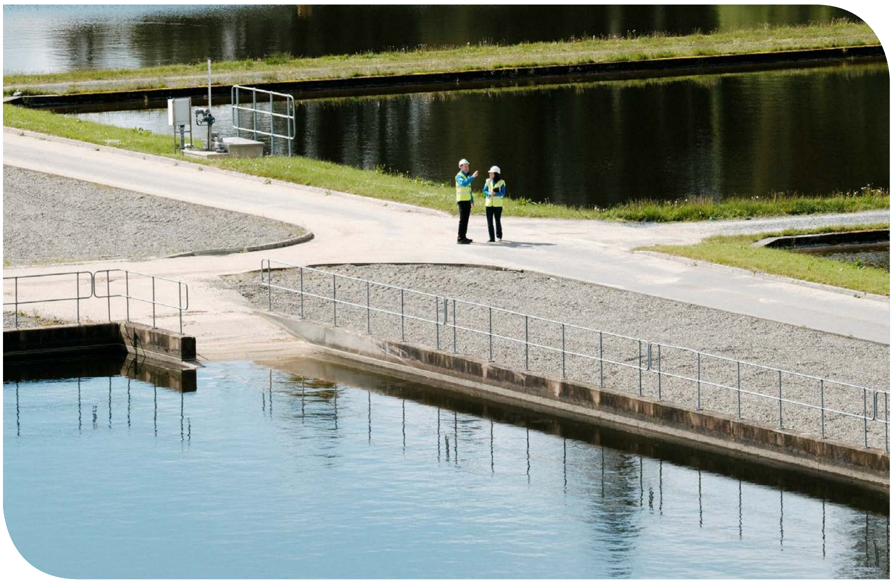
water.ie

Irish Water

Safe Design Guidance Document



November 2019

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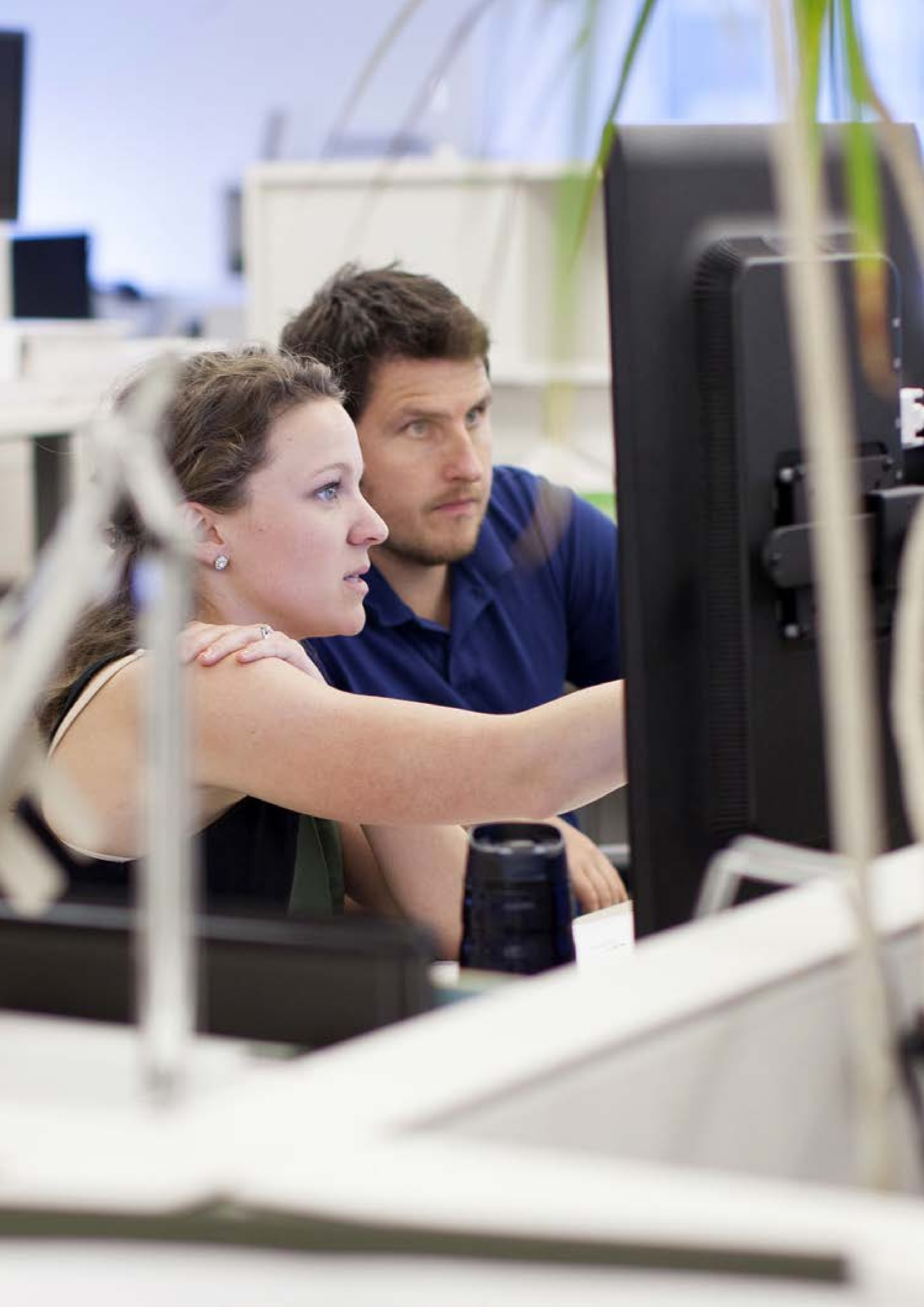


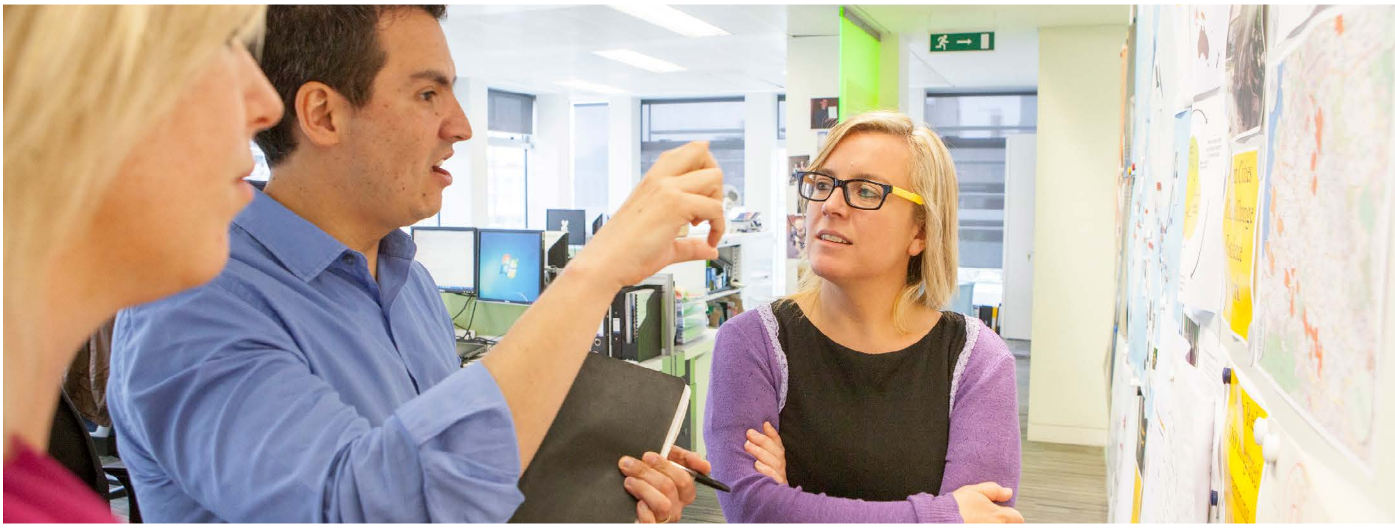
Contents

Note :

The Irish Water Safe Design Guidance document has been produced in partnership with Arup to provide guidance to designers in relation to safe design.

It remains the responsibility of all designers to ensure that their designs are carried out in accordance with all relevant health and safety laws, regulations and best practice.

