FORD ENERGY RECOVERY FACILITY AND WASTE SORTING AND TRANSFER FACILITY, FORD CIRCULAR TECHNOLOGY PARK

ENVIRONMENTAL STATEMENT

CHAPTER 4

ALTERNATIVES

4

4 Alternatives

Introduction

4.1 This chapter examines the significant alternatives considered during the development of the proposed Ford ERF and WSTF, including: combustion technologies, site layouts, building design, building materials and drainage solutions.

Legislation and guidance

4.2 The consideration of alternatives is central to the EIA process. In many cases, adverse environmental effects can best be avoided through consideration of alternative means of achieving a development proposal, such as different sites, layouts, and / or means of access.

4.3 The EIA Regulations provide guidance on the need for and content of an EIA. With regards to alternatives, Schedule 4 (Part 2) of the EIA Regulations states that ESs should include:

> *"A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."*

4.4 Paragraph 035 (Ref ID 4-035-20170728) of the Ministry of Housing, Communities and Local Government's on-line EIA guidance states that:

> "*Where alternative approaches to development have been considered, the Environmental Statement should include a description of the reasonable alternatives studied which are relevant to the proposed development and its specific characteristics and provide an indication of the main reasons for the choice made, including a comparison of the environmental effects (see regulation 18(3)(d)).*

Alternative combustion technology solutions

4.5 The following alternative combustion solutions have been considered for the ERF:

- Advanced thermal treatment
- Conventional combustion systems

Advanced thermal treatment

4.6 There are two types of advanced thermal treatment facilities:

- Pyrolysis
- Gasification

4.7 With regard to pyrolysis there is limited experience of successfully processing residual waste at the proposed waste processing capacity. Therefore, this is not considered to be a proven technology for the Ford ERF.

4.8 Gasification technologies are sensitive to the nature and composition of the waste being treated. To operate gasification facilities efficiently requires both a consistent feed stock and a certain proportion of different waste types. As such, gasification is limited in its flexibility to deal with the potential variation in the composition of the residual municipal solid waste that would be treated at the Ford ERF. The applicants do not consider that gasification technology is proven at the proposed capacity for the Ford ERF.

Conventional combustion systems

4.9 Direct waste combustion in a conventional EfW facility with combined heat and power (CHP) is a proven technology capable of delivering a flexible and sustainable waste management solution. EfW is used throughout the UK and Europe for the management of municipal solid waste (and similar commercial and industrial wastes) and is established as an efficient way to recover energy, especially where CHP can also be delivered from the plant. The technology is, by a very significant margin, the most widely deployed waste recovery solution in Europe (with over 500 operating plants). A conventional EfW facility would be capable of managing the predicted waste volumes and would effectively treat the likely composition of the waste predicted to be managed at the proposed facility. Given the technology is well proven it is also significantly less complex to fund. Furthermore, with developments in conventional combustion technologies in recent years, it has led to significant improvements in efficiency and that such facilities are now fully ‘circular’, with the residues from the process being 100% recoverable, with no residues being transferred to landfill. On this basis, the use of a conventional EfW facility is considered to be the most appropriate waste recovery technology option currently available.

4.10 Conventional combustion EfW facilities can be delivered through a variety of sub-technologies and the applicants have considered these technologies, as summarised below.

Fixed hearth

4.11 This type of furnace is generally not considered to be suitable for the management of large volumes of mixed waste and is best suited to low volumes of consistent waste. As a consequence, this technology is not used for the combustion of municipal waste in the UK.

Pulsed hearth

4.12 Pulsed hearth technology has been used for municipal waste in the past, as well as other solid wastes. However, there have been difficulties in achieving reliable and effective burnout of waste and it is considered that the burnout criteria required by the Industrial Emissions Directive (IED) would be difficult to achieve.

Rotary kiln

4.13 Rotary kilns have achieved good results with clinical waste, but they are not commonly used in the UK for municipal solid waste (or similar wastes). The capacity of a single rotary kiln unit is limited to 8 tonnes per hour. Therefore, four rotary kilns would be required to fulfil the proposed waste processing capacity. Furthermore, the energy conversion efficiency of a rotary kiln is lower than that of a moving grate.

Fluidised bed

4.14 Fluidised bed technology has been used for municipal waste at a few sites in Europe. In the UK, there are only two operating facilities which are located in Dundee and at Allington in Kent. The former has a long history of significant operational difficulties.

