Swim England

Facility Development Toolkit

FOREWORD

Jane Nickerson

At Swim England we are naturally passionate about all things aquatics.

We know the huge benefits being active in the water can bring to people. Swimming is a unique activity in that it can be enjoyed by people of all ages, improving both our physical and mental health, improving self-confidence and teaching people a skill that may one day save their life. Swimming also improves our communities - saving the NHS hundreds of millions each year and supporting social cohesion.

This variety is always on display at pools across the country. From Learn To Swim sessions teaching children (and adults) how to be safe in the water, family fun sessions providing opportunities for families to enjoy quality time together, aqua fit classes and lane swimming sessions supporting people to be active in an environment that works for them and a network of clubs up and down the country fostering lifelong friendships and helping develop the future international athletes across our whole range of fantastic aquatic sports.

None of this could take place though without the bricks and mortar swimming pools and leisure centres that make all this possible.

As we have reported previously, these facilities are facing many pressures and unless we build the new pools we need we face an acute shortage of swimming pools.

Building new pools, or where appropriate refurbishing existing pools offers an opportunity to deliver a network of much more sustainable pools. Pools that are more sustainable both financially and environmentally benefit everyone.

As well as continuing to campaign for the necessary government investment, we are using our facilities expertise to do all we can to support pool owners and providers to ensure we have the appropriate pools we need for the future. The purpose of this document is to help guide pool providers through the process of building new, replacing or refurbishing existing swimming pools in England to ensure we have the supply of pools we need.

Jane M Nickerson MBE
Chief Executive Officer – Swim England

Value of pools

We know swimming pools are much-loved community facilities, used by clubs, casual swimmers, schools, support groups and families alike.

Swimming is one of the most popular activities up and down the country, particularly amongst women and girls.

Unlike most activities, swimming can be enjoyed at any age and the unique properties of the water can be an ideal environment to help support people to be active who may struggle to exercise on land due to a range of health conditions.

Every £1 spent on community sport and physical activity **generates nearly £4** for the English economy and society[1].

Weekly swimming **saves the NHS** and social care system more than

£357m each year[2]

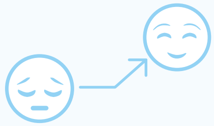
Swim England's Value of Swimming report showed that swimming supports:

Physical wellbeing

with swimmers reporting feeling **12 years younger** than non-swimmers

Mental wellbeing

1.4 million adults feel swimming has significantly reduced their anxiety or depression

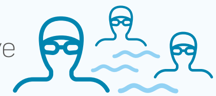


Individual development

with **women and girls** reporting that swimming more than **doubled** their levels of self confidence

Social and community development

swimmers have been found to be **more socially connected** and to have more friends than non-swimmers



Volunteering

swimmers are **26.1%** more likely to volunteer

1 https://www.sportengland.org/news/why-investing-physical-activity-great-our-health-and-our-nation
2 http://www.swimming.org/swimengland/value-of-swimming

Future of facilities

It is vital there are appropriate facilities in the right locations to ensure that everyone has the opportunity to enjoy the benefits of swimming and every child has the opportunity to learn an essential life skill.

We also need enough pools that are capable of supporting all our aquatic sports of swimming, diving, water polo and artistic swimming.

The 1960s onwards saw a huge increase in pools being built in England and the current national supply of water space is equivalent to 12 sqm of water space per 1,000 head of population.

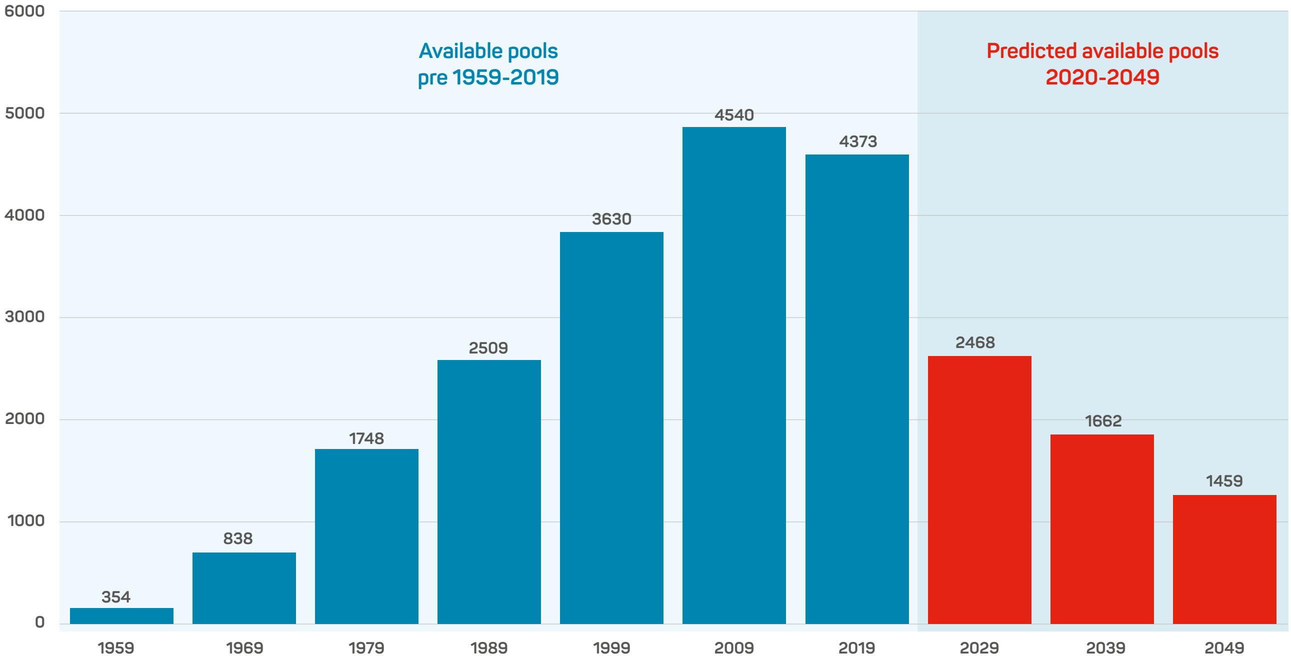
The average life of a pool built from 1960 onwards, based on open and close data of facilities since that time, is 38 years.

Therefore, many of these pools are now coming to the end of their lifespan or have closed and it is clear that the number of pools in England is in decline.

This, coupled with an increasing population, means that there is an urgent need to invest in new (or refurbish existing) facilities.

To ensure we have the pools we need for the future, long term capital investment into public leisure is needed.

Number of pools available at the end of each decade



Swim England objectives

Swim England is passionate about ensuring everyone has the opportunity to enjoy aquatics.

We aim to create a happier, healthier and more successful nation through swimming and key strategic goals will help us achieve our cause of every child learns, every community enjoys, every medal inspires.

Swim England is committed to supporting everyone involved in swimming: our members, our partners, the swimming workforce, those learning to swim, and those who already swim regularly.

We aim to provide expert guidance and support to the aquatics industry to ensure there is sufficient, quality water space, trained staff and effective programmes to enable everyone to enjoy regular swimming.

On behalf of the industry and our members we campaign for issues affecting the sector and lead collective campaigns to engage current and potential participants.

The purpose of this document is to guide pool providers through the process of building new, replacement of existing or refurbishment of the swimming pool supply in England.

