-use.

3. Geographical sciences literature

Friches urbaines: Voyage au centre des marges des villes, Federico Schiffrin, 18 janvier 2010 (University of Lausanne (Swissland))

Factors of BF origination include:

- Change in activities: From post-industry to tertiary services.
- Economic crisis since 1970 leading to industry closure.
- Globalisation leading to delocalisation of production from Europe to eastern Europe and Asia.
- Change of the traditional production system. Technological progresses lead to restructuration of the production system and the decrease of heavy industry. Increase of tertiary activity of city and decrease of secondary activities including manufacturing.
- Aging of production equipment and infrastructures requiring important investment for modernisation. It is therefore more profitable to delocalise.
- Land dynamic: Urban sprawling yields to have industries in town, where the price of the land becomes high. Environmental nuisances such as noise, odour, environment and landscape become are not acceptable once the industries are in town.

4. Industrial Ecology literature

Industrial ecology or industrial symbiosis is concerned with the shifting of industrial process from linear (open loop) systems, in which resource and capital investments move through the

system to become waste, to a closed loop system where wastes can become inputs for new processes. It is a strategy for the sustainable development of industrial activities. The project ECOSIND set a series of indicators which enable to assess the planning of Ecological Industry in industrial park. These indicators (even though they are not directly applicable BF origination) can be off interest as they describe the industries in a set area and are also representative of the robustness of industrial business. The following indicators may therefore be considered relevant for preventing BF origination:

- Site location and site environmental context: urban area, number of inhabitants living within 100m, within 15 minutes by car).
- Site activity, site use, site size: industrial, tertiary activity, others; large industry, SMEs.
- Economic activity: production, construction, extraction, services, retail, other sectors, cooperation among activities.
- Pollution: waste management, environmental impacts (air, CO_2 emission, noise, flooding risk, odour, geological, hydrological, water treatment).

5. Principles of sustainable land management

Principles and indicators of sustainable land management can also be considered as their application shall minimise environmental and promote social cohesion and stable economy. The non-respect of these principles can therefore lead to BF origination. Principles and recommendations of Sustainable Land Management include:

- Preservation and enhance heritage and conserve resources
- Improve the quality of local environment
- To ensure diversity
- To improve integration
- To reinforce social life

6. Conclusions

There are no French indicators on BF origination as such in the Contaminated Land and the literature reviewed for the purpose of this short study.

Some of the factors which may lead to BF origination are related to industrial history of the last century. Therefore these parameters are able to give insight on the causes of origination of existing BF, which are the passage of primary/ secondary activity (XIX) to secondary/tertiary activities (XX). These indicators are not necessarily representative of future changes (from XX to XXI century, tertiary to tertiary?) which may lead to less contamination problems. However, other questions may rise such as the potential role of massive development of new technologies of communication on future economic and social changes.

BF origination is strongly linked with the issue of pollution. One of the barriers of the development is that a site is not ready for use as it is “affected” by pollution, requires intervention or is contaminated. Pollution prevention is therefore a key factor for preventing BF origination: this one depends on legislative framework, authorities’ enforcements and industrial self-control of environmental emissions.

BF origination is strongly connected with urban development dynamics. No economic development alternatives may be readily applicable ate the site, yielding to latency period and under-used land. Moreover, inappropriate governance and legislative framework on land planning does not necessarily prevent urbanisation of greenfield and does not prevent urban sprawl.

Finally, these two main fields of influence (pollution & urban development dynamics) of BF origination may have different weights whether BF are contaminated or not.