Brownfield remediation: a lesson in time

There are many lessons to be learned from the history of how Brownfield remediation and redevelopment has occurred over a relatively short period of time, explains Marcel Steward.

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There is a tendency among planners, developers and others dealing with land redevelopment to consider Brownfield Remediation to be a 'one off event'. Land is 'dirty', 'clean' or 'cleaned' isn't it?

The fact that Brownfield Remediation is site specific aside, the way in which we approach Brownfield Remediation has changed with time.

Pressure to redevelop Brownfield land has never been greater and is only likely to increase as other land assets become compromised through climate change, increased flood risk, etc. The manner in which we achieve this now is much more sophisticated than in the past as our knowledge and technology advances in Brownfield Remediation Programmes. Furthermore, some past Brownfield Remediation Programmes are now entering their 'second' and 'third' phases of re-redevelopment in some instances, and these occurrences are likely to become more frequent in the future.

Firstly we must learn from the limitations of past Brownfield Remediation Programmes to 'future proof', as far as possible, those being carried out today and tomorrow.

Secondly, planners and architects must be aware of the limitations of past and present Brownfield Remediation Programmes as these sites may well form part of the new re-redevelopments going forward. We must adopt a risk management approach to the incorporation of these properties into our new towns of tomorrow if our communities are not to be compromised by the limitations of past remediation design. However, we cannot environmentally or economically afford to squander past investment in remediated sites just because they are yesterday's technology. We are therefore obliged to integrate both of these elements into the planning of tomorrow's towns if we are to realise the objective of new environmentally sustainable communities envisaged in the Government's Eco-Town Strategy.

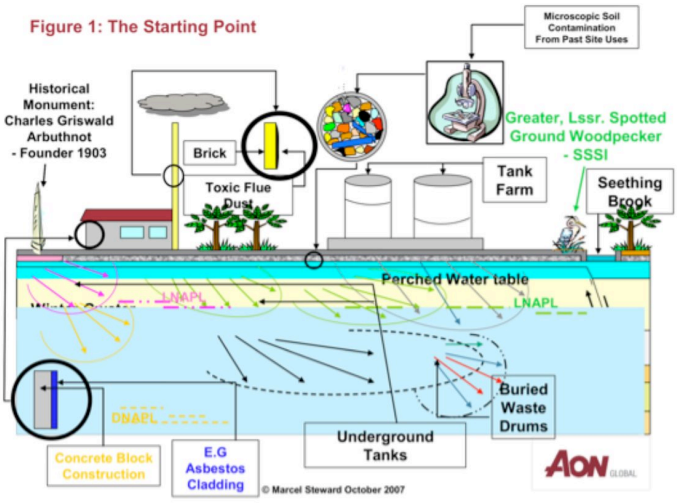
Let's examine the changes in Brownfield Remediation over time using proxy time lines and generalised, hypothetical case studies.

The Starting Point

Our starting point is the old Griswald's Mill Site, which is bounded on one side by Seething Brook.

The site has had a number of past uses that have contributed to its 'pollution profile' at and below ground level Figure 1.

Figure 1: The Starting Point



Pre – 1980:

Before 1980, Brownfield Remediation Programmes are difficult to identify. Site preparation of vacant land consisted of building demolition. Made ground and underground structures were left in situ. Tank bases containing residues or ponded water were pierced to allow drainage to the ground. The primary objective to this was usually the removal of salvageable plant and prevention of unauthorized occupation while the property lay vacant. Prior to the urban regeneration program in the 1980s, such sites often remained dormant for years, frequently decades.

When sites were redeveloped, the site was effectively 'levelled' by regrading existing material on site, including the debris from previously demolished buildings with the addition of imported fill from other sources, frequently industrial waste and hardcore from 'other' sites. The concept of ground and ground water contamination being taken into account to delineate planning and future development was only poorly known; little understood and generally not recognised. Figure 2.

Plot locations with water frontage typically attracted the highest 'per unit' property yield and hence were typically redeveloped for 'high value', low density housing – especially since this land was less likely to have been exposed to heavy industrial development and usage in the past. Plots that were located more interiorly to the site would typically be redeveloped as clustered residential types of 'Medium' and 'Low' value units, the zonation reflecting not only the

aspect of the individual plots, but also the level of past industrial activity. The more past development of a specific site locale for buildings means the more buried foundations in situ and a greater degree of difficulty for future development from the perspective of foundation design (especially on made ground). This led to the tendency for 'affordable' housing to be located within the interior of such plots, often high rise forms with a greater ratio of residents to square footage of building footprint.

