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Project name

Good Practice Notes: Treated Effluent Usage as a Non-Potable Water Source in Century City Building Developments

Century City Properties Owners Association (CCPOA)

17 September 2014

Revision: 1

Reference: 110024

Document control record

Document prepared by:

Aurecon South Africa (Pty) Ltd

1977/003711/07

Aurecon Centre
1 Century City Drive
Waterford Precinct
Century City
Cape Town
7441

PO Box 494
Cape Town
8000
South Africa

T +27 21 526 9400
F +27 21 526 9500
E capetown@aurecongroup.com
W aurecongroup.com

Document control						
Report title		Good Practice Notes: Treated Effluent Usage as a Non-Potable Water Source in Century City Building Developments				
Document ID		-	**Project number**		110024	
File path		P:\Projects\110024 Bridge Park Office Development\03 PRJ Del\6 REP\Aurecon CCPOA-Good Practice Notes- Treated Effluent Usage.docx				
Client		Century City Properties Owners Association (CCPOA)	**Client contact**		-	
Rev	**Date**	**Revision details/status**	**Prepared by**	**Author**	**Verifier**	**Approver**
1	17 September 2014	Issue for CCPOA distribution	DO'L	DO'L	-	JdP
Current revision		**1**				

Approval			
Author signature		Approver signature	
Name	Daniel O'Leary	Name	Jacques du Plessis
Title	Mechanical Engineer	Title	Technical Director

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1 DISCLAIMER

Please note that this document is for distribution by the Century City Properties Owners Association to potential building owners and their design teams to share Aurecon's experience in the use of the treated effluent water beyond solely for irrigation.

While the intention is to encourage an increase in the use of this supply as a more environmental sound option over potable water for appropriate consumption through the sharing of this experience, Aurecon, its representatives, employees and associates cannot be held liable for any systems designed and implemented by third parties. Design and implementation remains the responsibility of the particular design team and building owner which includes and is not limited to:

- Gaining updated information on water quality and availability
- Perform the detail design of the related systems
- Design and select appropriate components and systems
- Inform suppliers and the manufactures of the intended use of their equipment to understand and agree the impact on warrantees and performance
- Update the records of the quality of the water and to coordinate the installation and maintenance of these systems.

2 FAQ

The following misconceptions have been addressed during the design of the projects that Aurecon has been responsible for and would typically have resulted in the abandoning of these interventions had they not been disproved.

- **Will the toilets and urinals discolour over time?**

  Not if an appropriate post treatment is provided to the treated water - there is nothing left to discolour the units.

- **Will the toilets smell if not used over holidays and the water stands?**

  Not if an appropriate post treatment is provided to the treated water, there is little nutrients left in the water for micro-organisms to live off and chlorination sanitises the water.

- **Isn't the treatment system complex, difficult to look after and expensive?**

  No –the system is not that much more complex than a simple pool filter – most of the hard work has actually been done at the sewerage treatment plant already. It is similar in complexity to a rain water system and less complex than a grey water system and costs around R300,000.00.

- **Doesn't the maintenance cost more than what one can buy potable water for anyway?**

  Our lifecycle costing indicates that including the treated water supply cost itself, the lifecycle cost of the chlorination dosing, the electrical energy consumption and even the amortization of the capital cost over a 10 year rental period results in the cost per litre of polished treated effluent water 30 to 50% of that of potable water – the more you use the more cost effective it is which is why it makes sense for your polishing plant to provide as many uses of water as possible.

- **Doesn't the additional reticulation double the plumbing budget?**

  Actually there is not a lot of additional pipework – often the smaller pipes within the ablution facilities are split already and it is just the main riser pipes that get bigger. Office buildings have simple and few risers and so the expense is not that much compared to the existing costs of all the fittings that have to be bought and the extent of the more complex and extensive smaller pipes within the ablution facilities. The additional pipework is often only around 20 to 25% of the actual treatment cost.

- **Doesn't one have to use close circuit cooling towers to protect the chillers?**

  There are more cost effective ways to protect your chiller like putting a heat exchanger between the chiller and the cooling tower with an additional pump set should you decide that your treatment is not adequate – however with the correct treatment plant, this is not required and one could also consider the material that the chiller condensers themselves are manufacturer out of.

- **Isn't the quality and the quantity of supply not guaranteed and one would end up using a lot of potable water anyway?**

  Actually the CCPOA has not experienced much disruption in treated effluent water supply at all over the last number of years. There is variability in the quality of supply however this is not necessarily much more variable than what one would receive from showers in a grey water treatment, nor from the first rain after a long summer and so it is no more complex than rainwater or grey water systems that are becoming fairly commonplace. One should also note that both availability and quality of municipal potable water is not guaranteed either. Having a second water supply assists in providing redundancy during outages of municipal potable water supply

3 BACKGROUND

Century City has access to treated effluent water from the Potsdam Municipal Sewer Treatment facility. The original intention was to:

- Provide irrigation water to landscaping
- Maintaining canal water levels after further polishing the treated water to safe levels

However it has been found in the last few years that due to a combination of the storm water run-off into the canals and the canals' connectivity to the high water tables, the top up to the canals are no longer needed as the water levels do not vary significantly seasonally.

