Brown coal mining and rehabilitation: a landscape chronicle

Designing the rehabilitation of brown coal mines in Lusatia by integrating landscape narration with a landscape based approach to rehabilitation.

Rianne Knoot & Renée de Waal

Landscape Architecture Master Thesis

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Preface

Mining already exists since the first men started looking for some useful stones. Mining will stay important in the future until satisfactory alternatives are found on a large scale.
In Lower Lusatia, the study area of this thesis, brown coal was already found in 1789. The mines started small, but over time, the machinery and the mines scaled up and nowadays the mines can cover an area of about 40 square kilometres.

The impact on the landscape and the inhabitants is enormous and it is a difficult task to rehabilitate these large scale destructed landscapes. The goal of rehabilitation is to recreate a functional, healthy and sustainable landscape, and just as important, a landscape where people can relate to again.

In 2005, we first visited a former brown coal mine in Lusatia, where the influences of the mining activities were still very present. We were fascinated by the large scale impact of the mining process on the landscape and how this could have influenced the people living there. The fascination followed from a feeling of aversion to the landscape destruction, but also the amazing sight of uncommon forms and colours in the landscape that resulted from mining. This fascination led to the origination of this thesis.

In this Landscape Architecture Master Thesis, an integration of landscape narration with a landscape based approach to rehabilitation is researched to create a rehabilitated post-mining landscape which is healthy again and where people can relate to. Landscape based means to us that the processes and systems in the landscape are used in the functioning of the new landscape. Besides the rehabilitation activities which are obliged by law, we feel that a landscape narrative can help solving the mental problems concerning these landscapes.

The title of this thesis is ‘brown coal mining and rehabilitation: a landscape chronicle’. Figures of speech are used to articulate a landscape narration. In the design for the large scale landscape rehabilitation activities, the landscape chronicle is articulated. To refer to the history of mining in some places of the rehabilitated area, a memoirs is articulated.

In this thesis, the search for the role of the landscape architect in these kinds of projects was important to us. According to us, landscape architects should be involved in these projects because we are landscape experts, problem solvers and able to combine several disciplines into one coherent plan. We found however, that landscape architects are not always involved in designing mine rehabilitations in Lusatia yet. The narrative approach to landscape design is integrated with the obligatory rehabilitation measures which can be a contribution to the current practice.

Because of the struggling in the process to make a design for the whole 40 square kilometres of the mine area, we decided to approach the assignment more strategic. This resulted in design principles tested on a typical brown coal mine in Lusatia and on a specific site, the mine Klettwitz. We hope that this result inspires other landscape architects to be involved in these kinds of projects, and make detailed rehabilitation designs using this approach.

This project was not possible without the help of our tutors along the way, experts sharing their knowledge and material with us and friends and family supporting us in any kind of way.

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Rianne Knoot and Renée de Waal
May 2009
Wageningen, Wageningen University

Abstract

Brown coal mining and rehabilitation: a landscape chronicle

Designing the rehabilitation of brown coal mines in Lusatia by integrating landscape narration with a landscape based approach to rehabilitation.

In Germany brown coal still adds 24% to the gross power generation. Brown coal is mined in large open cast mines which have a big influence on the landscape and its underlying systems, and the people living in these landscapes. Although Germany is ahead in the production of renewable energy, it is expected that brown coal mining will stay important in the future.

On the former mining site of Klettwitz, in Lusatia in East Germany, has been analyzed which problems exactly occurred. The water level has been lowered over fifty meters, the soil quality has been degraded, severe acidity occurs and the landscape contours continually changed. Ecosystems have been destroyed which caused loss of habitat and species. About 3,400 people in four villages had to leave their homes for the mining operations to take place. Connections between villages were cut off by the mine. People's mental bond with the original landscape is disturbed, because the area became placeless due to the mining that removed everything.

The aim of this design research is to rehabilitate the physical landscape system by improving the degraded soil, water problems and removed topography. At the same time, the narration of mining and rehabilitation has to be told, making the site's historical development legible in the landscape. Using a landscape based approach to land rehabilitation gives nature the chance to recover itself as much as possible, and people to understand the changing landscape and turn their disturbed relationship with the site into a new positive image for the future.

Land rehabilitation is necessary to have a new land use again in the future. To fertilize the degraded soil, a more landscape based solution is proposed than the current approach. Crop rotation systems like strip cropping or alley cropping are ways to improve the soil structure and fertility more gradual over time. It is less expensive and more natural compared to the use of mineral fertilizers. A crop rotation system can be combined with locating windmills or solar panels to meet the vast scale of an open cast mine and have immediate yield from the fields. For the restoration of the water table and soil compaction, current techniques are considered to work well, until further research results in satisfactory landscape based alternatives.
To tell the story of this landscape, the theory of Westerink and van der Westen has been used.

The mining and rehabilitation can be seen as a landscape chronicle which can be articulated in the landscape by designing rhythm and addressing. The mining history at the site can be kept legible by articulating a landscape memoirs, using accentuation, anomaly, metaphor and addressing. Mining machinery like the spreaders can be deployed to manipulate the ground surface after mining to make it functional for crop rotation systems and leave legible traces from mining in the landscape. This is very important for the development of an identity, which is important to prevent the problem of the placelessness of the mined sites.

Design principles have been made to integrate the rehabilitation and narration principles into design principles. The design principles are tested in two compositions for typical Lusatian brown coal mines and one composition for the rehabilitation process of the mine site Klettwitz. The design principles appeared to be effective and are general tools for rehabilitation and narration of brown coal mining sites in Lusatia.

As conclusion can be said that the design research supports the thesis that integration of landscape narration with a landscape based approach to rehabilitation is a necessary contribution to the current rehabilitation practice in Lusatia.

Keywords: landscape architecture, brown coal mines, landscape based approach, landscape narration, mine site rehabilitation, land rehabilitation

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1 INTRODUCTION

Introduction

The world of today relies heavily on energy production. It is expected that this demand will only increase (Fig. 1.1).

A great share of energy is produced by non-renewable resources like oil and natural gas (Fig. 1.2); resources that will be finished one day. The contribution of renewable energy sources increases, but can not provide the world with enough energy yet. This is mainly due to the higher costs compared to fossil fuels and problems with storage and transport of the energy. A rising problem with biofuels is that the production needs a lot of cultivated land, which will compete with food production. Second and third generation biofuels are tested momentarily, which are less area consuming. But Peak oil, the moment from which the global petroleum production will decrease, is expected soon, or might have been already there. So how to provide the world with sufficient energy in the future?

The production of coal as energy source is quite certain. It is indicated that the global coal reserves amount to 847 billion tonnes (British Petroleum, 2008). That makes them significantly greater than the reserves of oil and gas. Moreover, the coal reserves are better dispersed over much more countries, which makes them more certain for future production (Závodská & Lesný, 2006). However oil and natural gas have a higher energetic value than coal, this certainty is the reason why many energy producers are still interested in coal mining sites.

In Europe, and even in the world, Germany is one of the major producers of brown coal (http://www.euracoal.org, on 1 February 2009). The brown coal production in Germany is competitive on the international market and produced unsubsidised, contrary to the hard coal mining. Furthermore, the brown coal industry is an important regional employer and investor, giving it a major economic significance.

The four main brown coal mining areas in Germany (Fig. 1.3) are the Rhenish Area Rhineland near Düsseldorf, the Central German mining area around Leipzig, the Helmstedt area near Magdeburg and the Lusatian mining area in the east of Germany (Koropp, 1999). There is hard coal production in the Saarland, but that will stop in 2018 because it is not profitable anymore.

The production of brown coal in Lusatia (Lausitz, in German), the study area of this thesis, is 60 million tons per year. It is still one of the biggest brown coal production regions in Germany (http://www.euracoal.org, on 1 February 2009).

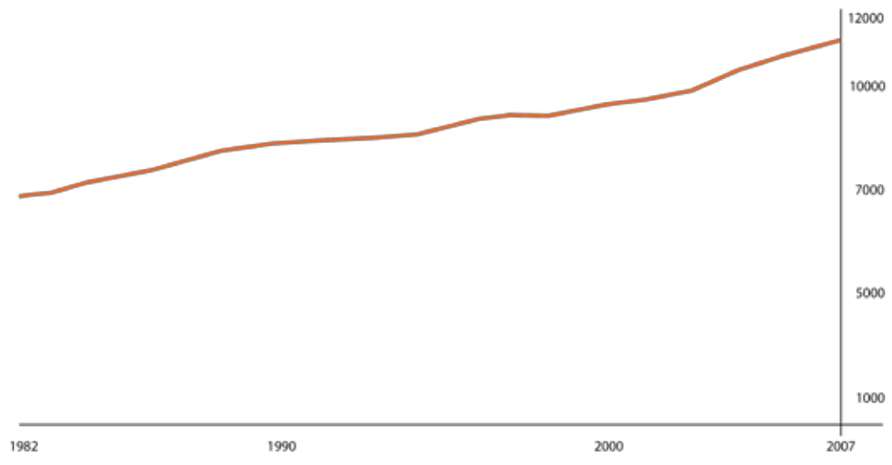


Figure 1.1: World Energy Consumption in million tonnes oil equivalent

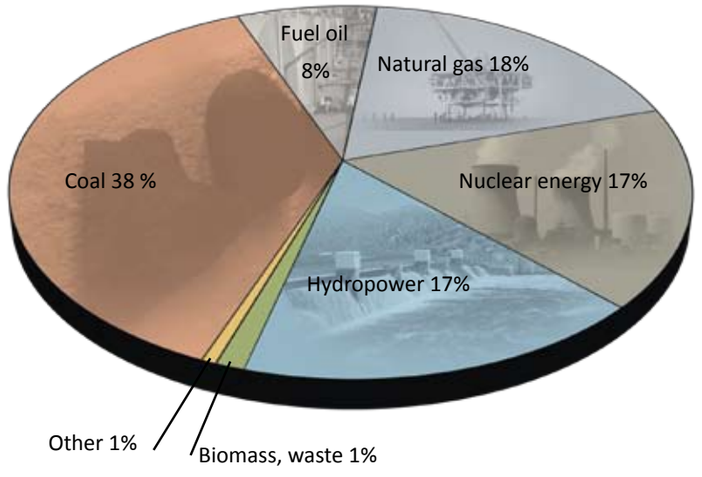
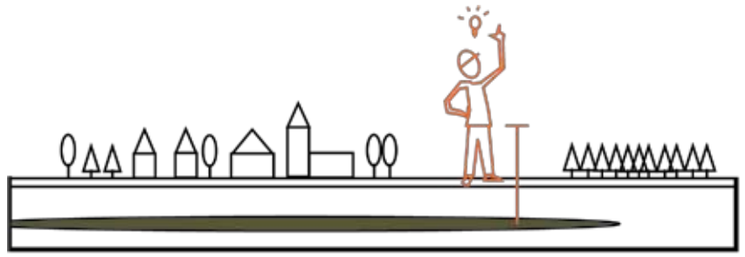


Figure 1.2: Electricity generation by primary energy sources in 2001, world wide

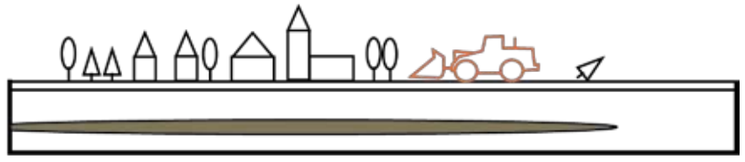
Figure 1.3: The four main brown coal areas in Germany

Introduction

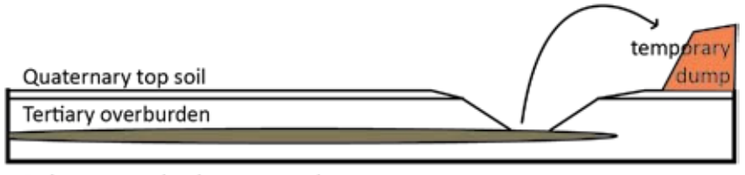
In general, the production of brown coal in Lusatia happens according to the following process, which is presented in the following scheme (Fig. 1.4).



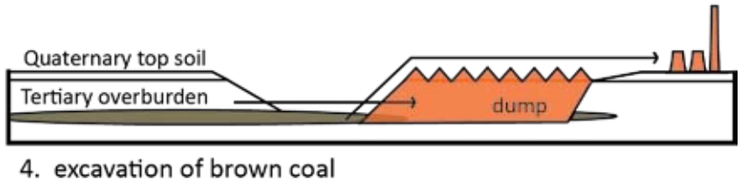
1. locating brown coal



2. remove everything that is on the surface

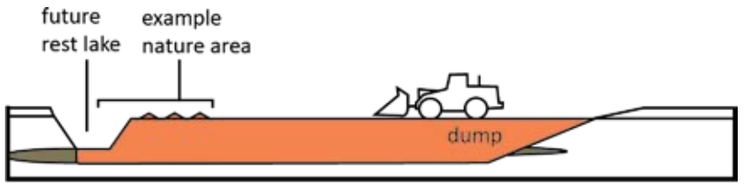


3. lay open the brown coal

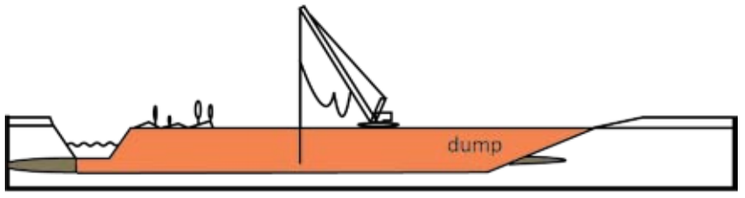


4. excavation of brown coal
   transportation to power plant
   generation of electricity

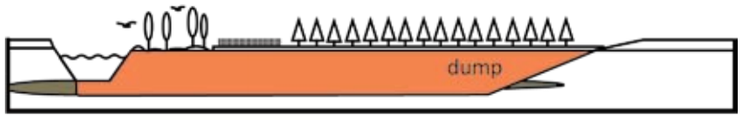
After brown coal mining, a destructed landscape remains. This landscape has to be rehabilitated, by the restoration of the landscape's systems, recreation and stabilization of the surface and a re-interpretation of the connections to the surroundings. The rehabilitation in Lusatia is mostly carried out according to the following process, also presented in the scheme below (Fig. 1.4).



5. replacement of deposits: surface reconstruction
   deciding locations for rest lakes and nature areas



6. geotechnical measurements
   restore ground water
   soil stabilization



7. soil amelioration and cultivation or forestation

Figure 1.4: Schematic overview of brown coal mining and land rehabilitation in Lusatia

Land rehabilitation from mining activities is increasingly important for several reasons. First of all, because there are more mining activities than ever, on bigger scale and in more countries. Also in Lusatia there are plans to open or re-open new brown coal mines. Second, there is more concern about the environment than in early days and third, there is a higher pressure for re-use of these landscapes than in early times (Berger, 2008).

But also brown coal production has disadvantages. Although brown coal is still abundantly present, it is stored underground which means that the current land uses like agriculture, forestry, infrastructure or even entire towns have to move for the excavation. Brown coal mines can easily have a size of forty square kilometres. Every new mine is more complicated to excavate, because the easy accessible fields have been finished yet. The necessary land rehabilitation is complex, costly and takes, together with the mining, the half time span of a human life.
Because of the low energetic value of brown coal, large quantities are needed for electricity generation, which causes high transport costs. The conversion into electricity happens in big power plants that are visible in the wide area. The emission of carbon dioxide, while generating electricity, is the highest compared to other energy sources (Fig. 1.5). Carbon dioxide is one of the green house gasses contributing to the global warming effect.

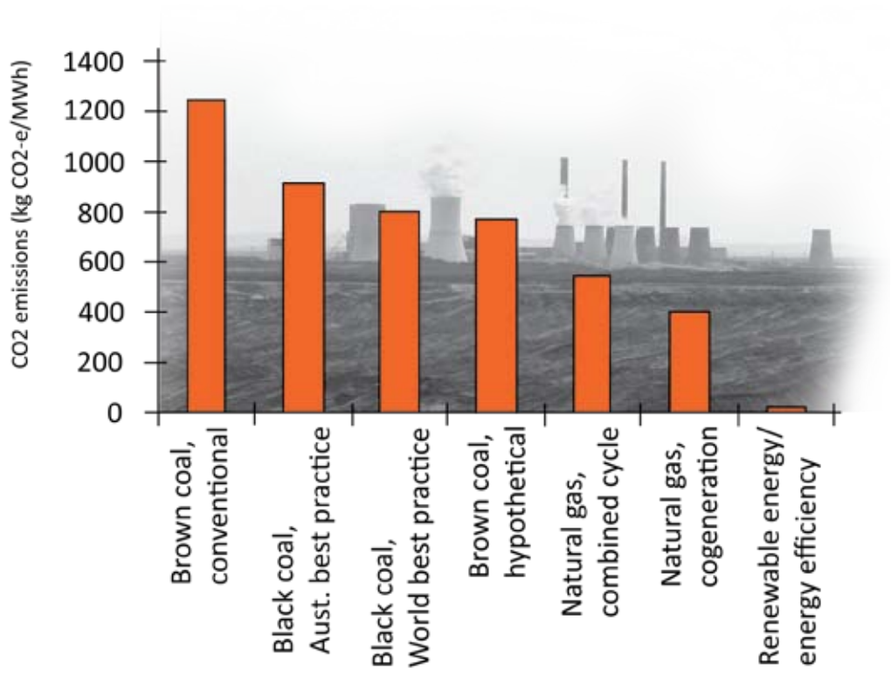


Figure 1.5: Carbon dioxide emissions from the different energy sources

In and around the mines several other environmental problems occur, like soil instability, acidity and drought. People's protests against new mines gain increasing support and importance. And last but not least, in the end also the brown coal will be finished. The world should be prepared for its electricity generation possibilities by then.

Despite the disadvantages, brown coal mining is a current affair and surely will be in the near future. In this thesis will be researched how landscape architects can deal with the landscapes that emerge from large scale brown coal mining.

The location of this study will be Lusatia, one of the four main brown coal areas in Germany. Lusatia has a large-scale industrialized brown coal mining history of about 100 years. We, the authors, visited Lusatia for the first time in 2005 during a university excursion.

A fascination for the large impact of the mining process on the landscape and its inhabitants led to this thesis. The large scale process of brown coal mining, the size of the machinery that is used and the landscape that is being left behind is impressive. The combination of the stunning sights that are created, but the feeling of aversion you feel at the same time to the destruction of a landscape in favour of economic profit, is astonishing. The philosopher Edmund Burke would probably call this a sublime experience, because this *'astonishment is that state of the soul, in which all its motions are suspended, with some degree of horror. (...) Astonishment, as I have said, is the effect of the sublime in its highest degree; the infererior effects are admiration, reverence and respect'*. (Wormersley, 1998 pp. 101)

The sublime experience in the mining landscape tempted us to study and rethink the current land rehabilitation practice. Land rehabilitation after mining is commonly considered to be necessary, but covers up all of the features that make the mining landscape so interesting. We would like to approach the rehabilitation assignment as landscape architects, because we think that we are able to contribute to the current approach. In these landscapes environmental and social problems occur, which makes it very relevant to act and take both questions into account while designing. Because of this relevance and challenge, an increasing number of landscape architects begin to take up assignments the rehabilitation of wastelands, former dumps, old industrial sites or mining areas all over the world.

Picture 1.1: The mine Ilse in Großräschen, in 2005

Picture 1.2: Detail of the dump area in the mine Ilse in Großräschen, in 2005

1

The particular mine Klettwitz within the brown coal region Lusatia has been chosen for practical reasons. Since the current and only brown coal producer in Lusatia, Vattenfall, could not provide data from current brown coal mines, a former mining site has been chosen. The mine Klettwitz is being rehabilitated at the moment by the Lausitz and Central-German Mining Administration Company, which helpfully supported us with information and map material.
The mine Klettwitz is excavated from 1951 till 1991. The site has some particular features like the village Kostebrau that was saved from excavation at the last moment. Kostebrau is located high in its excavated surroundings nowadays. Large parts of the area remained unrehabilitated since the final rehabilitation works started in 1994.

Picture 1.3: A street in Kostebrau

Picture 1.4: View from look-out point Kostebrau over the former mine Klettwitz

In chapter 2 the brown coal region of Lusatia will be elaborated while in chapter 3 the mine Klettwitz is further specified. In chapter 4 the problem statement, our criticism on the current rehabilitation practice from a landscape architectural point of view, the thesis statement and research questions will be presented.
Chapter 5 presents a research into six reference projects. Hence, in chapter 6 and 7, principles for landscape rehabilitation and landscape narration are developed, that are based on the information about the region and the specific area, the problem statement and the reference projects. In chapter 8 the landscape rehabilitation and narration principles are integrated into design principles. These have been applied on a typical Lusatian brown coal mine, to see whether the design principles are useful in designing the rehabilitation of brown coal mines in Lusatia.
Chapter 9 will present a design for the former mine Klettwitz that has been created with the earlier developed design principles. The new plan is compared with the rehabilitation plan that is being realized at the moment. The last chapter, chapter 10, presents the conclusions and recommendations.
At the end of this report an extensive summary is provided.

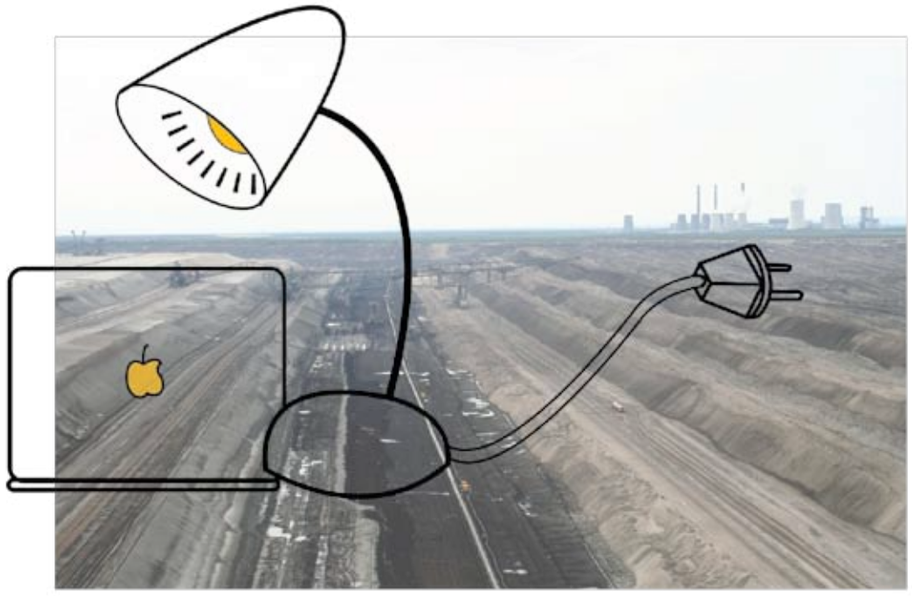


Figure 1.6: The effect of our energy consumption on the landscape outside in Lusatia

2 ANALYSIS - LUSATIA

ANALYSIS - LUSATIA

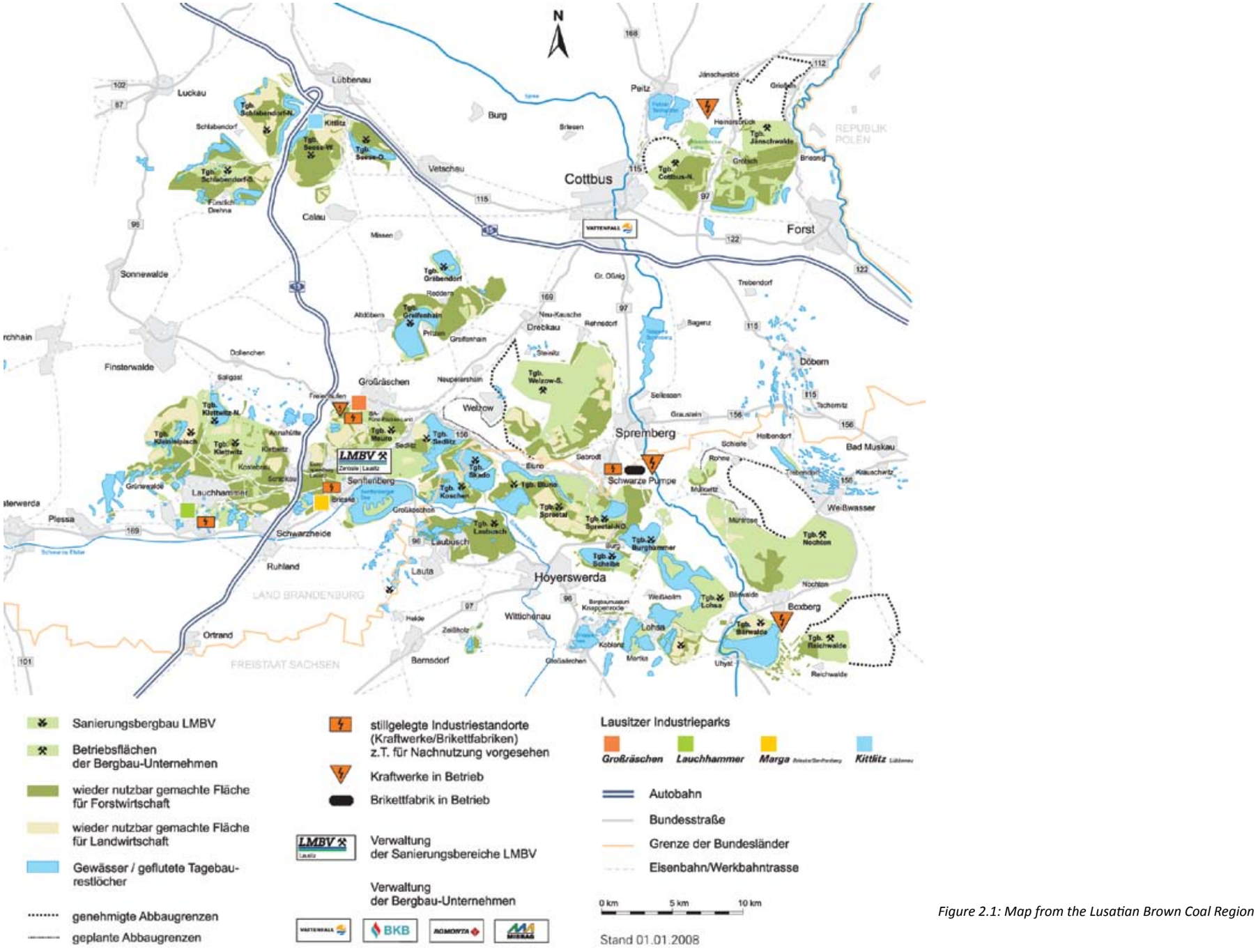


Figure 2.1: Map from the Lusatian Brown Coal Region

2

In this chapter background information on the study area and the subject will be provided. The location, the origination of the landscape, the socio-political and economical situation and the history of brown coal mining and rehabilitation in Lusatia are explained.

2.1 Location, landscape and political situation

Lusatia is a region in the east of Germany between the Neisse and Spree rivers. The area is situated between the cities of Cottbus and Dresden and adjacent to the border with Poland. The area extends from Luckau and Plessa in the west to Boxberg and Jänschwalde in the east, which is to see on the map on the facing page (Fig. 2.1). The area covers approximately 55 by 70 kilometers (3850 km^2).

The landscape in Lusatia is, apart from the brown coal mining, characterized by influences of the Saale glacial period about 450 000 years ago. The glaciers coming from the north created the 'Lausitzer Grenzwall', an ice pushed ridge which divided Lower Lusatia from Upper Lusatia (Fig. 2.2). Underneath the glaciers gentle slopes were formed that still exist in the landscape.

Most of Upper Lusatia is situated in Saxony where the landscape is quite hilly. The soil is fertile and there is a couple of interesting historic cities like Bautzen and Görlitz. Lower Lusatia, the study area of this thesis, is quite flat and situated more to the north, in the state Brandenburg. Cottbus is the most interesting historic city of Lower Lusatia.

Although the soil is less fertile than in Upper Lusatia, the economy was based on agriculture (LMBV, 2007). In agriculture the main crops are rye and potatoes and on the more sandy soils in the northern part also corn and sugar beets (Steinhuber, 2005).

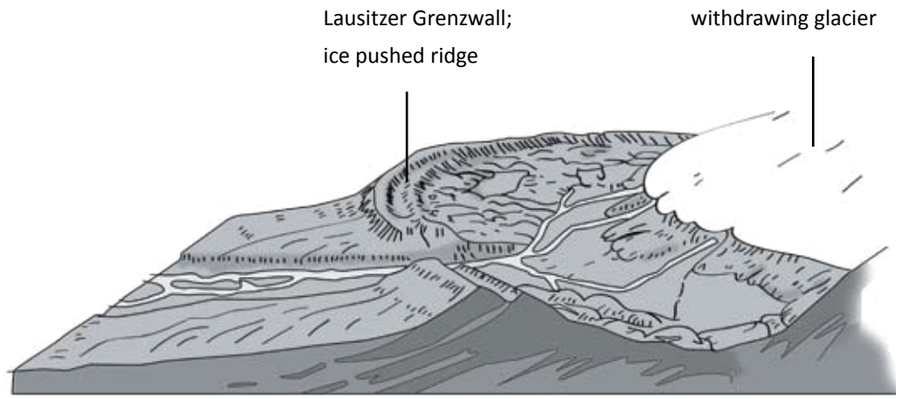


Figure 2.2: Origination of the Lausitzer Grenzwall by the glaciers in the Saale glacial period

Picture 2.1: Panorama of original landscape in Lusatia with high heath lands, forests, agricultural land, wet areas and ponds

ANALYSIS - LUSATIA

Before the brown coal mining there was about 75.000 hectare of forests in Lower Lusatia. Some native trees (pict. 2.2) are Pinus sylvestris (pine), Quercus petrea (pedunculate oak) and Quercus robur (sessile oak) (LMBV, 2008). Also Betula (birch) occurs often. Before the industrialization of the mining, the landscape was characterized by isolated heights, extended wet areas, lakes, and forests alternated by fields and meadows. Originally, the landscape in Lower Lusatia was wet and occupied with forests and meadows (LMBV, 2008). The name 'Lusatia' stems from the Sorbian word 'luz' which means 'swampy area with woods'. This referred to the landscape of Lower Lusatia where the Sorbs historically lived. The Sorbs are originally Slavic people and one of the few official minorities in Germany.

Lusatia has a turbulent political history. After the area was settled by the Sorbs in the 9th century, the region was conquered alternately by the Germans and the Poles. Nowadays the area belongs partly to Germany and partly to Poland. The Sorbs attempted several times to create an autonomous Sorbian state in the past, but they never succeeded. The last try was with the reunification of East and West Germany in 1990. Nowadays the states Brandenburg and Saxony guarantee cultural autonomy to the about 40.000 Sorbian people (http://info.britannica.co.uk, on 19 August 2008). Traces of the Sorbian culture are visible in for example the bilingual road signs, traditional clothing and houses.

Picture 2.2: Photograph of Pinus (pine), Quercus (oak) and Betula (birch); common tree species in Lusatia

After World War II, Nazi Germany was divided by the Allied armies of the United States of America, the United Kingdom, France and the Soviet Union. In the end, the western part of Germany became the Federal Republic of Germany (FRG), with a capitalist economy.
The eastern part became the German Democratic Republic (GDR), with a communist system. The Iron Curtain prevented that people would flee from East to West Germany, where the people were wealthier.

The government in East Germany desired to be self-sufficient in its energy needs. Since brown coal was abundant in Lusatia, the area became the energy centre of East Germany (Hüttl, 1998). It appeared later how big the influence of this decision would be on the landscape in Lusatia.

The German Democratic Republic came to an end in 1989, because the communist government fell due to a great uprising of the people. East and West Germany were re-united into one capitalist state, the Federal Republic of Germany, and Berlin became the new capital. After the reunification in 1990, the need for self-sufficiency in energy production was off and energy could be imported cheaper. The production of brown coal in Lusatia soon dropped. The highest production of brown coal in Lusatia was in 1989, amounted 195 million tons which were excavated in 17 mines (Häge, 1996). At the moment the production is about 60 million tons per year, coming from 4 large scale mines (Steinhuber, 2005).

Since the re-unification in 1990, East Germany became capitalist again. For most of the people, who experienced more than fifty years of communism, this was a great turn. The economy in Lusatia got on the decline by the strong competition from the western capitalist market. Many people, mainly young ones, took their chance and moved to the west of Germany in search for jobs and higher incomes. As a result the economy in Lusatia is poor at the moment, the rates of unemployment are high and the population density is low (Scholz, 2008).

2.2 History of brown coal mining in Lusatia and the development of related industries

Coal is a collective term for every product that comes to exist when peat goes through the process of coalification, which can ultimately lead to the origination of diamond. About 45% of the world's coal reserves are believed to be brown coal. Storing and transportation of brown coal is problematic because of the high moisture content and a high reactivity which could cause spontaneous combustion. Due to the high transportation this fuel is used primarily to generate electricity in close-by localized power plants (Závodská & Lesný, 2006).
Brown coal, which is also called lignite in American classification systems, is one of the first products of coalification. Hard coal has been pressed for a longer time and under higher temperature than brown coal and became stored deeper under the surface. Hard coal has therefore to be excavated by means of underground mining. This is more difficult than surface mining, but the energetic value of hard coal is higher (Závodská & Lesný, 2006).

The brown coal in Lusatia has been formed about forty million years ago, in the Tertiary period (Fig. 2.3). The entire process of brown coal formation in Lusatia took about 15-20 million years (Steinhuber, 2005). In this period the geological setting was very dynamic and there was a subtropical climate. Big variations in the sea level caused the flooding of parts of what is now Poland and Germany for several times. As the sea water retreated, a wet area remained in the coastal areas (Hüttl, 1998). In this wet coastal areas with a warm climate, the conditions for the growth of vegetation were very well. Much death plant material accumulated in the wetlands and slowly bogs and moors originated. Because this process went on for a very long time, thick layers of peat were formed (Steinhuber, 2005). This repeated several times, which caused the origination of five distinct peat layers alternated with marine sediments like sand (Hüttl, 1998). For the formation of brown coal out of peat, pressure is needed. The glaciers that reached the area from Scandinavia in the Quaternary period were heavy enough to start the process of coalification. The glaciers eroded and accumulated material on their way. By the influence of the glaciers, the upper brown coal seam has been removed at many places and the second, deeper Lusatian seam became divided into various brown coal fields. The second Lusatian seam is the most profitable to mine and exploited heavily (Hüttl, 1998).

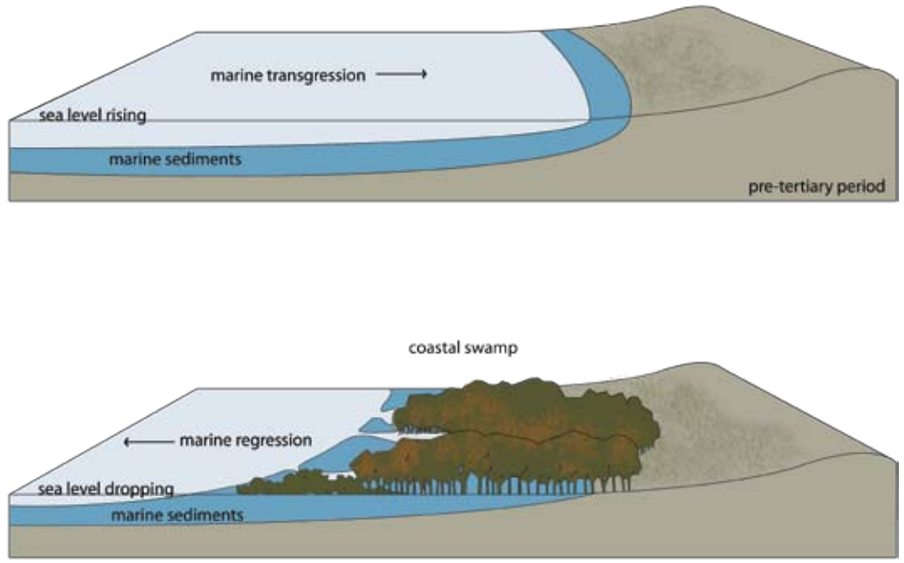


Figure 2.3: Schematic overview of the origination of brown coal in Lusatia in the Tertiary period

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The history of mining began when humans started to look for some useful stones. From this moment on the cultural ages of the men are named after important minerals or their derivatives, namely the Stone Age, the Iron Age, The Steel Age and the Nuclear Age. By the start of the Christian era, all 'Seven Metals of Antiquity', namely copper, tin, gold, silver, lead, iron and mercury were known and mined (Tatiya 2005). The Industrial Revolution at the end of the eighteenth century had an enormous impact on the development of mining. There was a strong increase in demand and use of minerals in this period. There were great improvements in mining technology that even continue today.

In the twentieth century, the invention of continuous mining equipment, which extracts softer minerals like coal without the use of explosives, was an enormous progress (Hartman & Mutmansky, 2002). A mine can be defined as an excavation that is made in the earth to extract minerals. Mining is the activity, occupation and industry concerned with the extraction of minerals (Hartman & Mutmansky, 2002).

The excavations can occur in all kinds of landscapes. The landscape is not necessarily a flat terrain, but can also be a mountain or a forest, which are being removed when necessary and profitable. The mines can start at, above, or below ground level and they can extend in any direction, for example horizontal, or vertically up. In general, based on locale, traditional excavation methods can be grouped into two main classes. There is surface excavation or surface mining, and underground excavation or underground mining (Tatiya, 2005). When the mining of a mineral deposit is undertaken by exposing the material to the atmosphere, it is known as surface mining (Tatiya, 2005). Brown coal, the subject of this thesis, is mined in surface mines. There are different types of surface mines, but the brown coal mines in Lusatia are all open cast mines. An open cast mine is suitable to mine out flat deposits while the overburden is backfilled in the worked out area or adjacent panel (Tatiya, 2005). The term 'casting' is commonly used in mining to indicate the process of excavating and dumping into a final location.

In Upper Lusatia the first brown coal was found in the year 1709 (Steinhuber, 2005). In Lower Lusatia the first brown coal was found in Bockwitz, near the town Lauchhammer, in 1789 (LMBV, 1999). On both locations the brown coal appeared at the earth's surface. Pick axes, shovels and wheelbarrows, driven by man power, were the main instruments to excavate the coal. Only small and separate mines were recognizable in the landscape (LMBV, 1999).
Soon the brown coal at the surface ran out. The people began to excavate in underground mining shafts. Still only the most superficial Lusatian brown coal layer could be mined. One of the first underground shafts was created in 1815 near Kostebrau.

Some of the transport was taken over by the use of horse power. Under the surface a network of approximately seventeen kilometres of mining shafts was constructed (LMBV, 2007). In the landscape only small traces were visible in the form of shaft entrances and a light hilly terrain because the ground subsided due to the underground activities (Steinhuber, 2005).

Picture 2.3: Brown coal mining in the beginning of the twentieth century

The production of brown coal provided a great capacity of electrical and heating power. This attracted several heavy industries to Lusatia. Around the city of Spremberg the first customers of the brown coal were settled. Among them were linen and textile factories, glass- and brickworks. The brickworks had the advantage that the clay was found near the brown coal and was mined as a by-product (LMBV, 1999). From 1872 the first briquette factories were established. A brown coal briquette is a solid block of dried and compressed brown coal and therefore of higher energetic value. Brown coal briquettes were soon very popular, because the transport, use and storage were easier and cheaper than for raw brown coal. Briquettes were used for industrial purposes, to make high quality cokes, but also suitable to heat households (LMBV, 1999).
Later power plants were set up to convert the brown coal into electricity. During the First and Second World War, war related industries like aluminium factories were brought to the region. In Schwarzheide, a large chemical plant (BASF) was established which is now of major importance for the region (LMBV, 1999).

With every new use of brown coal, the need for brown coal increased. Existing mines were extended, new mines were opened and new excavation techniques and machinery were developed. In the year 1893 for example, the first bucket wheel excavator was brought in use (LMBV, 1999). This machine enabled to remove thick layers of overburden material on a large scale, to get directly to the brown coal. It was even possible to reach the second Lusatian brown coal layer, which is stored sixty-five till hundred meters deep. This was the start of the transition from underground to large scale surface mining; open cast mines to be specific.

Picture 2.4: Piece of brown coal and two brown coal briquettes

Picture 2.5: Power plant to convert raw brown coal into electricty (Jänschwalde near Cottbus)

A water drainage system was now needed to reach the brown coal safely and easily (LMBV, 1999). Later the consequences of the draining became clear in enormous water deficits.

The overburden conveyer bridge was developed to transport the overburden in surface mines more effective. The first conveyer bridge was brought into action in the mine Plessa in 1924. This large machine only replaces overburden from one side of the mine to the other, making room for the smaller excavation machines to get to the coal. Railroads were created to transport the brown coal from the mines to the power plants or other comsumers, which led to a very close network of railroads in Lusatia. In the late twenties the first conveyer belt was developed, also to transport the brown coal from the mines to the consumers (LMBV, 1999).

Because of the increased employment, new workers were attracted to the region. New dwellings were built by mine owners to house them. These were neat neighbourhoods with social facilities like shops, a church and primary school. Some very nice examples were the so called garden cities; an example of this is the now monumental Gartenstadt Marga near Senftenberg.

During the worldwide economical crisis in the early thirties the production stagnated, but from 1933 the situation improved again. During World War II the Nazi regime exhausted the mines and existing machinery. It was already in the fifties before all the damage was repaired, also because the Russians took left over machinery as compensation for their losses in the war, but during the fifties the damage was repaired (Steinhuber, 2005).

From the moment that the GDR government wanted the country to become self-sufficient in its energy supply, everything was done to increase the productivity. There were rapid developments in machinery and excavation techniques and in scaling up of the mines (LMBV, 1999). During this period the conveyer bridge from the type F60 was developed by the firm TAKRAF GmbH, a world wide mining equipment supplier. The F60 is up till now the world's largest self-supporting moving machine (http://www.vattenfall.de, on 19 April 2009). It replaces overburden over a distance of more than 500 meters and has a height of 60 metres, which gave the machine its name (http://www.takraf.com/de/produkte/tagebauanlagen/main.htm, on 19 April 2009).

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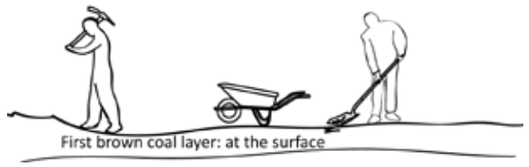
As the production increased in the open cast mines, signs of pollution began to show. In the many power plants the brown coal is burned to generate electricity. The sulphur dioxide in the emissions caused acid rain, which led to damage on trees.
The bare mining areas where subject to wind erosion, which led to a lot of dust in the air. This settled down as a light brown film on almost everything; houses, streets and vegetation.

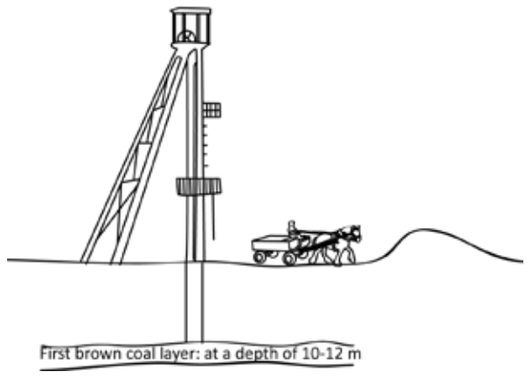
By the time Germany got re-united in 1990, many open cast mines were closed because energy could be imported from the west of Europe again. The artificially preserved overproduction from years was ended. Besides, western Germany took over the production of many other industries. Large scale land rehabilitation activities started and still go on. At present, there are three large active open cast mines in Lusatia, namely Jänschwalde, Welzow and Nochten. There are plans to (re)open three other ones. The mining process is more or less equal compared to GDR times, but techniques still improve.

Figure 2.4: Illustration of seven important steps in the mining history of Lusatia

Upper Lusatia: 1709 and lower Lusatia: 1789

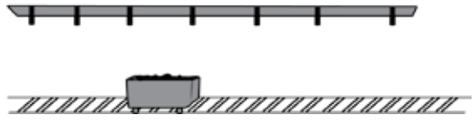


1815: one of the first underground shafts



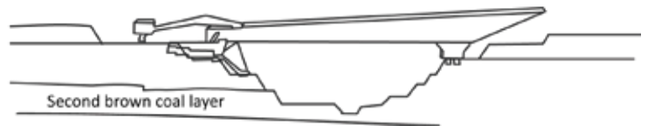
1893: first bucket wheel excavator

Late twenties: first conveyer belt and railroads for transporting brown coal

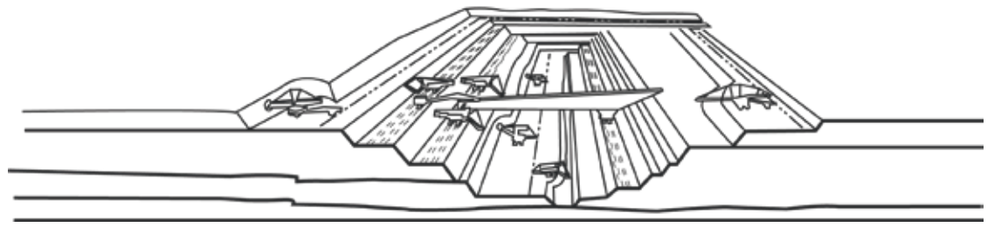


1905: the first large open cast mine

1924: The first conveyer bridge



Nowadays: very large open cast mines



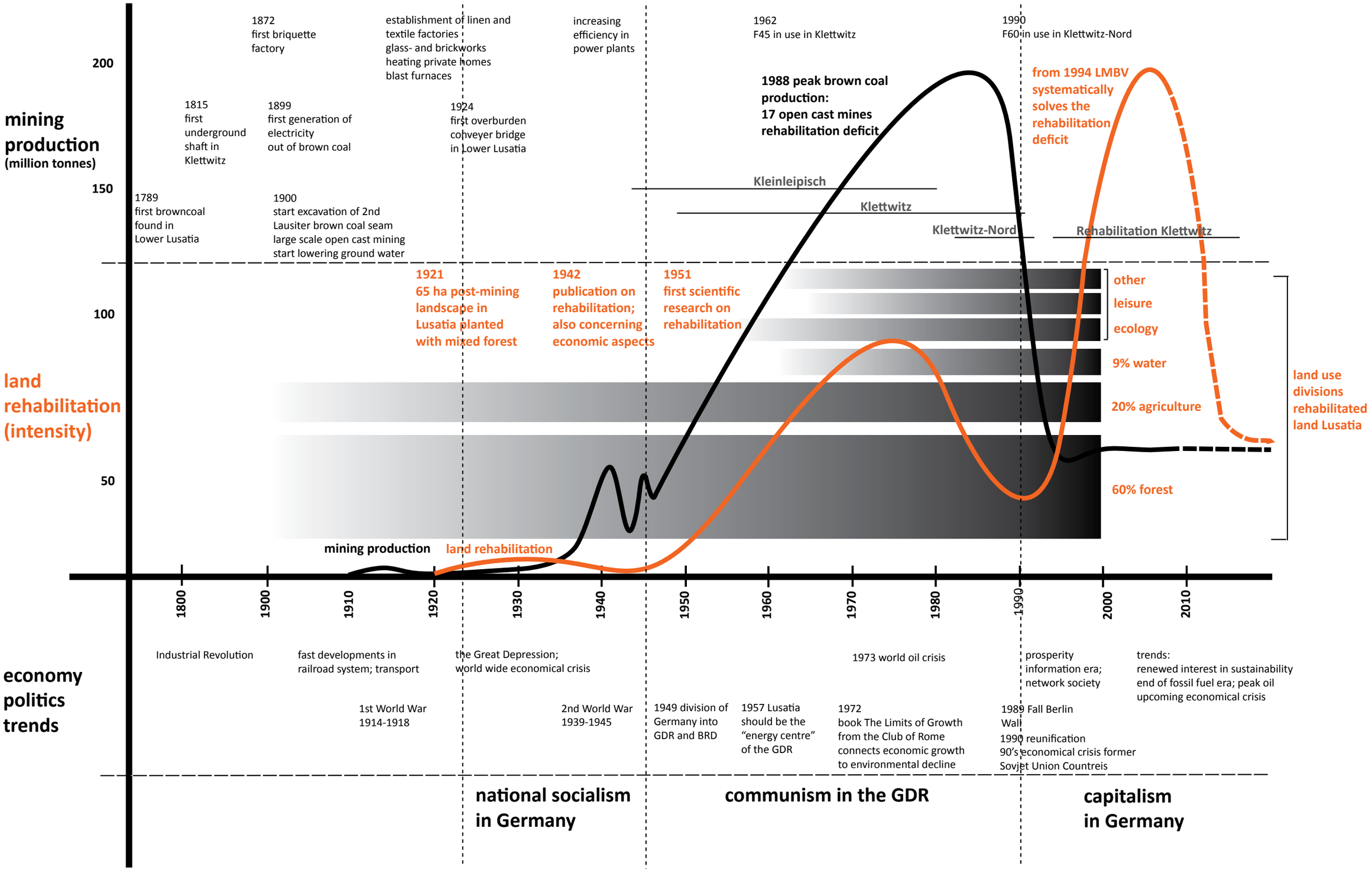
Further explanation on the current machinery and mining techniques will be provided in chapter three.

The problem with sulphur emissions are solved by filtering the emissions, but then carbon dioxide appeared to cause serious damage to the earth's ozone shield. The air quality in general is improved over the last decade and a lot of former GDR mines are being rehabilitated and made suitable for new land uses. Less and less people are employed in mining.

From the map at the beginning of this chapter (Fig. 2.1), it is visible that almost the entire region Lusatia is or was subject to brown coal mining. Some of the towns were saved from excavation, but in the period between 1945 and 1989 together 71 towns were removed completely and 42 partly. About 20,000 people had to move because of mining activities. Complete new villages or quarters were raised for the people that had to move and for immigrated workers.
Everywhere in the region there are active, rehabilitated and unrehabilitated brown coal sites alternated with power plants and related industries. Also old factories and buildings from activities in the past often remained. Some of them are qualified as industrial heritage, like the Biotürme in Lauchhammer (Pict. 2.6) or the power plant in Plessa (Pict. 2.7). Both can be visited today.

Picture 2.6: Biotürme in Lauchhammer; part of a former coking plant and industrial heritage now

Picture 2.7: The control room in the power plant Plessa that is recovered and a museum nowadays


mining production (million tonnes)
200
150
100
50
land rehabilitation (intensity)
1789 first browncoal found in Lower Lusatia
1815 first underground shaft in Klettwitz
1872 first briquette factory
1899 first generation of electricity out of brown coal
1900 start excavation of 2nd Lausiter brown coal seam large scale open cast mining start lowering ground water
establishment of linen and textile factories glass- and brickworks heating private homes blast furnaces
1924 first overburden conveyer bridge in Lower Lusatia
increasing efficiency in power plants
1962 F45 in use in Klettwitz
1990 F60 in use in Klettwitz-Nord
1988 peak brown coal production: 17 open cast mines rehabilitation deficit
from 1994 LMBV systematically solves the rehabilitation deficit
Kleinleipisch
Klettwitz
Klettwitz-Nord
Rehabilitation Klettwitz
1921 65 ha post-mining landscape in Lusatia planted with mixed forest
1942 publication on rehabilitation; also concerning economic aspects
1951 first scientific research on rehabilitation
other
leisure
ecology
9% water
20% agriculture
60% forest
land use divisions rehabilitated land Lusatia
mining production
land rehabilitation
1800
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
economy politics trends
Industrial Revolution
fast developments in railroad system; transport
1st World War 1914-1918
the Great Depression; world wide economical crisis
2nd World War 1939-1945
1949 division of Germany into GDR and BRD
1957 Lusatia should be the "energy centre" of the GDR
1972 book The Limits of Growth from the Club of Rome connects economic growth to environmental decline
1973 world oil crisis
1989 Fall Berlin Wall
1990 reunification
90's economical crisis former Sovjet Union Countreis
prosperity information era; network society
trends: renewed interest in sustainability end of fossil fuel era; peak oil upcoming economical crisis
national socialism in Germany
communism in the GDR
capitalism in Germany

2.3 Present: rehabilitation time

When the mine is exhausted, the mine is closed and rehabilitation activities can start. Rehabilitation is the act of converting wasteland into land that is suitable for use of habitation or cultivation (http://www.hyperdictionary.com/search.aspx?define=rehabilitation, on 09-03-2009). Mines are wastelands because the landscape and its systems have been altered and often degraded by the mining. After mine closure the land has to be rehabilitated for future beneficial land use and a sustainable situation. Then the mining landscape becomes a 'post-mining' landscape.

Rehabilitation

Land rehabilitation after mining was not always as obvious as it is nowadays. The sites of the small underground and open cast mines from the early times were not rehabilitated, because there was no real need for. But since the mines expanded due to industrialization, the need for rehabilitation became more urgent. The first experiments with grading and revegetation of excavated sites took place during the first decades of the twentieth century. It appeared hard to stabilize and cultivate the land after mining and this was the start of extensive scientific research into this topic (Steinhuber, 2005).

To serve the war industry during the Second World War, the brown coal production peaked. At that time, there was no attention, means or manpower to rehabilitate the exhausted pits (Steinhuber, 2005).

The GDR government had guidelines for the rehabilitation of open cast mines indeed, but the production was so high that the rehabilitation of mines was far behind by the time of re-unification in 1990. As a result, in the early nineties about 124 former open cast brown coal mines were waiting for decontamination and rehabilitation (LMBV, 2008). The relation between mining and rehabilitation (reclamation) intensity is visible in the graph on the facing page (Fig. 2.5).

Germany has a rich research history into the rehabilitation of brown coal sites with a focus on the technical aspects of rehabilitation in the field of ecology, soil science, hydrology and geology.

Figure 2.5: Relationship between the mining production land rehabiliation and the trends, politics and economy in Lusatia

The former mining sites that remained from the GDR time are called reconstruction sites ('Sanierungstagebaue' in German). For these sites special legislation is formulated. For Brandenburg this is described in the Regional Brown coal and Reconstruction Planning Document ('Gesetz zur Regionalplanung und zur Braunkohlen- und Sanierungsplanung des Landes Brandenburg' in German). This is a state document, which counts for Brandenburg, but the preconditions can be different for other states in Germany. The goal of a reconstruction plan ('Sanierungsplan' in German) is to map contamination and to compensate the damage as far as possible. In any case, the reconstruction plan should describe how:

- the surface should be recreated and either rehabilitation or restoration should take place;
- potential threats should be overcome and temporary prohibited area should be indicated;
- traffic routes and directions should be restored;
- and the water household should be balanced again.

