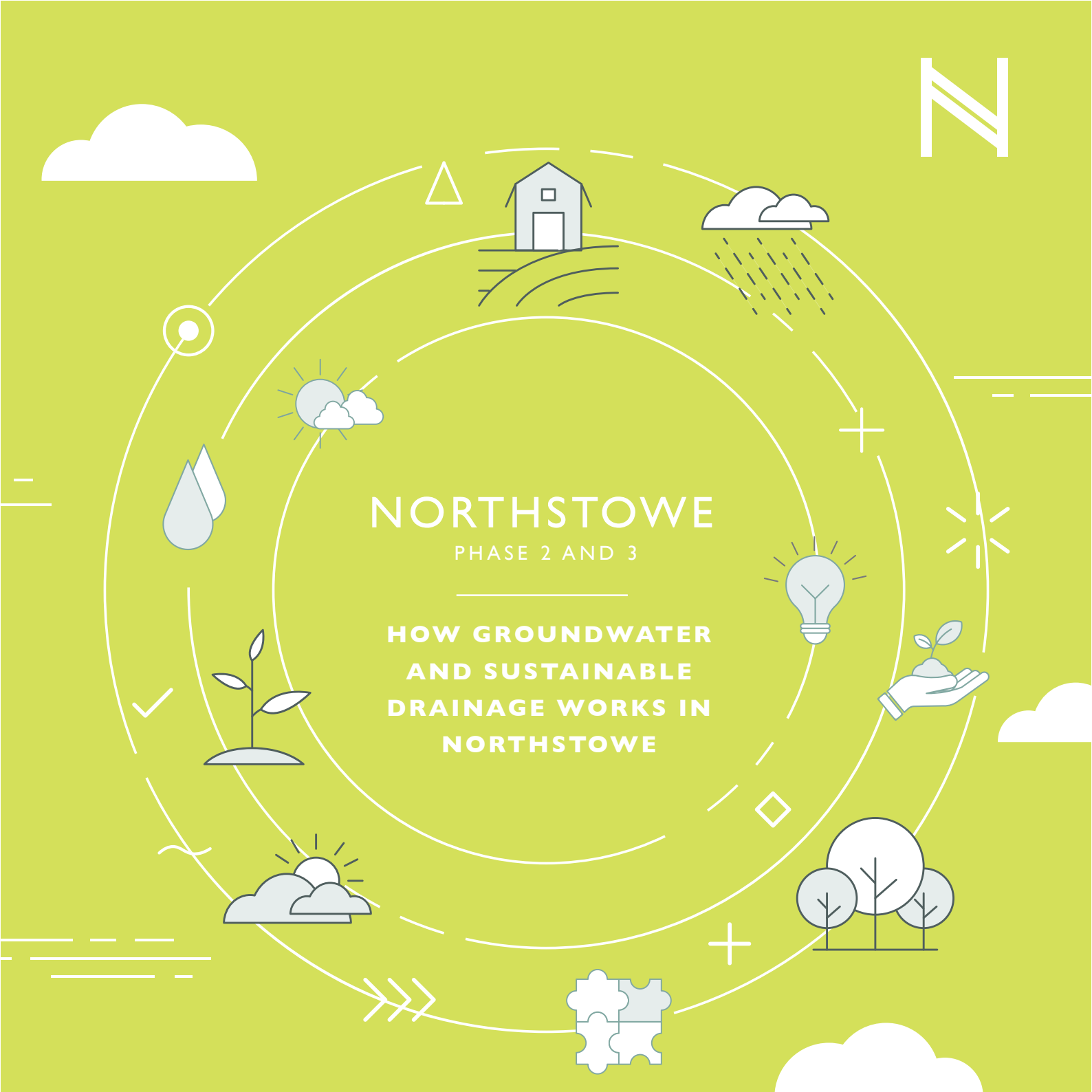
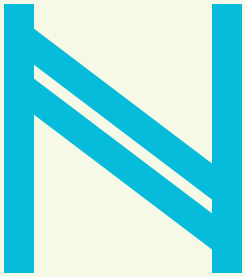

NORTHSTOWE
PHASE 2 AND 3
HOW GROUNDWATER AND SUSTAINABLE DRAINAGE WORKS IN NORTHSTOWE

CONTENTS



Northstowe is a sustainable new 10,000 home development near Cambridge which already has its own unique community, combining town life with outdoor recreation, including large easily accessible amenity lakes, open spaces and play areas, and two schools with further open spaces, education and community facilities and a vibrant town centre planned.

