

Afteruse of Landfills

Methodological approach, project requisites and relationship with the surrounding area

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Abstract

Sanitary landfills still today represent one of the most widely applied methods of waste management. However, the characteristics of this type of plant represent a particular challenge for the environment due to the potential release of pollutants, for the surrounding area as the plant may affect local organization and functions, and for the landscape as both the size and the morphology of a landfill may establish new relationships with the landscape.

In the case of older landfills, reclamation measures are frequently required, although these can be undertaken to enable co-existence with modern waste disposal operations based on an integrated system of waste management, and should be included by land-use urban planning as a place of mutual interest to the community.

The more modern types of landfill designed based on criteria relating to waste technologies and management developed to reduce the impact produced on the environment and the local area, may provide an opportunity to intervene with large-scale projects and thus restore spaces for community use and even provide a benefit. Based on these premises, it would be particularly interesting to focus on the possibility of future reclamation of the landfills under construction at the design stage by applying an approach that takes into account future use from a technical and, economical perspective from the outset.

Keywords

Afteruse, Waste, Landscape, Territory Planning, Community

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General aspects and state-of-the-art

Municipal solid waste management is consistently linked to a strong interrelationship between technology, the environment, the terrain and society. In the past, although in the presence of a dearth of disposal technologies, this interrelationship was concealed by the small scale of interventions, the low population density, the scarce mobility of the population and by a limited (at times absent) environmental awareness. Subsequent economic and demographic growth has raised the visibility of land use and environmental issues deriving from waste management. Means of transport, technology and the Internet have all promoted an increased mobility and enhanced the possibility of a widespread contact throughout a region.

The locality no longer provides residual spaces to be used for the purpose of waste disposal but dictates how waste management systems should be comprised as part of an overall land use plan linking the diverse areas of the local area in a process ultimately identifying the intended use of the areas within the context of an organised community. Accordingly, the disposal of waste evolves from an inexpert into a process and tool intended to foster new forms of land use. The planning activity underpinning the management and realization of a waste disposal facility should represent a contribution to

local territorial planning. This way the waste facility would be fully integrated with other urban structures (intended as the locations on which the attention of the community is focused), rather than being seen merely as the consequence of exclusions and concealments or limitations dictated by a state of emergency. Moreover, planning and design should strive towards obtaining consent at the time of decision-making, and in no case later than siting of the works. The consensus should never be considered in retrospective mode, especially in the presence of an organised opposition carried out by the populations concerned.

In terms of quality of the local terrain, it is no longer a sustainable practice to earmark extensive areas to be occupied by landfill, although the importance placed on this issue may vary according to the reference context concerned. In some countries, land reclamation is a firmly established condition aimed at guaranteeing quality of life under threat from an uncontrolled industrial development and population growth necessitating use of the land in question and avoidance of misuse (fig. 1). In this regard, a landfill represents a potential value in line with the context in which it is located. The functional reclamation of the Hong Kong landfills (Sai Tso Wan, Jordan Valley, Shuen Wan, etc.) is a concrete example. The latter landfills, all sited on areas of virgin land,



Fig. 1 – Garbage piles up at a temporary garbage dump in the eastern suburb of Beirut (photo: Joseph Eid).

were identified as valuable land to be used in creating leisure facilities and green spaces that were inevitably lacking throughout the territory.

When envisaged, the functional reclamation of the majority of landfills consists mainly in the siting of revegetation works on the final cover with the aim of mitigating impact, although these works are frequently limited to a mere restyling that rarely leads to an effective functional reuse of the area.

However, numerous cases of functional reclamation of old landfills have been described worldwide, attesting the real possibility of undertaking works for the good of the community. Thanks to a cultural approach that tends to view this type of work favourably, and due to a general lack of space, old landfills in Spain, Japan and China (for example) are frequently used for the purpose of creating urban green spaces with leisure and sport facilities.

Options resulting in a renewed use of areas are required to undergo a decisional/design process aimed at assessing the most appropriate final choice in terms of land reclamation, impact on the landscape, environmental sustainability and com-

munity consensus. These options are considerably limited by the fact that landfills are conceived to represent the final solution for a specific area, with reclamation not being taken into account during the important design stage. The limitations to be addressed during this process are linked mainly to management of the waste volumes concerned. Indeed, aboveground waste void space is developed to allow the deposition of as much waste as possible, resulting in the formation of masses that significantly limit re-use options. Old landfills, initially developed with a specific intended use, although not strictly viewed as pollutants, constitute a potential ‘polluting’ presence on the area that frequently deface the landscape and functionality of the area (for example the typical tronco-pyramidal shape, etc.).