(http://www.landesrecht.brandenburg.de/sixcms/detail.php?gsid=land_bb_bravors_01.c.15993.de, on 25 August 2008)

LMBV, the Lausitz and Central-German Mining Administration Company ('Lausitzer und Mitteldeutsche Bergbau-Verwaltungsgesellschaft' in German), is the semi-governmental organization that is responsible for the restructuring of mines that were not rehabilitated in the past. It has been founded in august 1994. LMBV and its operations are mainly financed with resources of the national government. About 8 billion euro will be used for basic redevelopment measurements in total, which means 830 million euro per year (LMBV, 2008). Between 1990 and 2006 about two thirds of the deficit in land rehabilitation has been solved by LMBV. Mainly in the recultivation of rehabilitated land, cleaning up of pollution and restoration of the water balance is still much to be done (LMBV, 2008).

At present, the mining company is held responsible for the rehabilitation of the area they influenced. In case of Lusatia, Vattenfall Europe AG is the only player in the market. The general regulations for rehabilitation in Germany are described in the federal mining legislation document. Apart from all kinds of technical preconditions, it is formulated that it is required to plan a reuse of the land which is equal or higher than the land use before the mining (http://www.buzer.de/gesetz/5212/a72002.htm, on 25 August 2008). Before the mining is allowed to start, the rehabilitation plan should be approved as part of the brown coal plan (http://www.landesrecht.brandenburg.de/sixcms/detail.php?gsid=land_bb_bravors_01.c.15993.de, on 25 August 2008).

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In a rehabilitation plan detailed guidelines for the rehabilitation process should described. The rehabilitation plan will serve as a binding agreement between the operator and the regulatory agencies for rehabilitation. The mining operator is in most cases the developer of the rehabilitation plan, but for a good rehabilitation plan, it requires an interdisciplinary approach to analyze the physical, chemical, biological, climatic and other site characteristics (Hustrulid & Kuchta, 2006). The contents of a rehabilitation plan are as follows:

- the creation of the surface and recultivation
- to overcome potential dangers and indicate temporary enclosures
- reconstruction of traffic roads and mains
- reconstruction of a balanced water system

(http://www.lmbv.de, on 1 October 2008)

These demands are more or less equal to what is described in the rehabilitation plans for reconstruction sites. The demands are becoming stricter however than in the past. The rehabilitated land should be mechanically stable, prevented from wind and water erosion and be hydrologically compatible with the surroundings. The new landscape should also be visually compatible with the surrounding landforms. Shaping, grading, erosion control are possible tools to realise these rehabilitation restrictions (Hustrulid & Kuchta, 2006).

In organizing the rehabilitation of mine sites, Vattenfall works often together with LMBV to use the experience that LMBV built up over decades in Lusatia. Next to LMBV and Vattenfall, the 'Internationale Bauausstellung Fürst-Pückler-Land' is important in the landscape restructuring after the mining in Lusatia. This organization, running from 2000 till 2010, has the goal to give an impulse to the structural change of the region. Through 25 exemplary projects, which have a focus on spatial, economical and social development, transformation is set in motion (http://www.iba-see.de, on 25 August 2008). The projects are thematically organized, which enables to develop the region in different identities. A great project of IBA is the creation of the Lusatian Lake Land. The open cast final voids that result from mining are flooded into lakes and made attractive for leisure and tourism purposes. Also trials with floating architecture are undertaken. The original idea is from the landscape architect Otto Rindt in 1966, who made in fact the first rehabilitation plan with a focus on landscape. Now his visionary plan becomes reality, which is visible from the three adjoining pictures, and the map on page 20.
The IBA also set up political structures and instruments for the future developments in Lusatia, to take it over when the IBA is finished in 2010. An example of this is the formation of the so called 'Zweckverband', an administrative union around a specific project or process with particular entities.
Together Vattenfall, LMBV and IBA are, next to the regular administrative unions, very important for the future development of the region.

Picture 2.8: The Lusatian Lake Land from the air

Picture 2.9: A beach at Lake Senftenberg in the Lusatian Lake Land

Picture 2.10: Floating diving school in Lake Gräbendorf

2.4 Lusatia in the future: policies, trends and opportunities

For a long time, there was a tendency in rehabilitation to restore the landscape as it was before the brown coal mining. The focus was on the (re)creation of agricultural and forestry land, added with a lake in the open cast final void to fill in the gap.

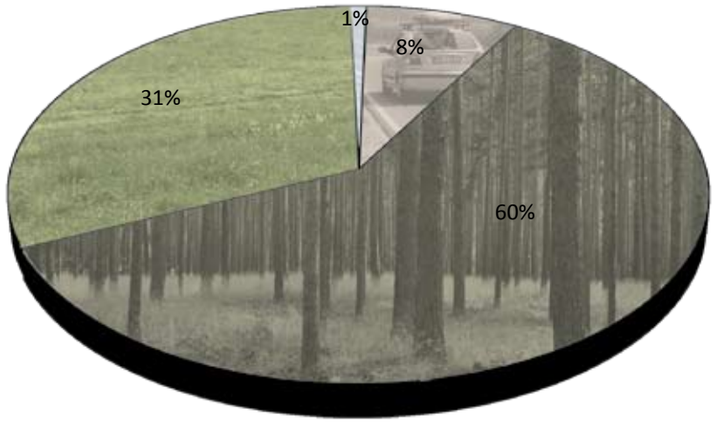

Figure 2.6: Land uses on sites that are claimed by mining in Lusatia, 1997

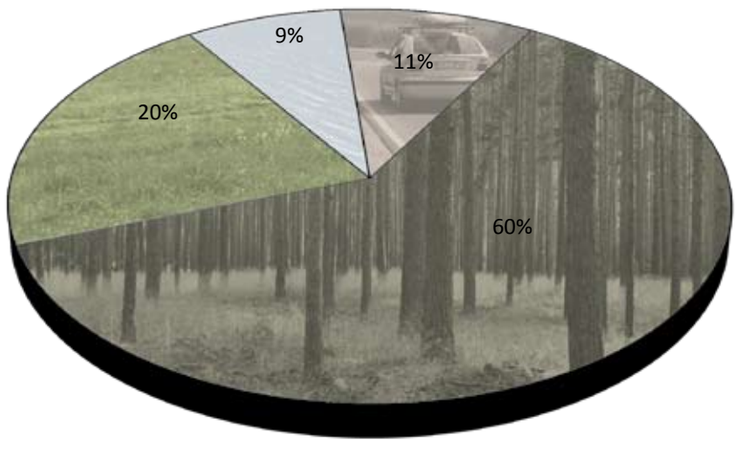

Figure 2.7: Land uses on rehabilitated mining sites in Lusatia, 1997

The diagrams on the left (Fig. 2.6 & 2.7) show the land use before mining and after rehabilitation. It is clear that the amount of surface water increased at the cost of the share of agriculture. For the rest the diagrams show a quite similar land use division before and after mining. A note should be made that the division of land uses within the main categories is changing the last decade. Renewable energy in the form of windmills and solar panels are often classified as 'agriculture' and of biomass woods as 'forestry'.

Forestry is economically very important in Lusatia. Therefore about 87% of rehabilitated land is forestry land and will be in the future (Häge, 1996). The prospects are that forestry will stay important in the future (Steinhuber, 2005). For a long time, Pinus (pine) dominated the rehabilitated areas which caused the origination of large monotonous woods of low ecological and recreational value. Nowadays more natural woods are grown with a mix of coniferous and deciduous species like Betula (birch), Quercus rubra (red oak), Robinia (black locust), Populus (poplar), Alnus glutinosa (common alder) and Pinus sylvestris (pine). The wood fringes are made more differentiated and open to enhance the biodiversity. Compared to existing forests in the surroundings, these new mixed forests on the mining dumps already show a high ecological value (Häge, 1996).

Agricultural land represented 22% of the rehabilitated land in Lusatia, which will decrease to fifteen till 20% because it is hard to make agricultural land from the mining dump area. The soil fertility is very low due the physical and chemical properties of the overburden material. Soil amelioration is costly, complex and not always effective. Soil substrates that would increase the fertility, like clay and loam, are rare in Lusatia (Häge, 1996). Besides, other land uses gain importance, like leisure landscapes and renewable energies.

In the report 'Future Landscapes, Perspektiven der Kulturlandschaft' the future for cultural landscapes in Germany in 2030 is projected in different scenarios (Artner, A. et al., 2006). The report is from the Federal Ministry of Transport, Building and Urban Affairs ('Bundesministerium für Verkehr, Bau und Stadtentwicklung') and the Federal Office for Building and Regional Planning ('Bundesamt für Bauwesen und Raumordnung'). Characteristic for every cultural landscape is that it is more or little strong influenced through humans, by which the influence of natural factors on the landscape declined or is even removed. Since the mining landscapes are considered to be part of the cultural landscapes in the Future Landscapes report, the scenarios are applicable. The scenarios are created for areas with an urban, semi-urban, rural and ubiquitary character (Artner, A. et al., 2006).

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Together with ongoing trends and key issues in regional development, the scenarios are based on developments in the economy and civic commitment. Economical development is explained here in terms of globalization, transport streams, leisure time, use of resources, mobility and settlement behaviour and structural changes in agriculture. Much of the future development of cultural landscapes is influenced by the commitment shown by the political entities on all levels and the civilians and their initiatives (Artner, A. et al., 2006).
The situation in former East Germany is characterized by a low population density, because many people went to the west after the re-unification. There is however a renewed commitment to initialize positive developments (Artner, A. et al., 2006). With the IBA Fürst-Pückler-Land, that runs till 2010, surely an extra impulse has been given to the developments in Lusatia.

Starting from the idea that the economy is poor at the moment but meant to develop well in the near future, that the civic commitment is high indeed, and that the region has a rural character with an industrial past, scenarios like historical industrial landscapes and Natura 2030 landscapes, designed to facilitate Natura 2000 European nature policy, are appropriate in Lusatia (Artner, A. et al., 2006).
When the economy stagnates and civic commitment decreases, a wild nature landscape or pasture landscape could fit well. These are interesting scenarios to think over, but in the end undesired because there are still too many people living in Lusatia to create landscapes where humans have no or only a very small role.
Two other scenarios, that could particularly fit in the mining landscapes but start from economical development and low civic commitment, are an agricultural production landscape and an energy production landscape. These two scenarios might work well in Lusatia because the scale of the brown coal mining corresponds with the scale of agricultural or energy production landscapes.

Based on these suitable scenarios for Lusatia it appears that next to forestry, nature, leisure and (renewable) energy will be important for the future in Lusatia. Policy, trends and chances for these land uses are presented next.

Nature

The European Union decided in Göteborg in 2003 to stop habitat loss from the year 2010 onwards. To reach this, the realisation of the Natura 2000 network, a European wide network of nature areas, is desired. The network will consist of nature reserves, but also include areas where the land will still be privately owned but sustainably managed in both an ecological and economical perspective (http://ec.europa.eu/environment/nature/natura2000/index_en.htm on 24 November 2008). For the best protection of threatened species, there should be enough connected area for a species to survive and location-specific measurements should be taken to optimize the quality of the areas for the species (http://www.bmu.de/naturschutz_biologische_vielfalt/natura_2000/ffh-richtlinie/doc/2256.php on 24 November 2008).

The European Union is divided into biogeographical regions, to be able to consider regions with similar natural conditions across political and administrative boundaries. Each biogeographical region has its own characteristics concerning the geology, climate and vegetation (http://ec.europa.eu/environment/nature/natura2000/sites_hab/biogeog_regions/index_en.htm on 24 November 2008). In Germany there are three biogeographical regions, the Atlantic, continental and alpine. Lusatia belongs to the continental region. It is counted for the species and the habitats whether they are well established, but from the table 2.1 it is clear that the situation is not very well. It can help to reach the goal of the species and habitat directives if in Germany, for example in Lusatia, nature areas are expanded and developed. A growing amount of people supports the Natura 2000 plan in order to maintain or develop the biodiversity (Artner, A. et al., 2006).

Germany is eager to implement the European Natura 2000 policies. In fact, the Germans want to use the occasion to build a national habitat network of even higher quantity and quality. This network is called the ‘bundesweiter Biotopverbund’, which can be compared to the successful concept of the Ecological Main Structure (‘Ecologische Hoofdstructuur’) that was introduced in the Netherlands in 1990. This national habitat network should cover ten percent of Germany, two percent more than the current share of nature area. The network has to build connected and protected core areas, where migration, protection, forage and reproduction possibilities are enhanced. Corridors and stepping-stones to connect the core areas are needed as well. The size and other specifications of core and connecting areas vary per species for which the area, corridor or stepping-stone is designed (http://www.bmu.de/naturschutz_biologische_vielfalt/kurzinfo/doc/4025.php on 24 November 2008).

An important part of the national habitat network is the ‘Grüne Band’, a nature area that came to exist between former East and West Germany, because of a lack of human activity in the borderland. Also abandoned military zones and closed mining areas have been restricted areas for a long time. They offer large, unbroken habitats, characterized by nutrient poor, differentiated and dynamic conditions. Exactly these characteristics create rare biotopes in a densely populated, urbanizing country like Germany.

Nature protection in the State Brandenburg has a high priority. There are fifteen large nature areas of different ecological and recreational value. Close to the design area Klettwitz are the Nature Park Niederlausitzer Heidelandschaft, of 484 km² and the Nature Park Niederlausitzer Landrücken, of 587 km². In Nature Parks in Germany the core is nature protection area, but also infrastructure and towns are present and the recreational value is high. The population density in these areas is low (http://www.mluv.brandenburg.de/cms/detail.php/lbm1.c.332153.de on 19 December 2008).

continental biogeographical region	species	habitat
well established	17 %	25 %
insufficiently established	28 %	49 %
badly established	29 %	21 %
unknown	26 %	5 %

Table 2.1: State of species and habitat establishment in the continental biogeographical region in Europe

Picture 2.11: Nature development on post-mining land in Lusatia

Tourism

The development of tourism and leisure in Lusatia is a possibility to diversify the economy and to create jobs. This is important, since the collapse of the brown coal and related industries in the ninetees. Landscapes like wastelands or post-mining landscapes are typical areas where structural change is needed to develop natural potentials into attractive and functioning landscapes again, and the development towards leisure and tourism might contribute. Chances are in the region's specific potentials, whereby it is important not to remain or recreate the traditional image, but to integrate new developments (Artner, A. et al., 2006). Since the population density in the surroundings is low and most of the people have not much to spend, it is important to attract people and money from further away (Boshold, 1999).

Recent general tendencies show that people will have more leisure time, but less money to spend while the fuel prices also rise. There is an increased demand for short breaks and weekend trips. Destinations which have a special character, out of the ordinary, but close by have an advantage for leisure and tourism. For the same reason nature areas will be valued higher in the future. Leisure and tourism within the home country are gaining more importance (Artner, A. et al., 2006).

A region becomes well-known for tourism and leisure if the climate, relief, infrastructure and facilities together, independent of the length of stay, present attractive conditions for leisure. Walking, swimming and water sports are at the top of most favorite leisure activities in open and flat landscapes (Pflug, 1998). Lusatia, with its mining landscapes waiting for rehabilitation, offers chances to be arranged for walking, swimming, water sports and other forms of leisure activities. The rest lakes for example, that result from flooding the open cast final voids, offer chances for water sports in this otherwise dry landscape (Pflug, 1998).

In Lusatia the entire tourism sector, the landscape and the infrastructure are new. The region has to compete established tourist regions in the nearby. There are for example Saxon Switzerland (Sächsische Schweiz in German), a sandstone rock area and nature park crossing the Czech and Polish border and the Spree Forest (Spreewald in German), famous for its branched canal structure that invites for canoeing. The industrial and mining history could be the unique features of Lower Lusatia to stand out compared to other, more found tourist regions (Boshold, 1999).
The landscape in Lusatia shows a long history in mining and rehabilitation. The landscape is fascinating and sometimes even stunning. Several pieces of industrial heritage are present (Boshold, 1999).

ANALYSIS - LUSATIA

Routes are created to connect the highlights like the F60 visitor monument, the mining museum in Knappenrode, the monumental briquette factory Louise and Biotürme mentioned earlier (Pict 2.6) The routes in Lusatia are included as regional route in the European Route of Industrial Heritage, which is a network of industrial heritage highlights all over Europe (http:// www.erih.net/nl on 08 January 2009). The Lusatian post-mining landscape with its industrial heritage offers interesting landscapes for experiences (Boshold, 1999).

Next to the industrial tourism, important trends for the development of leisure and tourism on the regional scale are the increase in cycle and walking holidays. Cycle and walking tourism need interesting, differentiated and typical landscapes, for cycling preferably flat, which is the case in Lusatia (Boshold, 1999).

Energy

It is expected that the renewable energy sector will be booming the coming period. The European Union has set high targets concerning renewable energy; in 2020 the share of renewable energy in the total energy consumption should be 20%, and the share for biofuels in petrol and diesel should be 10% (Orthen, 2008).

Plans are made on international level that can secure the world energy supply with renewable energy, for example the DESERTEC Concept. This concept is developed by the Trans-Mediterranean Renewable Energy Cooperation, founded in 2003 by The Club of Rome, the Hamburg Climate Protection Foundation and the National Energy Research Centre of Jordan. The DESERTEC Concept is designed to bring deserts and existing technology into service to improve global security of energy, water and the climate. The concept proposes Europe, the Middle East and North Africa to cooperate in the production of electricity and desalinated water by using concentrating solar thermal power and wind turbines in the MENA deserts (http://www.desertec.org, on 21 November 2008).

Germany is one of the leaders in the world concerning energy efficiency. Germany has a broad expertise in energy efficiency and renewable energy. Germany has the highest installed wind energy capacity (http://www.german-renewableenergy. com on 20 April 2009) and Germany is ahead in the production of solar energy in Europe (Tegenlicht: Here comes the sun, 2008). The photovoltaic panels are fit for circumstances where the weather conditions are not always sunny, like in Germany. Water energy is not applicable in Lusatia, due to the small height differences. The production of biomass for energy production is discussed, because it competes in land use with food production purposes. But on bad soils, where food crops cannot grow well, biomass for energy can be grown. The so called second and third generation biomass producers, making use of waste and algae, are less disputable but still under research. Geothermal energy is still under research. In Germany several drillings took place, but problems occurred and they had to stop. Other projects were already cancelled before they got started. Also geothermal energy projects cost a lot of money and can only be done in big projects (Janzing et al., 2008).

So wind and solar energy are the most sure and are becoming, because of rapid technical improvements, more and more cost-effective. The German targets for 2030 for the share of renewable energy are 30% in electricity, 14 % in heating and cooling and 18 % in the final energy consumption (Stryi-Hipp, 2008). Another advantage is the increase in jobs in the renewable energy industry. It is expected that in entire Germany in this sector 500,000 jobs will be available till 2020 (Block, 2008).

Lusatia is part of the bigger ‘energy region’ Lausitz-Spreewald. After a discussion from the Industrie- und Handelskammer Cottbus and the regional planning association Lausitz-Spreewald with the regional stakeholders in politics, economics and culture, it is decided that the function as energy region is the main focus for the future. In this way it is possible to move forward with the already existing energy identity from the brown coal mining time, but in a renewed way. In 1990 an agreement for the re-unity of Germany was signed and with this the political and economical framework for the brown coal industry changed fundamentally too. A new future for the brown coal economy was necessary to be able to sustain in an economical, social and ecological way. With the contemporary mines and power stations the region is contributing to the security of the national energy basis. At the same time, new technologies for energy production are pushing through at the Lusatian market. Windmills, biogas plants, biomass power stations, biodiesel plants and photovoltaic solar panels are contributing to a diversification of the energy production.

The pilot test installation for ‘carbon-dioxide free’ power generation in the power plant Schwarze Pumpe and the production of rotor blades for windmills in Lauchhammer are contributing to identity of the innovative (renewable) energy region (http://www.region-lausitz-spreewald.de/nr11_energieregion.pdf, on 10 November 2008).
The town of Lauchhammer set the goal to use free space for the production of renewable energy, in order to create new cultural landscapes and to support industries. The town wants to invest in environmental protection and considers a sustainable use of natural resources as important.
The region has in total 5366 MW installed electricity capacity at the moment. Thirteen percent is generated from renewable energy (Regionale Planungsstelle Lausitz-Spreewald, 2007).

This thesis is worked out within this context of policies, trends and opportunities.

Picture 2.12: Tourism in the post-mining landscape in Lusatia on a mining look-out point

Picture 2.13: Solar energy field

Picture 2.14: Windmills in the post-mining landscape in Lusatia

3 ANALYSIS - KLETTWITZ

Analysis - Klettwitz

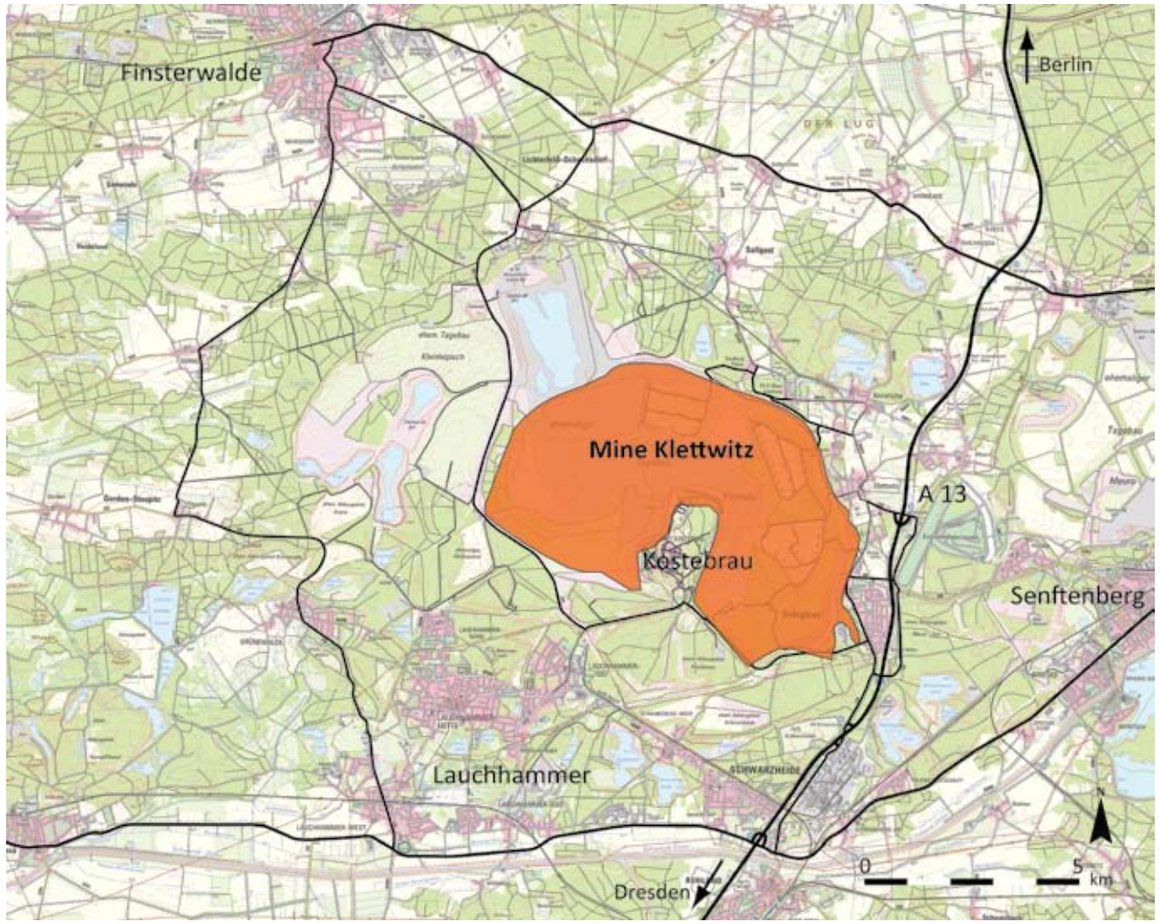


Figure 3.1: Location of the mine Klettwitz

In this chapter, the mine Klettwitz will be introduced. The location of the mine and the landscape that was originally here are explained. Hence the working of brown coal mines and the impact of mining on the landscape and the people will be explained after this specific mine. Also the landscape rehabilitation measures here are discussed.

3.1 Location

The mine Klettwitz is situated north of the industrial town Lauchhammer (Fig. 3.1). The area is connected to the A13 highway between Berlin and Dresden. The distance to Berlin is about 120 kilometres, to Dresden about 65. The mine Klettwitz is situated south-west in the Lusatian brown coal region and is part of the connected mining area Lauchhammer (Fig. 3.2). The other mines in this area are Kleinleipisch, Klettwitz-Nord and some older smaller mines in the south. The mine Klettwitz covers about 40 square kilometres.
The mine Klettwitz was closed in 1991 after reunification of Germany, and therefore it is a typical reconstruction site. The LMBV, the Lausitz and Central-German Mining Administration Company is responsible for the rehabilitation of this mine.
Kostebrau was not excavated during the mining of Klettwitz and therefore it remained as a higher ‘peninsula’ in its surroundings. Some monuments refer to the mining history that characterizes the town’s current position in the landscape, and the life of many of the people who lived here during the past century. At the edge of the village, near the former mining site, new houses are being built.
At the moment there are three official look-out points where you can have a view over the sites that are rehabilitated. This is a view with northern direction, towards the F60 visitor monument and the future rest lake, a flooded open cast final void, Lake Bergheide.

Picture 3.1: Impression of the current situation of the mine Klettwitz

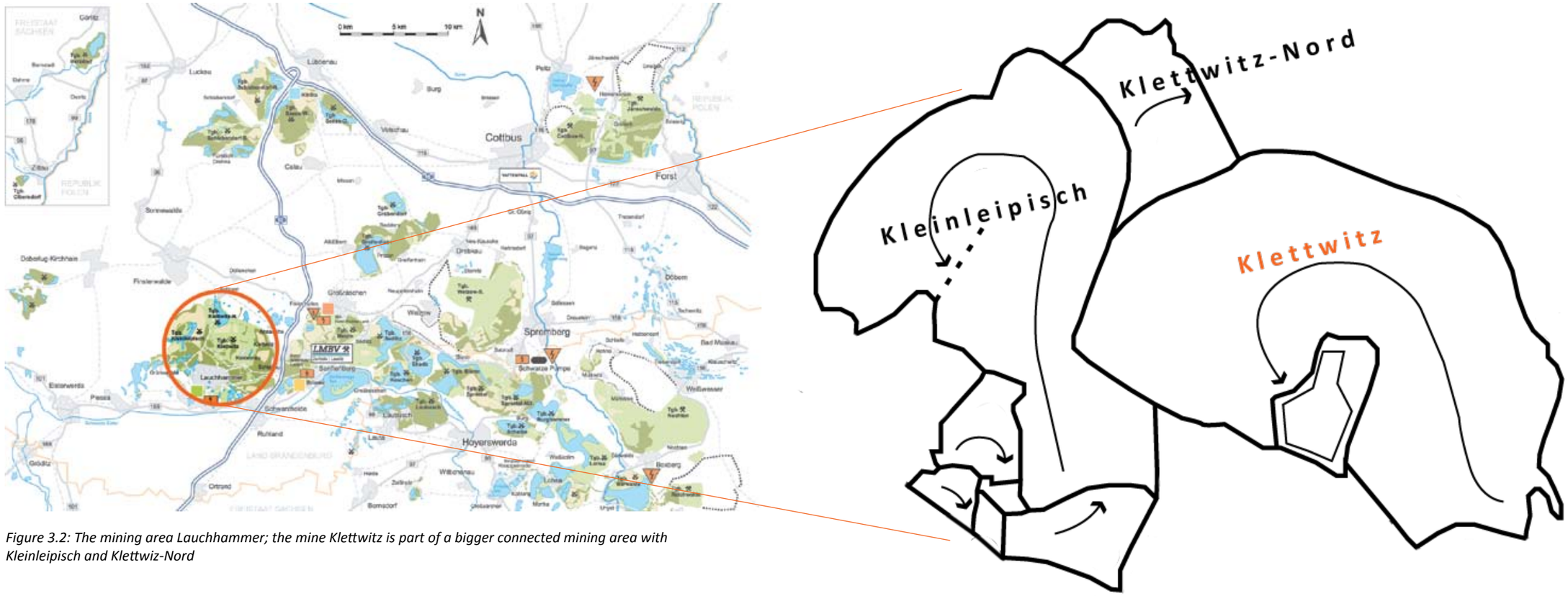


Figure 3.2: The mining area Lauchhammer; the mine Klettwitz is part of a bigger connected mining area with Kleinleipisch and Klettwiz-Nord

Picture 3.2: Impression of the village Kostebrau

Analysis - Klettwitz

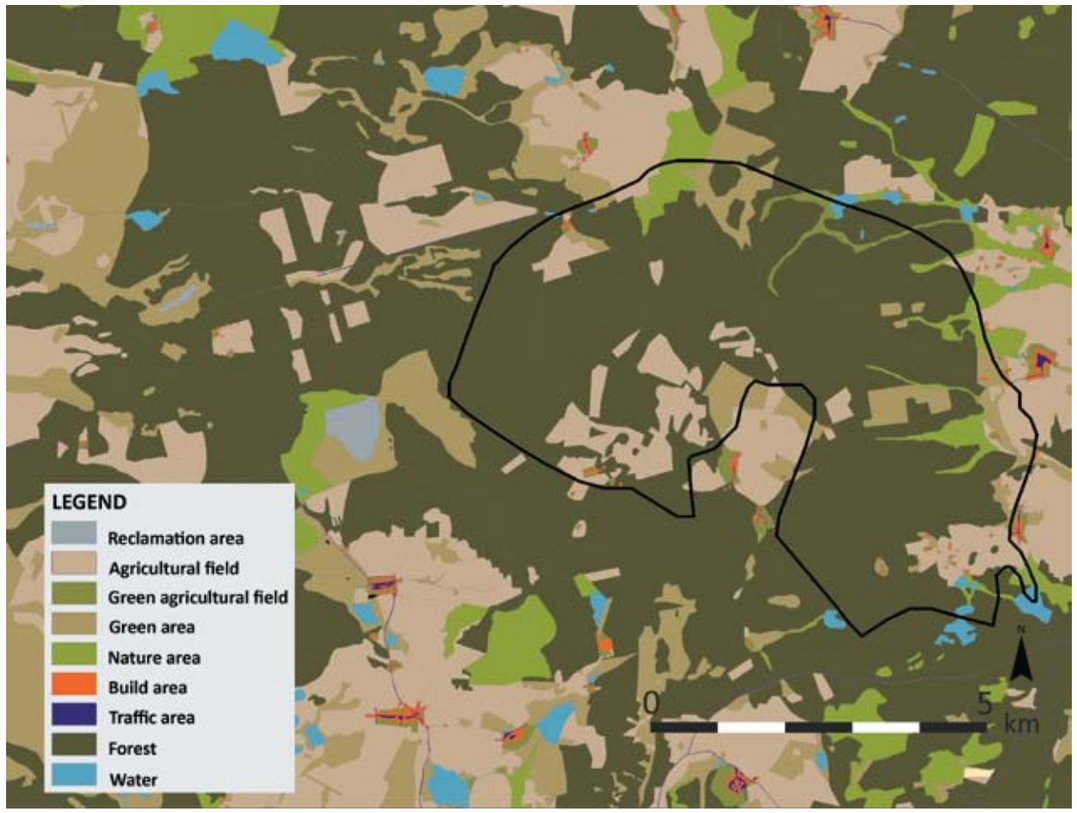


Figure 3.3: The original landscape of the mine Klettwitz in 1846

Figure 3.4: Original forest and water areas

Figure 3.5: Villages in the area. Römerkeller and Wischgrund are removed for the mining.

3.2 Original landscape

The mining area Lauchhammer is situated between the 'Lausiter Urstromtal' and the 'Niederlausitzer Grenzwall'. There were small height differences in the original landscape. The landscape in the area of the Schwarze Elster is 55 metres lower than the landscape in the north (Sanierungsplan, 1993). On the next page (Fig. 3.7) a geological cross section of the mine Klettwitz and the surrounding area show the height differences and the composition of the soil.

Figures 3.3, 3.4 and 3.5 show the original landscape of the mine Klettwitz. The black line in the figures show the contour of the mine Klettwitz that was not mined at this point. In the mines Klettwitz, Kleinleipisch and Klettwitz-Nord the original landscape existed mostly of forest, about 86% (Fig. 3.6). The naturally occurring pine forests in the mining area Lauchhammer were mixed with deciduous like oak, birch and aspen. Depending on the state of the site the blueberry- and heather-pine mixed forests were predominantly.

The groundwater flow runs from north-east to south-west. The biggest part of the groundwater is drained via the Pößnitz, the Hammergraben and several canals in south-western direction to the Schwarze Elster (Fig. 3.8). The streams north of the Klettwitz-Sallgaster plateau lead their water to the north in the Kleine Elster. The Kleine Elster flows at Wahrenbrück into the Schwarze Elster (Sanierungsplan, 1993).

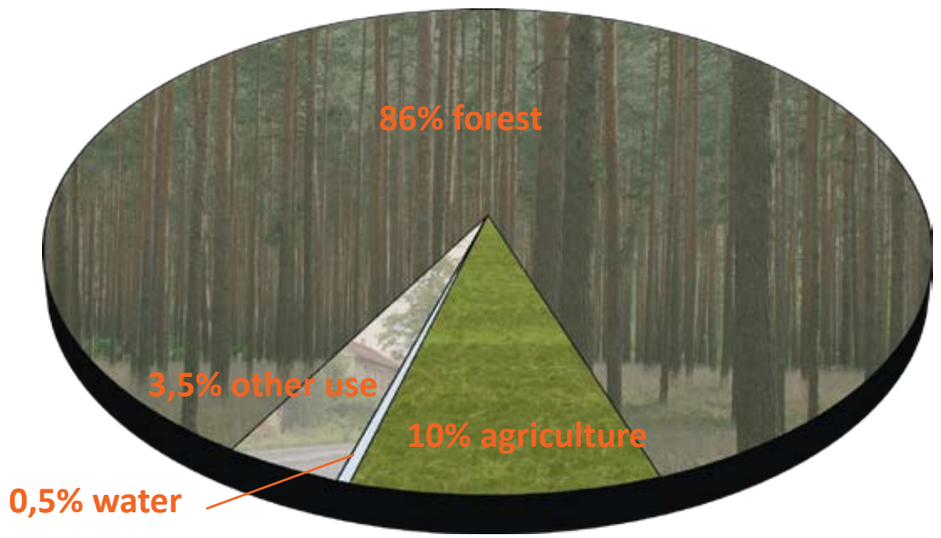


Figure 3.6: Original land uses mining area Lauchhammer

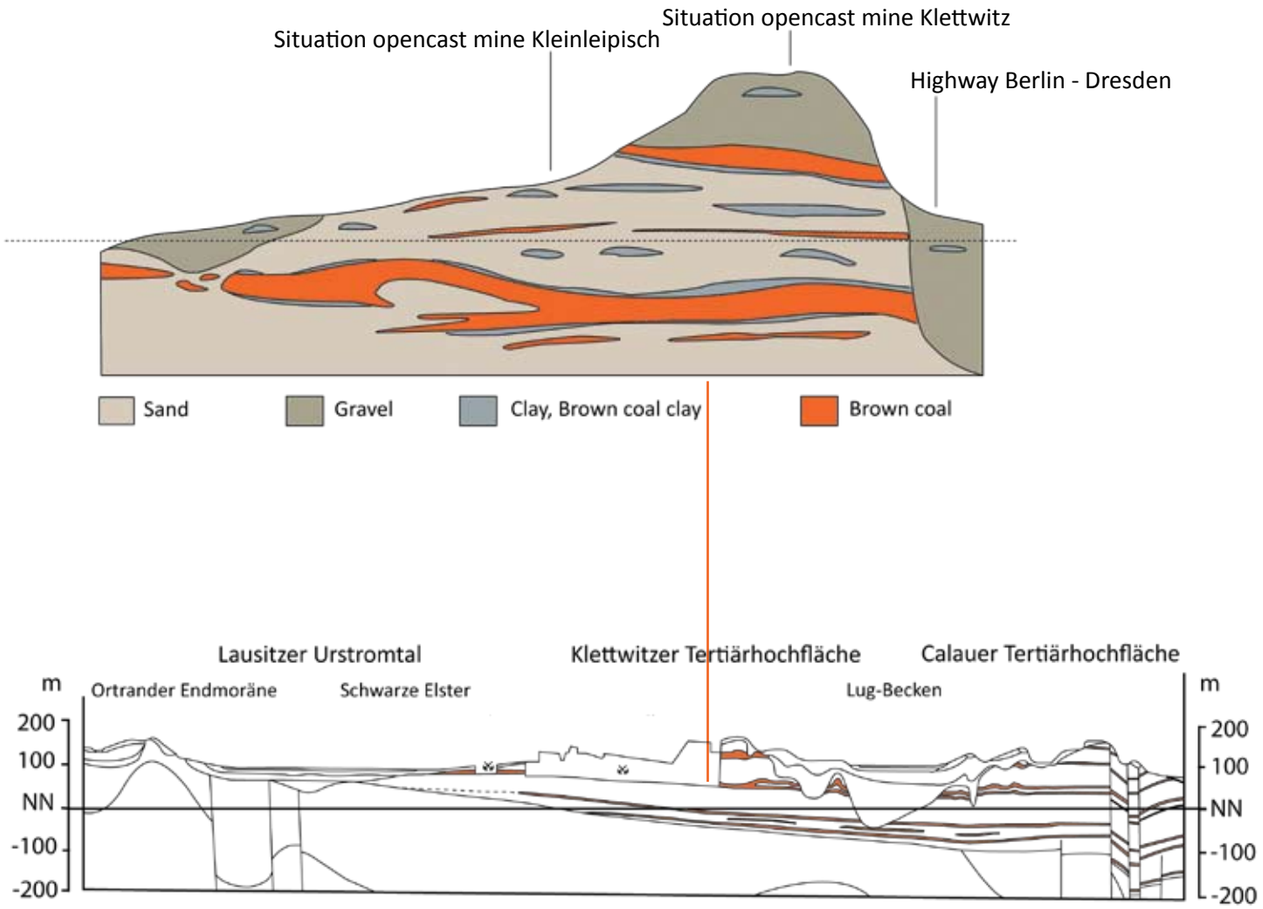


Figure 3.7: Geological cross section of Klettwitz and the surrounding area

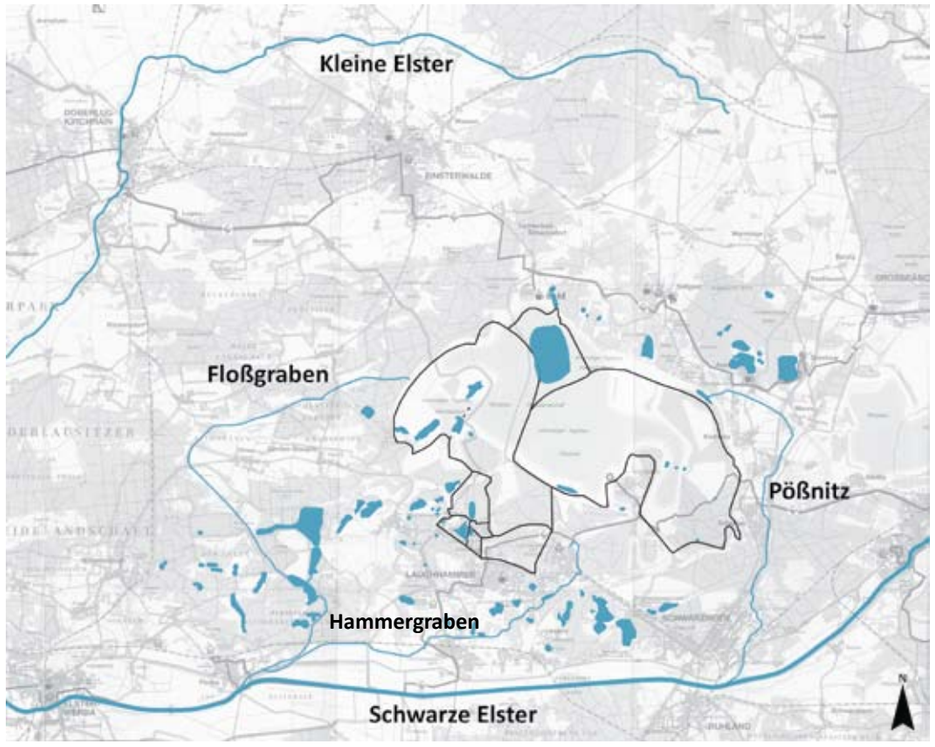


Figure 3.8: Water system

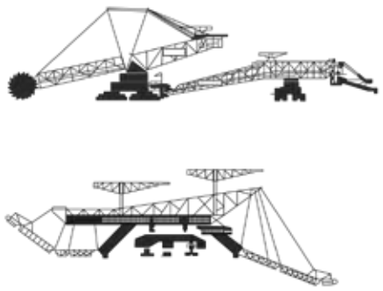
Analysis - Klettwitz

3.3 Open cast mining

To understand in general the working of the brown coal open cast mines in Lusatia, the basic definitions are explained (Fig. 3.9). Before mining activities start, the soil has different layers. Simply said, the top layer is the top soil layer, which has the most cultivation value. The layer underneath the top soil layer is the overburden layer. Overburden is the material that lies on top of the brown coal layer. The layer that is lying underneath the brown coal layer is the underground layer. The top soil layer, the overburden layer and the brown coal layer are being excavated. This is done by different types of machines; the most common are the bucket wheel excavator and the bucket dredger.
The overburden material is spread in the same mine where it is excavated, although sometimes the first material is spread in another mine. The place where the overburden material is spread is called a dump. The machines that spread the material are spreaders. The most common ones are spreaders by rail and conveyer. A machine that is unique for brown coal open cast mining in Lusatia, is the overburden conveyer bridge that excavates, transports and dumps material from one to the other side of the mine in one movement. Because of its enormous size it can only be used when mine is already partly excavated.

Figure 3.9: General working of an open cast mine in Lusatia

EXCAVATING

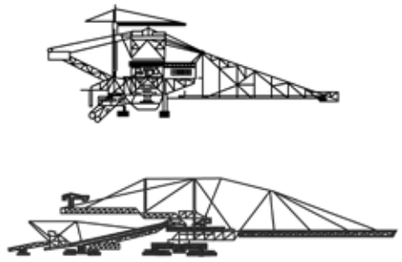


machines that excavate overburden material and brown coal

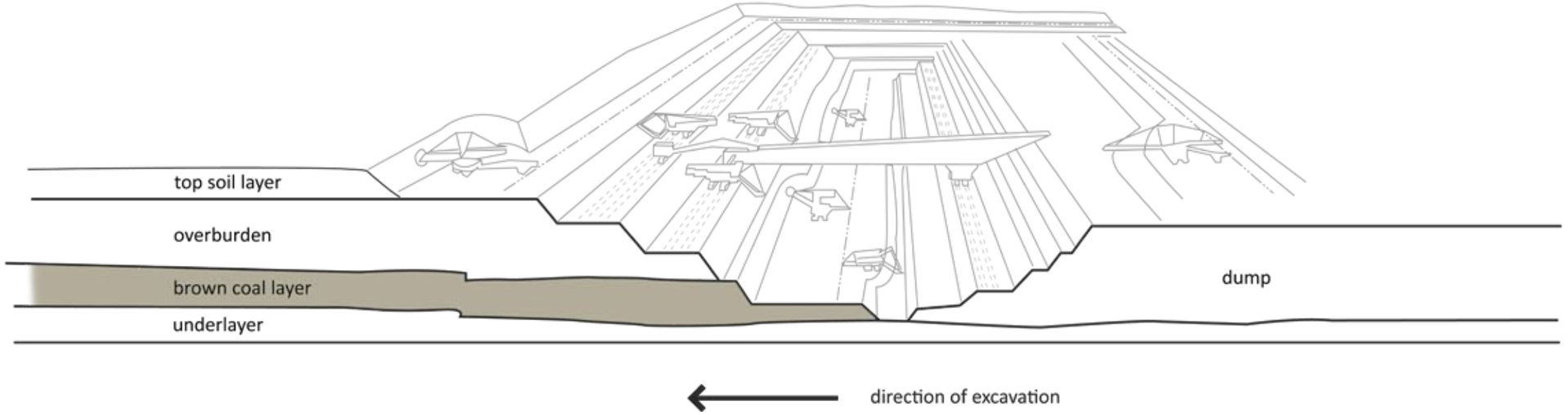
CONVEYING

overburden conveyer bridge, machine that excavates and spreads overburden material

SPREADING



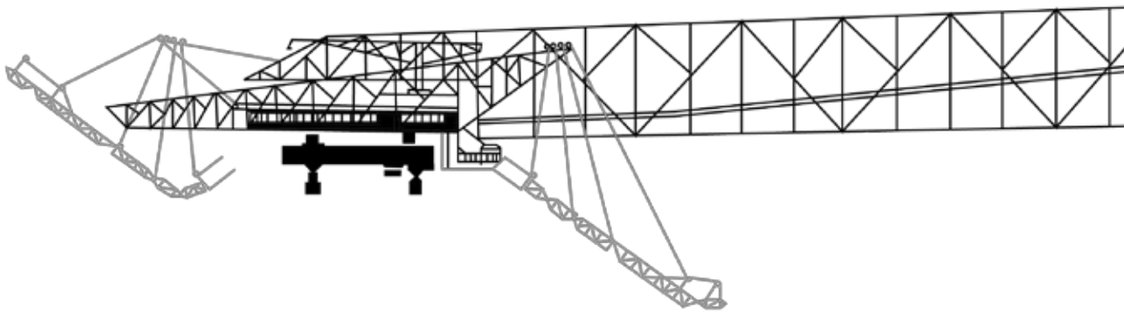
machines that spread material



Analysis - Klettwitz

The machines have different sizes and forms and each has its own way of excavating and spreading (Fig. 3.10). Also in the landscape the machines create different forms. The excavated brown coal or overburden material by the bucket wheel excavator and bucket dredger is transported via the machine on a conveyer belt or a train on a rail. The Brown coal is then transported away to the power plants and the overburden is transported to the spreaders. There is a spreader that spreads via a conveyer belt. This machine spreads the material in a curved form. The other spreader is moving in a straight line over a railway. The spreaders spread the material in small ridges. The overburden conveyer bridge is used to excavate and spread overburden material at the same time. The overburden conveyer bridge is connected with excavators, like the bucket dredger. The Bucket dredger excavates the overburden material and the conveyer bridge transports the material over a certain distance, depending on the size of the overburden conveyer bridge. Besides conveying, the overburden conveyer bridge also spreads the material on the dump. The overburden conveyer bridge creates large ridges on the dump.

Overburden conveyer bridge



Excavators: 1. bucket wheel excavator and 2. bucket dredger

1

2

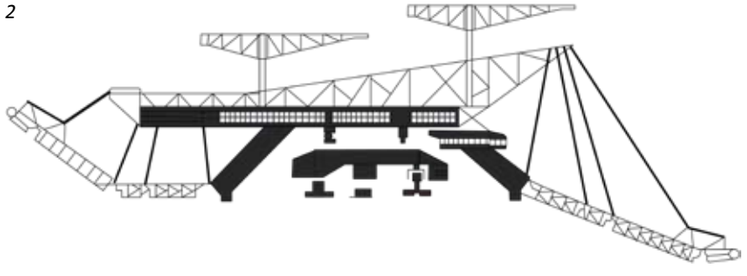
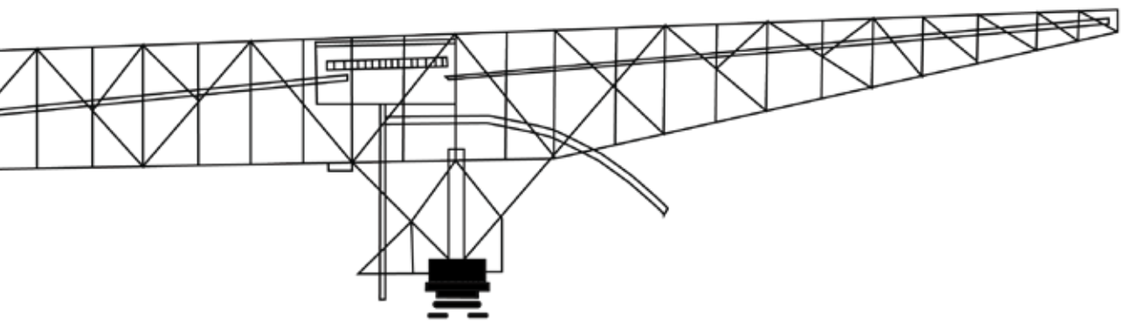
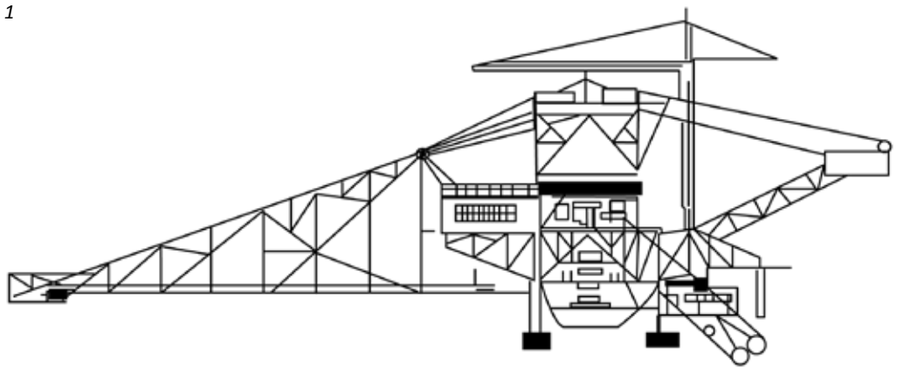


Figure 3.10 : The different machines and the forms they create in the landscape

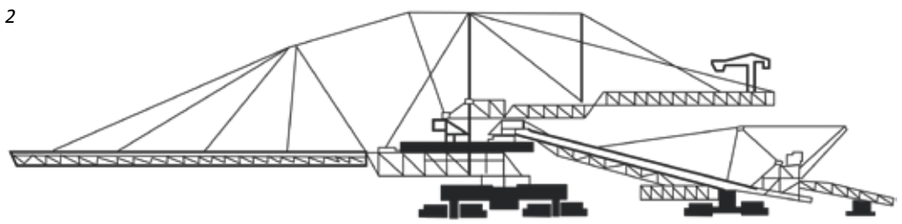


Spreaders: 1 spreader on a railway and 2. spreader with conveyer belt

1



2



Analysis - Klettwitz

3.4 History of the mining area Lauchhammer

In the mining area in the north of Lauchhammer, mining activities took place in different smaller mines, later joined to larger ones, between 1910 and 1991. At the map (Fig. 3.11) you can see the open cast mine Koyne (5), which was established in the north east of the industrial town Lauchhammer in 1919. In the beginning, the overburden was transported to the adjacent older mines of Grünewald. Later, as parts of the mine Koyne were dug out, the overburden was dumped here.

The brown coal of this mine was used in the briquette factory in Lauchhammer. In 1930 the site was expanded to the north were from 1933 an overburden conveyer bridge was used. This early type of conveyer bridge could transport overburden over 65-105 meters (LMBV, 2007).

Adjacent to the mine Koyne, the mine Kleinleipisch has been developed since 1910. In 1942 the pits Marie-Anne IV and V were joined to the mine Kleinleipisch. Also here, a conveyer bridge was in use from 1931. The brown coal of these pits was used in the briquette factories Milly and Marie-Anne. The mines Koyne and Kleinleipisch were joined later and formed a quite large open cast mine, which supplied brown coal till 1980 (LMBV, 2007).

In the south of Kostebrau, the mine Friedländer was opened in 1919. This mine moved 40 years in the direction of the town Schwarzheide. In the meanwhile, a lot of catastrophes happened like a big fire in 1923 and the breakdown of the conveyer bridge in 1928. The open cast mine Schwarzheide was in use between 1929 and 1953. In this period, about 345 million m^3 of brown coal was produced. Between 1970 and 1991 there was a waste dump in one of the empty pits of this mine (LMBV, 2007).