Introduction



Objective of the Guidance Document

Welcome to the Irish Water Safe Design Guidance Document. A core value of Irish Water is putting safety at the heart of everything we do. We believe that:

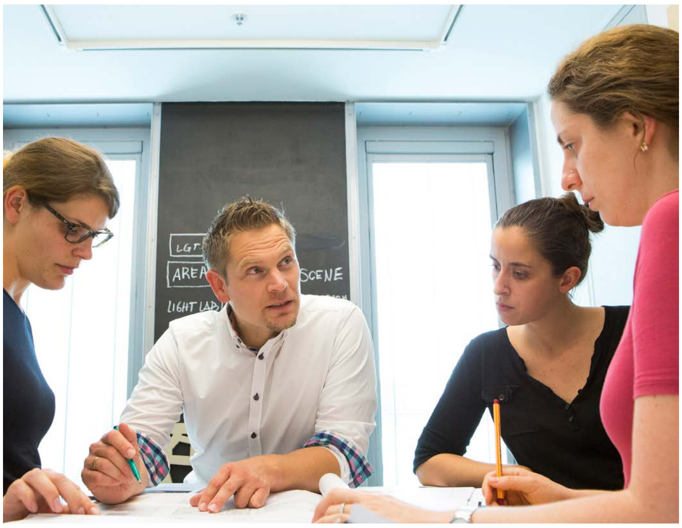
- All accidents are preventable
- No activity is so important that it cannot be done safely
- We all have a right to go home every day unharmed
- We all have a responsibility to look after one another and ourselves
- We all have a role to play in achieving our goal

The quality of our designs can have a significant impact on safety during construction, operation, maintenance and demolition of our assets.

This document has been prepared to provide guidance on the safe design of water and wastewater facilities being constructed and operated by Irish Water or their Contractors.

Safe design begins at the concept design stage. In these early stages there is more opportunity to design-out hazards or integrate control measures with the original design concept and functional requirements of the asset.

Safe design applies to every phase in the asset lifecycle, from design to decommissioning. This means designing out hazards as the plant is constructed, commissioned, operated, maintained and decommissioned.



Who is a designer?

You are a designer if you are engaged in preparing drawings, particulars, specifications, calculations and bills of quantities in relation to a project.

The term designer would include:

- Architects and engineers contributing to, or having overall responsibility for the design
- Building services engineers designing details of fixed plant
- Surveyors specifying articles or substances or
- drawing up specifications
- Contractors carrying out design work as part of a design and build project
- Anyone with authority to specify, or alter the specification or designs to be used for the structure
- Designers of temporary works or specialist suppliers designing formwork and falsework
- Specialist suppliers, specialist contractors or sub-contractors with design input

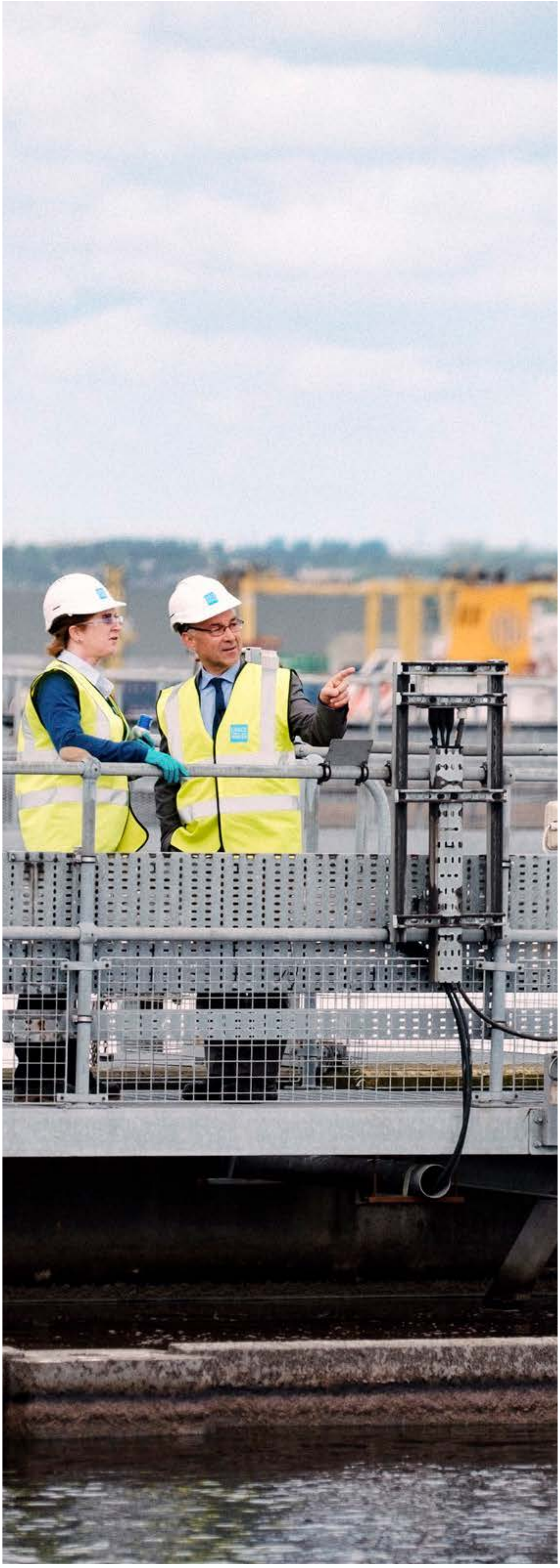
What duties do designers have?

The duties of Designers are set out in Section 15 of the Safety, Health and Welfare at Work (Construction) Regulations, 2013.

A designer should ensure, so far as is reasonably practicable, that the asset is designed without risks to health and safety throughout the asset's lifecycle.

Designers must:

- Identify any hazards that their design may present during construction and subsequent maintenance
- Where possible, eliminate the hazards or reduce the risk. e.g. can roof-mounted equipment be placed at ground level or can guardrails be provided to protect workers from falling?
- Communicate necessary control measures, design assumptions or remaining risks
- Co-operate with other designers, the client and stakeholders
- Take account of any existing information, drawings and surveys



General Principles of Prevention

Designers must take account of the General Principles of Prevention as set out in Schedule 3 of the Safety, Health and Welfare at Work Act 2005, when preparing designs.

The General Principles of Prevention (GPoP) are:

1. The avoidance of risks.
2. The evaluation of unavoidable risks.
3. The combatting of risks at source.
4. The adaptation of work to the individual, especially regarding the design of places of work, the choice of work equipment and the choice of systems of work, with a view, in particular, to alleviating monotonous work and work at a predetermined work rate and to reducing the effect of this work on health.
5. The adaptation of the place of work to technical progress.
6. The replacement of dangerous articles, substances or systems of work by safe or less dangerous articles, substances or systems of work.
7. The giving of priority to collective protective measures over individual protective measures.
8. The development of an adequate prevention policy in relation to safety, health and welfare at work, which takes account of technology, organisation of work, working conditions, social factors and the influence of factors related to the working environment.
9. The giving of appropriate training and instructions to employees.

Ability to influence safety of a design

Safety by Design is most effective when applied at the earliest stage of the design process. As we can see in Figure 1 below, there is a direct link to cost and difficulty of implementing controls the further we move along asset lifecycle. The most cost effective and enduring controls with regard to safety are usually applied between the concept stage and the detailed design. As the project progresses towards construction and operation, these controls get more difficult to introduce along with a substantial difference in cost.