After use of landfills: 3 potential scenarios of intervention

When considering the reuse of an existing landfill or hypothesising the functional use of a landfill yet to be constructed, the main features to bear in mind are: environmental conditions, technologies used to

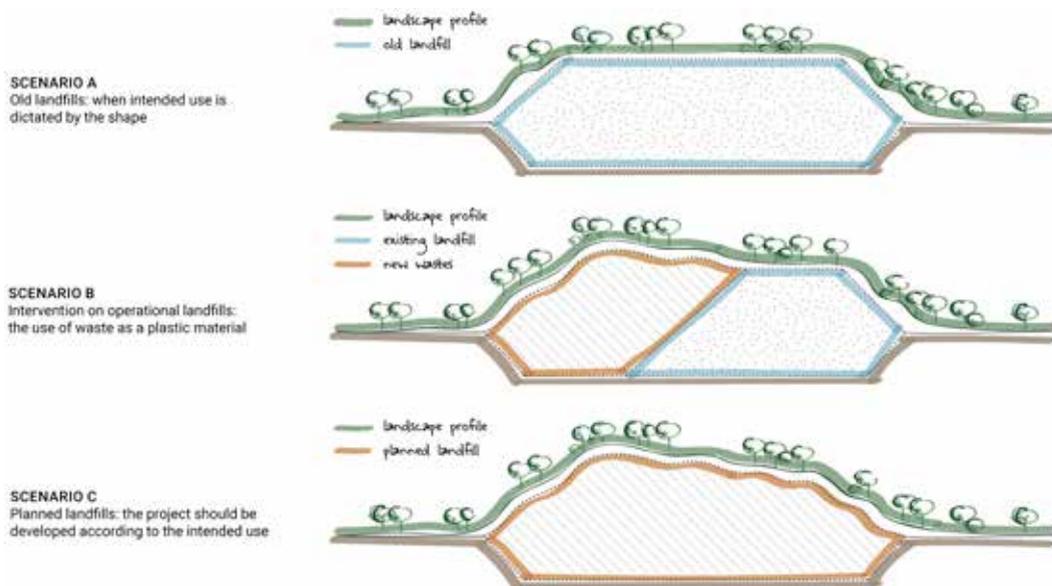


Fig. 2 – Scenarios of intervention (graphics: Studio Arcoplan).

mitigate impact, the impact on land use and infrastructure exerted by the facility within the context in which it has been sited, and landscaping in view of the value of transformation elicited on the existing landscape by siting of the landfill on the area. Functional reuse of a landfill may be envisaged in a series of different situations as follows:

- A Existing landfills requiring works of environmental reclamation or recovery
- B Existing modern landfills either undergoing construction or operational (or in which extension works are required)
- C Landfills still to be designed (details relating to siting, waste volumes to be deposited, etc. may not be known).

According to these situations there are three different scenarios (fig. 2).

Scenario A | Old landfills: when intended use is dictated by the shape

Reclamation of an old landfill is characterised from the outset by a predominantly negative view of the intervention: to reclaim; i.e. to undertake the recov-

ery of an environmentally compromised situation and re-establish links with the surrounding area. From a morphological viewpoint, old landfills were invariably constructed without any consideration for the landscape or urban planning, with the sole constraint of complying with the height limits defined by the competent Authorities at the time of authorisation. In an attempt to maximise the capacity of the facility, landfills were frequently developed without paying due attention to above ground waste volumes, thus resulting in the formation of improbable-shaped masses that interrupted the natural lines of the landscape. A recurrent skyline was represented by a troncipyramidal formation that, although designed according to laws enforced at the time (in terms of maximum height, slopes, etc.) left an invasive and permanent anthropic mark on the landscape. The resulting land conformation significantly limited the choice of intervention, with the pre-existing landfill constituting a highly visible element with which the restoration project would be required to interact.

A good functional rehabilitation project carried out



Fig. 3 – The El Garraf Massif, Barcelona. Project for a community park on the Val d'en Joan landfill drawn up by the architects Enric Batlle and Joan Roig (source: Batlle I Roig Arquitectes archives).

as illustrated in figure 2 (scenario A) should therefore assign an appropriate role to the pre-existing landfill, without attempting to mitigate or conceal it, but rather seeing it as a means of interpreting the entire project, continuing to testify the previous life of the site.

A relevant example to clarify this concept is provided by the restoration of the Hiriya landfill in Tel Aviv, an impressive 60m high 'mountain' of waste distributed over an area of more than 450.000 m². The landfill restoration project, drawn up by Latz + Partner in 2004, provided for transformation of the area into one of the largest urban parks in the world, thus changing the aspect and features of the 'mountain' of waste from a negative element of the landscape into a symbol of ecological renovation. The volume of the old landfill stands at the centre of the project like a large evocative totem, in clear view of visitors in all corners of the park. Taking into account the pre-existing facility, the transformation of the Hiriya landfill was designed as a sort of enormous theme park focussing on waste recycling and evolved into an innovative centre for research on recycling technologies that also hosts educational activities.