This note has been prepared to explain how surface and groundwater is to be managed within the town, for both phases two and three, and to clarify the interaction between the proposed and existing water features in relation to groundwater.

Why is groundwater and drainage so important to the development of Northstowe?

Northstowe has sustainability at its heart. Its open spaces and buildings are conceived to enhance biodiversity, creating green corridors all around that link to the wider Cambridgeshire area.

In fact, it is the landscape and green infrastructure of the natural land in and around Northstowe that has helped inform the layout of the town, integrating both green spaces and waterways into the mix for people to enjoy and relax around.

As Northstowe continues to be developed, great care and attention is being paid to drainage and groundwater to ensure the town and community is protected from the risk of major flood events. This is key alongside ensuring that water assets serve the varying needs of wildlife, nature, people and the environment in and around Northstowe.

What are the challenges around groundwater and drainage at Northstowe?

Management of rainfall runoff (also known as surface water runoff) and making sure that surface water does not increase as the town is built and cause flood risk issues downstream is a key consideration. The impact that climate change may have on these risks in future also needs to be taken into account.

We are also aware of concerns about the development impacting groundwater in Northstowe and Longstanton, and that abstraction of groundwater may be taking place. We want to reassure all stakeholders that these concerns are unfounded and this booklet will aim to explain how this is not the case, and what measures are being taken during phases two and three to ensure the town is being developed responsibly and with the aim of protecting the environment.

Furthermore, all phases of Northstowe have been subject to a comprehensive Environmental Impact Assessment, which sets out a procedure for assessing, consulting and coming to a decision on projects that are likely to have significant environmental effects. These are in addition to thorough Flood Impact Assessments.

How does drainage and flood prevention work at Northstowe?

Northstowe has an exemplary Sustainable Urban Drainage System (SuDS) designed into the fabric of the masterplan, which will manage surface water through a series of ponds, open swales, alongside roads and within green spaces, protecting the town from major flood events. It has been designed well above the normal development standard.

The drainage strategy has been designed to set key parameters for post-development surface water runoff from the site to prevent risk of flood issues downstream.

The system has been designed to be sealed, keeping groundwater and surface water runoff separate to ensure capacity for rainfall events.

While lakes in the new waterpark may appear 'full', they have been designed to be oversized, with a 2m permanent water depth and surface water attenuation on top of this to deal with the 1 in 200 year rainfall event (including an allowance for climate change), which exceeds planning policy requirements.

Water is then discharged at an agreed rate equivalent to the mean annual greenfield run off rate. In times of high rainfall, discharge rates will be lower than would otherwise occur were the site not developed.

In addition, when water levels within the adjoining Beck Brook are high, all surface water runoff can be held in the lakes for up to 48 hours, with zero discharge, to allow water levels in adjoining waterways to lower as part of our strategy of reducing flood risk – both for the town and adjoining communities.

Alongside these measures, groundwater monitoring is also being undertaken by Homes England across the site to understand the fluctuating groundwater baseline and how this is influenced by seasonal and climactic changes.

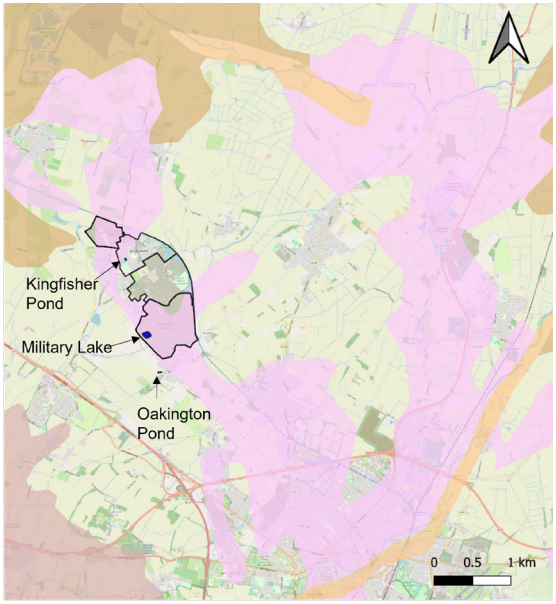
THIS BOOKLET WILL EXPAND ON THESE PLANS, INCLUDING:

1. The extent of the local aquifer under Northstowe, Oakington and Longstanton
2. How groundwater interacts with local geology, influencing water levels within onsite and offsite water features
3. Seasonal groundwater level changes
4. Design of Sustainable Drainage Features within the new site, responding to topography to manage surface water runoff as a result of the development proposals
5. We've also included a handy glossary of terms, recognising that this is a very technical area of work. Please refer to this when reading the booklet.


