BLUE BRIDGE PROJECT

ORLEN S.A.

1. Innovation Water and the Circular Economy

Shrinking water resources are becoming a challenge for maintaining sustainable development with increasing demand for water. In this situation, methods of obtaining water from alternative sources are being sought, and in the era of the closed-loop economy, treated wastewater can become such an alternative source of water to natural resources.

These are the assumptions guiding the Blue Bridge project, which aims to use municipal wastewater, generated in Plock and from neighboring municipalities about (140 000 P.E.) are treated by Plock Waterworks Ltd. at the Maszewo wastewater treatment plant, in ORLEN S.A.'s facilities to supplement raw water withdrawn from the Vistula River.

In order to create the possibility of using wastewater from the Treatment Plant in Maszewo, it is necessary to treat and condition it to a level close to the parameters of raw water, which is intaked by ORLEN S.A. to cover its production needs, as well as to build the necessary infrastructure to ensure its transportation to the final recipient. Preparation of wastewater for further use includes 3 stages of processing:

- the first stage is implemented based on the existing infrastructure of mechanical and biological wastewater treatment,
- the second stage is the recovery of water using processes for the removal of residual contaminants, mainly related to the suspended sludge present in the biologically treated wastewater and (optionally) disinfection of wastewater,
- the third stage is the treatment processes to the parameters of water required for the various production processes of the plant.

The planned capacity of the plant will ensure the use of more than 90% of the wastewater processed by the wastewater treatment plant, and the designed daily capacity of the plant is 20,000m3/d, which corresponds to the averaged daily wastewater flows. This amount of water obtained from treated wastewater, will be a significant addition to the water consumed by Orlen S.A.

Replacing the water taken by Orlen S.A. directly from the environment with water recovered from the treated municipal wastewater currently discharged by Plock Waterworks Ltd. into the Vistula River will provide a “win-win” effect, not only benefiting both companies (reduced wastewater discharge and reduced water intake), but also the environment by reducing the environmental impact of both plants.

A pilot-scale test was performed which confirmed the possibility of obtaining analytical parameters and ensuring the necessary bacteriological protection to prevent microbiological hazards. The devices intended for sewage water recovery system will be powered by renewable energy and there is no need to build a special pumping station to transport the recovered water due to the differences in levels, which makes it an energy-neutral solution.

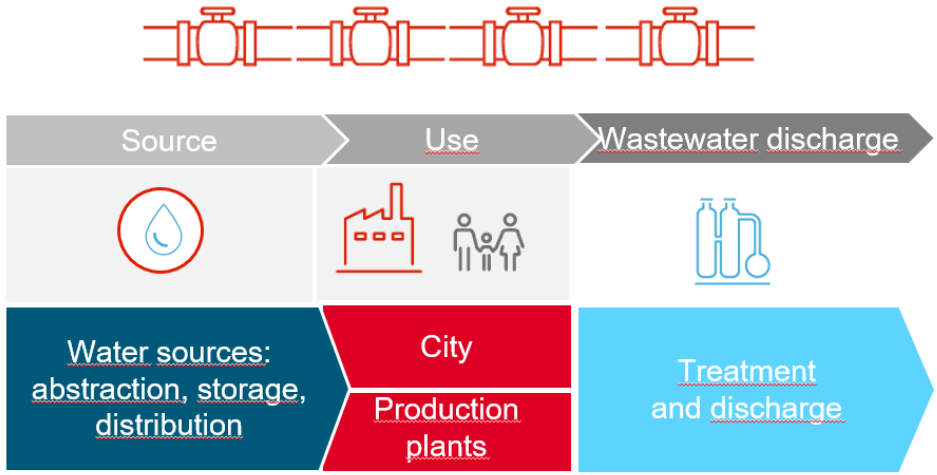
The Project's objectives are:

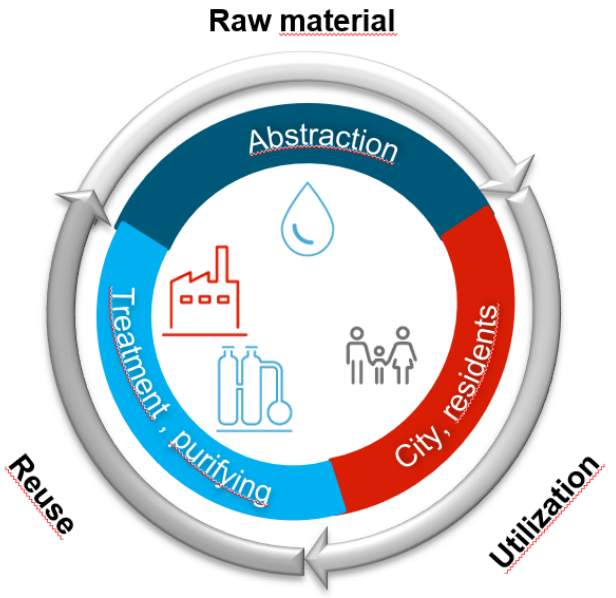
- ceasing/reducing the discharge of wastewater ca. 70-80% and discharge of pollutant loads contained in municipal sewage from the municipal wastewater treatment plant operated by Wodociągi Płockie Ltd. into the Vistula River,
- reducing the annual volume ca. 25% of water withdrawn from the Vistula River for the technological needs of the ORLEN S.A. Production Plant by approximately 7-8 million m3/year.

BLUE BRIDGE
PROJEKT ODZYSKU WODY ZE ŚCIEKÓW KOMUNALNYCH
MIASTO PŁOCK
Płock City
Zakład Produkcyjny Orlen S.A.
Orlen Production Plant
Ujęcie wody
Orlen S.A.
Water intake
– ORLEN
BLUE BRIDGE
WODOCIĄGI PŁOCKIE
Miejska Oczyszczalnia Ścieków
Wodociągów Płockich Sp. z o.o.
Municipal Sewage Treatment
Plant of the Płock Waterworks
Outlet from the municipal
sewage treatment plant
wylot z
oczyszczalni miejskiej

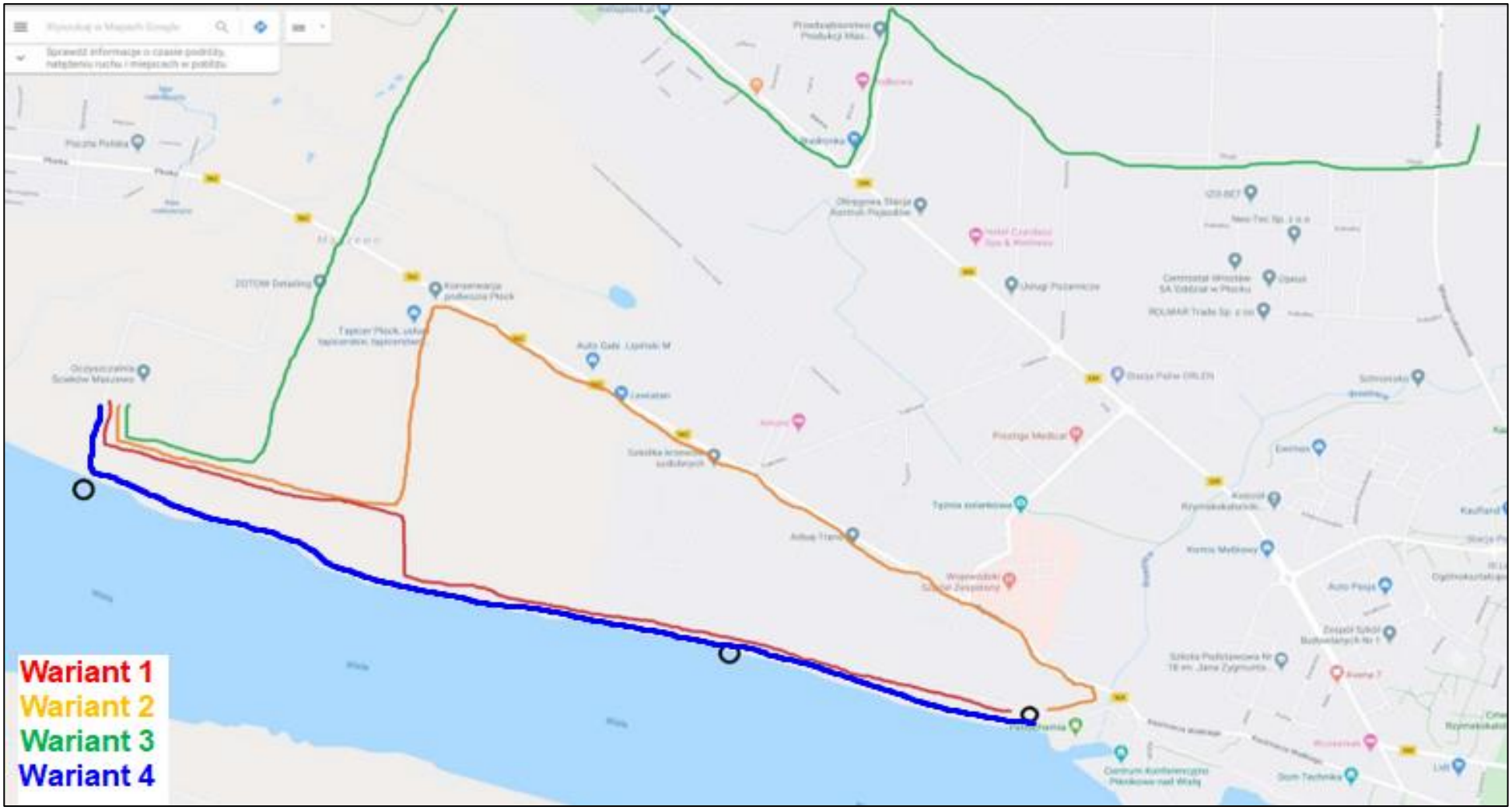
Elements of the water and wastewater value chain in Płock

