Environmental Site Audits & Urban Redevelopment

Students Paper Workshop 3

Audits and Certification, Environment & Energy BSc

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Introduction

Environmental site audits are conducted to examine and rate the compliance, environmental performance and the efficacy of the financial allocation of environmental issues of a facility (Pahuja, 2013). Compliance is evaluated against how well the facility adheres to environmental laws, regulations and standards, for example eco-label auditing, Environmental Impact Assessment and certification auditing among others. Environmental performance assesses whether the organization achieves environmental goals and targets. This is done using/examining environmental surveys, energy audits, environmental management systems among others. The financial type of environmental audits looks at the financial transactions relating to environmental activities. Cost-benefit analyses in tandem with the organization's method of allocating funds are critiqued during the financial audit process (Pahuja, 2013). This report assesses and examines two former mining sites of Zechenpark, Kamp-Lintfort and Graf Moltke, Essen mines.

Methods and Materials

The contents of this report discuss topics related to Environmental Site audits. Firstly, what makes an audit good was discussed. Using literature from Pahuja (2013), the steps taken to prepare for a site audit were then noted relating to Graf Moltke mining area, in Essen, Germany. Afterward, the former industrial site was characterized based on information regarding environmental compartments, buildings and site assessment forms. Next, the publication by Bell et al (2000) was read and the legacy of the former site activities at Graf Moltke were interpreted and related. Finally, the geographical features of the Kamp Lintfort site were compared to the Graf Moltke site primarily using literature from Bell et al (2000). Both sites' locations were compared regarding the benefit of the restoration taking all 3 aspects sustainability into account. An interpretation of which aspect of sustainability requires action most urgently was then presented.

Results And Discussion

Environmental Audit Form 1

Date of Audit: 04.12.2021 **Auditor**: Adiel Batson

Postal address for the site (if applicable also land parcel number):

Gelsenkirchener Str. 181, 45309 Essen, Germany

General site layout (size, type of built-up area, number of buildings, type of activity:

Previous mult-industry complex; mining, coking, benzol and ammonia production. Present day green-space, museum, bicycle park. Large surface area of 230000m² with surrounding

residences and businesses in the periphery (Bell et al, 2000).

Sources of information:

- Bell, F., Denske, D. & Bell, A., 2000. Rehabilitation of industrial areas: case histories from England and Germany. Environmental Geology, Volume 40, pp. 121-134.
- Zollverien, 2021, Homepage. Date Accessed: 01.12.2021 :https://www.zollverein.de/
- Google Maps, 2021, UNESCO Welterbe Zollverein, 2000m x 1200m. Date accessed: 2.12.2021: https://www.google.com/maps/place/UNESCO-Welterbe+Zollverein/@51.4903157,7.0339575,3117m/data=!3m1!1e3!4m5!3m4!1s0x47b8e7eee0699f89:0x78f558bfb85b6c1a!8m2!3d51.4877427!4d7.0439172?hl=en
- Naturschutzgebiet, 2021, No title, Date accessed; 2.12.2021: http://nsg.naturschutzinformationen.nrw.de/nsg/de/karten/eifel

Status at audit (in use/active, derelict, post-use)

Post-use

Contact person and type of audit: (contact at company; seller/buyer audit/other:

No contact person.

General environmental audit.

Disclaimer:

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Property Details:

Former form of land-use: mining & coking site with ammonia and benzol production.
Current form of land-use: UNESCO World Heritage site, recreational, educational, commercial and tourism purposes.
Envisaged form of land-use: same as current.
Percentage of area built-upon: <65, **Percentage of area not built-upon:** >35%

Photograph/Map:

Fig.1.0 Location of the now extinct Graf Moltke mining site, in Essen (modified from Google maps (2021)).