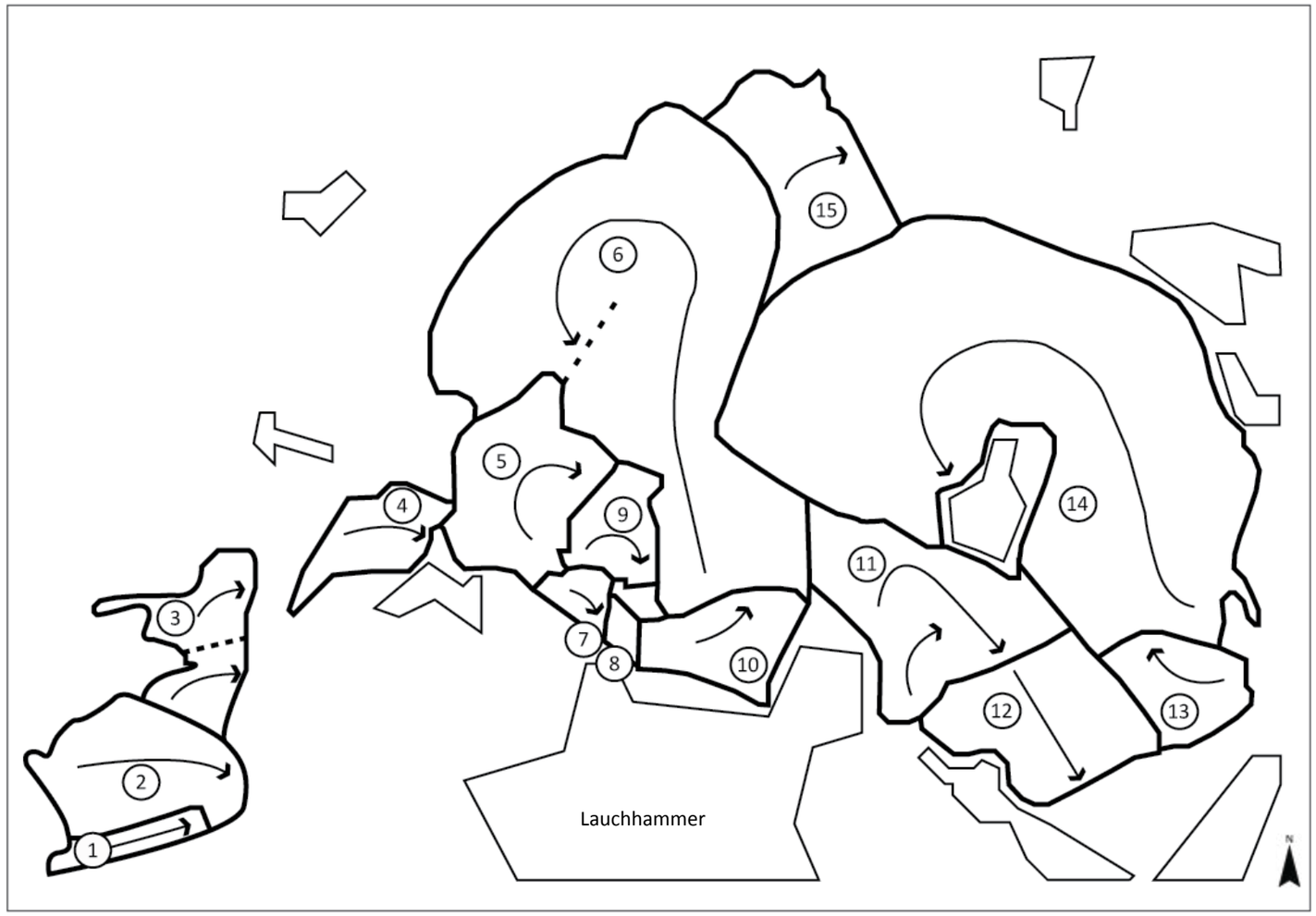
The machinery was often unique and very costly. Many machines, like the conveyer bridge, were reused from other mines.

The brown coal winning moved to the new mine Klettwitz from the year 1951, in the west from the small town Schipkau. During the excavation period, three conveyer bridges served here successively. At first the old conveyer bridge of the former mine Friedländer was moved here. This machine broke down in 1958 and was replaced by another old conveyer bridge. Over time, more and more overburden had to be removed to be able to get to the coal. At the moment that the overburden was more than 100 meters, the launch of a new conveyer bridge of the type F45, with two connected dredgers Es 1600 was necessary (LMBV, 2007).

This machine could remove 40-50 meters of overburden in one movement. From the year 1971, a yearly production of 55-60 million m^3 was reached, which is nowadays the total production of entire Lusatia.

The excavated raw coal was used to produce briquettes in manufactories in Klettwitz, Schwarzheide-Ost, Hörlitz, Brieske, Lauchhammer and Plessa (Fig: 2.1). The briquettes were used to produce high quality cokes in the coking plant in Lauchammer for industrial purposes all over East Germany, or were used to heat the households (LMBV, 2007).

Around 1984 the coal supplies in the mine Klettwitz ran out, but the demand from the briquette factories in Lauchhammer, Brieske and Senftenberg was undiminished. Therefore the mine Klettwitz-Nord was started. The first overburden material was dumped in the former pits of Klettwitz and Kleinleipisch. For this mine, new and very productive machinery was developed, like a brand new conveyer bridge from the type F60. This conveyer bridge replaced overburden over a distance of 500 meter at once. This machine became unnecessary soon, because in 1991 the mine Klettwitz-Nord was closed as a result of the reunification of East and West Germany. By that time 13 million tons of brown coal was produced, but there is still an estimated amount of 234 million tons of brown coal in the earth (LMBV, 2007)



Mines

1	Agnes	1897-1958
2	Plessa	1897-1958
3	Plessa-Lauch	1956-1968
4	Grünewalde	1950-1962
5	Koyne	1919-1954
6	Kleinleipisch	1945-1980
7	- Part I	1910-1921
8	- Part III	1918-1922
9	- Part IV	1921-1946
10	- Part V	1923-1947
11	Friedländer	1919-1946
12	Schwarzheide	1947-1955
13	Anna-Süd	1937-1947
14	Klettwitz	1951-1991
15	Klettwitz-Nord	1984-1992

Figure 3.11: Location and development of the mines around Lauchhammer

Analysis - Klettwitz

3.5 Mine development in Klettwitz

The development of the mine Klettwitz started in 1951 west from schipkau from the mine Anna-Süd and ended west from Kostebrau in 1991 (Fig. 3.12). The mining operations went counter clock wise around Kostebrau. It was complicated to open a mine here, since there had been various open cast and underground mines in the past. Later this mine was a large and highly industrialized site with three conveyer belt units for the transport of coal out of the mine.

The first overburden material from the mine Klettwitz was used in the mines Schwarzheide, Anna-Süd and Kleinleipisch to fill the open cast final voids. The machines were transported in 1990 to Klettwitz-Nord. To get an idea of the amount of material that is moved, Klettwitz is described in numbers (LMBV, 2007):

Overburden movement:	2526 million cubic metres
from which	
- by railway from 1954	653 million cubic metres
- by conveyer bridge from 1962	1200 million cubic metres
- by conveyer belt from 1973	471 million cubic metres
Brown coal production:	362 million tons
Land utilization:	5166 hectares

Other raw materials: clay (Hosena), silt, fine and coarse sand.

The mine Klettwitz moved almost all around Kostebrau, which was spared from excavation till the end of mining in 1991 and is now situated higher in the landscape then before. This makes the current village and surroundings very special (LMBV, 2007).

Parallel operation and turning operation

As can be seen on the development map of Klettwitz, there are a lot of lines that indicate the different time periods in the mine. The lines also represent the direction of the movement of the overburden conveyer bridge. There are two general ways of mine operations, namely parallel operation and turning operation. This can also be seen in figure 3.13 at the facing page, where the lines are presented with the two ways of operating. Parallel operation means that the conveyer bridge moves parallel in straight lines through the landscape. Turning operation means that the conveyer bridge makes a curve in the mining landscape and thereby always goes back to one point, the turning point. A more detailed explanation on the parallel and turning operation is provided in the schemes at page 50 and 51 (Fig. 3.14 & 3.15).

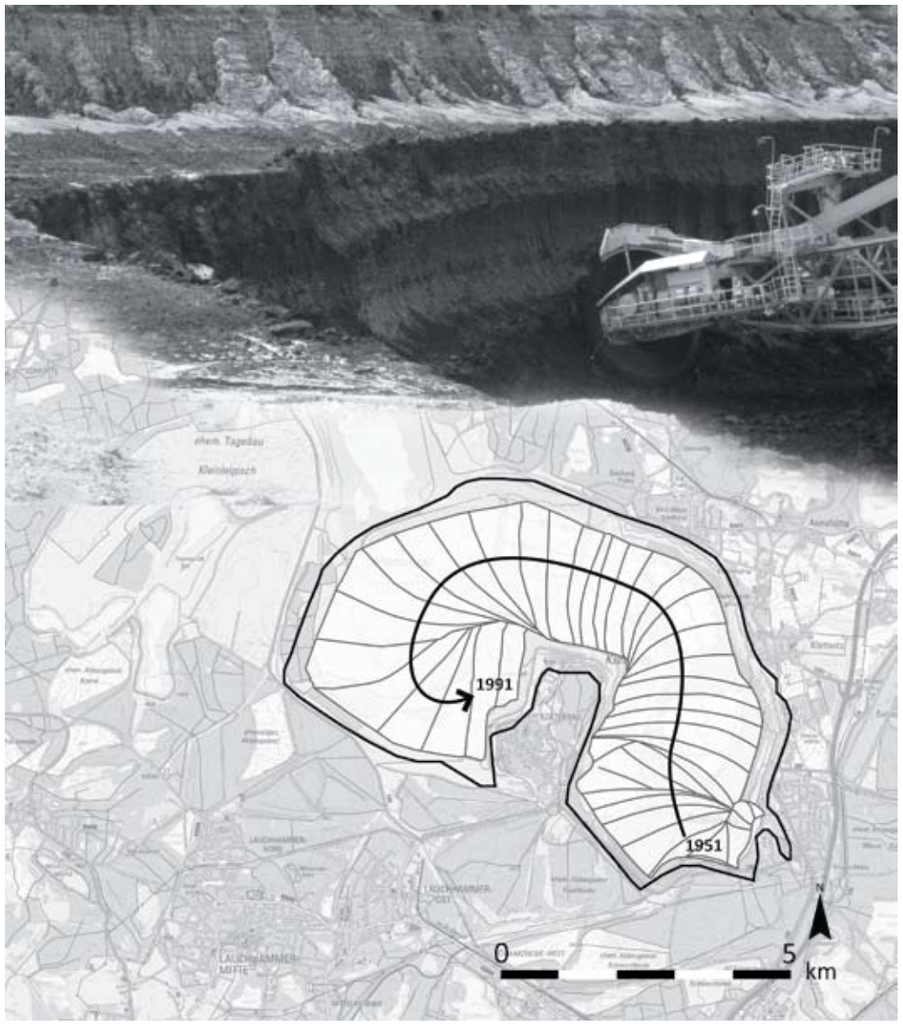


Figure 3.12: Map of the time development of the mine Klettwitz

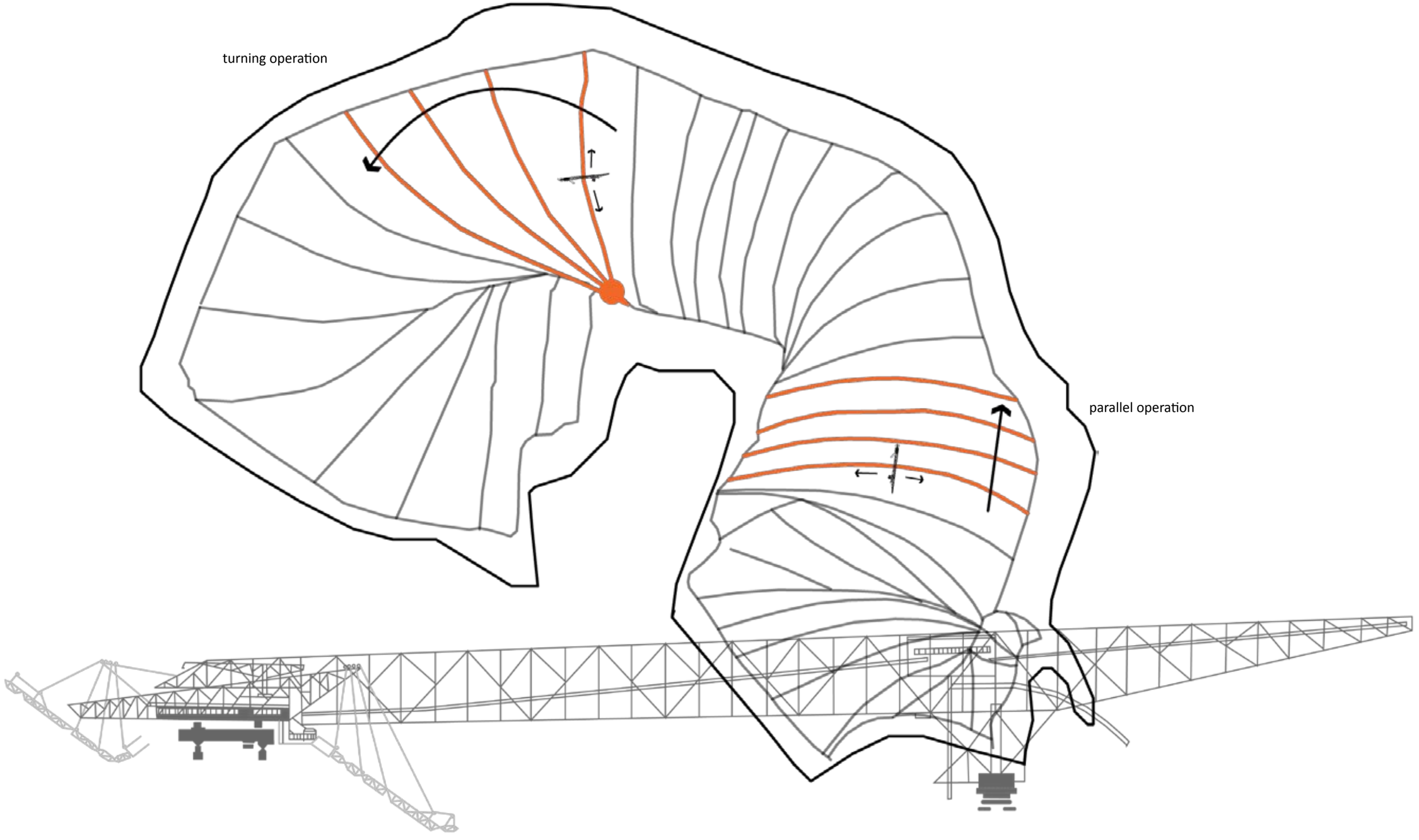


Figure 3.13: Each year of excavation is represented by a line and the lines are connected with the movement of the overburden conveyer bridge. The orange lines represent the two different ways of mining operations

Analysis - Klettwitz

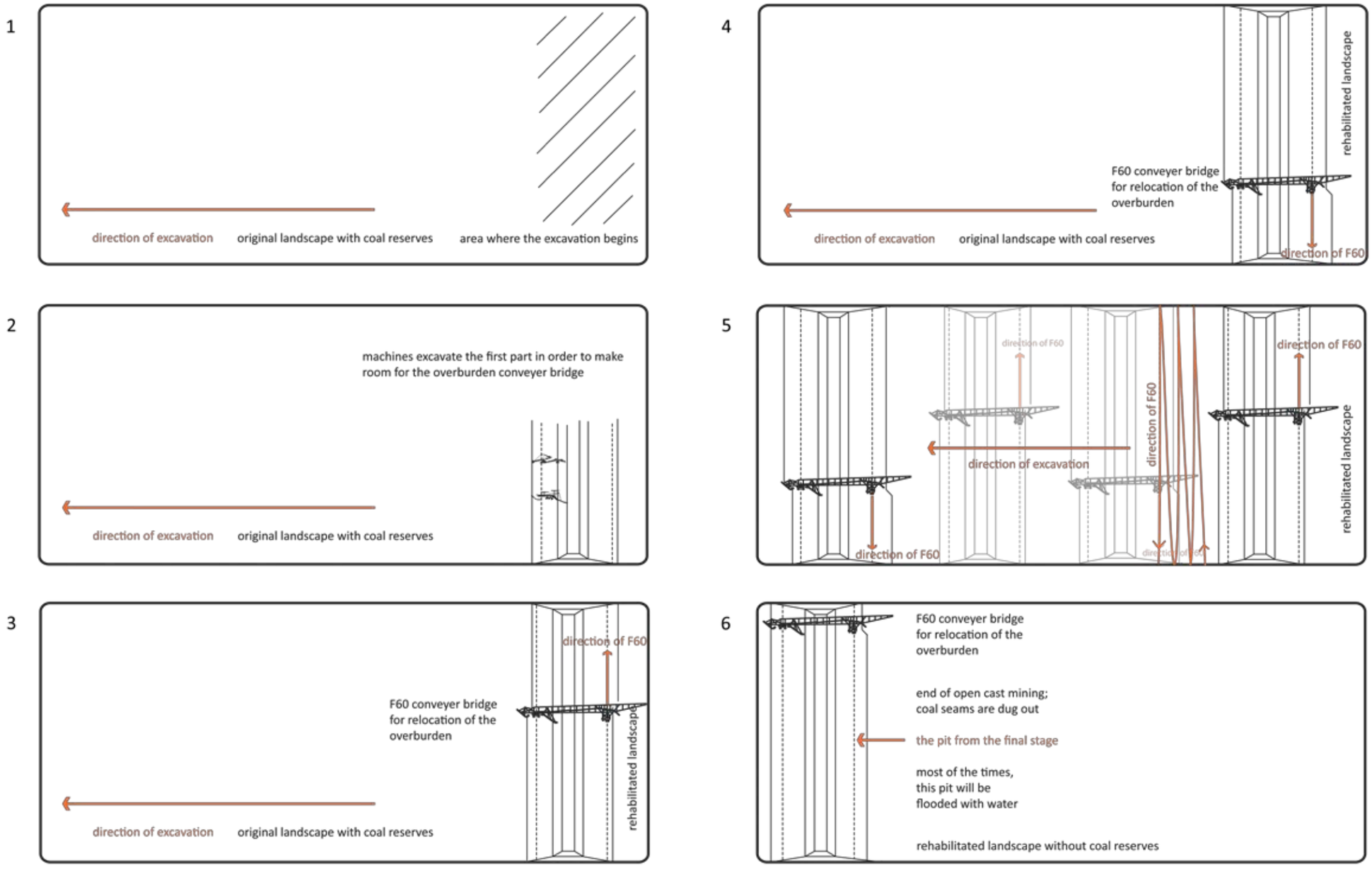


Figure 3.14: Schematic overview of parallel operation

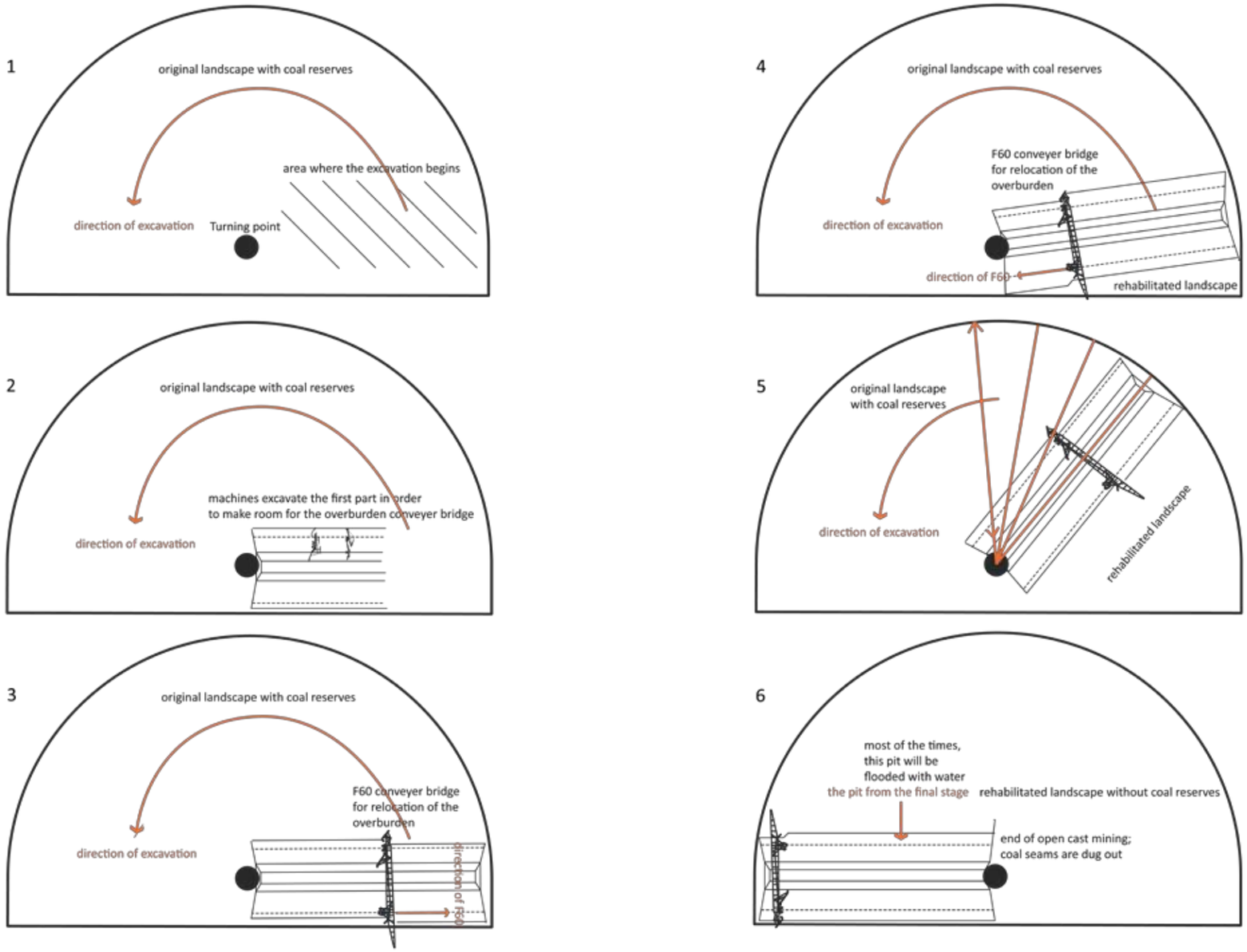


Figure 3.15: Schematic overview of turning operation

Analysis - Klettwitz

Dimensions

The cross section of a part of the mine Klettwitz (Fig. 3.17) indicates what dimensions a mine can have. The mine area of Klettwitz covers about 40 square kilometres. Off course only a part of this area is in operation at the same moment. The part that is in operation, is about 900 metres wide and 100 metres deep (Fig. 3.17). The overburden conveyer bridge is about 350 metres in the cross section. The size depends on the type of the conveyer bridge. The F60 is larger than the Eiffel tower that is lying on its side (Fig. 3.16).

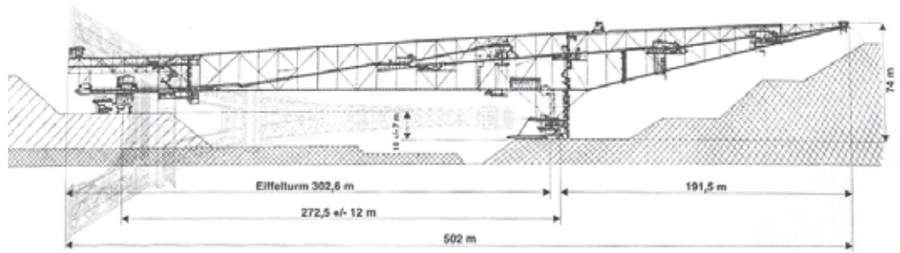


Figure 3.16: Proportion of F60 to Eiffeltower

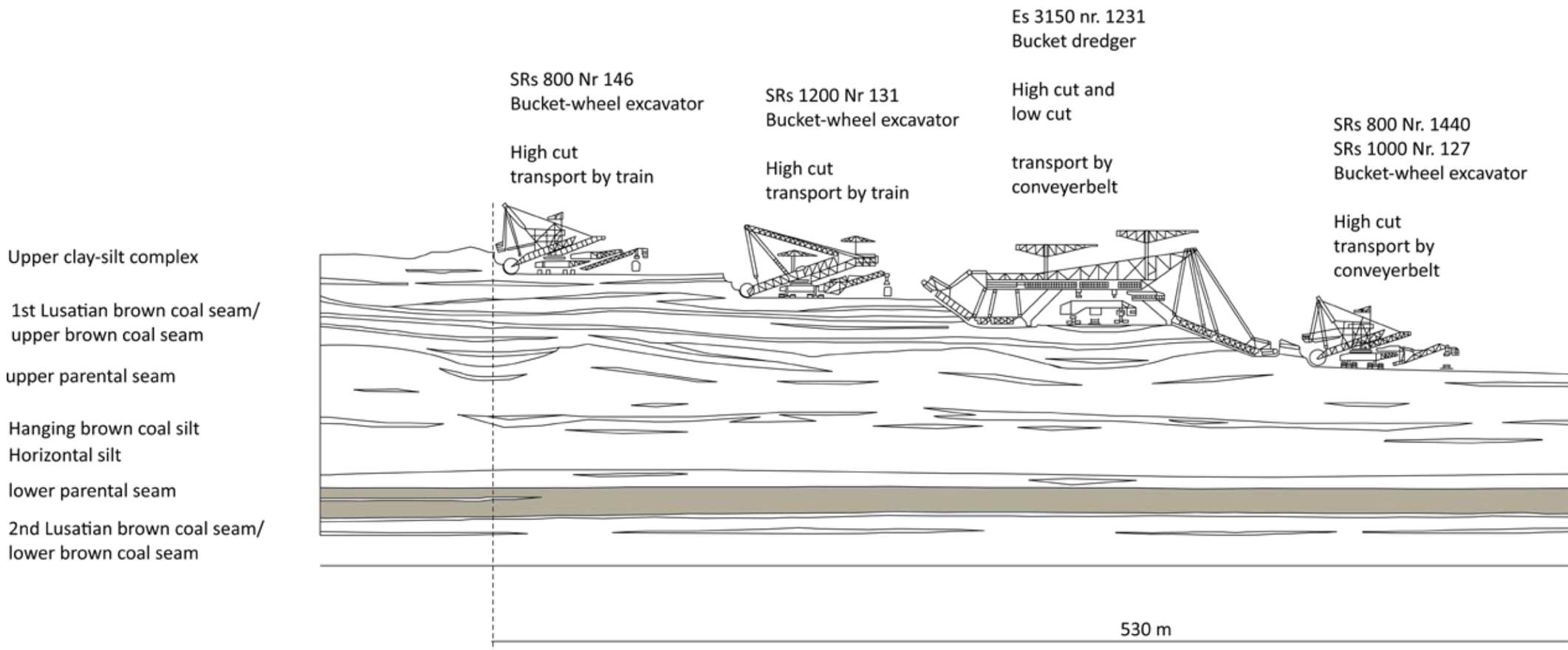
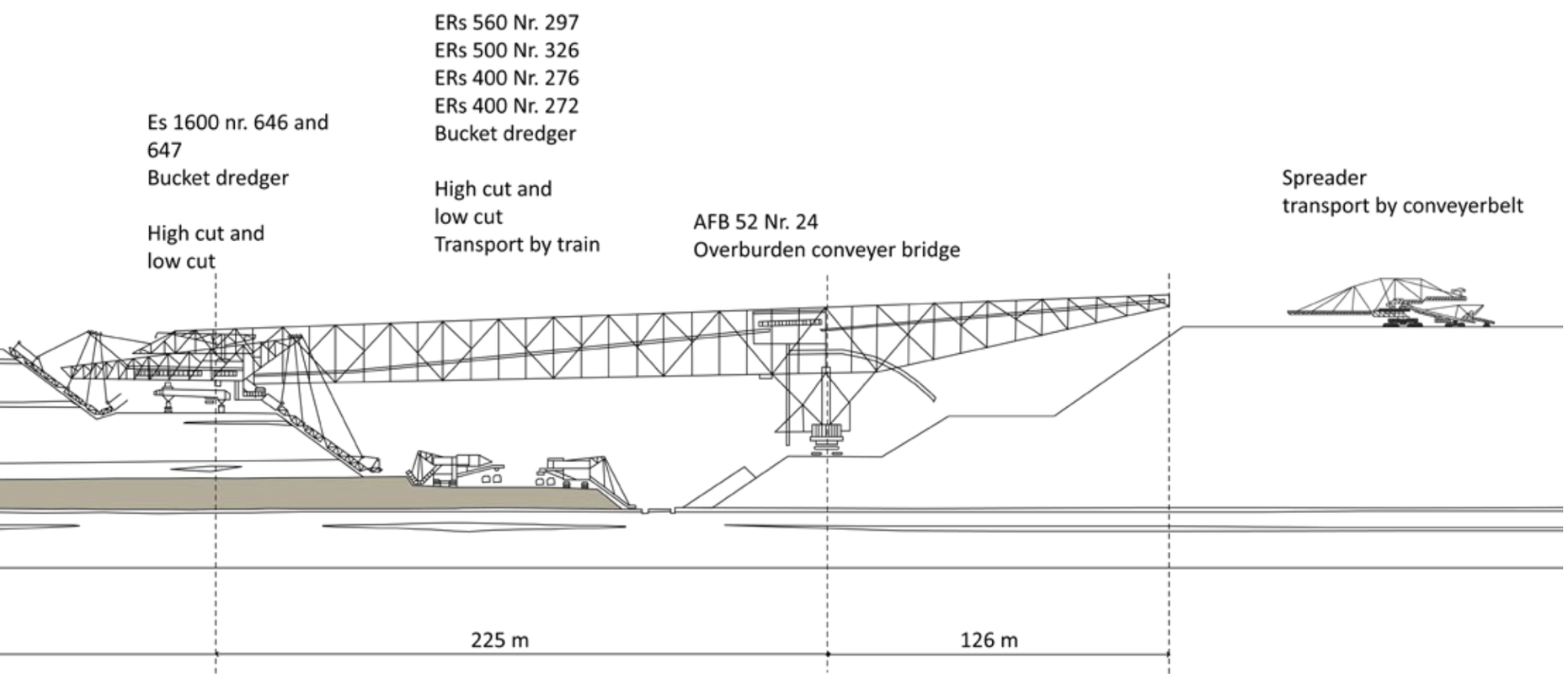


Figure 3.17: Cross section of the mine with mining equipment of Klettwitz


ERs 560 Nr. 297
ERs 500 Nr. 326
ERs 400 Nr. 276
ERs 400 Nr. 272
Bucket dredger
Es 1600 nr. 646 and 647
Bucket dredger
High cut and low cut
High cut and low cut
Transport by train
AFB 52 Nr. 24
Overburden conveyer bridge
Spreader
transport by conveyerbelt
225 m
126 m

Analysis - Klettwitz

Forms in landscape that result from mining

The development, dimensions and machines of the mining landscape result in several subdivisions with its own characteristics in the mining landscape. We distinguished 4 parts. These parts are present in Kettwitz (Fig. 3.19), but also in most brown coal mines in Lusatia. The four different parts are:

1. the dump;
2. the ‘Randschlauch’;
3. the open cast final void;
4. and the context.

First of all, the dump is the biggest part of the mine. The dump is the place where all the overburden material is placed, or you can say ‘dumped’. The overburden material is dumped by the overburden conveyer bridge and the spreaders. After that, other machines make sure that the dump becomes a safe and functional place again.

The second part is the ‘Randschlauch’. This part is always present when the brown coal is mined with a conveyer bridge system. Most of the time there is more than one ‘Randschlauch’. A ‘Randschauch’ is a gully that comes into existence during mining and they are situated alongside the dump. The gully originates because the conveyer bridge is not able to spread the overburden material at the edges of the dump. The ‘Randschauch’ can be filled with material by other machines or when it is left open eventually the water will rise in the ‘Randschlauch’.

The open cast final void is most of the time at the end of the mine. The void that originates during the mining has the volume of the brown coal that is excavated. Because the brown coal is transported away, there is always a void left in the mining landscape. Sometimes the void is filled up with material from another mine, but most of the time it will become a lake when eventually the water has risen back to a certain level again (rest lake, or Restloch in German). As soon as mining activities start, the topography of the original landscape will change. Roads are being cut off; agricultural lands are turned into a dump and so on. This means, that a part of the original landscape is changed into a mining landscape and the surrounding landscape has different edges. Because of the mining, the landscape is wiped out and placed out of its context.

The four subdivisions are simplified in the schematic overview of an open cast mine in Lusatia (Fig. 3.18). In the schematic overview the two different ways of operating are visible. At two sides a ‘Randschlauch’ is visible and a void at the end of the mine.

The mine Klettwitz has the four subdivisions and is therefore a typical Lusatian open cast mine. The differences are that the mine Klettwitz has a ‘Randschlauch’ all around the mine.

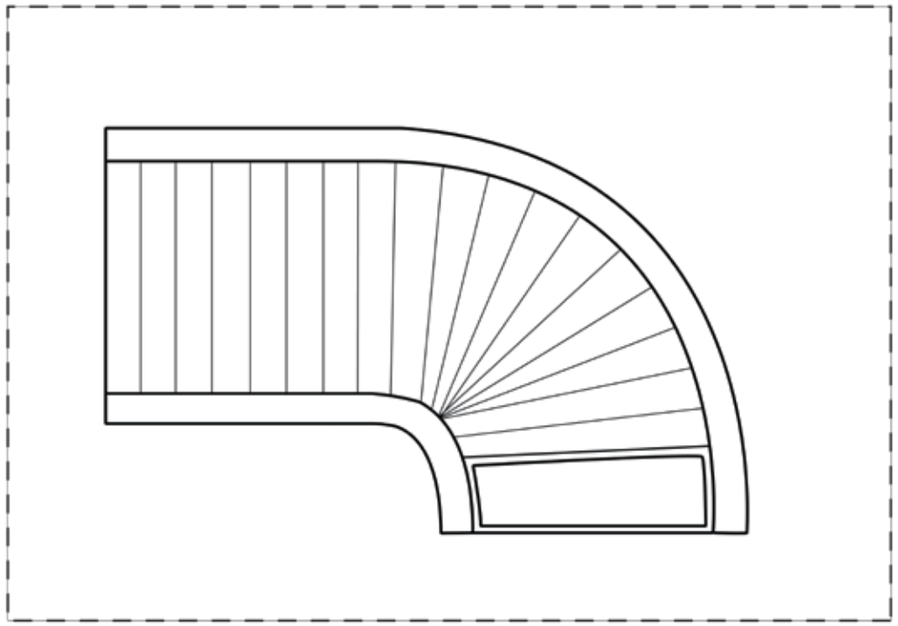
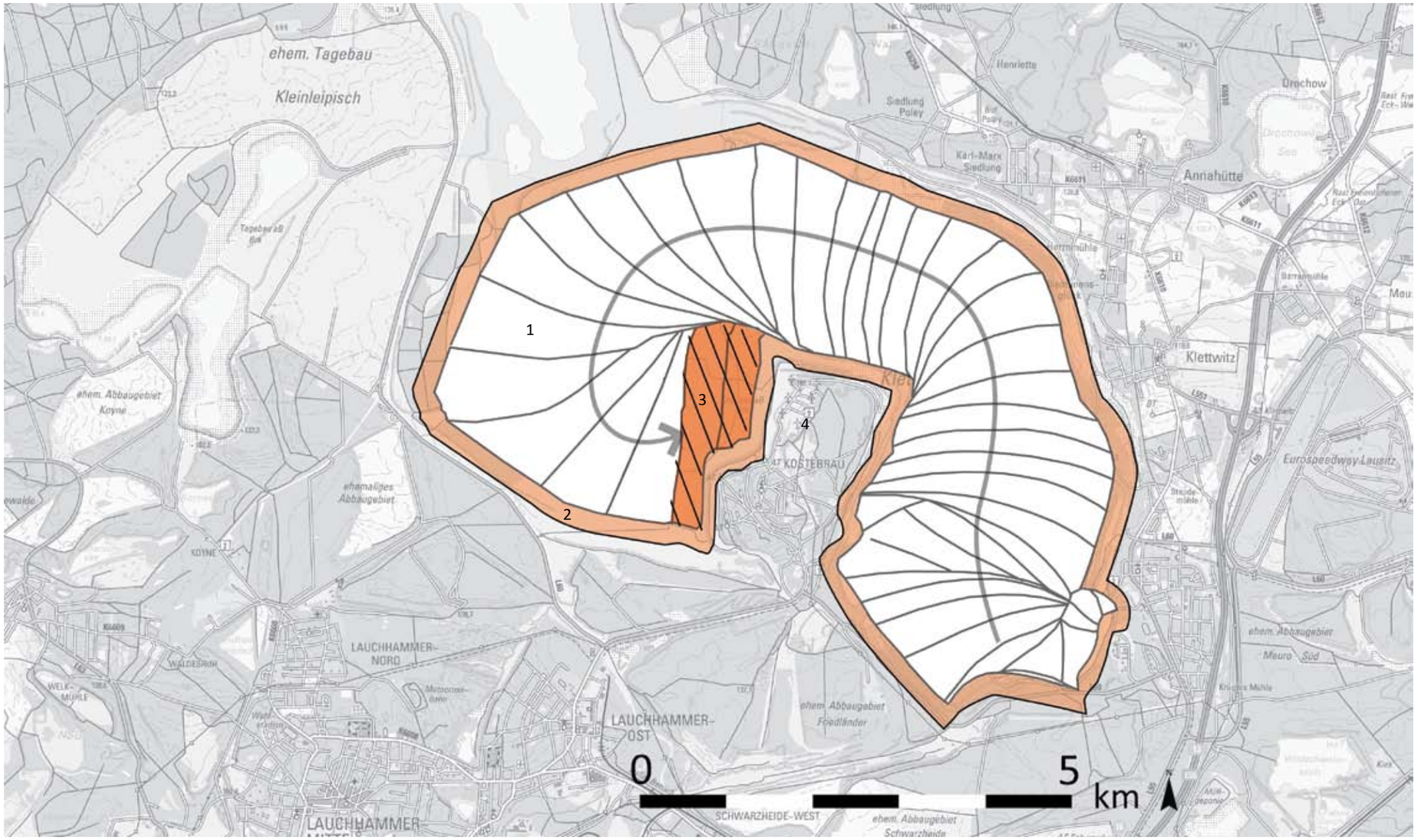


Figure 3.18: Schematic overview of the subdivisions of an open cast mine in Lusatia

Besides, The void that came to existence is filled with material from another mine, instead of being flooded to a lake. What is quite special about this mine is the situation of Kostebrau, that is spared and around the village the area is excavated.

Figure 3.19: Mine Klettwitz with the subdivisions: dump, ‘Randschlauch’, open cast final void and the context.



1. Dump

2. 'Randschlauch'

3. Open cast final void

3. Context

Analysis - Klettwitz

3.6 Impact from mining on the landscape and the inhabitants

Mining activities have impact on the landscape in a lot of different ways. The physical conditions are disturbed, like the soils and hydrology. The biological system is disturbed, for example the ecotypes that are being destroyed and wildlife that lost their homes and corridors. The mining activities also have a big impact on people. Besides that the physical landscape around them changed and infrastructure that is not there anymore, mentally, it also had a big impact on people. The problems that are discussed here are the soil problems, the water problems, the topography and context and the problems the mining caused to the people.

Degraded soil

The soil substrates that came to existence in Klettwitz and Kleinleipisch after spreading of the overburden material, are different from the original soil substrates (Sanierungsplan, 1993). The deposits that came to the surface are known as Tertiary deposits becauset hey are from the Teriary period. The Tertiary deposits often have a sandy texture, a limited fertility and they are extremely acid (Katzur & Haubold-Rosar, 1996), which means a pH value below 4.5. Besides, a sufficient quantity of organic substance is lacking, which means a low buffering capacity (Schmidt & Bannick, 1996).

The post-mining soils in Klettwitz are strong heterogeneous substrates, which differs from a normal situation where a soil consists of separate layers of substrates. Those soils are spread in Klettwitz by the spreader with a conveyer belt system. The soil types and also the geological origin of the materials (Fig. 3.20) are so irregular that it is not possible to make a division in homogenous sub-areas (Sanierungsplan, 1993).
It can happen that the soils are not useable for any agricultural purposes at al. In the former mine area Kleinleipisch, adjacent to Klettwitz, the soil is contaminated. The soils were polluted because the sewage with phenol from the coke factory in Lauchhammer infiltrated in the soils by the rain.
Besides the fact that the soils are poor and acid and it is difficult to grow plants on, the soils are increasingly sensitive for erosion. According to Keefer (2000) *'erosion is both detachment and movement of soil or rock, and this is caused by running water, wind or ice'*. The erosion in Lusatia is man-made, which is called accelerated erosion, because it is caused by changes people have made to the soil by movement of the earth (Keefer, 2000). In general, one can say that to make the soil safe and functional again, measurements are needed.

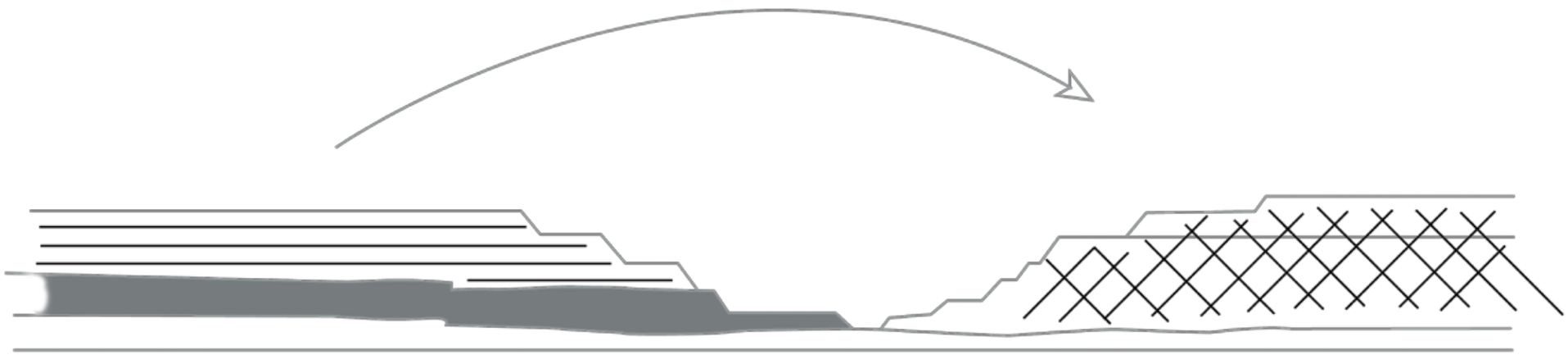


Figure 3.20: The soil layers change completely by mining whcih results ultimately in degraded soils and a bare landscape

Picture 3.3: Degraded soil with bare landscape after mining

Analysis - Klettwitz

Water problems

The mining activities have a big impact on the water system. The mining activities affect not only the water quantity, but also the water quality.
The mine Klettwitz is part of the water catchment area Schwarze Elster. In general, the groundwater stream runs from north-east to south- west, which means from the plateau north of the 'Urstromtal' to the Schwarze Elster in the south. The pumping of the water on behalf of the mining operations changed the water systems completely in the region. Already when the first brown coal layer was excavated, the groundwater was lowered. It is therefore very difficult to reconstruct the water situation as it was before mining (Sanierungsplan, 1993).

Because of the pumping of the water in the mines Klettwitz, Kleinleipisch and Klettwitz-Nord, which is about seventy square kilometres, the groundwater had been influenced over an area of 192 square kilometres (Fig. 3.21). The water deficit comes to 855 million cubic metres. A complete filling of this deficit is because of the changing landscape after mining, like rest lakes, not possible. According to an existing model, 500 million cubic metres are necessary to get a more balanced system again (Sanierungsplan, 1993). Naturally, the average supplementation of groundwater in the area is 6,4 litres per second per square kilometres, which would fill up the water deficit only very slowly (Sanierungsplan, 1993).
There are also parts in the landscape that have influence on the water system. For example, underneath the highway in the east of the area there is an impermeable soil layer, the 'Pößnitz-Rinne'. Therefore, there is a natural boundary between the drainage area of the mine Klettwitz west of the highway and mine Meuro east of the highway. In the north of the area there is also a natural barrier in the form of a interfering zone, the 'Wormlager Wald' and the 'Sallgaster Störung'. The watershed is therefore moved one kilometre to the north and just lowered 5 metres, while in the mines the groundwater was lowered 50 metres (Sanierungsplan, 1993).

At this moment mining areas Klettwitz, Kleinleipisch and Klettwitz-Nord are still being drained. In 1990, 550 sources pumped 150 cubic metres per minute, which is almost 80 million cubic metres a year (Sanierungsplan, 1993). Besides the enormous shortage of water, the quality of the groundwater has been influenced as well. The problem of the water quality is called Acid Mine Drainage, in short AMD. In the overburden occurs pyrite, which is FeS_2. When the groundwater is lowered because of the mining activities, oxygen, which is O_2, is able to contact the FeS_2 and oxidize it into iron and sulfate ions. The following chemical reaction occurs: $4FeSO_4 + 10H_2O + O_2 \rightarrow 4Fe(OH)_3 + 4H_2SO_4$. This leads to acid water with pH values of 2,5 to 3. This water stays in the subsoil and comes in the rest lakes to the surface. It is in most cases unpredictable what effects the acid causes in the subsoil.

Picture 3.4: Red water due to dissolved iron

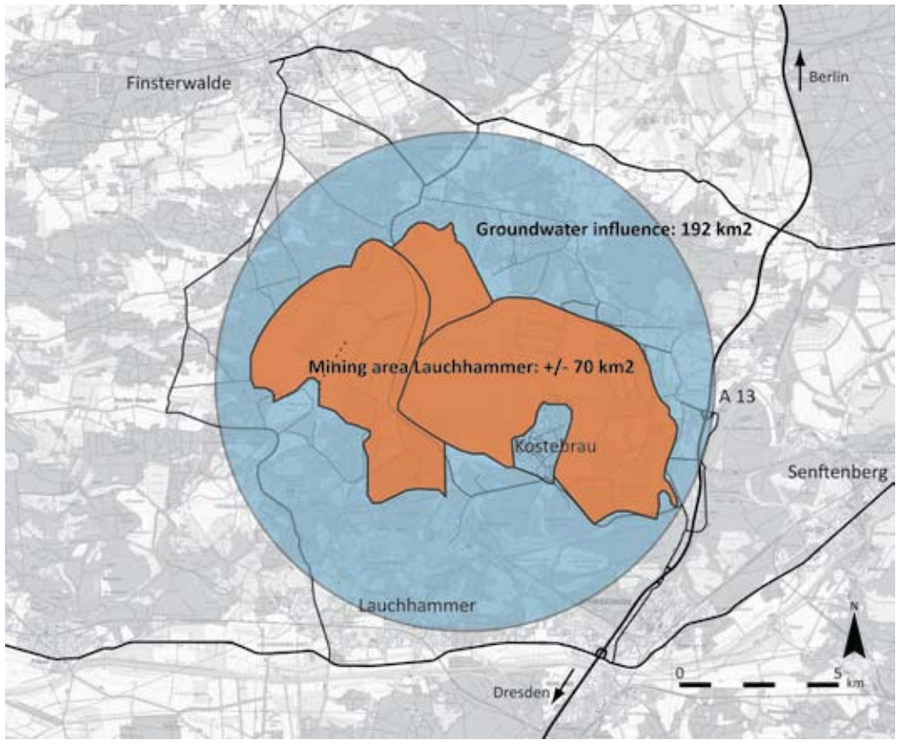


Figure 3.21: The impact of water pumping on the surrounding area

The shortage for a balanced system in mining area Lauchhammer is 500 million m³.
A Olympic swimming pool is fifty metres long, twenty-five metres wide and at least two metre deep.
This means a pool of at least 2500 m³. So one needs 200,000 Olympic swimming pools to create a balanced system again. (source: http://home.hetnet.nl/~vanadovv/Div.html on 3 April 2009)

Analysis - Klettwitz

Topography and context

According to the wordnetweb (2009), the definition of topography is the following: *'the configuration of a surface and the relations among its man-made and natural features'.*
In the mining landscape the topography is totally changed by mining activities. This means that the configuration of the surface changed dramatically, just as the man-made and natural features and their relations that were there before mining. In general the infrastructure like roads and water are destroyed and not connected to surrounding area anymore. Villages are destroyed and the people are 'relocated' in other or new villages. Agricultural and forest lands are destroyed, just like important routes for animals.

Mostly it is not possible to create the same landscape and nature after mining in comparison to the situation before mining (Sanierungsplan, 1993). This is also undesired, because this would mean an artificial restoration of the old situation, which would be strange because time has go on in between.

In the mines Klettwitz, Kleinleipisch and Klettwitz-Nord the landscape existed mostly of forest, about 86% (Fig. 3.6). These forest areas are completely destroyed by the mining activities. Sometimes, even important nature areas are destroyed by mining activities. Nature area 'Grünhaus' is for two thirds destroyed by the mining activities in mining area Kleinleipisch. The height differences that were present in the original landscape are flattened or created on other places. Two small rivers in this area were cut off and redirected in western direction (LMBV, 2007).

In the beginning the mines were small and the villages could be spared from excavation. Later, when the mines became larger, this was regarded too expensive. So the villages of Schipkau, Klettwitz, Bergheide, Grünhaus, Bushmühle, Kostebrau-Römerkeller, Kostebrau-Wishgrund, Klinkerwerk and Klingmühl were partly or entirely removed for the mines Kleinleipisch, Klettwitz and Klettwitz-Nord. What is left in the landscape are slopes, wastelands, and rest pits that are partly flooded to lakes (LMBV, 2007).

Picture 3.5: Desolate factory in Haidemühl, a village that will be excavated by the mine Welzow

Picture 3.6: Post-mining area that is restricted area because of dangers like soil instability

Impact on people

Due to the large scale destruction of the landscape by the mining activities in Klettwitz, about 3,400 people had to leave their homes. The villages Römerkeller and Wischgrund and parts of Klettwitz and Schipkau have been excavated (LMBV, 2007). Connections between villages were cut off by the mine, especially from Kostebrau with the surrounding villages. Not only people's houses have been destructed, but also their social environments. People's mental bond with the original landscape has been disturbed.

Landscapes that are destructed by mining activities are a manifestation of placelessness according to Edward Relph (1976). To understand this, some background information on his theory of space and place, as provided in the book 'Place and Placelessness' must be given.

Space is described as something intangible and without form; it is not an entity that can be directly described and analyzed. It is just there, around us, without special meaning to us. The concept of place cannot be described easily either, nor in a single definition. It exists of the following major components. A place has a notion of location, mainly in relation to other things and places. There is an integration of elements of nature and culture, making that place a unique entity. Places are part of a framework of circulation and they have a clear historical component. At last, places have meaning to people. Space forms the basis for places; space can become a place when one or more of the components above is present. The areas that have been sacrificed for the excavation of brown coal was certainly 'place' and not just space, since all of the above components are present in peoples' home environment (Pict. 3.7). But now that the mine removed everything that people can relate to, a placeless area remains (Pict. 3.8).

The concept 'sense of place' is to be described as the ability to recognize different places and different identities of a place (Relph, 1976). When there is no sense of place to be experienced, it is a matter of placelessness. Since the mining operations destructed much of the components of the original place, the phenomenon of placelessness occurs in these kind of excavated areas. Placelessness is considered as something negative; certainly when the space was a place before and when it concerns people's home environment. Also for the development of new uses in the landscape, mainly for tourism, it is very important that the identity and individuality of the place can be sensed otherwise people could have gone everywhere.

Since rehabilitation follows the mining, the physical landscape is gradually being rehabilitated. Measurements are taken to recover the soil and water system, and the connections to the surrounding topography. The former mining site will be suitable again for water and nature areas, agriculture and forestry, and in the end for human occupation again. The mining site of Klettwitz has been 're-located' in the terms of place mentioned above, since the area is accessible for humans again. The place is part of the traffic circulation system again by the restoration of the L60 road between Lauchhammer and Lichterfeld and smaller roads. The former nature area Grünhaus is being restored and opened to the public again.

There are however components of the concept of place, as listed above, that have not been achieved yet in the current rehabilitation approach. The integration of elements of nature and culture has been started, for example with the idea to let people adopt parts of the new nature area Grünhaus. On an internet site they can see how 'their' piece of nature is developing at the moment (http://naturerbe.nabu.de/projekte/gruenhaus/, accessed 14 February 2009). At present, the biggest mining machine, the F60 conveyer bridge that excavated Klettwitz is being transformed into a visitor monument in the former mine Klettwitz-Nord.

But in the landscape, traces of the mining period are disappearing. The current approach to rehabilitation means often a reconstruction of former land uses or other land uses that are functional again (Sanierungsplan, 1993). Landscape features that were characteristic for the mining period have been removed or covered up because they are useless in the new land use. To let the area develop to a place again, making the history visible in the landscape, and tell the story of the mining in the current landscape is very important.

Picture 3.7: Bückgen, a part of the town Großräschen before the Ilse mine came

Picture 3.8: The Ilse mine that excavated Bückgen. The result is a 'placeless' area

Analysis - Klettwitz

3.7 Rehabilitation

During and after mining, the landscape needs to be rehabilitated and recultivated. In order to make a liveable and functional landscape again after mining, it is important to take several measurements.

Reconstruction plan for the Lauchhammer mining area

The reconstruction plan for the Lauchhammer mining area is made by the Land Brandenburg, specifically by the brown coal committee, and bound by law when decided on. The LMBV is the organisation that executes the plan. The reconstruction plan is based on the knowledge and planning documents in the beginning of the ninetees. In general the planned land use is not very differentiated. This is because LMBV has to realize basic conditions for future uses. Later users could propose to build houses or installations or realise different land uses like recreation and tourism.

In the document of the reconstruction plan several aspects are being discussed. The mines under research, including the mine Klettwitz are introduced. Water management, nature and landscape are important topics that are elaborated. After this more general part, more detailed aspects of the rehabilitation of different areas are being discussed, like the distribution of the overburden material and land uses like agriculture, forestry, ‘renaturation’ areas and also the dealing with the final cast open voids. ‘Renaturation’ areas are areas which are kept free from intensive use and where special biotopes can develop. Parts of these areas can be used for succession.

In the plan forestry plays the most important role, just like in the original landscape before mining activities. Besides forestry, agriculture and ‘renaturation’ areas are also present in the new landscape (Sanierungsplan, 1993). A big difference with the original landscape is the amount of water. Big lakes are planned in the new landscapes. The lakes are the open cast final voids that are filled with water.

The existing situation nowadays differs from the redevelopment plan of 1993. There is for example less forest and the rest lake near Kostebrau is not flooded because of water shortage. Some major changes are the windmills on three agricultural fields, development of nature area Grünhaus and ‘energy forest Kostebrau’ (Fig. 3.22). LMBV did not change the rehabilitation plan on purpose, but new initiatives were developed and, when possible, adopted.

Windmills

Three windparks are placed in the former mining area Lauchhammer. Windpark Klettwitz Nord and Klettwitz Süd are constructed in the year 2000. The capacity per windmill is two thousand kilowatt. The hub height is seventy-eight metres and the rotor diameter is 66 metres. There are 38 windmills in the two areas together. The windmills are spread over an area of 276 hectares. In 2004 a new wind park with thirteen windmills is constructed, wind park Sallgast Süd. The capacity per windmill is two thousand kilowatt. The windmills do not only have a bigger capacity, they are also bigger. The windmills have a hub height of hundred metres and the rotor diameter is 80 metres. The wind park is 152 hectares (Energieatlas, 2007).

Nature area Grünhaus

Between 2003 and 2006 areas in the former mining area Lauchhammer are bought for nature purposes. The nature area is called in German ‘Naturparadies Grünhaus’. The foundation ‘NABU-Stiftung Nationales Naturerbe’ is developing this nature area since 2003, based on the one third of the area that was spared from excavation. Desert like areas combined with young forests and big rest lakes are present in this area at the moment. A lot of rare and endangered species and plants have re-conquered this new area of nature. People can observe and discover these species (http://naturerbe.nabu.de/projekte/gruenhaus/, accessed 20 March 2009).