4.15 Fluidised bed technology has a number of advantages over moving grate technology, including lower nitrogen oxide (NOx) formation, slightly higher thermal efficiency and the lack of moving parts within the combustion chamber. However, there are also a number of disadvantages:

- The waste stream needs to be homogenised and therefore would need to be pre-treated before feeding to the fluidised bed. This would lead to additional energy consumption and a larger building. The additional energy consumption tends to outweigh the combustion efficiency advantage.
- High fluidisation velocities can lead to the carryover of fine particulate material. This can lead to a higher particulate loading in the flue gases, so leading to higher quantities of flue gas treatment residues, which need to be disposed of as waste. However, the bottom ash tends to be of better quality.
- Although less NOx would be formed, secondary NOx abatement equipment would still be required to meet the emission limits imposed by the Waste Incineration BREF.
- The operational and capital costs of a fluidised bed are higher than the equivalent costs for a moving grate incinerator.
- Experience of fluidised bed plants in the UK has shown that they have a lower reliability than other EfW options.

Moving grate

4.16 This is the leading technology in the UK and Europe for the combustion of municipal and other similar wastes, being installed on approximately 90% of UK waste incineration facilities and some 98% of European incinerators. The applicants consider that moving grate is a proven technology from experience at the Lakeside EfW. Furthermore, there are a number of potential technology providers available to supply moving grate technologies. The various designs are proven to achieve the burnout requirements for compliance with the IED.

4.17 For the reasons set out above moving grate technology is proposed for the Ford ERF.

4.18 It is also worth noting that a front-end materials recycling facility (MRF) has not been included within the proposals for the Ford ERF as it is not considered to be a financially viable solution for the target residual waste market. The applicants will rely on source segregation of waste or segregation currently being undertaken at other waste management facilities who in turn will be contracted to supply non-recyclable waste to the Ford ERF.

4.19 Waste to be received at the WSTF will either be pre-sorted at source or will be subject to manual sorting and segregation upon arrival in preparation for bulking and onward transfer to appropriate waste management facilities. All non-recyclable waste leftover after sorting within the WSTF will be transferred to the ERF.

Alternative site layouts, building designs and materials

4.20 The development of the site layout has been informed by a number of factors, including the constraints and opportunities offered by the site, meeting the design objectives (as set out in the Design and Access Statement (DAS)) the requirement to ensure operationally efficient facilities and consideration of how to best mitigate the development's impact within its setting.

4.21 The potential distribution and orientation of the principal components making up the ERF and WSTF across the site were explored, together with consideration of alternative vehicle access and circulation strategies to best optimise the overall layout, segregation of operational and non-operational vehicles, and to establish efficient and safe traffic movements across the site.

4.22 The design team accepted from the outset that in order to allocate separate operational areas for the ERF and the WSTF that the square shaped site would essentially need to be spilt into two halves, with each sharing the single access in the south east corner of the site and a flexible central area for accommodating waste containers and bins, contractor vehicles, temporary cabins and storage areas during maintenance periods.

Stage 1 design evolution

4.23 The first phase of design work primarily focussed on the location for the ERF, with its footprint and arrangement having been determined in principal by a number of early key decisions, including:

- Adopting an optimised linear arrangement of the waste reception hall, waste bunker, boiler hall and FGT hall /stack was assumed, with ash handling, administration wing, turbine hall and ACC being located alongside.
- In order to minimise the height of the building the potential to lower areas of the building below ground level was considered. The information available at the time identified that the existing groundwater levels on the site were sitting 6 m below ground level (bgl) and this would be the lowest level that parts of the building could be dug into the ground in order to minimise intrusion into the groundwater. To lower the boiler hall (the tallest structure into the ground) would require major excavation works to provide vehicle access ramps to the lowest level and the footprint of this infrastructure would be such that the resulting increase on footprint area for the ERF would leave insufficient area on the site for the WSTF. The general lowering of the ERF

building process areas was therefore rejected, however, it was decided that the waste bunker would be set 6m into the ground (i.e. 6 m bgl) as it required no additional area for vehicle access. (Please note, groundwater levels and the depth of the bunker are revisited in paragraph 4.55).