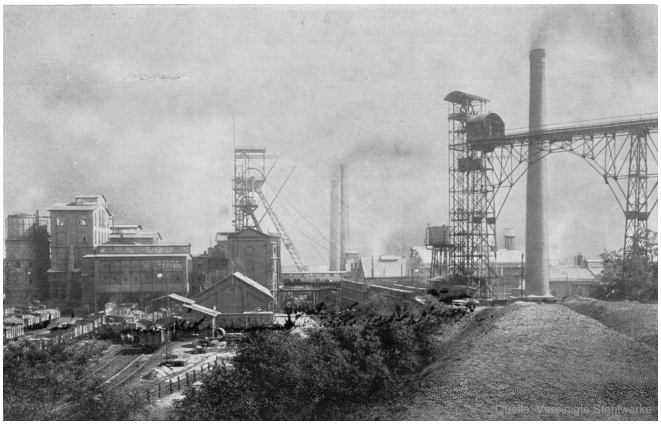

Fig. 1.1 Graf Moltke (1908). Source:

https://www.ruhrzechenaus.de/gladbeck/gla-graf-moltke.html

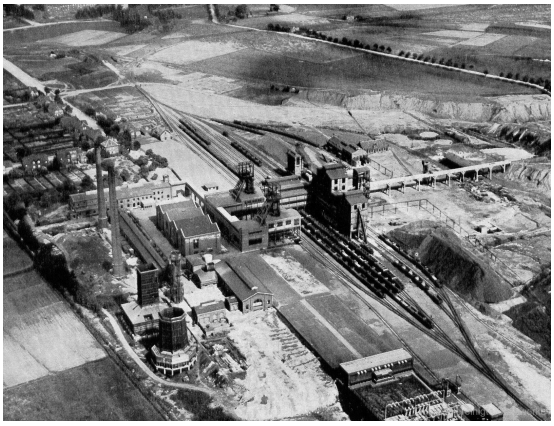

Fig 2.2 Graf Moltke Plan View (1932).
Source:
https://www.ruhrzechenaus.de/gladbeck/gla-graf-moltke.html

Table 1: Protocol of Site Walkover at Gelsenkirchener Str. 181, 45309 Essen.

Protocol Of Site Walkover			
Underground Storage Tanks (UST)	Yes	No	No evidence
Known or observable underground storage tanks? Y/N If yes: number of tanks ____ Status of tanks: (in use/decommissioned, observable damage? /status of manhole, etc.)			x
Type of underground storage tanks? Fuel type products (specify, give number)_____ Chlorinated chemicals (specify, give number)_____ Other substances (specify, give number) _____			x
Any evidence of leakage to subsurface (records, visible inspection)?	x		
Additional comments: PAH and DNAPLs found around the subsurface of the coking plant.			
Aboveground Storage Tanks (AST)	Yes	No	No evidence
Y/N If yes: number of tanks ____ Status of tanks: (in use/decommissioned, observable damage? /status of manhole, etc.)			x
Type of aboveground storage tanks? Fuel type products (specify, give number)_____ Chlorinated chemicals (specify, give number)_____ Other substances (specify, give number) _____			x
Any evidence of leakage to subsurface? Preventive measures in place?			x
Additional Comments: PAH and DNAPL in subsurface around the coking plant (Bell et al, 2000). No further documentation found on remediation of these contaminants, especially concerning present day literature.			
Storage containers for hazardous substances	Yes	No	No evidence
Reported or observable storage containers for hazardous substances? (specify substances & numbers)			x

Any evidence of leakage to subsurface?			x
Ecological Resources	Yes	No	No evidence
Protected areas: Protected biotope on site and a nearby protected nature reserve in Mechtenberg of 29.77.	x		
Protected species (species, number, location)	x		
Groundwater protection area?			x
Surface water?			x
Additional Comments:			
Waste & waste disposal	Yes	No	No evidence
Non-compliant electrical devices (e.g. transformators, cooling systems) (PCB, CFC)? Type: _____ Number_____			x
Sewage treatment state of utility lines:_____ storage of sewage waste/presence of infiltration areas			x
Other type of onsite waste storage	x		
Any evidence of leakage to subsurface?	x		

Environmental Audit Form 2

Date of Audit: 04.12.2021 **Auditor**: Adiel Batson

Postal address for the site (if applicable also land parcel number):
Wilhelminenstraße 2, 47475 Kamp-Lintfort, Germany

General site layout (size, type of built-up area, number of buildings, type of activity:
Site is approximately 1.3km long from North to south and at its widest circa 300m, spanning a total of 71 ha. It is located close to the city center, with residential areas, businesses, warehouses and a university on the periphery. Building density on the east side is relatively higher than on the right. Current use as greenspace, event centre, university research, museum and more, with the only commercial restrictions barring mining.