Energy forest Kostebrau

Energy forest Kostebrau, in German called ‘Energiewald Kostebrau’ is a forest with a combination of long-lasting trees for the visual long-lasting appearance and fast growing trees for energy production. The energy forest will be planted on an area of 700 hectares. In 2007 and 2008 part of the energy forest is already planted. The energy forest can partly supply for the energy need of the city Lauchhammer. The wood chips can be burned for heath supply and can be also used for energy supply when necessary. On the poor soils it is possible to grow the species Populus (poplar) and Robinia (black locust), which can be used for energy production. The area of the energy forest has ecological value too. (http://www.wallstreet-online.de/diskussion/1133389-121-130/wellenenergie-schwung-fuer-s-depot-oder-ein-langer-weg-thread-nr-1086180, accessed 19 November 2008).

3

On the following page, a map of the reconstruction plan with the later additions of the wind parks, the nature area Grünhaus and the energy forest Kostebrau is presented. The LMBV, who is occupied with the reconstruction of the former mining area Lauchhammer from 1993 till 2015, has the following goals:

- execution of rehabilitation and rededication in accordance with the stipulations set in the German Federal Mining Act (BBergG);
- redevelopment of the water system;
- closure of the rest lake complex around Kostebrau (partly and completely);
- stabilization of the banks of the future Lake Bergheide (around 250 Ha of water);
- preservation and extension of the protected nature area Grünhaus;
- development of the nature park Niederlausitzer Heidelandschaft (heath);
- preservation of special biotopes;
- forestation of 2300 ha of dump area;
- and realization of protected nature and recreation areas as post-mining landscape.

These goals have been partly achieved already.

Analysis - Klettwitz

'naturparadies Grünhaus'

Reconstruction plan

wind parks

energy forest Kostebrau

Figure 3.22: Reconstruction plan from 1993 with later changes and additions

3

4 FORMULATING THESIS

Formulating thesis

From the introduction it becomes clear that the subject of this thesis will be the landscape rehabilitation of open cast brown coal mining in Lusatia, and how landscape architects can contribute to this.

4.1 The role of landscape architects in land rehabilitation

Frederick Steiner (Steiner, 2000 pp. 4) defines 'landscape' as follows:

'The composite features of one part of the surface of the earth that distinguish it from another area is a landscape. It is, then, a combination of elements - fields, buildings, hills, forests, deserts, water bodies and settlements. The landscape encompasses the uses of land - housing, transportation, agriculture, recreation, and natural areas - and is a composite of those uses. A landscape is more than a picturesque view; it is the sum of the parts that can be seen, the layers and the intersections of time and culture that comprise a place - a natural and cultural palimpsest.'

This definition makes clear that landscape is very comprehensive and both physically and mentally present. It is a complex result of natural and cultural factors that had their influence over time.
In order to study landscape, the layer model of Mc Hargh is considered to be useful. Mc Harg (in Vroom, 2005 pp. 188) explains the landscape as a piling-up of different layers, including the physical, the biological and the socio-cultural layer (Fig. 4.1).
A combination of these two defines how landscape is seen in this thesis. The landscape is that what the user perceives from the natural and cultural influences over time; it is an interrelated system of physical, biological and socio-cultural layers.

Mining has a large scale influence on the landscape and all the layers that build up the landscape. The rehabilitation of the landscape is a large scale activity, influencing all the layers that are affected by the brown coal mining. Al together it is a huge landscape transformation which involves many people and addresses many problems and opportunities.

Landscape architects are the professionals that have landscape and the transformation of it as point of departure. Landscape architects bring together interventions in the different landscape layers and the effect of this on people's perception of the landscape.

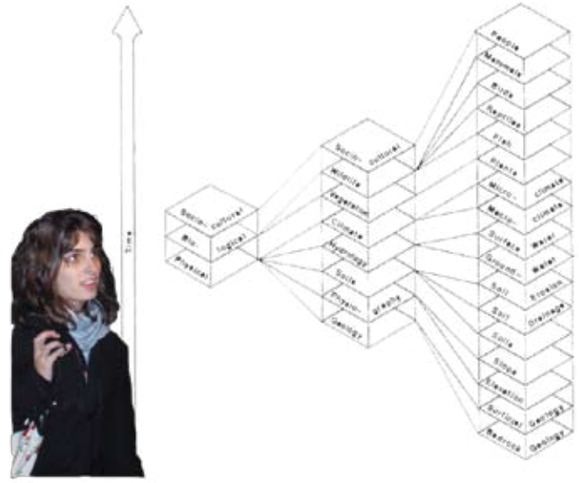


Figure 4.1: Layer model of Mc Hargh explains the landscape as a piling-up of layers with an observer forms a mental image of these physically present layer.

Landscape architects can create a landscape design that carries out meaning to the users. Landscape architects should understand on the one hand to physically rehabilitate land, and on the other how to make landscapes appreciated or at least accepted by society, and how to create beautiful landscapes (Berger, 2008). The problem solving attitude of landscape architects, their integral approach in between various scientific disciplines and the art of designing plans and their ability to understand dynamic landscape processes over time makes them fit to handle the complex assignments of land rehabilitation. Besides, the visualisation skills of landscape architects enable discussion about the subject with policy makers, scientists, citizens and other stakeholders (Berger, 2008).

So apart from the simple necessity to care for a healthy environment and the fact that there are more mining areas that have to be rehabilitated than ever before, there is a special need for landscape architects to be involved in rehabilitation design. Still, they are not always involved yet in Lusatia. To make more of the landscape rehabilitation after mining, it is necessary that landscape architects are involved early in the plan making (Boshold, 1999 and Scholz, 2008). Only then the physical rehabilitation activities can be attuned to the future use of these landscapes, and can attractive landscapes be designed for eventual leisure and tourism.

The new topography on the post-mining landscape should be connected well to the existing landscape and special mining features and structures can be maintained then. It is important that landscape architects work together with engineers in making rehabilitation plans from the beginning (Boshold, 1999).

From the other perspective, for landscape architects it is important to work on projects that are significant, present and have a social and environmental relevance (Koh, 2008). In working on assignments like mine rehabilitations, it is possible to contribute to the restoration of a healthy environment while at the same time building a sustainable and competitive economy by designing an attractive and suitable land use for the future.

Figure 4.2: Monument to remember the mining operations in Klettwitz

4.2 Problem definition

From the introduction, chapter two and chapter three it became clear that due to the mining several problems occur in Klettwitz, which count for all the brown coal mines in Lusatia.
The problems can be categorized into environmental problems, social problems and mental problems.

Environmental problems

Since brown coal mines can be very close to the built environment, it is important that the environmental problems related to brown coal mining are solved. Environmental problems caused by mining are:

- degraded soils;
- altered landscape contours;
- soil instability
- water shortage;
- acid mine water;
- removed topography on the mine location;
- and de-connected infrastructure.

Social problems

Also social problems occur from the mining. The most important is the loss of economical activity in Lusatia when the mining productivity drastically decreased, because the region totally depended on the mining and related industries. There is a high rate of unemployment nowadays and many young people leave Lusatia to search a job elsewhere in Germany. For a sustainable situation, the region's economy should diversify and jobs should be created. The political changes in Lusatia, becoming communist and fifty years later capitalist again, are not caused by the mining. Still it contributes to the extent of the change the region is going through.

Mental problems

The mental problem caused by the mining is the 'placelessness' of the landscape that results from mining. Only by small monuments (Pict. 4.2) people can remember the past mining in their area. The movement of entire villages to a new location happened more often, but during the communist GDR there was no room for the sentiments this caused (Dessine-moi une région/ die Weltenbauer, 2005). The rehabilitation cannot and should not restore the landscape that has been removed for mining, but it appears very difficult and lengthy to create a new place where people will be attached to again.

Formulating thesis

4.3 Formulating the assignment

In this paragraph first the current land rehabilitation approach is criticized, more precise how we as landscape architects judge the solving of environmental problems and the social and mental problems. Based on that, the thesis is formulated. To structure the following research to test this thesis, research questions have been created.

4.3.1 Landscape architectural criticism on the current rehabilitation approach

The brown coal mining and rehabilitation activities in Lusatia are very complex and addressed by many stakeholders and kinds of expertise. The mining operator Vattenfall, the Lausitz and Central-German Mining Administration Company (LMBV) and IBA Fürst-Pückler-Land are mentioned earlier as important players in mine rehabilitation in Lusatia.

Solving the environmental problems

The land rehabilitation arrears from the GDR reconstruction mines are quickly made up by the LMBV. On their website (http://www.lmbv.de/ accessed on 20 April 2009) the company shares the following mission:

'The mission of LMBV is the fast and cost-effective rehabilitation of decommissioned lignite mining and coal-upgrading facilities, as critical prerequisite for successful future utilization of these sites, for founding new industrial and commercial facilities, and for touristic activities.'

For Klettwitz counts that the rehabilitation is done by LMBV and quickly and cost-effective indeed, but that rehabilitation started two years after the closure of the mine. Some parts have been unrehabiltated for decades. For the new mines it counts that the rehabilitation starts as soon as possible after the mine moves a bit further. Within twenty years after mining there can be a landscape recreated with forestry, agriculture and leisure facilities (Die Weltenbauer/ S'il vous plaît, dessine-moi une région, 2006), whereby the environmental problems mentioned in chapter 3 are solved successfully.

It can be questioned whether the outward appearance of quickly rehabilitated landscape is attractive, and whether the land uses prepare Lusatia best for the future according to ongoing trends described in paragraph 2.4. The types of land use that mostly return after mining activities are agriculture and forestry, in combination with a lake that replaces the volume of the brown coal that is taken out. The division in land use before and after open cast mining did not significantly change, which makes the former brown coal mines quite unrecognizable in the landscape. For forestry, there has been a period that large monotonous pine tree woods were planted, which was unattractive for leisure purposes and of low ecological value (Koropp, 1999). LMBV mentions that they contribute to the development of tourism in the rehabilitation activities. The company plays an important role in the creation of the Lusatian Lake Land indeed, and creates for example a recreational road system around each lake for skating, horse riding, cycling and walking. But the landscape has to be really special to attract people from outside the region, which is necessary for the economic development. The region has to distinguish itself from other regions, and the mining history is a feature that makes Lusatia different from other regions and special.

The quickness of the current landscape rehabilitation has advantages indeed, certainly when taking into account that some mines from the GDR times have been left alone for years before rehabilitation started. But as landscape architects, reasoning from the processes in and functioning of the landscape we would propose a more landscape based approach to rehabilitation than the 'fast and cost-effective rehabilitation of decommissioned lignite mining and coal-upgrading facilities'.

A landscape based approach to land rehabilitation would give the landscape the time to restore the disturbed systems itself there and then when possible. A landscape based approach means to us that the processes and systems in the landscape are used in the functioning of the design. It also proposes to be efficient in the need for materials and the energy that is put in rehabilitation activities (Berger, 2008). An example of rehabilitation on a landscape based way is planting with native species, which enhances the chance that vegetation develops successfully and decreases maintenance efforts. On the long run, an ecological sound approach to rehabilitate wastelands is better for the environment, more sustainable and will therefore save costs and efforts in the rehabilitation activities (Corner, 2005).

Solving social and mental problems

IBA Fürst-Pückler-Land is ahead in the region in addressing the social problems, and also the mental problem of placelessness. With their various projects, the organization tries to involve the Lusatian people in the transformation of the region from the brown coal history into a new identity. IBA recognizes the need for the development of a renewed identity for Lusatia, on the one hand to support place making for the inhabitants, on the other to be able to distinguish the region from others in the development of leisure and tourism in the region. Still there is much to do in this field. When you ask randomly an older man in Lusatia there is a

great chance that he will start talking extensively about the mining history, the kind of work he did, in which mine he worked and where his house was in the early times. People are not over the large scale landscape, social, political and economical transformations yet.

The quick rehabilitated landscape tells only in few cases about the history and the former identity of the region, which makes the current identity vague too. This is however vital for new place making in the landscape (Relph, 1976). As an example of successful new place making in land rehabilitation, the IBA Emscher Park in the Ruhr area can be mentioned, of which is described more in paragraph 5.6. The park design is based on the historical layers of the site. Old industrial buildings are not removed or broken down, but a new use is found to maintain the characteristics of the place in a new and creative way. According to visitors of the park, the accessibility and visibility of the industrial history is one of the most attractive features of the park. Therefore, IBA Emscher Park coordinator Jörg Dettmar sees that it is very important to keep traces of the industrial period alive and not to cover them up (Dooren, v., 1996).

A landscape narration approach to land rehabilitation could be a solution to the placelessness as it is described in paragraph 3.6. Landscape narration can help to design a landscape where the history is legible in the landscape. This is important, because the history of the site inevitably contributes to the identity of the place, and the development of a new identity is very important in the process of place making because it helps people to relate to the place again.

The point is to see this as an opportunity, and not to refer to the negative side of the mining history. As described in the introduction, the mining landscape and the big machinery are fascinating features of this history. They can contribute to distinguish the region from other regions, and help to create a new identity of Lusatia.

The chance is in the integration

In the case of the reconstruction mines in Lusatia you see often that LMBV carries out physical rehabilitation activities first, and IBA follows later with initiatives to improve the spatial quality of the plan, or the attractiveness for leisure and tourism purposes. In some cases this means that features of the mining landscape that could be worth it to be conserved as a landscape monuments, are removed by rehabilitation measurements before there was a chance to prevent it.

Second, a landscape based approach to rehabilitation, making use of processes and systems in the landscape and the effect of time on these, lends itself much more to express the landscape transformation than a quick process of covering up. From paragraph 4.1 it becomes clear that landscape architects are the professionals that can bring all different aspects of landscape rehabilitation together. When landscape architects are involved early in rehabilitation planning, these steps can be combined and the landscape rehabilitation could be more effective.

Summarized, notwithstanding good results of the present interdisciplinary, quick and efficient approach to brown coal site reconstruction, we think that a landscape based alternative for the current rehabilitation activities and a landscape narration approach to prevent placelessness could contribute to an even better result in landscape rehabilitation. By taking both landscape narration and rehabilitation into account when designing, the process of landscape rehabilitation can be more effective. When seeing the land rehabilitation assignment as a chance and not only as a problem, extraordinary, beautiful and well-functioning landscapes can come to exist in Lusatia.

4.3.2 Thesis

Built on the previous, we suppose that:

1. the environmental problems should be based upon a more landscape based approach when this is a good alternative to the current practice;
2. the social and mental problems need a landscape narration approach to prevent the problem of placelessness in mined areas;
3. and integration of landscape narration with a landscape based rehabilitation approach is a necessary contribution to the current rehabilitation practice.

From this, the following thesis has been developed:

‘To solve the problems in Lusatia caused by the mining, the integration of landscape narration with a landscape based approach to landscape rehabilitation is needed’.

A landscape based approach means to us that the landscape processes, systems and time are used landscape are in the functioning of the design. To create a healthy and safe environment again, the landscape rehabilitation should focus in the first place on improving the soil conditions and stability, improving the water quality and quantity; and the re-interpretation of

Formulating thesis

the connection of the rehabilitated area with the surroundings. The landscape narration should focus on the creation of a landscape narration to show the historical development of the region in the landscape and to contribute to the development of a new identity for Lusatia, which is important for place making in the post mining landscape for the inhabitants and to develop a strong identity to attract leisure and tourism to the region.

4.3.3 Research questions

The goal for this research is to integrate a landscape based approach to the physical landscape rehabilitation with the articulation of a landscape narration in the landscape. In order to do this, research is done by doing a desk study, two interviews and four excursions to Germany. To structure this research, research questions have been formulated about the region and the specific site, the subject of brown coal mining and rehabilitation, the role of the landscape architect in landscape rehabilitation, a landscape based approach to land rehabilitation and on landscape narration. They are listed below.

1. Mining issues
- Why is brown coal mining so important in Germany?
- What are the disadvantages of brown coal mining?
- What are the products of brown coal mining?
- How has mining evolved from the past till now in Lusatia?
- What is the future of brown coal mining in Lusatia?
- What are the different types of mines and which mines are there in Lusatia?
- How do the different machines work?
- How does the process of brown coal mining work out on the landscape in Lusatia and exactly in the design area Klettwitz?
- How is the brown coal mining related to other social, economical, political and mental aspects in Lusatia?

2. Landscape rehabilitation issues
- How does the landscape rehabilitation of brown coal mines happen in Lusatia in the past and now?
- What are the technical preconditions for landscape rehabilitation in Germany?
- What is in Germany obliged by law in landscape rehabilitation?
- Are there alternatives for the current landscape rehabilitation approach in Lusatia?
- How is landscape rehabilitation related to other social, economical, political and mental aspects in Lusatia?

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- What are trends, policies and opportunities and land uses that can be created on the former mine sites?

3. Problems caused by brown coal mining
- How did the physical landscape systems operate before the mining process?
- How was the physical landscape system disturbed by the mining process?
- How will the physical landscape systems incline to restore themselves?
- How is the connection from the site with the surrounding landscape after mining?
- What problems are caused by mining in the physical landscape?
- What happened to the people when brown coal mining?

4. The role of the landscape architect in landscape rehabilitation
- What are useful contributions of landscape architects in landscape rehabilitation assignments according to others?
- How could a rehabilitation design from a landscape architect be the answer to all kinds of problems that are related to the mining?
- How could the spatial impact from mining be re-used or translated in a design?

5. Reference projects
- What are relevant and interesting reference projects?
- How is landscape rehabilitation treated in the reference projects?
- How is landscape narration treated in the reference projects?

6. Landscape based approach to land rehabilitation
- What are the conventional steps in mine rehabilitation in Lusatia?
- What is exactly a landscape based approach to land rehabilitation?
- How can a landscape based approach to land rehabilitation work in Lusatia and on the specific design site Klettwitz?

7. Landscape narration issues
- What is exactly a landscape narration?
- What is the landscape narrative that is to be constructed in Lusatia?
- How can a landscape narrative be constructed for Lusatia and on the specific design site Klettwitz?

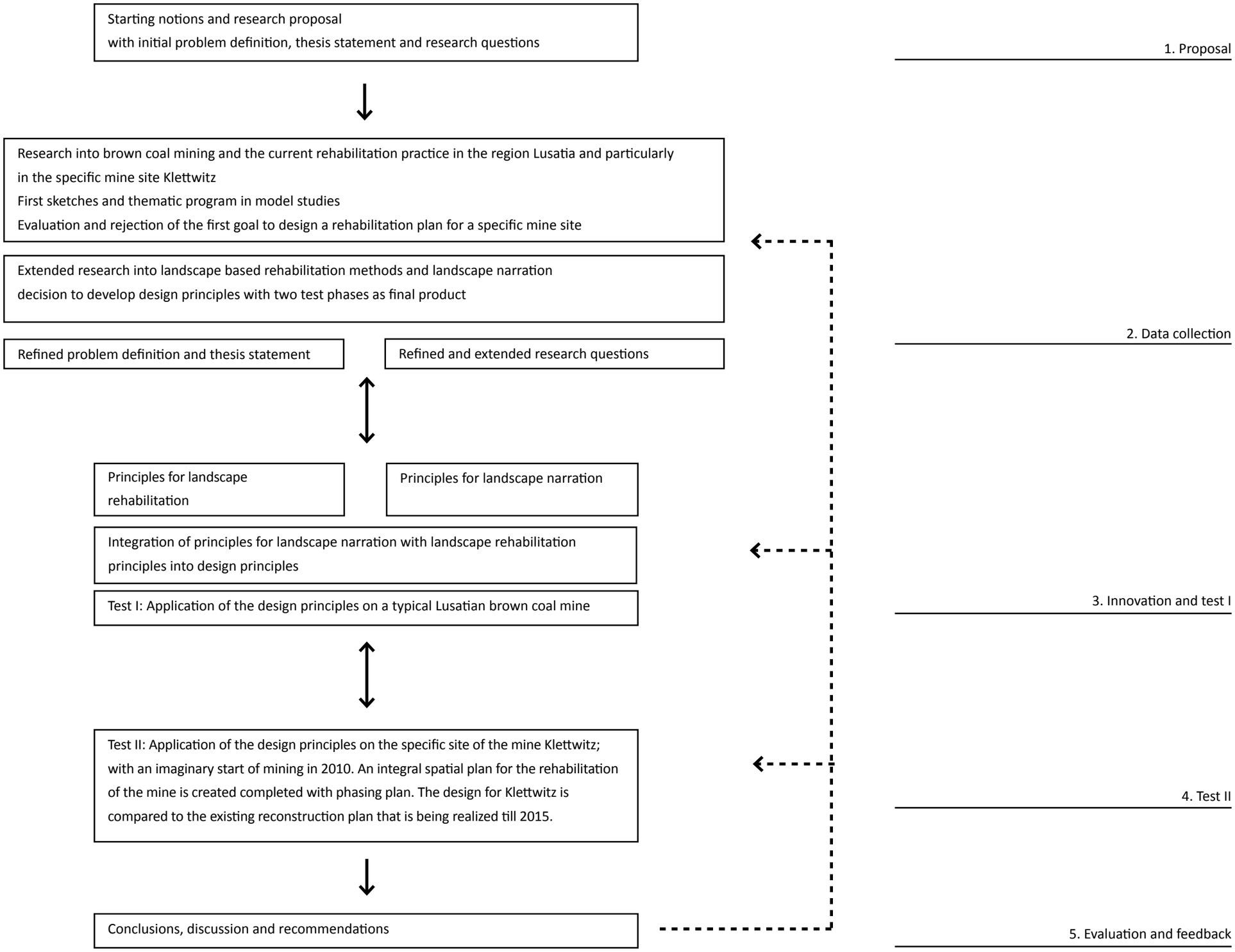


Figure 4.3: Schematic overview of the methodology behind this design research

4.4 Approach and method

The scheme on the previous page (Fig. 4.3) presented the steps that are undertaken in the research and design research. The different steps in the scheme are explained here.

1. Proposal

The first idea for this thesis came from the fascination that we developed for the mining and rehabilitation activities in Lusatia during this excursion in 2005. To get started with a thesis about this, a proposal has been written. A small research into background information has been done in order to formulate an initial problem definition and thesis statement and to explore the role of the landscape architect in these assignments, since brown coal mining and rehabilitation was unfamiliar to us then. Research questions have been formulated, and the first list of research questions to get started with the research.

2. Data Collection

The data has been collected from desk study, two interviews and four excursions to Germany. We started with a research into brown coal mining and the current rehabilitation practice in the region Lusatia and particularly in the specific mine site Klettwitz.
Then we started sketching and made thematic program explorations in model studies. It has been tried to translate trends, policy and opportunities directly into a design on the specific site. This alone however, did not lead to a satisfying result, because the scale of a mine site exists of forty square kilometres of blank area. Another approach had to be found. More research has been done into a landscape based approach to land rehabilitation, and very important, on landscape narration theory. This was necessary to define the problem and thesis statement exactly. Also the reference study influenced the criticism we formulated as landscape architects on the current rehabilitation practice in Lusatia.
It has been decided that not a detailed landscape design for the mine site Klettwitz should be made, but that design principles, based on an integrated approach to landscape based rehabilitation and narration should be developed in order to find a way for landscape architects to approach these sites.

3. Innovation and Test I

In part three, principles for a landscape based approach to land rehabilitation are developed, and principles for a landscape narration in Lusatia too. In chapter 8 of this report, they are combined to integrate these principles into design principles. It has been tested on the ground plan of a typical Lusatian brown coal mine to see whether the design principles contribute to designing the rehabilitation for brown coal mines.

4. Test II

Since the results of chapter 8 were promising, the design principles are taken to the specific mine site Klettwitz that was introduced in chapter three. Although this mine has been excavated from 1951-1991, we take an imaginary starting of the mining in 2010. Doing this enabled us to take with us all information about the context, the development of the mine and problems that occurred from mining for the imaginary situation. The design for Klettwitz that is based on the integrated and landscape based approach of land rehabilitation and narration is compared to the existing rehabilitation plan that is being realized till 2015. A phasing plan shows how the design for the rehabilitation will be developed over time along the forty year development of the mine.

5. Evaluation and feedback

In this last part we discuss the process and the results of this design research, and feedback is given to the earlier steps 2,3 and 4. Conclusions and recommendations for further landscape rehabilitation assignments and further research are formulated.

The approach of this research is a bit comparable to the way Clemens Steenbergen describes an ‘experimental design’ (‘proefontwerp’ in Dutch) (Steenbergen, 2008 p.p.387-389).
According to him, the experimental design aims to create an integral spatial proposal. In the experimental design systematic plan analysis, typological research and purposive design experiments are important. All three are present in the approach to this thesis. A plan analysis has been carried out on the existing rehabilitation plan for Klettwitz and on six reference projects in Germany and abroad.
From the research into mining and rehabilitation in Lusatia and Klettwitz, the groundplan of a typical Lusatian brown coal mine is deduced for the trying out of several spatial compositions for designing landscape rehabilitation plans in Lusatia. Later this compositional trying out is continued on the specific situation in the mine in Klettwitz.
Steenbergen compares this way of designing with the heuristics, an approach in science that seeks for new discoveries and inventions along the methodological way (Steenbergen, 2008). The heuristics employ in most cases experimentation and trial-and-error techniques. The heuristic method is particularly used to rapidly come to a solution that is reasonably close to the best possible answer, or optimal solution. In experimental design, designing becomes a form of heuristic investigation, directed at the exploration of possible or imaginable futures and the methodically invent of a right composition. In the experimental composition not the confrontation with the real situation, but the internal logic of reasoning is most important,

and whether the followed rules and conditions make this transformation suitable for new functions and programs. An ongoing adaptation of a series of experimental compositions is needed before a new and balanced composition is found (Steenbergen, 2008).
The employed approach in this thesis surely will not lead to one single possible solution. With the design principles, many compositions can be created. It is about the strategy how to come to this composition, and to test whether this is possible by showing a convincing composition for a specific and real situation in the end. In chapter nine, we expose a new and balanced composition for the rehabilitation of the brown coal mine in Klettwitz. But because of the design principles that built up the plan, this approach can be used for other brown coal mines in Lusatia too, and a new and balanced composition of the principles for that specific site can be found.
By employing the experimental design approach, it means insight in the black box of designing. With help of design experiments the unknown range of possible solutions is explored and new proportions and compositions are tried out (Steenbergen, 2008).
In this thesis, the design for the rehabilitation of the mine Klettwitz is based on landscape based rehabilitation and landscape narration principles that are integrated into design principles. These are combined into a final composition, by which the ‘black box’ of designing in this thesis became transparent.

The research for this thesis spans several scales. The introduction of this report concerns entire Germany, and after that an analysis of the brown coal region Lusatia follows. A specific problem analysis is done on the mine site Klettwitz. The problem definition and thesis statement count for the typical brown coal mines in Lusatia, and the landscape rehabilitation, narration and design principles too. Test I is there to look whether the design principles are applicable on typical Lusatian brown coal sites, so, on the regional scale. Test II is whether they fit on the specific mine site Klettwitz, on the local scale.

5 REFERENCE PROJECTS

Reference projects

Following on the thesis statement as it is formulated in chapter four, six projects have been selected to study both landscape based approach to rehabilitation and landscape narration. These reference projects will be:

- Eden Project, an educational amusement park in Cornwall in the United Kingdom;
- Fresh Kills, a park on Staten Island in New York;
- IBA Fürst-Pückler-Land, a regional development project in Lusatia in Germany;
- Desert-Oasis, a park design in Lusatia in Germany;
- Ferropolis, an excavator museum in Bitterfeld in Central Germany;
- Landscape park Duisburg-Nord, a park in Duisburg in the Ruhr area in Germany.

The projects represent a range from small to big scale, in Germany and abroad.

5.1 Eden Project

The Eden Project is created in a place which was ten years ago a barren china clay pit. This quarry was 160 years old and it is situated at Bodelva near St. Austell, in Cornwall. Before the mining, this region depended on traditional fishing and agriculture. The Eden Project is one of the Landmark Millennium Projects to mark the year 2000 in the United Kingdom, and is a great contradiction with the region's past. The Eden project became a great visitor attraction, which attracted more than 8 million visitors since the opening in 2000 (Berger, 2008).
The project consists of a couple of biomes (Pict. 5.1) that house millions of plants, symbolizing the enormous variation of life on this planet. One of the biomes is the biggest greenhouse in the world. One can find crops, landscapes and wild plants that grow in different parts of the world. The architecture and art are inspired by nature, which is most obvious from the unique roof construction of the biomes.
The Eden Project is owned by the Eden Trust, which is an educational charity. People are being educated by exhibits, events, workshops and educational programmes. The message that is to be passed on is what nature gives to us and how we should look after it. An important theme is 'learning by doing', by addressing important questions like how we ensure that the economic benefits of our work goes back into the local economy, and how we manage the global food supply and waste.

Tim Smit was the person to come up with the idea of the Eden project while he was restoring the Lost Garden of Heligan because he was fascinated with the stories that connected plants to people and brought them alive (http://www.edenproject.com on 26 February 2009).

The Eden project is integrated with existing tourism infrastructure to maximize the projects accessibility and reputation. The transformational benefits that Eden has brought to Cornwall have highly exceeded the original expectations. It became an icon for the repositioning of Cornwall and the south-west of England, in national and international perceptions. The so called 'Eden effect' has, among others, injected more than 750 million of value-added into the local economy, each year paying back in real terms the total costs of the publics funding investment. Eden Project attracted more than eight million visitors and directly created five hundred jobs, with particular emphasis on career development for locals. Next to this, Eden became a symbol to the environment movement of a 'can-do' attitude (Berger, 2008)

Picture 5.1: The biomes of Eden Project

Landscape rehabilitation

The landscape rehabilitation of the Eden project can be divided into three aspects, namely the basic construction, water management and the production of soil.

The area was not suited for people to access, so measurements were needed. It was necessary to relocate 1.5 million tons of fill material to create the basic landforms. Seventeen metres were sliced of the top of the former mine pit to put in the bottom. Unsafe slopes were transformed into slopes with a safe angle and terraces (Pict. 5.2) were created. A lot of rock anchors were driven into the sides of the pit to stabilize them and a mixture of plant seed and fertilizer was used on the slopes to knit the surface together (http://www.edenproject.com on 26 February 2009).

During the construction it rained a lot. All of the rainwater drained into the pit. To make use of this water the engineers came up with the idea of a subterranean drainage system that collects all the water that falls down on the site (Pict. 5.3). The water is used to irrigate the plants inside and flush the loos. Rainwater that falls on the Biomes is used to create mist inside the Rainforest Biome. About forty percent of the water needs are provided from this grey water harvested on the site (http://www.edenproject.com on 26 February 2009).

The project needed more than 83,000 additional tonnes of soil. The people behind Eden project wanted to take care of the creation of this amount of soil themselves, because it was important to get the right composition and they principally did not want to import it. The mineral components are sand from the china clay works and clay from Devon Clays ltd. Composted bark from the Biomes provided the organic component. The different climates in the Biomes need different soils, so the soils were tuned to the different climates inside the Biomes. Outdoors, composted domestic green waste was used. The ingredients were mixed in a nearby clay pit and worms helped dig and fertilize the new earth. This way of dealing with soils shows a way of environmental regeneration (http://www.edenproject.com on 26 February 2009).

Landscape narration

On the website of the Eden Project is written:
'Overall we believe the world we live in is facing radical change – and our aim is to help find positive futures in the face of that change. To get in shape for the challenges of the future we need a culture that knows how to sustain the things that sustain us and at the same time nurtures creativity, imagination and adaptability.' (http://www.edenproject.com on 26 February 2009).

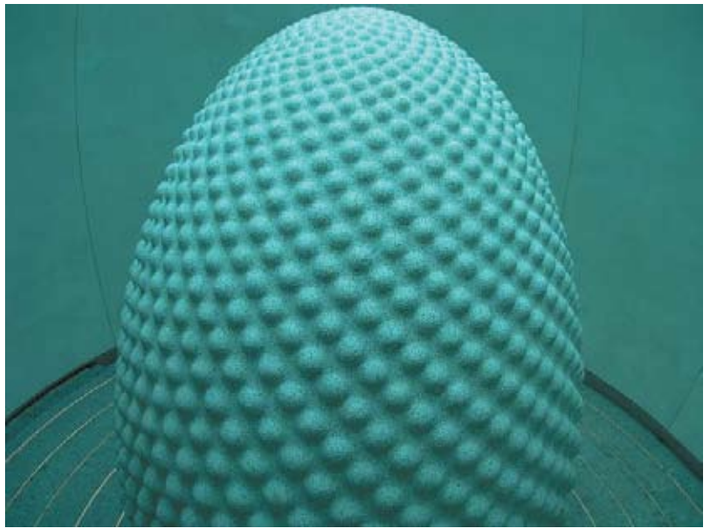
Picture 5.2: Rehabilitation: terraces in Eden Project

Picture 5.3: Rehabilitation: construction of watersystem in Eden Project

The site can be seen as a global garden which reflects the amazing biodiversity of our planet. According to the website of the Eden Project, the project can be seen as a symbol of hope for the future. It is important to remind people what nature gives us and to help people learn how to look after it in return. To communicate this message, it is articulated in the Eden Project in several ways.
The Eden Project tries to reconnect children with their natural world and their community. The project can be seen as a 'living theatre of plants and people', and what happens on stage is dramatically and constantly changing. In this 'living theatre' the story is told very literally by the story compass and the Pollinators. The Pollinators are performers, guides and storytellers to let people discover more about the Eden Project. The story compass is a handheld GPS companion. The GPS for example shows how the biomes were built, and tells about the plants and the temperatures in the biomes (http://www.edenproject.com on 26 February 2009).
In the more physical way, the diversity of our planet is shown in the biomes, where crops and wild plants from different parts of the world are being grown. There are also various landscapes, like the rainforest which is created in the Eden Project. The Seed (Pict. 5.4), a great granite sculpture, is an example of art inspired by nature (http://www.edenproject.com on 26 February 2009).

It is a fundamentally unique rehabilitation project, by pushing mine rehabilitation to the extreme in the form of this world's range in biodiversity in a nutshell. It is demonstrated that degraded land can be transformed into something positive, and taken into account the high amount of visitors, this message will be communicated to a large amount of people. Eden has proven that, with some imagination and determination, people can produce an enormous positive force for change.

Reference projects



Picture 5.4: Narration: the Seed, a granite sculpture in Eden Project, is an example of art inspired by nature

5.2 Fresh Kills Park: Lifescape

Fresh Kills was once the world's largest landfill, which is now being transformed into public parkland. The site is situated on Staten Island, New York, and covers about nine square kilometres. This is three times the size of Central Park in New York, the famous classical example of an urban park by Frederick Law Olmsted. Fresh Kills is in the middle of a metropolitan context, challenging but rich opportunities for development, and can serve as a model for land rehabilitation projects around the world. The transformation of Fresh Kills should be a model of continued public engagement. Field Operations, the office from landscape architect James Corner, is responsible for the master plan.

A long time ago, Staten Island was formed by glacial melt waters that deposited gravels, sand and silts. Marshland developed and the higher moraine of eastern Staten Island shed most of its rainwater west into the lower marches. These lower marches are now known as Fresh Kills. The name Fresh Kills was given by Dutch settlers and it means 'fresh creek' or 'fresh waters'. Not the whole site of Fresh Kills is landfill. More than half of the site consists of meandering creeks and tidal flats, extensive march and wetlands, areas of grassland, meadow and woodland. The landfill existed from 1948 and received its last barge of waste in March 2001.

Because of the World Trade Centre tragedy that took place on September 11 in the same year, the closure of the landfill was delayed until spring 2002, because the remaining material had to be placed in the dump area and covered with clean soil.
Several problems occurred due to the land filling and industrial cover operations. The health and productivity of the ecological systems are disturbed. The landfill mounds need extensive maintenance and repair over the long term in order to create better conditions for ecology. Also the soils are thin and poor, moisture levels are generally low, but highly variable, invasive species dominate, and there is very little species diversity.

Field Operations formulated six goals for the future park. It has to become a world-class, large scale park that capitalizes upon the unique characteristics of its metropolitan location, vast scale, openness and ecology. The ecological systems should be restored and a diverse and sustainable landscape should be created, potentially incorporating the use of state of the art land rehabilitation techniques, alternative energy resources and ecological demonstration projects. The vastness and metropolitan location of the site invites to create a range of activities and programs that are unique in the city, allowing for extensive, active and passive recreation, educational amenities and cultural enrichment. There should be a place to honour the events of September 11 and the enormous recovery effort that took place at Fresh Kills.
A limited system of ecologically sensitive park drives should be built, to optimize local and regional access to and around the park and reduce local traffic congestion through improved connectivity.
The implementation of the park is organized in several stages in a way that afford maximum public gain early on while also ensuring safe and effective operations of ongoing landfill closure, maintenance and monitoring. There is a phasing of implementation of three periods. Each period is ten years. It starts in 2007. In each phase, program, habitat and circulation improvements are integrated into purposeful project sets. (Field Operations, 2006)

Landscape rehabilitation

Because of the disturbed ecological systems of the site it is important to restore these systems and to cultivate a diverse and sustainable landscape. In this project it is important to use state of the art rehabilitation techniques, alternative energy resources and ecological demonstration projects.
For the restoration of the vast area of Fresh Kills larger-scale agricultural techniques are used instead of techniques that operate well on smaller scales. By renovating the soils and vegetative cover on the mounds not only the health and ecological diversity is improved. Also the performance of the landfill caps is improved by minimizing erosion, improving soil hydrology and drainage, and thickening the soil depth.

Figure 5.1: Aerial impression of Fresh Kills

This reduces the long-term maintenance costs at the same time.
Field Operations (2006) formulated critical objectives concerning the mound ecological restoration. It is important that the quality and quantity of the soil is increased and also that structural stability is ensured. Concerning the water problematic, more water needs to be retained for plants, and water accumulation needs to be avoided. Another important aspect are the species. The spread of invasive species needs to be reduced. Besides, native plant communities have to be introduced that are capable of building a diverse seed bank and establishing a robust cover. The last important aspect is the maintenance and costs. The maintenance requirements and costs need to be minimized, while complying with regulatory requirements.

Several techniques can be used for achieving these goals. For example in situ management over time, importing and/or manufacturing new soils for overlay on the cap and 'farming' the slopes to renovate soils in situ and then establishing new meadow cover. Although further research is needed, there is a big opportunity to foreground soil making, recycling and in situ rehabilitation (Field Operations, 2006).

For rehabilitating the mounds, strip cropping (Fig. 5.2) can be used. Strip cropping is used here because it is a less expensive industrial-scale technique that increases the organic content of the poor soils, reduces the plant uptake of metals in the soil, increases soil depth and controls weeds over a large area. Fast-growing plants are repeatedly grown following the contours of the mounds. The plants are gently ploughed. At last, the plants are ploughed into the soil to create a green manure, adding organic matter and depth to the soil. When the quality of the soil has improved enough, a final meadow mix may be sown and established. Besides this technical part of strip cropping, it also has spatial qualities. Strip cropping '*could be beautiful and experientially distinctive'* (Field Operations, 2006). A crop rotation system, like strip cropping can improve the existing topsoil cover without having to import large quantities of new soil. The soils that are cultivated can support native prairie and meadow.

On the mounds, there are dryer and wetter places. On the wetter areas, shallow rooted successional woodland will ultimately diversify the grassland biotopes. Besides, there are places where succession is allowed and where mowing is recommended (Field Operations, 2006).
For the cultivation of denser, stratified woodland on the mounds in early stages of the park's development new soil is needed. About a half to one meter of new soil is needed that would be stabilized and planted with native grassland. The woodland that is proposed on the mounds is situated adjacent to proposed lowland and swamp forests. The connection is made to widen the habitat corridor and at the same time conserving the amount of new soil to be imported (Field Operations, 2006).

For the rehabilitation of the habitats, the people from Fresh Kills removed invasive species and cultivated over time. Woodlands are used as buffer and for corridor connectivity. The habitats have to be created by *'workhorse species'*. This causes a natural, successional process to create diversity over time. Besides reliable plants were used with low maintenance needs (Field Operations, 2006).

Landscape narration

Fresh Kills shows the public that the former biggest dump on earth can be transformed into a healthy and pleasant urban park again. Fresh Kills, with its history of consumption, waste, cleaning up and the transformation into new parkland, calls out for the integration of art and culture. By that, a very negative image of the site turned into something much more positive. The concept that has been developed to structure this idea into a design is 'Lifescape'. According to Field Operations, Lifescape is an *'ecological process of environmental renewal on a vast scale, recovering not only the health and biodiversity of ecosystems across the site, but also the spirit and imagination of the people who will use the park. It is about the dynamic vegetation and wildlife; of program and human activity; of financing, stewardship and adaptive management; of environmental technology, renewable energy and education; and of new forms of interaction among people, nature, technology and the passage of time.'* (Field Operations, 2006).

Reference projects

The transformation in the park can be followed by people and it is believed that this will renew people's sense of the place. In a discovery centre people can learn from the site in transformation. Here the stories of Fresh Kills are told and people are educated. With this mental baggage, people that visit the park will recognize the site's recent past as an industrial facility, and they can also see the park evolving into an integration of nature, culture and technology (Field Operations, 2006).

There are some very articulating parts in the design. The earthwork monument that is created to remember the tragedy of September 11 got the shape of the Twin Towers but then in the surface. The floating gardens are referring to the former trash barges, symbolizing the site's history as a dump. To educate people in the energy flows that modern city life requires and influences, the energy infrastructure in the park has been revealed. The landscape transformation is very visible by the berm overlooks (Fig. 5.3) that are created to provide a view from the road system into the landscape. The road system in itself has been designed to provide directed views on the park, which is most clear from the slow scenic route through the park (Field Operations, 2006).

It will take about twenty till thirty years to complete the park. The park will continually grow and adapt. This growing over time will be recognizable in the forms, vegetation, habitat types, drives, paths, trails, surfaces, structures and amount of facilities in the park. The long time span shows people what it takes to (re)develop ecological structures. Because the people are invited in the park from the first stage immediately, they can see and take part in the transformation process, and generate enthusiasm and commitment (Field Operations 2006).

The Fresh Kills case shows several similarities with the mine sites in Lusatia. It is a dump and not a brown coal mine, but just as disturbed by human influence and needs to be rehabilitated. For the landscape rehabilitation methods have been used that are useful for large-scale recovery, and when possible, ecologically sound. The time necessary for such an approach is incorporated in the planning and to enhance the public involvement, the site has been made accessible from the first possible moment. To share the process of transformation with the public is considered as interesting, and educating to show that the world's former biggest landfill can be turned into a healthy place for ecology and people again in the form of an urban park (Field Operations 2006).

Figure 5.2: Impression from agricultural strip cropping as means of soil rehabilitation in Fresh Kills

Figure 5.3: Impression of an overlook as means of landscape narration in Fresh Kills

5.3 IBA Fürst-Pückler-Land

The abbreviation IBA stands for 'Internationale Bauausstellung', which means International Construction Exhibition in English. An IBA is an organization that coordinates and developes several connected projects in a limited time span, mostly ten years. The first IBA was held in 1901 in Darmstad, and different IBA's can run at the same time at different locations in Germany. An IBA is, although mainly financed by the government, an independent and temporary institution to give where necessary an extra push in urban development.

IBA Fürst-Pückler-Land is situated in Lower Lusatia, a former lignite mining region between Berlin and Dresden. Actually the study area in this thesis is part of the area IBA Fürst-Pückler-Land is occupied with. This IBA is, after IBA Emscher Park in the Ruhr region of which is explained more in paragraph 5.6, one of the first building exhibitions with a strong focus on structural regional development and the landscape transformation. This IBA runs from 2000 till 2010. The IBA is named after the German garden and landscape architect Prince Hermann von Pückler-Muskau, who lived in Lusatia from 1785 till 1871 and where he designed the famous Branitz Park and the park in Bad Muskau.

Lower Lusatia is Europe's largest landscape construction site today. The landscape that is left behind by a hundred years of mining industry is now rehabilitated and transformed into a healthy landscape again. Reshaping the landscape and the social conditions should go hand in hand in this process. The creation of new jobs, by making the region suitable and attractive for tourism, is one of the core activities. As already mentioned in paragraph 2.3, IBA Fürst-Pückler-Land guides and supports this process of both physical and mental transformation. The IBA takes initiatives for change itself, but acts also as a moderator between other parties in the region, supports fund raising and attracts international publicity to the region. Through 25 exemplary projects (Fig. 5.4), which have a focus on spatial and social development, the transformation is set in motion. From the map you can see that the projects are structured in nine topographical areas, which are called landscape islands, each with their own character:

1. IBA Centre: information about the landscape in transformation and several projects
2. Lauchhammer-Klettwitz: industrial heritage
3. Gräbendorf-Greifenhain: landscape art
4. Welzow: a landscape in transformation
5. Lusatian Lake Land: lake landscape and tourism development
6. Seese-Schlabendorf: pre-industrial heritage and post-industrial nature
7. Cottbus: the development of a recreation lake near the city
8. Bad Muskau-Nochten: Fürst-Pückler heritage landscape
9. Guben-Gubin: one city divided by the border-crossing with Poland (Wolf, 2005).

The Fürst-Pückler-Radweg is the one of the 25 projects that connects the projects and the landscape islands with each other by means of a cycle tour of 490 kilometres.

Landscape rehabilitation

The IBA itself does not focus on land rehabilitation as such. The organization jumps in existing rehabilitation projects, mainly carried out by the LMBV, to make more out of the activities than physical land rehabilitation alone.
The LMBV is responsible for the rehabilitation of the former brown coal mines. The LMBV enables a fast and cost-effective rehabilitation of the landscape that was left behind after mining activities. LMBV is responsible for the planning of rehabilitation measures, for project management, and for the controlling of restoration efforts. The LMBV is also responsible for the water resource management.
The mining operations had an enormous impact on water resources and water equilibrium in these areas. There is a need for the restoration of a balanced water system that is extensively capable of self-regulation. In Lusatia and the Central-German regions LMBV had to recharge approximately 12.7 billion cubic metres of water into the aquifers and the mining lakes of these areas. The restoration was done by filing up the aquifers and flooding from outside water sources. By early 2004, almost more than one-quarter of the total required amount had been returned to the area.
The LMBV secures potentially dangerous landscape features around former mining sites. After securing and large-scale landscaping, most of the times additional measurements like (re) colonization by fauna and flora is necessary to make these areas suitable for new and future uses. The LMBV develops and carries out entire rehabilitation plans for recultivation, which starts with the treatment of the soil, and extending to planting of forests and other flora (http://www.lmbv.de/ on 20 April 2009).

Landscape narration

IBA Fürst-Pückler-Land wants to bring the extraordinary process of landscape transformation that took place in Lusatia under attention. In the visitor centre, a lot is explained about the region and the effects from the brown coal mining.
By the time the Federal Republic of Germany and the German Democratic Republic got reunited in 1990, the brown coal and related industries collapsed and only one third of the earlier production remained. Ongoing mechanization made even more people unemployed. The IBA works hard to provide a future perspective for the region, by connecting the

Reference projects

landscape rehabilitation that is taking place at the moment with the economic, social and mental transformation.

At places where the landscape is being rehabilitated, IBA organizes that the activities are tuned to the economical and social developments. As an example, IBA played a key role in the development of the Lusatian Lake Land (see paragraph 2.3). As a result from the mining, open cast final voids of the same volume of the brown coal that has been excavated remain in the landscape. A technical good solution is to fill these voids with water. In addition, in the Lusatian Lake Land, all kind of developments have been started to make this area interesting for leisure and tourism. The lakes get beaches, restaurants, camping places, hotels and bungalow parks. The lakes got connected by navigable canals, to make it interesting for longer sailing trips. Parking lots are built and a network of ring roads around each lake for walking, cycling and inline skating is being created.

Next to the realization of the lake land, the IBA organizes promotion and publicity to receive public attention for these developments.

Besides the Lusatian Lake Land, numerous other projects illustrate the landscape in transformation (Fig 5.4). In every project, on the one hand the landscape is being rehabilitated; on the other leisure and tourism provide employment and socio-economical development in the region. Together with promotion activities, the IBA puts Lusatia back on the map as an attractive region.

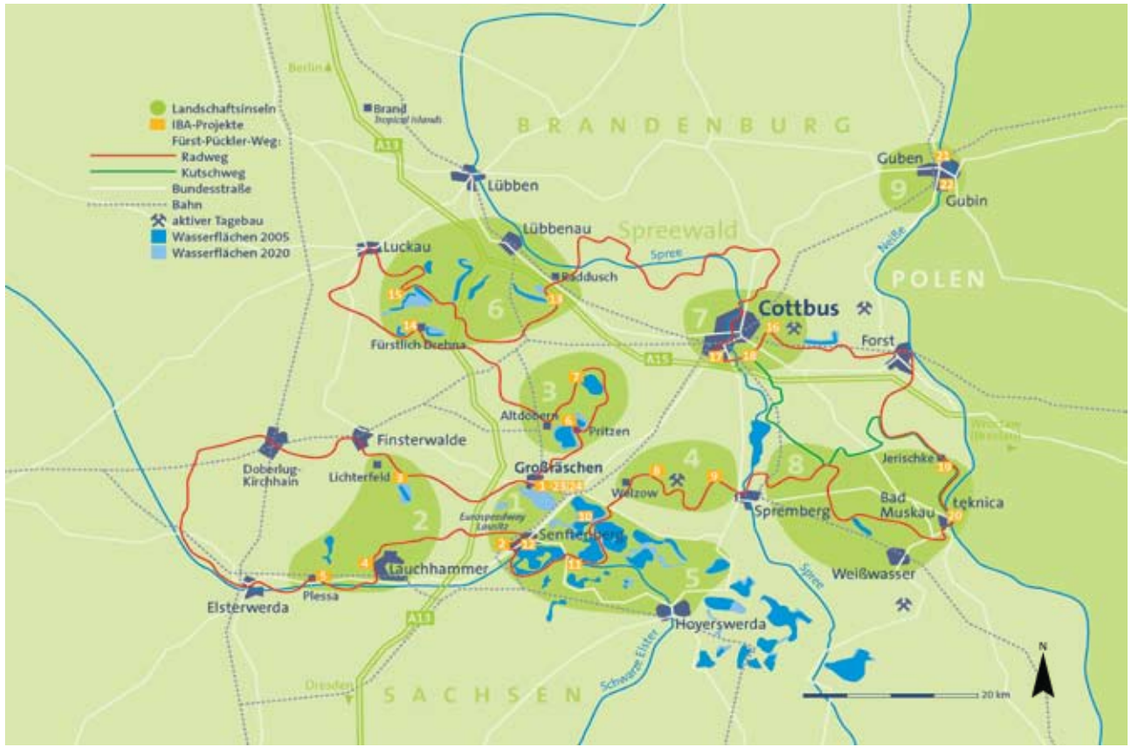


Figure 5.4: Map from the IBA Fürst-Pückler-Land with the nine topographical areas, the landscape islands

Picture 5.5: The rehabilitation of a former mine site, stabilization with 'Rütteldruckverdichtung'

5.4 Desert-Oasis

The Desert-Oasis project (original name is 'Wüste-Oase' in German) is a landscape design (Fig. 5.5) for the brown coal site Welzow that is still partly in use. The project is near the village Welzow, in Lusatia, and is related to IBA Fürst-Pückler-Land. The design for the site of 700 hectares is from the landscape architecture office BGMR together with Archiscape in Berlin.

The goal of this project is to use the specialty of the post-mining landscape and the process of landscape transformation for the development of leisure and tourism. The oasis, a green and blooming area is in the design the starting point to explore the otherwise desert like post-mining landscape. At the same time it is a perspective of the future rehabilitated landscape. The design is based on the shapes that the former mine left behind in the landscape. The dimension and direction of the mining activities have been used, and also the turning points where the mine started to move in a different direction. The spreader, a large machine that is used to replace overburden material after the brown coal has been excavated, is used as a 'designer' by employing it in a more creative way than normal. The amount of used soil material is to be in balance to spare costs, but it is proposed to create relief instead of the flat landscape that normally emerges from land rehabilitation and that was there originally. At some places the new ground level has been created consciously below or above the future ground water table, to vary in the type of habitats that are possible at the location.
BGMR and Archiscape developed a new kind of topography for post-mining landscapes consisting of cones, linear elements and free forms. The conscious use of the different available soil substrates and soil improvement measurements starts of the development of different vegetations on different locations to support the design.

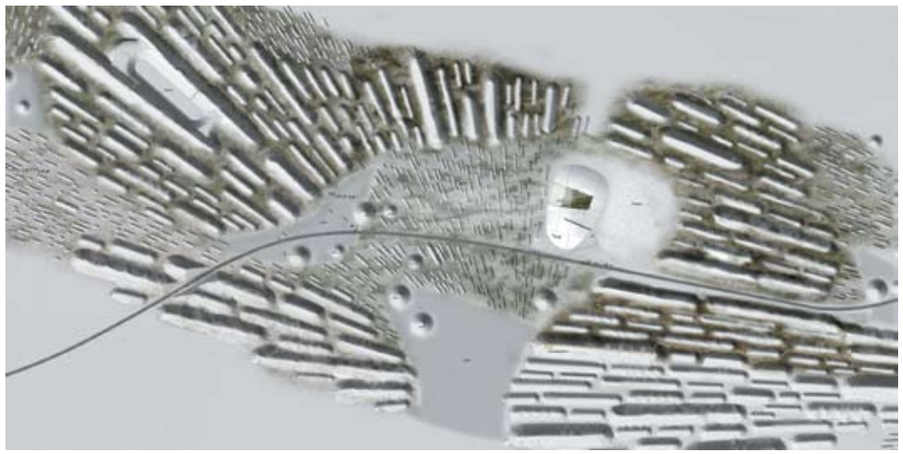


Figure 5.5: Plan of the Desert-Oasis project

The plan is developed in cooperation with IBA and the mining company Vattenfall and LMBV, because a part of the mine Welzow is already been excavated and rehabilitated in the past. In this way, the design is in full accordance with the technical restrictions and conditions determined by the mining process and rehabilitation process (Vattenfall, 2004).

Landscape rehabilitation

The rehabilitation of the landscape in this project is mainly focussed on succession processes. These depend heavily on the first species that will settle in this place, the conditions of the soil substrate and the dispersion possibilities.