- With the size of the waste bunker being determined by the volume of waste it is required to hold, the level at which the waste bunker is set into the ground has a direct impact upon its footprint. In order to minimise its footprint and the buildings overall size, it was decided to elevate the waste reception hall floor to +8m above ground level. This best balanced the building footprint and height and allowed for workshop and store areas to be located within the space created below the waste reception hall floor, thereby making the ERF footprint and its overall size more compact.

4.24 These early studies established that due to the site's shape being slightly more rectangular than square and the access being in the south east corner, that a north – south orientation of the ERF made more efficient use of the site than an east - west orientation. It also ensured that a sufficient area would be left available for the WSTF. This orientation also enabled the highest parts of the building to be set back from current and potential future receptors lying beyond the site's western boundary.

4.25 A variation of the north - south alignment, which located the administration wing and car parking on the eastern face of the ERF was considered successful as the majority of operational vehicle movements to the centre of the site would allow its eastern face to be developed as a more 'civic' frontage and provided the opportunity for segregated car and HGV access to be explored further.

4.26 Mirroring the north - south alignment such that the waste reception hall was on the south was also tested, but it required the vehicle access ramp to the waste reception hall to be located on the eastern façade and this would result in HGV's having to circumnavigate the whole site on entering and leaving. It was considered that this would result in increased visual and noise impacts in relation to receptors to the east of the site and therefore maintaining such activities in the centre of the site was considered preferable.

4.27 For performance / operational reasons the ACCs need to be as close as possible to the turbine hall. Alternative locations were considered but deemed unviable due to: noise concerns, the fact that IBA handling would have to move to the eastern facade and would therefore require HGV movements to deviate from the centre of the site and also a deterioration in the quality of the eastern facade as a civic frontage.

4.28 Having established in principle a preferred location and orientation for the ERF, layout studies were developed to incorporate the WSTF buildings and explore the relationship between the site's joint uses, as well as their shared infrastructure.

4.29 There were several key principles adopted at this stage which informed the layout of the WSTF:

- The inclusion of areas around the site's perimeter within which landform screening, landscaping, planting and biodiversity improvements could be incorporated. Located along the site's western, eastern, and northern boundaries these areas would be capable of being bunded or walled up to 5m in height in order to visually and acoustically shield nearby receptors from the site's low-level operational activities, particularly that of manoeuvring vehicles. It was not possible to provide a similar zone for bunding along the site's southern boundary due to the alignment of the access road into the site and the area required to incorporate the necessary entrance gatehouse and weighbridge arrangements. Sufficient area does, however, remain for planting and walls to be included along that boundary.

- Establishing a central operational zone sitting between the ERF and WSTF to offer shielding of HGV related activities from the east and the west by the buildings themselves and within which to include an area to accommodate waste containers and bins, contractors' vehicles and temporary cabins during maintenance periods of the ERF.
- Achieving a coherent traffic strategy which optimises the independent operation of the ERF and WSTF and maximises the adoption of one-way traffic systems and the safer right hand down reversing arrangement for HGVs.
- Maximising the segregation of HGVs and cars within the site.

4.30 The key components forming the WSTF include a vehicle workshop building, which also contains administration and welfare facilities, and a main building where the WSTF unloading / sorting / loading activities would take place. The footprint and location of these were very much determined by the drive to satisfy the key principles identified above.

4.31 The WSTF layout developed at this stage located its workshop building at the southern end with its main building to its north. This ensured that the car park would be located close to the site entrance and its arrangement avoids cars having to circumnavigate the site and optimises their segregation from the HGV circulation routes.

4.32 Access doors into the northern component of the main building and the workshop and their manoeuvring apron for reversing vehicles, are all located on its eastern façade. Facing onto the central operational zone of the site ensures that these activities, including the opening of the 8 m high doors to the unloading bays and vehicle workshop, are visually concealed from receptors to the east and west of the site.

4.33 Access doors into the central part of the building and into the internal loading of the northern part are located on the south facade with exit doors on the north and east facades. This arrangement also ensures that there are no HGV access doors located on the western facade and allows that elevation to remain uninterrupted and visually uncluttered.

4.34 The location of the WSTF has been set as far back as possible from the western boundary. This reduces the apparent scale of the building when viewed along that boundary, but also leaves sufficient space for the internal perimeter road and vehicle parking areas, all of which are concealed from view beyond the site's 5 m high bunding / wall arrangement.