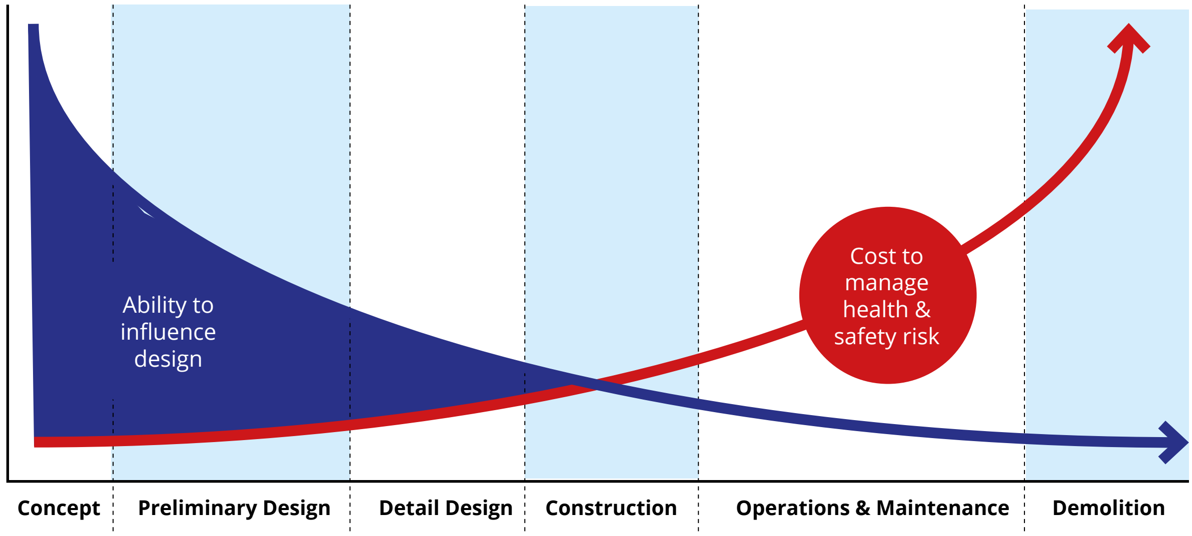
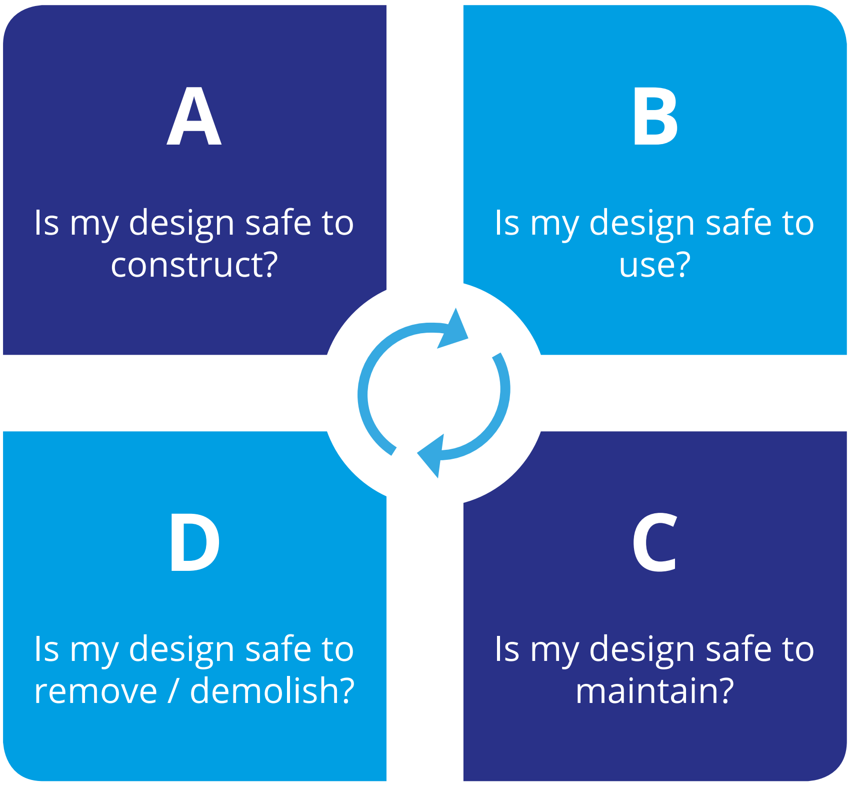


Figure 1: Ability to influence safety outcomes over lifecycle of asset

4 Key Questions Designers should ask themselves:



A

Is my design safe to construct?

Below are some examples of Design Mitigation measures relating to the construction of a structure:

- re-routing existing utilities cables before construction begins
- consider the use of offsite construction (prefabrication) to reduce the risks such as fall from height during construction
- designing traffic areas to separate vehicles and pedestrians, including adequate access for delivery of construction material and plant to the site. Including areas for laydown and crane positioning
- limiting the size of prefabricated components where site access is restricted
- for works located at existing operational sites, ensure that the new works can be carried out safely while the existing site remains operational, taking into account issues such as electrical power supply, presence of confined spaces, liquid flows, etc.
- check that the design inputs of the various designers (e.g. structural, architectural, M&E, process, etc.) are co-ordinated together during the design process to provide integrated design solutions

B

Is my design safe to use?

Consider the operations of the asset, including the likely systems of use, and the type of machinery and equipment that may be used.

Below are some examples of how risks relating to operations of assets can be addressed by:

- designing in access for maintenance purposes (e.g. fixed stairs to a machine room)
- using non-slip materials on floor surfaces in areas exposed to the weather or dedicated wet areas
- providing sufficient space within the facility to safely install, operate and maintain plant
- providing suitable lighting for intended tasks in the facility
- designing in aids for lifting (e.g. lifting davits)
- eliminating the need to enter confined spaces, work at height, etc.
- designing spaces in which workers can use mechanical plant or tools to reduce manual handling
- eliminating the installation of equipment at height which represent a hazard to the end user
- designing effective noise barriers and acoustical treatments to walls and ceilings
- designing floor loadings to accommodate heavy machinery that may be used in the structure
- clearly indicating on drawings the design loads for different parts of the facility
- designing for specific task demands
- considering for potential future use
- designing to accommodate the physical characteristics of different users
- installing measures to prevent exposure to harmful gases or chemicals
- providing suitable barriers to prevent falls into water, e.g. aeration ponds
- providing operation manuals that are comprehensive and understandable to enable safe use of designed accessways, access systems and their components

C

Is my design safe to maintain?

Some examples of how risks relating to cleaning, servicing and maintaining a structure can be addressed by:

- designing the structure to eliminate maintenance of equipment at height
- eliminating or minimising the need for entry into confined spaces
- designing safe access (such as stairways or fixed ladders) and enough space to complete structure maintenance activities
- using long-life components such as LED lighting that don’t require frequent replacement
- using durable materials that do not need to be re-coated or treated.
- designing features to avoid dirt or moisture traps
- designing and positioning permanent anchorage and hoisting points into structures where maintenance needs to be completed at height

D

Is my design safe to remove / demolish?

A structure should be designed so it can be decommissioned safely. The designer should provide information so that potential demolishers can understand the structure, load paths and any features incorporated to help with demolition. They should also provide information on any features that require unusual demolition techniques or sequencing or any information relating to potentially hazardous components or substances.

Providing & Obtaining Information

Designers have obligations to provide information about their design so that persons constructing, operating, maintaining or decommissioning their design can fulfil their responsibility safely.

Designers should also ensure that information regarding their design is communicated and coordinated with other designers. This allows them to take each other's designs into account and will ensure that potential risks are addressed.

With regard to obtaining information, a designer should be satisfied that they have all the required information to design safely for the whole lifecycle of an asset. This information includes but is not limited to:

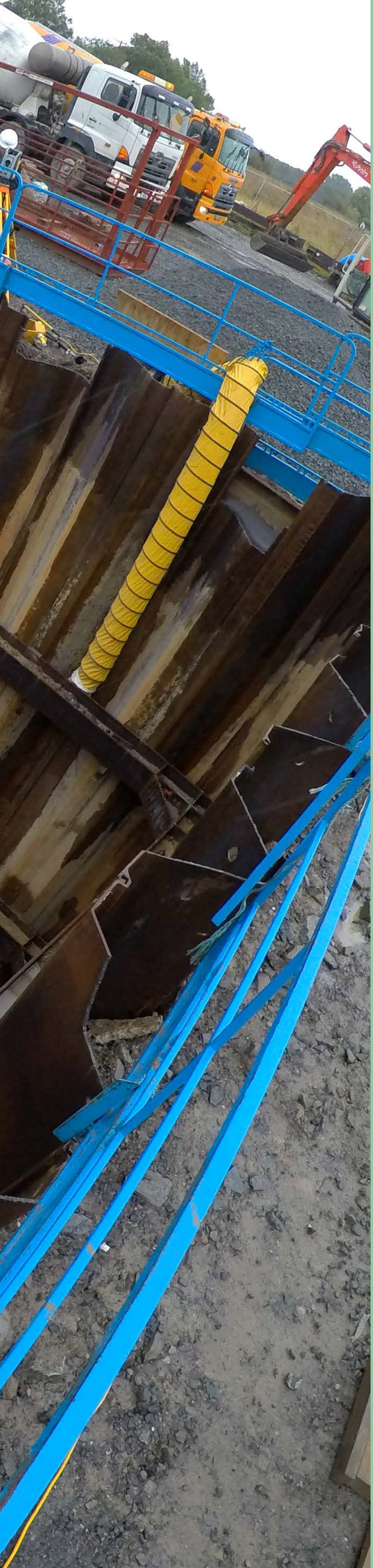
- A defined design scope
- Environmental, client and planning restrictions
- Location of existing services
- Site investigation information
- Existing drawings
- Existing survey information
- Information regarding future use and maintenance
- Existing safety file

Specific Design Safety Issues

In the following sections, guidance is provided on specific design safety issues relevant to water and wastewater facilities. Examples of good practice are presented, and some examples are shown where the design has not resulted in optimum safety outcomes.