This, in combination with the growing environmental prerogatives in the building industry and increase in potable water costs, have led to building owners and design teams investigating uses for this water source beyond the original intention of having the supply available.

However it has been identified that a major reason for this not being considered for alternative uses is a lack of understanding and limit of example applications. Projects are typically too fast track for building owners and consultants to gain this understanding at the early stages of the design process and the idea of using this resource beyond irrigation is often dropped from consideration due to this lack of understanding. This document is intended to inform building owners and designers that other project are using this water extensively and how, so that they have a starting point for their projects. Further design development and implementation can then be carried with regards to their particular project needs and constraints.

4 EXISTING BUILDINGS THAT USE IT FOR MORE THAN IRRIGATION

The following two buildings have extended the use of this supply:

- Aurecon office building
  - Treated effluent for cooling tower consumption
  - Irrigation
- Bridge Park
  - Treated effluent for cooling tower consumption
  - Flushing of toilets and urinals
  - Irrigation

Both of these projects have been designed by Aurecon and this document offers to share the experience of these with other building owners and design teams to increase the level of understanding of this potential resource available to those projects.

5 POTENTIAL USES AND RELATED EXPERIENCE

Based on the above projects, the following feedback and guidance is provided on the following uses:

- Toilet and urinal flushing
- Cooling tower consumption
- Irrigation

5.1 TOILET AND URINAL FLUSHING

The Bridge Park project is including a polishing plant that further treats the treated effluent supply to ensure a constant quality, remove the potential for odours and discoloration and sediment and particles that can cause corrosion or fouling. In this particular project, the storage tanks are connected to a rain water harvesting system with the primary top up during dry spells coming via the treated effluent supply. The system is designed to polish both the treated effluent and rain water collectively and thus reduces reticulation, pump sets and storage vessels as well as related maintenance.

The flowing treatment is provided for that:

- Settling tank for large sediment and leaves etc.
- Holding tanks with overflow to storm water primary top up is with treated effluent source
- Sand and activated carbon filter
- 30µm particle filter
- In line, proportional flow chlorine dosing
- Buffer tank to assist with reducing the size of the filtration plant

The above treatment is also sufficient for cooling tower consumption as well as irrigation and so a single plant can be used for the entire building. However the irrigation water is treated separately as described further on in this document.

5.2 COOLING TOWER CONSUMPTION

Aurecon has taken the following two approaches to date with regards to providing treated effluent water to cooling towers, both with the aim of not using more expensive and energy inefficient closed circuit cooling towers.

5.2.1 Minimal treatment with a heat exchanger to protect the chiller and open circuit cooling tower

In Aurecon's offices – a 5 Star Green Star SA Design Office v1 certified building – treated effluent water was used to top up rain water collected for the cooling tower. Basic filtration was provided and the cooling tower was run with a greater cycles of concentration (increased bleed off rates) to reduce the potential of fowling. During this project, the possibility of using the water for toilet and urinal flushing was not considered and therefore a larger polishing plant was not considered. While the system does work satisfactorily - the higher cycles of concentration does result in more water use and the additional pumps and heat exchanger do required additional energy and maintenance.

5.2.2 Additional treatment to protect the chiller and open circuit cooling tower

For Bridge Park, it was decided to consider treated effluent water for flushing of urinals and toilets. The additional filtration and treatment required for that resulted in water quality higher than that required for both the cooling towers and chiller manufacturers – considering that once water has passed through a cooling tower itself a number of times, it is no longer potable anyway. Based on Aurecon's experience of the design of their own building, it was decided in turn to simplify the heat rejection circuitry and opt for a conventional cooling tower and condenser water configuration. To improve the corrosion protection of the chiller's condenser, the design included Copper-Nickel (90% / 10%) condenser tubes. This system also includes conventional cooling tower dosing equipment.

5.3 IRRIGATION SYSTEM

The following is included as a note for interest.

In the Bridge Park project, the Landscape Architect preferred to take the treated effluent supply directly, and not from the polishing plant process. This was so as not to split the responsibility between the quality of the water and the maintenance and warrantee of the irrigation system from each other. It was expressed that should the spray nozzles etc fail, that there was a preference that the irrigation sub-contractor could not blame the treated effluent polishing plant supplier. As the inline filter was inexpensive and the maintenance of it typical to the irrigation sub-contractor that would be the responsibility of that sub-contractor, contractually it seemed to make more sense to have a separate system.

