Appendix One

Water Treatment Options at Tottenham Green Leisure Centre

Report & Impact Assessment

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Assessment Spreadsheets

Haringey Council

1 Background

The pool water treatment system at Tottenham Green is 20 years old. This is generally regarded, within the leisure industry, as close to the end of the economic life of a system such as this. A major refurbishment may extend its life by 5 years. At installation in 1989, the system reflected more or less the state of the art in leisure water treatment in Europe and featured Ozone Sterilisation and carbon-based filter media.

General wear and tear and the substitution of the Ozone system for a more conventional chlorine-based sterilisation system have, over the life of the plant, led to maintenance and management issues which could only be overcome by major refurbishment or replacement.

An opportunity to bring the water treatment system back into a condition suitable for the needs of Tottenham Green's general business plan was identified within the Sport and Leisure Investment Programme, Year 2. Given that the minimum work required would be a complete rebuilding of the filter vessels involving enlarging the filter access doors to new EU standards the economics of a conventional refurbishment looked less attractive as further requirements/work was added.

2 Options Appraisal

Homes for Haringey have been commissioned to specify and tender a package of work to bring the water treatment up to current standards which are fit for the future and also reduce the centre's environmental impact.
The filtration method utilised currently relies on traditional sand filters which are found in the majority of public pools throughout the UK. A fundamental aspect of this type of treatment system is the need for each of the very large filter vessels to be cleared of accumulated filter debris in a frequent process called 'backwashing'. This necessarily results in the dumping of massive quantities of heated pool water with the attendant costs in purchased energy, carbon emissions and operating revenue.
The water thus lost must be made up from the mains. This, of course, is relatively cold and neutral in terms of the chemistry required of pool water. In order to maintain the quality of water in the system, this mains water needs to be heated and chemically treated to levels that match the remaining body of water in the pool.
Along with the heating and dehumidification of the pool hall air, these processes make the building one of the largest energy users in the Borough.
The economics of the existing system are well understood and an opportunity to reduce the expenditure on energy and chemicals prompted an alternative stream of research into refurbishment and replacement options.

3 Proposal

It is proposed to include in the procurement exercise an option to completely replace the water treatment system with one based on regenerative filtration technology.

A filtration technology that is well established outside of the EU has performance characteristics that could meet the centre's goals both operationally and environmentally. Known generically as Regenerative Filtration, it utilises a medium that has a much higher mechanical filtration efficiency than do sand and glass-based media. The medium is a fired volcanic glass material known as Perlite. It is widely available and common in the hydroponics industry which uses it as the primary growing medium for a wide variety of vegetable produce.

The working face of the regenerative filter is not a single, horizontal flat bed as in the sand filter but a collection of vertical tubular 'fingers' resulting in a very much expanded surface area over which to pass the pool water. It can regenerate its own filter face by temporarily shedding the media from the fingers and then rebuilding it simply by changing the direction of flow for a few minutes.

Filtration efficiencies of sand filters are typically expressed as their ability to remove particles of 10-12 microns in diameter. The Regenerative Filter removes matter less than 1 micron and can significantly reduce the presence of particulate matter to 0.5 microns. This efficiency, along with the retention of trapped matter on the surface of the filter face rather than buried within its depth, results in massive reductions in the need for fresh water for cleaning the filter itself.

A secondary factor of regenerative filtration installation will improve the swimming environment for the end user, operator and structure. Operating with lower levels of chemicals will reduce the associate odours familiar in swimming pools and thus reduce the corrosive elements on the pool halls equipment and structure.

4 Impact Assessment

The impact on the centre's utility usage was split into 4 categories upon which any water treatment technology would impact:

1. Gas energy usage
2. Electrical energy usage
3. Potable Water usage and Drainage volumes
4. Chemical usage

The significant advantages of the regenerative process are:

- Massive reduction in water wastage
- Highly efficient filtration effect resulting in reduced chemical demands
- Significantly reduced water circulation energy

An impact assessment has been carried out to measure the difference between the 4 parameters above under both a traditional refurbishment regime and under a total replacement of the system with regenerative filters.

Clear advantages in water volume exist in a regenerative system as they do not require a large backwash volume. This impacts on the system's use of resources broadly in line with the figures set out below.

	Category	Estimated Reduction
1.	Gas energy usage	97.6%
2.	Electrical Energy usage	52.7%
3.	Water and Drainage volumes	96.3%
4.	Chemical usage	62.9%

(For clarity, these reductions are expressed in terms of what the existing water treatment systems consume in isolation rather than as a fraction of the centre's overall consumption.)

As can be seen, the impact in this respect is very significant indeed.

Carbon Emissions

Carbon emissions (expressed as Carbon Dioxide equivalent) are similarly impacted; each element of the reduced impact having its own embedded carbon content.