MILITARY LAKE
LONGSTANTON
PHASE 2 DEVELOPMENT
WATERPARK
PHASE I WATERPARK

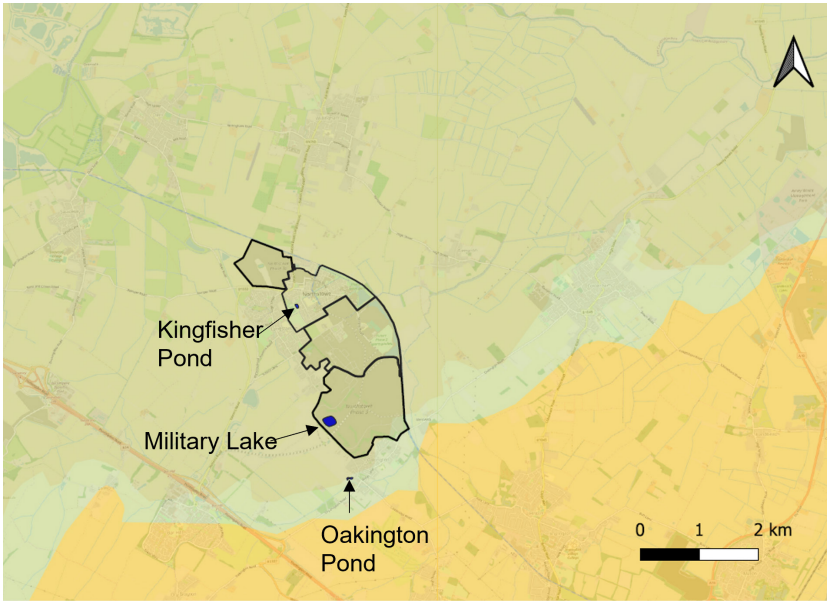
Northstowe, Longstanton and Oakington are underlain by superficial deposits and bedrock. The overlying superficial deposits at Northstowe are called River Terrace Deposits. These are mostly clays, but include some sand and gravel deposits that have high porosity. The sand and gravel deposits can have mobile groundwater within the pore spaces. The River Terrace Deposits are classed as a Secondary A Aquifer and extend through part of the site as illustrated below, and throughout the wider area.

This means it has permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases may form an important source of base flow to rivers. For example, at Northstowe, the River Terrace Deposits provide water to the Kingfisher Pond and some water to the Military Lake but are not of regional or national importance.



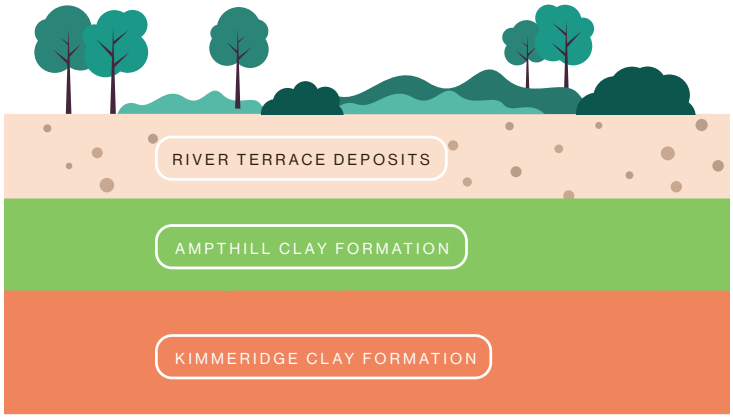
Key:

- Alluvium (Secondary A Aquifer)
- Peat / alluvium (Secondary A Aquifer)
- Sand and gravels (Secondary A Aquifer)
- Diamicton (Secondary (Undifferentiated) Aquifer)