Sources of information:

- Data Municipality Kamp-Lintfort, IHK (2017) Demographiekompass 2040 https://www.ihk-niederrhein.de/hauptnavigation/wirtschaftsstandort/regionalpolitik/demografie-undfachkraefte-3978684
- Google Maps, 2021, Zechenpark, scale: 1000m x 800m: Date accessed 2.12.2021: https://www.google.com/maps/place/Zechen+Park/@51.4939142,6.5473161,1323m/data=!3m1!1e3!4m5!3m4!1s0x47b8a3ba493fb35b:0x42511ee302aa2aa!8m2!3d51.4947606!4d6.550022?hl=en
- Redevelopment of the former mining site: Masterplan Bergwerk West: https://www.kamp-lintfort.de/www2/sitzungsdienst.nsf/HTML/B762C08B8735C9C1C125791400367092/$FILE/Grundlagenermittlung%20Haupttext_1.pdf
- Regionalverband Ruhr (2020), Kamp-Lintfort Bergwerk West, Neues Stadtquartier - und Gartenschau. Accessed 02.12,2021: https://www.rvr.ruhr/politik-regionalverband/europa/bergbauflaechen/die-20-standorte/kamp-lintfort-bergwerk-west/#collapse140654
- Geoportal Niederrhein, (2021), Wasserschutzgebiet. Accessed 01.02.2021: https://geoportal-niederrhein.de/Verband/?layerIDs=29105,29106,29107,29108,200370,20071,20070,20038&visibility=true,true,true,true,true,true,true,true,true&transparency=0,0,0,0,0,0,0,0,0&center=343217.4999567606,5718174.99927957&zoomlevel=1

Status at audit (in use/active, derelict, post-use)

Post-use

Contact person and type of audit: (contact at company; seller/buyer audit/other:

No contact person.

General Environmental Audit

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Property Details

Former form of land-use: Mining, coking, industrial.
Current form of land-use: Recreational, event space, educational, commercial with mining restrictions, urban heat island
Envisaged form of land-use: Same as current

Percentage of area built-upon: 38% **Percentage of area not built-upon**:62% (Regionalverband Ruhr, 2020).

Photograph/Map

Fig.2.0 Zechenpark, Wilhelminenstraße, 47475 Kamp-Lintfort (adapted from Google Maps (2021)).

Fig.2.1 Kamp-Lintfort Mining Area.
Source: https://www.mindat.org/photo-1067248.html

Fig 2.2 Kamp-Lintfort Mining Area (2004).
Source:
https://peterveltheon.nl/bergwerk-west-at-kamp-lintfort/

Table 2: Protocol of Site Walkover at Zechenpark, Kamp-Lintfort.

Protocol Of Site Walkover			
Underground Storage Tanks (UST)	Yes	No	No evidence
Known or observable underground storage tanks? Y/N If yes: number of tanks ____ Status of tanks: (in use/decommissioned, observable damage? /status of manhole, etc.)			x
Type of underground storage tanks? Fuel type products (specify, give number)_____ Chlorinated chemicals (specify, give number)_____ Other substances (specify, give number) _____			x
Any evidence of leakage to subsurface (records, visible inspection)? No documentation that shows the present presence of storage tanks, after last remediation.			x
Aboveground Storage Tanks (AST)	Yes	No	No evidence
Y/N If yes: number of tanks ____ Status of tanks: (in use/decommissioned, observable damage? /status of manhole, etc.)			x
Type of aboveground storage tanks? Fuel type products (specify, give number) Chlorinated chemicals (specify, give number) Other substances (specify, give number)			x
Any evidence of leakage to subsurface? No evidence found of present leakage. Preventive measures in place? Sealed ground cover with growing grasses and flowers on top.			x
Storage containers for hazardous substances	Yes	No	No evidence
Reported or observable storage containers for hazardous substances? (specify substances & numbers)			x
Any evidence of leakage to subsurface?			x
PAH and PCB present reported during last analysis			