Safe Design

Chapters



Chapter 1

Working at Height

Chapter 1

Working at Height

Working at height remains one of the biggest causes of fatalities and major injuries in the water industry, and accounted for 18 incidents across Irish Water operations in the last year.

What is working at height?
Work at height means working in a place where a person could be injured by falling from it, even if it is at or below ground level.
Examples of working at height in the water industry:

- Accessing equipment at high levels
- Working on top of tanks
- Deep excavations
- Accessing manholes & chambers

Designers should consider the GPoP such as:

1. Eliminate Working at Height

Designers should first consider if working at height can be eliminated in their design. Designers should consider designing the element so that work can be carried out at ground level. For example, instead of placing equipment on roofs or at high level, can it be placed on the ground? Can equipment located at heights be lowered down by mechanical means, to be maintained/worked on at ground level?

2. Reduce the risk of injury arising from working at height

Where equipment or elements of plant are required to be installed at height, designers should consider safe access means for personnel, such as permanent access platforms, designed to the required codes. Surfaces should be free of obstacles and non-slip, taking into account the local environment in the water/wastewater facility (e.g. presence of water).

Designers should consider how the distance of a fall could be reduced in their design. Consideration should be given to reducing the height of some elements (where possible), designing the placement of equipment closer to ground level. For example, can gauges, meters, etc. be placed at eye-level to prevent the need to work at height?

Designers should consider collective means of protection for all stages in the lifecycle rather than relying solely on a safe system of work or personal protective equipment. Examples of collective measures include protective handrails / guardrails installed at heights.

3. Controlling the Risk - Use of Personal Protective Equipment

Designers should only consider Personal Protective Equipment as a last resort and preference for controlling the risk should be given, per the measures outlined in sections 1 and 2 above.

When considering the use of PPE, such as fall-arrest systems incorporating harnesses, designers should consider the limitations of the PPE. These include the maintenance and serviceability of the equipment, access to and inspection of anchor points and suitability of anchor points.

Example of poor design

Image 1.1 The sensor is installed at height but is not easily retractable for maintenance, leading to risk of falls from height when leaning in to work on the sensor.

Example of good design

Image 1.2 Hinged arrangement

Designer Considerations (this example)

Eliminate the Hazard

Where is the sensor required? Does it have to be at height? In this case, yes.

Can a hinged arm arrangement be used to allow the sensor to be swung into a safe position for maintenance and repair? In this case, yes.

Reduce Risk

Can a low maintenance unit be specified?

Could a separate suitable access platform be provided at the sensor?

Control Risk

Develop a detailed and well-managed procedure for the sensor maintenance, including safe systems of work.

Chapter 2

Working over or near water

Chapter 2

Working over or near water

In the water industry, there is a risk of drowning due to the frequency of works carried out over or near open water and sewerage.The high volume of alone working should be considered by designers.

What is working over or near water?
Working Over or Near water means exposing persons to a risk of drowning in a body of water or liquid.

Examples of elements containing liquids in the Water Industry:

- Treatment tanks
- Outfalls / Discharges
- Manholes & Chambers
- Watercourse intakes
- Reservoirs

Designers should consider the GPoP such as:

1. Eliminate working over or near Water

Designers should consider designing elements that do not require persons to work over or near water. Can items be constructed away from water or can the area of construction be dewatered during construction? Can items that are required for regular interaction with users be designed away from water? Can the designer give consideration to the use of technology for sampling & monitoring rather than taking direct samples over water or near water?

2. Reduce the risk of drowning / injury from working over or near water

It is likely that there will always be an element of working over or near water due to the nature of water and waste sites, however designers should consider making the interaction between persons at all stages in the lifecycle as safe as possible.

This includes:

- specifying low or no maintenance equipment for use within water bodies
- providing safe access to the water's edge, designing suitable rescue and recovery systems
- designing systems that can be removed from within water or from the water's edge without the need to expose persons to the risk of drowning
- designing systems that can be remotely monitored

Designers should consider collective means of protection to reduce the risk of drowning. Examples of collective measures include edge protection, enclosing tanks and chambers, placing maintainable items away from the water's edge.

3. Controlling the Risk - Use of Personal Protective Equipment & Floatation devices

Personal Protective Equipment & Flotation Devices are useful, but should only be incorporated after all other measures have been exhausted to eliminate the risks associated with working over or near water.

When considering the use of PPE or flotation devices such as lifejackets or rescue buoys, designers should consider the limitations of PPE. These include the maintenance and serviceability of the equipment, access to the equipment and suitability of the equipment in the environment in which it is being used.

Example of poor design

Image 2.1
Handle directly over water

Example of good design

Image 2.2
Handle directly over platform

Designer Considerations

Eliminate the Hazard	Reduce Risk	Control Risk
The hazard of working near water cannot be entirely eliminated in this case.	The risk is greatly reduced by the presence of the handrail and the location of the handle directly over the platform on the correct side of the handrail.	Personnel operate the handle from the correct side only.

Chapter 3

Manual Handling

Chapter 3
Manual Handling

There were 41 recorded incidents across Irish Water Operations related to Manual Handling in the last year. It is imperative when looking to reduce incidents or accidents on sites that designers focus on issues related to manual handling.

What is Manual Handling?
Manual handling refers to the use of individual's physicality to lift, lower, carry, push or pull an item. When manual handling is carried out incorrectly, it can lead to a variety of musculoskeletal injuries in the affected personnel, e.g. strained back.

Examples of Manual Handling in the Water Industry:

- Lifting of Manhole / chamber covers / grills
- Handling / Lifting pipework & associated equipment such as valves
- lifting of chemical drums
- Lifting of dosing or sampling equipment
- Manual lifting of heavy items during the construction phase

Designers should consider the GPoP such as:

1. Eliminate Manual Handling
Consideration should be given to designing out the need for manual handling, where possible. This can be achieved by designing / specifying materials/ elements that are capable of being lifted only by mechanical means.
When considering the operational and maintenance stage of the asset lifecycle, the designer should consider designing in lifting aids such as self-lifting struts on covers, or automated dosing and sampling systems.

2. Reduce the risk of Manual Handling injury
If the risk of Manual Handling cannot be avoided, designers should consider limiting the amount of manual handling interactions needed in the design at all stages in the element's lifecycle.

Designers should consider there is no "safe load" with regard to what a person can safely lift. This is reliant on several factors such as age, physical fitness, existing medical conditions or environmental risks such as weather.

When looking at preventing the risk posed by manual handling, designers should consider the following elements of risk management:

- Avoid Manual Handling / Design out Manual Handling
- Reduce the weight of items to be handled
- Reduce the amount of manhandling required
- Design in mechanical lifting aids such as opening struts
- Design in provision for mechanical lifting such as adequate room and lifting eyes
- Design or specify items that can be safely handled in the construction phase
- Avoid placing lifted items in awkward corners or inaccessible places, which will make the items more difficult to lift
- Ensure there is space around and above the item to allow clear access for lifting

Image 3.1

Example of poor design

Due to the position of the cover under a guardrail, it is not possible to use mechanical means for safe removal

Image 3.2

Example of good design

Example of 2 man cover lift.

A culvert in an existing water treatment plant required ongoing maintenance. This required removing the concrete covers that measure 0.8m x 1.5m in size to gain access. These covers were a considerable weight (the covers had to be heavy-duty due to vehicular traffic). The covers were specified to include slots for use of lifting keys for lifting using a two-person lift, which was considered low-risk.