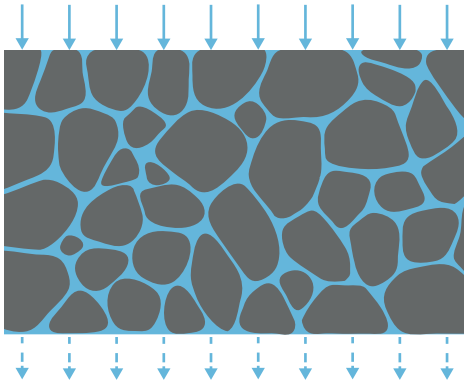


Key:

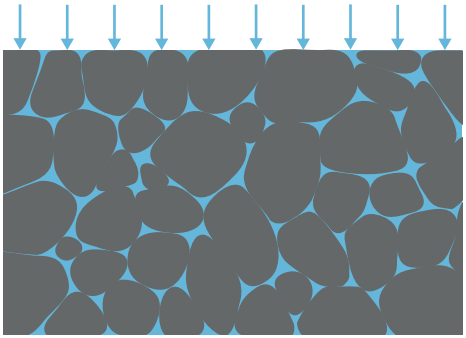
- Gault Formation (Unproductive strata)
- Woburn Sands Formation (Principle Aquifer)
- Kimmeridge Clay Formation and Ampthill Clay Formation (Unproductive strata)



The underlying bedrock at Northstowe is the Ampthill Clay Formation and the Kimmeridge Clay Formation. The pore spaces within clays are very small and poorly connected and as a result clay is impermeable. The Ampthill Clay Formation and the Kimmeridge Clay Formation are classed as unproductive rocks. They are defined as rock layers with low permeability that have negligible significance for water supply or river base flow.



Connected pore spaces in River Terrace Deposits



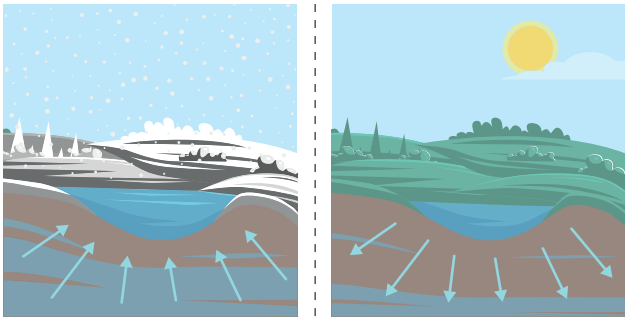
Unconnected pore spaces in Ampthil Clay Formation and Kimmeridge Clay Formation.

Fluctuations in the groundwater levels happen due to changes in rainfall between seasons.

Rainfall in the UK is generally highest during the winter and spring months when infiltration in the overlying River Terrace Deposits recharges the groundwater levels.

During summer months, there is less rainfall and vegetation uses more water from the soil before it can recharge the groundwater, resulting in **low groundwater levels in the summer.**

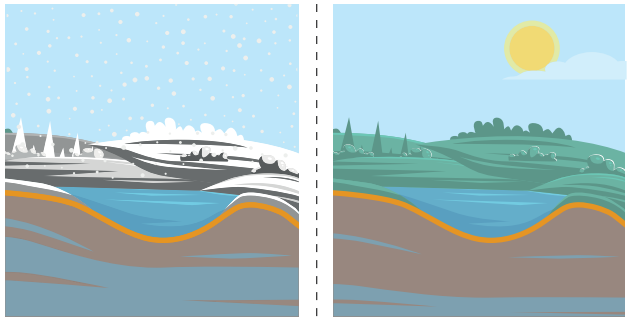
The Kingfisher Pond is located within the River Terrace Deposits (phase one).



Natural Pond water levels high when groundwater levels recharged in winter, and low in summer when less rainfall

Groundwater therefore supports the water level in the pond, which in turn is likely to fluctuate seasonally. Possible natural sediment build up at the base of the pond may also reduce this connectivity.

The majority of the Military Lake, Oakington Pond and Northstowe waterparks are located within the Kimmeridge Clay Formation (phases two and three). The water level in these ponds is predominantly supported by surface water runoff. Less surface water run off in the summer will mean lower water levels in Military Lake, Oakington Pond and the Northstowe waterparks.