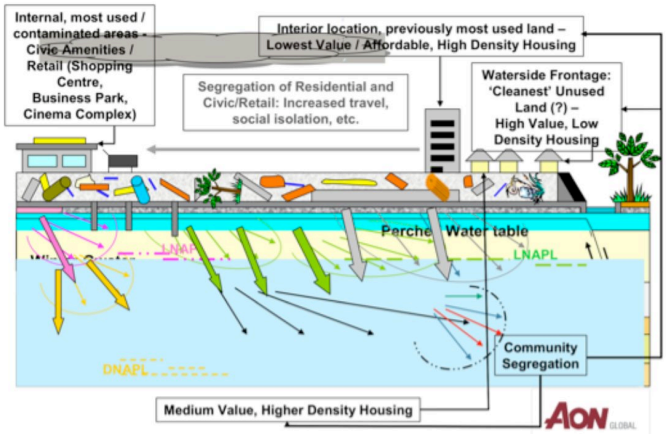
Whatever the causation for the distribution of the housing types, the result of such developments has typically been the segregation of housing types and communities. As a result these communities are inherently unstable as residents move from one zone to another as life circumstances change, from first time buyer, to upsized family home and down sized mature residence.

With the typical 'efficiency' exhibited by such developments we also see the segregation of residential areas from retail and civic amenities with the implications that this brings for traffic and amenity inaccessibility for specific sectors of the community.

From a 'remediation' perspective, this was often typically non-existent. Potentially hazardous polluting materials from past site uses, unregistered past dumping of waste, buried waste, leakage from above and below ground tanks and contained hazardous materials from demolished structures on site (and often imported from elsewhere as fill material for made ground) were simply interred in the leveled site surface.

Indeed, the process of the original site demolition and 'opening' of the site surface (i.e. destruction of the existing hard standing), the long period of being allowed to lie fallow, and subsequent levelling / regrading

Figure 2: Pre 1980 Urban Redevelopment



of the land, often caused existing contamination to spread vertically and laterally into previously uncontaminated areas of the site by leaching of pollutants and migration of contamination in pollution plumes.

If 'remediation' was created in any form by this process, then it was more than likely by the reinstallation of hard standing or structural ground cover within the new development, creating an effective barrier layer between the new site users (residents and workers) and the potentially buried hazardous substances below.

As and when these sites fall due for subsequent redevelopment, e.g. as part of the new Super Sites to be assembled for future Eco – Town developments, then only exceptionally will it be possible to place certainty on the pollution status of the land. Further remediation may be expected to be required. Modern remediation programs will take account of the ground and ground water pollution profile in the remediation design that will of necessity be integrated into the future redevelopment infrastructure and distribution of land uses.

Early 1990:

By the 1980s / early 1990s, active Brownfield Remediation Programmes as an identified 'strategy' can be defined. Large scale urban regeneration programmes were underway in many major cities, counteracting inner city decay. With this came the wider awareness and acceptance that past site usage pollution risks made the clean-up of the land prior to redevelopment for environmentally more sensitive land use a necessity. The question was how to do it?

What 'standards' should apply to measure contamination or indeed the level of decontamination?

At this stage (and indeed, even now) there were no 'standards' as to how such sites were investigated, what substances were analysed for, how analyses were carried out or how the results of the analyses should be interpreted. More recently the voluntary membership of reputable analytical accreditation schemes, as well as the establishment of environmental consultancy sector 'standards', established by common usage and consensus, means that variation in interpretation and remediation design is less of a phenomenon now than in the past. However, in the 1980s and 1990s, variations in analytical methodologies, analytical results and interpretation were common and potentially huge. It was certainly possible for two environmental consultants to carry out a site investigation of the same site and be able to pronounce the property 'clean / suitable for redevelopment' or 'contaminated / requiring remediation' without deliberately falsifying their findings in any way whatsoever. However, with contamination already sufficiently well established by this time to cause a land asset to have a negative equity value, the pressures to interpret site investigation results 'favourably' may have been present in many circumstances.

Nevertheless, site remediation programs had moved forward a little. By and large it was common practice for hazardous materials to be removed from the fabric of existing buildings to licensed landfill prior to demolition. However, site preparation pre-redevelopment was generally unchanged since the previous pre 1980 time horizon previously described. Figure 3.