Designer Considerations

Eliminate the Hazard

The designer could not avoid the risk by designing out the culvert cover as this was an existing plant.

However, in the design of a new plant the designer could have considered the need for the culvert and if access hatches were required, fitting them with lifting struts and an integrated edge protection system such as shown below:

Reduce Risk

Consider reducing the risk of manual handling injuries by changing the covers for lighter covers subject to traffic load imposed such as shown below:

In this instance, due to the existing conditions
and traffic load imposed, it was decided to keep the existing culvert covers.

The designer specified a lifting device specifically for lifting and handling these covers that reduced the need for manual lifting.

Control of Risk

Deliver training for use of the equipment provided and a safe system of work on site.

Image 3.3 Example of cover with integrated edge protection and gas lift assisted struts

Image 3.4 Example of light cover

Image 3.5 Purpose built lifting and handling cart for lifting and handling heavy covers

Chapter 4

Electricity

Chapter 4

Electricity

The risks posed by electricity are present on almost all projects and sites. Last year, there were 50 incidents involving Electricity on Irish Water sites.

Image 4.1

Designers should always consider the risks associated with electricity in their designs and should bear in mind that there is no safe voltage. The main hazards with electricity are:

- Contact with live parts causing shock and burns
- Faults which could cause fires
- Fire or explosion where electricity could be the source of ignition in a potential flammable or explosive atmosphere

Examples of Electricity in the Water Industry:

- Underground cables
- Overhead services
- Internal electrical cabling
- Electrical supply to items of plant and equipment
- Electrical panels & controls
- Lighting
- Emergency / Temporary Generators

Designers should consider the GPoP such as:

1. Eliminate interaction with Electricity

Designers should consider the following approaches:

- designing elements (where possible) that do not require persons to work with or near electricity
- designing the location of cables both above and below ground to minimise the long-term risk of interaction with the cables (e.g. buried cables should not be located in areas where future works are planned)
- designing out the need for electricity in locations where there is an environmental risk such as a water ingress or an explosive atmosphere

2. Reduce risk of injury from Electricity

Designers should consider the following approaches:

- collective means of protection to reduce the risk of contact with electricity - this includes ensuring all live electrical parts such as Buzz Bars, cable termination points etc. are securely protected against access. Designers should always ensure there are physical barriers separating persons from direct access with electricity , where possible routing cables in a logical controlled way such as in a cable tray or service trench and highlighting this route both on drawings and visually on site to prevent future accidental contact
- due to the nature of the water environments in which electrical equipment will be utilised, designers should consider the water / weather proofing requirements as well as the ATEX requirements for explosive environments

Designers should consider making the interaction between persons and electricity as safe as possible. Potential measures include:

- for works on existing sites, designers should identify all services likely to cause risk ahead of the construction phase. If cables are found to be in the path of construction or if there is an elevated risk of striking the cable during the works then consideration should be given to diverting the cable prior to the main works starting
- consideration should be given to safe access and isolation of electrical items with regard to future operation and maintenance, designers should consider if there is sufficient room for working on panels and if there is sufficient spare capacity in ducts/cable trays for future cabling needs
- ensuring all electrical items are clearly identified both in drawings and visually on site through the use of signage
- Designers should take into account the guidance provided in the following codes of practice:

  - COP for Avoiding Hazards from Overhead Electricity Cables (ESB/HSA)

  - COP for Avoiding Danger from Buried Services (HSA)

Example of poor design

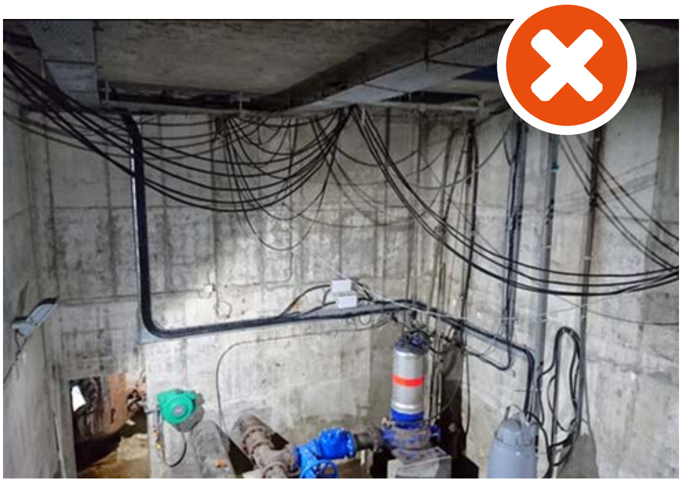


Image 4.2 Example of poor cable planning, routing and management: In an existing facility, cable containment was found to be inadequate for the site's requirements. This led to the risk of damage to cables and risks to safe access, future safe use and future maintenance.

Example of good design

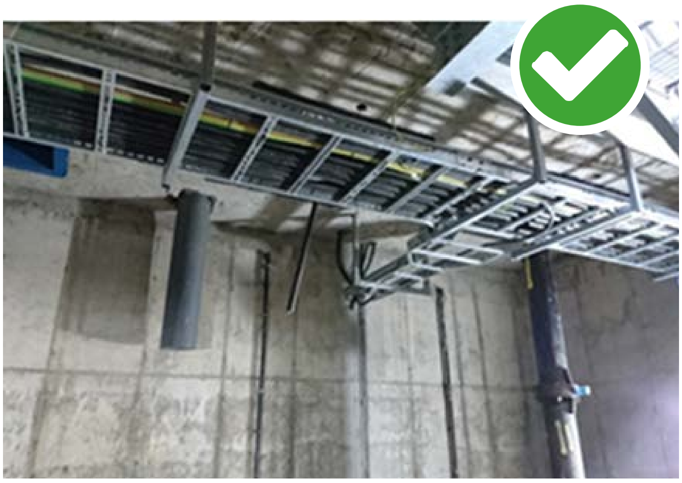


Image 4.3 Example of good cable planning, routing and management

Designer Considerations (this example)

Eliminate the Hazard

Consider suitable cable layout and management and design accordingly.

Consider future capacity needs and how cables are likely to be routed. Cable runs should be designed to be as simple and safe as possible, with safe access and good visibility.

Reduce Risk

Consider reducing the amount of cables, the voltage carried by cables and the environment in which the cables are routed.

In explosive environments, ensure the design incorporates the ATEX requirements and the design is safe in all phases of the lifecycle of the asset.

Consider the following additional control measures:

- Containment of cables in ducts or cable tray
- Labelling of cables and panels
- Designing systems that are lockable and secure
- Designing systems that are suitable for the environments in which they operate
- Designing systems for safe isolation and maintenance

Control of Risk

Safe systems of work on site.

Chapter 5

Confined Spaces

Confined Spaces

Confined spaces accounted for 7 incidents across Irish Water operations last year.

Image 5.1

A Confined Space refers to any place, including any vessel, tank, container, pit, bund, chamber, cellar or any other similar space which, by its enclosed nature, creates conditions that give rise to a likelihood of an accident, harm or injury of such a nature as to require emergency action due to the presence or reasonable foreseeable presence of:

- A flammable or explosive atmosphere
- Harmful gas, fume or vapor
- Free flowing solid or an increasing level of liquid
- Excess of oxygen
- Excessively high temperature
- The lack or reasonably foreseeable lack of oxygen

Examples of Confined Spaces in the Water Industry

- Manhole Chambers
- Pumping chambers
- Large diameter pipes
- Deep Excavations
- Sumps / Wells

Designers should consider the GPoP such as:

1. Eliminate Confined Space Entry

Designers should eliminate the need for confined space entry for all stages of the lifecycle of an asset. For example, can open-topped bunds be used instead of enclosed tanks?

Consideration should be given to the use of in-situ sampling or monitoring devices, in-situ cleaning systems, incorporating vision panels or portholes to allow inspection without entry or, in some cases, simply designing the roof or wall panel of the space to be removed for inspection and maintenance.

2. Reduce risk of injury from Confined Spaces

Designers should consider reducing the risk for confined space entry for all stages of the lifecycle of an asset, including operation and maintenance. The requirements of the **Code of Practice for Working in Confined Spaces (HSA)** should be taken into account by Designers.