4.35 In developing the overall layout for the site further refinements were made to the ERF to reflect detailed development of the facility. This included re-sizing of various components making up the facility and adjustment to traffic routing around the building. A key development was the 90 degree rotation of the administration wing, such that it would span the internal road system, with its glazed facades facing north and south. This was in order to mitigate its potential night-time lighting impact on nearby receptors. Orientating its facade to face the entrance to the site also afforded the opportunity for the architectural design to explore developing a more 'civic' frontage for the administration wing.

Stage 2 design evolution

4.36 The first stage of architectural design development mainly focussed upon the massing of the ERF building (as it is the largest building on site) and was developed in parallel with the site layout work to enable the potential visual impact of the development to be considered from the outset. A number of key viewpoints were identified and the design has been largely informed throughout its development by the use of 3D modelling and photomontages and the development of the landscape and visual impact assessment (LVIA).

4.37 Whilst recognising that the internal process equipment and related activities dictate the minimum building envelopes required for the main ERF structures, how the design could be developed to best mitigate its visual impact was a key consideration. While accepting that it would be impossible to make a facility of this size 'disappear', it was important that alternative design approaches were considered at an early stage in the design evolution process in order to best minimise the scale of the development.

4.38 Initial massing studies of the proposed design were prepared using outline 3D computer aided design (CAD) models. As the design was being developed in parallel with the LVIA assessment work, formal record photographs from key viewpoints were not available at that time. Therefore two informal, eye level views were used to test the visual impact and appearance of the proposed design from the surrounding area. The views against which the design studies were tested were identified as: View 1 - view westwards from the site's former exit road west of Rodney Crescent and View 2 - the view north westwards from the site's access road leading from Ford Road.

4.39 An early study was to test initial basic massing of the building in 3D in both views which identified several issues that needed to be addressed:

- The height and massing of the boiler hall appeared excessive in relation the remainder of the building
- The overall profile of the building's roofscape against the sky was considered overly rectilinear and fractured, and that alternative profiles should be explored
- The overall visual scale of the building would need to be broken down by consideration of contrasting materials / colours
- The ERF would clearly be seen as a large building within the landscape and that while consideration should be given to architectural designs which might assist in blending the building with its surroundings, designs which were focussed on making a positive and confident architectural statement should not be ignored.

4.40 A range of design studies were then undertaken to test alternative approaches to the shape and the roof form of the main ERF facility. Using variations of the 3D CAD model several early massing / colour studies were developed:

- How the overall massing might be broken down through the use of varying colours / tones was explored on the basic cubic massing. In the first option a dark colour banding was applied to the lower cubic forms to create a darker plinth around the building. This proved successful in breaking up its overall scale through colour contrast and also in reinforcing the stepping in scale between the lower and upper parts of the building. The opportunity for the base to be darker than the upper parts of the building was considered to allow the lower parts of the building to be colour blended with the darker groundscape and the upper parts with the lighter sky.
- The principle of layering the building in a series of dark and light tones was developed further. The darker plinth was retained and further options with three or four layers were developed.
- To further break down the overall scale, designs which accentuated and created additional ‘steps’ and layers in the building’s profile were developed and bands of colour added at high level to add further visual interest.
- To address the scale of the tallest boiler hall structure alternative profiles for the building’s roofline were developed. Using the layered studies as a base several curved roof design options were considered. This culminated in a curved roof design where a single curved ‘wing’ over sailed the majority of the upper parts of the building, but to keep the overall height as low as possible it was set such that it intersected with the upper boiler hall rather than cover it. From the outset the design team were keen to include features that reflected the dynamism of flight and the curved roof form reflected the upper cross section of an aeroplane wing and hence was considered reminiscent of the site’s history as a former airfield.
- At this time the opportunity to use the office and welfare accommodation wing to create a ‘civic’ eastern frontage was also being explored. There was, however, consideration given to the possibility that the internal lighting of its glazed façade may result in an unwelcome night-time visual impact for receptors to the east of the site. To address this concern, it was decided that this accommodation wing should be rotated 90 degrees such that glazed areas would be more southerly and northerly facing and as such be less impacting as a result.

4.41 Accepting that while every effort would be made to best mitigate its visual impact, the building would clearly remain a large feature within the landscape. Therefore, the opportunity to celebrate it as a confident piece of architecture, a landmark within its setting, was also explored in a number of design studies and included drawing attention to the boiler hall by applying folding over-cladding to its facades to visually fracture its overall shape, or to wrap a curved over-cladding around it to visually soften it. Both approaches were considered to add visual interest and each could be further enhanced through the careful selection of materials / colours.