WHO EU Poland





Transition from a linear water-wastewater economy to a circular one



PIPELINE ROUTE OPTIONS

Test results from the pilot station

Parameter	Inflow [g/m^3]	Outflow [g/m^3]	Comments
Turbidity	7,53	3,01	reduction ~60%
Suspended solids	7,2	3,2	reduction > 50%
Total phosphorus	0,39	0,27	reduction ~30%
BOD5	13,6	10,4	reduction > 20%
Kjeldahl nitrogen	2,95	2,37	reduction ~20%
Total nitrogen	6,89	5,96	reduction ~15%

Test results from the pilot station
Comparison with water from the Vistula River

Table - Comparison of water quality in the Vistula River with water recovered from sewage

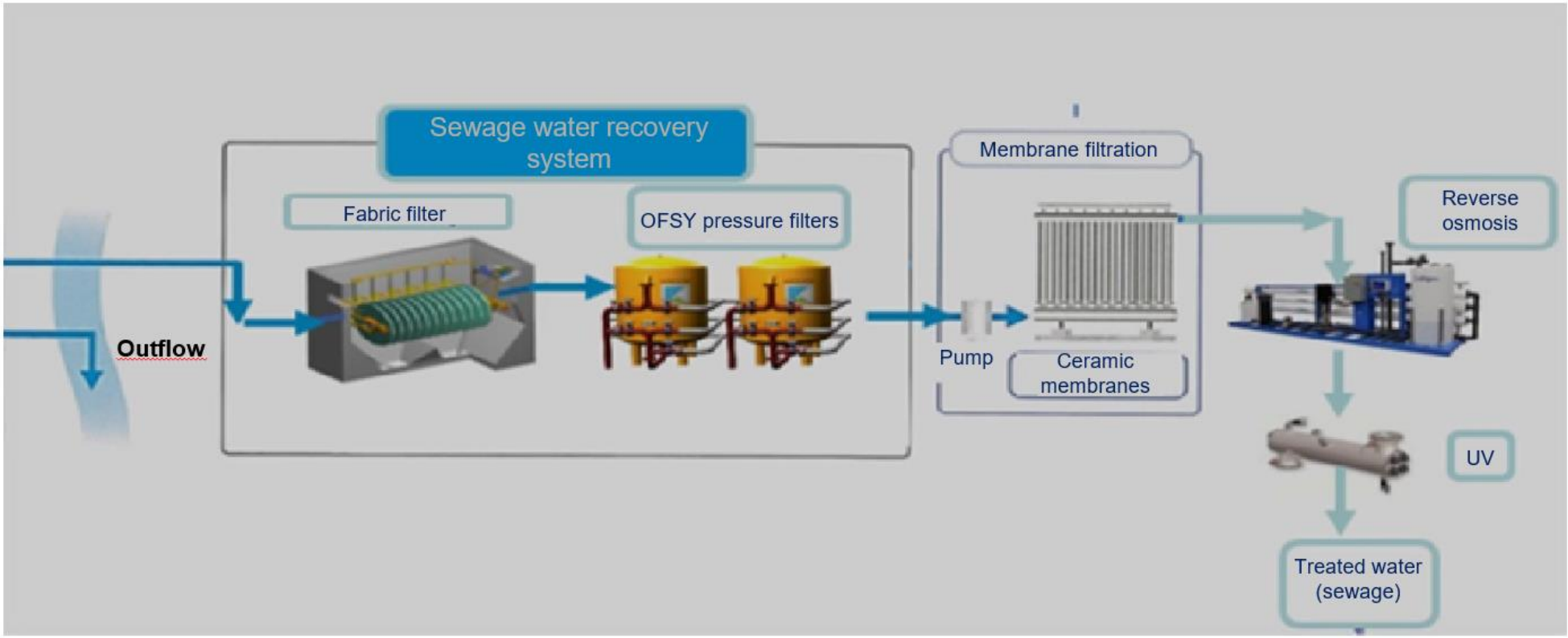
Parameter	Warszawa – intake Gruba Kaśka	Warszawa - 500m Outflow WTP Czajka	Kazuń Nowy	Wyszogród	Płock – before intake	Recovered water - after disinfection
Total microorganisms at 22°C: Average of measurements [jtk/1ml]	7 300	9 700	11 700	7 400	5 500	**4 200**
Total suspended solids - medium[g/m3]	48,3	49,3	22,5	17,2	13,9	**4,4**

Table - Results of microbiological tests of treated sewage and reclaimed water (average of measurements)

Parameter	Unit	Treated sewage	Recovered water - after filtration	Recovered water - after disinfection	Reduction on the filter	Reduction after UV
Total microorganisms at 22˚C	[jtk/1ml]	**230 000**	**96 000**	**4 200**	**58,3%**	**98,2%**
Total microorganisms at 36˚C	[jtk/1ml]	**104 000**	**56 000**	**2 600**	**46,2%**	**97,5%**