Collective means of protection are preferable in relation to risk reduction - examples include designing lockable access doors, covers or hatches that are clearly labelled as Confined Spaces to prevent unauthorised access.

Consideration should be given to ensuring that entry and exit of the space can be achieved with as much ease as possible.

Consideration should be given to installing sampling points for carrying out atmosphere sampling without entering or opening the space.

Consideration should also be given to designing out the risk of falling from heights, such as with open manholes and chambers. This can be done by designing in a “pop up” or integrated edge protection system, where applicable.

Designers should consider how persons are to be removed from the confined space in the event of an emergency. If recovery is by means of a winching & harness system, the designer should make suitable provision for a suitable point to attach the winch such as a davit system or a lifting eye. Designers should also consider the available room around the outside of the space for the setup of rescue arrangements.

3. Control the risk for persons who are required to work in Confined Spaces

Specific requirements are set out in detail in the Code of Practice for Working in Confined Spaces (HSA) in relation to the procedures required when entry is planned into confined spaces, which covers the following elements:

- Hazard identification (e.g. what activity is planned in the Confined Space (e.g. welding or cleaning) and can that activity itself generate fumes or vapours?)
- Competence, training, supervision and suitability of staff involved
- Permit to Work procedure
- Gas purging and ventilation
- Testing and monitoring of atmosphere
- Mechanical, electrical and process isolation
- Respiratory protective equipment
- Safe System of Work Plan or Risk Assessed Method Statement (RAMS)
- Access and egress
- Emergency rescue plan

Chapter 5

Confined Spaces

Example of good design

Image 5.2 Safe and easily accessible stairway to confined space

Example of poor design

Image 5.3 Access to confined space includes ladder access. A better solution would be if the confined space was fully accessible by stairs to enhance access for emergency recovery.

Designer Considerations (this example)

Eliminate the Hazard

Consider if access into the space is entirely necessary? For example, if the access has been created for visual inspection. could a vision panel have sufficed?

If the access was to provide entry for future unblocking, could a CCTV / rodding / jetting door be installed that was unsuitable for human access?

Reduce Risk

Design the space so that person-entry is not required. Examples include cleaning and maintaining the space from outside.

Design the inside of the space to require a limited amount of maintenance.

Design to minimise the risk of blockage or build-up of materials within the space. Ensure adequate access and egress arrangements, provision for emergency rescue set-up (e.g. lifting davit if required).

Specify equipment (e.g. pumps) which can be retracted from the space.

Control Risk

Ensure that the space is designed so that the control requirements set out in the Code of Practice for Working in Confined Spaces can be implemented safely and easily.

Install signage and safety systems to make sure that Confined Spaces are clearly identified to all relevant personnel.

Chemical

Chapter 6
Chemical

Chapter 6

Chemical

Due to the nature of the water industry, there is a risk of persons interacting with chemical agents. Chemical related incidents accounted for 32 incidents across Irish Water operations in the last year.

Designers should consider the risk to persons of exposure to chemical agents at all phases in the lifecycle of an asset as well as suitable mitigation measures to remove or combat the risk.

What are Chemical Risks?

A chemical hazard is a type of occupational hazard caused by exposure to chemicals in the workplace. Exposure to chemicals in the workplace can cause acute or long-term detrimental health effects.

Chemical risks can be present at all or at different times in the design lifecycle such as construction in a live waste water environment or dosing chemicals during water treatment or carrying out maintenance on plant used in the treatment process.

Examples of Chemical Risks in the Water Industry:

- Applying chemical treatments such as waterproofing in the construction phase
- Dosing of chemicals during the operational phase
- Cleaning using chemicals during the maintenance phase

Designers should consider the GPoP such as:

1. Eliminate exposure to Chemicals risk

Designers should consider eliminating the need for using chemicals in all stages of the lifecycle of an asset. Examples of this include specifying water-based treatments rather than solvent based treatments during the construction phase.

Where possible, the design should be executed to allow the use of the least hazardous chemicals available to provide the technical results required by the process.

2. Reduce risk of injury from Chemicals

Due to the nature of the water industry, it is likely that Chemical risks will be present.

Consideration should be given to eliminating personal interaction with chemicals. Examples of this include using remote means for cleaning and unblocking screens in waste water treatment, automating the handling and dosing of chemicals in the system.

- Chemical storage areas should be designed to store the specific chemicals in use, with the following possible measures employed:
- Sealed/bunded storage to allow safe recovery of accidental spills
- Chemical tanks are made of adequately resistant material, overfilling can be reliably prevented, leaking liquids are safely collected in bunds
- A safe and locking security cabinet is available for storage of small quantities of combustible, fire-assisting or toxic or corrosive hazards at the workplace (e.g. laboratories, workshops)
- Provisions are made to prevent environmental impact in the event of leakage
- Safe separation of non-compatible chemicals
- Applying chemical treatments off site in controlled environment during the construction phase
- Designing in ventilation and/or extraction, as appropriate
- Designing in storage areas for PPE local to the hazard
- Designing areas for decontamination local to the hazard

3. Control the risk for exposure of persons to Chemicals

Designers should only consider Personal Protective Equipment as a last resort. Preference for controlling the risk should be given, per the measures outlined in sections 1 and 2 above.

The use of PPE such as gloves, chemical suits, face-masks, breathing apparatus, etc. should be in accordance with the advice of the chemical providers, as well as industry best practice.

Example of poor design

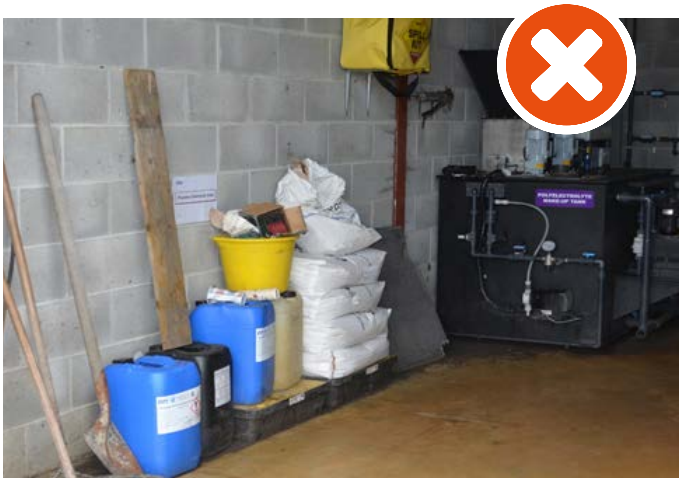


Image 6.1 Example of no design provision being made for chemical storage used in process

Example of good design

Image 6.2 Example of good provision of information and labelling with regard to chemicals

Designer Considerations (this example)

Eliminate the Hazard

- If possible, avoid the use of harmful chemicals in the design. Reduce the amount of chemical used in the process.
- Consider if there is another option such as high pressure washing when cleaning equipment rather than a chemical treatment.
- Consider if there is a need for the storage of chemicals at the location – design this up front.

Reduce Risk

- Store the chemicals in an area away from the process in a bunded ventilated area.
- Design in segregation of the chemicals to prevent a reaction.
- Design in self-loading and dosing systems to eliminate or reduce human interaction with chemicals
- Design a suitable sized storage area, adequately laid out.
- Design suitable bunding.

Control Risk

- Specify clear labelling and easy availability of Safety Data Sheets.
- Suitable procedures on site for managing the safe storage of the chemicals.


Leakage Reduction Programme
Replacing the water mains to ensure clean and safe water
Part of ervia
Kubota

Chapter 7
Working on or near Public Realms

Chapter 7

Working on or near Public Realms

Public Realm works pose a significant risk not only to persons carrying out work but also to members of the public that interact with the works. Public Realm works accounted for 79 incidents across the Irish Water operations in the last year.

What are Public Realm works?