The impact assessment in Appendix 1 shows both:

- the direct reduction in practical measured units (Kilowatt Hours of gas & electricity, Litres of Water, etc.) and
- The attendant carbon reduction implicit in each of these.

Overall reduction in CO_2 emissions is calculated to be 64,500 Kg in a full year of operations.

<u>What do these reductions mean?</u>

Carbon output into the environment can be expressed in many ways. As an aid to appreciating what 62,000 Kg of CO_2 means, several analogies have been included below:

- The equivalent of 620,000 miles of motoring per year in the Borough
- The same carbon reduction as would be achieved by fitting 1,000 homes with 100% Low Energy Light bulbs
- Taking the Council's entire vehicle fleet off the road for 7 weeks every year

<u>Are these savings good value for money?</u>

The Council is currently bringing its Housing stock of 17,000 dwellings up to the current Building Regulations standard for energy efficiency. The CO_2 reduction of this

programme will realise 460,000 Kg per year at a cost of £11,000,000 over a period of 5 years. The cost will be £23.91 per Kg reduction.

The equivalent performance of the proposals in this report will be 64,500 Kg at a cost of £2.17 per Kg and construction duration of just 10 weeks.

Economics and Business Case

Simple Payback

A simple payback analysis assuming Retail Price indexing at 2.5% results in payback point early in year 4. Reduced costs in energy, water, drainage and chemical use amount to approximately £30,100 per annum.

Note: H.M. Treasury Forecast for natural Gas is +13.1% between March 2009 and April 2010; beyond that point is difficult to predict. Based purely on the retail gas forecast for 2010 and acknowledging that reduction in gas expenditure represents just under 25% of the overall savings, it is likely that the simple payback will actually occur in late Year 4 rather than early Year 5.

Impact Assessment

Basic physical and environmental data.

Impact Assessment- Based on Tottenham Green - 2 pools at stated total volumes					
Red = Sand Filtration					
Green = Regen Filtration	Black = Common Data				
Pool Metrics			**Operational Data**		
Backwash Process Volume	7297.88	m3	Mains Temperature (measured, local)	9.12	C
Based on Current regime with Sand Filters	7297880	Litres	Pool Temperature Setpoint	31.00	C
Coefficients used			Delta T	21.88	C
CO_2 embedded in 11,000 VAC (HV) Supply	0.54	$Kg.KW.hr^{-1}$	**Plant Data**		
Electrical energy embedded in Water Supply and Drainage	0.7212	$KW.hr.m^{-3}$	Boiler combustion efficiency	0.860	
On-Peak Electrical Energy	0.11769	£/KW.hr	Heat Exchanger efficiency	0.935	
Off-Peak Electrical Energy	0.07936	£/KW.hr	Combined Heat Transfer Efficienc	0.804	
Potable Water	0.9799	$£.m^{-3}$			
Drainage Charge	0.5193	$£.m^{-3}$			
Specific Density (Average of @ 9.8 C and @ 31 C)	0.9975	$kg.l^{-1}$			
Specific Heat Capacity at 21C	4.18	$KJ.Kg.C^{-1}$			
Purchased Energy Data					
Energy Type	**Natural Gas**				
Energy Tariff	0.033953	£/KW.hr			
End User Energy Carbon coefficient	0.210	$Kg.KW.hr^{-1}$			
Primary Energy Type	**Grid Electricity**				
Energy Tariff Day	0.11769	£/KW.hr			
Energy Tariff Night	0.07936	£/KW.hr			
End User Energy Carbon coefficient	0.591	$Kg.KW.hr^{-1}$	(SAP 2009)		

Comparative Performance

Traditional Sand Filters (Existing) **Regenerative Filtration** system

Backwash Water Impact			**Backwash Water Impact**			**£ Deltas**	**Kg CO_2**
Backwash Volume	7297.88	m^3	Backwash Volume	272	m^3		
Energy content of backwash water	665808	MJ	Energy content of backwash	24858	MJ		
Convert to Tariff Unit (KW.hr)	184947	$KW.hr.yr^{-1}$	Convert to Tariff Unit (KW.hr)	6905	KW.hr		
Energy Cost	7809	£	Energy Cost	292	£	7517.79	
Carbon Dioxide Equivalent	38839	Kg	Carbon Dioxide Equivalent	1450	Kg		37388.78
Pump Energy Impact			**Pump Energy Impact**				
Pump Energy Required for Circulation	77452	$KW.hr.yr^{-1}$	Pump Energy Required for Circulation	36626	$KW.hr.yr^{-1}$		
Energy Cost, Peak	6077	£	Energy Cost, Peak	2874	£	3203.24	
Energy Cost, Off-Peak	2049	£	Energy Cost, Off Peak	969	£	1080.00	
Carbon Dioxide Equivalent	45774	$Kg.yr^{-1}$	Carbon Dioxide Equivalent	21646	$Kg.yr^{-1}$		24128.43
Water & Drainage Impact			**Water & Drainage Impact**				
Backwash Volume	7297.88	$m^3.yr^{-1}$	Backwash Volume	271.80	m^3		
Potable Water Charges	0.9799	$£.m^{-3}$	Potable Water Charges	0.9799	$£.m^{-3}$		
Drainange Charges	0.5193	$£.m^{-3}$	Drainange Charges	0.5193	$£.m^{-3}$		
Water Charges for Backwash	10940.98	£	Water Charges for Backwash	407.48	£	10533.50	
Water embedded CO_2	3110.86	Kg	Water embedded CO_2	115.86	Kg		2995.01
Water Treatment Chemical Impact			**Water Treatment Chemical Impact**				
Chemical Costs ***	12340.00	£.yr-1	Chemical Costs	4573	£.yr-1	7767.09	
Notes				Reductions per Year		**30101.62**	**64512.21**