Having highlighted in our 'Decade of Decline' report the perilous position our sector faces, this document supports interested parties through the process of developing new facilities. Contained within are links to various guidance and supporting documents that can help deliver the swimming facilities our communities need for the future.

Developing a strategy

The predominant supply of water space to communities within England is provided through public owned facilities. These facilities enable thousands of people to swim each day, however they are ageing, often unsustainable and the need to replace or refurbish is ever increasing. The starting point for asset owners or providers of facilities is to appropriately review the demand for swimming within the local area, to undertake an appropriate analysis of the existing stock (supply) and its ability to provide for the future. This would require the development of a built facilities strategy.

Working alongside Sport England we have developed a single approach with detailed guidance to complete the first phase of facility development. The Strategic Outcomes Planning Guidance (SOPG) is about understanding and having clear strategies for positive community outcomes and how to ensure more interventions help to achieve healthier more active communities and addressing inequality – an important aspect of this will be to ensure communities have access and opportunity to learn to swim and swim regularly - so understanding how much water space is needed is important at this stage. Swim England has a dedicated facilities team that can also help support interested parties through the development of an appropriate facilities strategy.

Strategic Outcomes Planning Guidance (SOPG)

The SOPG process developed by Sport England provides a way of identifying local physical activity needs and translating them into the places and spaces which make up a locality-based active environment. In order to make an effective investment into facilities and services, it's essential to have a clear, strategic and sustainable approach to sport and physical activity. While all local authorities will have some or most of this work in place, this cannot be a 'one size fits all' approach.

The guidance is designed to help you create a focus and vision on local outcomes informed by customer insight. This will deliver interventions that affect behavioural change in your target audience, ultimately delivering the desired results for your local authority.

It describes the bespoke approach required to ensure investment best meets local strategic outcomes and the needs of your community. Split across four stages, it seeks to provide key principles to support your journey, while recognising the resourcing challenges facing local authorities. The four stages are **outcomes, insight, interventions and commitment**.

At each stage, the guidance signposts where additional help or advice can be found, dependent on the local authority's current circumstances. This could be at the beginning of a commissioning cycle, at the change of a political administration, or when new facilities or service deliveries are required.

The process involves:

- **Identifying the shared outcomes for a place:** this brings together strategic stakeholders who all have remit to deliver at locality level. The creation of a shared agenda means that communities benefit from a co-ordinated approach in which stakeholders all work towards the same priorities.
- **Developing insight which tells the story of a place and its people,** why they face the inactivity barriers they do and what they need to address these.
- **Identifying the interventions** which are needed to address local barriers. These may be new places and spaces in which to be active (Community Leisure Hub, active travel routes), more and different activity offers, better partnerships, etc.
- **Developing the partnership commitment necessary to deliver the actions.** Partnership commitment embraces resources (people and funding), timescales, and project development.

Demand for water space

Identifying the need for water space is the first step of the process. This should have been developed with some level of detail through the SOPG process. The average amount of water space required across England equates to 12m² of water space per 1,000 head of population. This should be a principle target or gauge of your deficit of water space.

12m²
Per 1,000
head of population

Defining a need for water space is essential, how that water space looks however is critical to the success and sustainability of a facility. Through the SOPG process you should have identified the key user groups of your facility taking into account the profiles, depths and provision at other facilities within the region. Providing a facility with the provision for an extensive learn to swim scheme is vital and often at the forefront of facility development however you should also take considerations for the requirements of the sports that take place within your pools.

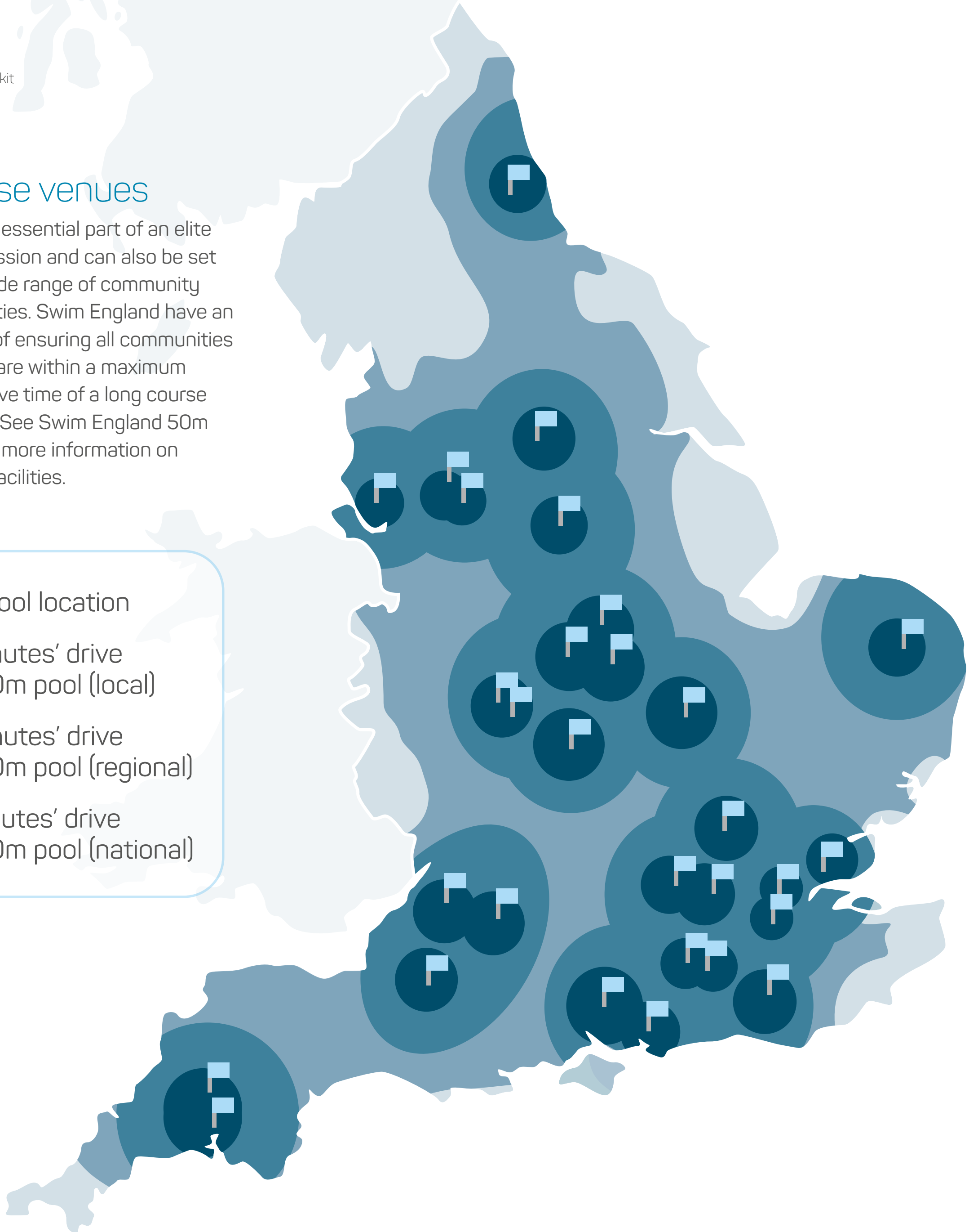
Club Swimming

Ensuring swimming clubs and members have access to facilities in order to train and develop swimmers is an essential part of Swim England's strategy. Our aim is to ensure that communities have access to 25m swimming facilities within no more than a 20 minute drive time. See *Swim England 25m Pool guidance* for more information on 25m community facilities. In order for those swimmers to develop we must also have facilities capable of enabling them to compete at various levels, these pools are what we refer to as competition pools which have the capability of hosting galas and events. Ideally every authority should have the provision of at least one pool that is capable of hosting competitions. These facilities will provide spectator seating (*spectator seating guidance document*), a raised end and incorporate technology such as electronic timing within the build. Regional competition facilities should follow the *FINA facilities rules guidance*.