The absence of accepted 'standards' had a variety of effects. In the first instance, early Brownfield Remediation Programmes were primarily focused on ground contamination. Ground water was usually not recognised as an issue.

The lack of commonly accepted remediation standards also had an influence on remediation design. Either 'do little or nothing', or endeavor to remove as much as possible in order to 'future proof' the remediation against future increased or heightened imposed standards.

Under the first scenario the remediation programme design may have been more or less successful at remedying the environmental risk. The second scenario may not have been better. There are several reasons for this.

Removal of large volumes of soil and replacement with imported fill materials frequently required excavation to below seasonal ground water

level. In order to maximize the extent of excavation, as well as facilitate the works execution, such "dig and dump" programmes were usually carried out during the drier summer months when ground water was at its lowest levels. With no treatment of the ground water (even if the technology had been available) recovery of the ground water levels, or lateral migration of mobile contaminants from adjacent land means that pollution was frequently reintroduced to 'cleaned' areas during winter. This is of course pre-supposing that the 'fill material' used to backfill the 'cleaned' excavations was itself, clean. Observations at the time would indicate that recovered fill materials (demolition material), industrial waste products, pulverized fuel ash, etc. may well have been contaminated at levels above an 'acceptable' standard, but were never identified due to an absence of testing. Finally, notoriously, anyone who has witnessed such a works programme will know that three meters of fill on the plan does not always equate to three meters of fill in the ground, particularly as budgeted costs escalate. Figure 4.

Even where such 'dig and dump' remediation was carried out, significant contamination sources were frequently missed, not through lack of thoroughness, but simply due to the limitations of the investigation techniques. Even where a site has been subjected to extensive excavation, it cannot be assumed that all original contamination has been removed or that dilution over time will have lessened the problem. Underground tanks, possibly not from the previous development / s but the usage before this, etc., and buried waste, may well still be present and a source of pollution to the ground water, adjacent properties and surface water rivers, etc.

Figure 3: Early 1990 Pre-Site Redevelopment - Site Demolition

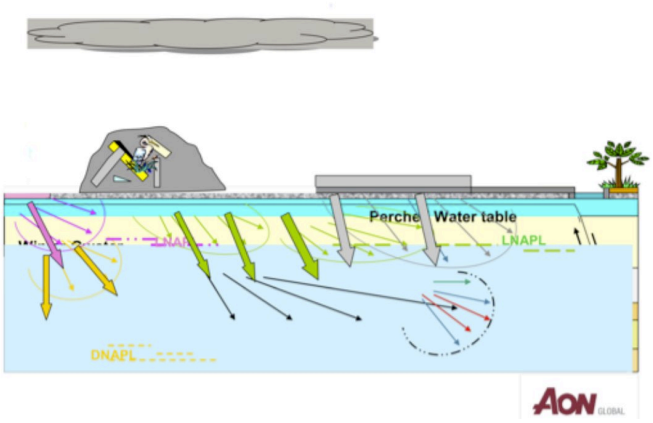


Figure 4: Early 1990 Pre-Site Redevelopment - Site Preparation

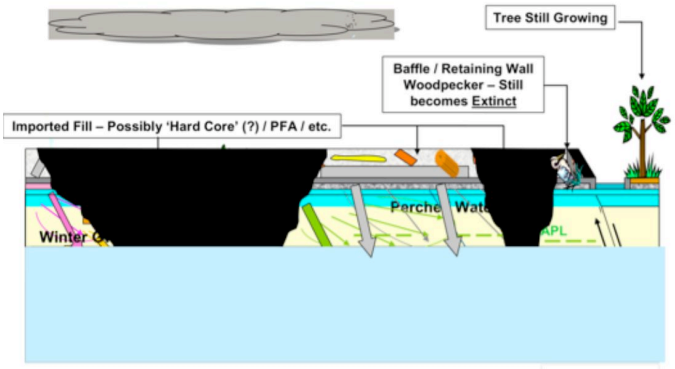
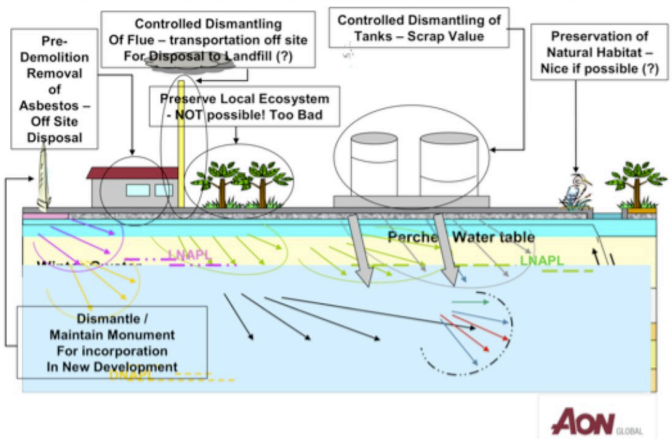