*** This is not possible to calculate beyond the purely financial impact with the data available at the time of this report.
Chemical loadings have been calculated on the basis of the savings in backwash volumes alone.
There will be further change in chemical dosing levels due to the higher mechanical efficiency of the regenerative filter process. This will certainly be a downward change.
The degree will not become apparent until the design is fully developed.

Appendix 2
Risk Log

Risk Log

The replacement of the Water Filtration and Treatment system at Tottenham Green Leisure Centre with Pre-Coat Regenerative Filters

Risk Category	Risk	Likelihood	Impact	Mitigation
Procurement				
Tendering	That an adequate market test is not available to meet the requirements of the Council's Standing Orders.	Med	High	A set of tenders received in April 2009 produced a result compliant with the Council's Financial Regulations. A Tender Report with Recommendations will be submitted at the Procurement Committee of 12th July 2009.
Business Continuity	That failure to secure match-funding results in the procurement exercise failing to produce a solution that maintains the service provided by the Centre.	Med	High	A fall-back position has been secured through the inclusion of a refurbishment of the existing filtration system in the Tender. There are 3 very close tenders available to meet this eventuality and all could be taken up without delay.
Verification	That, as no comparable installations exist in the UK, it would be difficult to verify the quality and effectiveness of the technology in a real installation	High	High	The Engineering Consultant and two representatives of Tottenham Green's management visited one of the few installations outside of the USA on May 7th 2009. The Watershed Centre at Kilkenny, Ireland features this technology and an investigative visit was carried out in order to verify the manufacturer's claims generally. The Chief Executive of the centre and a Plant Operator/Duty Manager were interviewed on the 3 hours visit. A tour of the

				plantroom was made also. The ease of operation and maintenance of the plant were verified as were the reduced chemical usage, Perlite storage requirements and the water quality achieved.
Financial Stability	That, being a non-European corporation, there would be increased risk to the Council in terms of trading conditions etc.	High	High	There would be two parties involved with the procurement process, the manufacturer, Neptune-Benson Inc., and the installer, one of two UK companies. The Council's Construction Procurement Group carried out the standard tests on all tendering organisations in terms of creditworthiness, financial stability and Risk of Business Failure prior to the tenders being published. All companies have suitable credit ratings and have lower than average risk of business failure. All of these tests are inside the Council's requirements for trading partners.
Operations				
Maintenance of Service	That the Centre may be closed to the public for extended periods.	Med	High	The recommended tender includes practically no shut-downs that would impact the delivery of existing services to the public during the installation process.
Staffing and Training	That additional demands would be made on existing pool operating staff.	Med	Med	The proposed plant is virtually automatic in its day to day operations and the lack of the need to carry out frequent and time-consuming back-wash processes will liberate a significant amount of staff time for other duties.
Planned Preventative Maintenance and	That, given the ultra-specialised nature of the installation,	Med	High	Subsequent to the 12 months Defects Liability Period, the equipment

Response Maintenance	adequate maintenance and breakdown cover would not be available.			would be maintained by a UK agent of the manufacturer. This agent offers regular servicing routines and a breakdown and repairs service. The same agency currently maintains an existing hydrotherapy pool in Tottenham.
Perlite Supplies	That an adequate and economically-priced supply of the specialised filter medium is not available in the UK.	Medium	High	There are many suppliers of Perlite in the UK. The major ones are based in Staffordshire, Yorkshire and Hampshire. Perlite usage is very modest and it would be easy to store over 2 years supply on site in existing accommodation at Tottenham Green.
Latent Defects	That inadequate Warranty conditions apply to the new plant.	Low	High	A 10 year Warranty on all critical parts of the filter vessel is standard from the manufacturer. Testimonials from existing users are very positive in respect of reliability in use. This compares very favourably with traditional sand filters.
Financial Stability of Contractor	That the contractor may not have the trading and business account standards required by the Council.	Low	High	Construction Procurement Group has taken out the normal Financial References for the recommended contractor and they have met all of the Council's requirements in this respect.