Credit: Robert Limbricks/Sandwell Council

Long course venues

50m pools are an essential part of an elite swimmers progression and can also be set up to provide a wide range of community access and activities. Swim England have an ambitious target of ensuring all communities have access and are within a maximum of a 70 minute drive time of a long course competition pool. See Swim England 50m Pool guidance for more information on developing 50m facilities.



Water Polo

When considering if there is a need for a facility to be inclusive of water polo consultation with clubs and users of such facilities must take place in order to aide in identifying a significant demand. Although Swim England do not set travel distances or locations on facilities capable of hosting water polo we do aim to ensure each region has access for this discipline within facilities, this should be considered when developing new and refurbished facilities.

Water Polo Pool Configuration – FINA Standards

Field of play: The distance between the respective goal lines shall be 30.0 metres for games played by men and 25.0 metres for games played by women. The width of the field of play shall be 20.0 metres. The depth of the water shall be nowhere less than 1.8 metres, preferably 2.0 metres. Exception may be allowed on the discretion of the federation controlling the match.

The water temperature shall not be less than 26 degrees plus 1 degree minus 1 degree Centigrade and the light intensity shall not be less than 600 lux.

A ceiling height of 5.0 metres is usually sufficient, but there may be the occasion where a ball does rise above this height due to deflection from the cross bar of the goal or another player.

Although it is unlikely to be travelling at great speed at this height, the ceiling and the fixtures and fittings should be designed so they are not susceptible to damage easily from this type of activity.

Water Polo Pools for Olympic Games and World Championships

Exceptions from the field of play requirements are not allowed and competition generally only takes place in the 50.0 metre pools with the correct depth profile. The water temperature shall not be less than 26 degrees plus 1 degree minus 1 degree centigrade and the light intensity shall not be less than 1500 lux.

Markings and goals

Distinctive marks shall be provided on both sides of the field of play to denote the goal lines, lines 2.0 metres and 5.0 metres from that line, and half distance between the goal lines. These markings shall be clearly visible throughout the game.

As uniform colours the following are recommended for these markings:

Goal line and half distance line – white

2.0 metres from goal line – red

5.0 metres from goal line – yellow

A red or other visible coloured sign shall be placed on the end of the field of play 2.0 metres from the corner of the field of play on the side (opposite to the official table). The boundary of the field of play at both ends is 0.3 metre behind the goal line. The minimum distance from the goal line to the pool wall shall be 1.66 metres.

Sufficient space shall be provided to enable the referees to have free way from end to end of the field of play. Space shall also be provided at the goal lines for the goal judges.

Goals: The goal posts and crossbar must be of wood, metal or synthetic (plastic) with rectangular sections of 0.075 metre, square with the goal line and painted white. The goal posts must be fixed, rigid and perpendicular at each end of the playing space, equal distances from the sides and at least 0.3 metre in front of the ends of the field of play or of any obstruction. Any standing or resting place for the goalkeeper other than the floor of the pool is not permitted.

The inner sides of the goal posts must be 3.0 metres apart. The underside of the crossbar must be 0.9 metre above the water surface when the water is 1.5 metres or more in depth, and 2.4 metres above the bottom of the pool when the depth of the water is less than 1.5 metres. Limp nets must be attached to the goal fixtures to enclose the entire goal space, securely fastened to the goal posts and crossbar and allowing not less than 0.3 metre clear space behind the goal line everywhere within the goal area.

As permitted by FINA Swim England agree to compromise for low level competition and training.

Ideally Water Polo should be played in pitches with a minimum depth of 1.8m however Swim England have determined that low-level training and competition can take place in conventional 25m x 10m pool, with depth of 0.9m to 1.8m.

For low level competition the water polo pitch goal and side lines including goals 0.75m in depth provides a 23.5m pitch between goal lines; with the side lines suitably coloured to outline the goal line and half way – white, 2.0m from the goal line red and 5.0m from the goal line yellow.

Artistic Swimming

When considering if there is a need for a facility to be inclusive of artistic swimming consultation with clubs and users of such facilities must take place in order to aide in identifying a significant demand. Although Swim England do not set travel distances or locations on facilities capable of hosting artistic swimming we do aim to ensure each region has access for this discipline within facilities, this must be considered when developing new and refurbished facilities.

Artistic Swimming Pool Configuration – FINA Standards

Figure section: For the figure section of competition two areas each 10.0 metres long by 3.0 metres wide are to be provided. Each area is to be close to a wall of the pool with the 10.0 metres long side parallel to and not greater than 1.5 metres from the pool wall. One of these areas is to be of 3.0 metres minimum depth and the other area is to be of 2.5 metres minimum depth. The areas for figure competition can occupy the same area of the pool as that used for routine competition.

Routine section: For the routine section of competition a minimum area of 12.0 metres by 25.0 metres is required, within an area of which 12.0 metres by 12.0 metres must have a minimum depth of 3.0 metres. The depth of the remaining area shall be 2.0 metres minimum.

Where the water depth is more than 2.0 metres, the depth at the pool wall may be 2.0 metres and then sloped down to reach the general depth at 1.2 metres maximum from the pool wall.

If there are no lane markings the floor of the pool must be marked with contrasting lines in one direction, following the length of the pool.

What this means is that the majority of conventional configuration 25.0 metre swimming pools cannot accommodate artistic swimming at FINA competition standard. The only swimming pools that have sufficient surface area to accommodate the larger of the areas, the Routine Section are 50.0 metre swimming pools and 33.3 metre swimming pools by six lane or more.

Pools for Artistic Swimming in Olympic Games and World Championships

For the routine section of competition at Olympic Games and World Championships a minimum area of 20.0 metres by 30.0 metres is required, within which an area of 12.0 metres by 12.0 metres must have a minimum depth of 3.0 metres. The depth of the remaining area shall be 2.5 metres minimum. The sloped area from 3.0 metres depth to 2.5 metres depth should be over a minimum distance of 8.0 metres.

The light intensity shall not be less than 1,500 lux to accommodate television.

Credit: Robert Limbricks/Sandwell Council

Diving

When considering if there is a need for a diving facility consultation with clubs and users of such facilities should take place in order to aide in identifying a significant demand. Although Swim England do not set travel distances or locations on diving facilities we do aim to ensure each region has access to quality dry and wet diving facilities, this must be considered when developing new and refurbished facilities.

When electing to include diving whether diving platforms are to be sited into the deep end of the main swimming pool or sited into a pool exclusively for diving the depth and spatial specification must conform to FINA Rules if intended for competition and if not being used for competition depth and spatial specification must be safe to use, which suggests that they will not vary significantly from FINA Rules (See *FINA Rules PDF*). Any variations of depth and spatial distances, heights, widths etc. must be subject to a risk assessment that explains the logic of the dimensions variations.