4.42 The final suite of design studies followed a technical review which established that the profile of the boiler hall and FGT area could be further stepped to more closely follow the height of the internal equipment. This generated a 3-level roof to the boiler hall and the impact of this was explored. Further development of a stepped / layered shape to the building was developed and which further fragmented the overall height of the building and offered further opportunities to vary colour between the horizontal bands. Treating the stepped profile as a single dynamic sloping roof form also offered an efficient fit to the internal process and helped lower the building's profile at its southern end. Treating this upper volume in a contrasting colour would assist in breaking up its scale. It was also considered to make a bold architectural statement, with a dynamic representation of flight.

Stage 3 design evolution

4.43 Following several internal team reviews it was decided that a number of the previous range of design studies warranted further development and this third stage of design development focused on advancing three alternative concepts (layered, curved and wings). Each was developed in 3D and reviewed in the previously noted views, but also from an additional eye-level view from the west of the site. The design concepts were also repeated on the WSTF as being the closest part of the development to the west, as this would offer an important visual foreground and how the overall concept might achieve a visual 'family of buildings' on the site was an important design objective.

4.44 Key design features that were brought forward from the previous design studies included:

- The use of a darker colour on the lower parts of the building to create a visually grounded plinth upon which the upper parts of the building would sit.
- The 90-degree rotation of the administration wing to ensure glazing faces north and south rather than east
- To conceal vehicles entering / leaving the elevated waste reception hall the access ramp would be clad such that it enclosed the upper part of the ramp, including the access door. This was to partly shield moving vehicles and their lights from nearby receptors, particularly on exiting the waste reception hall.

4.45 For technical reasons an increase in the size of the ACC from four cell to six cells also had to be accommodated in all three designs.

Layered concept

4.46 Based upon one of the previous design studies, this design adopted a strict 'form follows function' approach and layered the building to relate to the differing stepped roof plates and to use blocks of contrasting light and dark colours to break up the overall massing of the ERF. Being a tight fit to the internal process volumes, this architectural design was the most volumetrically efficient and as such minimised the building's overall scale. The WSTF was treated similarly to the ERF, but being lower in height would be less layered than the ERF.

Curved concept

4.47 This option explored wrapping the boiler and FGT enclosures in a single architectural form which would conceal the steeped roof profile of the ERF behind parapet walls, the tops of which would be angled / sloped to generate the curved appearance of the roofline and conceal rooftop equipment and vents behind. The overall appearance offered a soft profile and this was also applied to the corners, which being curved would visually soften the building further by removing its corners and blurring the transition between facades in light and shadow. This feature was also applied to the roof of the WSTF to soften its appearance from western views by folding the wall into the roof.

Wings concept

4.48 This design developed an alternative version of the curved roof principle. Rather than extend the upper volume as a single feature across the length of the building it sought to break up its scale into two angular upper forms. These would be treated as two dynamic and contrasting interlocking ‘wings’, which would celebrate the site’s historical links with aviation. As with the curved design, the northern and southern extents of the building would be lower than the central area and assist in bringing its scale closer to ground and the parapet approach would conceal rooftop equipment.

4.49 A pre-application meeting with WSCC was held to review the design development work that had been undertaken to-date and included the shortlisted designs. WSCC offered the following comments and feedback:

- Given the likely scale of the building within the surroundings it will inevitably be visible
- Industrial style ‘blocky’ buildings with limited aesthetic quality should be avoided
- An outstanding, visually attractive and innovative architectural design, which promotes high levels of sustainability and raises the standard of design in the area will be required. The design should consider taking cues from local heritage or character and respond carefully to the existing and future setting (noting the surrounding housing allocation / planning application)
- Materials / finishes should be carefully considered to aid in reducing the impact in long distance views
- A range of viewpoints within which to test the proposed design need to reflect the key sensitive receptors (i.e. Arundel Castle, public rights of way, village greens and close-range viewpoints from around the site, including those related to the potential new development close to site)
- Ancillary structures, particularly the ACC needed to be carefully incorporated into the design to minimise impacts and to read cohesively
- The buildings for the two facilities proposed on the site should be architecturally complimentary
- Opportunities to maximise landscape screening, including bunds and planting around the site and biodiversity enhancement must be taken
- Consider opportunities for lowering building into the ground to minimise maximum heights

4.50 Following the pre-application meeting with WSCC an internal design team review was conducted and it was considered that whilst the layered concept offered the most visually compact design, it lacked ambition and its more standard industrial building appearance would not be appropriate for its scale within its surroundings. Similarly, the 'blocky' appearance of the WSTF when viewed from the west did little to offer an appropriate architectural language to enhance its appearance.