The conditions of soil substrates are among others influenced by soil type, pH-values and coal content. There is a range in conditions, each having its own colonization possibilities.
In some Tertiary mining deposits in this area the soil type consists of more than 70 percent of sand, the pH-value is lower than 4 or more and the content of coal is more than 10 percent. In these conditions, recolonization is severely delayed and causes sometimes very long stages of barren grounds. For recolonization this is bad, but in the design it is used on purpose to leave some ridges barren (Vattenfall, 2004).
The recolonization on clay deposits happens slowly too. After a couple of years there is no covering vegetation and restricted species diversity. Also the slope has an influence on colonization. On slopes of 15-30 % or steeper, which emerge from spreaders, continually new barren grounds come to the surface. This slows down succession, and is again done on purpose to exaggerate the drama of the former mining landscape (Vattenfall, 2004).
High groundwater tables, which mean less than 2 metres depth, can mitigate the bad characteristics of Tertiary deposits. With the rising of the ground water table in mind, this can be used to create wetter and more fertile conditions and with that a differentiation in the vegetation development (Vattenfall, 2004).

The time that a substrate has laid untouched is important for the fertility. With the age of different substrates also different vegetation types come to exist. Corynephorus canescens (Grey Hair-grass) can be found on young, sandy barren grounds. These species are partly fit for acid Tertiary deposits or high dynamic dunes or hills. The seeds of the Corynephorus canescens are spread by the wind. Calamagrostis epigejos (Bushgrass) grows on fine-grained

substrates, which are the 16-30 year old deposits. The Betula pendula (Silver Birch) is together with the Pinus sylvestris (Scots pine) within the 30 years in pre-forest stage. After 10 years, the spreading of the Betula pendula goes faster because of seed maturation. For the Pinus sylvestris, the spreading goes faster after 15-30 years (Vattenfall, 2004).

Landscape narration

To develop the new typology for post-mining landscapes, based on the mining characteristics but with new qualities for leisure purposes, different studies into the creation of relief have been made by BGMR and Archiscape. Different forms of relief, like cones and ridges have been tested with the help of visualization techniques like 3D computer models, sand models, ground plans, and analogies (Vattenfall, 2004).

The different soil substrates influence the vegetation and show in that way how the site's conditions influence the outward appearance. The soil qualities influence people's perception and the sensitivity to erosion of the relief in the future. It is not exactly predictable which substrate will be where in the end, which makes the design subject of change over time.

BGMR also did a study into the edges with the surrounding cultural and cultivated landscape. These edges can be clear for example, or unclear, contrasting or not (Vattenfall, 2004).

As a conclusion, a flexible spreading technique is desired, to create cones, hills, ridges, troughs, plateaux and terraces as an arty reference to the forms that were in the landscape as a result from the mining. A triple radial structure in the relief is chosen to show the centres and fractions and regularity of the creation of the former mining landscape. Special features will be added to the design to make a good connection to the surroundings, and for the internal organization of the space. The development of the green oasis in this otherwise desert like landscape, to emphasize the contrast, will complete the plan (Vattenfall, 2004).

This project is an impressive and notable landscape design. The different governments, the mining company Vattenfall, the LMBV and IBA all supported the plan, but it has been rejected by the inhabitants. The inhabitants found the design too extreme and they did not like the idea of an permanent desert in their living environment. After half a century of mining, they liked to have a rest lake in the open cast final void, like any other mine in the surroundings after closure. Till now the project has not been realised, and it is unlikely to be realised in the near future, but maybe one day the time will be ripe for it (Scholz, 2008).

Figure 5.6: Impression of the landscape that is created by the spreader and where succession is allowed

5.5 Ferropolis

Ferropolis, which means as much as 'city of steel', is a collection of five former excavation machines serving as a museum and event stage now. The museum is built on a peninsula in the Gremminer Lake near Dessau in Germany. This lake is the flooded open cast final void of the earlier mine Golpa-Nord. In the past, the power plant was situated here, from which also remains are included in the museum.

To the five machines belong spreaders, bucket wheel excavator and a bucket dredger, each measuring up to 30 metres high and 130 metres long. Together, their weight is 7,000 tonnes. The minister of finance of the Saxony-Anhalt formally opened the project in December 1995 already, but the site developed further for a long time. In December 2005 the museum was integrated into the 'European Route of Industrial Heritage', ERIH (http://www.ferropolis.de on 09 March 2009). Also several projects of IBA Fürst-Pückler-Land in Lusatia are connected to this network.

Landscape rehabilitation

The main focus of this project is the museum that is built to show the impressive machines that worked in the mine. Of course, just like in any other mine, standard measurements were needed to make this place to a safe and functional environment again. This was done by the LMBV, the same way as happens in Lusatia. For example, the water table had to rise again in order to create the lake.

Landscape narration

On the internet, Ferropolis is described as *'Ferropolis, the fragment of a new city in the middle of a desert created by open-cast mining, is both an ominous monument and symbol of the extensive exploitation of the countryside and the ecological consequences of doing so. (…) It is an attempt, at the end of an epoch, to create new perspectives for a landscape depleted by industrial exploitation.'* (http://www.industrielles-gartenreich.com/english/03_projekte/313_bergbaufolge.htm on 28 March 2009)

This is true; however this is the message of almost all rehabilitation projects that have been studied so far. The five excavators are unquestionably impressive, and the museum and event stage are very accessible for a broad public. But the site seems to be designed less dramatic than the comments suggest, because the open cast final void surrounding it is a lake now and the site is a nicely constructed museum. However the site is one big and literal reference to the past, it is disputable whether the site is a symbol of extensive exploitation indeed.

Picture 5.6: Aerial picture of Ferropolis

5.6 Landscape Park Duisburg Nord

From 1989 till 1999, the IBA Emscher Park was held in the Ruhr area in west Germany. This area has been characterized by heavy industries over the past century. As one of Europe's biggest projects in landscape restructuring at that time, the IBA Emscher Park occupied an area of eight hundred square kilometres. The area is between Duisburg and Bergkamen and has two million inhabitants. The area serves as a construction site for various tangible and visible projects. The goal is to create a better living environment and take architectonical, social and ecological improvements as a starting point for economical restructuring in the former industrial region. The IBA Emscher Park searches for a new identity in a region that has been neglected for a long time (http://www.iba.nrw.de/main.htm on 18 March 2009).

The Landscape Park Duisburg Nord (Fig. 5.7) is one of the one hundred and twenty projects within this IBA, designed by bureau Latz+Partner from landscape architect Peter Latz. In 1990 they won the international competition organized by IBA Emscher Park and in 1994 the first parts of the park officially opened. According to Landscape architect Jörg Dettmar, coordinator of IBA Emscher Park, the park became a symbol for the restructuring of the entire Emscher region, and one of the best examples of translating historical layers of a site into a design for the future (Dooren, v., 1996).

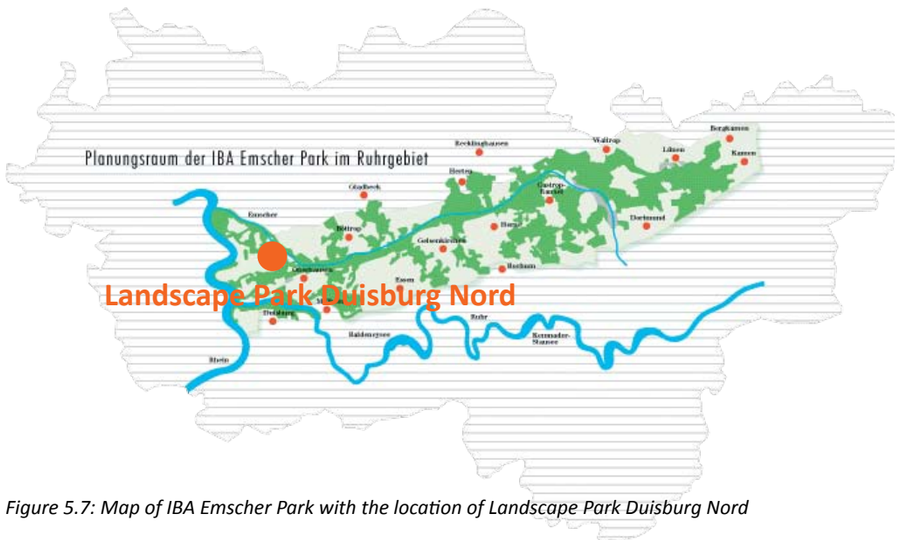


Figure 5.7: Map of IBA Emscher Park with the location of Landscape Park Duisburg Nord

Reference projects

Landscape rehabilitation

The heavy industries in this region caused a lot of disturbance in the environment. It is important that the pollution that remained is treated with care. The water system (Pict. 5.8) requires the most attention (Latz, 1996). The water system in this project has to restore the natural processes within the disturbed landscape. The water system is both artificial and natural. This means that the processes are determined by the rules of nature, but that the processes are started and maintained by means of technology (Latz+Partner, 2008). The concrete bed of a former sewer is turned into a canal system with clean water and flora and fauna is developing here. The shape of the former sewer basically stayed the same. To create a clean water system, the rainwater is collected from roofs and surfaces, afterwards cleansed in the former cooling and settling ponds and then diverted into the new canal. Visitors can sit along the new watercourse and small islands are colonized by plants and animals. Wind power is used to enhance the water quality. The power of the wind pumps the water up and allowing the water to fall back into the canal after the water made its way through gardens (Latz+Partner, 2008). There is also a pond between a school and sports centre. This pond serves as a retention basin. The basin lays partly under the meadow and keeps the water cool. A water curtain provides oxygenation (Latz+Partner, 2008).

Another way in which the landscape park Duisburg Nord dealt with the contamination, is filling the contaminated material into former storage bunkers. These bunkers were sealed afterwards. On top of the bunkers roof gardens were placed (Latz+Partner, 2008). Besides dealing with the contamination, also attention was paid on how the design of the open spaces is connected with their context. This was a focus on the effect that *'elements of distance, surroundings and panoramic views have on the space'* (Latz+Partner, 2008).

Landscape narration

In the Landscape Park Duisburg Nord it is emphasized that the region is a former industrial region by keeping old industrial buildings and structures as they were (pict. 5.9). This layer in history is created to remember and to use these features for the future. This is expressed by giving the industrial relics a new function. In an old gasometer now a diving school is settled, and in former coal bunkers climbing walls are created. Also the former blast furnace with a forty five meter high tower is 'recycled'; it has been made accessible and became the highest viewpoint over a region in transformation (Latz+Partner, 2008).

According to visitors of the park, the accessibility and visibility of the industrial history is one of the most attractive features of the park (Dooren v., 1996). But the negative aspects the industrial past, like the environmental problems have to be dealt with. Very important is the cleaning up of the Emscher water system and polluted soils, which is explained earlier. This process is also made visible in the design.

For example a great variety of vegetation types exists in the landscape park. Some foreign species only occur here because of the ore that came here with the industrialization. Rather than fight them, this fascinating phenomenon is fostered by the landscape architect (Latz+Partner, 2008).
The Piazza Metallica is an arty floor of square rusty plates, functioning as a public space in between old industrial buildings. The rusty plates are a symbol for the industrial time, but are subject to erosion nowadays which is as much a natural process (Weilacher, 2008)
It appears to be attractive to stage cultural events in front of the old industrial buildings and machinery. Otherwise desolate and degraded spaces become places for festivals, films, dancing theatre and music. New possibilities for use are also discovered by free-climbers (Pict. 5.7), who use the cracks in old bunker walls to climb (Latz+Partner, 2008). The gardens on top of the bunkers that store contaminated soil from the past are seen as experiential and provocative, because it appears to be contradicting to create something beautiful out of such bad conditions (Weilacher, 2008).

Like in the Eden Project, also this site has an educational interest. In the first place is the entire park a message in itself, but also the development of a training farm in the landscape park is important to learn children, also in an urban environment, how plants and food grow and how the earth can regenerate life. Apparently pupils cultivated the soil with enthusiasm (Latz+Partner, 2008).

Like in the Fresh Kills project, the people are involved in the creation of the park. Together with people around the training farm has been set up, and also the first structures in the park were constructed with the help of interested citizens. The continuing enthusiastic use of the park is the involvement nowadays (Latz+Partner, 2008).

Picture 5.7: Landscape narration: old storage bunker transformed into climbing walls

Picture 5.8: Rehabilitation: water system in Landscape Park Duisburg Nord

Picture 5.9: Landscape narration: old industrial relic in Landscape Park Duisburg Nord

6 LANDSCAPE REHABILITATION

Landscape rehabilitation

In general one can say that a mine in Lusatia consists of four subdivisions as discussed in chapter three. Namely the dump, the open cast final void, the ‘Randschlauch’ and the surrounding topography of the mine. It is important that after and during mining the landscape of these subdivisions will be rehabilitated, each with its own specific treatment. The subdivisions of the landscape on which we will focus is the rehabilitation of the soil system, the water system and the topography.

6.1 The conditions of the soil after mining

In order to get good soil conditions, it is important that the following factors are present in a sufficient quantity (Fig. 6.1): light, heat, water, carbon dioxide, oxygen, nutrients and mechanical support (Keefer, 2000). Off course all those aspects are interrelated. The mine soils in Lusatia lack some factors mentioned in a sufficient quantity.
Because of the mining activities, the original soil is excavated and spread by machines in a shuffled composition to make a new surface. These dumped soils mostly consist of Tertiary overburden material (Katzur & Haubold-Rosar, 1996). This overburden material often has a limited fertility and is extremely acid (Katzur & Haubold-Rosar, 1996), which is a pH value below 4.5. A sufficient quantity of organic substance is lacking, which means a low buffering capacity (Schmidt & Bannick, 1996). According to Keefer (2000) ‘a buffer is a material in a soil that resists a change in soil pH’. Buffers in soils are clays and organic matter.
So it is important to fertilize the mining soils and to neutralize the acidity of those soils. This causes an improvement of the soil properties and the restoration of soil functions, which means an establishment of an active soil micro organism community in connection with a favourable humus and nutrient balance (Blechschmidt, et al., 1999).
The improvement of the soil functioning and structure reduces the problems of erosion and enables plants to grow again. For safety issues it is sometimes also necessary to make the soil more compact. When the soil is more compact, it will be safer for people to enter, and constructions can be made like infrastructure.

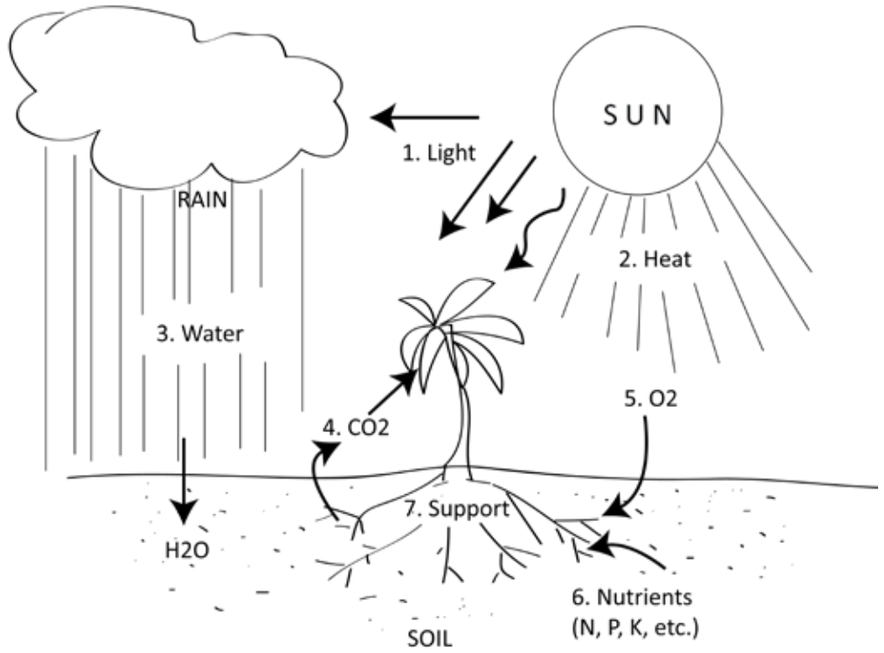


Figure 6.1: Factors and their influence on plant growth

Picture 6.1: Tertiary overburden material cause barren grounds in Lusatia

6.1.1 Creation of the surface contours for the new landscape

During mining, machines excavate the original soil and by this the soil is shuffled. The spreaders replace the shuffled soil to create a new surface. Most of the time, the soil is spread approximately to its original height level. The spreader can however also spread a relief when it is useful for a future use. This is for example done in the reference project 'Desert-Oasis'. In this project they used the available overburden material to develop a new kind of topography for post-mining landscapes referring to the relief from the mining period. So instead of levelling the landscape again they made cones of 5, 10 and 20 metres high as a reference to the mining dumps. This is done to make an unusual and interesting place for tourists to experience the post-mining landscape.
The bulldozer (Planierraupe in German) is also used to make the final contour of the surface. The bulldozer is used after the spreaders. The spreaders cause ridges in the landscape and the bulldozer can flatten and shape these ridges on a smaller scale. So one can say that the spreaders and the bulldozers shape the contour of the new landscape, after which it can be further improved for the future use.

Although doing nothing with the dumped soils is uncommon and at a lot of places undesirable, for some purposes it can be a good thing. The soils that are left alone can become of significant value for nature. Several policy documents, as mentioned in paragraph 2.3, like 'Natura 2000' on European level and the German 'Bundesweiter Biotopverbund' show an increase in need for more, bigger and more connected nature areas to counteract the ongoing loss of biodiversity. When sites after mining are being left alone in Lusatia, extended areas without humans, nutrient poor soils, variation in relief and the possibility to see the process of succession from the very beginning make that these areas can be important for nature development. In the post-mining landscape the following rare biotopes can develop: lakes, islands, steep slopes and dry sandy areas. Fauna species like the goose, wild boar and red deer can exist in these types of landscapes. Sielmans Naturandschaft Wanninchen (Pict. 6.2) is a post-mining landscape 30 kilometres to the north of Klettwitz where a nature area is being developed by the Sielmanns Foundation (www.sielmann-stiftung.de, on 3 March 2009). In total there is 3000 hectares for sustainable natural and undisturbed nature development of which 700 hectares left alone for natural succession.

Doing nothing at all can also result in a bare hilly landscape where nothing grows and erosion occurs. Sometimes a part of a mining area is left alone because of the interesting bare hills. An example in the neighbourhood of Klettwitz are the 'Geigersche Alpen' (Pict. 6.3). This is an overburden dump where nothing has grown for fifty years, and it is unlikely that anything will grow in the future when they are being left alone. The Geigersche are preserved as a site of historic interest, in German called 'Denkmalschutz' (http://www.lr-online.de/regionen/Senftenberg;art1054,1897182, accessed 3 March 2009).

The reference project Desert-Oasis is also an example of a site where succession and erosion can take place. The succession process depends on the soil substrates and the first species that will settle on those substrates. Corynephorus canescens (Grey Hair-grass), Calamagrostis epigejos (Bushgrass), Betula pendula (Silver Birch) and Pinus sylvestris (Scots pine) are examples of species that can settle on the bad post-mining soils.

Picture 6.2: Protected nature area Wanninchen

Picture 6.3: Geigersche Alpen; protected landscape area near Lauchhammer

Landscape rehabilitation

spreader

succession

bulldozer

erosion

Figure 6.2: Principles for the creation of the surface

6.1.2 Soil quality rehabilitation

Stabilization

There are several technical ways for improving the soil stabilization by soil compaction (Fig. 6.3). Soil compaction can be defined as the method of mechanically increasing the density of soil (http://www.concrete-catalog.com/soil_compaction.html, on 21 March 2009).
Three techniques will be discussed and they are all used in Lusatia. The techniques are used when the area needs to be secure again for people or when constructions need to be placed on the soils. It also prevents erosion. The techniques cause soil compaction of deeper soil layers.

The first technique that is used is 'Sprengverdichtung'. This is a technique using underground explosions to make the soil more compact. This technique is most suited at mining soils and slopes with a fine-grained portion, a high water saturation and a danger of ground subsidence (Gehrisch, et al., 2005). The depth of the soil compaction varies from 20 to 30 metres.

Another technique that is used in Lusatia is 'Rütteldruckverdichtung'. This technique uses underground vibrations to make the soil more compact. 'Rütteldruckverdichtung' happens with a vibrator hanging on a cable haulage dredger. The vibrator can be used in soils with water saturation and also in earth wetted mining soils, but then water needs to be added. The distances of the soil compaction points vary between three and five meter in moist conditions and between 6 and 10 metres in water-saturated soils (Gehrisch, et al., 2005)

The last technique that is used is the so called 'Fallplattenverdichtung'. By multiple dropping of a mass of maximal 40 tonnes from a dropping height of maximal 40 metres at a soil compaction point, the soil will be pressed and compacted. The dropping height and falling mass will influence the depth effect. This technique can be used on dry and water saturated soils (Gehrisch, et al., 2005). When a soil compaction is needed until 12 metres depth, at for example future bank areas, this technique can be used.

'Sprengverdichtung'

'Rütteldruckverdichtung'

'Fallplattenverdichtung'

Figure 6.3: Principles for soil stabilization

Landscape rehabilitation

Fertilization

There are several ways for the improvement of the soil properties. The following ways will be discussed: use of original top soil, mineral fertilizers, brown coal ash and organic waste (Fig. 6.4). In lusatia the humus top soil layer had not been extracted separately in a sufficient quantity (Schmidt & Bannick, 1996). When it is possible to extract the top soil layer in a sufficient way before mining, this can be used to improve the soil in the post-mining landscape. One needs a cultivable soil layer of at least 100 centimetres thickness (Katzur & Haubold-Rosar, 1996). Also a choice can be made to use the topsoil only for a part of the post-mining soils when there is not enough top soil for the whole area.

A fast and often used way of improving the soil are mineral fertilizers. A complete fertilizer contains the elements nitrogen (N), phosphorus (P), and potassium (K) (Keefer, 2000). There are also fertilizers that contain only one of those elements. For making the soil less acid, a source of lime is needed. Lime contains the elements calcium (Ca) and/or magnesium (Mg). The mineral fertilizers are worked into the topsoil. In this way its uptake by woody plants is guaranted (Katzur & Haubold-Rosar, 1996). A problem of the mineral fertilizers are that it can lead to immediate leaching and especially of NO_3- (Blechschmidt, et al., 1999). Also the problem of eutrophication occurs. Both nitrogen and phosphorus contribute to this problem. All of the other elements are also useful, but they are only used in small amounts.

Another soil improvement means that is often used in the Lusatian mining area is brown coal ash. The brown coal ash is generally captured from the chimneys of power plants and it also comes from briquette factories. Brown coal ash is recommended when a very high lime requirement is needed. There are several advantages of using brown coal ash as fertilizer. There is a slow weathering of the ash and also a lasting release of bases that cause a sustained liming effect. What is also important is the fact that the ashes contain a lot of magnesium and potassium and this improves the nutrient supply of soils. The negative aspect of brown coal ash is the considerable changing composition of the ashes. Besides the brown coal ash sometimes contains a high boron content, which causes health problems for animals and people (http://www.lenntech.com/elementen-periodiek-systeem/b.htm, on March 2009). Therefore a complete examination is needed before the decision is made to apply the brown coal ash (Katzur & Haubold-Rosar, 1996).

Another way to improve the soil conditions is using organic waste. Organic waste that is used is for example sewage sludge and compost. Using organic waste as soil improver is still under research, but a lot of results were positive. Organic waste seems to be a source for micro organisms (Emmerling, et al., 2000). Organic waste also has a long term availability of N.

The use of organic waste for mining soils makes it possible to recycle waste on a large scale. However, organic waste consists of nutrients and therefore one needs to be aware of a maximum admissible nutrient load, but also the risk of input of pollutants.

top soil

brown coal ash

mineral fertilizer

organic waste

Figure 6.4: Principles for soil fertilization

Landscape rehabilitation

Other erosion preventing principles

According to Keefer (2000) *'erosion is both detachment and movement of soil or rock, and this is caused by running water, wind or ice'*. The erosion in Lusatia is man-made, which is also called accelerated erosion, because it is caused by changes people have made to the soil by movement of the earth (Keefer, 2000). Erosion can have an interesting influence on the landscape as discussed earlier in this chapter, but mostly it has to be prevented.

There are several ways to deal with erosion (Fig. 6.5). It is important that there are cementing substances in the soil. These substances can be found in by-products during the decomposition of organic matter. Other cementing substances are clays, Cadmium (Ca) and Ferro (Fe) (Keefer, 2000). First of all you can improve the soil structure, which is comparable to stabilization and fertilizing means mentioned before in this chapter.

Another way of improving the soil structure is covering the soil with plants. It is therefore important that the plant thrives well in the soil. Sometimes other improvements are necessary before plants can grow in order to prevent erosion.

Covering the soil with mulch can also reduce erosion. Mulch is a protective layer of material that is spread on top of the soil. Besides reducing the erosion on the top soil it protects the plants' root system and can add nutrients to the soil (http://www.lowes.com/lowes/lkn?action=howTo&p=LawnGarden/mulch.html, on 27 March 2009). Mulch can be divided into organic mulch and inorganic mulch. Organic mulch is for example compost, leaves, bark, straw, pine needles and manure. Inorganic mulch is for example recycled rubber, plastic, brick or stone and geotextile. The inorganic mulch lack the soil improving properties.
The organic mulch can be partially mixed with the soil. Although it can be less effective against raindrop damage, it is in this way more effective against runoff and erosion. If the mulch is mixed with the soil, it can encourage faster decomposition, so more cementing substances. If trees or shrubs need to be planted it is important to apply at least three inches of compost or well-rotted manure around each plant. If mulch needs to be applied on a bare soil, it needs to be done as soon as possible to keep to ground covered (Keefer, 2000).

Another way of coping with erosion is adding special structures to the landscape. This can be done by for example breast walls, brush layering , terraces and other comparable forms. Breast walls are constructions where rock is loosely placed on the undisturbed soil with soil added on the uphill side of the wall (Keefer, 2000). Brush layering means that branches of ground cover which is easy to root, or trees are planted on the contour of a steep slope. It is important that the tips of the plants remain exposed while fill is placed in successive layers around them. When the plants start growing, the slope stabilizes and this can be useful on steep slopes on which grass is difficult to maintain (Keefer, 2000). In Lusatia, often a form of brush layering is applied. Another way is making terraces, which is done by moving earth to form level areas on slight to moderate slopes (Keefer, 2000).
The Eden project also made use of structures to make the slopes accessible and safe for people again. 17 Metres were sliced off the top of the mine area to put in the bottom. Unsafe slopes were transformed in slopes with a safe angle and terraces where created. Rock anchors were driven into the sides of the pit to stabilize them, and also a mixture of seed and fertilizer is used on the slopes to knit the surface together (www.edenproject.com, on 26 February 2009).

covering the slope with plants

breast wall

organic mulch

brush layering

inorganic mulch

terraces

Figure 6.5: Principles for erosion prevention

Landscape rehabilitation

6.1.3 Landscape based soil rehabilitation using agricultural systems

Following the previous steps in soil rehabilitation, one can choose for further improvement by applying agricultural systems (Fig. 6.6). This is a more landscape based alternative compared to further artificial fertilization or stabilization means. Using agricultural systems is suitable for large scale improving of the soil conditions and reducing the danger of erosion. These systems have been practiced for a long time already.

One example is strip cropping. Already in the 1930's this was practiced in the United States to have more control over water and wind erosion on slopes up to 16 % (Dalton, et al., 1995). In Australia they used strip cropping on low gradient lands, up to 0,5 %, that were subject to relatively deep, major overland flooding (Dalton, et al., 1995).
Strip cropping is an agricultural system of growing crops in a systematic arrangement of strips across a field. It is most effective when the alternating strips have a precise arrangement. There is an arrangement of a strip of grass or close-growing crop alternated with a clean-tiled strip or a strip with less protective cover. Most of the times, the strip widths are equal. When soil particles erode by raindrops or surface water on slopes, the strips are laid out on the contour or across the general slopes (Carman, http://www.sera17.ext.vt.edu/Documents/BMP_strip_cropping.pdf, on 10 February 2009).
Strip cropping is a practice with multiple purposes and can have the following effects (Carman, http://www.sera17.ext.vt.edu/Documents/BMP_strip_cropping.pdf, on 10 February 2009):

- reduced erosion by raindrops and surface water;
- reduced wind erosion;
- increased infiltration and available soil moisture;
- reduced dust emission into the air;
- improved water quality;
- improved visual quality of the landscape;
- improved wildlife habitat;
- improved crop growth;
- and improved soil quality.

In Lusatia, a lot of problems could be overcome by strip cropping, for example the emission of dust into the air, which has always been a big problem in this region.
Strip cropping is most effective when grasses and legumes can be rotated with crops requiring more intensive cultivation. It is not effective when a certain slope lengths are too long. This can be reduced by other techniques like making terraces and diversions. Another important aspect to be effective is when the strips are as close as possible to the contour (Carman, http:// www.sera17.ext.vt.edu/Documents/BMP_strip_cropping.pdf, on 10 February 2009). Crops that can be used in Lusatia are for example summer rye, winter rye, lucerne and Lupine.

Rye is a grass that grows extensively as a grain and forage crop. Rye grain is used for flour, rye bread, rye beer, some whiskies, some vodkas, and animal fodder. Lucerne (Medicago sativa) is a flowering plant in the pea family Fabaceae, cultivated as an important forage crop.
Although this system takes time to improve the soil quality and structure, it is low in costs.
In the reference project Fresh Kills strip cropping is also used. This method was used in the project because *'it is a potentially less expensive industrial-scale technique for increasing the organic content of poor soils, reducing plant uptake of metals in the soil, increasing soil depth and controlling weeds over a large area'*. It can also be *'beautiful and experientially distinctive'* (Field operations, 2006). The mines in Lusatia are also a large scale areas, and Lusatia would benefit from solutions that are not that expensive. So this agricultural system can be used to rehabilitate the soil and it can also be at the same time visual beautiful.

Another way of using an agricultural system for improving the soil is alley cropping. Alley cropping is a method where field crops, horticulture crops, or forage crops grow between rows of trees or shrubs (http:// www.nrcs.usda.gov/programs/env_assess/EQIP/AppB_ Forestry.pdf, on 10 February 2009). This technique can restore nitrogen to the top layer of soil. A lot of benefits of strip cropping also come back in the use of alley cropping. According to the USDA (1997) alley cropping is used *'to enhance or diversify farm products, reduce surface water runoff and erosion, improve utilization of nutrients, reduce wind erosion, modify the microclimate for improved crop production, improve wildlife habitat, and enhance the aesthetics of the area'*.
In Lusatia the soils are, especially after mining, very poor. According to Gruenewald et al., (2007) *'the integration of trees in the agricultural landscape, particularly on marginal arable land, like in Lusatia, is supposed to be a promising option for future land use'.* Especially because of the upcoming reduction of EU subsidies in the agricultural sector until 2013 there is a need for innovative, i. e. economically feasible, socially accepted, and ecologically sound strategies for the revalidation of such marginal lands (Gruenewald et al., 2007). In Lusatia the tree rows can, for example, be used for the production of woody biomass for energy transformation purposes. Besides the above mentioned advantages of alley cropping, it can create jobs for the Lusatian people. Already several projects of alley cropping exist in Lusatia. The highest productivity was achieved by the tree specie Robinia pseudoacacia (black locust).
As a conclusion it can be said that *'the combination of well adapted tree species and crops in an agro forestry system offers a promising alternative to farmers for integrating fuel wood and crop production within one management systems and, parallely, enhancing site fertility through positive ameliorative effects from nitrogen fixation and soil structure formation by root proliferation'* (Gruenewald et al., 2007).

Looking at the short future of Lusatia, the transition to renewable energy becomes more important as already mentioned in Chapter 2. Lusatia wants to change its identity of energy region depending on brown coal, in an energy region running increasingly on renewable energy like wind, solar and energy from biomass. The demand for renewables can be integrated in the agricultural rotation systems to improve the soil quality. The type of renewable energy that will be generated can depend on the demand at the time. The use of renewable energy systems can already start during mining when the first part of the mine is rehabilitated. The poor soils first have to be improved with stabilizers and fertilizers and then windmills or solar panels can be placed to generate energy at the same field. After 20 years, the solar panels and windmills need replacement. This can be done by newer versions or even other land uses when there is a demand for other uses. In the twenty years the soil had the time to improve, so also other functions can be possible, depending on the rate of rehabilitation.

alley cropping

strip cropping

agricultural system with renewable energy

Figure 6.6: Agricultural principles for soil rehabilitation

Landscape rehabilitation

6.2 Rehabilitation of the water system

The conditions of the water system

As mentioned in chapter 3, the groundwater has to be lowered and kept beneath the deepest working level of the open cast mine. The groundwater is lowered by water pumping. The pumping has not only a local influence, but influences a large area because of the hydrological connections between the different aquifers (Grünewald, 2001). The area in Lusatia that is affected by the groundwater lowering is 2100 km2. The mean ratio of pumped water to extracted coal is 7:1 (Grünewald, 2001). The sudden closure of many mines after the German reunification in 1990 led to the rapid decline of pumped groundwater (Koch et al., 2005). Despite the decline of pumped groundwater, there is still a big demand of several users, which means that water scarcity is to be expected in the future.

Besides the shortage of water quantity, there is also a problem of water quality. Because of the groundwater lowering during mine operations, waste material is exposed. The exposure of these materials to oxygen results in the oxidation of sulphide minerals, and consequent acidification. Acidic mine waters are generated when water comes in contact with these weathering products (Totsch et al., 2006). Thus, like in other mining areas, the water problems are related to low alkalinity, low pH values, high concentrations of iron and sulphate (Unger, 2007). This problem is called Acid mining drainage, in short AMD.

When dealing with the water problems, it is important that water quantity and water quality are combined in finding solutions and making strategies (Grünewald, 2001).

Water quantity and quality

There are several ways of dealing with the problems concerning the groundwater (Fig. 6.7). First of al the restlakes (open cast final voids filled with the rising groundwater) can be flooded with surface water. This accelerates the natural filling process by the groundwater. It is important to realise that it is difficult to flood the restlakes because of the enormous shortage of water. But after mining often a void is left, and a lake is can be of touristic value like the lake landscape that is developing at the moment initiated by the IBA. Secondly, the surface water can hold back the acid- and sulphate-rich groundwater. Third, it dilutes the acid- and sulphate-rich water and increases the acid buffer capacity (Hangen-Brodersen, 2005). If no surface water is added, the groundwater rises very slow and the lakes become less acid very slowly. When a lake stays acid, only the utilization as ‘landscape lake’ can be planned (Hangen-Brodersen, 2005). A pH value of 6-7 is needed for recreational uses of the rest lakes.

According to Skousen et al., (2000) there are *‘two ways of dealing with acid mining drainage (AMD), namely active chemical treatment and passive treatment’*. There are six chemicals that can be used for treating AMD: limestone, hydrated lime, pebble quicklime, soda ash, caustic soda and ammonia. Each chemical has its own characteristics and are more or less appropriate for a specific condition. The decision of which chemical to use depends on both technical and economic factors (Skousen et al., 2000).

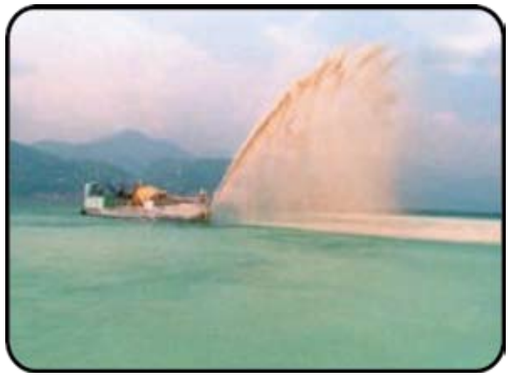
In Lusatia, many lakes were filled partially with industrial products like ash from the brown coal combustion or low-density sludge from acid drainage treatment plants (Unger, 2007).

The active chemical treatment is often an expensive process and a long term liability.

The passive treatment systems do not require continuous chemical input and it takes the advantage of naturally occurring chemical and biological processes to cleanse contaminated mine waters. The primary passive technologies include constructed wetlands, anoxic limestone drains, successive alkalinity producing systems, limestone ponds and open limestone channels (Skousen et al., 2000).

The long-term performance and cost-effectiveness of the passive treatment seems to be negative according to several researchers, although there were some exceptions (Kalin et al., 2006). German researchers have taken interest in the potential of passive remediation techniques to restore the acidic rest lakes (Kalin et al., 2006). Kalin et al., (2006) believe that ‘systems incorporating flourishing populations of primary producers such as algae in the water column, can be considered truly sustainable in conjunction with sediments, which they supply with carbon’. The research that is done in the rest lakes of Lusatia confirmed that sediments are the key to biogenic acid consumption. It is although not yet possible to engineer a self-contained, self-sustaining treatment system that economically and effectively treat AMD (Kalin et al., 2006). But Kalin et al., (2006) believe that ecologically sound strategies for treating AMD offer the greatest promise. This means for this thesis that passive treatment can be used as a principle, but further research is needed. But it is worth investigating, because when it works correctly, it is a more landscape based approach than the other two principles mentioned in this paragraph.

The reference project of paragraph 5.6, Landscape Park Duisburg Nord, is also a good example of dealing with water problems. The water system in this project is both artificial and natural. This means that the processes are determined by the rules of nature, but that they are started and maintained by means of technology in order to direct and speed up the process.



active treatment: using chemicals

flooding with external surface water

passive treatment

Figure 6.7: Principles for dealing with water problematic

Landscape rehabilitation

6.3 The rehabilitation of the topography

As mentioned in chapter 3, the mining activities remove the entire topography on that spot, in a way nothing is the same anymore. This means in general that infrastructure like roads and water are destroyed and not connected anymore to surrounding area. Villages are destroyed and the people are ‘relocated’ in other or new villages. Agricultural and forest lands are destroyed, just like important routes for animals.
After the mining activities a new topography has to be created (Fig. 6.7). The connections in infrastructure have to be re-interpreted again, new land uses that suit the current needs are to be constructed, important routes for animals to the surrounding areas have to be connected again and potential areas for nature or cultural heritage that result from mining activities need to be conserved before they are removed by land rehabilitation activities.
In the creation of the new topography, it is important that a landscape is created where people can relate to again, but more about that in the following chapters.

connecting ecological areas

construction and connection of infrastructure

construction and connection of water ways

new land uses

Figure 6.7: Principles for dealing with the rehabilitation of the topography

6.4 Suggestions for a landscape based approach to rehabilitation

In the previous three paragraphs, a list of principles is provided to rehabilitate the landscape after mining. In several cases, the principles are substitutes for each other, whereby some can be preferred over others for different reasons. The reasons can concern for example the costs, the necessary time or the rate of sustainability. In the case of this thesis it is stated that rehabilitation of the landscape should happen using a landscape based approach when possible, which is also described as an ecologically sound way.
For some of the landscape based alternatives for rehabilitation it is not sure what the precise effects will be in the long-term. And sometimes principles like soil compaction with machines or fertilization with mineral fertilizers are indispensable to make an area safe and functional again for people within the foreseeable future. But some general aspects can be considered. For an ecologically sound rehabilitation, soil and water quality improvement using natural materials and processes is better than active and fast treatment with chemicals, which can cause problems in the environment. Rehabilitation using recycled material would be better than using materials that need to be newly created.
The following steps are needed for ecologically sound rehabilitation according to Peter Del Tredici in the book Designing the Reclaimed Landscape (Berger, 2008, pp. 13-25):

1. Improve the chemical and physical conditions of the present mine soil substrates so that the growth of plants is supported;
2. No efforts need to be spared to enrich the degraded soils with organic matter like cover crops or mulch; this is important because it increases the speed of soil forming processes, it increases the water holding capacity, and it facilitates nutrient cycling;
3. When plants need to be selected, choose native species that are well adapted to the circumstances because they will grow most sustainable and low cost. Sometimes for aesthetic or other reasons new species can be chosen. The selected trees and shrubs have to have a strong capacity to produce new shoots because they are the start in revegetating the entire area
4. There is a need for ongoing maintenance. Maintenance is needed in all phases for all constructed landscapes on all scales. ‘Sustainable is not self-sustaining’ (Berger, 2008). Some examples of maintenance are irrigation, weeding, pasture, mulching and replanting.

In the Fresh Kills project similar steps are undertaken while designing the rehabilitation of the large garbage dump underneath the park plan. In this thesis these steps are taken along if there is a choice for an ecological sound, landscape based alternative above other rehabilitation measures.

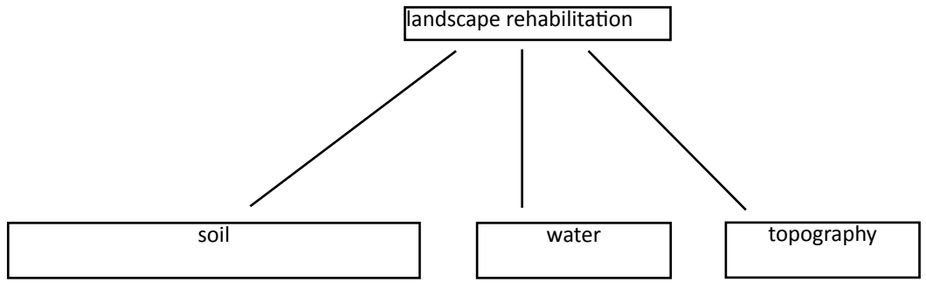


Figure 6.9: Schematic overview of rehabilitation principles for mines in Lusatia

7

LANDSCAPE NARRATION

Landscape narration

In this chapter it is discussed what landscape narration is, what the story is that is to be articulated in Lusatia, how it can be articulated in the landscape and how this narrative approach fits into the general landscape approach that is used in this thesis to deal with post-mining landscapes.

7.1 Theory on landscape narration

The MSc thesis 'Articulatie in het Landschap' (Articulation in the Landscape) of Bart van der Westen and Peter Westerink, tutored by Jaap Lenkeek and Paul Roncken from Wageningen University, is considered to be useful for the rehabilitation of the mines in Lusatia and Klettwitz in particular.

The thesis 'Articulatie in het Landschap' starts from the supposition that *'stories constitute an essential part of the landscape for people, and by analyzing and employing these stories and histories the unique character of the hundreds of cultural relics and elements can be articulated.'*
Landscape narration can be seen as an implicit characteristic of landscape, and can be employed for both landscape analysis and as design approach, which is the case here.
In the past, landscape narration has been used in landscape architecture much more often, like the mediaeval monastery gardens that symbolized the Gardens of Eden and the English parks in the nineteenth century that were inspired by Greek mythology. In the modernist time, the focus of designing was rather on composition and structuring of elements in the landscape. But the current post-modernism recognizes the importance of storytelling again. The challenge for the landscape architect in landscape narration is in the finding and determination of hidden characteristics and stories. And second, to make them legible in the landscape (Van der Westen & Westerink, 2006).

A story is in the Chambers Twentieth Century Dictionary described as *'a continued account of any series of occurrences'* (Van der Westen & Westerink, 2006). Aristotle, in the past, mentioned time, place and action as the three main components to create a story around. A story can be told by various media, for example by a storyteller, in a book, film, and dance or in the landscape (Van der Westen & Westerink, 2006).

The thesis 'Articulatie in het landschap' provides insights to determine the kind of narrative that can be told. Moreover, tools are provided for the landscape architect to articulate this specific story type, or mix of type, in the landscape. Van der Westen and Westerink see the

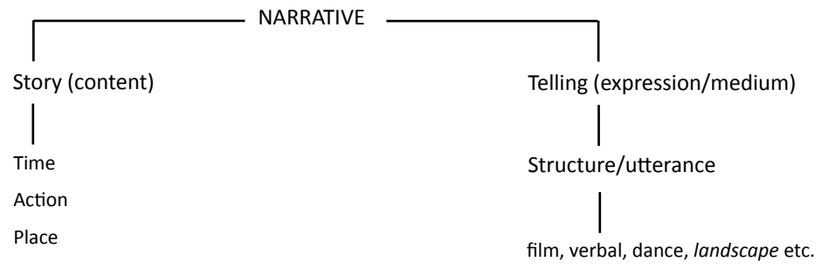


Figure 7.1: The narrative is the overall term for the content of the story and the way it is told

landscape as a layered system of physical and mental layers, more or less in accordance to how landscape has been described in this thesis in chapter 4. Van der Westen and Westering add to this definition that conceptualizing the landscape in layers is a mental construction. The real landscape is a complex and dynamic system. Also stories in the landscape are mental constructions. There are numerous stories told and possible to tell in the landscape, big stories known and supported by many, and small more personal memories (Van der Westen & Westerink, 2006).

Instead of story, van der Westen and Westerink prefer the term narrative. A narrative covers the content of the story and the communicative aspect. Instead of story telling they speak about articulation. The landscape itself can never tell a story; stories are human constructions and therefore need a human being to be told. Since the landscape is the medium in this thesis, and the landscape can only instruct and guide the user to construct a story in the mind, the term articulation is preferred. At the end, the term landscape narrative is defined as the coordinating term of a story that is articulated by means of the landscape as a medium (Fig. 7.1) (Van der Westen & Westerink, 2006).

To study the approach of landscape narration, van der Westen and Westerink turned to existing literature of Potteiger and Purinton, from which they derived four categories of landscape narratives. Also Anne Whiston Spirn has been consulted, who is one of the most famous authors about the translation of narratives into the landscape (Van der Westen & Westerink, 2006).

4 types of stories

The four types of narratives that are applicable for the landscape architect in analysing and designing are the chronicle, report, memoirs, and novel. The four types are different in how strict the story is related to physical elements in the landscape and how the elements time, place and action are treated in the articulation (Van der Westen & Westerink, 2006). In figure 7.2 on the right is shown how the types of landscape narratives relate to each other.

The mental landscape is still physically present in elements in the landscape, but requires more imagination of the user than the physical landscape. In the following overview the four types of landscape narratives are explained.

Chronicle

The landscape chronicle makes use of chronologically ordered facts. Processes in time and the physical landscape, caused by a natural or cultural force, are important. Showing the landscape chronicle, gives insight in processes like erosion, growth, succession, restoration, destruction and how they work on the landscape. Also the influence of time on the landscape is important. When these influences are legible in the landscape, the landscape is more understandable for the user. The chronicle is to be represented in a strict direction; the logical time sequence is characteristic. The subject of the story is characteristic for a certain area, which determines the location of the chronicle (Van der Westen & Westerink, 2006).

Report

The report is the articulation of what happens at the moment or happened in the past, by means in the landscape. By making use of actual historical relics in the landscape, it tells a historical layer of the place. The report articulates a specific time period and occurrences, but the author is free how these are articulated and the place is free as long as the intention is clear. The report is physically present in the landscape (Van der Westen & Westerink, 2006).

Memoirs

The memoirs connects new or existing physical elements in the landscape to historical occurrences and memories. This creates a perceptible collective or personal bond with the environment. The relationship between the place and the occurrences can be in two ways; when the occurrence actually took place on the specific site, or when the current context functions as a reference to an occurrence in the past. To tell the memoirs it is necessary that time, place and action are being articulated in the real configuration; therefore the memoirs is characterized by a strict direction. The people have to construct the connection between the physical object and the remembrance themselves. Therefore, this genre has a bigger relationship with the mental landscape than the chronicle (Van der Westen & Westerink, 2006).

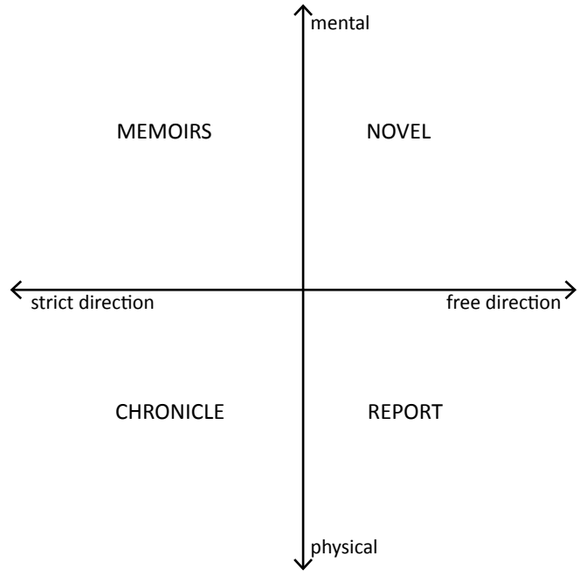


Figure 7.2: Bi-axial figure positioning the four types of landscape narration

Novel

In the novel, new structures are added to the existing landscape to articulate a new, often fictitious story. The story is often unrelated to the original landscape and has more connection to the mental landscape. The novel is characterized by a loose direction. Each random story can be articulated and time, action and place can be determined by the author as long as a clear plot structures the main mutual elements (Van der Westen & Westerink, 2006).

Landscape narration

How to articulate the different narratives in the landscape

There is a 'standard toolbox' for the landscape architect, consisting of landscape elements like trees or materialization, and concepts like mass versus open space. This toolbox has mainly a structuring and organizing character, therefore it is not possible to directly articulate a narrative in the landscape with the existing tools. To develop ways that lead to legible stories in the landscape, figures of speech and rhetoric means are employed, in addition to the tools that are already there. The rhetoric means are a kind of mental stepping stone (Fig. 7.3) between the content of the narrative, and the articulation in the landscape (Van der Westen & Westerink, 2006).

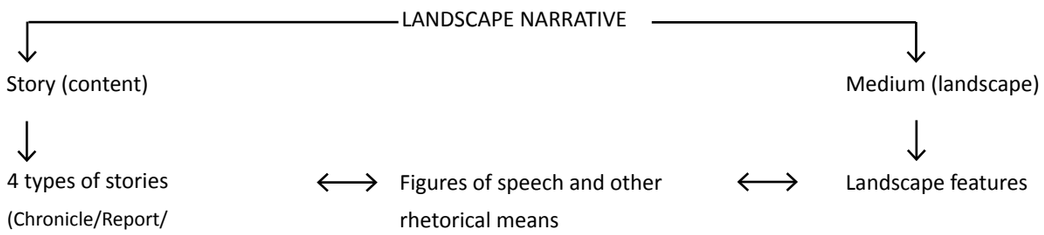


Figure 7.3: Rhetorical means are the mental stepping stone between the content of the story and the medium

Based on Spirn, 28 figures of speech have been distinguished that are to a small or greater degree applicable for landscape architecture. They can be divided into six categories, which are

- accentuation;
- climax and anti-climax;
- anomaly;
- metaphor;
- paradox and irony;
- and addressing

(Van der Westen & Westerink, 2006).

Not all figures of speech can be made directly recognizable. Some are only recognizable when the user has mental foreknowledge. This foreknowledge can be provided in many ways, for example by giving walkers a Global Positioning System with extra information, or tell the story beforehand in a visitors or information centre. The use of different figures of speech does not exclude each other. The six categories are elaborated now.

Accentuation

This category concerns the accentuation of a specific element, which means at the same time that another element becomes less important. Specific forms of accentuation are

- positioning (Pict. 7.1);
- framing;
- contrast (Pict. 7.2);
- exaggeration;
- transformation (Pict. 7.3);
- sound;
- and rhythm (Pict. 7.4 and 7.5)

(Van der Westen & Westerink, 2006).

In the photograph below positioning is illustrated, and the photographs on the facing page illustrate contrast, rhythm and transformation.

Climax and anti-climax

In a climax the highest or most intensive point in an experience or series of occurrences is emphasized, step by step becoming more intense. In an anti-climax the same happens, but the expectations are not fulfilled in the end (Van der Westen & Westerink, 2006).

Picture 7.1: Accentuation: positioning

Picture 7.2: Accentuation: contrast

Picture 7.3: Accentuation: old overnight train that is transformed into a youth hostel

Picture 7.4: Accentuation: rhythm of trees and benches in an urban environment

Picture 7.5: Accentuation: rhythm in the landscape created by a spreader

Landscape narration

Anomaly

This category indicates the landscape that is incongruous; the landscape is different from the expectation. There are four types of anomalies, which are the:

- anachronism, when something old is placed in a new setting (Pict. 7.6);
- prochronism, when something new is placed in an old setting (Pict. 7.7);
- anachonism, when something is placed out of its normal context;
- and the anastrophe, which is an inversion of a normal order

(Van der Westen & Westerink, 2006).

The upper photograph illustrates an anachronism, by ridges that remained from the mining in a landscape were new developments take place.

The photograph below illustrates a prochronism, by a pier that is already created for the future flooding of this open cast final void.

Picture 7.6: Anomaly: anachronism

Picture 7.7: Anomaly: prochronism

Metaphor

A metaphor is a direct connection between two elements, people or phenomena that seem unrelated at first sight. Also here, there are different types. There are the

- synecdoche, when a part symbolizes the whole entity (pic 7.8);
- metonymy, when the name of an object is substituted for that of another closely associated with it;
- personification, which is the identification of the non-human with the human;
- euphemism, which is a form of mitigation of something unpleasant;
- the allegory, a symbolic representation of an idea or other abstract notion in art (Pict. 7.9);
- and the cliché, which is a saying, expression, or idea which has been overused to the point of losing its original meaning

(Van der Westen & Westerink, 2006).

The upper photograph shows a synecdoche because the sails mark a future canal in the landscape and stand for a future use by much more sailing boats.

The photograph below shows an allegory, because the concept of nature is symbolized in the urban environment with artificial green floor covering and flower boxes.

Picture 7.8: Metaphor: synechdoche

Picture 7.9: Metaphor: allegory

Landscape narration

Paradox and irony

A paradox is an apparent contradiction, which is actually true. In Irony, there is an incongruity between what one says or does and what one means or what is generally understood. These two forms are closely related and often used together. There are different forms, which are the:

- antithesis, when emphasizing the substantial contrast (unlike the contrast mentioned earlier, which is about the contrast in outward appearance);
- oxymoron, a combination of two normally contradicting phenomena;
- antiphrasis, which is the use or material in an unexpected or opposite way than normal;
- litotes, when something is described by denying the opposite;
- meiosis, when making something less important than it is by using a certain material or form;
- and dramatic irony, when a group of watchers is able to observe a group of actors in what they are doing (Pict. 7.10)

(Van der Westen & Westerink, 2006).

Dramatic Irony is illustrated below, by people who stand on a elevation, seeing each other's shadow move when they move.

