

# Park & Stannon Lakes Raw Water Resources

South West Water's innovative pumping stations for abstraction of raw water from two flooded china clay quarry pits

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**P**ark and Stannon Lakes lie high up on Bodmin Moor. Both lakes were created by the flooding of decommissioned china clay extraction quarry pits. South West Water (SWW) identified the opportunity to abstract raw water from the pits and acquired the sites from the mine operator Imerys. Abstraction pumping stations have been constructed and are now both operating to deliver flow from the new resources to existing treatment works, helping to put South West Water in a strong position in terms of water resources this summer.



*Stannon Lake in 2007, viewed from the area of foreshore where the abstraction intakes and pumping station have now been constructed. Park Lake is similar in scale and appearance although the side slopes are not as steep (refer to Figure 2) - Courtesy of Hyder Consulting (UK) Ltd*

## Background - previous use of the pits

The sites comprise the lakes, various mica dams, and overburden and spoil tips. The margins of both lakes are predominantly steep softened (kaolinised) granite slopes. Mining ceased in 1996 and 2002 respectively and the pits were allowed to flood naturally. Landscaping, geotechnical and drainage works were undertaken by the mine operator Imerys to stabilise the pit slopes and spoil heaps and encourage natural habitat regeneration.

## Environmental catchment abstraction management strategy

The mid-Cornwall region is heavily reliant on storage within surface water lakes to maintain water supplies during dry summers and periods of peak holiday demand. This is due to its hydrological character - a hard rock area with no significant aquifers and short river systems with flashy flow characteristics. Ground water and off-stream winter filled raw water resources are therefore preferable.

Park Lake is located in the Upper Fowey River catchment where there is limited water available from surface water or river abstraction sources. Stannon Lake lies within the Upper River Camel where there is more surface and river water available, however the River Camel catchment is also a designated SSSI and a cSAC,

which requires competent authorities to promote measures to maintain favourable conservation status, particularly with respect to migratory salmon and sea trout.

Feasibility studies by Hyder Consulting (UK) Ltd and South West Water, and discussions with the Environment Agency (EA), indicated that there was significant potential to use the lakes as off-stream, winter filled raw water resources without incurring any significant detriment.

## Abstraction licences

Abstraction licences for both sites were granted by the EA following a detailed hydrological and hydro-geological analysis by Hyder to assess the effects of abstraction and determine appropriate parameters for abstraction from the lakes. Recharge rates were estimated from the rates at which the pits flooded and hydrological modelling. The potential effect on the adjacent watercourses and ground water table was assessed and found likely to be insignificant, nevertheless it was agreed that it would be prudent to implement a programme of ongoing monitoring of ground water levels and watercourse flows near to the lakes, which has been captured in the licence conditions.

Piezometer boreholes have been sunk at strategic locations to monitor the ground water levels, and flumes and weirs constructed to monitor the flow from the lake overflows and in the adjacent watercourses.

At both sites fish screens have been installed on the overflow spillways from the lakes, to prevent loss of migratory spawning species from the watercourses into the lakes.

The allowable drawdown at Park is 7.5m. At Stannon this is only 3m, due to concerns that the steeper pit sides may become unstable if the lake level is drawn down rapidly or excessively. Small slope failures are known to have previously occurred at Stannon and to mitigate the risk of any turbid water discharging to the stream a stop-log facility is provided at the lake overflow to temporarily contain spills of turbid water should a slip occur into the lake.

### The lakes – resource data

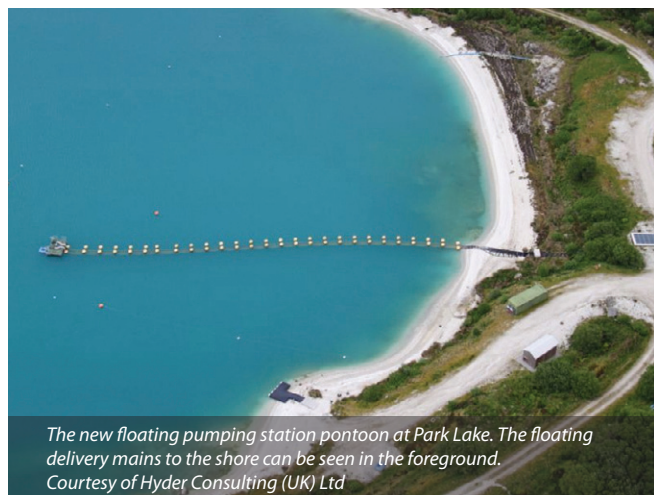
A brief summary of the key data for the new resources:

	Park Lake	Stannon Lake
Gross Storage Volume	7,773MI	8,020MI
Maximum Depth	55m	60m
Top Water Level	225.9m AOD	219.1m AOD
Surface Catchment Area	0.46km <sup>2</sup>	0.45km <sup>2</sup>
Replenishment Rate (observed during initial fill of the pits)	5.88MI/d	3.7MI/d
Long Term Replenishment Rate (based on Hydrological Modelling Assessment)	1.1-3.2MI/d	1.2-2.8MI/d
Allowable Abstraction Rate	139l/s	73l/s
	0.5MI/hr	0.263MI/hr
	8MI/d	4MI/d
	2,920MI/yr	1,464MI/yr
Allowable Drawdown	7.5m	3m

### Water network supply strategy

From a water supply strategy perspective, the pits are very well placed. Park Lake is very close to Colliford Reservoir and the raw water main feeding St Cleer Water Treatment Works (WTW), while Stannon Lake is very close to the raw water main between De Lank and Lowermoor WTWs, which in turn have links to St Cleer WTW. Water from the lakes can be fed to a number of different supply zones in Cornwall.

Other strategic advantages include the scale of available storage, the high elevation locations, and the limited risk of environmental



The new floating pumping station pontoon at Park Lake. The floating delivery mains to the shore can be seen in the foreground. Courtesy of Hyder Consulting (UK) Ltd

impact from construction of abstraction infrastructure given that they are environmentally sterile former china clay pits. The raw water quality is also high and the treatment cost low.

### Design and delivery – project management

The abstraction scheme designs were developed and delivered by South West Water, Hyder, and May Gurney working in partnership under IChemE Green Book Target Cost contracts. Park was completed in 2009 with Stannon completed in 2011.

Hyder were involved from feasibility study through to detailed design and delivery, providing technical and project management services at all stages. Technical specialists from Geotechnical, Hydrogeological, Civil, Mechanical & Electrical and Ecology teams all contributed to the development and design.

May Gurney were involved from an early stage with developing conceptual designs as well as detailed design, and subsequently delivered both schemes as Principal Contractor with the vast majority of civil, structural, mechanical and electrical construction work undertaken using in-house resources.

South West Water's Project Manager Nol Vincent actively led the delivery of both projects; regularly visiting the sites, managing procurement challenges and coordinating the project team to achieve a notably successful partnering spirit between the teams throughout. South West Water handled the legal, conveyancing, public relations and estates issues directly. There were a number of unusual challenges to be overcome, particularly with regard to the ownership, duty of care toward potential users of the sites, quarry decommissioning responsibilities and adjacent landowners.

The schemes were both delivered to programme and budget, with marginal savings achieved on the Park scheme distributed between the partners.

### Detailed design and construction details

**Park Lake** - At Park Lake the abstraction pumping station consists of a catenary chain moored pontoon located approximately 100m offshore. Flygt floating pump modules are attached to the pontoon. The floating arrangement was selected in view of the 7m allowable drawdown, which could only be achieved at this distance from the shore due to the profile of the lake bed. The arrangement is also straightforward to move or alter in the future. Flow is delivered to the shore via 2 (No.) polyethylene pumping mains suspended just below the surface of the lake from mooring buoys adapted for the purpose. Access to the pontoon is via a small safety boat, with pump modules detached and towed to shore if required.

**Stannon Lake** - In contrast to Park, at Stannon the lake bed drops off steeply and the allowable drawdown is only 3m. A shore based pumping station and intake arrangement was therefore feasible,



The floating Flygt pump modules attached to the mooring pontoon at Park. Access is via a dedicated safety boat. The pump modules can be disconnected and towed to shore for maintenance



The intake structure under construction at Stannon

Courtesy of Hyder Consulting (UK) Ltd

allowing unrestricted access for maintenance. Intake pipes reach into the lake supported by a steel intake structure. The intake structure comprises a fixed beam section anchored to a concrete bank seat, with a hinged section reaching out 9m into the lake where the depth is approximately 6m. The end of the hinged section, intake pipework and intake screen baskets are supported on mooring buoys.