FINA Diving Specifications

The depth of the diving pool or diving pit is determined by the height of the highest diving platform or spring board and the depth requirement at the plummet.

FINA preference is for the synchronised boards to be adjacent to each other, with no intervening platforms. *Link Document.*

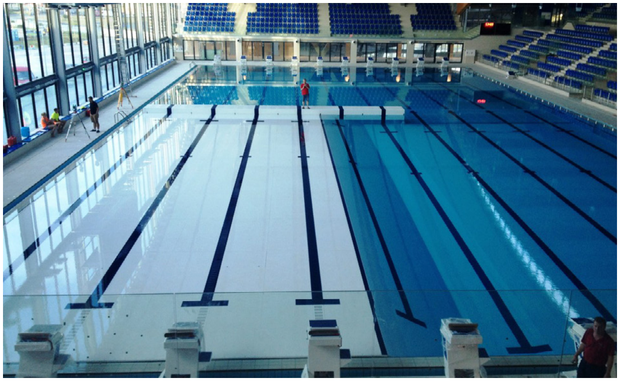
Although FINA only refers to the greater width of the 10.0m platform for synchronised platform diving, Swim England prefers the width of the 7.5m, 5.0m and 3.0m platforms to reflect the 3.0m width.

The configuration of a diving pool or diving area in a main pool limits its use in relation to wider community use and it is for this reason that Swim England recommends the installation of a moveable floor in diving areas so that the programming of this area is more flexible and with the moveable floor raised the area can be used for shallow and deep water swimming lessons, exercise in water, fitness swimming etc.

Credit: Robert Limbricks/Sandwell Council

Flexible Pool Space

Facing a decline in the number of pools due to the ageing of pool stock, even with investment it is likely we will see a reduction in the amount of water space available in local areas. Financing restrictions may result in building the number of pools or types identified through an SOPG process unachievable, therefore you may face the reality of building back fewer pools or in some cases pools of smaller size. Therefore the water space you do provide in new facilities is critical and the flexibility of that water space to provide for communities is essential. Moveable floors and bulkheads are not new to the industry and we have been equipping pools with these technologies for over a decade now. Their ability to enable a pool programme to provide for a wide array of users and programmes still exist and are an essential element of developing the brief for the right pool. The cost of the moveable floor can be significant therefore its inclusion or exclusion should be well thought through comparing the programme opportunities between a fixed pool floor and a variable one.



Credit: Variopool

Moveable floors have advanced in recent years and the capability of latest floors to split into two depths increases the flexibility for pool providers and ability to host varying activities and levels of swimmers ability in one pool tank at one time.

Outdoor Pools

The supply of outdoor swimming pools known collectively as Lido's should also be considered when undertaking an analysis of swimming facility stock within a region or local authority. The popularity of these facilities is increasing and consideration should be made to how they can contribute to the supply of available water space. Historically it has been difficult to account for this water space due to the seasonality at which they operate rendering them inaccessible during certain periods of the calendar year. However recently these facilities have been found to operate for the majority of the year and in some cases they are open indefinitely throughout the year. Therefore more detailed analysis needs to be undertaken as to the water provision available and the accessibility of it within Lido's. Furthermore building new Lido's is also becoming increasingly common and Swim England has supported and number of these projects and would therefore encourage you to contact us if this type of provision is under consideration.

Leisure Water

We also recognise the importance of leisure water and the benefits it can bring to any facility. Leisure water is a great asset to a facilities ability to generate income whilst also providing an environment for getting people active in water and having fun. It can often be the introduction to aquatics and can lead on to learn to swim.

Developing a design brief

Having now completed a strategic definition for the project your next step is to establish a design brief, this will enable you to then undertake feasibility studies and move to the next step of concept design. The brief is critical in ensuring your project meets the strategic outcomes of the insight gathered from the communities your facilities will serve. Swim England facilities as a funded partner of Sport England provide support and consultancy to all public leisure projects in England during this stage.

Further developing the brief

The briefing stage of a project is a key element of the overall design process. The process can often be rushed, however a well-defined brief can provide a solid platform for a building design with buy in from all key stakeholders from the outset.

As outlined above, the SOPG will outline the overall requirements of water area needed in a particular facility alongside the key user groups. These two aspects are integral to the overall brief however there are many other elements to take into account to produce a robust high-performance brief for wet leisure zones.

The key aspects to be discussed and agreed are:

Flexibility: There are many ways to provide flexibility to ensure it can be utilised by the maximum number of user groups. Moveable floors can provide variable depth pools for varying activities, including split floors providing two depths in the same tank.

User groups: Highlighted by the SOPG, each of the key user groups should be identified and their individual needs discussed from an operational, cultural and spatial requirements point of view to ensure the facilities match their requirements.

Activities supported: How the pool is to be utilised including any primary and secondary uses should be clarified. Be it lane swimming down to inflatable leisure uses.

Required adjacent facilities: A number of key adjacent facilities should be identified and included as part of the area schedule.

> **Changing provision** - areas are based on the overall water area and usage and typically include unisex cubicle provision (single, double and family sized), group changing rooms for schools and groups, WC and pre and post shower provision, accessible change and WC provision.
>
> **First aid room** – a standard requirement under Sport England guidance and best practice to include in all schemes.
>
> **Pool storage** – required for all wet facilities. Single large store or can be split based on needs.

Potential adjacent facilities: Dependent on the overall brief the adjacencies of spaces should be agreed from an operational and functional point of view. These include:

> **Additional pool areas** – the adjacencies of pools and the spaces between is a key design parameter. As is the location of deep water in relation to access for safety.
>
> **Leisure pool/water confidence zones** – the extent and location of these zones is key to ensure the safety of those using them.

Connectivity: The connections between each of the brief requirements should be discussed and agreed in principal at an early design stage.

Key inclusions and exclusions: should be discussed and agreed. Including the need for raised ends, timing pads, spectator and competitive seating.

Look and feel: The importance of this element should not be underestimated at the early design stages. Do the client require a black box, artificially lit space or is the inclusion of natural daylight integral to the design.

Community Leisure Hub

Community Leisure Hub and Leisure Local describe concepts that can be fine-tuned to suit the individual features of a particular location and at the same time promote the benefits of physical activities. The documents provides examples of carefully considered options for local community leisure provision. The intention is that the facility mix provides an acceptable level of quality and flexibility in design that responds to the needs of customers and specific local circumstances.

Active environments

An active environment might be a building with places and spaces dedicated to sport and physical activity; it might be an outside space with a green gym or playing pitch or simply space in which to run around or exercise outdoors. Active environments may combine indoor and outdoor places; they should facilitate informal and formal inclusive opportunities, to be more engaged with physical activity. Ideally they will connect into cycle/walking routes so active travel becomes part of the active environment.

Refurbishment

Replacing aging unsustainable stock is one way of solving the future decline of available swimming pools, however refurbishment is another option. It is often feasible to refurbish the building envelope, pool tank and environment to create a sustainable fit for purpose facility , refurbished to modern standards capable of providing water space for years to come. Please contact Swim England facilities for further support on refurbishing facilities.

