



El Port de la Selva

Monitoring and control of  
water reuse in SAT

Elisenda Taberna, VEOLIA





## SUMMARY

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- Location. Sampling points
- Parameters of concern / implemented countermeasures
- Chemical analysis
- Microbiological analysis
- Trace Organic Compounds
- Actions in progress





# Location of sampling points





## Parameters of concern and implemented countermeasures

Parameter	PoC	Goal/threshold	Countermeasure
Total phosphorus	TE	Goal < 2 mg/L	Install Fe-Dosing
Ammonia	SE	Goal < 1 mg/L	Increased aeration in WWTP
Total Nitrogen	TE/IP	Limit* < 10 mg/L	Improved control + increased retention time in WWTP
<i>E. coli</i>	TE/IP	Limit* < 1000 cfu/100 mL	Filtration + UV
Salinity	SE/IP	Goal < 1500 $\mu$ S/cm	(a valve to prevent seawater intrusion at the WW pumping station) EC online probe to shut system down in case of high EC
Turbidity TSS	TE/IP	As low as possible to avoid clogging of ponds	Install frequency converters to improve operation of filtration
AOX	TE	Formation of chlorinated disinfection by products	Chlorination to be switched off

\*RD1620/2007

PoC: Point of compliance SE: Secondary effluent TE: Tertiary effluent IP: Infiltration pond



# Chemical analysis

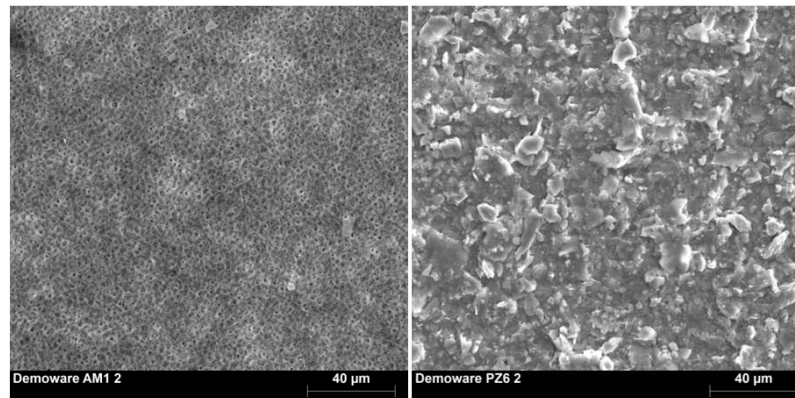
<b>Parameter</b>	<b>units</b>	Sampling date: 19/20-11-2015			Sampling date: 06/11-04-2016			<b>RD 140/2003</b>
		<b>PZ 7</b>	<b>PZ 6</b>	<b>AM1</b>	<b>PZ 7</b>	<b>PZ 6</b>	<b>AM1</b>	
pH	upH	6,9	6,9	7,1	6,8	6,9	6,9	6,5-9,5
<b>Conductivity</b>	μS/cm	437	434	426	1205	870	452	2500
<b>Chloride</b>	mg Cl/l	75,0	74,0	77,0	289,3	187,0	82,9	250
Nitrites	mg NO <sub>2</sub> /l	< 0,1	< 0,1	< 0,1	< 0,1	< 0,1	< 0,1	0,1
<b>Nitrates</b>	mg NO <sub>3</sub> /l	2,5	2,6	4,0	4,5	3,3	4,2	50
<b>Orthophosphates</b>	mg PO <sub>4</sub> /l	< 0,1	< 0,1	< 0,1	< 0,1	< 0,1	< 0,2	
Sulfates	mg SO <sub>4</sub> /l	32,1	32,4	27,1	64,8	51,1	27,7	250
<b>Ammonia</b>	mg NH <sub>4</sub> /l	< 0,1	< 0,1	< 0,1	<0,1	<0,1	< 0,1	0,5
Bicarbonates	mg HCO <sub>3</sub> /l	69,0	64,0	62,0	98,6	78,6	75	
Bromide	mg Br/l	0,2	0,2	0,2	1,2	0,7	< 0,2	
Fluoride	mg F/l	< 0,1	< 0,1	< 0,1	< 0,1	< 0,1	< 0,2	1,5
<b>Sodium</b>	mg Na/l	44,0	44,6	39,5	158,6	103,5	50,1	200
Potassium	mg K/l	2	2	2	6,5	4,2	2,3	
Calcium	mg Ca/l	23,6	24,2	24,0	48,8	42,5	26,4	
Magnesium	mg Mg/l	9,6	10,0	9,3	18,2	16,6	10,8	