Picture 7.10: Paradox and irony: dramatic irony

Addressing

Addressing is not a figure of speech in itself, but used to categorize the following forms. To addressing belong the:

- apostrophe, which is the interruption of an effect, which leads the focus to this effect;
- aposiopesis, which is an interruption of a reasoning or reference that has to be completed in the mind (Pict. 7.11);
- and exclamation, when a statement is made that clearly stands out of the context (Pict. 7.12)

(Van der Westen & Westerink, 2006).

The photographs below illustrate an aposiopesis, because of the interrupted view on the path, and an exclamation because of the statement a machine with such dimensions and architecture makes in the landscape.

Picture 7.11: Addressing: aposiopesis

Picture 7.12: Addressing: exclamation

In table 7.1 it is summarized which rhetoric means and figures of speech belong to which main category.
Van der Westen and Westerink classified the figures of speech to their suitability to articulate each or more of the four types of stories (table 7.2). According to them, the chronicle can be articulated best by means of accent and addressing, by which accent is specifically articulated by means of rhythm. The report can be articulated by accent, anomaly and addressing, by which accent is mainly articulated by means of contrast and rhythm. A memoirs can be expressed by accent, anomaly, metaphor and addressing, by which synecdoche is the specific form of a metaphor and aposiopesis and exclamation are specific forms of addressing.
The novel makes use best of accent, by means of contrast and rhythm, anomaly by means of anachronism and anastrophe, and metaphor, by means of allegory (Van der Westen & Westerink, 2006).

There is a striking overlap in use of the same figures of speech for the different types of landscape narratives. Accentuation for example should be able to express all categories of landscape narratives, and addressing at leas three. Other rhetoric means have not been assigned, like the climax/ anti-climax. It seems to depend on the application, how strong the figures of speech work in articulating a particular narrative type.

In paragraph 7.3 it will be illustrated more detailed how this translation of a story into the landscape happens by means of using the figures of speech described above. This is done by analyzing the 6 reference once again and more closely on the articulation of the narrative in the design. But first the content of the story that is to be told in Lusatia is discussed in paragraph 7.2.

accent	**climax/ anti-climax**	**anomaly**	**metaphor**	**paradox/irony**	**addressing**
positioning	climax	anachronism	synechdoche	antithesis	apostrophe
framing	anit-climax	prochronism	metonymy	oxymoron	aposiopesis
contrast		anachonism	personification	antiphrasis	exclamation
exaggeration		anastrophe	euphemism	litotes	
transformation			allegory	meiosis	
sound			cliché	dramatic irony	
rhythm					

Table 7.1: The six main categories of rhetoric means and their specific forms

chronicle	**report**	**memoirs**	**novel**
accent	accent	accent	accent
- rhythm	- rhythm		- rhythm
	- contrast	anomaly	- contrast
- addressing			
	anomaly	metaphor	anomaly
		- synecdoche	- anachronism
	addressing		- anastrophe
		addressing	
		- aposiopesis	metaphor
		- exclamation	- allegory

Table 7.2: Overview of the rhetoric means to articulate the particular types of landscape narratives

Landscape narration

7.2 The narration of Lusatia

In the landscape lots of narratives are hidden and legible, also in Lusatia. To use landscape narration consciously in making a design, the content of the narrative has to be determined first. This narrative can completely or partly correspond to the 'true' story of Lusatia. In that case, a chronicle, report or memoirs is being articulated. Also a fictitious story can be articulated, and then it is a novel. The 'true' story of Lusatia has been described in the introduction, chapter two, three and four of this report.

To determine what the content of narrative of Lusatia should be, a short inventory has been made of stories about Lusatia articulated the last couple of years (table 7.3). This concerns stories communicated by other media than landscape. In the following table has been determined what the medium and the content of the story are.

Picture 7.14: Photograph of André Baschlakow of the mining landscape

Picture 7.13: Restoring the old topography of Bückgen in the Ilse Mine during the theatre workshop of Jürg Montalta

Picture 7.15: One of the books in the 'Zeitmachine Lausitz' series

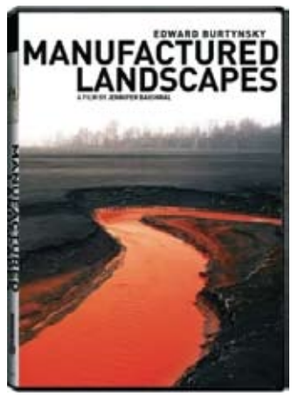
project	year	medium	content of the story
‘Alles verloren- alles gewonnen?’ Jürg Montalta	2005	theatre workshop	Landscapes on the outside and on the inside. A search with people, into how people deal with transformation/destruction of their home environment.
‘Was ist Heimat?’ Jürg Montalta	2006	theatre workshop	A search with people, into questions like - What is homeland, is it a place or a feeling? - Can you create new homeland when destroyed once?
‘Die Weltenbauer’/’S’il vous plaît, dessine-moi une région’ Urs Kalbfuss, television company Arte	2006	television documentary	The landscape in transformation. How has the region been changed by mining, and how does it change into the future.
André Baschlakow	2007-2008	photography exhibition	Baschlakow portraits that what is unseen otherwise. The big scale landscape transformation, but also the details on the smallest scale.
‘Minescape Dreams’ ‘Metamorphose’ Petra Petrick	2004 2007	photography exhibitions	Petrick shows bizarre landscapes that enable the spectator a view between the times. On the pictures are the beauty of the mining dismantling zones where at the same time new nature comes to exist
‘Niemandsland’ Corinna Fuckas	2009	photography exhibition	Fuckas portraits the problems caused by the mining around the village Horno in Lusatia; landscape destruction and empty villages. Her pictures seems to be from another world.
Alexander Schippel	2009	photography calander by IBA and Vattenfall	Schippel shows the present situation of landscape transformation in Lusatia as being active mines, in-between landscapes and projects of IBA Fürst-Pückler-Land.
‘Zeitmaschine Lausitz’	2003-2004	book series	In separate parts, all kinds of aspects of Lusatian history are described. Examples are ‘Landschaft und Bergbau’, ‘Vom Pfützenland zum Energiebezirk’, ‘Arbeitswelt und Alltag’.

Table 7.3: Overview of other media and the story they tell about Lusatia

Landscape narration

This overview does not pretend to cover all the stories that have been or could have been told from Lusatia. It does not address the Sorbian history of the region for example, or the influence of the close border with Poland on the region.
But, it can be concluded from the table that the landscape in transformation has been at least one of the structural topics in the last years. It is about the landscape how it was before the mining, and what the mining did to the landscape and the people. It is also about the present rehabilitation of the landscape, and how it can be in the future.
It seems that the different media treat the main topic of landscape in transformation in different ways. The photographers illustrate how bizarre the landscape can look in this process of transformation, by the specialty of the subject of their pictures, striking colours, contrasts, and the vastness of the scale. The theatre workshop and the book series show the need for people to talk and read about what happened during this landscape transformation, as a kind of help in coping with what they went through. The Arte television documentary and the photo calendar provide the view into a better future.

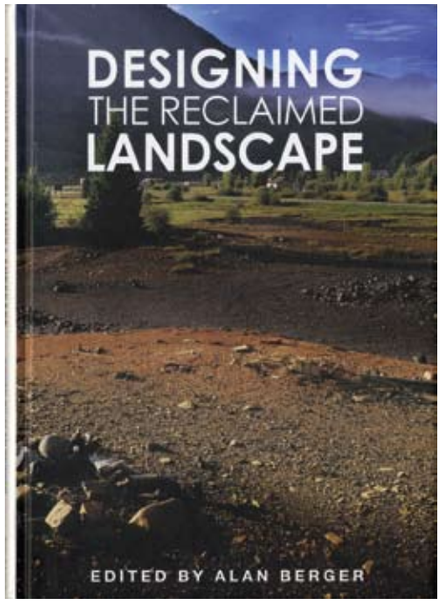
That the topic of landscape transformation and rehabilitation after destruction is a relevant subject is also supported by the work of photographer Edward Burtynsky. He pictured the global impact of contemporary economic and producing systems on the environment and human life. In the well-known documentary film Manufactured Landscapes (2006), Burtynsky self is filmed, during his photographing. By the striking beauty of his photographs, the attention is being drawn to the, most of the times far from beautiful, message behind picture, communicating the people and the landscapes that are subject of destruction and degradation as a result of our modern lifestyle (Baichwal, 2007).

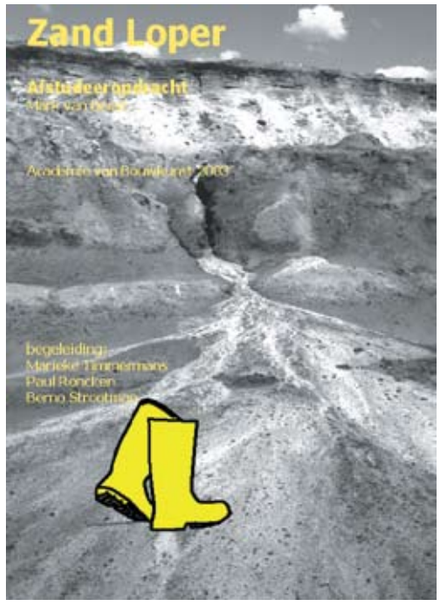


Picture 7.16: Documentary 'Manufactured Landscapes' by Jennifer Baichwal and
Picture 7.17: Photograph of Robert Smithson from the Monuments of Passaic collection

One of the first to draw attention to the beauty of industrial relics was photographer and land art artist Robert Smithson. In his project Monuments of Passaic, dating from the 60's, he photographs an industrial city in New Jersey, from a for that time unusual perspective (http://www.robertsmithson.com/photoworks/monument-passaic_300.htm. on 12 March 2009)

Landscape architects recognize themselves as being the profession who has to be involved in dealing with these sites and this problematic of degraded and destructed landscapes, as is concluded in paragraph 4.1. A second question is then: how to rehabilitate these landscapes. Alan Berger puts it in his book Designing the Reclaimed Landscape (2008) as follows: *'If the idea of designing with altered sites is considered broadly, then the notion of replacing time, or designing with merely the palette of historical accuracy, such as in restoration, is anathema. That is, as designers, we choose to reclaim, rather than restore, when we project into the future, which is why the topic of rehabilitation is so vital to today's and tomorrow's design discourse.'*
He criticizes land rehabilitation in the way of restoration, because landscape architects have the power to project the future and make landscapes that are fit for future use and inspiration.





Picture 7.18: Book 'Designing the Reclaimed Landscape' by Alan Berger and
Picture 7.19: Thesis 'Zand Loper' by Mark van Beest

Also in landscape architecture student work this innovative approach instead of restoration has been explored, from which the landscape architecture thesis of Mark van Beest, ‘Zandloper’, is a good example. He transformed an abandoned quarry in the south of the Netherlands into a geological experience park, by bending characteristics emerging from the otherwise destructive mining activities into new opportunities and qualities.

To counter negative feelings that are among the Lusatian people about their region, it is important to change the negative impression they have into something positive. Like in the work of Edward Burtynsky, Robert Smithson or Mark van Beest, it is important that landscape architects search and show the beauty and opportunity in that what is normally considered to be negative. Sometimes, people simply have to be reminded that after rain comes sunshine.

However the mining was absolutely bad for the healthiness of the landscape; to the people it also meant a job and plenty of energy. Apart from landscape destruction, the mining caused fascinating and aesthetically impressive views. Part of their quality lies in their temporality, but it may be worth it to conserve a few beautiful locations, like barren ridges as shore of a flooded open cast final void, or a mining machine that is full of memories of former mine workers, and has aesthetic qualities from itself by its rusty material and extraordinary size and functioning. In this phase of landscape transition, contrasts show up by themselves, like a brave mushroom that shoots up from the surface as first, or the beautiful flower contrasting the bare soil around her.

Besides, certain areas could be designated where these landscapes are simply being left alone, to be able to see what happens when nature is to recover the destruction by itself. Then the earliest stages in succession processes are visible again, which is becoming rare in Germany.

Other parts of the post-mining landscape should facilitate the future land uses that keep the region economically healthy, because the former mining productivity has not been replaced yet by other activities. The post-mining landscape has to be rehabilitated first, which is described in chapter six. Then, depending on the possibilities and the needs, different land used can be developed over time (see paragraph 2.3). As a start, agricultural rotation systems can be combined with large scale renewable energy installations, to rehabilitate the soil, but also to yield renewable energy in the near future. The process of landscape transformation will be interesting for tourists to explore and attend. When the soil conditions improved, in a couple of decades, other agricultural systems can provide food, biomass or production forests can be grown, or the landscape can be built on. For the far future it is difficult to predict what is necessary, but by then the soil is suitable for any kind of land use.

These land uses can be designed in such a way that the process of landscape transformation is emphasized and legible in the landscape. Where necessary, some spots can be added or exaggerated to strengthen the story, or mental baggage can be provided in a visitor’s centre in the area.

The time that it takes to rehabilitate the landscape in physical terms, should not be much shorter or longer than it takes in peoples mind to be able to cope with this enormous landscape transformation. When using a more landscape approach to physical landscape rehabilitation, it takes more time to recover the landscape. But from the popular theatre workshops of Jürg Montalta in 2005 and 2006, it is clear the topic is still very alive in people’s minds in Lusatia.

Summarized, the narrative that is to be articulated in Lusatia should consist of

- the destruction that the mining caused to the landscape and the people;
- the beautiful and bizarre landscape features that also existed in the mining landscapes;
- how the landscape is being rehabilitated at the moment
- and a positive future perspective.

The media film, book, photograph and theatre have been used more often already to tell this story. It is striking that it has not been articulated in the landscape except for a couple of projects. Landscape itself may be the most obvious medium since the subject actually is landscape. Instead of that, in the current rehabilitation, the history in the landscape is being erased, covered up and cultivated as soon as possible. When articulating the narrative of Klettwitz and other mines in Lusatia in the landscape, people can be made aware of the history and identity of the place, which is missing at the moment.

Using a landscape approach to rehabilitation means that it is proposed to find a more ecological way to landscape rehabilitation, using the regenerative capacity of the landscape itself, making use of its processes and systems. This makes the process of transformation in the landscape much more visible than a quick way of rehabilitation. This makes it so interesting to try whether there are landscape based alternatives for the current way of rehabilitation.

Landscape narration

7.3 Articulation in the reference projects

By giving the landscape narratives in the reference projects of chapter 5 a closer look, it has been tried to recognize means of articulation in these projects by looking for some examples. With the available information of the projects, it is possible to classify the means of articulation in the six main categories of figures of speech as elaborated in chapter 7.1. When very clear, also the specific form of this rhetoric mean is distinguished. Based on the examples of rhetoric means that are present, it is distinguished which kind of landscape narrative has been articulated.

In this case, the theory of van der Westen and Westerink has been used as an analysis tool.

Eden Project

The content of the story in the Eden project is the message that new life can come to exist on this very degraded landscape. The project tells about the challenges of the future and that we need a culture that knows how to sustain the things that sustain us. By using creativity, imagination and adaptability to communicate this message, the importance of these qualities is communicated too.

The Eden project can be seen as a global garden, symbolizing the enormous biodiversity of our planet. This is a metaphor in two ways. In one way it is a synecdoche because the Eden project stands for the world's entire biodiversity. It is also an allegory, because the symbol of the garden is new on the site, and the concept has been pushed to the extreme through the entire project. The current use of the site as Eden is a strong contrast with its past. It can be seen as an anomaly, an anastrophe more precisely, because of the apparent contradiction in making an Eden at a degraded site. Artists, performers and GPS are also employed to tell the story in the Eden project; so not exclusively landscape means have been employed.

The type of landscape narrative that has been used is the novel, because metaphor and anomaly are recognizable. It is discussable whether it could be a memoirs too. There is a reference to the past in the strong contrast of the site's new use compared to its past. But because the new structures and story added to the place are omnipresent, it is most a novel.

Fresh Kills

The motto of the park is 'Lifescape'. This stands for an ecological process of environmental renewal on a vast scale, recovering not only the health and biodiversity of ecosystems across the site, but also the spirit and imagination of the people who will use the park. This is regarded to be the content of the story too.

Like in the Eden project, Fresh Kills as a whole can be seen as a contrast with the past; as an anomaly or anastrophe to be precise. But here is no new construction, like the biomes in Eden; there is rather a transformation of a dump into a park. In this way it can be seen as a paradox, because how can a former dump be transformed into an attractive park? Also the ecological approach to land rehabilitation is a contrast to the former use of the dump.
The ongoing story of the transformation is articulated by the realization of the park in different stages. It depends on the closure of the dump when a new part of the park can be realized, which causes a rhythm in time.
Small decorative lights on the former dump areas (Fig. 7.4) run on gas that is produced out of the decomposing trash underneath. This is both metaphor and accentuation. It is accentuation because the attention is drawn to the former dumps, and it is an allegory (metaphor) because light means something positive, although it concerns a dump here.
The floating gardens (Fig. 7.4) are a symbol for the barges that brought the trash to the dumps earlier. This is an antiphrasis, because a garden is not expected here since it was trash that was transported.
The revelation of the energy infrastructure in the park is a means of accentuation, like the scenic routes and berm overlooks that are created to have certain directed views from the road system into the park.
The September 11 monument in the form of large earthwork with the same shape as the former Twin Towers is a means of addressing, an exclamation in fact. It is a reference to the ruins that have been dumped on Staten Island and a statement against that what happened.

In the design for Fresh Kills two types of landscape narrations are used. There is the chronicle first, which tells about the site's transformation, and which is articulated by the overall structure of the park and the staging in time to develop the park. There are many references to the past, using accentuation, metaphor and exclamation, which makes it a memoirs too.

Figure 7.4: Lights on the dump mounds and floating gardens in Fresh Kills

Picture 7.20: Cyclists on the Fürst-Pückler-Radweg just leaving the F60 visitor monument

IBA Fürst-Pückler-Land

IBA Fürst-Pückler-Land wants to present the story of the landscape transformation to the broad public by the motto 'Landscape in motion'. Landscape in motion means to IBA that structural change in the landscape goes together with social and economical improvements.

Many of the twenty-five projects of IBA articulate this main motto to small or greater extend. Because the projects are dissimilar, the way the story is articulated in each project is different too. There are for example projects that show transformation, a form of accent. These are the visitor monument F60, the Biotürme and Kraftwerk Plessa. These examples show an old mining machine, part of a coking plant and a power plant that have been transformed into museums. They are anachronisms at the same time, because they remain from the past in a changing environment. The development of the leisure landscape around the Lusatian Lake Land, open cast final voids that are flooded into lakes, is also a form of transformation. The transformation examples here can be seen as euphemisms too, because they mitigate the bad results of the mining a bit by rehabilitation of the landscape and the prospect economical development by creating a leisure and tourism economy. The new watchtower at Lake Sedlitz is a real landmark. In the entire vicinity of the Lake Land this tower is visible, marking the crossing of three lakes. This is a form of exclamation. The floating diving school in lake Gräbendorf is a kind of anomaly, an anachonism to be precise, because people do not expect a diving school in a landscape were originally no big lakes existed. The marking of a future canal in the landscape by means of seven temporary blue sails is a metaphor. The sails stand for a future use by much more sailing boats, therefore it is a synecdoche.
The Fürst-Pückler cycling tour connects the twenty-five projects with each other (Pict. 7.20). This accentuates the projects in the landscape. The spreading of the IBA See logo on all their projects became a metonymy; 'See' stands for a project towards the structural development of the region.

Also IBA makes use of numerous non-landscape means to articulate the story of landscape transformation. Events are organized to draw attention to for example the start of the flooding of an open cast final void. And there is the IBA visitor centre where foreknowledge about the region and the process of transformation is provided. When people have the foreknowledge, it is presumed that visitors recognize the articulation in the landscape earlier.
All kinds of rhetoric means and narratives are present. That is not surprising, because IBA is a coordinating organization with 25 projects. Altogether they articulate the message that the landscape, and with that the social and economical structures are in transformation.

Landscape narration

Desert- Oasis

The Desert-Oasis project wants to employ the unique features of the mining landscape for the development of a leisure landscape, in order to develop tourism in Lusatia. It wants to show the beauty and specialty of the desert like landscape that results from the mining process and the contrast with the healthy landscape by creating the oasis.

The spreader is used as a designer. This machine is used to create a pattern of ridges and cones as a reference to former relief in the mining landscape. The triple radial structure in the relief is chosen to show the centres, fractions and regularity of the former mining landscape by means of rhythm (Fig. 7.5 and 7.6).

Different available soil substrates are used to get differentiation in the development of vegetation. This is a form of accentuation.

The contrast of mining and healthy landscape is emphasized in the concept of desert versus oasis.

The desert part representing the mining landscape and the oasis representing the healthy landscape is a means of a metaphor (synecdoche), because a part stands for the whole.

The use of contrast and rhythm articulates a chronicle here. But still the design is considered to be rather a memoirs, because the designers were very free in representing the rhythm and time development and the chronicle needs it to be told in a strict way. Also the metaphor and accentuation are important, which makes it more of a memoirs.

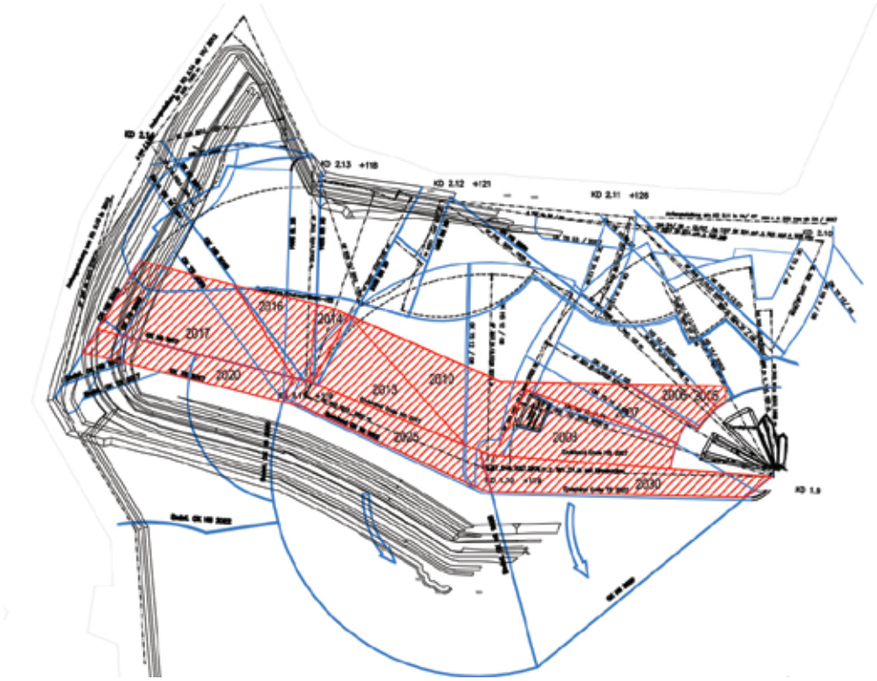


Figure 7.5: Fractions in the direction of the former mining operations of the mine Welzow

Ferropolis

Ferropolis means to show some of the bizarre features of the former mining history of the site in a museum.

Five former excavators have been brought together in a museum that is situated on a peninsula in the open cast final void of the mine where they excavated earlier. The open cast final void is being flooded at the time to a lake. The five excavators are an anachronism (form of anomaly), because they are remains from the mining period in a new environment.

To keep five instead of one excavator emphasizes the narrative power of the collection. It is a form of exaggeration, but also of rhythm because of the repetition. The site is being used as a museum and as a stage for cultural events (Pict. 7.21). This means a transformation of the former use of the site. Because the story has been articulated physically in the landscape with real remains from the past, on its original location, it is most a report. Because this is a smaller and less versatile project, it is easier to classify into one of the narration types than other projects.

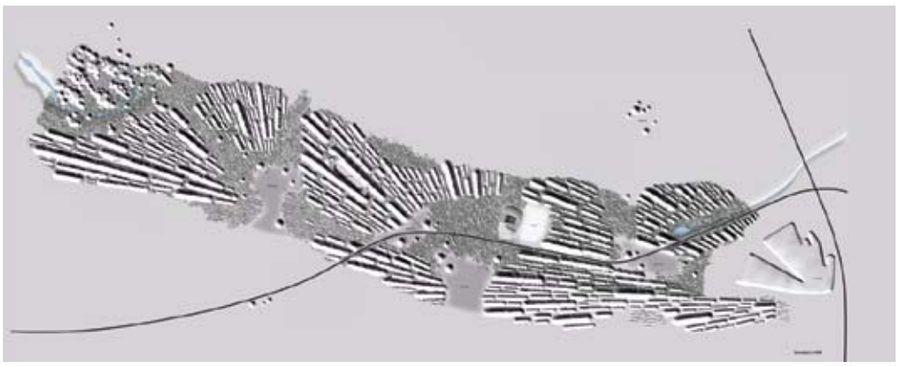


Figure 7.6: Ground plan of the Desert-Oasis project showing the new mining landscape topography based on the relief and fractions in the direction of the former mining operations

Picture 7.21: Ferropolis by night during an event

Picture 7.22: Piazza Metallica in Landscape Park Duisburg Nord

Landscape Park Duisburg Nord

With the Landscape Park Duisburg Nord, the landscape architect and the IBA Emscher Park want to show that a former industrial area can be rehabilitated into a successful and attractive park again. Many old relics have been remained and got a new function. The blast furnace is a watchtower now and the Piazza Metallica is a gathering place or stage (Pict. 7.22). This transformation in use is a form of accentuation.

The roof gardens on the bunkers, filled with the contaminated remains from the past, are seen as a statement. They highlight that negative effects of the former industrialization can lead to beautiful roof gardens in the future. This is an exclamation, a form of addressing.

The different layers in the park concept show remains of different uses over time. The layers are quite legible in the park.

The Landscape Park Duisburg Nord is a kind of summary or symbol for the approach of the IBA to the entire Emscher region. It is the main visitor attraction, on which other developments like housing and business areas and the development of a regional green structure are connected. Because the park symbolizes the way the development of the entire region is approached it can be seen as a synecdoche.

The transformation of this site is clearly articulated because very much of the industrial history has been remained in different layers in the overall park structure. The time development of the site is very important in the articulation of a chronicle. Also a memoirs is articulated because sometimes the references to the past have been articulated very free, so that the visitor has to complete the hint in the mind.

For all projects, It appeared to be difficult to categorize the landscape narratives, because often several narratives are told in one project. To recognize the articulation in the form of rhetoric means is difficult because it is disputable whether something is more an antithesis or a simple contrast (Desert-Oasis), or both a metaphor and accentuation (also Fresh Kills) for example. Articulation happens also on many scale levels. The smallest flower can indicate new life on a barren site, but an entire Eden project does so too.

It has to be noted however, that although the design has been judged in this analysis, none of the reference projects is designed according to the theory of Van der Westen and Westerink. Still rhetoric means are recognizable in the design gestures.

The content of the story plays an important role in the interpretation and classification of the rhetoric means, and therefore in the classification of the type of narrative too. This is supported by the need to provide foreknowledge in some cases to enhance the legibility of rhetoric means in the landscape. The performers in the Eden Project show that it is hard to communicate a complete story in the landscape by landscape means alone. This remark is made by van der Westen and Westerink in their thesis, and confirmed by this short attempt in analyzing the reference projects.

Landscape narration

7.4 Narrative principles for the rehabilitation of mines in Lusatia

In spite of the difficulties in analyzing the landscape narratives in the last paragraph, it was helpful to have a closer look to the reference projects in order to determine how the theory of van der Westen and Westerink can be applied in this thesis.

Fresh kills and Landscape Park Duisburg Nord have much in common when considering the content of the story. The narrative types are the chronicle and the memoirs. The content of the narratives in the two projects is more or less in accordance with the narrative of Lusatia, as it is determined in paragraph 7.2. This combined with the description of the types of landscapes narratives in paragraph 7.1, leads to the choice to articulate a chronicle in Lusatia completed with a memoirs too (Fig. 7.7)

In the chronicle (see 7.1) the process of landscape destruction, rehabilitation and the future perspective will be articulated, because the chronicle makes use of chronologically ordered facts. Processes in the landscape, changing over time are important. Showing the landscape chronicle gives insight in processes like erosion, growth, succession, restoration and destruction. When these influences are legible, the landscape is better understandable which makes that people can relate to the landscape easier.
The mining was very physically present in the landscape, had a clear subject, time development and direction in space. These features can be emphasized by designing the rehabilitation in specific way, making use of the same dimensions, location, staging in time, and/ or direction. By using a landscape based approach to rehabilitation, it is assumed to be easier to articulate the chronicle. In the chronicle, all stages in the mining and rehabilitation process get value and attention, from the first brown coal findings till developments in the far future. According to the theory, the rhetoric means of accentuation in the form of rhythm and addressing will be applied (Fig. 7.8 and 7.11)

In the memoirs (see 7.1), new or existing physical elements in the landscape are connected to historical occurrences and memories. This creates a perceptible collective or personal bond with the environment. In this case, references to the mining history will be kept or made legible in the landscape. So beautiful spin-offs from the mining past, like bare desert like landscapes, can be conserved. It also gives people the opportunity to remember the passed mining period which was related strongly to the, also passed perished, GDR governance system. According to the theory, the rhetoric means of accentuation, anomaly, metaphor (synecdoche in particular) and addressing (aposiopesis and exclamation in particular) will be applied (Fig. 7.8, 7.9, 7.10 and 7.11).
This division helps to design both a landscape structure, the memoirs, and flexible uses in the landscape, the chronicle, as a way to design the future of post-mining landscapes.
For a part of the principles examples are already there in Lusatia, mainly in the form of an IBA project, or LMBV land rehabilitation activity. In that way, the theory suits the present situation. But it is important to integrate the narrative approach to landscape rehabilitation with the necessary rehabilitation measures to create a coherent spatial plan for these sites, to go one step further.

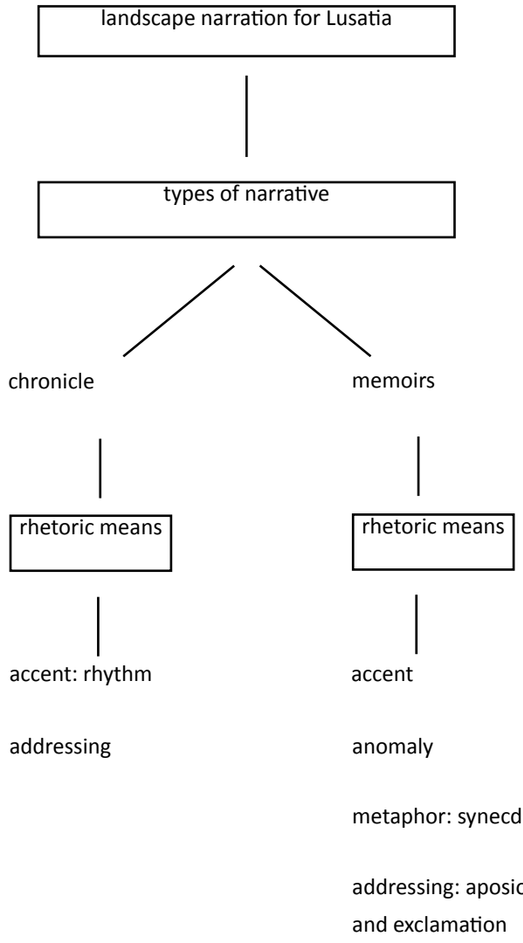


Figure 7.7: Schematic overview of landscape narration principles for mines in Lusatia

rhythm

positioning

contrast

transformation

exaggeration

sound

framing

Figure 7.8: Landscape narration principles to articulate accentuation

anachonism

prochronism

anastrophe

anachronism

Figure 7.9: Landscape narration principles to articulate an anomaly

synechdoche

aposiopesis

apostrophe

exclamation

Figure 7.10: Landscape narration principle to articulate a synecdoche (metaphor)

Figure 7.11: Landscape narration principles to articulate addressing

8

DESIGN PRINCIPLES

Design principles

This chapter will be the synthesis of the principles developed in chapter 6 and 7, about landscape rehabilitation and narration, with the mine and its typical subdivisions. In this way, design principles will be created, applicable for the brown coal mines in Lusatia.

8.1 The subdivisions of a Lusatian brown coal mine

In chapter 3, where the mine in Klettwitz has been studied precisely, a general scheme of a brown coal mine in Lusatia has been derived. The four typical subdivisions of a Lusatian brown coal mine (fig 8.1) were distinguished as:

1. the dump; app. 25-50 km^2
2. the *'Randschlauch',* app. 3-15 km^2
3. the open cast final void; app. 4-10 km^2
4. the context

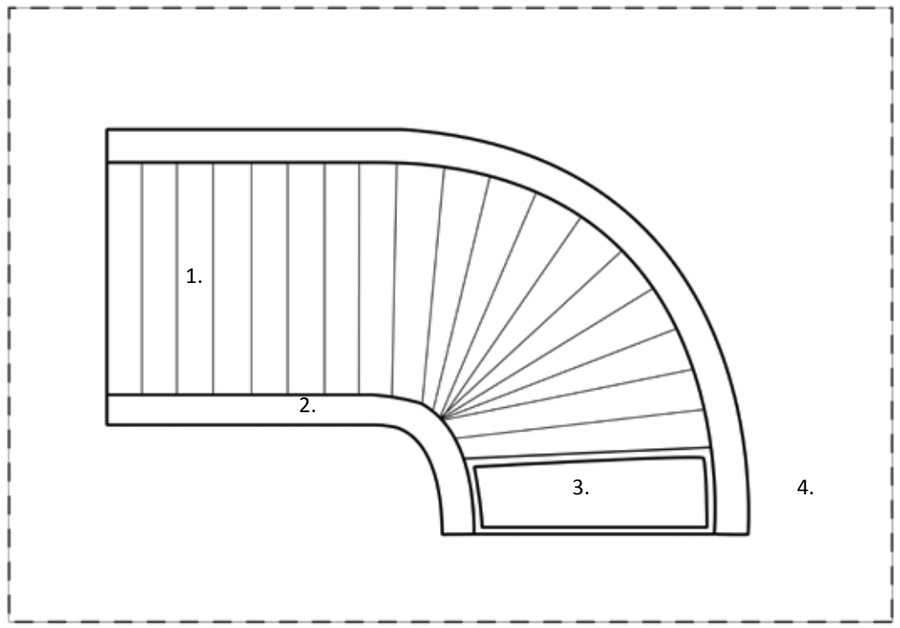


Figure 8.1: The subdivisions of a typical Lusatian brown coal mine

1. dump

2. '*Randschlauch*'

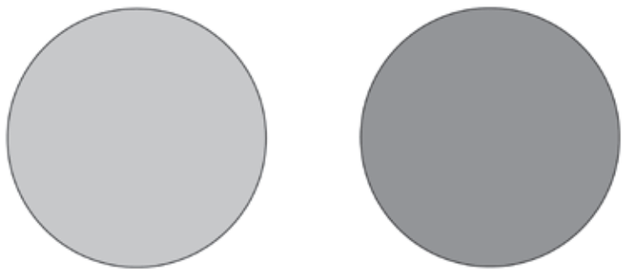
3. open cast final void

4. context

8.2 Landscape rehabilitation and narration principles

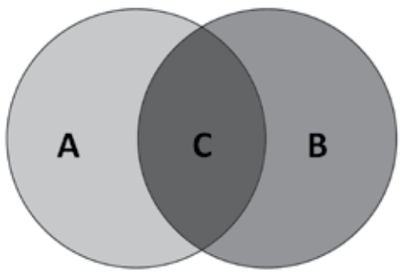
In the scheme presented on the following page (Fig. 8.3), it is summarized which principles are there to rehabilitate the landscape from brown coal mining, and which principles can be used to narrate the story of brown coal mining and rehabilitation in the landscape.
The principles that are developed in chapter 6, landscape rehabilitation, can be seen as a physical 'must', and the principles developed in chapter 7, landscape narration, can be considered as a mental 'must'. It appears that measurements taken to rehabilitate the soil for example, can at the same time articulate a part of the narrative. Therefore, the overlap in the different origin of principles delivers the design principles (Fig. 8.2).

This can be outlined as follows:



A. landscape rehabilitation: physical 'must'

B. landscape narration: mental 'must'



A + B = C
the overlap between rehabilitation and articulation principles
= the typical field of landscape architecture

Figure 8.2: Overlap in the design principles of landscape rehabilitation and landscape narration

In case of Lusatia, one can say that the LMBV is the expert in the realization of part A. The figures show, that about two thirds of the former unrehabilitated mining sites from the GDR time have been cleaned up and rehabilitated by the year 2006 (LMBV, 2008).
The problem in the way post-mining landscapes are dealt with in Lusatia, which is elaborated in chapter 3 and 4 earlier, is that technical landscape rehabilitation alone does not make the former mining sites a *place* again. It is important that the place develops an identity again, which is partly to be based on its history. When the place has a clear and legible identity, people can more easily develop a bond with the place, which is considered to be positive.

Several successful initiatives have been undertaken to communicate a story in Lusatia, part B. There are examples in which the former mining identity of the place can be experienced, like the F60 visitor monument or the museum in the former power plant in Plessa. Also the IBA visitor centre in Groβräschen is important, which provides information about Lusatia as a start to exploring the region. From the visitor centre, there are guided tours that go into the mines by foot or jeep. But then the medium to transfer the story is the tour guide, or images and text, and not the landscape alone, which the narrative is actually about. As described in the landscape architectural criticism on the current rehabilitation practice in paragraph 4.3.1, the landscape as a medium to articulate the narrative in Lusatia is underused at the moment. Moreover, the measures in the current rehabilitation practice concern either A or B separately, while we as landscape architects would think that the value-added is in the integration.

So part C is the most important part of the diagram for this thesis, because it will show that the steps that have to be taken in landscape rehabilitation can be integrated with creating the articulation of a landscape narrative.
We suppose, that doing so is essential in three ways:

- the landscape chronicle is about mining but also about rehabilitation *itself*, and a landscape chronicle can be expressed best by using a landscape based approach to rehabilitation;
- because it is only possible to authentically articulate the site's history before characteristics are eventually erased by landscape rehabilitation measures already. This is necessary to be able to articulate the landscape memoirs;
- and integrating landscape narration principles with the obligatory landscape rehabilitation measures is efficient and prevents that it will cost more effort and or money than necessary.

chapter 6

landscape rehabilitation

soil | water | topography

landscape creators

spreader
succession
bulldozer
erosion

stabilizers

'Spreng-verdichtung'
'Rütteldruck-verdichtung'
'Fallplatten-verdichtung'

fertilizers

top soil
brown coal ash
mineral fertilizer
organic waste

erosion preventing

covering the soil with plants
mulch
special structures

agricultural systems

strip cropping
alley cropping
renewables rotation system

adding surface water
active chemical treatment
passive treatment
doing nothing: in a natural way

infrastructure
waterways
(new) land uses
ecological connections

chapter 7

landscape narration

defining content of the narration for Lusatia

2 types of narrative:

chronicle

rhetoric means:

accent: rhythm

addressing

memoirs

rhetoric means:

accent

anomaly

metaphor: synecdoche

addressing: aposiopesis and exclamation

input design principles

Figure 8.3: Summarized overview of the origin of the landscape rehabilitation and narration principles as input for putting together design principles

8.3 Development of the design principles

To construct a landscape rehabilitation design for a mining area, the landscape rehabilitation and narration principles have to be integrated with each other (Fig. 8.2 and Fig. 8.3), and then connected to the four subdivisions of the brown coal mine (Fig. 8.1). Then design principles come into existence, landscape typologies in fact, with which new compositions are made later in this chapter.

The integration of the principles has been worked out in the following examples. Of course, there are numerous possibilities when combining 25 landscape rehabilitation with 15 landscape narration principles and one out of four locations. The most suitable combinations for Lusatia are shown. It is decided to start from the landscape narration principles, to guarantee that there will be a landscape chronicle and memoirs in the end, and then to work back. First design principles have been put together to articulate the landscape chronicle, because the chronicle is the overall story here and takes the biggest area on the mine site. Suiting the process character of a chronicle, this part of the mine should be most flexible in land uses and rotation times. Hence, design principles have been put together to articulate the landscape memoirs. This concerns more point and linear elements. Suiting the remembering character of the memoirs, these topologies should form a long lasting structure in the landscape. In this sense, the chronicle and the memoirs complement each other. When the design principle consists of a photograph, it means that these examples are already present in Lusatia or the mine Klettwitz. Otherwise, a drawing has been made.

Picture 8.1: Putting together the landscape rehabilitation principles, landscape narration principles and the subdivision of the mine where the design principle is applicable

Chronicle

1. *rhythm* *dump* *strip cropping*

In this design principle, the narrative principle rhythm is combined with a strip cropping system. This is an in-expensive, large scale agricultural technique to gradually improve soil over time, which makes it appropriate on the dump area. First, the surface needs to be created with the spreader and bulldozer. Probably, the surface needs stabilization. The soil needs to be fertilized, preferably with organic waste. The different strips with crops can be designed in a rhythm, in the direction the former conveyer bridge moved.

succession processes on former dump area in different development stages

Design principles

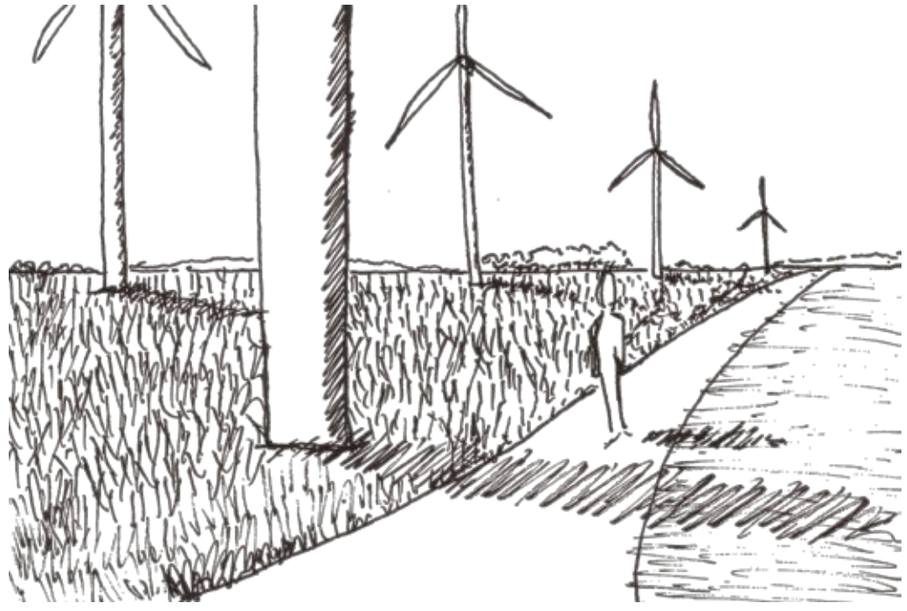
2. *rhythm* *dump* *alley cropping*

In this design principle, the narrative principle rhythm is combined with an alley cropping system. This large scale agricultural system is suitable for the dump area, because it gradually improves soil over time. It generates wood for biofuels too. This system is proven to work well and is cost-effective in Lusatia.
First, the surface needs to be created with the spreader and bulldozer. Probably, the surface needs stabilization. The soil needs to be fertilized, preferably with organic waste. The different alleys with trees alternated with crops can be designed in a rhythm, in the direction the former conveyer bridge moved.

alternated alley cropping system on the dump with rotation times of about years for the crops 1-2 years and for the trees 12 years when used for biomass energy production

3. *rhythm* *dump* *rotation with renewables*

In this design principle, the narrative principle rhythm is combined with a crop rotation system with renewable energy. Like strip and alley cropping, the growing of certain crops improves the soil conditions over time. By combining the system with wind mills or solar panels, renewable energy is generated in the meanwhile which is profitable.
First, the surface needs to be created with the spreader and bulldozer. Probably, the surface needs stabilization. The soil needs to be fertilized, preferably with organic waste. The windmills or solar panels can be positioned in a rhythm, on the dump, in the direction the former conveyer bridge moved. After twenty years, the windmills or solar panels need to be replaced by newer versions or other desirable land use.



crop rotation system with renewables

4. *rhythm* *dump* *new land use: production forest*

In this design principle, the narrative principle rhythm is combined with a production forest at the dump. Like the agricultural systems, trees have a positive influence on the soil conditions. They bind nitrogen to the soil, prevent erosion and improve biological activity in the soil. The trees can be placed in a rhythm and when different parts of the dump are planted in different time stages the time development is emphasized too. First, the surface needs to be created with the spreader and bulldozer. Probably, the surface needs stabilization. The soil needs to be fertilized, preferably with organic waste. After 30 years when the first trees are cut, the soil can be used for other purposes or a new cycle of production forest again.

production forest on former dump area in different development phases

5. *rhythm* *dump* *succession*

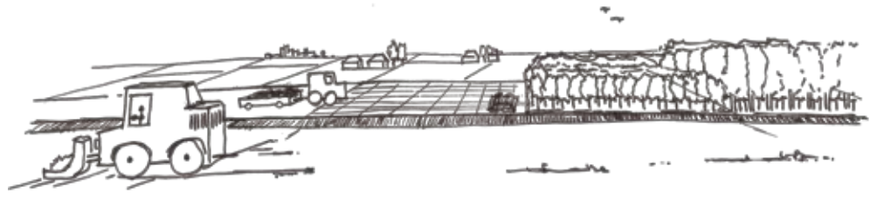
In this design principle, rhythm is combined with the landscape rehabilitation principle succession in the dump area. The development of nature in the dump area has to be facilitated by spreading first a relief to create different conditions in height and wetness. In areas where people come, soil has to be stabilized. Ground water that rises has to be cleaned with a passive treatment system and/or external surface water can be added to the area. When the areas are prepared directly after mining, a time difference will show of about 40 years between the most and less developed nature areas.

succession processes on former dump area in different development stages

Design principles

6. *rhythm* *'Randschlauch'* *new land use: production forest*

In this principle rhythm is combined with the creation of a production forest on the former *'Randschlauch'.* In this case, the *'Randschlauch'* has to be filled up with material from the dump by the spreader. The soil needs to be stabilized and fertilized, preferably with organic waste. Trees will improve the soil's condition further over time. Basically it works the same as the production forest on the dump. But on the *'Randschlauch' ,* this rising landscape element can emphasize the transition from mining area to untouched landscape. Because the form of the *'Randschlauch'* is even more elongated, the different stages of development of the production forest can be noticed even clearer.



production forest on former 'Randschlauch' in different development phases

7. *rhythm* *'Randschlauch'* *succession*

In this design principle, rhythm is combined with the landscape rehabilitation principle succession in the *'Randschlauch'*. The development of nature in here has to be facilitated by spreading first a relief to create different conditions in height and wetness. In areas where people come, soil has to be stabilized. Ground water that rises has to be cleaned with a passive treatment system, and/or external surface water can be added to the area.
When the areas are prepared directly after mining, a time difference will show of about 40 years between the most and less developed nature areas. Because this is situated on the *'Randschlauch',* this landscape element will emphasize the transition between the mining landscape and the untouched.

succession processes on former 'Randschlauch' area in different development stages

Memoirs

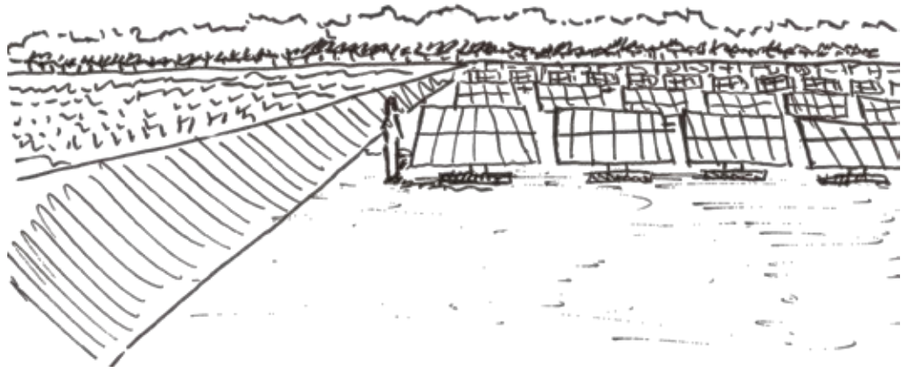
The previous examples show ways to articulate a chronicle in the landscape. It appears that the dump and the *'Randschlauch'* are most suitable to articulate the chronicle, because of the larger and elongated form. Also with respect to the history of development it suits to design a chronicle on the dump and the *'Randschlauch'.* Here the machines operated and the mine moved forwards. This was the dynamic and productive part of the mine, which can be translated into a new productive system with agriculture, trees and/or renewable energy.

The open cast final void is much more the end point of the mining activities, and therefore less appropriate to design a process over time. It is more logical to design a statement here, a marking of the end of the process. Since this is can be articulated in the memoirs, the final void plays a more important role here as will be shown below.

The surroundings of the mine are less appropriate to articulate the chronicle either, because the process happened in the mine and not out of it. The surroundings of the mine are more important to articulate a contrast with what happened and happens in the mine, and to make a new connecting topography again. Because these design interventions influence the surroundings but actually happen on either the dump, the *'Randschlauch'* or the final void, in the elaboration of the putting together of the following design principles the context will not appear as such and has a passive character.

8. *exclamation* *open cast final void* *new land uses: solar panels*

In this design principle the narrative principle of exclamation has been put together with a form of renewable energy in the open cast final void. To construct solar panels in the final void, the soil has to be stabilized and prevented from erosion. When adding a fertilizer like organic waste, it is possible for perennials to grow in between the panels and rehabilitate the soil condition over time. The final void means the end of the mining operations. To place a large field of solar panels, a renewable energy, right here is a statement in favour of clean solar energy.



the large field of solar panels is a striking contrast with the dump area, and a statement in favour of clean solar energy instead of brown coal

Design principles

9. *contrast* *open cast final void* *succession*

In this design principle, the narrative principle contrast has been combined with succession in the open cast final void. The contrast here is the new land use full of live compared to the old area with hostile conditions for colonization. But with a couple of measurements it is possible to create natural conditions on post-mining landscapes that became rare in Germany. The spreader and bulldozer can create a relief, to get a variety in slopes and dry and wet conditions. The water quality can be improved by passive treatment or adding external surface water. Banks should be stabilized with *'Rütteldruckverdichtung'* or *'Fallplattenverdichtung'*. The soil is very poor, which is actually very good for certain species. The areas have been left alone by people for a long time, which makes it attractive for species to recolonize right these areas.

nature area on post-mining landscapes offer biotopes for rare species: new life on barren soil

10. *contrast* *open cast final void* *flooding with external surface water*

Here the contrast has been put together with adding external surface water in the open cast final void. This is meanwhile a proven way of dealing with open cast final voids, in Lusatia and outside. The banks of the future lake have to be stabilized with *'Rütteldruckverdichtung'* or *'Fallplattenverdichtung'*. The lake has to be flooded with external surface water, because waiting for the ground water table to rise takes far too long. When the lake gets a recreational purpose, it has to be made less acid, for example by adding lime. The contrast is created by the water in the lake with the surrounding area, because Lusatia became quite dry due to the mining activities.

flooding an open cast final void to a rest lake is an often used possibility

11. *anachronism* *open cast final void* *new land uses: leisure landscape*

In this design principle, the narrative principle anachronism has been combined with the creation of a new land use in the final void. A former conveyer bridge, that reaches its last working place in the final void of the mine, has been changed into a visitors monument and got a new life by that. For inhabitants and tourists this monument from the past is an attractive place to visit, because it is an impressive machine and it is nice to get to know the history of it and its surrounding landscape. The F60 can start other developments towards a leisure landscape because it might function as a pull-factor for other initiatives. To secure the safety of people, the machine has to be secured and transformed, like the surroundings that have to be stabilized.

the F60 is a former mining machine. In the open cast final void he reaches the final stage of the mining and of his work. Transformed into a visitors monument it can serve also in the future.