Credit: DB leisure

Credit: DB leisure

Typical facilities

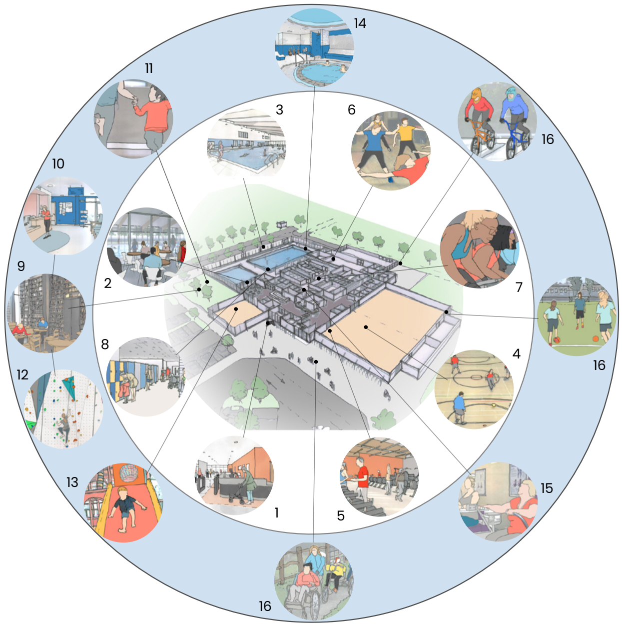
The core elements in the examples illustrated include:

- Reception hub 1
- Water space (pool and fun wet area) 3
- Fitness suite 5
- Changing rooms and accessible WC provision 8
- Flexible activity space 11
- Health suite 14
- Plant room (not shown on diagram)

The options could be enhanced with a range of other potential facilities that could include:

- Social space (inc. cafe) 2
- Movable pool floor 3
- Multi-purpose hall/studio hall 4
- Studios 6
- Group cycle 7
- Public library/resource 9
- Public healthcare facility 10
- Climbing facility 12
- Adventure play/childcare 13
- Toning suite 15
- External activity space and community links 16
- Fitness and cycle trails. (not shown on diagram)

[3] https://www.sportengland.org/how-we-can-help/facilities-and-planning



Both Community Leisure Hub and Leisure local documents are available to download via the Sport England Website and contain further details on these concepts including information on the following:

Environmental design:

- Planning/Building Regulations
- Climate Emergency
- Methods towards more sustainable buildings
- Energy and carbon neutral reducing technologies

Financial viability

- Capital cost
- Life Cycle Costs
- Operation
- Typical usage breakdown
- Income/Revenue Assumptions

Going green

Heat pumps

Heat pumps are not new, they have long been used to generate heat and to provide air conditioning. In more recent times they have been used as replacements for boilers, in generating hot water to use for space heating and generating domestic hot water.

Heat pumps are electrically driven and convert 1 unit of electricity to between 2 and 5 units of heat. It's this performance that makes them attractive, they use less energy than gas boilers.

In recent years, the amount of carbon generated from 1 unit of electricity has reduced significantly, due to the amount of wind turbines and solar panels the country now uses to generate electricity. This means they produce signficantly less carbon than equivalent gas boilers.

The downside is that currently electricity is five or six times more expensive than a unit of gas. Where heat pumps generate 3 units of heat to each unit of electricity, but electricity is six times more expensive than gas, the cost to run heat pumps can be double that of gas. What will happen in future in terms of fuel costs, is speculation.

What we do know is the amount of carbon generated from producing electricity will continue to fall, as more and more electricity is generated from carbon free sources, this is why heat pumps are seen as a key element in decarbonising.

There are several different types of heat pumps, but the most common and cheapest are air source heat pumps. They take heat from the air and covert it to hot water. The peak efficiency is seen at the lowest water temperatures, with around 50C seen as the optimum temperature. Generating water at higher temperatures to that, will result in reduced efficiency and hence higher running costs and carbon emissions.

Most existing heating systems use water from boilers at 80C, so replacing a gas boiler with a heat pump can be problematic, as the heat emitters will not give off the same amount of heat. It may be necessary in such circumstances to replace all the heat emitters, or maybe use gas boilers to supplement the heat pumps.

A similar issue is also seen when generating hot water for showers. To reduce the risk of legionella, hot water must be stored at 60C, so traditional air source heat pumps can't do this efficiently.

Recent developments in heat pump technology have seen heat pumps which use CO2 as a refrigerant, these can generate water at 80C and still have high efficiency, but they are expensive and add complexity to the design. They are also only suitable for generating domestic hot water and not to use in conjunction with radiators.

Ground source heat pumps are similar to air source, but have slightly better efficiencies. They extract heat from the ground, by passing water through pipes in the ground. Because ground temperature is generally higher than air temperatures (especially in winter when most heating is needed) , there is more heat available, hence they are more efficient.. They are though very expensive, as the cost of either excavating, or drilling deep boreholes is an expensive activity.

In summary:

Traditional air source heat pumps are good at heating modern new buildings, but not good for generating domestic hot water.

Heat pumps which use CO2 are great at generating domestic hot water, but are expensive and not good for heating the building.

Ground source heat pumps provide great efficiency, especially for heating, but are expensive to run and depend greatly on the ground conditions of the site.

It is likely that compared to using gas boilers to produce heat and hot water, heat pumps will be more expensive, but significantly reduce carbon emissions.

Ceramic microfiltration

Introduction

Microfiltration is a physical filtration process where a contaminated fluid passes through a specific pore sized membrane, to separate out microorganisms and suspended particles. Microfiltration has been used across all engineering and manufacturing industries for over 30 years, but only introduced to the European swimming pool market approximately 10 years ago.

The most common material used for microfiltration system membranes is Ceramic, or Recrystallised Silicone Carbide (R-SiC). This material is perfectly suited to the harsh and aggressive fluids passed through the membrane and can cope with extreme temperature ranges. The membrane material has a controlled and test porosity level, designed to capture suspended particulate >4 microns.

Technical overview

This filtration process is considered to be more effective than traditional media bed filtration systems. Based on a honeycomb structure of the material, the membranes provide a large filtration area, up to 20x that of media bed filtration vessels. The filtration rate through each membrane is slow (approximately 1.5m3/m2/hr) which contributes to an improved filtration process. This technology is therefore very effective in the fight against Cryptosporidium (99.996 per cent removal first pass).

A microfiltration system is typically modular, with each membrane filtering a maximum flowrate (15m3/hr). The membranes are mounted within chambers and fixed to a frame, containing all pipework and control valves, collectively achieving the design flowrate of your pool system. As a modular design, the system can be delivered to site as a complete unit (pre-tested and commissioned) or it can be broken down into component parts, for existing sites with restricted access.

Water is pumped through the membranes and particulate >4 microns are collected within the pores of the material. The pressure differential across the system is monitored (digitally) and when the membranes reach a pre-set pressure parameter, the system will automatically enter a washing process.

This involves isolating membranes (either singular or pairs), blasting high pressure air through the membranes to dislodge all particulate, then flushing with a small amount of water to discharge the particulate from the membrane chamber. For systems with multiple membranes, the pool will remain fully operational during this washing process, as membranes are isolated whilst other membranes remain in filtering mode. On a busy public pool, this washing process would typically occur four to six times per 24 hour period.

After a period of four to six weeks, with the daily washing process described above may not be returning the membranes to their original clean state. This would be due to a build-up of greases and biofilm in the material pores. A clean in place process will therefore initiate, which soaks the membranes in strong detergent.