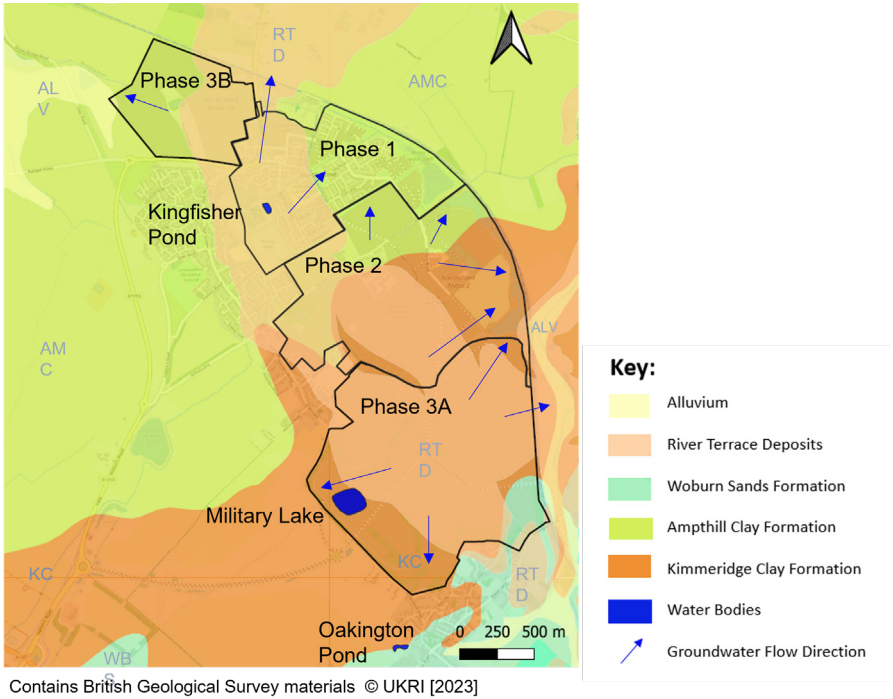
Northstowe Waterpark are clay lined, filled only by rainwater from site, with no interaction with groundwater.

Superficial deposits lie under parts of Northstowe from approximately ground level to 7m below ground level. These create local pathways for groundwater to flow through and have been assessed through the Environmental Impact Assessment for both construction and operation.

Groundwater monitoring is being undertaken by Homes England across the site to understand the fluctuating groundwater baseline, and how this is influenced by seasonal and climactic changes.

The Environment Agency monitors groundwater through the Water Act 2003, and Transfer Licences are required where development will remove groundwater to discharge it into local watercourses. The Lead Local Flood Authority also manages construction discharge licences for any works during construction.

Homes England liaises closely with all stakeholders in developing the site wide development strategies, and the further details required for construction, ensuring management of groundwater will be carefully monitored and regulated.



Much of Northstowe is underlain by clay. Precipitation which falls on the clay will not enter the ground but will flow over the impermeable clay surface to a topographical low point (i.e. Beck Brook and Oakington Brook). Northstowe is a very small area of the wider topographical catchments which feed these watercourses.

The site gradient falls in many directions and so Sustainable Drainage Systems (SuDS) have been included in the masterplan proposals to mimic natural pathways and runoff routes. These include Greenways and strategic attenuation basins located at low points to capture surface water runoff from the development and minimise any overland flow routing in extreme events flowing offsite.

The Sustainable Drainage Systems designed for Northstowe will limit rainfall runoff to no more than the normal flow from an undeveloped greenfield site for up to and including the 1 in 200 year rainfall event, plus additional allowance for climate change and will include:

- New waterparks proposed as both recreational and management features for surface water.
- Swales alongside roads and through pleasant Greenways. These carry rainfall water west to east to large lakes in the new waterpark.
- Onplot SuDS features, such as permeable paving and raingardens.
- The Military Lake is an existing feature within the site. Created by the Ministry of Defence, it is partially fed by groundwater and predominantly by surface water runoff, and will remain as part of the development proposals.

This means peak runoff rates into Beck Brook and Oakington Brook will remain low even in extreme events, reducing flood risk downstream.