Parameters analyzed by CTM



# Chemical analysis

<i>Parameters</i>	<i>units</i>	Sampling date: 19/20-11-2015			Sampling date: 06/11-04-2016			<i>RD 140/2003</i>
		<i>PZ 7</i>	<i>PZ 6</i>	<i>AM1</i>	<i>PZ 7</i>	<i>PZ 6</i>	<i>AM1</i>	
COD	mg C/l	0,9	2,0	0,5	1,8	1,1		
UVA254	abs 254	0,024	0,033	0,018	0,040	0,031		
Aluminum	µg/l Al	21	85	17	8	1020	200	
Iron	µg/l Fe	24	81	45	14	995	200	
Manganese	µg/l Mn	3	9	4	0,5	23	50	
Copper	µg/l Cu	1	5	9	7,2	5	2000	
Arsenic	µg/l As	1,4	2,1	0,9	2,0	4	10	
Boron	µg/l B	25	26	31	86	49	1000	
Nickel	µg/l Ni				2,3	2,8	20	
Zinc	µg/l Zn				6,0	11,0		
Cadmium	µg/l Cd				0,2	< 0,1	5	
Lead	µg/l Pb				0,5	1,9	10	
AOX	µg/l					<0,1		





## Microbiological analysis

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- BACTERIOPHAGES
  - Somatic coliphages
- BACTERIA
  - E.coli
  - Total Coliforms
  - Enterococcus Faecalis
  - Clostridium Perfringens
- VIRUS
  - Rotavirus
  - Enterovirus
  - Norovirus GGI
  - Norovirus GGII
  - Adenovirus

Parameters analyzed by Empresa Mixta d'Aigües de la Costa Brava, S.A.

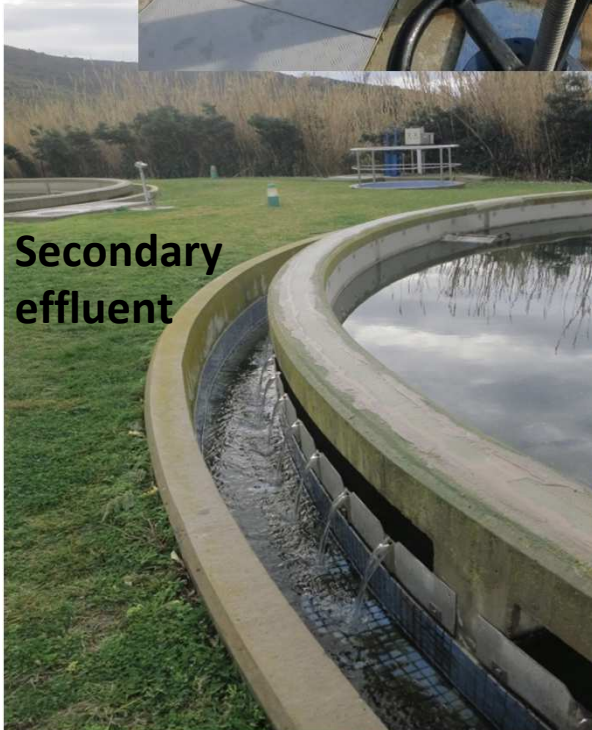
Parameters analyzed by Department of Genetics, Microbiology and Statistics Biology faculty -UB



# Microbiological Analysis. Sampling points



**Biological treatment inlet**



**Secondary effluent**



**Reclaimed water**





# Microbiological analysis. Sampling points



**Basins inlet**



**Piezometers 7,6**



**PZ6**



## Microbiological analysis. BACTERIOPHAGES

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SOMATIC COLIPHAGES		
BIOLOGIC INLET	4 - 6	u log
SECONDARY EFFLUENT	3 - 4	u log
RECLAIMED WATER	< 1	u log
BASINS INLET	40 - 70	pfu/ 100 ml
PIEZOMETERS 7,6	2 - 80	pfu/ 100 ml



## Microbiological analysis. BACTERIA

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E.coli		
BIOLOGIC INLET	5 - 6	u log
SECONDARY EFFLUENT	3	u log
RECLAIMED WATER	< 1 - 10	cfu/ 100 ml
BASINS INLET	< 1 - 4	cfu/ 100 ml
PIEZOMETERS 7,6	< 1	cfu/ 100 ml



## Microbiological analysis. BACTERIA

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TOTAL COLIFORMS		
BIOLOGIC INLET	5 - 6	u log
SECONDARY EFFLUENT	3	u log
RECLAIMED WATER	< 1 - 23	cfu/ 100 ml
BASINS INLET	< 1 - 11	cfu/ 100 ml
PIEZOMETERS 7,6	< 1	cfu/ 100 ml



## Microbiological analysis. BACTERIA

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ENTEROCOCCI		
BIOLOGIC INLET	4 - 5	u log
SECONDARY EFFLUENT	1 - 2	u log
RECLAIMED WATER	< 1 - 6	cfu/ 100 ml
BASINS INLET	< 1 - 5	cfu/ 100 ml
PIEZOMETERS 7,6	≤ 1	cfu/ 100 ml