6 AVAILABILITY AND QUALITY

The CCPOA confirms that they receive between 350 – 3000 m^3/day of treated effluent (see confirmation letter in the addendum). This is based on their daily requirement which changes seasonally due to the irrigation requirement. The maximum daily supply is 4000m^3. Monthly supply data is tracked by the CCPOA for the purposes of billing consumers as well as reporting to the City of Cape Town. The graph below shows the average daily consumption of treated effluent per month for 2005 to 2010. It shows that there is still more than 500m3/day capacity available in the supply, without any management of irrigation timing which could be used to reduce the current daily consumption.

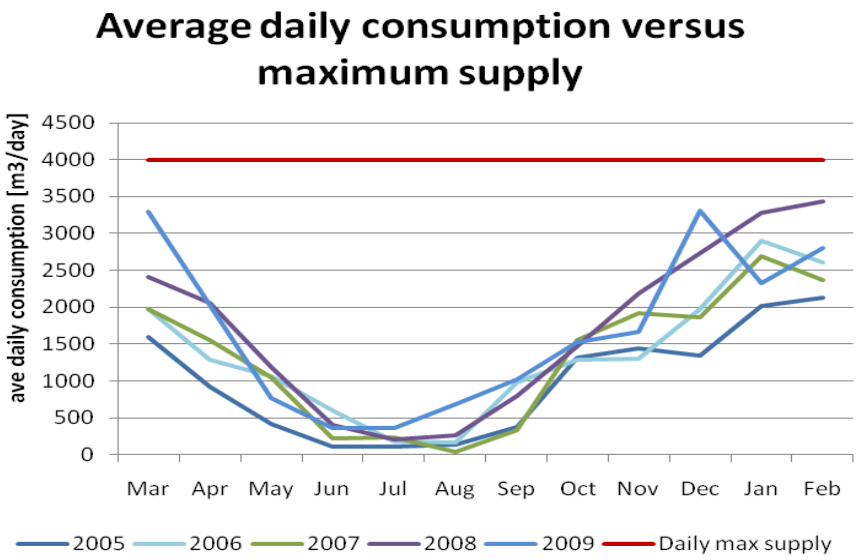

Figure 1: CCPOA daily effluent consumption

Based on the Bridge Park building, the maximum daily consumption of treated effluent water would be between 13 and 15m^3 per day for a +-18,000m^2 office building. Effectively 300 more buildings of the same size could be connected to the same supply during the summer months where the peak consumption occurs and minimal capacity is available. This is far more than the allowable bulk stil to be developed at Century City. Therefore there is more than adequate supply available, and to date, the CCPOA has experienced no problems with availability.

With regards to quality of supply – the table below shows the testing as arranged by the CCPOA to provide an indication of water quality for initial investigations. However it is proposed that a series of samples are arranged by the relative consultants for testing on a per project basis to ensure that the latest test results are used.

Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	CANAL TARGETS	Pots Dam
													COD in mg/L
4404	4061	4950	3311	3795	3125	322	912	2035	767	1287	4115	100 ug/L	Total-P in ug/L
4251	4021	4844	2932	3683	2854	173	803	1933	586	1210	3814	35 ug/L	Ortho-P in ug/L
												2500 ug/L	Nitrate as ug/L
13.25	12.08	12.439	9.38	11.59	6.491	8.524	12.06	9.3	11.16	7.537	6.627	mg/l N	Soluble Nitrite + Nitrate
													Suspended Solids in mg/L
7.17	5.26	13.37	78	75	16	1.7	17	7.2	5.3	40	29	0-15	Chlorophyll-a in ug/L
2.47	0.94	2.45	1.9	3.9	3.8	1.7	0.82	2.1	4.4	3.6	8.7		Phaeophytin in ug/l
												300 ug/L	Ammonia Nitrogen in ug/L (NH4-N)
0.151	0.048	0.123	0.011	0.636	0.073	0.033	0.106	4.64	0.601	0.884	1.869	mg/l N	Soluble Ammonia
9000	10300	21000	11600	9000	4029	15600	28400	1520	3700	1340	7800	< 1000 cfu / 100ml	Faecal coliforms per 100ml
6100	7300	15500	6800	6600	2190	9000	20600	1050	3100	830	5300	< 1000 cfu / 100ml	E.coli 100ml

Figure 2: Pots Dam Treated Effluent Water Quality tests October 2011 to September 2012

Aurecon South Africa (Pty) Ltd
1977/003711/07
Aurecon Centre
1 Century City Drive
Waterford Precinct
Century City
Cape Town
7441
PO Box 494
Cape Town
8000
South Africa
T +27 21 526 9400
F +27 21 526 9500
E capetown@aurecongroup.com
W aurecongroup.com