Generally, a functional restoration and landscaping project will need to address the issue of the complex management of a landfill during the post-filling stage. It will need to take into account the presence of the visible impact of some infrastructure (i.e. leachate drainage and/or treatment plants, biogas extraction plants, etc.), of subsidence and settling of the waste, of the existing slopes and topography in general, of water management and layering of the final cover. All these elements, if not assessed previously with a view to final recovery, will further limit any possible form of reuse.

The landscaping and agronomic management of the site should be carefully investigated during the planning stage. The area should be planted in order to enhance a correct balance between surface runoff, infiltration and evapotranspiration, thus promoting a correct control of infiltration water.

Indigenous trees and shrubs are to be preferred, having roots which are suited to the substrate and leafy coverage to enhance run-off and evapotranspiration. Herbaceous species should be fast stabilizing, hardy and with a low degree of flammability. In the scenario A, possible outcomes are represent-



Fig. 4 – The El Garraf Massif, Barcelona. Project for a community park on the Val d'en Joan landfill drawn up by the architects Enric Batlle and Joan Roig (source: Batlle I Roig Arquitectes archives).

ed by nature parks or green spaces with leisure facilities (theme parks, motocross tracks, cycle paths, golf courses, model plane fields and sport and leisure facilities in general). Other more complex and structural constructions are hard to achieve.

It is however possible to achieve a good outcome in the functional reclamation and landscaping of old landfills denoted by high quality architectural features, as attested by a wide series of projects undertaken throughout the world.

Reclamation of the Barcelona landfill situated in the *Val d'en Joan* in the natural Garraf Park, is still today deemed a reference project of excellence for this type of intervention. The project for restoration of the landfill was drawn up by the Spanish architects Enric Batllé and Joan Roig, and in one sole intervention was aimed at achieving three major aspects: solving a complex technical problem, creating a new community area and providing a new landscape (fig. 3-4).

The complex technical issues deriving from the closure and final covering of the landfill underpinned the rationale behind the working hypothesis. This consist in the organization of the stepped consol-

idation terraces, the containment banks and road access marked the geometry of the landfill and determined the placing of the pipelines required by the gas treatment plant to generate electricity, for the drainage system and the transfer of leachate. The third objective, the development of a new landscape, came with the desire to merge the old landfill with the Natural Garraf Park. Naturally, the morphology of the site today has greatly changed if compared to the original one. However, the Garraf Park comprises cultivated valleys that have been modified by means of agricultural techniques (fig. 5) purpose-adapted to the local geography using systems of terraces, drainage and cultivation in order to meet the technical requirements of closure and final covering of the landfill.

The outcome saw the construction of eleven stepped terraces planted with native drought-tolerant species compatible with integration of the landscape. Moreover, an irrigation system was set up throughout the area. An underground drainage system was devised to separate the pollutant liquids and recirculate the water to irrigate the park. The landfill also provided biogas used in the produc-

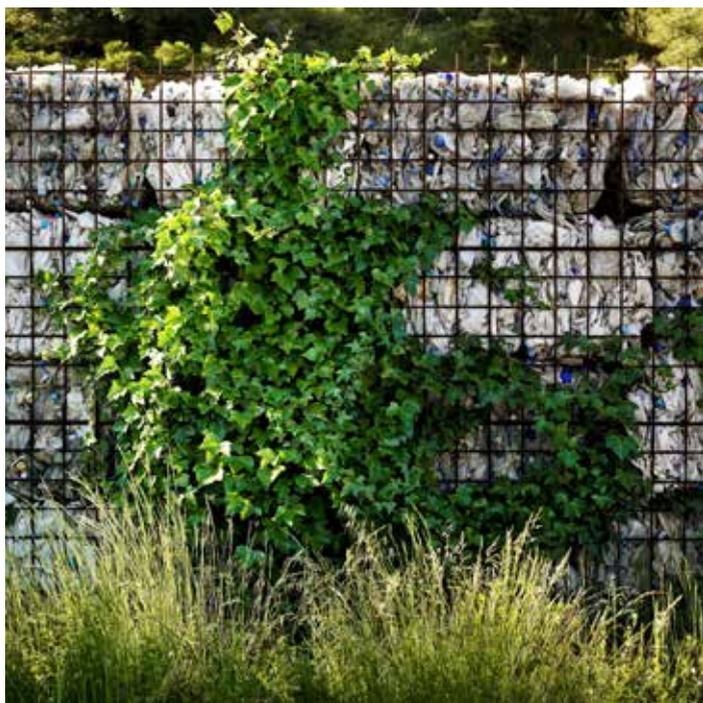


Fig. 5 – Project for a community park on the Val d'en Joan landfill: constructive and vegetation systems, inherited from traditional agriculture (source: Batlle I Roig Arquitectes archives).