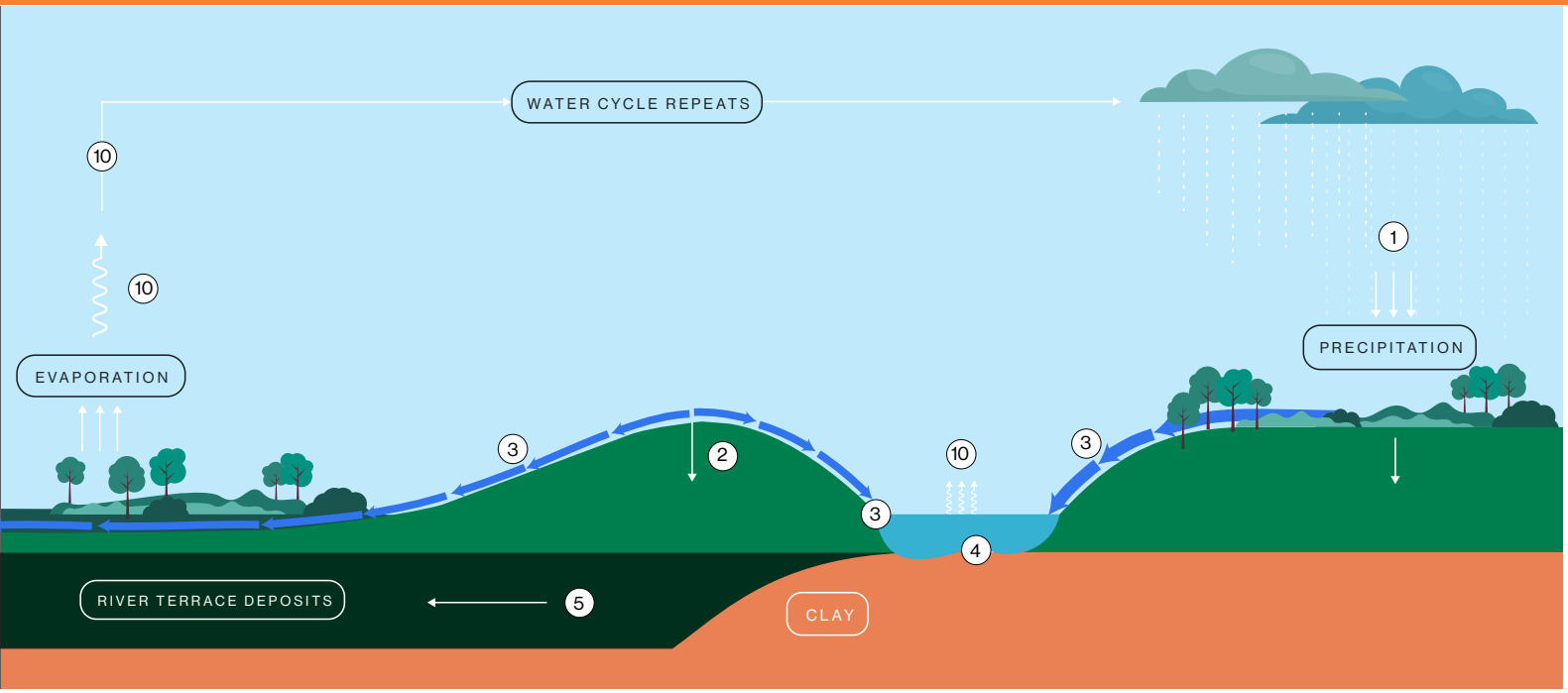
Northstowe phase two drainage has been designed as a sealed system, keeping groundwater and surface water runoff separate to ensure capacity for design rainfall events is available. This will be the same for Phase three, as indicated within the Planning Consent.

However, where feasible, onsite SuDS features will be designed to help recharge groundwater.

The waterparks and SuDS corridors will be attractive for residents and beneficial in terms of ecology but with additional storage capacity for rainfall runoff.