Ecological Resources	Yes	No	No evidence
Protected area : Die Leucht (adjacent to site), protected nature reserve, 361 ha is size.	x		
Protected species (species, number, location)	x		
Groundwater protection area?		x	
Surface water?		x	
Additional comments: Continued treatment of groundwater on site by LINEG. Geoportal Niederrhein (2021) excludes Kamp-Lintfort as groundwater protection area.			
Waste & waste disposal	Yes	No	No evidence
Non-compliant electrical devices (e.g. transformators, cooling systems)			x
Sewage treatment state of utility lines:_____ storage of sewage waste/presence of infiltration areas			x
Other type of onsite waste storage			x
Any evidence of leakage to subsurface?			x
Additional comments: No current data found on waste and waste disposal. In former times PCBs and PAH were prominent.			

The Auditing Process

A good audit is quantitative, exhaustive and factual. Audits are based on accurate logical inferences of credible, objective data sources. They utilize a combination of checklists and questionnaires with the core purpose of gathering accurate, honest information, which can be later assessed later (Pahuja, 2013). Pahuja (2013) defines the process of an audit in 4 phases:

1. Pre-audit Phase: Objective and scope are defined, review of background information, audit criteria is selected, audit plan/protocol is formulated, the facility is informed and the audit team members with broad expertise sets are selected to best conduct the audit.
2. On-site Phase: The opening conference is held, areas of concern are identified, the site is inspected, records/documents are reviewed, staff is interviewed, initial review of findings and closing of conferenced is conducted.
3. Post-audit Phase: The final evaluation of findings are done, a preliminary report is submitted, approval of management is obtained, exit conference is held and the final report is submitted.
4. Follow up/review Phase: The actions taken on audit findings or recommendations are verified.

These steps can be taken to audit the old mining site at Graf Moltke in Essen. Today, the site has already been remediated. Bell et al (2000) used a catalogue of historical analysis of old building permits, plans, documents, old maps, aerial photographs to gain information of the development of the site at Graf Moltke for example.

Legacy of the former mining Sites at Zechenpark, Kamp-Lintfort

The former mining site of Zechenpark also operated a coking facility. On the compound a transport train ran through the east wing of the compound. Drees and Sommer (2011) state that details about degree of contamination are not well defined because the values need to be interpolated. Therefore, a follow up analysis of the soil and groundwater contamination needs to be done in order to have clear data on the levels of contamination. Nevertheless it can be expected that the operation and closing of the mine lead to substantial soil, groundwater air pollution. In this regard one major challenge is designing a comprehensive approach to treat/counteract the damage done by a wide range of pollutants, having had the time to settle complexly in various compartments in the earth subsurface. Perhaps this is the reason for the accumulation of the contamination into a hill and its containment with topsoil and light vegetation. Perhaps also, in this regard the treatment option was so expensive in the long run more bioremedial/passive methods were opted for instead. Outside of the environment remediation issues of the site there were some social challenges as well. The site itself was a major industrial hub of the region. One significant challenge upon the closing of the mine is the loss of jobs, and the constant emmigration related to that, plaguing the area ever since (Regionalverband Ruhr, 2020).

Legacy of the Former Mining Site at Graf Moltke

The mining site at Graf Moltke was a multi-industrial complex covering a vast area of 230000 m². It was the largest mining site in the world (Zollverein, 2021). Graf Moltke was also the site of a coking plant, benzol and ammonia factories. It operated for approximately 50 years until the closing of the mine in 1971, after which it became a wasteland. It was later decided to remediate the site as an “Internationale Bauaustellung " and establish an industrial park. In areas near the coking site, contaminants such as PAH and other DNAPLs migrated through heterogeneous soil layers with a complex network of contamination. These networks of contamination were categorized as “regionalized variables" and a remediation method was set up to rehabilitate them. Rubble-fill from large foundation structures had a thickness of 2-9m beneath the surface. Both soil and ground water compartments were severely contaminated, with high amounts of PAH and DNAPLs. It was decided that it would be too expensive to remediate the soil by

excavating and landfilling it, and so the contamination was contained by sealing, compacting and using geotextiles to contain and manage the pollution on site. It was similar to the site at Zechenpark in this regard. Furthermore, many observation and flushing wells were also constructed. (Bell et al, 2000).