All of the filtering, washing and cleaning processes are fully automatic, which is a significant benefit over traditional media bed filtration systems. All valves are fully automatic and software in the control panel can be remotely viewed, controlled and adjusted. The automation and digital instrumentation provide operators will performance data that isn't available with manual systems. Data tags are gathered from the control software, analysed, and presented in graphical form to the operator, enabling the system to achieve optimum efficiency on water quality and energy consumption, depending on bathing loads.

Construction advantages

For new build projects incorporating this technology, there are a number of key advantages over media bed filtration systems:

1. The skids units have a smaller footprint and do not require large access routes for future replacement (as required with large sand filters). The potential footprint reduction is up to 40 per cent and smaller structural openings are required for initial delivery.
2. Traditional media bed filters require a minimum clear plantroom height of 3.5m. Microfiltration system only require 2.8m, which can reduce construction costs particularly with basement plantrooms.
3. A large reservoir of water is not required for backwashing; on level deck pools, the balance tanks sizes can therefore be reduced significantly (up to 60 per cent).
4. Related to item three, media bed filtration requires a high flowrate drainage infrastructure and attenuation of large volumes from backwashing. This is not required with microfiltration; the maximum flowrate is 20ltrs/second, but only for short bursts of three seconds per membrane.

Sustainability

The slower filtration process described above equates to a reduction in friction losses through the system. A media be filtration pumping system would typically be designed to 16-18m head (whole system). Microfiltration systems are designed to 10-12m head. In addition, media bed filters are generally backwashed once per week, with the pressure (and pumping power) increased as the filter gets dirtier. The regular automated washing process on microfiltration also ensures that these pressures are lower. The resultant reduction to absorbed power consumption is therefore approximately 40 per cent, which is a significant potential saving for the life of the building.

The key objective with any public swimming facility is to achieve optimum water quality for bather comfort at all times; this must not be compromised. There are a lot of factors to consider in achieving good water quality, one of which is dilution, which is necessary to keep Total Dissolved Solids (TDS) levels under control. The UK recommended dilution rate (based on media bed filtration systems) is 30ltrs/bather. Water is discharged from the system through filter backwashing, evaporation and natural losses from the pool tank. As stated above, microfiltration uses less water for the washing process, but it is still imperative that the pool is adequately diluted. Based on the improved filtration efficiency, which contributes to lower TDS levels, the dilution rate could be as low as 15ltrs/bather. Water quality must be maintained, but there is an opportunity to therefore reduce water consumption, heat consumption and chemical usage with microfiltration systems.

Based on the above sustainability benefits, microfiltration is specified by the Passive House Institute, to meet their certification on swimming pool projects.

Steel as a greener alternative

Steel can be a viable alternative to concrete, the following review was undertaken by an independent panel to compare the carbon emissions between concrete and steel pool tanks.

The scope included lifecycle stages from cradle to handover according to EN-15804: Raw material supply (A1), transport (A2), manufacturing (A3), transport to site (A4), installation process (A5). The Embodied carbon coefficients are obtained from transparent and reliable sources where available, established using the same protocol in order to fairly compare. Assumptions have been made where specific material coefficients were unavailable, in which case coefficient were based on materials of comparable composition.

As a comparison, the embodied energy attributed to the construction of an Olympic sized 50m steel pool is approximately 46 per cent less when compared to that of a concrete and tiled pool of the same size. The same comparison for a 25m 10-lane pool results in a 45 per cent reduction in embodied energy again using a steel pool. Details of the assessment are included in the table below for a 25m swimming pool.

Embodied energy calculation - Comparison Myrtha versus Concrete - 25M Pool

pool type: 25m x 25m x 2m pool			MYRTHA			CONCRETE		
Location: Sydney, Australia	Embodied kgCO2eq/ unit	unit	Quantity		Embodied kgCO2eq/	Quantity		Embodied kgCO2eq/
STRUCTURE								
Concrete floor slab	**336.0**	kgCO2/m3	150	m3	**50,486**	174	m3	**58,371**
Concrete pool walls and gutter	**336.0**	kgCO2/m3				131	m3	**43,881**
Reinforcing steel (assume recycled up to 65%)	**2,400.0**	kgCO2/T	12	T	**27,811**	32	T	**76,689**
Stainless Steel Pool walls (incl. butress and gutters)	**3.6**	kgCO2/kg	8999	kg	**32,710**			
Formwork (inclu propping)	**32.0**	kgCO2/m2	26	m2	**840**	463	m2	**14,818**
Waterproofing Sealant	**6.0**	kgCO2/kg				281	Kg	**1,689**
FINISHES								
Tiles to floor	**12.9**	kgCO2/m2				656	m2	**8,492**
Tiles to walls (incl. hob and gutter)	**12.9**	kgCO2/m2	71	m2	**924**	280	m2	**3,624**
Tile adhesives	**6.0**	kgCO2/kg	357	kg	**2,142**	4,682	kg	**28,090**
Epoxy grout	**6.0**	kgCO2/kg	77	kg	**459**	1,011	kg	**6,066**
Polyester resin for gutter	**6.0**	kgCO2/kg				69	kg	**411**
Hard PVC sheet for walls and gutters (0.5mm thickness)	**5.2**	kgCO2/m2	298	m2	**1,549**			
Reinforce PVC floor membrane (1.5mm thickness)	**14.0**	kgCO2/m2	636	m2	**8,897**			
Sealant for Myrtha walls	**6.0**	kgCO2/kg	11	kg	**65**			
Energy required to bond PVC to SS and cut panels	**0.1**	kgCO2/Mj	6700	Mj	**657**			
TRANSPORT								
Total distance over sea	**0.03**	kgCO2/T-Km						
Total distance over road	**0.15**	kgCO2/T-Km						**5,965**
					Embodied kgCO2eq/			**Embodied kgCO2eq/**
GRAND TOTAL					**136,770**			**248,096**
COMPARISON %			Reduction		**45%**			

1. Recycling

The recycled content is the proportion, by mass, of pre- or post-consumer recycled material in a product. Recycling reduces the impacts on the environment resulting from extraction and processing of virgin materials.

The walls in a steel pool system provided by Myrtha pools consist predominantly of stainless steel. Due to the inherent value of stainless-steel as scrap, and the efficiency in which it can be recycled, stainless steel recycling has been in existence for many years. The stainless steel used to fabricate the pool walls' panels, gutters, and buttresses contain up to 65 per cent recycled content. Although to a lesser extent, the PVC used for the waterproofing of the pool walls and floor, and the ceramic tiles used for the pool edges, contain a proportion of recycled content as well.

2. Design for disassembly and adaptive re-use

Design for disassembly and re-use is a holistic approach in which buildings are designed from the outset for ease of disassembly, with as goal to promote re-use of components at the 'end of life' stage. The construction industry is actively exploring initiatives for a circular future, where building materials keep circulating at their highest value. In this approach, the additional value of the labour and energy invested in the making of the individual component is retained.

3. Modular design and offsite fabrication

As a modular system, the steel pool components are fully fabricated offsite and installed by a specialist installation team. This not only practically eliminates the material waste on site, but also significantly minimizes the rework due to defects during construction. The steel panels are fabricated and installed to meet the rigorous tolerances required for competitions, eliminating the need to use additional material to achieve dimensional accuracy, as required for concrete pools.

The panels and components can be handled by two people, reducing the need for heavy machinery or cranes for assembly of the pool walls. The assembly method reduces time and energy used for onsite construction. The reduced weight and size of components leads to advantages in terms of site access.