## Microbiological analysis. BACTERIA

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CLOSTRIDIUM PERFRINGENS		
BIOLOGICAL INLET	4 - 5	u log
SECONDARY EFFLUENT	3	u log
RECLAIMED WATER	1 - 8	cfu/ 100 ml
BASINS INLET	2 - 27	cfu/ 100 ml
PIEZOMETERS 7,6	< 1	cfu/ 100 ml



## Microbiological analysis. VIRUS

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ROTAVIRUS		
BIOLOGICAL INLET	1,39E+03 – 4,58E+06	GC/L
SECONDARY EFFLUENT	ND – 1,84E+05	GC/L
RECLAIMED WATER	ND – 3,45E+05	GC/L
BASINS INLET	ND - 3,01E+05	GC/L
PIEZOMETERS 7,6	ND – 1,35E+03	GC/L

LOD Biological inlet: 620 GC/mL (Confidence Interval 95%: 474-964 GC/mL)

LOD other samples: 3873 CG/L (Confidence Interval 95%: 2959-6028 GC/L)



## Microbiological analysis. VIRUS

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ENTEROVIRUS		
BIOLOGICAL INLET	ND	GC/L
SECONDARY EFFLUENT	ND	GC/L
RECLAIMED WATER	ND	GC/L
BASINS INLET	ND	GC/L
PIEZOMETERS 7,6	ND	GC/L

LOD Biological inlet: 663 GC/mL (Confidence Interval 95%: 486-1093 GC/mL)

LOD other samples: 4142 CG/L (Confidence Interval 95%: 3040-6833 GC/L)





## Microbiological analysis. VIRUS

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NOROVIRUS GGI		
BIOLOGICAL INLET	ND – 1,12E+04	GC/L
SECONDARY EFFLUENT	ND – 6,19E+01	GC/L
RECLAIMED WATER	ND	GC/L
BASINS INLET	ND	GC/L
PIEZOMETERS 7,6	ND	GC/L

LOD Biological inlet: 66 GC/mL (Confidence Interval 95%: 49-111 GC/mL)

LOD other samples: 411 CG/L (Confidence Interval 95%: 308-691 GC/L)



## Microbiological analysis. VIRUS

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NOROVIRUS GGII		
BIOLOGICAL INLET	3,53E+04 – 1,07E+06	GC/L
SECONDARY EFFLUENT	ND – 2,18E+04	GC/L
RECLAIMED WATER	9,91E+02 – 1,98E+03	GC/L
BASINS INLET	1,77E+02 – 1,36E+03	GC/L
PIEZOMETERS 7,6	ND – 4,90E+04	GC/L

LOD Biological inlet: 473 GC/mL (Confidence Interval 95%: 375-654 GC/mL)

LOD other samples: 2959 CG/L (Confidence Interval 95%: 2343-4085 GC/L)



## Microbiological analysis. VIRUS

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ADENOVIRUS		
BIOLOGICAL INLET	6,30E+04 – 9,33E+05	GC/L
SECONDARY EFFLUENT	3,76E+02 – 6,42E+01	GC/L
RECLAIMED WATER	9,91E+02 – 1,98E+03	GC/L
BASINS INLET	1,77E+02 – 1,36E+03	GC/L
PIEZOMETERS 7,6	ND – 2,34E+02	GC/L

LOD Biological inlet: 34 GC/mL (Confidence Interval 95%: 25-58 GC/mL)

LOD other samples: 214 CG/L (Confidence Interval 95%: 193-360 GC/L)



# Trace Organic Compounds - JRC



EUROPEAN COMMISSION  
JOINT RESEARCH CENTRE  
Institute for Environment and Sustainability

## 45 substances analyzed in PZ7/PZ6

	< LD	< 1 ng/L	< 10 ng/L	<100 ng/L	100-200 ng/L	> 200 ng/L
n° substances	20	7	8	5	3	2



Sulfamethoxazole 520,92 ng/L  
Sucralose (2041,343 ng/L)

10-11-dihydro-10,11-dihydroxy-carbamazepine (172,52 ng/L)  
Benzotriazole (192,84 ng/L)  
Diuron (128,74 ng/L)



## Priority substances

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- Analysis of the 45 regulated substances in Directive 2013/39/EU (RD 817/2015 transposition)
- Selection of substances with concentrations between the annual average concentrations and maximum permissible concentration or higher than the maximum permissible concentration \*
- Pesticides are the substances found

Secondary effluent October 2014	Reclaimed water April 2016	PZ7/PZ6 April 2016
Terbutryn Cibutrine* Diuron	Cibutrine*	Cibutrine

CSIC-IDAEA



## Actions in progress

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- Last sampling campaigns
- UV system upgrade to improve microbiological quality
- Activated carbon pilot plant after sand filters to remove trace organic compounds



# THANK YOU FOR YOUR ATTENTION





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