Grangemouth Flood Protection Scheme

Technical Note - General Principles for Flood Defence Alignment

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Grangemouth Flood Protection Scheme

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1. Introduction

This technical note outlines the 'general principles' that have been applied when determining the flood defence alignment as part of the Grangemouth Flood Protection Scheme (Grangemouth FPS).

Multiple factors can influence the alignment of flood defences such as, but not limited to, ground conditions, location of existing utilities, physical constraints, environmental considerations, economics, and buildability. Therefore, the level at which these principles have been incorporated or met will vary across the scheme, the 'general principles' for the alignment of proposed flood defences have been used as a guide to the design in an effort to apply consistency across the entire scheme whilst recognising that elements of the design won't satisfy all of these principles.

The 'general guidance / principles' to be followed for determining flood defence alignment are identified below and discussed further in later sections:

- Protect existing buildings and infrastructure and land identified in local development plan for development
- Avoid encroachment into sensitive environmental sites
- Minimise disturbance of existing riverbanks and coastline
- Retain existing undeveloped flood plains
- Avoid in water working
- Avoid utility diversions
- Locating flood defence adjacent to residential properties but outside the residential property boundary to reduce the loss of private garden
- Locating flood defences out-with the operational areas of the petrochemical site
- Retain passive resistance to embedded walls to reduce pile lengths
- Consider Loading, Form of Defence and Land Take
- Adopt solutions that minimise disturbance of contaminated soils
- Maintain a straight alignment e.g., avoid frequent changes in direction
- Minimise the use of floodgates and demountable defences
- Maintain consistent standard of protection
- Minimum tree felling and vegetation clearance
- Consideration of future maintenance and access requirements
- Ensure the residual pluvial flood risk is appropriately mitigated and no increase in pluvial risk as a result of the construction of fluvial/coastal flood defences, and provide betterment
- Ensure key transport arteries are resilient to flood events
- Minimise impact on the road network
- Minimise impact on cultural heritage sites
- Use topography to reduce visible height of flood defences

2. General Alignment Principles

2.1 Protect existing buildings and infrastructure and land identified in local development plan for development

Flood protection schemes are for the "management of flood risk" in an area, typically with a principal aim to protect people, property, important historic or environmental sites and infrastructure from flooding. Flood defences should be constructed to protect residential properties and commercial/industrial premises at risk of flooding; however buildability, economic viability and technical construction aspects will be considered when determining flood defence alignment. In some situations, it may be impractical to protect existing properties and alternatives such as property flood resilience measures or purchasing/relocating the building/land may be required.

However, it may also be appropriate to consider including land identified within the local development plan and other similar plans and strategies within the area protected. These sites when developed will however have to consider flood risk in line with current planning guidance.

2.2 Avoid or reduce encroachment into sensitive environmental sites such as SPA's, SAC's and SSSI's

The impact of a flood protection scheme on the surrounding environment must be assessed through an Environmental Impact Assessment (EIA) and where necessary a Habitats Regulations Assessment (HRA). The EIA provides information to determine the potential impact of the project on the environment though an assessment that covers a range of topics. Any potential adverse impacts should be mitigated, through the scheme design or additional mitigation measures.

Special Protection Areas (SPA), Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs) are designated sites that should be avoided or safeguarded. Mitigation measures may need to be incorporated to offset any potential impact. Early discussions with NatureScot will provide clarity as to wider mitigation and compensatory measures which may be available together with the extent to which these measures can be incorporated either into the Scheme design or committed to by the Council at a later stage in Scheme construction or operation.

2.3 Minimise disturbance on riverbanks and coastline

Engineering activities within the water environment are regulated by SEPA through the Controlled Activities Regulations 2011 (CAR) or Marine Scotland through a Marine Licence. Construction work must demonstrate that best practice has been adopted. Minimising disturbance of existing riverbanks limits ecological harm, provides natural erosion protection, and maintains natural sediment processes.

2.4 Retain floodplain

It is best practice to avoid the loss of flood plain storage by setting back flood defences where practical or possible. The benefits of this approach are to maximise water storage and slow the flow of water in the river channel. This has the effect of reducing flood risk further downstream and reducing the height of flood defences. Additional benefits from retaining the natural flood plain include the reduction in levels of bank erosion/sediment loss, improving habitat diversity, increasing biodiversity both in channel and on land and improving the aesthetics of the landscape.

2.5 Avoid or reduce in water working

As stated in Section 2.3, SEPA regulations (CAR) stipulate that adoption of best practice is to be demonstrated when considering engineering activity within or close to a watercourse. Avoiding or reducing in water working significantly reduces the risk of a pollution incident and avoids the potential for geomorphological impacts

caused by the in water temporary works. Other benefits include the reduction in risk associated with high river/ water levels causing delays and disruption during the construction phase.

Furthermore, under the Construction Design and Management Regulations 2015 (CDM 2015) it is the responsibility of the 'designer' to identify any hazards arising from proposed construction works and to reduce or mitigate the associated risks to avoid injury/death to construction personnel. The best way to mitigate risk is to avoid the hazard in the first instance, so working within the watercourse should be avoided or reduced.

2.6 Avoid or reduce required utility diversions

Diversion of existing buried or above ground utilities or pipelines can have significant capital costs and have a longer-term negative impact on road users, pedestrians and local residents, especially if the diversion of multiple utilities is required. Flood defence type and position should be selected to avoid the need to divert utilities and any crossing of utilities required being perpendicular to the utility.