Stage 4 design evolution

4.51 The next stage of design development sought to address the comments raised by WSCC. When comparing the two design approaches it was considered that the wings concept design offered a better visual balance and was more effective in breaking down the overall scale of the building. In reviewing the 3D views of the curved design there were also concerns that the curving of the corners on the ERF and the leading edge of the WSTF roof would lead to sun reflection highlighting these areas and thereby drawing attention to the building within the landscape. For these reasons the curved design was rejected, and the wings design was developed further by the team.

4.52 While the key principles of the site layout and architectural design remained unchanged, they were revisited and the following changes made.

Site layout

4.53 The revised proposal focused on improving the relationship between the ACC with the ERF building and consider in further detail the opportunity for landscape screening around the site. It included the following changes:

- A 90-degree rotation of the ACC to allow it to blend into the buildings behind
- This change also allowed the access route to the ERF car park to be set further west and provide additional area for landscape screening along the site's eastern boundary
- The car park for the ERF was enlarged to ensure it catered for both staff and visitor numbers
- The landscape screening was extended along the site's northern and western boundaries and around its north western corner to improve noise and visual screening to nearby receptors
- Having plotted the route of the historic canal a break was introduced in both the western and eastern screening landforms to signify the former path of the canal, which on the eastern side was also marked by the location of the administration wing and water feature

4.54 The internal layouts for both the ERF and WSTF were also revised. In the case of the WSTF this was to ensure that the internal material storage bays were sufficiently sized to accommodate the required material but also the internal unloading / loading of HGVs.

4.55 The layout changes to the ERF were mainly as a result of there being updated information from new groundwater level monitoring data for the site (see ES Technical Appendix G: Ground conditions and the water environment). This showed that the actual level was between 2.3 m and 2.45 m bgl across the site. For that reason it was decided that the base of the bunker would have to be raised from -6m to -2m to avoid interaction with the underlying chalk and groundwater. This in turn required the footprint of the bunker and the waste reception hall to be revisited, but also that the floor level of the waste reception hall would also have to be increased from +8 m to +10 m above ground level. The length and plan arrangement of the vehicle access ramp had to be revised accordingly.

Architectural design

4.56 Alongside the development of the site layout, the scale and colouring of the proposed design was tested in a range of viewpoints identified by the LVIA team and agreed in discussions with WSCC.

4.57 When considering the initial massing study in views from the South Downs National Park it was evident that the building would be read mainly against a backdrop of ground and slightly against the seascape, and that while the shape of the building may not be discernible the colour would. Using mid-tone colours instead of very light or very dark would better blend the building with the landscape whilst a light neutral colour would best mitigate the visual impact of the stack.

4.58 When tested in more medium range viewpoints from the north (i.e. Arundel Castle) the shape of the ERF building is more apparent and seen mainly against a backdrop of ground, but with its upper volumes breaking the horizon line and seen against a backdrop of sky. From such views the dark plinth worked well in bedding the building into the foreground and that using mid-tone colours instead of very light or very dark also better blended the building with the landscaped background. Again, the use of silver grey and coppery earthy colours for the different wings was successful in softening its appearance in these views, but also in breaking up its overall scale. Adopting a light colour for the stack was considered to better blend it with the sky.

4.59 This colour palette was also considered to work well in medium range views from the south, where the lower parts of the ERF building are essentially screened by foreground tree belts and where the upper part rises above the tree line and is read against the raised landform of the South Downs National Park. Again, this proved that the use of lighter colours would be less successful in mitigating its visual impact as the proposed colours helped blend the building with the tree belts and against the landscaped background.

4.60 In other medium range views, the ERF building would again be seen rising above foreground and adjacent tree lines and be partly read against a background of sky. However, in these views the building in the most part was still considered to be relating more to the groundscape than the sky, and the combination of the inclined roof forms and their colouring were successful in breaking up its shape and scale and blending it with the landscape.