Fig. 6 – Project for a community park on the Val d'en Joan landfill: detail of plant walls, built of non-degradable products of the old landfill (source: Batlle I Roig Arquitectes archives).

tion of electricity. Some wastes left on the top of the landfill in large steel cages to remind visitors the origin of the site (fig. 6).

The architect Israel Alba who curated the transformation of the *Valdemingómez* landfill in Madrid adopted a similar strategy. The project for the recovery and transformation of the *Valdemingómez* landfill required the application of complex environmental engineering processes, as well as new landscape architectural strategies. Today, this place can be incorporated, with full guarantees, into the city structure, as long as it is seen as a monumental public space. It is recovered ground capable of becoming a new, free, metropolitan space that can answer the current and future needs of society, especially if it remains as such over time.

The landscape architectural project undertaken involved the proposal of new strategies to create an area that would remain open, flexible and dynamic throughout time, in search for equilibrium between city and nature. The *Valdemingómez* landfill proposes a model of continuity between the forest and the surrounding area, as a pseudo-botanical garden with indigenous species seeking integration into the *Parque Regional del Sureste* (Southeast Regional Park). Now it has been transformed into a free, public area with pedestrian paths and bicycle lanes, along with woods and wetlands, which have

helped to create small, localized ecosystems. The life of both nature and city can be observed within.

The project for the general reclamation of the old 'Fresh Kills' landfill in New York, designed by James Corner Field Operations, is one of the most widely known. Firstly, as it is the largest existing landfill worldwide. Since the closure of the landfill in 2001, the value and significance of this urban site of more than 890 hectares have changed considerably. This artificial landscape located to the east of Staten Island is today as an extraordinary resource for the fast growing population of New York with its pressing need for green spaces. Only 45% of the Fresh Kills site has actually been used as a landfill. The remaining area features the extensive swamps that have characterized the New York archipelago since its origin. The wide variety of natural environments forms a habitat for numerous indigenous and migratory animal species. The aim of the project was transforming Fresh Kills into a twenty first century urban park whilst maintaining both the large dimensions and the essential underlying character of the area (fig. 7). The buildings and the activities are all confined to specific areas, thus leaving the rest of the site as open and natural as possible.

The project will be completed over a thirty-year period, with the first challenging ten-year stage comprising work on the northern and southern sections



Fig. 7 – Aerial view of Fresh Kills Park.

of the park (fig. 8). The implementation strategy is based on a series of flexible and incremental steps aimed at ensuring a balanced execution of works to close the landfill, start up the site management processes and transform the area into a public park.

Scenario B | Intervention on operational landfills: the use of waste as a plastic material

Reclamation works performed on a landfill will have a far greater chance of success when studied and developed during the stage of active management of the landfill (during the construction stage, during waste deposition or at the time of a potential extension). Indeed, employing new wastes as a plastic material, whose shape can be moulded, extends the pool of potential uses assigned to the project and provides greater freedom in reinventing the final configuration of the area (fig. 2 - scenario B). In addition, it facilitates important budgetary savings in terms of material employed to modify the structure of the site.

110 By intervening during the operational phase rath-

er than the post-management phase, not only enhances the possibility of modelling the banking of new wastes in line with the project design (fig. 9), but also enables operations aimed at the functional recovery and landscaping of the area that start when the landfill is still operational (e.g. in the previously established closed sectors). In other words, in scenario B the intervention entails an immediate functional use of the areas with a progressive involvement of other sectors.

The main difficulties encountered in the planning and design are due to the coexistence of the ongoing operations of waste deposition and remediation of the landscape, thus requiring careful planning throughout. The establishing of a timeline representing the chronological development of the project is fundamental, and should scan the different operations in line with the state of waste deposition in the landfill sectors (fig. 10) according to a series of future short, medium and long-term scenarios developed over a period of no less than 30 years.