Figure 5: Mid to Late 1990 Pre-Site Redevelopment Site Demolition



Typically site redevelopment at this time was either on the same format as previous developments with zonation / segregation of housing types and central retail / civic amenities separated from residential development the with the negative draw backs noted above.

The variability of these early Brownfield Remediation Programmes and the need to create future 'certainty' with respect to future site redevelopment makes them perhaps the most challenging to assess in terms of the remediation that has been carried out, the environmental risk remaining and the further remediation that will be needed. Where good, auditable information is available, it is possible that further remediation may be minimal. In other circumstances full scale remediation may be needed to clean up the last remediation program.

Mid to Late 1990

In many respects, the mid to late 1990s saw the arrival of modern remediation programmes. Environmental issues in general, as well as those related to Brownfield Redevelopment means that the approach to site investigation and remediation design was significantly different from the early days of the 1980s / early 1990s.

More attention was now paid to the removal of hazardous materials from existing structures as compared to the 1980s and early 1990s, with disposal off site of these elements. Remaining materials from the building structures, now known to be relatively inert, are used in the site remediation.

Where possible, eco habitats were now maintained, albeit as a means of maintaining site aspect and therefore commercial value considerations, as opposed to any early manifestation of conservation criteria per se.

Removal of below ground

contamination, localised landfilling and waste disposal during past site uses are excavated under the commonly employed strategies of this time, and may be removed from site to landfill, or in some instances may be redeposited on site in line with incoming sustainability criteria and awareness of the necessity to reduce the volume of material being transported off site and taking up landfill capacity (as well as reducing off site disposal costs to the project). Figure 5.

A remediation design improvement in the form of an engineered capping layer to seal the land surface separating site users from underlying residual pollution is more effective as well as supporting a more utilitarian land use above ground than previous Brownfield Remediation Programme designs. Waste depositories created for on site waste disposal are now well engineered to isolate hazardous materials from the surrounding ground, ground water and site users. Their position demarcated for future reference.

The preservation of structural features, and even the establishment of eco-systems, such as soft landscaping *(note: not yet the re-establishment of previously existing eco-systems)* is more common in Brownfield Redevelopment schemes from this time going forward, indicating the growing awareness of life quality values in new communities, even though the segregation of community types and residential and retail / civic amenities persists. Figure 6.

From a Brownfield redevelopment perspective, sites remediated at this time will be more predictable in terms of their current and future pollution status. Risks will always remain from potentially undiscovered underground tanks and previous site usage arising from ad hoc burial of waste. It can even be argued that with the minimisation of excavation in comparison with the days of dig and dump remediation, the risk from undiscovered pollution sources may even be higher, but overall the level of ongoing environmental risk from these sites to future redevelopment of the land should be less than from earlier Brownfield Remediation Programmes.

Figure 6: Mid to Late – 1990: Urban Redevelopment

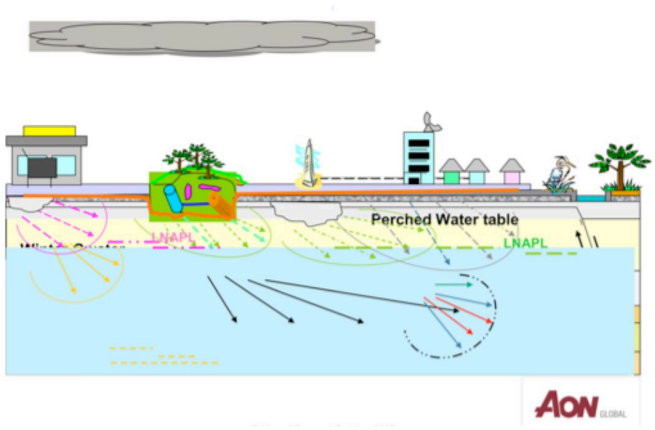
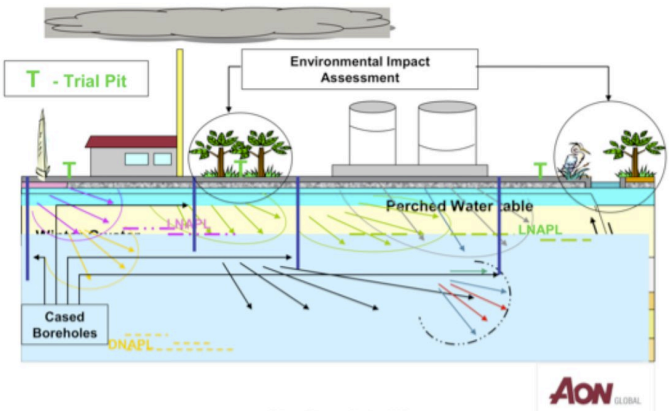