4.61 In contrast to the medium and long-range views, the more local views, including the previously tested views from the east, showed that much of the ERF building would be read against the sky. Two additional viewpoints were selected in order to consider how the design would appear when viewed from the west and north west. Both images illustrated that the inclined wing forms were successful in both breaking up the scale of the building but also in bringing the northern and southern extents of the ERF to the ground. The silver grey and coppery earthy colours on the different wings further fractured its overall size and balanced the contrasting colour demands of ground and sky blending. The use of a light grey colour for the stack proved appropriate and best blended it visually against both clear and overcast sky backdrops.

4.62 Overall, the consideration of the proposed design from the range of selected viewpoints showed that the use of inclined and interlocking wings assists in breaking up the size of the ERF and that contrasting silver grey and coppery earthy colours are appropriate in blending the building with its surroundings. At the same time it was considered that the proposed design delivers a confident and visually dynamic architectural landmark, which draws upon the aviation heritage of the site.

4.63 Having established the preferred design approach, the architectural design was then revisited in order to try and address the remaining WSCC comments, while at the same time develop the design in further detail. This included:

- Incorporating photovoltaics on the inclined roof of the ERF and the flat roof of the WSTF workshop
- Detailed development of the floor layout of the ERF administration wing including offices, meeting rooms, staff welfare facilities and the visitor centre spaces
- Incorporating a water feature at the base of the ERF administration wing, close to where the former canal entered the site
- Identifying the location of ventilation louvres on both the ERF and WSTF
- Refinement of the glazed facades of the ERF's administration wing and the inclusion of vertical solar shading fins to better shield the potential night-time light spill to receptors to the north east and east of the site
- The potential to visually screen lower areas of the ACC support structure was reviewed but due to technical reasons could not be implemented. However, it was decided that cladding would be applied to screen the pipe duct and support structure that would span between the turbine hall and the ACCs
- Developing the design of the WSTF roofscape to incorporate roof lighting that would face away from nearby receptors to minimise the potential for night-time light pollution

4.64 A second pre-application (virtual) meeting was held with WSCC to offer an update on the design progress made since the last meeting. The following issues were raised:

- A decision would need to be taken on the inclusion of aircraft warning lights on top of the stack
- Need to show integration with adjacent landscape including at site entrance / access road
- The treatment along the southern boundary was questioned and the proposed design needs to make the most of opportunities for some planting and integration with anything off-site on the adjacent playing fields (which form part of the housing application)
- It was considered that the northern elevation of the ERF appeared to be quite stark as a large blank area and there might be some exploration of texture or other means to break this up

- Explanation required on why the building can't be sunk further into the ground
- Need to show that the existing public right of way at the north east is clearly provided for
- Lighting issues should include impact on amenity

Stage 5 design evolution

4.65 The final stage of design development sought to address the second set of comments made by WSCC. With the landscape design being developed in further detail the interface between planting, screening, landforms, mitigation and ecology also required there to be slight modifications to the site layout. Other operational related amendments were also accommodated in the final design. The final iteration of the site layout included the following changes:

- Change from double banked premier screening landforms to single banked in order to reduce their slope and reduce the overall height of the landforms from 5 m to 2 m in order to lower the height of the gabion retaining structure and incorporate a 3 m high acoustic timer fence. This would ensure that the concrete filled gabions would only be visible from within the site and the combination of landform and acoustic fence around the perimeter would still provide the required noise and visual mitigation but with a softer appearance. The reduced angle of the slope gradient is also considered to improve planting success
- Relocating the WSTF refuelling bay further north to ensure that a regular width of perimeter landform is maintained along the sensitive western boundary
- Relocating the perimeter security fence to along the northern boundary and in combination with a 5 m high acoustic fence, maximise the provision of planting between them
- Replacing the landform originally proposed along the southern half of the eastern boundary with a 5 m high flint wall in order to free up more space for planting in that area
- Including a 3m high acoustic timber fence along the southern boundary
- Increasing the provision of vehicle washdown bays
- Providing additional vehicle parking bays adjacent to the WSTF workshop

4.66 Changes to the architectural design include:

- Incorporating areas of flint walling to key areas on the ERF and the WSTF to add local character and visual interest and offer a visual contrast to the scale and finish of the metal cladding
- The future capability to incorporate aircraft warning lights on top of the stack

4.67 Further details on the design approach are set out in the DAS that supports the ERF and WSTF planning application.

Alternative drainage strategies

4.68 Although a wide range of sustainable drainage system (SuDS) techniques were considered, there are very few methods that would be practically feasible and suitable due to the extensive built footprint within the site boundary and its geological and hydrogeological setting. Specifically, considering the high potential groundwater levels and contamination at the site in conjunction with its location within a high vulnerability zone on a Principal aquifer. Infiltration was therefore not considered to be a viable option. A summary of the SUDS options considered but rejected is set out in table 4.1.