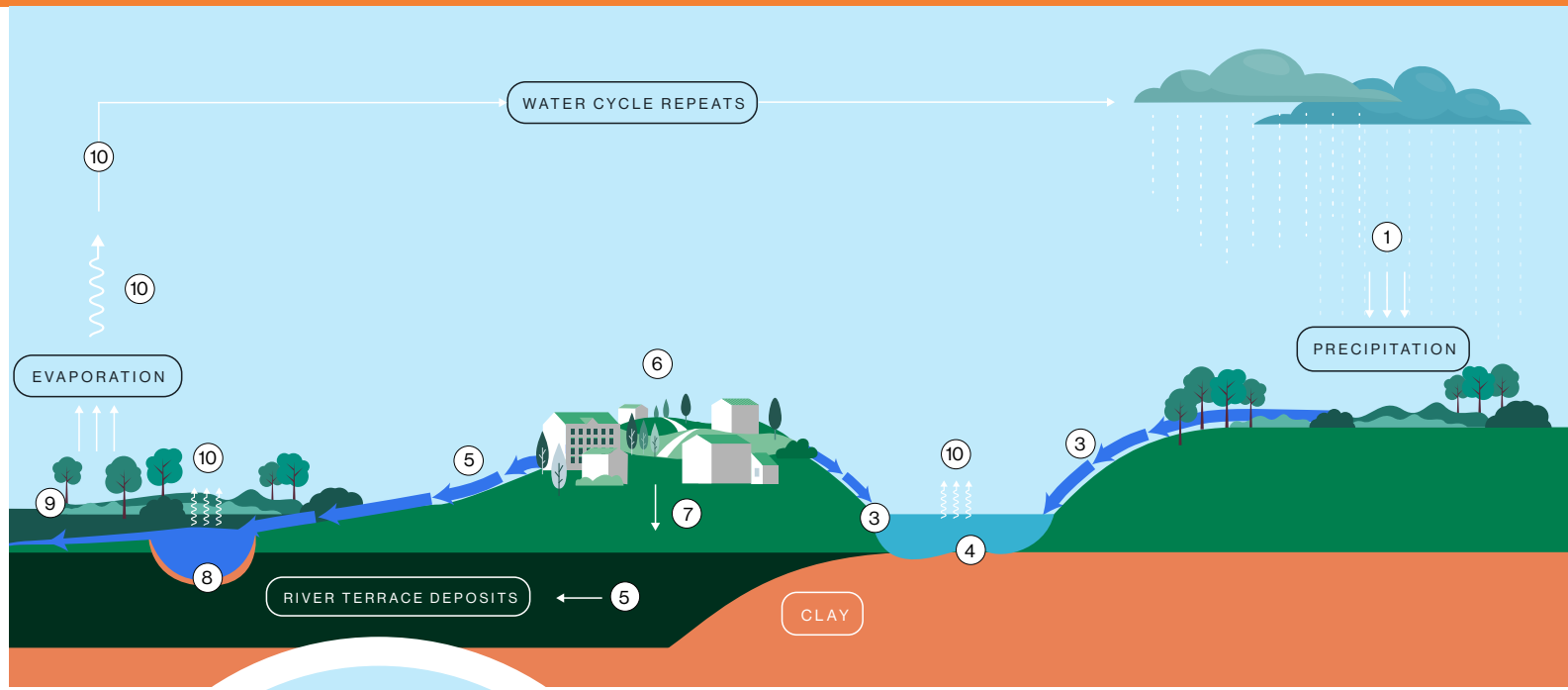

Water Park
Water Park
Water Park
Runway Lake
Swale
Military Lake
Southern Basin

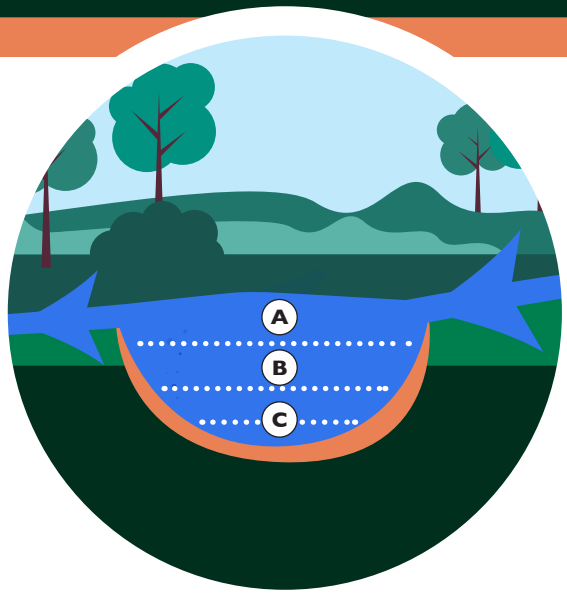
WATER CYCLE PRE-DEVELOPMENT



1. Precipitation as rain, snow, sleet or hail form depending on the air temperature.
2. Infiltration – precipitation soaks into the ground and recharges the groundwater.
3. Surface water run off over the ground.
4. Military Lake is manmade and predominantly fed by surface water runoff.
5. Groundwater flows through the River Terrace Deposits.
6. Drains collect surface water runoff and use this water to fill the Northstowe waterpark.
7. SuDS designs allow precipitation to infiltrate the ground and recharge the groundwater.
8. Northstowe waterpark is a series of man-made lakes which are clay lined (please see the magnified view for details). The waterpark is supplied purely by surface water runoff collected by the drains.
9. Water from the waterpark is discharged to the Beck Brook in a controlled fashion.
10. The water vapour then cools and condenses forming water droplets in the atmosphere and in turn forming clouds. The cycle then starts again with precipitation.