The distribution of vegetation should be imple-

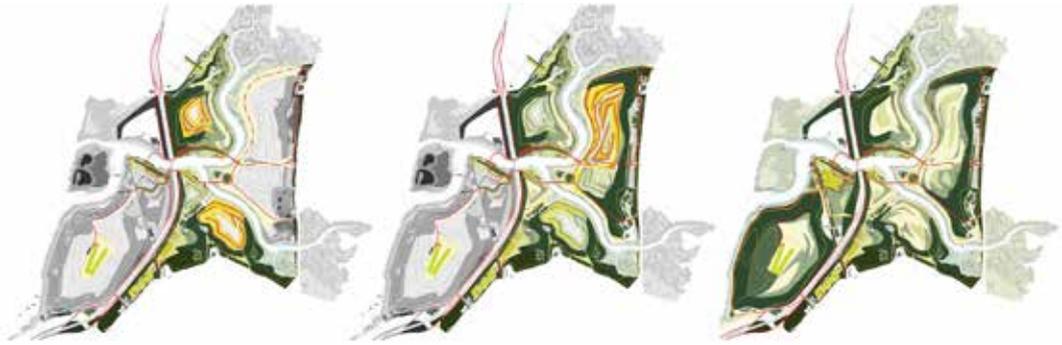


Fig. 8 – Chronological evolution of the landscaping of the Fresh Kills landfill, New York.



Fig. 9 – Cross section of a landfill. The wastes used as a plastic material to shape the land (graphics: Studio Arcoplan).

mented in full compliance with the original existing landscape and should be completed taking into account not only the technical aspects described above, but also the functional reclamation of the area to be achieved once waste placement operations have terminated and the relative sectors have been covered. Plant distribution throughout the area therefore should be envisaged in synergy with the operations and functions provided for by the function reclamation project (fig. 11).

Furthermore, undertaking works at this stage enables the planning of operations that are more complex. It also foresees a marked local involvement, thus promoting a widespread positive impact. Accordingly, a project for valorisation of an area should be developed in line with the specific aim of creating important synergies with the locally present manufacturing and entrepreneurial concerns.

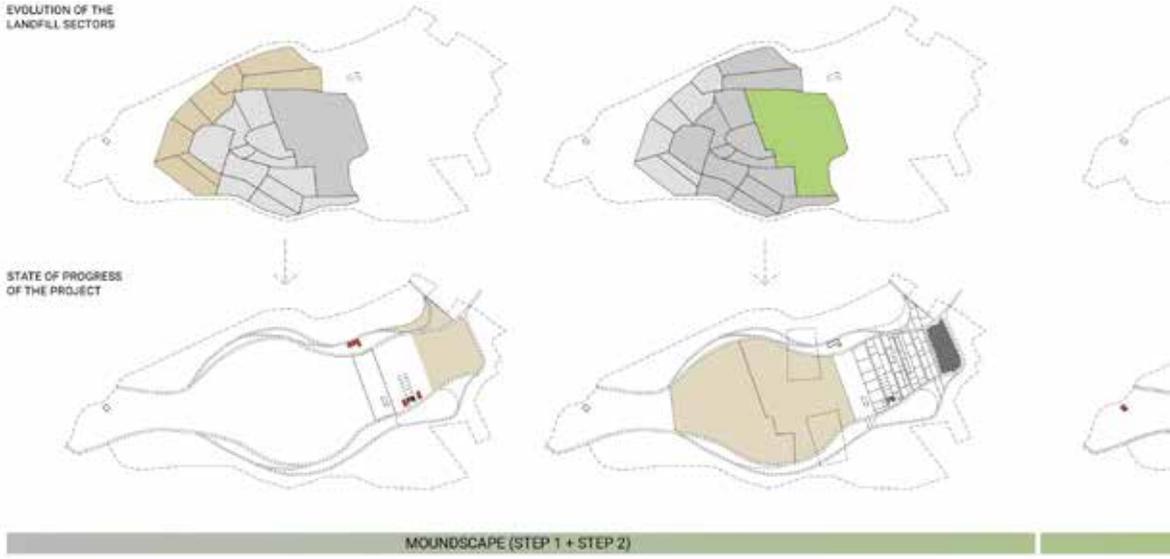
Scenario C | Planned landfills: the project should be developed according to the intended use

When designing a project on the basis not solely of

the designated use of the site as a landfill, but rather in view of the ultimate use established, since the beginning of the project waste contribute to shape and model the final morphology of the landscape. From the outset, therefore the structure of the project depend on the final use of the area. In line with the parameters established by the project, the deposited wastes may be used today as a plastic material to shape the area for tomorrow (fig. 2 - scenario C).

Establish operational synergies between the location, the form and the volume of waste to be banked, the architectural materials and language of the buildings destined to house the facilities, together with all other features of the project, will enable a dual function. A first temporary function associated with operations of disposal and treatment of the waste, and a second more permanent aspect linked to the future intended use determined during the stage of landfill design (fig. 12).

The planning and design phase for a new landfill therefore provides all the necessary conditions to



envisage a coherent contextual change in line with the needs of the locality.