4. PVC

The steel Pool system provided by Myrtha uses a durable PVC membrane to provide the effective waterproofing technology for the swimming pool body. The embodied energy calculation shows that the PVC membrane has a significantly lower embodied energy when compared to a tiled finish of a concrete pool.

(The carbon emissions comparisons in this study do only apply to Myrtha panel pool systems)

Enhancing the building (passivhaus)

The UK's first passivhaus swimming pool and leisure complex is due to open early 2022 however the passivhaus standard has been going for over a decade. It started with a housebuilding programme and more recently, developed a supported-care housing scheme using the methodology. The passivhaus Institute, which is the certifer will also monitor new projects extensively when they are operating, with the results used to inform a new passivhaus standard for UK leisure centres.

For passivhaus accreditation, the total primary energy demand – including space heating, hot water, cooling, ventilation and electrical loads, including lighting – is 375kWh/m2 per year.

Energy Targets:

- Space heating demand for the pool hall of <40kWh.m2 per year
- Space heating demand for all other areas of <20kWh.m2 per year
- Gym cooling demand <22kWh.m-2 per year
- Pool water heating demand <73kWh.m-2 per year
- DHW heating demand <56kWh.m-2 per year
- Total electricity demand (ventilation, lighting, appliances, pool water treatment and circulation <120kWh.m-2 per year

The principles of passivhaus can still be applied without a requirement to obtain certification, with the simple principle of reducing CO2 emissions and making our pools more sustainable.

CASE STUDY

Spelthorne Leisure Centre

The scheme will be one of the first certified passivhaus wet and dry sport and leisure facilities in the UK, contributing towards the borough's zero-carbon objectives, and using the principles of inclusive design to ensure long-lasting community value.

Project Details:

Name: Spelthorne Leisure Centre

Location: Spelthorne, Staines-upon-Thames

Status: Live

Client: Spelthorne Borough Council

Value: £32 million

Universal Design meets Sustainability: The UKs first passivhaus-certified wet and dry leisure centre.

Overview:

Supported by a forward-thinking council, Spelthorne Leisure Centre is a cutting-edge, exemplar community hub, located in the centre of Staines-upon-Thames.

The scheme will be one of the first certified Passivhaus wet and dry sport and leisure facilities in the UK, contributing towards the borough's zero-carbon objectives, and using the principles of inclusive design to ensure long-lasting community value.

The state-of-the-art leisure centre includes an eight lane 25m Pool, four lane 20m teaching pool (with a moving floor), splash pad, large café connecting with adjacent Staines Park, luxury spa, six court sports hall, three squash courts, two studios (plus state-of-the-art spin studio), 200 station gym, climbing zone, soft play area, flexible multiuse space, four rooftop 3G pitches, rooftop community garden space, and cycle trails to connect to the local park.

The overall design has been optimised to meet the strict targets set by the Passivhaus Institute, which will reduce operational energy usage by circa 80 per cent. Additionally, careful material selection informed by building biology principles, ensures a comfortable and healthy indoor environment for all end-users and staff.

The multi-zoned, complex nature of the project demonstrates the industry's capability to reduce carbon and energy demand across complex sport and leisure facilities and is leading the way for a new wave of sustainable sport and leisure facilities in the UK.

> The passivhaus certified design methodology created for Spelthorne Leisure Centre will result in energy savings of 50-60 per cent compared to standard facilities, with an additional water saving of between 40-50 per cent.

What?

In November 2017 Spelthorne Borough Council appointed GT3 as the design team to undertake a feasibility study to better understand the viability of replacing the existing Spelthorne Leisure Centre with a brand-new facility. The aim was to look at the fundamental role sport and leisure plays in the health and wellbeing of the community, an objective which was further prioritised during the Covid-19 pandemic.

CASE STUDY

GT3 Architects' Performance+ brief writing and engagement process was used and a Vision Workshop undertaken with Council Officers, the incumbent operator, and community members, to crystallising the aspirations and expectations of all stakeholders. The emerging brief was then further developed to capture public engagement and stakeholder comments, with the team consulting with local individuals, sports clubs, junior groups, disability user-groups, and wider community groups, to ensure the differing requirements and aspirations of the community were incorporated. The resulting design and facility mix centres around delivering a welcoming, accessible, and inclusive community hub, which will support the needs of both the council and the local community for years to come.

Whilst Sustainability aspirations played a key part in the above brief, initially Spelthorne Leisure Centre was aiming for BREEAM excellent certification. However, when the council declared a climate emergency in 2020, the council, along with design team, decided passivhaus was the only certification comprehensive enough to demonstrate a sufficient commitment to sustainability challenges.

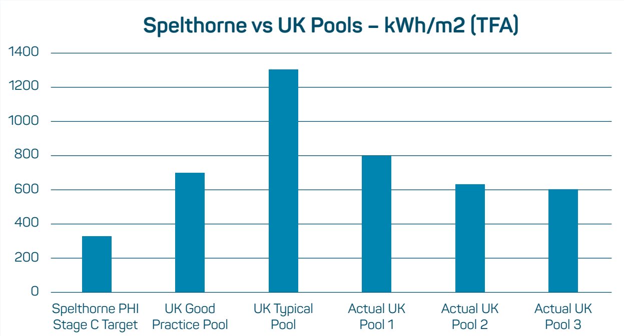
Spelthorne Leisure Centre was subsequently the catalyst for the creation of new standards and guidance for leisure and fitness facilities – which are inherently high energy users – offering a new and advanced way of ensuring this complex sector supports Net Zero targets.

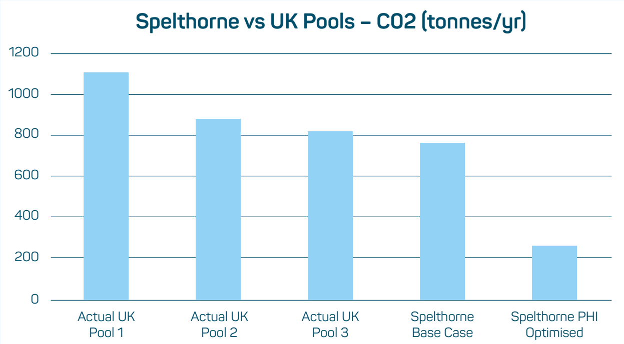
Why?

Standard leisure facilities are high energy consumers and can be prone to comfort and overheating issues. Thanks to complex facility mixes, multi-use environments, and varied operational times, a standard UK leisure centre facility needs:

- Temperatures to be maintained at high levels with plant operating continuously 24 hours a day, 365 days a year.
- Space heating and hot water loads to be higher than any other building type.
- Electrical energy demand is high due to pool water filtration processes, fan power, and pump power loads, plus fit-out items such as gym and catering equipment.

Of all building types, applying passivhaus compliance to sport and leisure facilities therefore makes the most sense. The project was already in Stage 3 when the climate emergency was announced, so the design team needed to work together to revise the information and translate the multi-faceted needs of a varied community into a sustainable and carbon friendly design, compliant with passivhaus Institute Standards. The design was approved by the passivhaus Institute and (as of February 2021) Stage 4 was completed. Spelthorne Leisure Centre has recently been approved for construction with opening in 2023/2024.





CASE STUDY

How?