Figure 7: 2000 and after Pre-Site Redevelopment -Site Investigation



Since properties remediated during this time period are from our more recent past, second phase redevelopment of these locations is not likely to be as frequent in the near term future, in spite of the potentially negative socio-economic drawbacks inherent in their layout and planning.

2000 and After

Entering the present timeframe we see the deployment of a more environmentally risk managed approach to remediation design. More detailed environmental risk assessment and identification during the site investigation stages of the Brownfield Remediation design allows for a more highly tuned response to the environmental pollution risks present. This will now also include the conservation of existing ecosystems or their reinstatement where this is necessary and practical to achieve Figure 7.

Careful segregation of materials derived from the site, together with an integrated approach to the engineering of the remediation design means that such materials can be safely treated and/ or retained on site, adding value to the remediation process.

Waste isolation and removal of hazardous materials at the beginning of demolition, for example, can help to minimise the volume of waste requiring disposal. Treatment of contaminated soils on site using a variety of land farming and soil treatment techniques can further reduce the volume of material requiring special disposal techniques and even provide clean backfill material for use in top soil covering to the site. Hardstanding and building demolition aggregate can be reused in the engineering of the capping layer to the site. Materials contaminated with non-soluble pollutants may be incorporated into the engineered capping layer at depth where it will remain segregated from site users. Where underground storage tanks are identified these will almost certainly be removed, or as a minimum the void space grouted up to ensure that they do not constitute a source of contamination in the future. Where ground water has been contaminated, technology is now available to pump and treat to prevent spread of contamination and or reintroduction of contamination at a later date. As with all site investigation and remediation, short of complete site excavation to depth, the potential for undiscovered underground waste still remains as a risk going forward, although with more refined and targeted site investigation techniques it is reasonable to expect that environmental risk arising from these types of sources will also be less than those present within

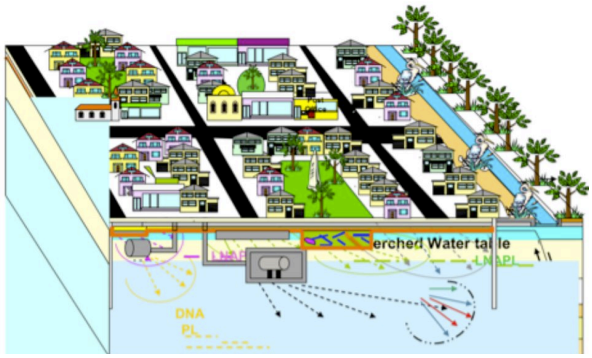


Fig 10 2000 and after: tomorrow's eco-town?

previous types of Brownfield remediation design. Figures 8 and 9.

With lessons learned from past urban development programmes, from the Victorian period to the present day, we are now developing a better understanding of what makes a community a place where people want to live and to spend their lives in. In the new towns of the future anticipated by the Government and their advisers, The Princes Foundation for the Built Environment, it is hoped that planners and developers alike will adopt a series of values to make these communities both sustainable as well as endurable. Mixed residential housing types within a single area so that people can buy their 'starter home', upsize to the family home and downsize again when the family has left without leaving the community.

The reasonable mixing of retail amenities in the residential environment such that people living in these settlements can meet their reasonable daily needs within walking distance of their home and many more life quality criteria can be engineered into sustainable urban developments of the future. Where these are planned for Brownfield land, integration of the remediation program with the development plan will not only allow the achievement of sustainability criteria for the settlement from the start, it may valuably contribute to the Carbon Zero values required of such developments under the Eco-Town imitative. Figure 10.