The construction of a new landfill according to a project aligned with the surrounding landscape and urban spaces is dependent on a fully integrated project strategy and a multidisciplinary approach that can only be achieved by relying on a team of designers with competence in numerous sectors (environmental engineering, geology, agronomy, landscape architecture).

The abovementioned principles are however deemed extremely innovative when compared with common practice as they dictate a change in the terms of the project: we are no longer the designers of mere landfills, but rather of community spaces.

In order to make provisions for the project as a whole, the planning of the intended future use of the area should be articulated on the basis of the three subsequent levels of in-depth technical analysis provided for by current law, i.e. a preliminary design, a definitive project and an executive project. The study should imply detailed analysis to provide for a detailed budgetary control from the outset. This will allow to accrue sufficient sums during

the operational phase of the landfill to effectively finance the carrying out of all works.

These important concepts, which should drive the planning and design of new landfills and shift the focus of the designer, unfortunately often fail to be taken into account.

Methodological approach

Generally speaking, designing a final solution for the area and studying the morphology and configuration the site will possess once waste deposition will be completed, implies an inherent need to identify the relationship that the new development will establish with the surrounding natural and cultural landscape, thus determining the success of future relationships. Therefore, in order to define the relationship of the facility with the local context the forms assumed by the environment, the history of the area, the locations, the presence of places of interest throughout the area, should all be examined in detail. The same happens to define what functions it may fulfil and - in case of designing e.g. a park - what species of plants should be used to cover it. At the same time, it is to envisage the use of

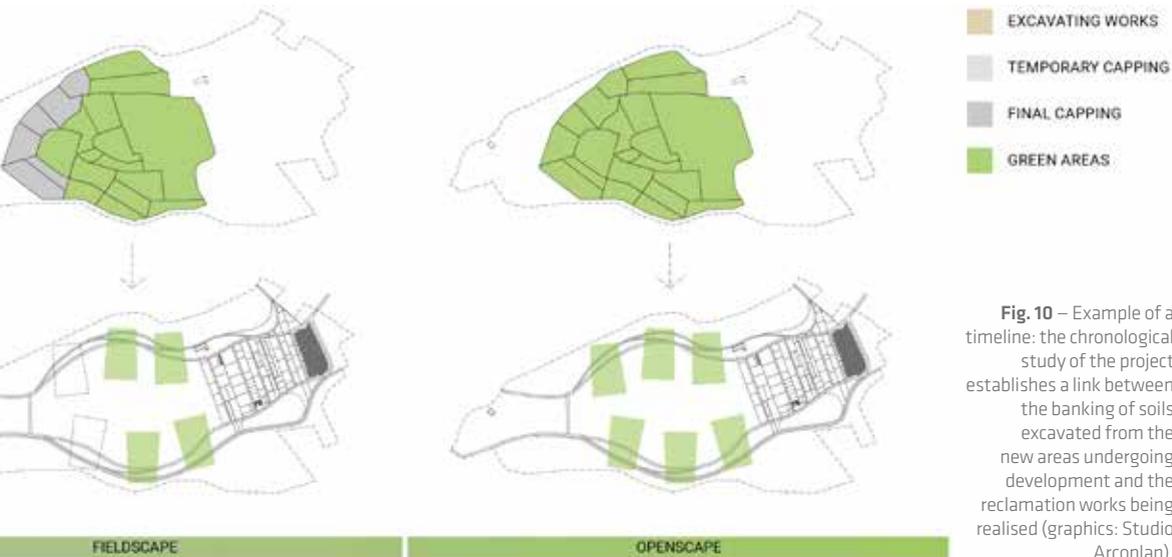


Fig. 10 – Example of a timeline: the chronological study of the project establishes a link between the banking of soils excavated from the new areas undergoing development and the reclamation works being realised (graphics: Studio Arcoplan).

the waste mass as a 'plastic' element (an architectural term for rich, three-dimensional or sculptural presence of an architectural element or building) for the reconstruction of a coherent and redeveloped landscape.

The following paragraphs focus mainly on landscaping, integration into the surrounding area and public perception.

Assessment of the surrounding area

In line with the most elementary principles of land use planning, the assessment of the surrounding area undeniably represents the most important step to be undertaken prior to drawing up of the project and irrespective of the type of intervention to be carried out (scenarios A, B, and C).

As for any other type of area, the re-naturalization of a landfill, whether it be in existence or still at the design stage, is largely linked to an understanding of the area and the territorial structures present in order to enhance the integration of the area and the establishment of necessary bonds with the pre-existing urban and natural structures.