Design Team Approach:

A Vision Workshop was undertaken with Council Officers, the incumbent operator, and community members, to understand, articulate and illustrate all visions, values, objectives and aspirations, and the emerging brief was further developed to capture public engagement and stakeholder comments. This brief set the tone for, and ensured all stakeholders were clear on the outcomes and aspirations for the project.

The design method then looked at all the key energy drivers; fabric, space heat, pool water, DHWS, cooling, filtration, lighting ventilation and fit out items. By reviewing the aspirations of stakeholders and local community, and using passivhaus and building biology techniques, the design team were able to develop a flexible and inclusive facility, which will act as an exemplar project for achieving both health and wellbeing and sustainability objectives.

During construction and as part of the certification process, there will be a rigorous methodology of quality control and checking to prove the thermal performance criteria of the design has been implemented.

Spelthorne design at stage C was optimised to follow the passivhaus methodology. Bespoke energy targets are to be further refined by the PHI design team.

A carbon analysis was also carried out for the Spelthorne scheme which included an analysis of all energy drivers within the facility. Items that are omitted in the building regulations such as unregulated fit out items (gym equipment, display screens, care equipment, office equipment etc.) and pool filtration was included.

Technical collaboration:

Initially, Spelthorne Leisure Centre didn't have passivhaus targets, only BREEAM excellent was set as the project brief. When the council declared a climate emergency in 2020, the council, along with design team, decided that the passivhaus was the way forward which had a greater emphasis on energy reduction than the BREEAM target.

A passivhaus certified design methodology for Spelthorne will result in energy savings compared to standard facility of 50-60%. In addition, the added water saving features will support those already proposed by the design team to ensure 40-50 per cent water savings.

When the implementation of passivhaus Standard was decided the project was already in Stage 3. The design team, along with Gale and Snowden passivhaus consultants revised the Stage 3 information to ensure the design is compliant with the passivhaus institute standards. The design was approved on the design information to date by the passivhaus Institute, and currently (February 2021) Stage 4a has been completed.

A number of key design changes were adopted to ensure maximum efficiency of the design in line with the certification criteria, while still adhering to the aesthetic that had been previously presented to the public at consultation. Primarily, the orientation of the pool hall was changed to due south to maximise solar gains, and the thermal envelope performance increased to perform substantially better than current UK building regulations. The Mechanical and electrical strategy was also revised to maximise a balance between efficient systems and optimal comfort internally.

Energy Performance Targets	
Space Heating demand (Pool Hall)	23 (kWh/m2TFA/year)
Space heating demand (all other areas)	15 (kWh/m2TFA/year)
Total Useful Cooling demand	5 (kWh/m2TFA/year)
Pool Water Heating demand	42 (kWh/m2TFA/year)
Domestic hot water demand	0.7 (kWh/year/per person)
Total electricity demand	32 (kWh/m2TFA/year)
(all lighting, ventilation, applications, pool water treatment and circulation)	94 (kWh/m2TFA/year)

CASE STUDY

Building Envelope performance values U-value limits and air tightness	
External walls	≤0.128 (W/m2K)
Roof	≤0.100 (W/m2K)
Floor Slab	≤0.150 (W/m2K)
Thermal separation between zones of ≥4K	≤0.300 (W/m2K)
Curtain wall framing Glass Spandrel panels	≤0.90 (W/m2K) ≤0.60 (W/m2K) ≤0.15 (W/m2K)
Doors	≤0.85 (W/m2K)
Thermal Bridging	fRsi ≤ 0.70 (generally) fRsi ≤ 0.80 (Pool Hall)
Air Tightness	q50 ≤ 0.4 m3/h/m2

Key sustainability features:

Pool zones

- Orientation of pool hall amended so that pool halls face due south.
- Pool hall divided in to two zones with two separate AHUs systems, allowing for the temperature in each zone to be controlled separately, to reduce pool water evaporation and energy consumption associated with pool water heating and ventilation loads.
- Review of air distribution strategy in the pool halls for passivhaus optimisation – low level extract, high level supply.

Internal thermal zoning

- Hot/cool zones have been thermally separated such as fitness suites/studios/sauna cabins/offices. Including changing room from the pool hall.
- Fitness suite and studios (cool zones) positioned to the south of the building due to layout constraints, increased solar shading and glazing reduced, where orientated on high solar gain façades.
- Allowance in design for Passivhaus insulation levels in walls, floors, and roof and between zones. Glazing and doors upgraded to Passivhaus required levels for U values, thermal and air tightness.

Air tightness

- Air tightness will reduce the risk of warm moist air migrating into the fabric due to unwanted infiltration thus protecting the fabric.
- Air tightness will reduce heating energy associated with cold air penetrating the fabric and it will greatly improve comfort.
- Required target: q50 ≤ 0.4 m3/h.m2 AHU systems.
- Sports hall ventilation of roof terminals changed from natural ventilation to AHU in winter.
- Separate AHU systems required for all internal thermal zones.
- Specific energy targets adopted for fan power Optimised Wet Systems distribution.
- High efficiency prime heating and cooling plant with optimised pipework distribution design (to reduce pressure losses) coupled with variable speed inverter driven pump sets.

Optimised DHW

- Hot water demand to be reduced by flow restrictors limited to 6 litres/min on all fittings complete with run on timers.

Pool Filtration

- Maximum pressure head for pumps 12m and Low pipe velocities 1.0-1.3 m/s to reduce pressure drop. High efficiency pump selection.
- Undercroft introduced – to increase pump efficiency and reduce the need for pipe insulation.

CASE STUDY

Heating and cooling plant/heat recovery

- CHP changed for air source heat pump combined heating and cooling to exchange energy between cooing process to space and water heating (improve COP).
- Water to water heat pump added to pre heat domestic hot water.
- Additional heat exchange process to recover heat from back wash tanks, that would typically go to drain.

Commissioning and monitoring:

The project will be monitored during construction with regular passivhaus construction quality assurance site visits, reports, and feedback to construction team. A final passivhaus compliance report will be completed at Stage 5.

Project/delivery teams:

Client: Spelthorne Borough Council

Lead Architect: GT3 Architects

Passivhaus designer: Gale & Snowden

Project Manager: Gleeds

Cost Manager: F+G

Engineer: Engenuiti, VZDV

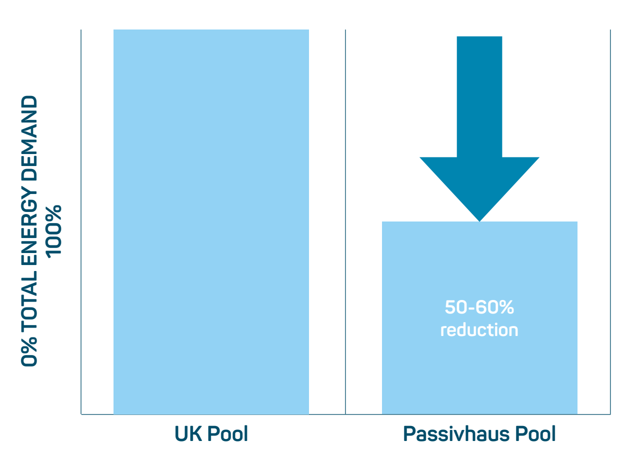
Climate modelling:

Leisure Consultant:

Main Contractor: Willmott Dixon

Certifier: Passivhaus Institute

Other tables/graphs:



Acknowledgements

Swim England would like to thank the following individuals and organisations for their support in the development of this document.

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Report published August 2022

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02234SE 11/22