2.7 Locate flood defences outwith residential property boundaries

Flood defences should be positioned outwith the boundary of residential properties to avoid the reinstatement of private gardens and reduce the potential need for liability agreements with landowners.

2.8 Locate flood defences outwith the operational areas of the petrochemical site

Flood defences should be positioned outside the boundary fence of the petrochemical plant to avoid construction work taking place within the operational site, this would bring complex interactions with infrastructure and operations at the petrochemical plant along with health & safety considerations, both in terms of the construction and operation. It is likely that construction work out-with the boundary fence will also need to be authorised by the petrochemical plant operators, if it is proposed on land they own or near their apparatus.

2.9 Retain passive resistance to embedded walls to reduce pile length

The soil in front of an embedded wall can contribute to the passive resistance, aiding the global stability of the structure. Where there is limited soil in front of an embedded wall, it is not considered in the stability analysis and the wall must be designed for full height retention and any additional forces behind the wall. This is likely to result in a much more expensive solution where significantly longer pile lengths are required, and construction duration is increased. The benefits of retaining sufficient soil in front of the wall will also support the principle of setting the flood defences back from the riverbank.

2.10 Adopt solutions that minimise disturbance of contaminated soils

As stated in Section 2.5, under CDM 2015, there is a responsibility on 'designers' to identify hazards and reduce/mitigate risks associated with engineering proposals. Where work is to take place on contaminated or potentially contaminated land, risks to construction personnel can be reduced or mitigated by the adoption of design solutions that limit the need for excavation and removal of contaminated soils from site. Additional benefits include the avoidance of soil remediation or the disposal of soil which can add significant costs to the project.

2.11 Consider loading, form of defence and land take

The position of the flood defence can have an impact on the design loading e.g. a wall placed adjacent to a road may require the loading from vehicle impacts to be considered. This in turn can have an impact on the form of flood defence e.g. gravity wall, embedded wall with or without tie rods/ ground anchors. The form of defence can then impact on the required land take, potentially dictating the minimum separation between the flood defence and adjacent structures to accommodate foundations and other critical components that contribute to the stability and strength of the flood defence.

2.12 Maintain a straight alignment

Cost savings can be found in the simplification of the flood defence alignment. Constructing a flood defence with minimal changes in direction reduces material, and construction time costs allowing for standardisation and repetition. Additionally, consistence with wall finishes, reduces the number of bespoke wall finishes for individual properties.

2.13 Minimise use of floodgates or demountable barriers

Floodgates require a long-term maintenance regime and usually personnel to operate, the additional costs associated to both, need to be considered. It is good practice to design out floodgates with the adoption of passive structures e.g. stairs and ramps to cross over flood defences.

The above generally applies to flood gates that are normally open and closed when a flood is forecast. Flood gates or demountable barriers may be used to provide access for maintenance and would be normally closed/ erected and only opened/removed when access is required. Reducing floodgates/demountable barriers would lower the risk of the barriers not being fully closed or failure to deploy correctly and the risk of vandalism.

2.14 Maintain consistent level of protection

The same level of protection is to be applied (e.g. a 1 in 200 year standard). This should be with consistent reference to the 'general principles' and with a consistent 'protect / not protect' approach applied.

2.15 Avoid the felling of trees/vegetation

Design the flood defences to ensure existing trees and vegetation is retained. Where trees and vegetation will need to be cleared for the scheme, appropriate replanting/reinstatement will be necessary.

2.16 Consideration of future maintenance and access requirements

The flood defence alignment should allow for future access for both planned and unplanned maintenance. Positioning flood defences close to existing roads and access tracks is the simplest way of achieving this although as noted in Section 2.9 this can impact on the loads considered in the design of the defence.

2.17 Ensure the residual pluvial flood risk from the proposed flood defences is appropriately mitigated

Allow sufficient space on the dry side of the proposed flood defences for a secondary drainage system to be installed to mitigate any pluvial flood water that may pond here.

2.18 Ensure key transport arteries within the scheme area are resilient to tidal/fluvial flooding and operational up to a 1 in 200yr event

Ensure key road and rail routes are resilient to tidal/fluvial flooding, this may require new bridge structures to be built to ensure the structure remains operational during a flood event. This also potentially reduces the number of gate/ramp structures.

2.19 Minimise impact on the road network

Minimise the use of local roads by building dedicated haul roads within the construction boundary. The introduction of traffic management measures will be necessary at some locations and will be carefully planned in consultation with the local authority to reduce impact upon road users and the local community.

2.20 Minimise impact on cultural heritage sites

Avoid construction where within known sites of historical interest or cultural heritage sites. Early dialogue with Historic Environment Scotland (HES) is recommended to identify historic sites across the proposed scheme and ensure proposed construction activity does not adversely impact on these sites and that protection measures are adopted. The proposed works should also be sensitively designed to ensure no impacts on the setting of the site.

2.21 Use topography to reduce visible height of flood defences

The flood defence alignment should make use of existing topography to minimise the height of flood defences above existing ground level. This could be achieved by positioning the flood defences at the top of riverbanks on higher ground rather than positioning at the bottom of, or on slopes.

3. Summary

The 'general principles' set out in this technical note provide a basis for determining the flood defence alignment. These principles, guide the design, to ensure a level of consistency across the scheme. As highlighted in this document, the level at which these principles have been incorporated or met will vary across the scheme. The 'general principles' for the alignment of proposed flood defences act as a guide to the design but it must be recognised that elements of the design won't satisfy all these principles.