WATER CYCLE POST-DEVELOPMENT





A **Freeboard** – depth of basin that does not have water within it, but provides extra storage to allow for rainfall events over and above the designated event to minimise any flood risk to the surrounding area

B **Storage depth** – designed to store rainwater runoff for up to and including 1 in 200 year rainfall event, including an allowance for climate change. This also allows NO discharge from site for up to 48 hours when downstream water levels are elevated, to allow the Brook River levels to reduce before discharge at the pre-development greenfield runoff recommences

C **Permanent water level** – remains in basin all year round to enhance biodiversity and amenity of the area. Is not connected to outfall or groundwater. Basin is lined where required.

Northstowe waterpark is a series of man-made lakes which are clay lined. There is no interaction between these lakes and groundwater. The waterpark is supplied purely by surface water runoff collected by the drains.

SuDS designs at Northstowe will allow precipitation to infiltrate the ground and recharge the groundwater, where feasible, helping to reduce the impact of an increase in impermeable surfaces from development of the site.

The waterpark reduces runoff from the site and reduces flood risk to the surrounding area during heavy rainfall.

Northstowe is approximately twelve times smaller than the River Terrace Deposits aquifer, therefore the development is likely to have a negligible impact on overall catchment wide groundwater levels.

1:200 Year Rainfall Event: A rainfall event that has a 1 in 200, or 0.5% chance of occurring in any one year.

Aquifer: A subsurface zone or formation of rock or soil containing a significant body of groundwater.

Bedrock: The main mass of rocks forming the Earth that are present everywhere, whether exposed at the surface or concealed beneath superficial deposits or water.

Environmental Statement: A document that sets out an assessment of the likely environmental impacts of a proposed development, typically required to support major planning applications.

Geology: The underlying structure of an area's land, together with the types of rocks and materials that exist within it.

Greenfield: Relating to land that has never been developed, other than for agricultural or recreational use.

Groundwater: Water found below the surface of the ground, which has passed down through the soil and become trapped within the underlying geology.

High porosity: Soil or rock that has a reasonably high porosity and permeability that allows it to contain water and transfer it from pore to pore

Lead Local Flood Authority (LLFA): Unitary Authority or County Council responsible for developing, maintaining, and applying a strategy for local flood risk management in their areas, and managing the risk of flooding from surface water, groundwater, and ordinary watercourses.

Loose deposits: Superficial deposits are the youngest geological formations (less than 2.6 million years old) and are generally unconsolidated

Low porosity: Soil or rock that has a reasonably low porosity and permeability and therefore water cannot transfer from pore to pore

Outfall: The point, location, or structure where surface water runoff discharges from a drainage system.

Permeable Paving: A surface that provides a pavement suitable for pedestrian and/or vehicular traffic, which is constructed with void spaces through which water can pass through the surface to the underlying structural / drainage layers.

Principle Aquifer: Aquifers from which groundwater can be extracted to provide significant quantities of drinking water, and water for business needs.

Porosity: Porosity is the ratio of pore volume to its total volume, ie the amount of empty space within a given material.

Raingardens: A shallow planted depression that allows runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils prior to collection or infiltration.

Secondary Aquifer: Aquifers from which groundwater may be extracted to support local water supplies, and which may form an important source of base flow to watercourses.

Superficial Deposits: The youngest geological deposits, typically found close to the ground surface, which rest on older deposits or rocks referred to as bedrock.

Surface Water Runoff: Water flow over the ground surface into a drainage system, which occurs if the ground is impermeable (e.g. as a result of built development), is saturated, or if rainfall is particularly intense.

Sustainable Drainage Systems (SuDS): Drainage systems that are designed to maximise the benefits and minimise the negative impacts of surface water runoff from developed areas, by slowing down and reducing the quantity of surface water runoff to manage downstream flood risk and reducing the risk of runoff causing pollution.

Swales: A shallow vegetated channel designed to convey, treat, and occasionally store surface water.

Topography: The physical appearance of the natural features of an area of land, especially the shape of its surface.

If you would like to discuss contents
of this brochure further, please contact:

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