Public Realm works are works carried out on or under public spaces, footpaths or trafficked carriageways, including the following examples:

- Installation of water mains and associated piping in public areas
- Installation of metering and monitoring equipment in public areas
- Managing, diverting or controlling of traffic including pedestrian traffic
- Reinstatement of public work areas
- Emergency works such as leak remediation carried out in public areas

Risks associated with working in the public realm include:

- Traffic accidents involving vehicles or pedestrians, affecting members of the public and/or construction personnel
- Clashes with existing buried or overhead services in the public realm
- Causation of significant traffic congestion problems, leading to increased pollution and detriment to the local residents
- Security of the site during non-working hours

Designers should consider the GPoP such as:

1. Eliminate work in the Public Realm

Designers should consider ways to reduce the amount of work which takes place in public realm areas, especially trafficked areas, for example:

- Can constructed elements (for example pipelines) be located away from roadways/trafficked areas (e.g. across agricultural land)?
- Can items that are required for regular interaction with users/operators (e.g. meters, valves) be designed away from carriageways?

2. Reduce Risk

If public works cannot be avoided, the designer should give consideration as to how the risk posed by street works can be reduced. Designers should consider the following:

- Limiting the extent or duration of the works
- Considering the extent of working space required to carry out the works safely. It is also necessary to evaluate the remaining space in the public realm for existing public traffic (including pedestrian) and to liaise with the local traffic authorities accordingly
- Identifying and communicating all known existing services at the design stage
- Routing the works to avoid conflicts with existing services
- Considering traffic and pedestrian volumes and phasing works accordingly
- Co-ordinating installation of various services (e.g. gas/water/other) in the same project, to minimise disruption to public space
- Considering use of technology such as ground penetrating radar rather than invasive site investigation excavation works
- Consideration being given to trenchless technologies
- Consideration being given to relining existing in ground assets rather than open cut replacement

Chapter 7

Working on or near Public Realms

3. Control Risk

Measures will be required at construction stage (or maintenance work, for example cleaning of drains) to control the risks. These should be specified by the designers to the Contractor in the contract documents. Measures may include:

- Consideration being given to the safe management of traffic (including pedestrians) in the design process
- Consideration being given to the phasing of the works to reduce the impact on members of the public / road users
- Emergency access being maintained at all stages in the works
- The presence of existing buried and overhead services are being taken into account

Sample Design Hazard

An existing large diameter sewer pipe was showing considerable signs of aging and damage, this pipe was located at a depth of 4 meters on a heavily trafficked public street in a built up urban area. Designers had to consider the following risks:

- Heavy vehicular traffic
- Heavy pedestrian traffic
- Effects on local businesses
- Conflict with existing services
- Depth of excavation required
- Logistics of excavating and replacing a sewer at 4-meter depth – space for truck movements / plant requirement
- Vibration damaging buildings noted to be in poor condition
- Noise / Dust creation in an urban environment

It quickly became clear to the designers that the replacement of the existing sewer has several high risks.

Example of poor design

Image 7.1

Example of good design

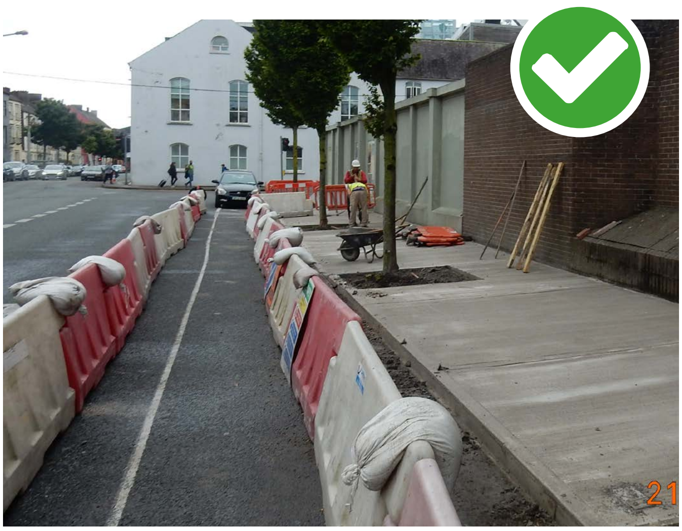


Image 7.2


UISCE ÉIREANN : IRISH WATER
akage Reduction Programme
fixing leaks for a
better water supply
Part of ervia group

Working on or near Public Realms

Designer Considerations (this example)

Eliminate the Hazard

In considering the risk posed by replacing the existing failing sewer, the designer identified that, in this case, it was impossible to avoid carrying out works on the sewer. The designer was able to avoid confined space entry in the investigation phase by specifying a CCTV survey using a wheeled remote-controlled camera system that could be fully controlled from outside the existing sewer.

Reduce Risk

The Designer was able to reduce the risk in several ways on this project at the design stage by adopting the following in the design:

A review of existing technologies and methods for sewer rehabilitation identified that relining the existing sewer would be appropriate in this instance. This had several benefits with regard to Health & Safety along with cost and programme. These benefits included:

- Reduced impact to traffic, pedestrians and business owners as two excavations of 4 metres x 4 metres at each end of the effected sewer were required rather than the alternative of open cutting 2 metres wide by 1000 metres long at a depth of 4 metres
- The likelihood of conflict with existing services was reduced by lessening the extent of the excavation
- The need for several hundred truck movements removing arisings and importing backfill for excavations was significantly reduced
- The amount of Plant required on site was reduced
- Noise / Dust & vibration were also reduced

Control Risk

The Designer was able to further control the risk by:

- Obtaining and communicating the most up to date Service drawings
- Taking account of service locations when identifying the launch & reception excavations
- Specifying Ground Penetrating radar surveys in areas of key concern
- Carrying out condition surveys on existing buildings to help inform how excavations could be progressed without causing damage to buildings noted to be in a poor structural condition.
- Preparing a preliminary traffic management plan identifying possible phasing of the project to further reduce impact on vehicles, the public and business owners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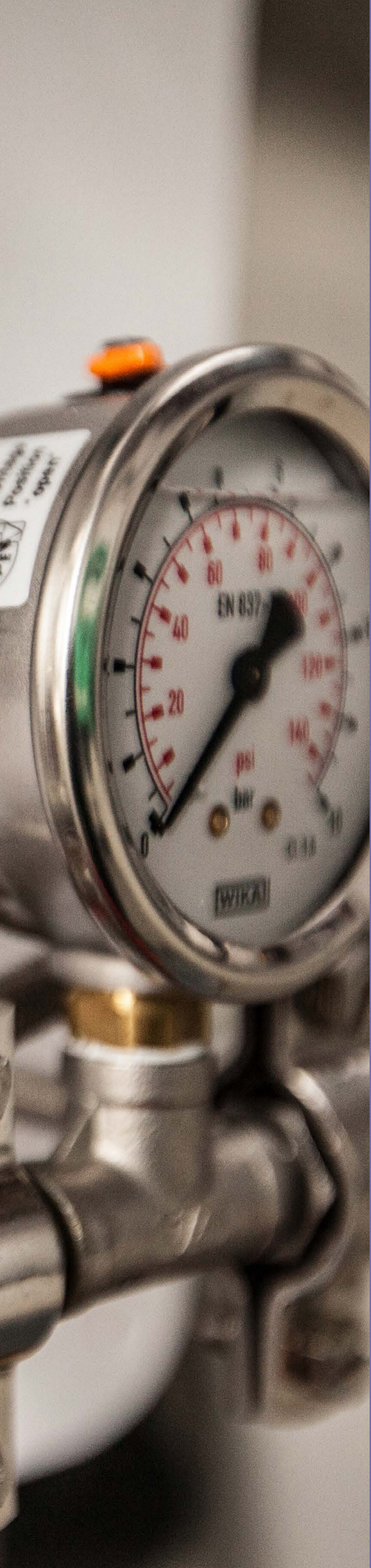

Chapter 8
Fire & Explosion

Chapter 8
Fire & Explosion

Fire & explosion remain a very real risk in the water industry due to the handling and dosing of chemicals and the presence of the naturally occurring flammable & explosive gases such as methane & hydrogen sulphide. This area accounted for 12 incidents across the Irish Water operations in the last year.

What are Fire & Explosion Risks?
Working with flammable liquids, dusts, gases and solids is hazardous due to the risks of fire and explosion. The effects of fires or explosions can be devastating in terms of lives lost, injuries, damage to property and the environment, and to business continuity.

Designers should consider that both fire and explosion risks can be present during the lifecycle of an asset, such as construction in a live waste water environment or dosing chemicals during water treatment, or when carrying out maintenance on plant used in the treatment process.