SuDS Group	Technique	Description	Reason for rejection
Retention	Balancing pond	Provides both storm water attenuation and treatment. Runoff from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation	The space within the site boundary is considered to be too limited for this option
Wetland	Shallow wetland, extended detention wetland, pond wetland, pocket wetland, submerged gravel wetland	Wetlands provide storm water attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detain flows for an extended period to allow sediments to settle and to remove contaminants. They can provide significant ecological benefits	The space within the site boundary is considered to be too limited for this option
Infiltration	Infiltration trench, infiltration basin, soakaway	Surface water runoff can be discharged directly to ground for infiltration by soakaways, basins, or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to receive the quality and quantity of water generated	Considering the hydrogeology of the site, infiltration is not considered a suitable option
Filtration	Surface sand filter, sub-surface sand filter, perimeter sand filter	Structures designed to treat surface water runoff through filtration using a sand bed filter medium. The filters can be designed with or without infiltration. Temporary storage of runoff is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required	There is no requirement for high pollution reduction at the site
	Filter trench / drain	Shallow excavations filled with rubble or stone that create temporary subsurface storage for filtration of storm water runoff. They receive lateral inflow from an adjacent impermeable surface	Not suitable due to the hydrogeology of the site
Detention	Detention basin	Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility	Not suitable due to the limited availability of space within the site boundary
	Enhanced dry swale,	Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be	Not suitable due to the limited availability of space within the site boundary

SuDS Group	Technique	Description	Reason for rejection
	enhanced wet swale	designed to allow infiltration, where appropriate	
Conveyance	Conveyance swales, rills	Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate	Accessible homes comprise part of the proposed development. Conveyance swales/rills might cause disabled access issues and thus, these options are not considered suitable for the proposed development

Table 4.1: A summary of the SUDS options considered but rejected

4.69 The following SuDS were, however, considered potentially suitable:

- Sub-surface storage (and infiltration) – achieved through oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure.
- Porous paving / permeable paving - which allows runoff to infiltrate through to sub base layer and then infiltrate into the ground or be conveyed into storage or drainage systems. Porous paving was considered viable for access routes, car parking and bike storage areas on site.
- Bioretention / filter swale – where vegetated strips of land are designed to accept runoff as overland sheet flow between a hard-surfaced area and a receiving system. Filter swales were considered possible, however, limited space on site was considered an issue.
- Rainwater harvesting - using the rainwater coming from the roofs to supply site activities / processes where appropriate.

4.70 Of the above, lined below ground cellular storage tanks, with an impermeable membrane to avoid potential groundwater ingress, was considered most practical at the site, together with rainwater harvesting. The proposed attenuation storage systems will be located at the south western, northern and north eastern parts of the site and will collect surface water from rainwater pipes and external hardstanding areas. If required, oversized pipes will supplement the attenuation tanks.

4.71 The design of the tanks will ensure that surface water from the site will be attenuated prior to discharge at greenfield runoff rates. Further details on the drainage strategy proposed are set out in chapter 3 and the Drainage Strategy Report that forms part of Technical Appendix G.

Conclusion

4.72 This chapter has summarised the alternatives considered during the development of the proposed ERF and WSTF:

- A number of alternative combustion solutions have been considered for the ERF, including both advanced thermal treatment and conventional combustion systems (i.e. fixed hearth, pulsed hearth technology, rotary kilns, fluidised bed technology and moving grate). As moving grate is a leading technology with a proven track record for achieving the burnout requirements for IED compliance, it has been selected for the Ford ERF.

- A review of alternative site layouts, building designs, materials and colours has led to the selection of a design that meets the operational requirements of the technical processes, is practical in terms of vehicle circulation, reflects the local history of the site and reduces potential noise and visual impacts where possible.
- The review of alternative SuDS has led to the selection of lined, below ground cellular storage tanks and rainwater harvesting for dealing sustainably with surface water at the site.