12. *prochronism* *open cast final void* *new land uses: leisure landscape*

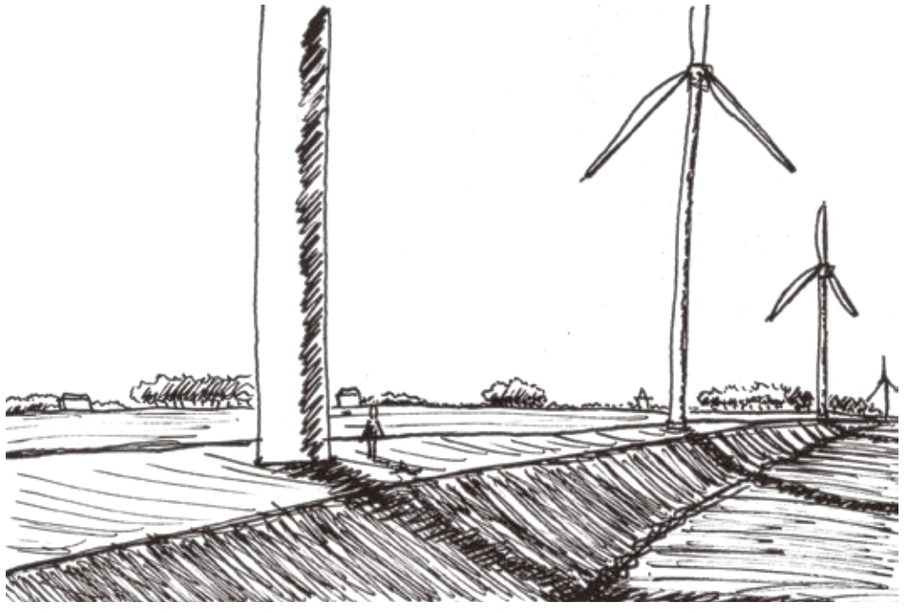
Here the opposite from the previous design principle has been created. This is also an existing example in Lusatia. It is a pier, waiting for the water table in the adjacent rest lake to reach it. The object is its time ahead. This is also an attractive feature for people to visit and keep following during the flooding of the rest lake, as a reference for the amount of water that is added since the last time.
To secure the safety of the people, the area has to be stabilized and eventually fertilized depending on the plans for the surrounding.

the pier in Lake Ilse is a clue that once the water level will be so high that the pier is in the water

Design principles

13. *anastrophe* *'Randschlauch'* *spreader*

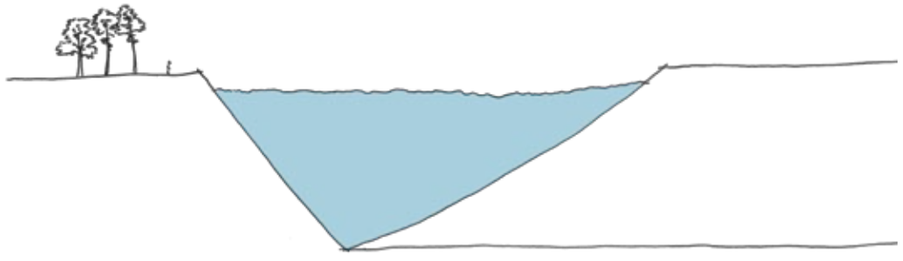
In this design principle, the anastrophe has been used in combination with the spreader to create a ridge in the *'Randschlauch'* instead of the gully that it was. This is an inversion of the normal order, and by that the location of the former *'Randschlauch'* is emphasized in the landscape. The *'Randschlauch'* needs to be filled by the spreader with material from the dump. Hence it needs to be stabilized. It is proposed to place wind mills on the *'Randschlauch'* because a higher place in the landscape is better to catch the wind. When a fertilizer is added, perennials get the chance to grow under the wind mills, to start up a process of gradual soil improvement. Later maintenance could be done by pasture with sheep.



the 'Randschlauch' is inversed from a gully into a ridge by filling it with material from the dump. Now it is an excellent location for windmills

14. *contrast* *'Randschlauch'* *flooding with external surface water*

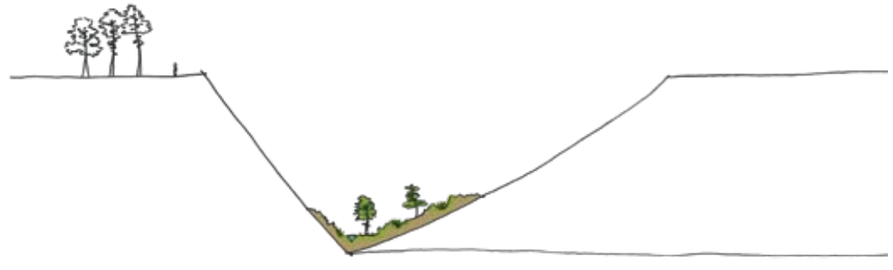
Here the narrative principle of contrast has been put together with the landscape rehabilitation principle of flooding the *'Randschlauch'* with external surface water. In fact, the same is done in principle 10, where the final void is flooded. In the *'Randschlauch'* the contrasting effect is even bigger, because the *'Randschlauch'* is more elongated and encloses the mining area. In this way, the transition between the mine and the untouched landscape is emphasized.



like the open cast final void, also the 'Randschlauch' can be flooded into a water body

15. *aposiopesis* *'Randschlauch'* *connecting ecological areas*

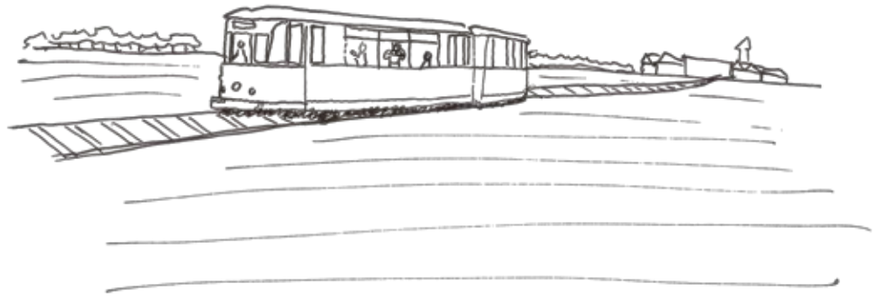
In this design principle, ecological areas are connected through the *'Randschlauch'.* For the people this can articulate an aposiopesis when guiding a path through the rough area because there will be not much view on the course of the path.
The Randschlauch can be partly filled, when material has to be dumped somewhere, but not completely to keep the linear structure clear. The pumping has to keep working, because the conditions may be a bit wet but not too because then animals and people cannot enter the place anymore. The place has to be stabilized. Furthermore succession will take over the development of the Randschlauch, eventually supported by the creation of a little extra relief or adding a fertilizer to speed up the vegetation growth.



the 'Randschlauch as linear connection between nature areas is at the same time an exciting place for hiking; when succession develops there is less and less view on what will be next

16. *apostrophe* *dump* *construction and connection of infrastructure*

In this design principle the narrative principle apostrophe is combined with the (re)connection of infrastructure in the dump area. By using old railroad tracks from coal transport systems, a slow train for tourists can guide people through the post-mining landscape in transition towards a new future. When creating a scenic route for the train, the attention is focussed which is what the apostrophe means to do. The old railroad tracks have to be re-used and a train has to be found. The area in the dump where people come has to be secured by stabilization measurements. The train should be connected to several locations in the surrounding, to parking lots where tourists can leave their car to get on the train.



creating a tourist slow train with former rail road tracks in the mine restores the accessibility for people into the mine, can be designed as a scenic route and is a reference to the past at the same time

Design principles

17. *anachronism* *dump* *erosion*

Directly after mining, the dump is full of material which has been dumped in parallel ridges in the landscape, mapping the mining process. This dump is not suitable for any other form of land use, which makes landscape rehabilitation necessary in almost any case. But conserving some of the ridges in the landscape can create spectacular references to the past. Due to the bad soil conditions of these conveyer bridge ridges, they remain barren for decades. Erosion processes have free play, which is interesting to watch over time. When no people enter the ridges and view is provided from a distance, no additional measurements have to be undertaken.

also characteristics from the dump during mining activities are worth conserving in the landscape as notable landscape features articulating the history of the site.

There must be much more possibilities to create combinations between the landscape rehabilitation and narration principles with each other and with a subdivision of the mine. This is however a promising selection of appropriate possibilities for Lusatia, to combine landscape rehabilitation and narration into the design for an interesting landscape.

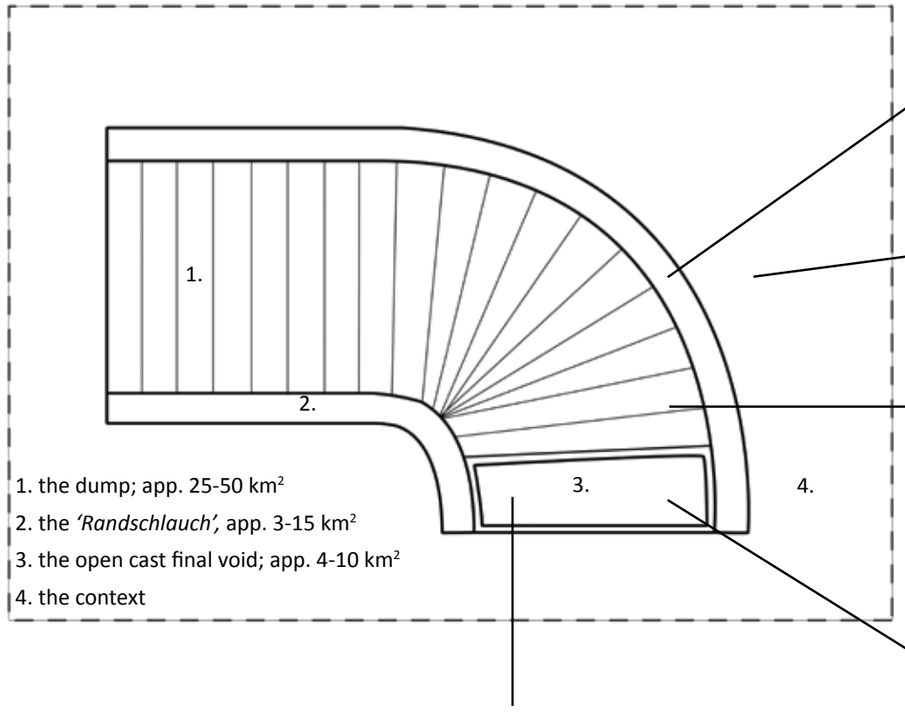
It is striking that narrative principles can be explained in more than one way, and that the same thing in the landscape can articulate more than one narrative principle in return, which is shown in the F60 visitor monument, which illustrates the narrative principle ‘exclamation’ (on page 114), but also the design principle anachronism + open cast final void + new land uses: leisure landscapes (on page. 139).

Also in the articulation of the memory the context is not used, except in relation with interventions on the dump, the *‘Randschlauch’* or the open cast final void, to emphasize a contrast or to reconstruct connections. Therefore, the context is still an essential part of the subdivisions of the mine.
For the other three subdivisions of the mine counts that there are five or more design principles elaborated. It seems that there is a covering design possible with use of the landscape rehabilitation and narration approach. To test this, in the last paragraph of this chapter two combinations of design principles are put together, to see whether it is possible and satisfying to make a rehabilitation design for the mine using one of the principles for the dump, one for the *‘Randschlauch’*, one for the open cast final void and what intervention is suggested then for the context.

Design principles

8.4 Test I: design principles on the typical Lusatian brown coal mine

In the following two examples design principles have been put together to cover the four subdivisions of the mine site. This is meant to check whether it is possible and desirable to design the landscape rehabilitation and narration for the mine site using the design principles.



1. the dump; app. 25-50 km²
2. the *'Randschlauch',* app. 3-15 km²
3. the open cast final void; app. 4-10 km²
4. the context

windmills on the former 'Randschlauch'

re-use of old rail road tracks for tourist train

agricultural strip cropping system on the dump

transformation of the former conveyer machine into a visitors monument

lake in the former open cast final void

8

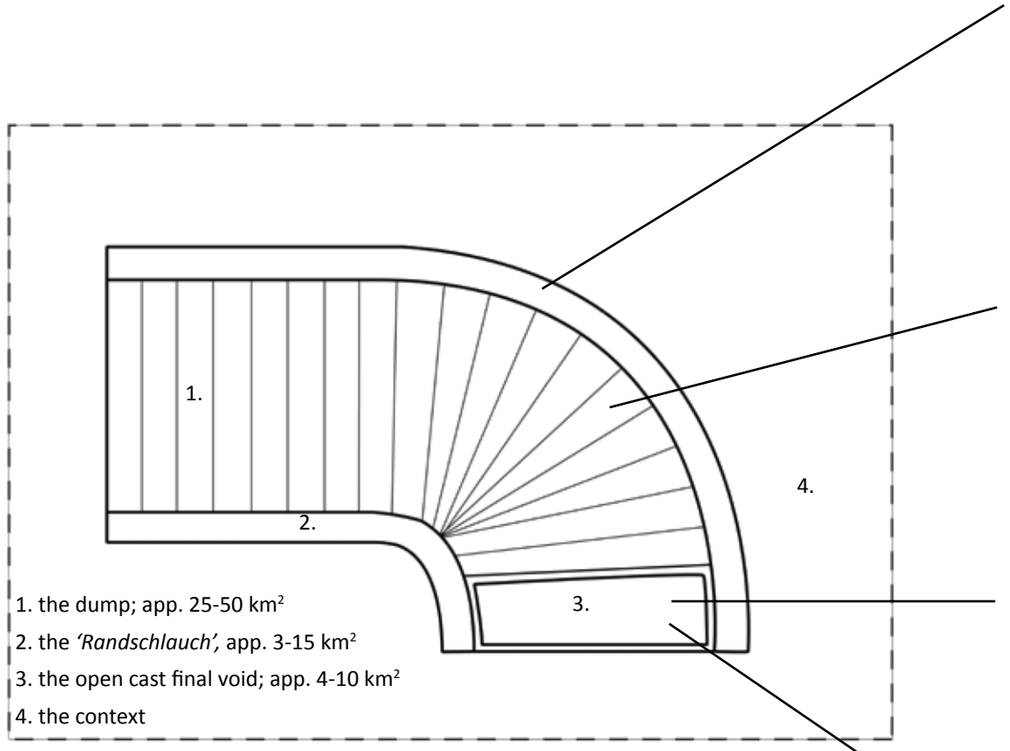
In this composition the entire dump is arranged for a strip cropping system, to yield and improve the soil at the same time. The dump is rehabilitated over time till a fertile and solid soil is created. The crop rotation system starts as soon as possible as the dump can be tilled, probably with perennials that do not demand from the soil but mainly improves the structure and bind nitrogen. In the beginning there is not much to see, but the system will expand when the mine moves on. The crops change every couple of years, and when possible crops that have higher demands in soil quality can be farmed. The system can be kept for decades for a good result. Then other land uses may be urgent and the system can be changed. The development time and the strict direction of the rows in the crop system refer to the mining system before. Therefore the crop rotation system tells the chronicle in this composition.

The *'Randschläuche'* are filled up with material from the dump so that the dump stays a bit lower but on the former gullies ridges comes to exist. On these artificial heights a row of windmills is planted. This is an inversion of the old situation and emphasizing the crossing of the context and the mine. The use of renewable energy is a sign of transformation, but keeping close to the region's identity as an energy centre.
The open cast final void will be flooded with external water so that a lake will exist, which is a transformation too and a contrast with the surroundings. The former conveyer bridge, which will be transformed into a visitors monument, will get a place near the lake, since this is the 'natural' place where this machine has done its last conveying work. In the entire mine the old railroad tracks are re-used to facilitate a tourist slow train. People can get on the train at the visitor monument and cross the area with a guide. The conveyer bridge and the tourist train are references to the mining history, and get people in the mining area again. These design measures articulate the memoirs in this composition.

Altogether a landscape comes to exist where renewable energy is produced, that is interesting for tourism and works in the meantime on the rehabilitation of the soil quality, for eventual future purposes of the big dump area.

Design principles

In the following composition the focus is on nature landscapes and energy production.



1. the dump; app. 25-50 km²
2. the *'Randschlauch',* app. 3-15 km²
3. the open cast final void; app. 4-10 km²
4. the context

water course in the former 'Randschlauch'

agricultural rotation system with renewable energy on the dump

nature area in the open cast final void

conveyer bridge ridges conserved in the landscape

In this composition the narrative principle rhythm is combined with a crop rotation system with the production of renewable energy. Like strip and alley cropping systems, the growing of certain perennial grasses, or later even agricultural crops, improves the soil conditions over time. By combining the system with wind mills or solar panels, renewable energy is generated in the meanwhile which is profitable. First, the surface needs to be created with the spreader and bulldozer. Probably, the surface needs stabilization. The soil needs to be fertilized, preferably with organic waste. The windmills or solar panels can be positioned in a rhythm, on the dump, in the direction the former conveyer bridge moved. After twenty years, the windmills or solar panels need to be replaced by newer versions or other desirable land use. In this way the chronicle is articulated in the landscape.

The *'Randschläuche'* are filled with water, to mark the crossing between the context and the former mine. At the same time they catch the rising ground water when the pumping stops. When clean external surface water is added, the water quality in the area will be improved. When the water balance is restored again, the water can be used to water the crops that are combined with the renewable energy production on the dump area. The water in the 'Randschlauch' contrasts with the new land use on the dump. The open cast final void is filled with material from the dump. The entire surface will be lowered a bit, but that is not so bad. On some areas relief should be created so gradients come to exist like dry and wet, high and low, and steep and flat areas. The different conditions attract rare species, also because the mining area has been left alone by people for a long time. In this nature area ridges of dump material from the conveyer bridge can be left alone to see how succession will take place over time. The amazing strength of nature to recover itself will show on the long run, contrasting the devastation of the mining period, and pretty few in rehabilitation measurements has to be done.

Altogether a landscape comes to exist where the production of renewable energy is important, which strengthens the desired identity Lusatia as an innovative energy region.
In other parts, nature can develop on its own. The people who are really interested, can recognize the area of the former mine by the water course in the previous *'Randschläuche',* the time development and plant direction of the crop rotation system with renewable energies and the conveyer bridge ridges in the nature area. This is how the memoirs is articulated in this composition. The nature area can be visited by people and used for research into nature development on post-mining landscapes.

From the two compositions one could say that:

1. it is certainly possible to design all of the four subdivisions of the mine with the landscape approach, either passive (context) or active (dump, 'Randschlauch' and open cast final void) using design principles based on integrated landscape narration and rehabilitation principles;
2. in fact it is necessary to design the entire mine site in one plan, because the different design principles mutually influence each other, mainly in the construction of a narrative. When for example a contrast is to be created, to emphasize the contour of the former mine site, the design for the three subdivisions of the mine should be tuned to each other;
3. and sometimes more than one design principle can be applied on one area. In the first composition, there is a strip cropping system to rehabilitate the soil at the dump and to articulate a chronicle, but also a tourist train referring to the mining period and to show it all to the people. The design can be made more complex, and more interesting when applying more design principles, especially when tourism is desired like in the first composition.

In chapter nine another composition of design principles will be elaborated for the specific situation in the mine Klettwitz, and here the design is made more complex by using more design principles per subdivision of the mine.

9

TEST II: KLETTWITZ

Test II: Klettwitz

In chapter 9 an alternative plan will be presented for the former mine site Klettwitz. Part of the reconstruction plan and new plans are already executed by the LMBV and others on this site, which means that the alternative plan is imaginary. The information that is already known about the former mine site Klettwitz, like the size, direction and the time span are taken along as data in the new plan. The alternative plan departs from the context as it is at the moment. In the imaginary case the mine KLettwitz starts mining in 2010. This means that the trends and principles that are investigated can be used as starting point.

First, the existing situation will be discussed. The reconstruction plan and other executed plans show the development of the mine site Klettwitz. After the existing situation, a short analysis of the possibilities for a new 'imaginary' future of Klettwitz will be presented. From this, design principles can be chosen and a new ground plan with the same level of detail as the reconstruction plan will be created. The design principles which we think are most appropriate to articulate the chronicle of mining and rehabilitation and the memoirs that refer to the mining history in Klettwitz are chosen. Impressions illustrate the new composition. The development of the proposed plan over time is shown as well in this chapter.

9.1 The mine Klettwitz and the reconstruction plan

As mentioned in Chapter 3, the mine Klettwitz started in 1951 and developed counter clockwise around Kostebrau where in 1991 the mining operations ended. So the mine operated for forty years. Kostebrau is situated higher than the surroundings, because the mine lowered the surroundings. Kostebrau is almost a peninsula and can therefore serve as a look out point over the mining and rehabilitation operations (Fig. 9.1).

Reconstruction plan

The reconstruction plan is a zoning plan which gives a general impression of the future landscape of the area of a mine (Fig. 9.2). For the mining area Lauchhammer, where the mine Klettwitz is part of, also in 1993 a reconstruction plan is made as aready mentioned in chapter 3. For Klettwitz a lot of forest was planned. Also a big lake, agricultural fields and 'Renaturierungsflächen' were planned.
After this plan was made, several changes were made for the mine KLettwitz. For example the open cast final void will not become a lake anymore because the water rises too slow and therefore it is filled with material from the mine Klettwitz-Nord. Also windmills were placed in 2000 and 2004 on the agricultural fields. The 'NABU-Stiftung Nationales Naturerbe' purchased between 2003 and 2006 area for nature areas, including areas in the former mine Klettwitz.

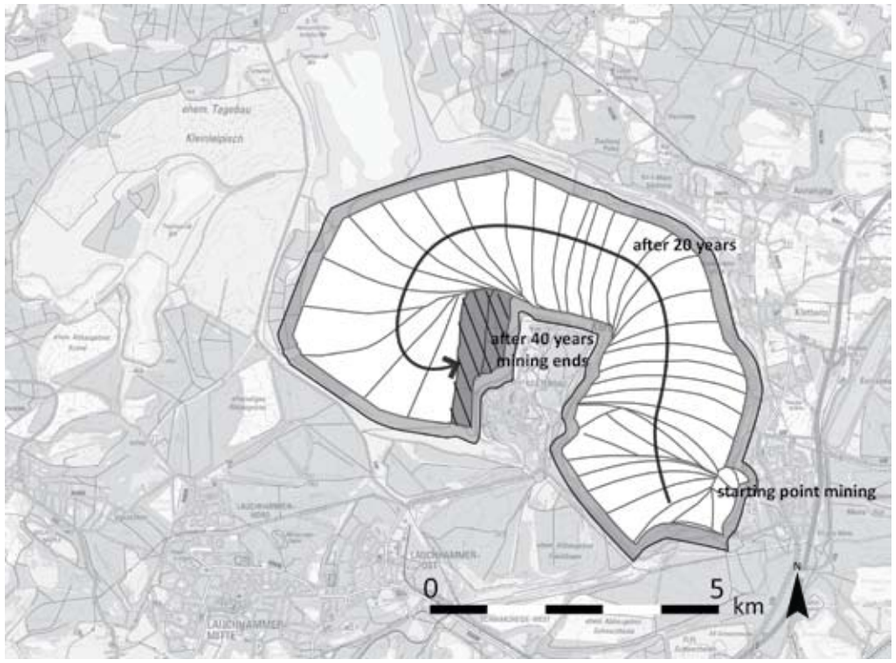
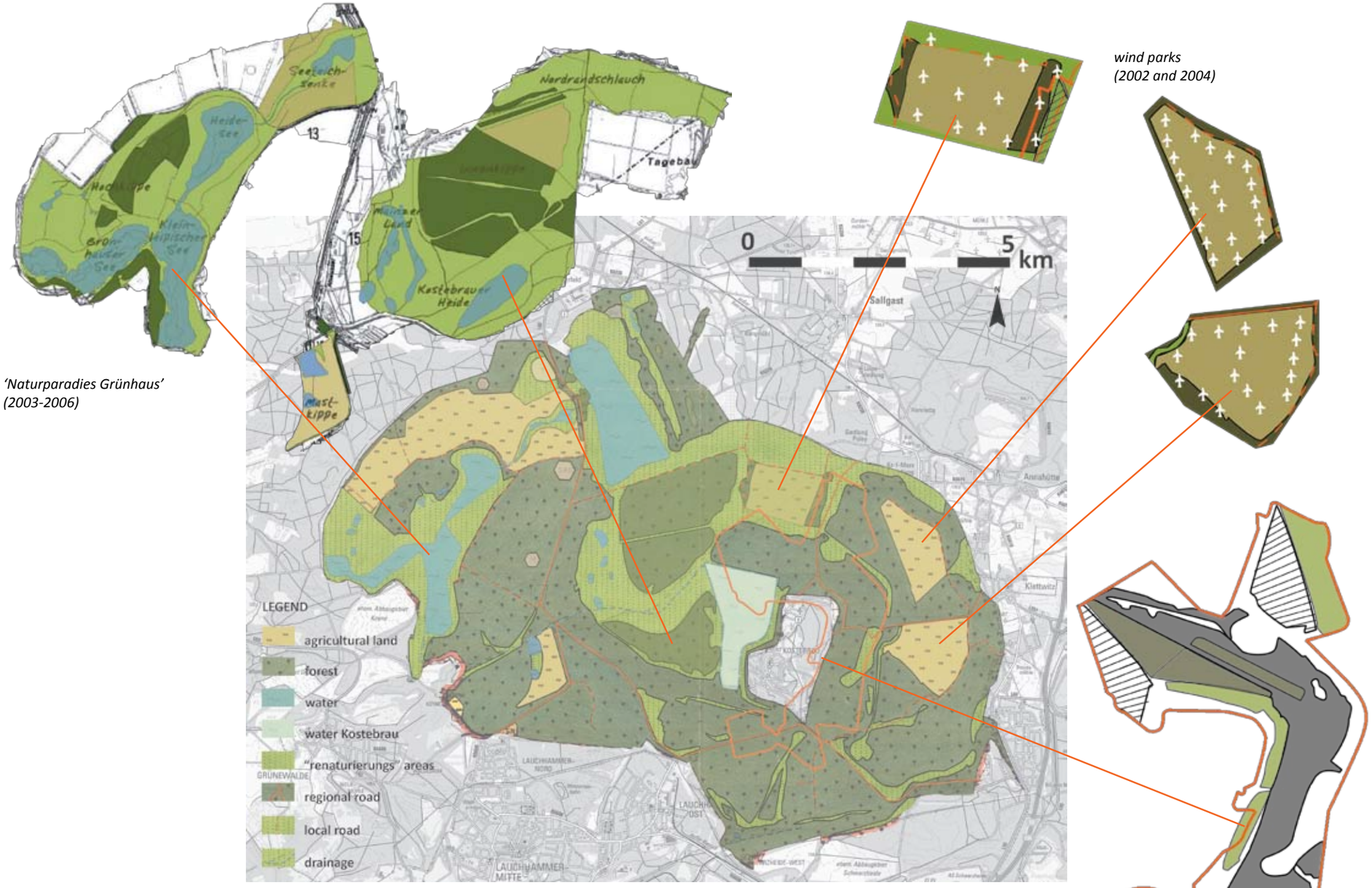


Figure 9.1: Mine Klettwitz with the different parts: dump, 'Randschlauch', open cast final void and the context.

The last big change in the reconstruction plan is the energy forest that is planned around Kostebrau. In 2007, the first trees were already planted.

Although the alternative plan, that will be presented later on in this chapter, starts from the idea that mine Klettwitz is excavated again from 2010, the information that we already know can be taken into account when making the new plan. So, a new interpretation for this area can be given with help from existing information.



'Naturparadies Grünhaus'
(2003-2006)

wind parks
(2002 and 2004)

Reconstruction plan 1993

energy forest Kostebrau
(2007 and 2008)

Figure 9.2: Reconstruction plan from 1993 with later changes and additions

Test II: Klettwitz

9.2 Analysis of the context and trends in the mine Klettwitz

Trends and the analysis of the current context are taken into account for the new plan. Trends can help with the filling in of the program for the new landscape and the context gives information about connections and lines that should be restored.

Trends

As discussed in paragraph 2.4, several trends can be seen in Lusatia. Production forest is of economical value for the future as it was already in the past. In the past these forests were monotonous pine forests but nowadays the forests are more natural grown with mixed species like the birch, red oak, black locust, poplar and common alder. These have more ecological and recreational value.

For Europe it is decided that the loss of habitat must be stopped. The European Natura 2000 network and the German 'Bundesweiter Biotopverbund' are political initiatives to prevent the habitat loss. Since mining areas have been restricted areas for a long time, they offer large unbroken habitats, characterized by nutrient poor, differentiated and dynamic conditions. Therefore mining areas are already used and can be used in the future for nature development.

It is important for Lusatia to diversify the economy and to create jobs. Tourism and renewable energy can provide in this for the future.

General tendencies in tourism are an increased demand for short breaks and weekend trips to destinations that have a special character, out of the ordinary, but close by. The Lusatian post-mining landscape with its industrial heritage can offer these special, out of the ordinary landscapes for experiences.

All over the world, but also in Lustatia the transition towards sustainable energy is becoming very important. For Lusatia it is important to stay an energy region but then in a new way, focussing on a economy and technology of renewable energy.

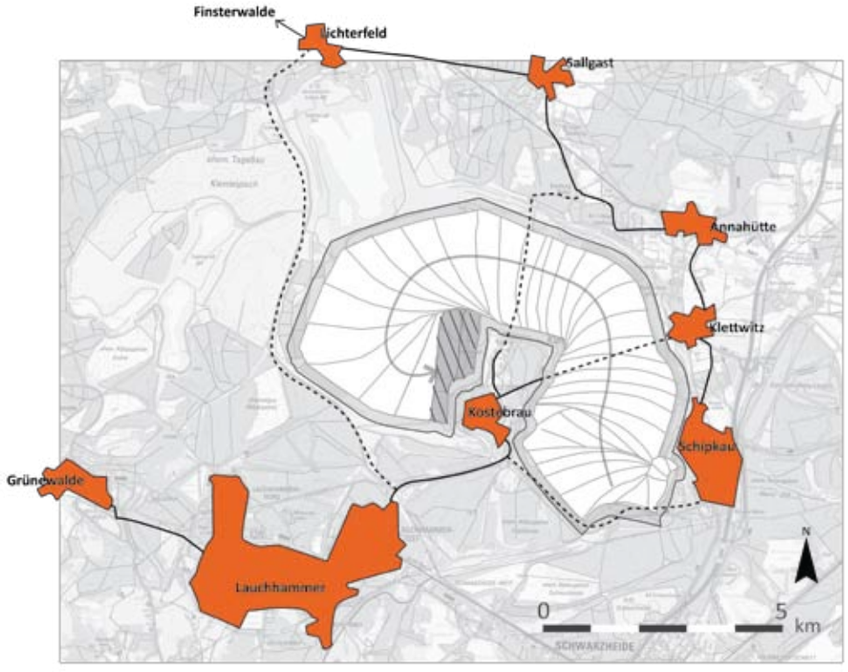


Figure 9.3: Reconnecting the villages around the mine with Kostebrau

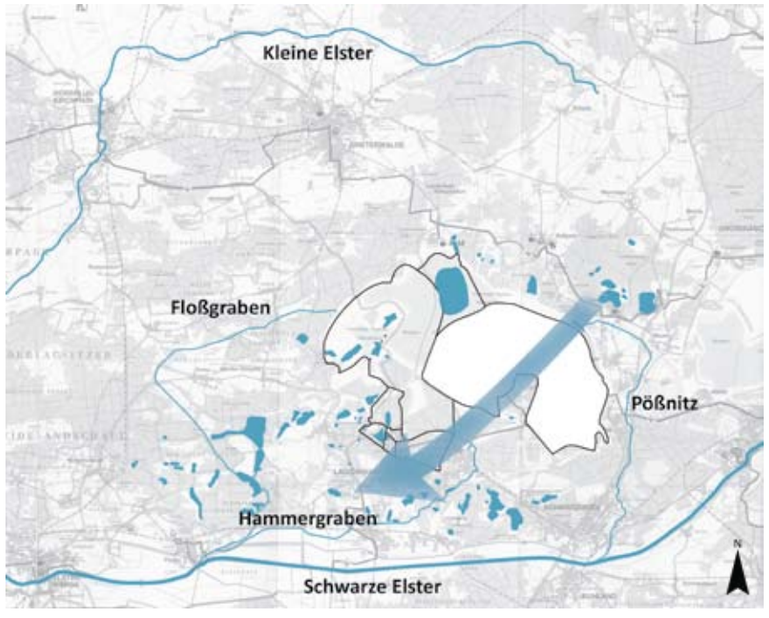


Figure 9.4: Guiding the water system: from north east to south west in the area

Analysis of the context and connections mine Klettwitz

Just like the trends, the context of the mine also gives cause for future development. The developments in the context show comparison with the trends. This is an opportunity for the mine Klettwitz to strengthen the positive developments in Lusatia for the future.

First of all, there are some general aspects concerning the context that need to be developed again in the plan for the mine Klettwitz. Infrastructure needs to be constructed to enable movements again in the area and to connect the different places. This can be routes for fast and slow traffic. In the case of the mine Klettwitz it is important to connect Kostebrau again to the surrounding area (Fig. 9.3).
Besides infrastructure it is important to guide the water flows. In the area of KLettwitz the main direction of the water is from north east to south west (Fig. 9.4). The water is guided to the river Schwarze Elster. To keep the water inside the area channels should be made smaller and eventually more natural.

The area around the mine Klettwitz has a high nature value. Since the starting point for the development of the mine Klettwitz is the existing context, several areas are important.

First, the redevelopment of nature area Grünhaus west of the mine is important. This area is connected to a bigger area of natural value, namely Nature Park 'Niederlausitzer Heidelandschaft'. Southern of the mine Klettwitz are some older mixed forests, which have ecological value too. The last important area is north of the mine. During mining activities of the mines in mining area Lauchhammer, a lot of animals migrated to this area. This means that this area is not official a nature area but has potential to be one. And it is important that the fled species can re-enter the former mining site again from here (Fig. 9.5).

The current context also shows development of tourism and energy. In the north, the F60 overburden conveyer bridge is placed on a terrain which became used as event space. The F60 is a tourist attraction which people can visit. South of the F60 a lake is developing that will be used as a recreational lake in the future.
South of the area Klettwitz, Lauchhammer is situated. Lauchhammer is a town which wants to present itself as a city of energy economy and technology. The company Vestas is situated here, which makes rotor blades for windmills. Besides, industrial heritage like the 'Biotürme' is present in Lauchhammer, which is also a tourist attraction (Fig. 9.6).

Figure 9.5: Important areas with ecological value

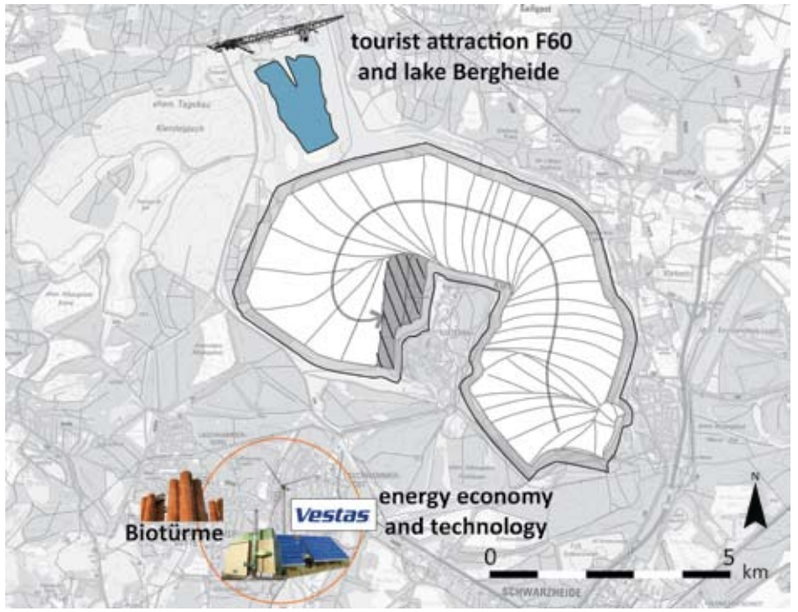


Figure 9.6: Tourist attractions in the north of Klettwitz and energy technology in Lauchhammer

Test II: Klettwitz

9.3 The plan for Klettwitz

From the previous, starting points for the new plan for Klettwitz can be formulated.
From the existing information of the mine Klettwitz, the following will be taken along:

- time development of 40 years
- direction of the mine; counter clockwise around Kostebrau
- slow rising of groundwater

Also the trends are taken along in the plan and other important future land uses:

- production forest
- nature
- tourism
- renewable energy

From the analysis:

- the construction of new connections between places
- connection of areas with nature value
- guiding the water system
- make use of the existing developments around the mine area, like Lake Bergheide in the north and the energy identity of the town Lauchhammer

Going back to the thesis in chapter four, the new plan of Klettwitz needs to integrate landscape narration with a landscape based approach to rehabilitation.

Time phasing

The time span of this mine is forty years. During mining activities in those forty years also rehabilitation activities begin. And even new land uses are created. Therefore the new plan is described in different time phases. It starts in phase one, when the first excavation activities start. Of course before this phase the site is prepared for mining activities.

Phase 1: 2010

Phase 1 is the imaginary start of the mining activities (fig, 9.7). We start from a blank surface; the existing typology has already been removed. First, machines like the bucket wheel excavator and the bucket dredger remove the first material and start digging a hole in the surface. When the hole is big enough the overburden conveyer bridge can be placed next to the excavators to remove overburden material and to place it again on the dump.

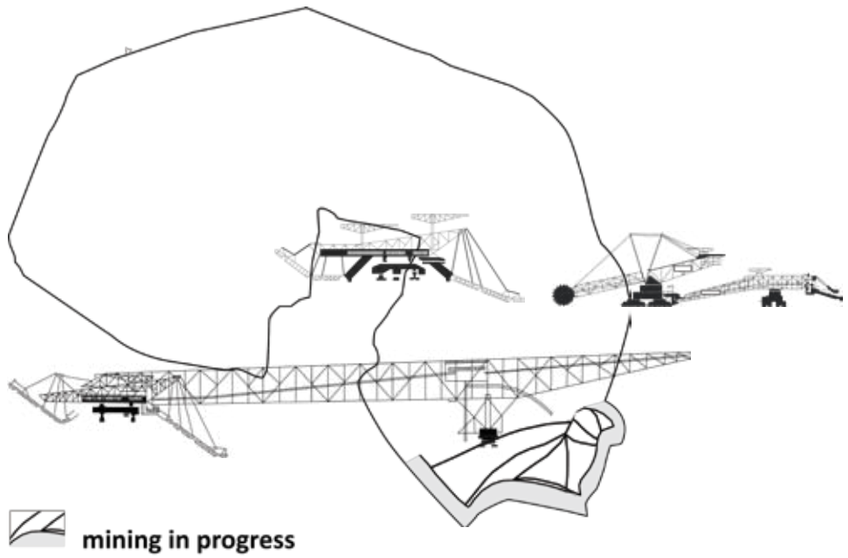


Figure 9.7: Start of the mine Klettwitz in 2010

Phase 2: 2020

The mine is already ten years on its way (Fig. 9.8). In one part of the mine the excavation activities are in full blast. In the beginning of the mine area, rehabilitation activities can start. This means that the overburden material is spread by the spreader, the bulldozer makes the ridges flat and the soil needs stabilization and fertilization. The fertilization can be done by organic waste. Organic waste is preferred because it is a way of waste recycling.
The southern 'Randschlauch' can be spread with overburden material, because the 'Randschläuche' in the east and the south of the area are filled and at some places heightened because in the future windmills will be placed on those heights. The heights need stabilization and also erosion prevention on the slopes. Therefore the slopes can be planted with grass and pasture with sheep (Heideschnucke) can do the maintenance of the area.

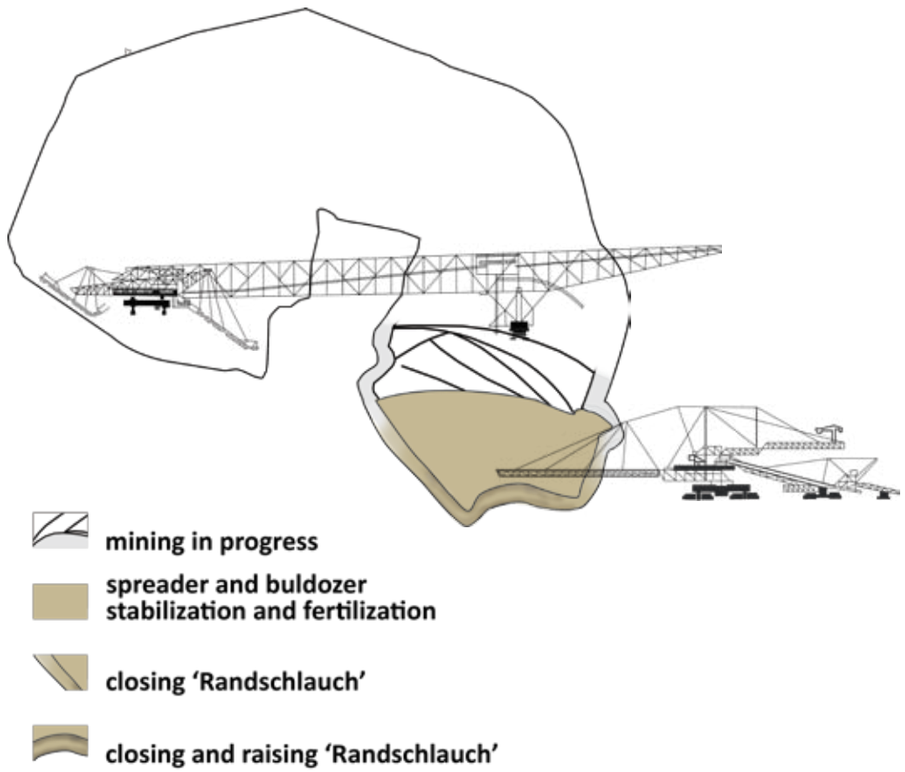


Figure 9.8; Continued mining and start of the rehabilitation of the mine Klettwitz in 2020

Phase 3: 2030

At this point, the mine is half way (Fig. 9.9). The first part of the mine can start with an alley cropping system for improving the soil. Besides that they improve the soil, biomass trees that will be planted are profitable. The trees are small when the first alleys are planted. Suitable trees and that grow well on the poor Lusatian mine soils are

- Robinia (black locust)
- Populus (poplar)

The alleys can be planted with for example:

- Medicago sativa (lucerne)
- Lupinus (lupine)
- Secale cerale (summer and winter rye)

Lupine and lucerne bind nitrogen from the air into the soil which increases the fertility over time. The crops are alternated with fallows. When the soil of the southern 'Randschlauch' is solid enough, the windmills can be placed on the heights. A road is constructed to connect Kostebrau with Schipkau again. In the second part of the mine the overburden material is spread, the soil is stabilized and fertilized. The 'Randschlauch' around Kostebrau is not filled with material, because it will be a water body in the future. The water can slowly start to rise from the moment that the mining activities allow it.

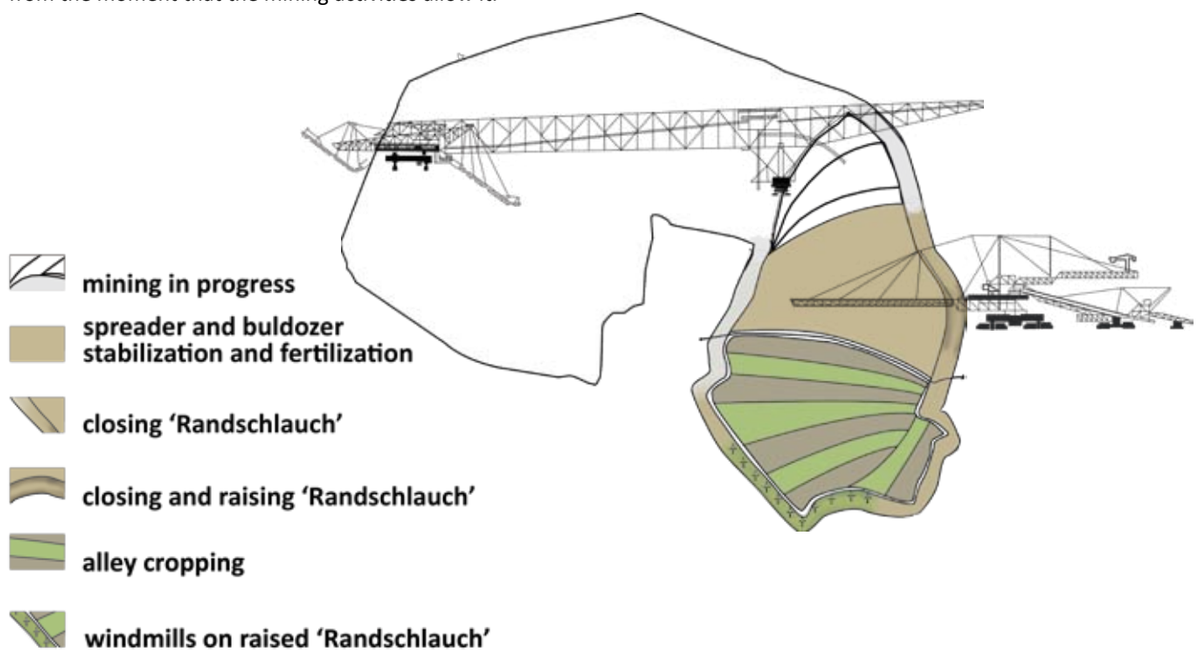


Figure 9.9: Continued mining and rehabilition of the mine Klettwitz in 2030

Test II: Klettwitz

Phase 4: 2040

In phase four, the machines still have to excavate the last one third of the mine (Fig. 9.10). In the first part the trees and crops from the alley cropping system have grown high and the trees can almost be chopped to supply for energy. In the second part the alley cropping system has just begun growing. A second road is constructed between the second and the third part of the mine to reconnect Kostebrau with Annahütte. In the third part of the mine the overburden material is spread, the soil stabilized and fertilized.

On the 'Randschlauch' in the east, the other wind mills can be placed now. The water in the 'Randschlauch' around Kostebrau very slowly rises. The slopes of this 'Randschlauch' need stabilization by means of 'Rütteldruckverdichtung' before the water rises too high. When the 'Randschlauch' is filled, it will accentuate the special location of Kostebrau.

The northern and the western 'Randschlauch' will be used for nature development and a path for animals and people. The 'Randschlauch' is necessary to make a connection for species to migrate between three adjacent areas of ecological value. The spreader will fill the 'Randschlauch' till it remains maximum 15 metres deep and makes height differences and narrows in it. The slopes have to be stabilized, but small scale erosion processes are not prevented. In the beginning it is an open space, but slowly rain water will be collected in the 'Randschlauch' and vegetation will start to develop. Because a secure corduroy road will be created in the 'Randschlauch', people can watch and enjoy the play of erosion and succession that takes place here. In the 'Randschlauch' the people do not see the end while walking the corduroy road because of vegetation, height differences and curves in the 'Randschlauch'. This makes it an exciting route. First species that will grow are for example on the raw soils:

- Corynephorus canescens (grey hair-grass)
- Festuca ovina (sheep's fescue)
- Calamagrostis epigejos (wood Small-reed)
- Agrostis vulgaris (hair-grass)
- Oenothera parviflora (evening primrose)

and on the more wet places:

- Juncus bulbosus (bulbous Rush)

In this part of the 'Randschlauch' the pumping will go on. This water can be used for other parts in the former mine that need water, like the biomass trees, or to fill the water body around Kostebrau.

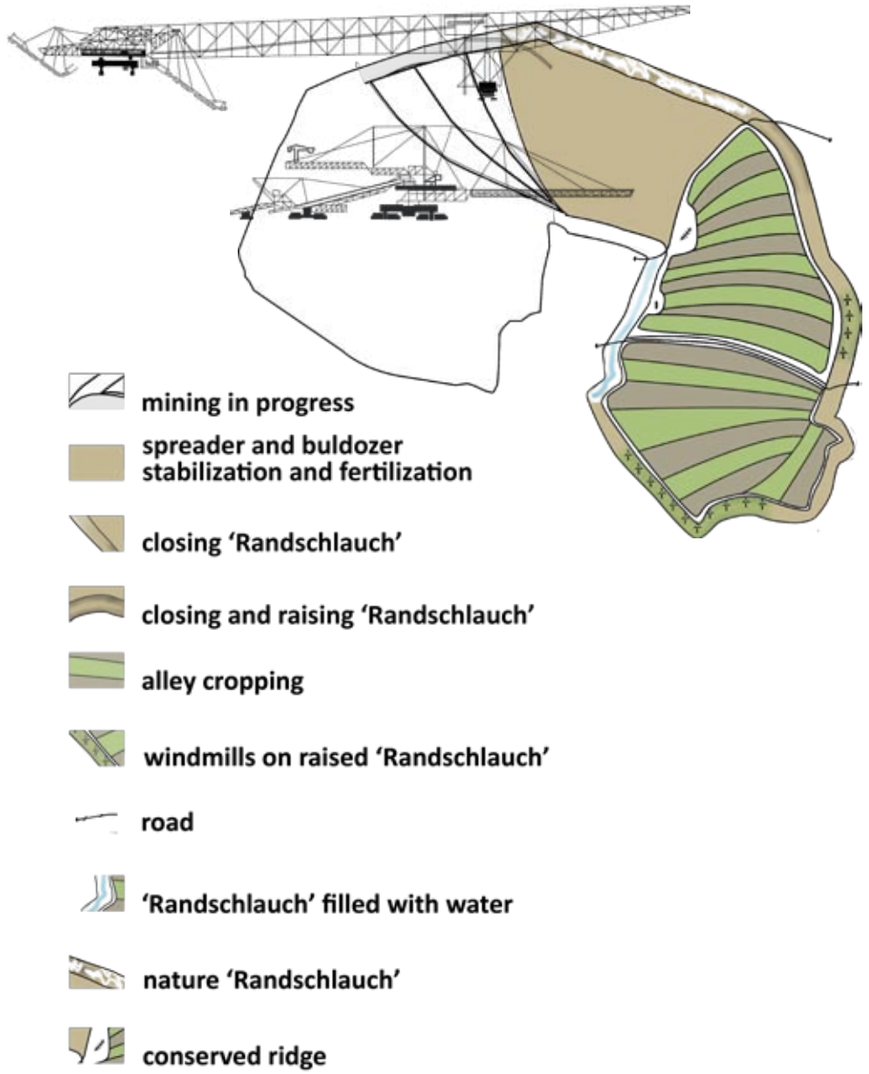


Figure 9.10: Continued mining and rehabilition of the mine Klettwitz in 2040

Phase 5: 2050

At this moment the last brown coal has been excavated (Fig. 9.11). While the last part of the mine still needs stabilization and fertilization, in the middle part the crops and trees of the alley cropping system are growing already faster than in the beginning. On the first part of the alley cropping system, the trees have been chopped, the soil has improved a lot and therefore the alley cropping can be replaced with the production forest. The production forests differ from the past, they are more differentiated now. This reduces the production value a bit, but gives a much better appearance and it is also enhances the ecological value and the further improvement of the soil. Trees that can be planted well in the production forest are:

- Betula (birch);
- Quercus rubra (red oak);
- Robinia (black locust);
- Populus (poplar);
- Alnus glutinosa (common alder);
- and Pinus sylvestris (pine).

At this moment, it can be seen clearly that there will be three different typologies for the ‘Randschläuche’ in this composition. In the south and east, it is filled with material and heightened at some places with windmills on top. In the north going southwards, a nature ‘Randschlauch’ develops where also people and animals can pass through. Around Kostebrau a water ‘Randschlauch will be created. In later succession stages in the nature ‘Randschlauch’ trees start to grow like the:

- Betula pendula (silver birch);
- Pinus sylvestris (Scots pine);
- and Robinia pseudoacacia (black locust).

and even later:

- Quercus robur (English oak)
- and Quercus rubra (red oak).

Some of the animals that will occur here will be

- birds: sand martin (Riparia riparia);
  small plover (Charadrius dubius);
  hoopoe (Upupa epops);
  tawny pipit (Anthus campestris);
  common crane (Grus grus);
  and wild goose (Anser anser);
- amphibians: North american green toad (Bufo debilis);
  and European green toad Bufo viridis);
- insects: dragonflies (Odonata);

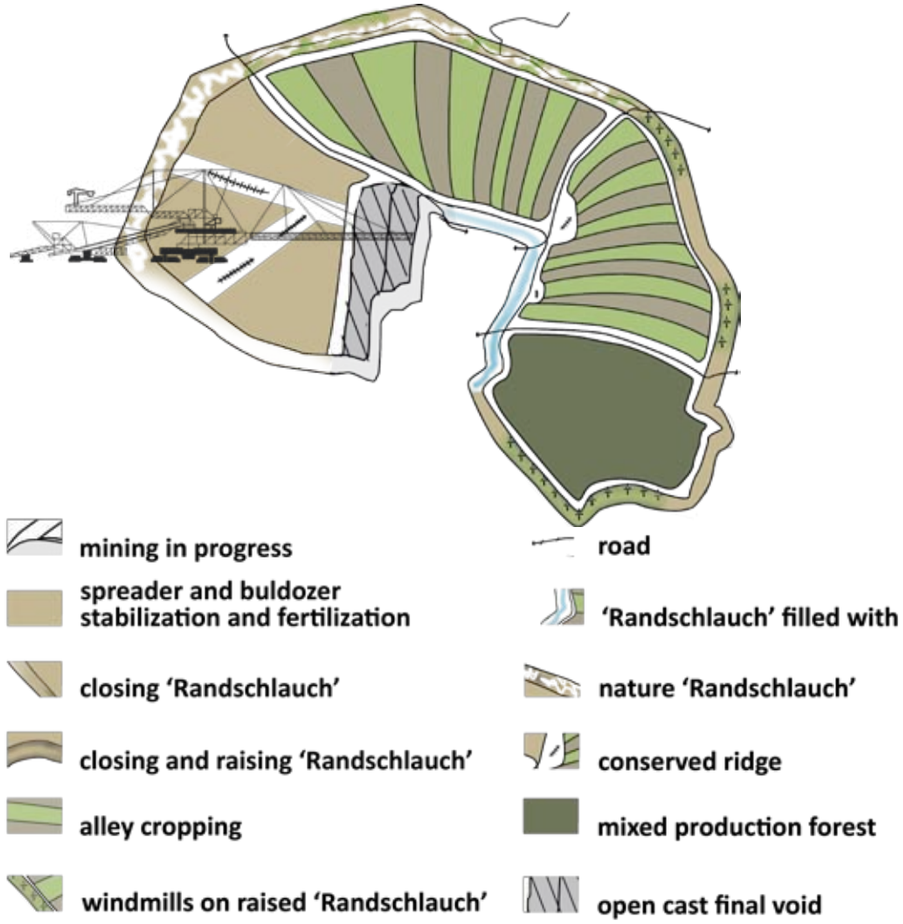


Figure 9.11: Continued mining and rehabilition of the mine Klettwitz in 2050

  and sand wasp (Bembix rostrata)
- mammals: European brown hare (Lepus europaeus);
  and later roe deer (Capreolus capreolus);
  wild boar (Sus scrofa);
  red deer (Cervus elaphus)
  and when the area is connected even further to Poland and the Nature Park Niederlausitzer Landrücken in the north, the grey wolf (Canis lupus) may come.

Now the mining has stopped, the mining equipment should be removed from the place and the open cast final void can be prepared for the future solar panels. This mainly concerns stabilization measurements, and some fertilizer, preferably organic, is to be added to support the grow of a ground cover.

Test II: Klettwitz

Phase 6: 2060

In phase six it is ten years after closure of the mine. Still the developments on the former mining site are going on (fig 9.12).

At this moment there is a great solar panel field on the place of the former open cast final void. The size is 1.3 square kilometres, which can supply energy for 32,500 households, which is much more than the town Lauchhammer needs with its 19,000 inhabitants. So the mine can export energy again, like in the early times, but now as an inexhaustible source. This field, which is really large, is a statement towards the large scale brown coal mining that was there in the past. The energy production refers to the earlier function of the region. While sticking to the old energy identity, the transition towards clean and renewable energy improves the image of the region at the same time.

The village of Kostebrau is the starting point for entering the area. When driving to Kostebrau from the south-east, following the road L60, the first introduction to the area are the windmills on the former southern 'Randschlauch' (Fig. 9.13 and 9.14). The 'Randschlauch' was a gully during mining activities, but is filled now with material from the dump. To accentuate the edge of the former mining site, a row of windmills is placed on the 'Randschlauch'. To exaggerate this, and for the windmills to catch more wind, the 'Randschläuche' are not only filled but also elevated with 8 metres compared to the surroundings. This is an anomaly, since it inverts the previous situation of a gully. The rehabilitation here is that the 'Randschlauch' is filled, elevated and stabilized, and than planted with grass, pastured by sheep, to prevent the new slopes from erosion. The windmills are a new and profitable land use.