Project benefits: Amount of avoided pollution – which will not be released into the Vistula after the implementation of the Blue Bridge project.

Pollution parameters	Unit	Average concentration	Daily load (average) [kg/day]	Annual load (average) [kg/year]
BOD5	[mgO_2/l]	4,462	85,890	31 350,031
COD Cr	[mgO_2/l]	46,692	898,888	328 094,286
Total phosphorus	[mgP/l]	0,350	6,738	2 459,356
Ammonium nitrogen	[$mgNH_4/l$]	0,783	15,080	5 504,273
Total nitrogen	[mgN/l]	8,431	162,303	59 240,748
General suspension	[mg/l]	7,300	140,535	51 295,136
Phenols	[mg/l]	0,001	0,019	7,027
Chlorides	[mg/l]	223,333	4299,461	1 569 303,257
Sulfur	[mg/l]	95,000	1828,875	667 539,445
Total organic carbon	[mg/l]	15,550	299,358	109 265,667


Sewage water recovery system
Fabric filter
OFSY pressure filters
Membrane filtration
Outflow
Pump
Ceramic membranes
Reverse osmosis
UV
Treated water (sewage)

Schedule

Blue Bridge Project

Preliminary and analytical work

Kick-off

2019 — *NDA Agreement, Workshops, Research and analysis of water and wastewater parameters, Studies, Legal and environmental analyses*

2020 — *Technology analysis, route analysis, utilization analysis*

Study of possibilities

2021 — *Preparation of summary material, agreements, decisions, proceedings*

2022 - 2025 — *Signing of Agreements, Contracts, Pilot Studies, Preparation of Documentation*

Implementation

2026-2029 — *Implementation, acceptance, project closure, use*

We are here today