The complexity of the landscape and the wealth of

elements characterising the area should be carefully analysed in the light of the predominant factors. Once the main objectives of the project have been established, the methodological process should include an accurate assessment of the territory as detailed below:

1. Analysis of the landscape and terrain

Assessment of the terrain and land use are fundamental to analyse the predominant features of the concerned area. In particular, a detailed analysis of the agricultural context and the dominant environmental factors is mandatory in identifying the lines structuring the new landform design and establishing the specific land use of the restored site.

This type of analysis consists in the identification of the environmental components that will be involved in the project. The environmental system is thus split into elementary components. In the same way, as in routine land use planning, this type of analysis is conducted by means of overlay mapping of the natural system in which the major components (elevations, waterways, etc.) have been broken down.

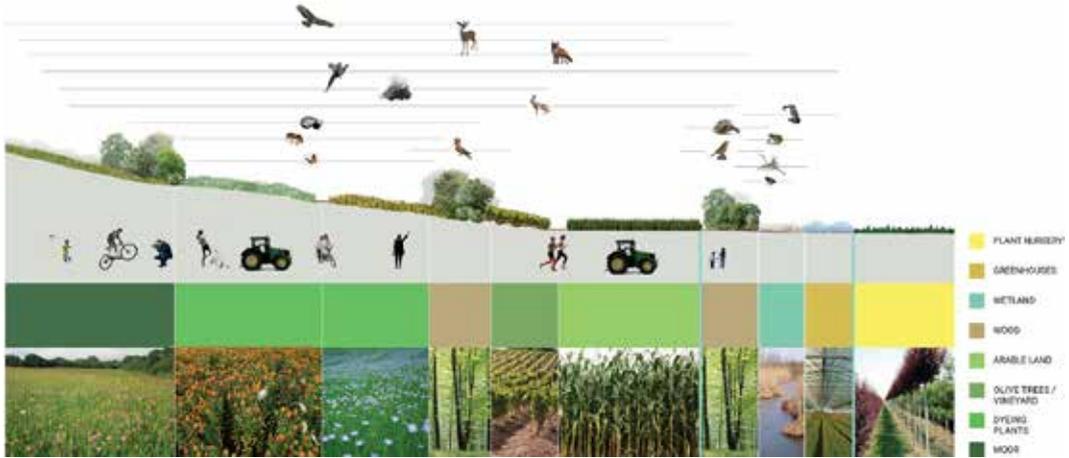


Fig. 11 – Example of landscape design based on the intended use provided for in the general project (graphics: Studio Arcoplan).

2. Analysis of the residential | infrastructural system

This assessment possibly represents the most important stage of the preliminary analyses and is fundamental in ascertaining the size of the catchment area of potential users, also in view of the vicinity/distance from the main towns and cities that will need to be taken into account. A thorough knowledge of the history of the area and of the existing facilities is mandatory to identify a potential lack of infrastructures and determine future relationships.

3. Analysis of the productive system

The existence and articulation of resources (underpinning the specific local characteristics) should be highlighted: identification of the latter will contribute towards revealing the magnitude of the environmental values and pinpointing of those areas displaying signs of incompatibility with potential transformation works. Subsequently, any existing restrictions should be examined.

Analysis of prevalent activities: this should be carried out to assess the possible links to the project and to identify potential involvement of the local manufacturing industry (fig. 13).

Project requisites

Downstream of the outcomes of the preliminary territorial analysis, the planning and design should be developed to foster a harmonious insertion of the intervention in the local context, in respect of the morphology of the surrounding landscape by recreating the essential forms and lines of the spatial continuity. To reuse a landfill, the project should restore the terrain to its natural vocation, moreover providing a benefit and meeting the requirements of the local community by bridging a potential gap in the lack of infrastructures. It should furthermore provide a series of educational, social, cultural and leisure facilities to attract potential users.

Moreover, the design concept should promote a positive outcome and economies of scale, bearing in mind the economic feasibility of the transformation, and should strive towards creating an 'exportable model' to become a reference project in similar contexts.

The success of a project will depend largely on the consensus received from the local community who will benefit from the presence of a quality-controlled environment, from local manufacturers and consumers. Two possible involvement processes are illustrated in figure 14. In the approach 'En-