In Kostebrau, you can park at the new information centre where information is exposed about the transformation of the landscape around Kostebrau. Since the mining excavated the surroundings, Kostebrau is like an elevated peninsula in the former mining site. Towards Annahütte and Schipkau fast traffic routes are recreated, to connect Kostebrau again. On the peninsula, there is a path of about 3.5 kilometres length from which you can overlook the rehabilitation activities around. This path is designed as an apostrophe, because it directs the attention by walking the route. There is also a path from Kostebrau into the mining area, connecting Kostebrau to the visitor monument F60 and Lake Bergheide in Lichterfeld at the other side of the mine. This is a slow traffic route, also connected to other slow traffic routes or walking paths in the surroundings.

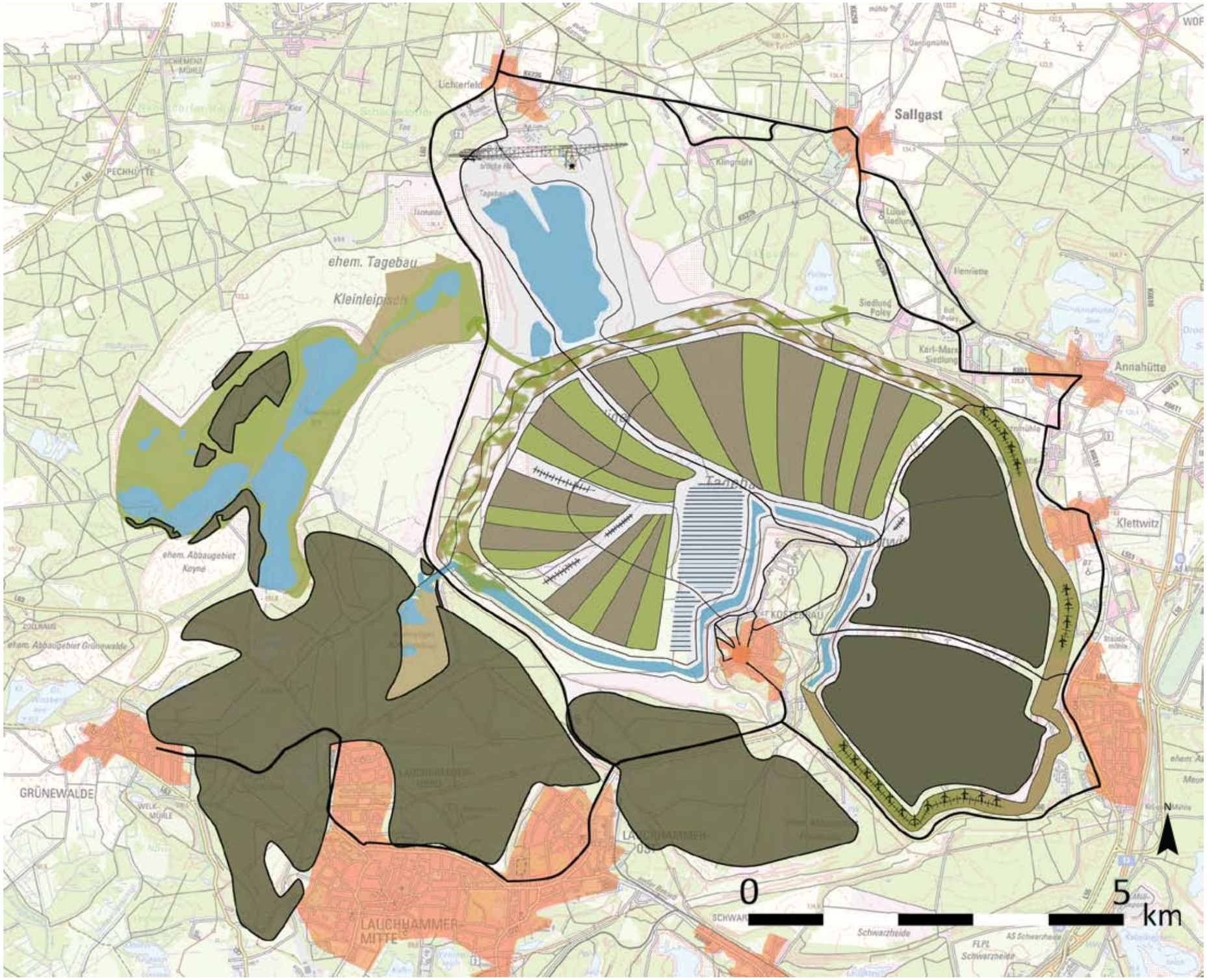
From Kostebrau, some conserved features of the mining time are visible. These are former conveyer bridge ridges that are left alone in the landscape, like a landscape monument.

Because of the bad soil quality of the dumped soil substrates, the ridges will be barren even after many years. Erosion processes have free play and create interesting structures. When walking the path from Kostebrau to Lichterfeld, you are guided through this landscape monument (Fig. 9.13 and 9.16). The rehabilitation in this case is consciously doing as less as possible and show erosion as a process that creates interesting forms in the landscape. The path through these ridges should be made safe of course. The ridges articulate a reference to the past, which is in this case called an anachronism.

Following the path, one is guided through the alley cropping system. In phase 3 is explained more about the working of the system. What one can see now is the system in a younger and in an older stage, which causes variation in the large scale area and shows the influence of time on developments in the landscape. The planting lines of the alleys, the crops and the fallows in between are in line with the earlier direction in which the conveyer bridge moved, which makes the system a reference to the mining past. In the twenty years that the areas are in use for alley cropping, the soil is improved for later uses and produces even energy.

Looking back towards Kostebrau, one can see that its extraordinary location is even more accentuated because the 'Randschlauch' around Kostebrau will be flooded with water. Initially, external surface water can be added to accelerate the flooding which decreases the acidity of the ground water at the same time. In the end, when the pumping for the mining stops, the direction of the groundwater streams will be from north-east to south-west, like it was in the past. The 'Randschlauch' around Kostebrau catches the water from the surroundings, after which it is drained into the Hammergraben and ultimately into the Schwarze Elster. The rehabilitation here is the restoring of the water household.

Following the path from Kostebrau into the mine, the 'Randschlauch' is entered again at the place where the water 'Randschlauch' changes into a 'Randschlauch' for nature development and leisure purposes. How nature develops and will be developed here, is earlier described in phase 5. The corduroy road can be followed for a hike of 4 kilometres, after which one may turn towards Lake Bergheide and the visitor monument F60. Or one can hike another 6 kilometres towards the village Annhütte (Fig. 9.13 and 9.15). The nature 'Randschlauch' connects the nature area Grünhaus, in the Nature Park Niederlausitzer Heidelandschaft, with the forest on earlier mines in the south of the 'Randschlauch' and the area north of the mine, where many species fled to when the mine came.



LEGEND

dump
- alley cropping
- production forest

"Randschlauch"
- nature development
- windmills on heights
- water

open cast final void
- solar panel field

roads
- regional road
- local road
- slow traffic route

other
- information centre Kostebrau
- ridges in dump area
- tourist attraction F 60
- lake
- nature area
- forest
- build area
- water guided to Hammergraben
- nature areas connected through "Randschlauch"

Figure 9.12: Composition for the mine Klettwitz in 2060

Test II: Klettwitz

Near Annahütte the nature ‘Randschlauch’ changes into the windmill ‘Randschlauch’, which continues till the mine approaches the road L60 again. At height of the villages Klettwitz and Schipkau there are no windmills and there the ’Randschlauch’ is not elevated, to prevent noise nuisance and to enable a visual relationship from the surroundings into the former mining area. The path can be followed along the first row of windmills and continues through the production forest. This forest is a mixed wood, in this stage still very young but in the and of ecological and recreational value.
There are paths from Kostebrau going into the mine varying from 5 to 20 kilometres in length. This last one goes along the nature ‘Randschlauch’ which is only for walking and provides so a really interesting and challenging hike.

Back in Kostebrau, one takes the car again to follow the road L60 further in the direction of Lichterfeld. From the road, several open areas along the road enable view on the area. First the ‘Randschlauch’ that is filled with water is visible from the road. Behind it, the rows of the alley cropping system are recognizable. Then a view comes on the former conveyer bridge ridges in the landscape. Then the ‘Randschlauch’ continues as a nature area. In some parts, the area will be very low, so that the alley cropping system is still visible for a while. On other parts, the area is higher and wooded, so that no view is possible. Then at the end of the route the gigantic monument of the former conveyer bridge looms up, inviting for a visit.

The total plan makes use of the lines and conditions in the landscape created by the mining. In the first place this is done because the subdivisions of the typical brown coal mine are kept visible in the landscape and new land uses are searched that fit to the sites conditions.
On the dump the rhythm and time development of the alley-cropping system, and later the transition to the production forest, articulate the landscape chronicle. It belongs to the chronicle, that even after the production forest, something else can be grown or placed here, because a chronicle is about processes in direction and time and will go on also in the future. The ‘Randschlauch’, the open cast final void and the relations to the context are much more fixed for the future. They together built a long-lasting structure in the landscape, referencing to the mining past, accentuating important landscape features and permanently re-establishing new connections for humans, flora and fauna.

After 2060 there will be new trends and initiatives which are unpredictable now. The mine can develop along with these developments. In the first pat of the dump there is production forests now, but when these forests need to be chopped, new development can take place. This plan makes the area profitable from the first possible moment, by the choice for generating different kinds of renewable energy in various phases of the rehabilitation. The plan narrates the landscape chronicle that is going on here and establishes the identity of the region building on the past and future image of Lusatia as an energy region. At the same time, the plan rehabilitates the landscape in the meantime and prepares it for other land uses in the far future.

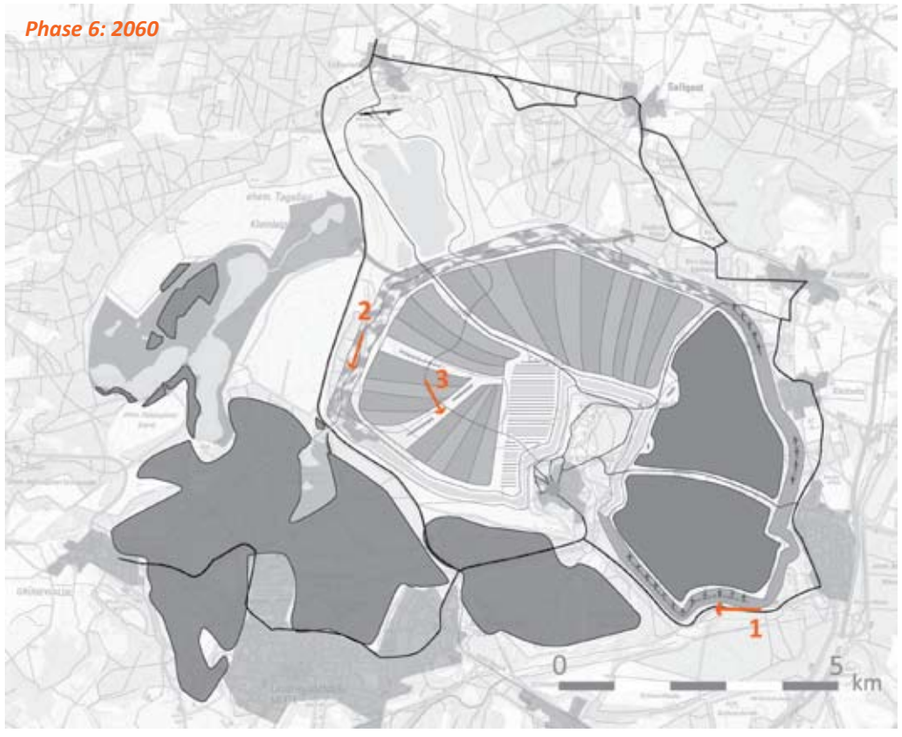


Figure 9.13: Locations of the impressions on the next 3 pages

Figure 9.14: Impression of the 'Randschlauch' with windmills when entering the area on the road L60

Figure 9.15: Impression of the 'Randschlauch' with nature development and corduroy road for hiking

Figure 9.16: Impression of the dump area with a conveyer bridge ridge as landscape monument

Test II: Klettwitz

9.4 Evaluation of the plan

Feedback to the design principles

Summarized, from paragraph 9.3 it can be concluded that the following design principles, nine in total, are used to create the final composition for Klettwitz in 2060:

anachronism + dump + erosion =

characteristic features of the mining dump are worth conserving in the landscape as notable landscape features articulating the history of the site. Rehabilitation is consciously not undertaken.

contrast + 'Randschlauch' + flooding with (external) surface water =

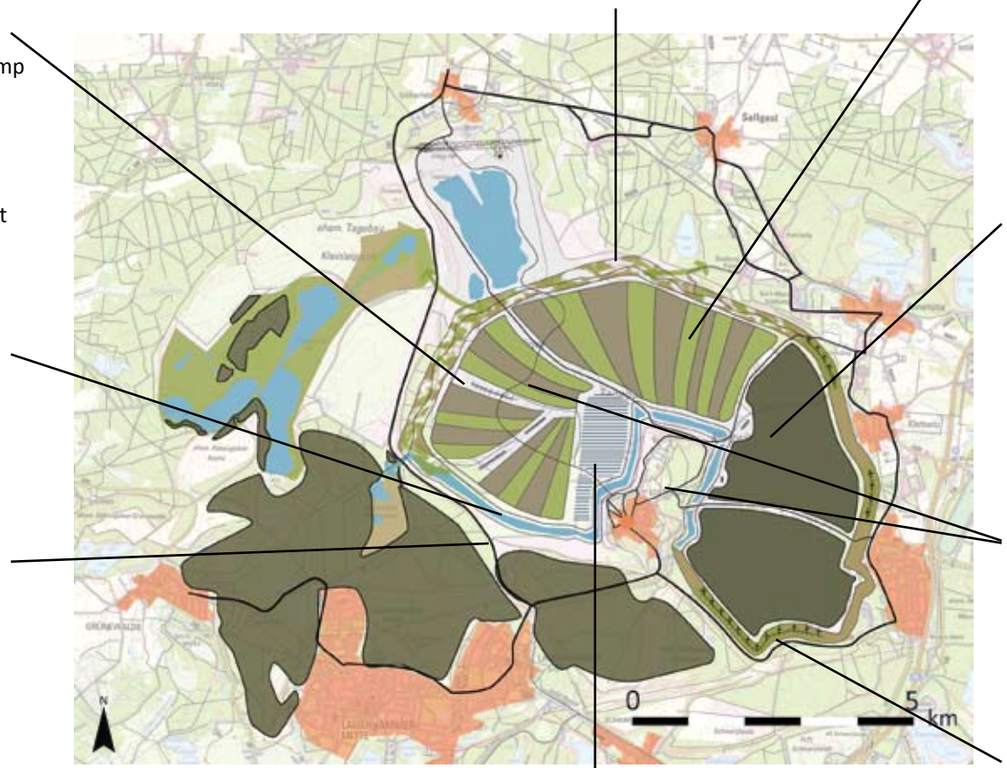
new linear water body accentuates the fromer edges of the mine in the landscape while restoring the water household and water quality.

apostrophe + dump + reconnecting infrastructure =

reconstructed road L60 as a scenic route focussing the attention on the newly designed features in the former mine.

aposiopesis + 'Randschlauch' + (re)connecting ecological areas =

the 'Randschlauch' as a linear connection between nature areas is at the same time an exciting place for hiking; developing succession, curves in the path and height differences enable few view on what will be next.



exclamation + open cast final void + new land uses: solar panels =

the large field of solar panels is a striking contrast with the surroundings and a statement in favour of clean solar energy instead of brown coal. The new land use is a profitable land use and suiting the identity of an innovative energy region.

rhythm + dump + alley cropping =

alternated alley cropping system on the dump with rotation times of about 1-2 years for the crops and for the trees 12 years when used for biomass energy production. The planting rows and different planting times refer to the direction and time development of the mine in the past, while the soil is being improved.

rhythm + dump + new land use: production forest =

the direction of the tree rows in the production forest on the former dump area and the different development phases refer to the time development and direction of the mine in the past like the alley cropping system does, while the soil is being improved.

apostrophe + dump + reconnecting infrastructure =

the paths around Kostebrau and into the mine provide an overview of the rehabilitation activities going on and connects Kostebrau to the surroundings again.

anomaly + 'Randschlauch'+ spreader =

the 'Randschlauch' is inverted from a gully into a ridge by filling it with material from the dump. Now it is an excellent location for windmills, which are a profitable new land use.

Feedback on the landscape narration

The landscape chronicle makes use of chronologically ordered facts. Processes in time and the physical landscape, caused by a natural or cultural force, are important. Showing the landscape chronicle, gives insight in processes like erosion, growth, succession, restoration, destruction and how they work on the landscape. Also the influence of time on the landscape is important. When these influences are legible in the landscape, the landscape is more understandable for the user (see paragraph 7.1).

In this alternative rehabilitation plan, the landscape chronicle is articulated in two ways (see the picture on the left). In the first place, the phasing in six steps to the composition in 2060 expresses already how processes over time change the landscape, and how they can be used to rehabilitate a site from an intervention like the brown coal mining. Second, on the biggest part of the mine, there are the alley cropping system and the production forest designed on the same lines in the landscape as the mining was organized. Since these land uses may change again in the future, the chronicle will go on, showing now the process of mine rehabilitation and in the future other processes that may happen in the landscape.

The memoirs is the connection of new or existing physical elements in the landscape to historical occurrences and memories to create perceptible collective or personal bond with environment (see paragraph 7.1). In the plan this is articulated by the other design principles than the alley cropping system and the production forest on the dump, which is visible on the picture on the left. The references to the past, that are articulated in the memoirs, support the chronicle because they tell about the past, while the chronicle visibly refers to the current situation and to the future.

Feedback on the landscape rehabilitation

The landscape rehabilitation measurements indeed concern the degraded and instable soils, water shortage, acid mine water, removed topography on the mine location and the de-connected infrastructure.

Finding an alternative landscape based approach to rehabilitation in this composition mainly succeeded by improving the soil structure and fertility. This is done by applying organic waste instead of mineral fertilizers and letting vegetation and time do the work as much as possible. Some other parts of the mine are consciously *not* rehabilitated: the former conveyer bridge ridges and parts of the nature ‘Randschlauch’.

There is no landscape based alternative found for the current soil stabilization measures, because waiting for the soil to stabilize automatically takes centuries and that is too long. The water in the ‘Randschlauch’ around Kostebrau is purposely not for recreation, so it is not very bad if the water quality is acid here. Therefore, automatically raising of the ground water is waited for. If this is considered to take too long, still external surface water can be leaded to the area. The passive treatment principle to improve the water quality over time is not used in this plan, but is certainly promising for future rehabilitation plans, when it is developed further.

Feedback to the trend and context analysis

The rehabilitation plan anticipates the predicted trends for Lusatia (see paragraph 2.4) by proposing land uses like production forest, renewable energy, connecting and extending nature areas, and taking the tourism interest into account.

Comparison with the current reconstruction plan from LMBV

In paragraph 9.1 the current reconstruction plan for Klettwitz is shown. Comparing it to the phases 1-6 of the rehabilitation plan that is proposed in this thesis, some things are notable.

The proposed land uses of the new rehabilitation plan are for a great part similar to the reconstruction plan and its later additions. The share of renewable energy is even higher because of the addition of solar panels. The share of nature is smaller, but smarter because the ‘Randschlauch’ still connects important nature areas in the area and clearly incorporates the leisure interest better than before.

The way the new composition is designed differs a lot. While the reconstruction plan rather seems to be composed by coincidence, the new rehabilitation plan is based on the design of the mine in the past with the 4 typical subdivisions, because apart from a reference to the past, this provides a coherent basis for a composition for the future. Still the composition is very flexible, because for the subdivisions numerous design principles can be designed, and also one or more principles can be applied on the subdivision if this is desired. The former dump can be flexibly adapted to new land uses, while the other parts of the former mine form a long term structure with references to the past. From the whole, the processes that took and take place in the landscape are legible, and an identity as energy region is clearly established. This is directly the result of taking along landscape narration into designing.

To execute the new rehabilitation plan might take more time than carrying out the reconstruction plan like it was, because a landscape based approach to rehabilitation takes more time. But, it is better for the environment and it is expected to be less expensive. In the meantime the landscape is certainly not useless, because already in the beginning renewable energy can be yielded. And after 20 years, which is necessary for the current rehabilitation, also in the rehabilitation plan that proposed here, there is a functioning landscape.

To rehabilitate the landscape slower, means that people have more opportunity to get along the changes going on in their environment, and to not loose the bond they have with the landscape surrounding them.

The phasing plan takes future needs into account as far as foreseeable which prevents later changes or additions that do not fit in the overall structure.

10 CONCLUSIONS

Conclusions

The most important outcomes of the design research are the following.

About the reference study:

Worldwide there are reference projects in which landscape architects play a role in landscape rehabilitation (see chapter 5). In these cases, the designs show besides rehabilitation either the story of the transformation in the landscape or references to the history of the site or even both.

About the rehabilitation and narration principles:

A landscape based approach to rehabilitation (see chapter 6) might take more time than the current rehabilitation approach, because then processes in the landscape are used. We think that the pressure on land is not that high in Lusatia, so that this time can be taken. Like in the current mine site rehabilitations in Lusatia, in 20 years after the mining a functioning landscape is created again, although it is maybe not a blueprint or final image. Moreover, as soon as possible the rehabilitated land can yield biomass for energy production and wind energy.

A landscape based approach might be good to strive for, but complete mine site rehabilitation cannot do without some of the current rehabilitation techniques. Mainly for soil stabilization there is no good landscape based alternative found yet. The passive water treatment is very promising, but more research should be done first.

The theory of Van der Westen and Westerink on landscape narration can be applied in this thesis rather successfully as an analysis tool and as a design tool for sure (see chapter 7).

From an inventory appeared that the landscape transformation and the bizarre mining landscape is also the topic of numerous other stories in other media than landscape in Lusatia, like photography and books. Therefore it is decided that a landscape chronicle is to be articulated to tell about this transformation process, and a landscape memoirs is to be constructed that refers to the bizarre mining landscapes and process.

About the design principles:

The overlap between rehabilitation and articulation principles is the typical field of landscape architecture. In this overlap, the landscape rehabilitation principles can be integrated with landscape narration principles, which succeeded well (see chapter 8).

Integration of the landscape narration principles with landscape rehabilitation principles is necessary because:

1. it is certainly possible to design all of the four subdivisions of the mine with the landscape approach, either passive (context) or active (dump, ‘Randschlauch’ and open cast final void) using design principles based on integrated landscape narration and rehabilitation principles;
2. in fact it is necessary to design the entire mine site in one plan, because the different design principles mutually influence each other, mainly in the construction of a narrative. When for example a contrast is to be created, to emphasize the contour of the former mine site, the design for the three subdivisions of the mine should be tuned to each other;
3. and sometimes more than one design principle can be applied on one area. In the first composition, there is a strip cropping system to rehabilitate the soil at the dump and to articulate a chronicle, but also a tourist train referring to the mining period and to show it all to the people. The design can be made more complex, and more interesting when applying more design principles, especially when tourism is desired like in the first composition.

The design principles can be successfully connected to the subdivisions of the typical Lusatian brown coal mine as distinguished earlier in the report (see paragraph 8.4). This is proven by two interesting and coherent compositions of several design principles that show that the design principles are applicable.

About the final composition as alternative to the current reconstruction plan:

As it is evaluated in chapter 9.4, the new rehabilitation plan is an answer to the environmental problems as much as the current reconstruction plan, but then making use of landscape based systems when possible. In this case alley cropping systems and succession processes are employed to improve the soil conditions over time.

The new rehabilitation plan is better equipped to solve the mental problems than the current reconstruction plan because a landscape narration is used. A landscape chronicle is articulated that makes the process of landscape transformation legible in the landscape, as well as the landscape memoirs that refers to the mining landscape and activities in the past. It is expected that this makes that people can relate better to the place again.

The rehabilitation plan is a better solution to the social problems than the current reconstruction plan, because more renewable energy production will be realized which is profitable now and in the future. The plan takes the development of tourism more into account, by creating a special landscape and experiences which can be explored from Kostebrau and the new visitor centre in the plan. Since this is expected to be profitable too, the economy diversifies which gives more certainty for the future.

Altogether, the land uses of the new rehabilitation plan are for a great part similar to the reconstruction plan and its later additions. The share of renewable energy is even higher because of the addition of solar panels. The share of nature is smaller, but smarter because

the ‘Randschlauch’ still connects important nature areas in the area and clearly incorporates the leisure interest better than before.
The way the new composition is designed differs a lot. While the reconstruction plan rather seems to be composed by coincidence, the new rehabilitation plan is based on the design of the mine in the past with the 4 typical subdivisions, because apart from a reference to the past, this provides a coherent basis for a composition for the future. Still the composition is very flexible, because for each subdivision numerous design principles can be designed and also one or more principles can be applied on the subdivision if this is desired.
The former dump can be flexibly adapted to new land uses, while the other parts of the former mine form a long term structure with references to the past. From the whole, the processes that took and take place in the landscape are legible, and an identity as energy region is clearly established. This is directly the result of taking along landscape narration into designing.
To execute the new rehabilitation plan might take more time than carrying out the reconstruction plan like it was, because a landscape based approach to rehabilitation takes more time. But, it is better for the environment and it is expected to be less expensive. In the meantime the landscape is certainly not useless, because already in the beginning renewable energy can be yielded. And after 20 years, which is necessary for the current rehabilitation, also in the rehabilitation plan that is proposed here, there is a functioning landscape.
To rehabilitate the landscape slower, means that people have more opportunity to get along the changes going on in their environment, and to not lose the bond they have with the landscape surrounding them.
The phasing plan takes future needs into account as far as foreseeable, which prevents later changes or additions that do not fit in the overall structure.

Feedback to the thesis:

In paragraph 4.2 it is stated that:

Built on the previous, we suppose that:

1. the environmental problems should be based upon a more landscape based approach when this is a good alternative to the current practice;
2. the social and mental problems need a landscape narration approach to prevent the problem of placelessness in mined areas;
3. and integration of landscape narration with a landscape based rehabilitation approach is a necessary contribution to the current rehabilitation practice.

Feeding back to these statements, the outcomes of this design research are promising because of the following.
The first test of the design principles in chapter 8 shows that integration of landscape rehabilitation principles with landscape narrative principles causes an interesting overlap from which design principles can be derived, which are useful for designing typologies for the subdivisions of the typical brown coal mine in Lusatia.
In fact, some rehabilitation measures contribute to the narrative by their own, like an agricultural strip cropping system shows a direction in space and time, like the landscape chronicle wants to articulate.
Chapter 9 shows that these design principles can be applied successfully on a specific mine.
In the overall conclusions it is concluded that the landscape based approach can be an alternative for current land rehabilitation measures, and that the landscape narrative can be an answer to prevent placelessness, the mental problem caused by mining activities.
From this it can be concluded that integrating landscape rehabilitation measures with landscape narration is a good combination, and that the participation of landscape architects in landscape rehabilitation is an addition.
The trend analysis to determine the kind of land uses that are important for the future appeared to be an essential addition to the approach, because the improvement of the economical situation is essential to solve the social problems here.

In answer to the thesis

‘To solve the problems in Lusatia caused by the mining, the integration of landscape narration with a landscape based approach to landscape rehabilitation is needed’.

can be said that the results of this design research support the statement, with the addition of a trend analysis into land uses of future importance.

Following the methodology of the experimental design, it can even be said that the thesis is true, with the addition of a trend analysis into land uses of future importance. But to be able to prove the thesis in practice, a detailed mine site design has to be made based upon this landscape based approach which integrates landscape rehabilitation and narration. Then the design should be executed, tested and evaluated.

Discussion on the results

It is a bit disappointing how landscape based the landscape rehabilitation can be at this moment. Only for improving the soil fertility and structure satisfying alternatives have been found. To make soil stabilization and improvement of the water quality and quantity more

Conclusions

landscape based is possible, but will take a really long time, which is probably unacceptable. This shows however again, the proportion of the impact of using brown coal as major energy source on the environment.

We assume that the landscape narration method can be an answer to the found problem of placelessness, as this phenomenon is described by Edward Relph. Edward Relph however, proposes extended community participation in plan making to re-establish the bond of people with their environment. Within this thesis such an approach was impossible, and we wanted to test whether the landscape narration method could be a solution to placelessness too. We think that it will work, but to be sure, this approach should be applied and executed in real situations and the inhabitants and visitors to the area should be questioned.

The landscape narration theory is a practical tool for analysis and to help designers in setting up the articulation of a landscape narrative. The figures of speech that are described by Van der Westen and Westering were however ambiguous sometimes in the translation into a landscape language. The two of us discussed quite a lot of examples. The question is, whether people in the landscape, unaware of the intention of the designer, recognizes the narration that is articulated. Second, if the people read the right story from it. We hope that, by applying a number and also strong narrative principles, the attention of people will be received. By creating a visitor centre in Kostebrau, at the start of the experiences that have been created, enough background information is provided to understand the story that is intended to be articulated in this area.

Not all rehabilitation measures have to articulate something, like not every narration principle always necessarily rehabilitates. Although particularly this overlap was the subject of research in this thesis, it has to be mentioned that a complete design for rehabilitation will contain pure rehabilitation and pure narration elements too.

The extent to which landscape narration is integrated with landscape rehabilitation depends on the situation. This thesis shows that the two are a good couple. But in an entire mining area, not all the mines should tell the same story. In the mine Klettwitz, this approach suits the site well because in Lusatia other former mines are developed differently.

Playing with the rehabilitation and narration principles and building other design principles than shown in this thesis is very well possible in another assignment for another site.

Discussion on the process

The first attempt, by following a path of site analysis - doing background research - making a concept design - designing details did not work out for the area. This can have several reasons, which combined are most likely the cause. In the first place, the assignment to design a site of about 40 square kilometres of wiped out topography, is too big to grasp in one stretch from getting to know the area till a detailed plan. At least it was for us, we were relatively unknown to the area and inexperienced in brown coal mining and rehabilitation. Moreover, the contribution of landscape architects to these assignments in Germany, which we started to study then, was not established yet.
Second, the precise problem of these former mining areas is so complex that it became not yet clear during the background research and first two excursions. Therefore the concept design was not underpinned, let alone detailed elaborations succeeded. After studying the reference projects, especially the ones of Fresh Kills and Landscape Park Duisburg Nord, we came to the conclusion that making a detailed design for this assignment would need an extended and iterative design research process, which is not feasible in the time span of our master thesis.
Instead, we decided to approach the assignment more strategically, by making the first step in the extended and iterative design research process. Design principles are developed with which landscape architects, together with other disciplines can approach rehabilitation assignments in Lusatia. In our view, the tests on two levels of detail show a promise for further application and research. The more strategic approach to this assignment by making design principles instead of a detailed plan in one stretch was necessary to define the problem with existing rehabilitation practice exactly. In this way, this design research can be seen as the first step in a landscape architectural contribution in rehabilitation assignments.

Our recommendations for further design research would be:

- to do extended research into landscape based but less time consuming alternatives for land stabilization and improvement of the water quality and quantity can support the ability to solve also these problems with a landscape based approach;
- to calculate if and how much longer a landscape based approach to mine site rehabilitation would take compared to the current practice. The same counts for the financial costs;
- to use this approach so far to make a detailed plan, and refine the approach by the findings;
- and to test whether people experience that the place is different from other mine rehabilitations when the landscape narrative is added, and if this approach really enhances the sense of place in rehabilitated mining areas again.

Our recommendations for the further application of this approach would be:

- to organize the plan making interactively with the people following a participative approach, then the interest of people in landscape rehabilitation is increasingly taken into account. The people can play with the design principles together with landscape architects and other professionals until a plan originates that is broadly supported;
- to intertwine this approach with the current practice. The current experiences in landscape rehabilitation from IBA, LMBV and Vattenfall are necessary to be sure that the safety of the landscape is guaranteed, and the environmental damage will be handled professionally. The proposals done in this thesis might however inspire to choose for a more landscape based approach to improve the soil quality. When the landscape architect is involved in the planning early, it is most effective.

SUMMARY

Summary

Lusatia is one of the four major brown coal production regions in Germany and played a big role in the energy supply of the former German Democratic Republic (GDR). The brown coal production will stay important in the near future; there are still productive mines and plans to open new ones, although the dimensions of the production are smaller than the period between the fifties and the nineties of the last century. The main reason for this continued brown coal production is the importance for the national electricity supply, to which it contributes 24% at the moment.

Lusatia

In chapter two is described how the brown coal mining and the related industries have influenced the landscape in Lusatia and its inhabitants. The brown coal in Lusatia is originated in the Tertiary Period. The brown coal that is excavated is mainly used to make brown coal briquettes or to convert it into electricity in power plants. The history of the mining in Lusatia goes back to the end of the eighteenth century. In the beginning the mines were small and people collected the coal at the surface using pick axes and wheelbarrows. Later shafts were created to reach coal that was stored till twelve metres deep. Nevertheless underground mining lost it from the developments in surface mining, and later all the brown coal mines in Lusatia became large open cast mines which also excavated the second Lusatian brown coal seam till 100 metres deep.

Landscape rehabilitation measures follow the brown coal mining, but sometimes not directly after closure of the mines. From the peak production in the GDR still unrehabilitated sites exist, but these are rapidly reconstructed now by Lausitz and Central-German Mining Administration Company (LMBV). For the rehabilitation of present and future mines the mining operator is responsible and now rehabilitation follows directly after the mining. In Lusatia there is only one mining operator left which is Vattenfall. Obligatory steps in the rehabilitation process are surface reconstruction, restoration of the water household and soil stabilization and soil amelioration for agricultural cultivation or forestry.

The current image of Lusatia, together with the quite similar divisions in land uses before and after mining and rehabilitation, led to a trend analysis into future land uses in Lusatia. Extension and connection of nature areas, renewed production forests, the production of renewable energy and tourism are important for the future (see paragraph 2.4).

Klettwitz

The mine Klettwitz is part of the connected mining area Kleinleipisch, Klettwitz and Klettwitz-Nord in the Lauchhammer mining area, which is described in chapter 3. This mine is excavated between 1951 and 1991, counter clockwise around the village Kostebrau. Originally the landscape existed here for 86% of forest. The other land uses were small villages, heath lands and agriculture on the higher parts and ponds and wet areas in the lower part. The stream direction of the ground water was from north-east to south-west and ultimately ending in the Schwarze Elster.

The mining equipment in the mine Klettwitz existed of bucket wheel excavators and bucket dredgers to excavate overburden, a conveyer bridge to transport overburden to the other side of the mine and rail and conveyer belt spreaders to replace the overburden on the dump area. Under the conveyer bridge smaller excavators removed the brown coal. On rail and conveyer belt systems the coal was transported to the power plant. In Klettwitz the mine operated alternately as a parallel and turning operation, which means that the mine went straight and curved through the landscape. The brown coal mines in Lusatia are all organized according this principle, with some small exceptions. A typical ground plan for Lusatian brown coal mines is deduced, which consist of a dump area with a ‘Randschlauch’ at both sides, an open cast final void at the end and the context of the mine.

In Klettwitz the reconstruction is organized by LMBV and runs from 1993-2015. A research led to an integral spatial plan working towards a safe situation with new land uses of water, agriculture and forestry. Later initiatives add windmills, a biomass forest and the extension of the nature area Grünhaus to the plan.

Problem definition

In paragraph 4.2 the problems are defined. The mining caused and causes in Lusatia environmental, mental and social problems. Environmental problems are degraded and instable soils, changed landscape contours, water quality and quantity problems and removed topography and connections to the surrounding landscape. A mental problem caused by mining is the placelessness that comes to exist when the mining removes everything that is from the surface of the mining area. These problems are universal for brown coal mines.

In the GDR, Lusatia was entirely arranged for energy production and related industries. As Germany got reunified, energy and other products could be imported from the west better and the economy in Lusatia collapsed. Now there is a low economic activity, a high rate of unemployment and the composition of the population got unbalanced because young and higher educated people moved to the west because of better job opportunities.

The problems from mining are environmental, mental and social. Landscape architects know about the working of the landscape and the underlying processes and systems, but also how people behave in the landscape and perceive it. Landscape architects have a problem solving attitude, use an integral approach to assignments and have visualization skills to project a future situation on maps or images. Landscape architecture is the profession that is able to solve all three kinds of problems caused by mining in an integrated way. Nevertheless, they are not often involved in Germany yet in designing the rehabilitation for brown coal fields.

Landscape architectural criticism

As landscape architects we criticized the current rehabilitation as being a solution to the environmental problems most and insufficiently addressing the mental and social aspects (see paragraph 4.3.1). The solutions to the environmental problems from mining can be more landscape based according to us. A landscape based approach means to us that the processes and systems in the landscape are used in the functioning of the design. Besides, the mental and social problems need to be addressed more because we experienced no sense of place in the rehabilitated areas yet. The observed criticism together with the environmental, mental and social problems led to the following three statements:

1. the environmental problems should be based upon a more landscape based approach when this is a good alternative to the current practice;
2. the social and mental problems need a landscape narration approach to prevent the problem of placelessness in mined areas;
3. and integration of landscape narration with a landscape based rehabilitation approach is a necessary contribution to the current rehabilitation practice.

Thesis

This criticism results in the thesis that

'To solve the problems in Lusatia caused by the mining, the integration of landscape narration with a landscape based approach to landscape rehabilitation is needed'.

A landscape based approach means to us that the processes and systems in the landscape are used in the functioning of the design (see paragraph 4.3.2).

Approach and method

To test this thesis, the design research in this thesis is organized according to the following steps:

I initial research and proposal writing
II data collection
III innovation and test I
IV test II
V evaluation and feedback

The data collection was done by desk study and four excursions to the area. The innovation consists of the integration of landscape rehabilitation and landscape narration principles in the development of design principles to approach this kind of landscape rehabilitation assignments. In the first test, these design principles are tested on the typical Lusatian brown coal mine, in the second test they are tested on the mine site Klettwitz.
This approach comes close to the 'experimental design', a form of design research as described by Steenbergen in 2008 (see paragraph 4.4).

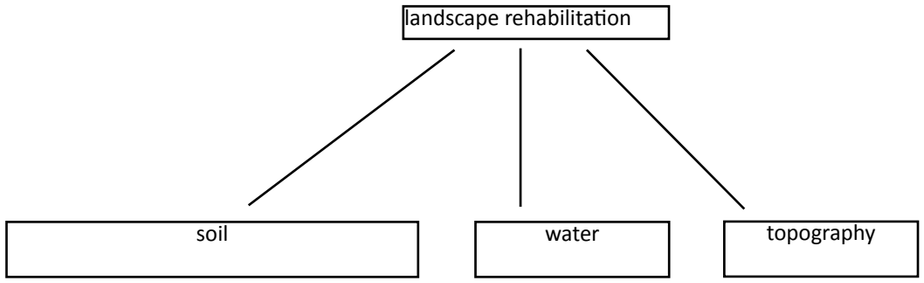
Reference projects

Six reference projects in landscape rehabilitation are analysed in chapter 5 to see how landscape rehabilitation is approached here and whether a landscape narrative has been told. All the projects deal with rehabilitation of soil and water quality, environmental pollution, altered surface contours and soil instability. Some projects consciously use landscape based alternatives for landscape rehabilitation, like the Fresh Kills project or the Landscape Park Duisburg Nord.
In none of the cases a landscape narrative is articulated purposely, but all the designs tell the story of the transformations in the landscape and the power of the landscape rehabilitate after large scale destruction. Obviously, this fascinates people. Also it is studied how this message is articulated in the reference projects. This varies from landscape scale gestures in the Desert-Oasis project to small scale musealizing of the mining equipment in Ferropolis. IBA Fürst-Pückler-Land is also studied as a reference project, although the study area in this thesis is the same and the design area Klettwitz is actually one of the IBA projects. To study it as a reference project was important because none of the other reference projects was so large scaled as the assignment in Klettwitz, and the regional and integral approach of IBA is also not used in the other projects.

Landscape rehabilitation measures in Lusatia

In chapter 6, landscape rehabilitation measurements are studied more in detail to develop applicable principles for land rehabilitation in Lusatia. The principles concern improvement of soil conditions by means of stabilization, fertilization and prevention from erosion, water quality and quantity improvement and the creation of a new topography and connections of the mine site to the surroundings. For the improvement of the soil conditions, agricultural systems can be applied as a more landscape based alternative for extended application of mineral fertilizers and artificially improving the soil structure.
The rehabilitation principles are partly substitutes for each other. When there is a choice, the most landscape based opportunity should be chosen according to this thesis. Suggestions for a landscape based approach to landscape rehabilitation, based on the four steps towards ecologically sound rehabilitation from Peter Del Tredici, can help in the choice for particular rehabilitation measures.

Summary



landscape creators		adding surface water	infrastructure
spreader	succession		
bulldozer	erosion	active chemical treatment	waterways
stabilizers		passive treatment	(new) land uses
‘Spreng-verdichtung’	‘Fallplatten-verdichtung’		
‘Rütteldruck-verdichtung’		doing nothing: in a natural way	ecological connections
fertilizers			
top soil	brown coal ash		
mineral fertilizer	organic waste		
erosion preventing			
covering the soil with plants	special structures		
mulch			
agricultural systems			
strip cropping	renewables rotation system		
alley cropping			

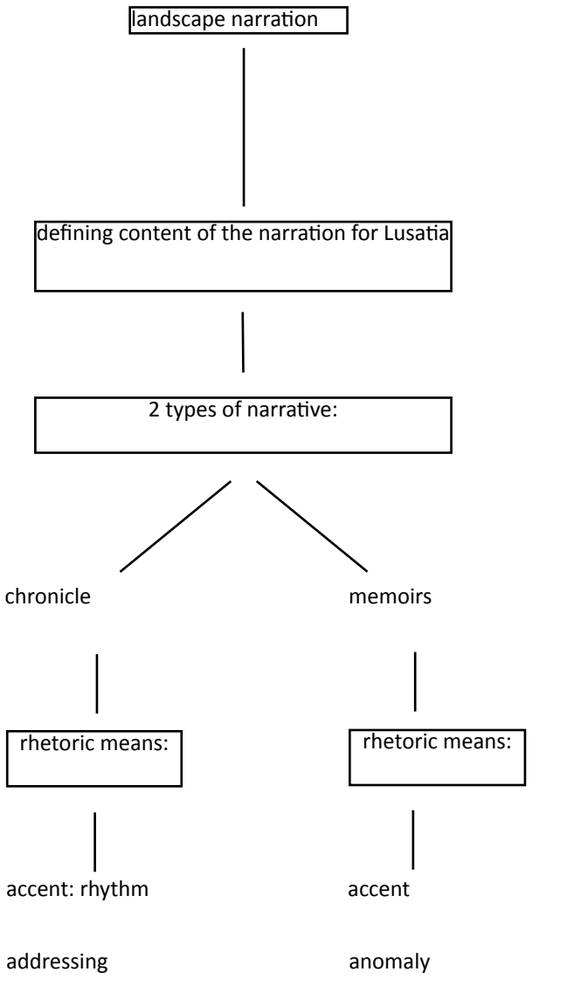
Overview of the landscape rehabilitation principles

Landscape narration in Lusatia

In chapter 7 theory on landscape narration is elaborated. The theory that is used in this thesis, is developed in the master thesis of Van der Westen and Westerink, and meant as a design analysis tool and a design tool as well. Van der Westen and Westerink based their theory on important works from Potteiger and Purinton and Anne Whiston Spirn on landscape narration. First it is explained what a landscape narrative is, which four types of landscape narratives can be articulated in the landscape and how a story can be articulated in the landscape. Based on Spirn, figures of speech are translated into a landscape language.

To determine the content of the narrative to be told in brown coal mine rehabilitations in Lusatia, an inventory of existing stories making use of other media than the landscape, like photographs and books, has been made. The bizarre features of the mining landscape and process and the large scale transformation process in the landscape are favourite subjects. This last subject was also a result from the reference projects. Obviously these two subjects are important to be told and discussed in Lusatia. It is concluded that the landscape narration in Lusatia should tell about the transformation in the landscape, which means that the type of the landscape narrative is the landscape chronicle, added with references to the bizarre mining landscape and process from the past, which is the landscape narrative type of the memoirs.

Hence the reference projects studied earlier are called back, to take a closer look at how the story of landscape transformation is articulated in these projects. In this case, the theory of van der Westen and Westerink is used as an analysis tool. Figures of speech could indeed be recognized in the designs, although they are not purposely designed so. This analysis was however promising to use the theory also as a design tool.



Overview of the landscape narration principles

Design principles

In chapter eight of the report, the landscape rehabilitation principles are combined with the landscape narration principles. The principles of landscape rehabilitation and narration partly overlap; we consider this to be the field of the landscape architect.

So part C is the most important part of the diagram for this thesis, because it will show that the steps that have to be taken in landscape rehabilitation can be integrated with creating the articulation of a landscape narrative.

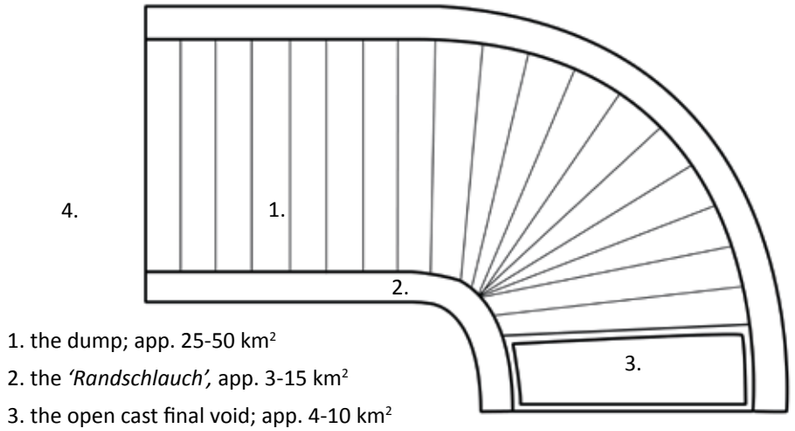
We suppose, that doing so is essential in three ways:

- the landscape chronicle is about mining but also about rehabilitation *itself*, and a landscape chronicle can be expressed best by using a landscape based approach to rehabilitation;
- because it is only possible to authentically articulate the site's history before characteristics are eventually erased by landscape rehabilitation measures already. This is necessary to be able to articulate the landscape memoirs;
- and integrating landscape narration principles with the obligatory landscape rehabilitation measures is efficient and prevents that it will cost more effort and or money than necessary.

Together with a location on one of the subdivisions of the typical Lusatian brown coal mine, the rehabilitation and narration principles are integrated into design principles. As a try-out, seventeen combinations are made of which seven articulate the landscape chronicle in the landscape (the transformation process) and ten articulate the memoirs (the references to the history and identity of the place). The combinations result in an image of a landscape typology for either the dump, 'Randschlauch', or open cast final void. The context got no separate design principles, because it plays a passive role. When the landscape typologies already exist in mine rehabilitations in Lusatia, a photograph is used. When new typologies are developed a drawing is presented.

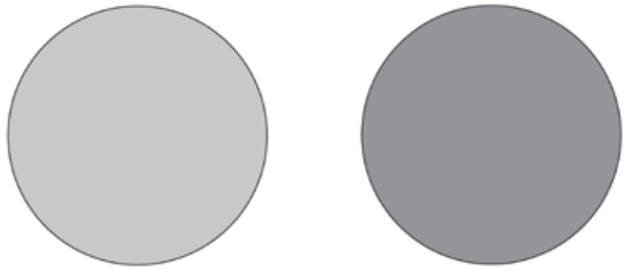
To look whether the landscape typologies fit together, two experimental compositions are made for the typical Lusatian brown coal mine. From the two compositions one could say that:

1. it is certainly possible to design all of the four subdivisions of the mine with the landscape approach, either passive (context) or active (dump, 'Randschlauch' and open cast final void) using design principles based on integrated landscape narration and rehabilitation principles;
2. in fact it is necessary to design the entire mine site in one plan, because the different design principles mutually influence each other, mainly in the construction of a narrative. When for example a contrast is to be created, to emphasize the contour of the former mine site, the design for the three subdivisions of the mine should be tuned to each other;



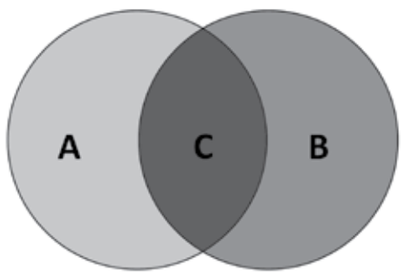
1. the dump; app. 25-50 km²
2. the *'Randschlauch',* app. 3-15 km²
3. the open cast final void; app. 4-10 km²
4. the context

The subdivisions of a typical Lusatian brown coal mine



A. landscape rehabilitation: physical 'must'

B. landscape narration: mental 'must'



A + B = C
the overlap between rehabilitation and articulation principles
= the typical field of landscape architecture

Overlap in the design principles of landscape rehabilitation and landscape narration

3. and sometimes more than one design principle can be applied on one area. In the first composition, there is a strip cropping system to rehabilitate the soil at the dump and to articulate a chronicle, but also a tourist train referring to the mining period and to show it all to the people. The design can be made more complex, and more interesting when applying more design principles, especially when tourism is desired like in the first composition.

It appeared that a coherent plan for the typical mine site can be composed based on the design principles.

Application of design principles on Klettwitz

In the second test, presented in chapter 9, the site of Klettwitz is used. First all background information on the site, the problems that result from mining and the predicted trends in land use are called back. In the same way as the first test, the design principles are combined into an experimental composition. This composition is more precise and based on an actual situation. The case is imaginary in the way that the case as it is studied is mined already, and for the new plan the mining is to start in 2010.

A phasing in 6 time stages towards the composition for the site in 2060 as the mining ended, is added. The plan is explained by pretending to walk and drive through the area and illustrated with impressions. The design principles that are used in this composition are:

- aposiopesis + 'Randschlauch' + (re)connecting ecological areas;
- anachronism + dump + erosion;
- contrast + 'Randschlauch' + flooding with (external) surface water;
- apostrophe + dump + reconnecting infrastructure;
- exclamation + open cast final void + new land uses: solar panels;
- anomaly + 'Randschlauch'+ spreader;
- apostrophe + dump + reconnecting infrastructure;
- rhythm + dump + new land use: production forest;
- and rhythm + dump + alley cropping.

Altogether, the plan is evaluated to be

- an answer to the environmental problems as much as the current reconstruction plan, but then making use of landscape based systems when possible. In this case alley cropping systems and succession processes are employed to improve the soil conditions over time;
- better equipped to solve the mental problems than the current reconstruction plan because a landscape narration is used. A landscape chronicle is articulated that makes the process of landscape transformation legible in the landscape, as well as the landscape memoirs that refers to the mining landscape and activities in the past. It is expected that this makes that people can relate better to the place again;

- and a better solution to the social problems than the current reconstruction plan, because more renewable energy production will be realized which is profitable now and in the future. The plan takes the development of tourism more into account, by creating a special landscape and experiences which can be explored from Kostebrau and the new visitor centre in the plan. Since this is expected to be profitable too, the economy diversifies which gives more certainty for the future.

The way the new composition is designed differs a lot. While the reconstruction plan rather seems to be composed by coincidence, the new rehabilitation plan is based on the design of the mine in the past with the 4 typical subdivisions, because apart from a reference to the past, this provides a coherent basis for a composition for the future. Still the composition is very flexible, because for each subdivision numerous design principles can be designed and also one or more principles can be applied on the subdivision if this is desired.
The former dump can be flexibly adapted to new land uses, while the other parts of the former mine form a long term structure with references to the past. From the whole, the processes that took and take place in the landscape are legible, and an identity as energy region is clearly established. This is directly the result of taking along landscape narration into designing.

Conclusions, discussion and recommendations

In answer to the thesis

'To solve the problems in Lusatia caused by the mining, the integration of landscape narration with a landscape based approach to landscape rehabilitation is needed.'

can be said that the results of this design results support the thesis, with the addition of a trend analysis into land uses of future importance. Following the methodology of the experimental design, it can even be said that the thesis is true, with the addition of a trend analysis into land uses of future importance. To be able to prove the thesis in practice, a detailed mine site design has to be made based upon this landscape based approach which integrates landscape rehabilitation and narration. Then the design should be executed, tested and evaluated.

Main discussion points on the outcomes of this design research are about the extent to which the landscape based approach can be an alternative for current landscape rehabilitation methods, and whether the theory on landscape narration explained by Van der Westen and Westerink is an applicable tool for design analysis and designing a landscape narrative. Organizing a participative planning process, which is suggested by Edward Relph might be even a better solution to create a sense of place, but we think that the landscape narration is at least a good contribution. In designing a detailed mine site rehabilitation, landscape rehabilitation and narration principles will be employed apart from each other too, and the extent of integration of landscape narration with landscape rehabilitation depends on the specific situation and surrounding mine site rehabilitation plans. About the process is remarked that the initial approach of doing a site analysis, define a problem statement, thesis and research questions, doing a further research and making a concept and a detailed design did not succeed because we were too unfamiliar to the subject, the area to design is too big and the matter is too complex to do this in one stretch within a master thesis. An extended and iterative process is needed to come to a design for mine site rehabilitations. Instead, we did a design research that resulted in design principles that can be seen as the first step in such an extended and iterative design process.

Our recommendations are

- to do extended research into landscape based but less time consuming alternatives for land stabilization and improvement of the water quality and quantity, can support the ability to solve also the land stabilization and water assignment with a landscape based approach;
- to calculate if and how much longer a landscape based approach to mine site rehabilitation would take compared to the current practice. The same counts for the financial costs;
- to use this approach so far to make a detailed plan, and refine the approach by the findings;
- to test whether people experience that the place is different from other mine rehabilitations when the landscape narrative is added, and if this approach really enhances the sense of place in rehabilitated mining areas again;
- to organize the plan making interactively with the people following a participative approach, then the interest of people in landscape rehabilitation is increasingly taken into account. The people can play with the design principles together with landscape architects and other professionals until a plan originates that is broadly supported;
- and to intertwine this approach with the current practice. The current experiences in landscape rehabilitation from IBA, LMBV and Vattenfall are necessary to be sure that the safety of the landscape is guaranteed, and the environmental damage will be handled professionally. The proposals done in this thesis might however inspire to choose for a more landscape based approach to improve the soil quality. When the landscape architect is involved in the planning early, it is most effective.

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