One enormous problem for Graf Moltke site is the fact that it is the largest mining site in the world, remediation costs were too immense for traditional remediation options, as there was an enormous area to be treated. This, intandem with the unknown of sealing a surface and experimenting with a new remediation method at the time; combining geosynthetic fabrics and geotextiles, testing the limitations of the new materials and altogether confining the soil and preparing it for further utilization and development, in its envisaged use.

Comparison of Geographical Features of the Minings Sites

Both the sites at Graf Moltke and Kamp-Lintfort were mining sites with coking facilities. Graf Moltke was however a significantly larger operation than the mine in Kamp-Lintfort. Using images from Google Maps (2021) it is clear that today they both have been rehabilitated for similar purposes with the goal of recreational, educational and commercial development among others for the sites. This is further reinforced by the works of Zollveirien (2021). The geographical features are largely similar between the sites, except Graf Moltke appears to be further along the time horizon in terms of industrialization. Graf Moltke shows developed commercial areas, residential areas, event holding areas and more all on the former land surface of the mine. In comparison to Zechenpark, Graf Moltke has well established development areas, much larger than in Kamp-lintfort.

Comparison of the Benefit of Restoration of the Former Mining Sites Considering All Three Aspects of Sustainability

The former mining sites' restoration benefits were environmental, social and economical. In the case of Graf Moltke, today the site is a UNESCO world heritage site with many touristic/entertainment offerings, social venues, educational and commercial events and opportunities. In this way the site is socially oriented, turning the woes of the legacy of the mine into a financial opportunity and community heritage site simultaneously. The foundation Zollverien (2021) is managing the site activities amicably. When it comes to the environmental aspect of sustainability, noteworthy to mention is the only commercial restriction of the site is that of mining. The leadership of the site seems geared at progressive development with a substantial focus on environmental health. Concerning the site at Zechenpark, similar analyses can be made since the sites share a similar legacy and similar remediation goals. The aspect of sustainability requiring the most urgent action in kamp-lintfort are the social viability; dwindling population numbers and continued emmigration of the population here reduce the potential of harvesting the potential and skills of the people here, contributing to an overall "brain-drain" in the area.

Conclusion

Environmental site audits are great tools to check environmental compliance, environmental performance and the environmental financial planning and monetary allocation. Important topics cover a broad range of specialized disciplines, requiring diverse auditing teams to adequately conduct assessments during the audit. Technical data on location, topography, setting, neighborhood, environmental data on the site history, environmental management systems, emissions, waste management etc., social data on labour conditions, CSR reporting etc., and governmental factors such as the differences in perspectives of the buyers and sellers of a site and health and safety factors all play quintessential roles in the auditioning process (Reich, 2018). In the Graf Moltke and Zechenpark sites examined in this report not enough information was analyzed, extracted or presented to give an immensely in depth assessment of the site. Importing auditing processes and tools such as site visits, interviews, questionnaires and checklists were also not included in the study. Nonetheless, the post-use evaluation of the sites yielded very interesting results in the lengths remediation and sustainability go into developing a more efficient, sufficient and consistent attitude and result on the path toward sustainable development.

References

Bell, F., Genske, D. & Bell, (2000), A. Rehabilitation of industrial areas: case histories from England and Germany. Environmental Geology, Volume 40, pp. 121–134: https://doi.org/10.1007/s002540000158

Data Municipality Kamp-Lintfort (IHK), (2017) Demographiekompass 2040: https://www.ihk-niederrhein.de/hauptnavigation/wirtschaftsstandort/regionalpolitik/demografie-undfachkraefte-3978684

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Google Maps, 2021, Zechenpark, scale: 1000m x 800m: Date accessed 02.12.2021: https://www.google.com/maps/place/Zechen+Park/@51.4939142,6.5473161,1323m/data=!3m1!1e3!4m5!3m4!1s0x47b8a3ba493fb35b:0x42511ee302aa2aa!8m2!3d51.4947606!4d6.550022?hl=en

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