Examples of Fire & Explosion Risks in the Water Industry:

- Working on or near wastewater treatment where naturally occurring gases (e.g. methane, hydrogen sulphide) can build up
- Unventilated spaces allowing the build-up of gases such as manholes and chambers
- Flame cutting or grinding during the construction process near waste water treatment
- Using non-intrinsically safe equipment in ATEX designated zoned areas
- Processes that involve breaking through the crust or solidified layer in waste water treatment, allowing a sudden discharge of gases.
- Electrical fires in panels and motors

Image 8.1 The effects of fire can be devastating

Designers should consider the GPoP such as:

1. Eliminate exposure to Fire & Explosion risk

Hazards relating to risks from dangerous chemicals can be eliminated by removing the need for these chemicals at the design stage.

It is not possible to fully eliminate the presence of dangerous gases such as methane (which present a fire and explosion risk) in wastewater systems. Therefore, the emphasis is on risk reduction in the design of systems.

Image 8.2

2. Reduce risk of injury from Fire & Explosion

Designers must consider the design of collective means of protection to reduce the risk of exposure to both Fire & Explosion risks, including the following possible measures:

- Ensuring the ATEX requirements are understood and incorporated into their design, examples of which include deigning and specifying intrinsically safe equipment for installation in ATEX zones.
- Designing open or ventilated spaces that prevent the build-up of flammable gases, or if necessary mechanically ventilated spaces with back-up systems
- Where suitable, provision of permanent gas warning devices
- Designing out human interaction or automating the handling and dosing of chemicals, remote means for cleaning, remote mixing and agitation within tanks, design systems that do not require human interaction for routine cleaning or unblocking (hence reducing human exposure)
- Structural measures can limit the areas at risk from explosion, where required/appropriate

3. Control the risk for persons who are exposed to Fire & Explosion Risk

Control measures which can be specified by designers which will impact on the risks of fire & explosion during any phase of the lifecycle of the asset could include:

- Operation of the ventilation and/or extraction systems, as appropriate
- Suitable storage areas for chemicals, including bunding and containment for flammable liquids
- The use of remote monitoring and suppression systems
- Incorporating signage and warnings into the design warning of the risk


FIRE HOS
BOX

Chapter 8
Fire & Explosion

Sample Design Hazard

A significant hazard on treatment sites is the risk of explosive atmospheres

Image 8.3 Site board detailing ATEX zones

Image 8.4 ATEX sign giving warning to entrants

Designer Considerations (this example)

Eliminate the Hazard

Hazards relating to risks from dangerous chemicals can be eliminated by removing the need for these chemicals at the design stage.

It is not possible to fully eliminate the presence of dangerous gases such as methane (which present a fire and explosion risk) in wastewater systems. Therefore, the emphasis is on **risk reduction** in the design of systems.

Reduce the Risk

To reduce the risk posed by explosive atmospheres designers should consider designing out explosive or potentially explosive atmospheres, in their design. Consideration should be given to natural ventilation or removing possible ignition sources such as hot surfaces or electrical items.

The designer can also consider introducing forced ventilation triggered by a remote atmosphere monitoring device, keeping the atmosphere from reaching explosive levels.

Control of Risk

Where areas have been identified as having a potentially explosive atmosphere, designers should consider the items such as electrical panels, motors, etc. that are being specified for use in these areas. All electrical items being specified in these areas must be intrinsically safe and suitably ATEX rated.

Designers must consider providing suitable warning and signage outside of these ATEX zones to warn persons of the risk.

Chapter 8

Access & Egress

Access & Egress

The safe movement of persons and vehicles around the water sites, and to all parts of the facility (including at heights) is a fundamental aspect of safe design. Access and Egress incidents accounted for 25 incidents across Irish Water operations in the last year

What are Access Risks?

Access and egress refers to the ability of personnel to enter and exit the site, to move safely around the site, and to gain safe access to all parts of the plant, equipment or other elements within the site.

Routes that provide access and egress should be controlled, safe, suitably constructed, kept free of obstructions and well maintained.

A significant number of accidents occur within the water industry due to access and egress issues such as slips, trips & falls.

It must be considered by designers that access risks can be present at all or at different times in the asset lifecycle. This includes during construction in relation to vehicles accessing the site, during use by operators accessing the top of tanks and process equipment & during maintenance such as maintaining valves and pumps in chambers or at height

Examples of Access Risks in the Water Industry:

- Build-up of algae or contaminants on walkways causing a slip hazard on outdoor walkways and platforms
- Process equipment such as pipes and trays obstructing walkways
- Access to heights or depth during the construction phase
- Visibility & Lighting Levels
- Headroom and clearance on access paths
- Accessibility to high level areas for future maintenance
- Accessibility to equipment which requires ongoing operator interaction
- Access & Parking for vehicles during all phases
- Risks to pedestrians from vehicles of plant moving around the site


Image 9.1

Image 9.2

Access & Egress

Designers should consider the GPoP such as:

1. Eliminate exposure to Access risk

Designers can eliminate the risk posed by unsafe access by ensuring that there is safe, well designed access to all key areas. Measures can include designing well-lit and clearly marked non-slip walkways and segregation of pedestrians from vehicles while protecting them from process risk and falling from height or drowning.

Issues related to the specific risks associated with working at height are addressed in Chapter 1 of this guidance document, and risks associated with drowning in water are addressed in Chapter 2.

Traffic routes and thoroughfares should be laid out in such a way to prevent risks from vehicles during operation.

2. Reduce risk of injury related to Access issues

Safe access means are to be designed to allow safe access to all parts of the site, including all elements such as valves, gauges, meters, equipment, stores, etc. All workplaces should be reachable as directly and conveniently as possible.

Paths should be even and unobstructed by parts of the plant or other obstacles. Obstacles such as open channels or conveyor belts should be bridged over.

Floor coverings, gratings, roads and paths should be non-slip and free-draining.

Traffic routes should be present in adequate numbers and their layout and dimensions are such that they can be safely used by pedestrians or vehicles according to their function, e.g. adequate turning areas for vehicles, suitable parking and laydown areas, with segregation of pedestrians, where appropriate, suitable lighting levels for works at night.

Fixed ladders, manhole steps, staircases and platforms should all be designed to the required codes and standards.

Consider access and storage requirements for construction and maintenance.

3. Control the risk

A suitable site traffic management or site mobility plan should be in place.

Sample Design Hazard

A design hazard that pops up time and time again is Access. Designers must consider safe access in relation to all lifecycle phases of the asset. The examples below demonstrate that access is still a key risk area and something that should be considered in detail by designers:

Example of poor design

Image 9.4 Several examples of davits outside edge protection system and hand actuated valves placed at height

Example of good design

Image 9.5

Designer Considerations (this example)

Eliminate the Hazard

Consider placing the valves at ground level, removing the access at height requirement.

Consider automating the valves to avoid the need for human interaction during use.

Reduce the Risk

Consider placing equipment inside or behind edge protection systems to prevent access risks.

Consider placing maintainable items such as motors within easy access for maintenance.

Design sufficient lighting and space for safe access.

Design clearance between hand actuated items and obstructions such as pipes and steel work.

Control of Risk

Ensure safe system of work is in place for all maintenance and operation activities.

Safe Design

Reference documents

Health & Safety Legislation for consideration by designers:

Safety, Health and Welfare Act 2005
(S.I. No. 10 of 2005)

Safety, Health and Welfare at Work
(General Application) Regulations 2007 (S.I. No. 299 of 2007)

Safety, Health and Welfare at Work
(Construction) Regulations 2013 (S.I. No. 291 of 2013)

Safety, Health and Welfare at Work
(Exposure to Asbestos) Regulations 2006 and 2010

Codes of Practice for consideration by designers:

Code of Practice for Access & Working Scaffolds – 2018

Code of Practice for the Chemical Agent Regulations – 2018

Code of Practice for the Design and Installation of Anchors – 2017

Code of Practice for Working in Confined Spaces – 2017

Code of Practice for Avoiding Danger for Underground Services – 2016

Code of Practice for Safety in Roof Work – 2016

Code of Practice for Biological Agents – 2013

ESB Code of Practice for Avoiding Danger from Overhead Electricity Lines – 2008

Useful resources

Health & Safety Authority
www.hsa.ie

Association of Consulting Engineers of Ireland
www.acei.ie

Engineers Ireland
www.engineersireland.ie

The Royal Institute of the Architects of Ireland
www.riai.ie

water.ie