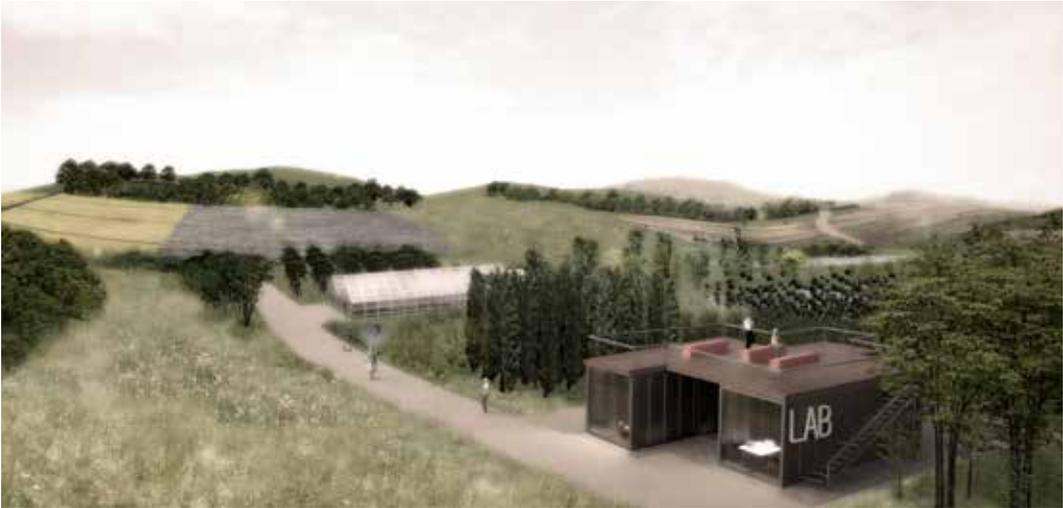


Fig. 12 – Aerial view of the future use of a landfill site (graphics: Studio Arcoplan).



Fig. 13 – The project and potential involvement of the local manufacturing industry. The figure shows, in a matrix format, the relationship between the design choices and the productive system, associating the different products obtained from the exploitation of designed surfaces and the local prevalent activities.

age-Design-Deliver', some key representatives of the wider community are brought in at the very start to discuss and agree the scope of the project and the involvement process with the technical team. This takes longer than the start in the old model. The team, the core group and many others then engage in the process 'Decide Together'. Then, instead of having to announce the proposals to an unsuspecting public, not only (most of) the public will be already aware but some will have contribut-

ed directly to those proposals. Instead of objecting they will often support, even 'champion' what many by now consider 'their' project. However, some defending is always still needed.

Conclusions

A sanitary landfill, intended as the last link in a circular economy, should be conceived as an endeavour that is developed throughout the duration of the operational phase. Completion of construction will only

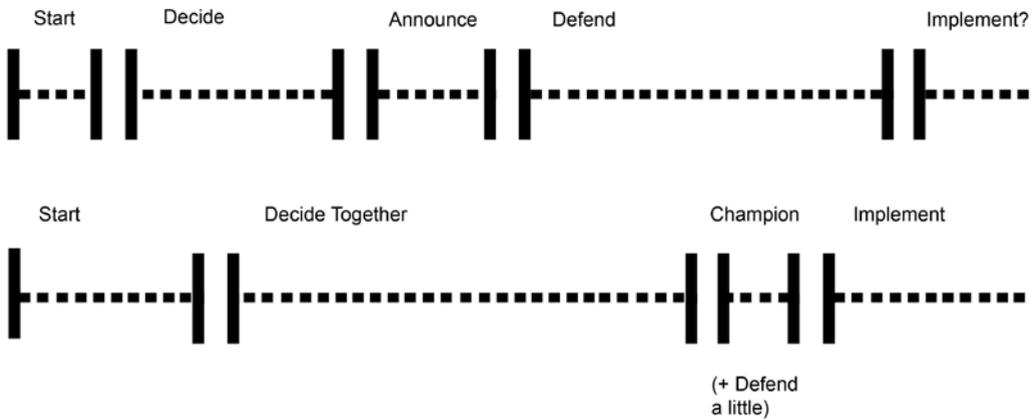


Fig. 14 – Involvement processes: diagram 1 - Decide-Announce-Defend (common process) - diagram 2 - Engage-Design-Deliver (recommended approach) (source: Jeff Bishop Studio).

be achieved once the global project has been terminated. Accordingly, the operational phase of a landfill should be seen as an extension of the building.

In a circular economy perspective, landfills occupy an unavoidable rather than a disputable position and should be seen as a necessary facility in the same way as all other services a community relies on. Indeed, it is the overwhelming need for landfills to legitimize construction of the same and likewise justifies the need to ensure they remain near the community they serve.

An environmentally sustainable landfill should assume programmatic significance through a planned intervention that contributes towards the overall design of the locality and meets the requirements

of the two life phases of the landfill itself: the operational phase (temporary use as a landfill) and post-operational phase (final use created on the basis of the deposited wastes). Therefore, a precise time horizon and specific technical regulations should be established in line with the final intended use of the site as determined in the initial project.

Municipal waste sanitary landfills should therefore be seen as an integral part of local area planning with a functional rather than a disposable intended use. It should no longer be construed merely in the light of its intended use, but as a process heralding the development of a new form of intended use.

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