Hyder developed the concept and undertook structural and buoyancy design from first principles, with May Gurney's assistance to develop steelwork, pipework and buoy connection details for practicality and fabrication. The structure was assembled on shore and installed sequentially using a mobile crane. The bank seat was precast away from the lake, and all steelwork fabricated offsite, to minimise risk of pollution into the lake.

Godwin HL100M 'Dri-prime' pumpsets with variable speed drives are installed in a below ground pumping station chamber onshore.

The high suction capabilities (up to 8.5m lift) and integral priming systems are required as the lake level can be drawn down as far as 3m below the pump level. The priming systems are fully automated, allowing pump start up to be triggered from a remote location without site attendance.

May Gurney undertook much of the mechanical and electrical detailed design; contributed significantly to detailed design of the abstraction pumping station designs; fabricated electrical panels, steelwork and much of the control building structure. Steel fabrication work was undertaken in-house by May Gurney's fabrication shop in Bodmin; and electrical panels were fabricated and constructed by May Gurney Control Solutions in Hatherleigh.

**Control strategy**

Pumps and instrumentation are fully integrated via ADSL (broadband) telemetry link with South West Water's regional SCADA (Supervisory, Control and Data Acquisition) system, allowing remote visibility of the site status and triggering of pumping. At both sites automated instrumentation and sampling systems are used for monitoring of water quality and flow rates. The control philosophy and provision of instrumentation was developed and refined collaboratively by the team. Hyder facilitated an independent review of business and process risks to SWW.

**Pumping mains – design and construction**

Both sites are connected to existing raw water mains by approximately 1km of new 300/400mm dia main. PAM St Gobain cement mortar lined ductile iron water pipe was used at both sites, with PAM anchored joints at bends for thrust restraint. May Gurney laid pipeline in accordance with strict internal quality control and records systems, which ensured no problems with gradient and alignment. Pressure tests were successful on the first attempt with no defects found.

Surge analysis was carried out on both of the new pumping systems, including the lengths of existing mains affected by the



The intake structure under construction at Stannon  
Courtesy of Hyder Consulting (UK) Ltd



The Godwin pump sets in the below ground chamber at Stannon.

Courtesy of Hyder Consulting (UK) Ltd

new connections. Maximum pressures were found to be within proposed and existing pipe pressure and thrust restraint capacities without the inclusion of surge vessels.

#### Ecological & environmental considerations

A condition of the purchase of the pits was that South West Water should continue to realise Imerys's vision that they should become "exemplars of post-mining regeneration and sustainable re-use". To this end, SWW has established an environmental management group for the pits and associated land in conjunction with the Environment Agency, riparian interests, the SW Lakes Trust and other interested parties.

Measures to mitigate environmental and ecological detriment during construction included:

- Spreading of peat excavated from pipe trenches onto barren spoil areas to encourage regeneration, and use of arisings for bedding and backfill – no aggregate waste was exported from the sites.
- Minimisation of concrete usage and transportation by the use of anchored pipe joints rather than thrust blocks.
- Diversions of pipe routes to avoid frog and newt habitats.
- Timber cladding of control buildings to blend with surrounding landscape.
- Adding of gravels to the stream beds at Park to encourage migratory fish spawning.

Construction of the flow monitoring structures in the streams was planned and implemented following discussions with the EA and obtaining appropriate Flood Defence Consents. Designs and construction methods were reviewed to ensure flows and velocities would allow fish passage and control of water pollution, and construction was programmed outside of spawning season.

#### Conclusion

The schemes are unique in nature, and both the concept and

detailed design has required some 'back to basics' thinking and design from first principles. Suppliers of materials, equipment and plant have provided valuable assistance to allow existing product designs to be incorporated into the schemes. Successful partnering has been essential to overcome the problems with interfaces and detailing the bespoke design concepts.

The schemes are now both delivering flow and abstraction from the lakes has helped put South West Water in a strong position in terms of water resources this summer.

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