Figure 8: 2000 and After Pre-Site Redevelopment - Site Demolition 1

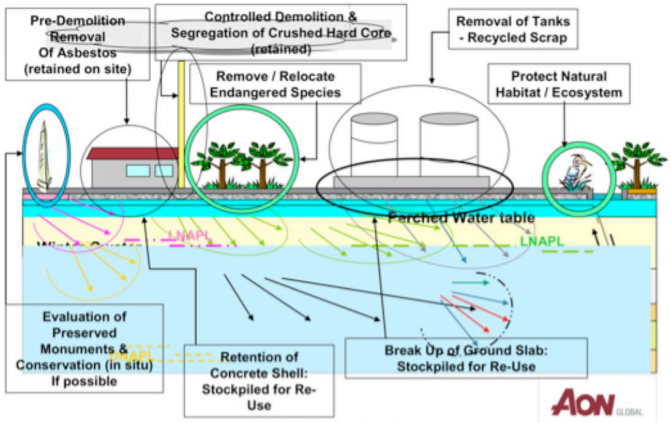
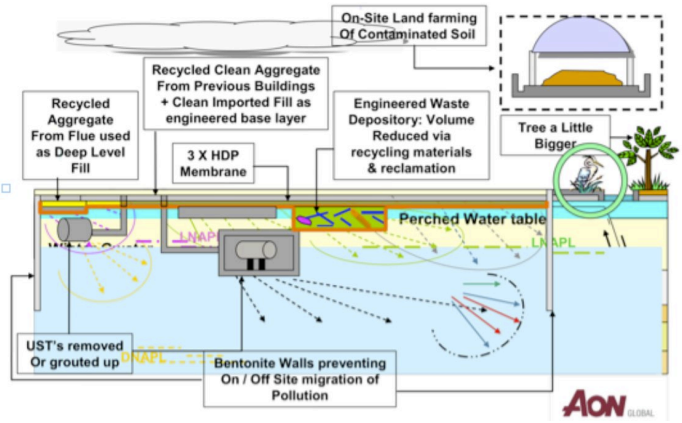


Figure 9: 2000 and After Pre-Site Redevelopment - Site Demolition 2



Lessons learned

There are many lessons to be learned from the history of how Brownfield remediation and redevelopment has occurred over the space of a relatively short period of time, from the 1980s to the present.

These lessons can be valuably applied to our Brownfield Remediation Programmes of today and tomorrow and may include some common themes that can be identified:

• As far as it is possible, we must strive for the highest practicable remediation standards achievable.

• Past Brownfield Remediation Programmes that have been carried out to a high level actually achieve many of the standards now expected today from such redevelopments in regard to the minimisation or removal of the environmental risk presented by these properties.

1. Accurate verification of the specific elements of the remediation programme, combined with accurate and auditable records, maintained in an updatable and accessible database format is the best means of ensuring that future Brownfield Remediation Programmes can be future proofed by augmentation where necessary as standards advance, rather than being completely re-engineered because the environmental risks and limitations of these programmes are unknown.

2. Acknowledgement that what is happening under the ground surface has a direct impact on what it is economically, environmentally and sustainably possible to develop above ground. Failure to integrate Brownfield Remediation Programmes with the future planning of new redevelopment projects will not only compromise achieving the environmental sustainability objectives required, but may actually present a risk to future site users by failing to match the remediation design to the eventual site end use.

This aspect is particularly important when the pressure to redevelop Brownfield Land for increasingly more environmentally sensitive end uses such as domestic dwellings and housing is increasing. Contaminated sites which would previously have not been economically or practically possible to remediate for housing in the past will almost certainly be called upon to be redeveloped in this way in the future.

3. Given the present and projected demands for housing in line with the Government's targets, the concept of the Eco-Town must be expected to be a reality.

It is expected that 60 – 70 per cent of the new Eco-Towns will be developed on Brownfield land.

Given the size of the 'Super Sites', which it will be necessary to create for such communities, especially where these exist as infill projects, or extensions to existing cities, it is reasonable to expect that Brownfield Sites will need to be remediated. Further, it is likely that Brownfield properties redeveloped before the 1980s and into the 1990s will form part of these portfolio Super Sites. Failure to understand the limitations of past redevelopment / remediation programmes will lead to unnecessary expenditure and inappropriate planning, potentially compromising the wider Environmental Sustainability Objectives set out for these communities in the future.