Deliverable 3.

Updated Watersave+ prototypes design for both zoos

Updated Watersave+ prototype design for Zoo Liberec.

Photon Water Technology s.r.o.

Liberec 2/2024

Content

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Figures

1 Introduction

The Liberec Zoo is the oldest ZOO in the Czech Republic. It covers an area of about 14 ha. With up to 170 species of animals from all continents (1438 animals) has a water consumption of 60 000 m3/year, ~20% of which is drinking tap water, without water reuse. The aim of this project is the construction and operation of a full-fledged water treatment and circulation system in selected parts of the Liberec Zoo using a nature-based wastewater treatment system (NBS), in combination with subsequent hygienization through a container ultrafiltration unit, which will ensure microbial safety of water for watering troughs and pools in animal enclosures.

The basic principle is water treatment with subsequent accumulation, which allows water from animal pools to be recirculated. This will maintain the quality and minimise the need to subsidise the water from the sources. The aim is to reduce the consumption of both domestic and mains water and the operation will become more independent of these sources.

2 Zoo Liberec – Existing condition – Site characteristics

The Liberec Zoo complex is located in the eastern part of the city Liberec. The zoo is located on the watershed of the Jizersky stream, which flows through the ZOO area from northeast to southwest and feeds the Swan Pond.

In addition to potable water from the public water supply, the source of water for the zoo area is also several sources of non-potable water. These are water intakes from Jizersky stream and boreholes in the lower part of the zoo. The intake from the Swan Pond supplies the upper part of the zoo area, where there is an interest pavilion for elephants and tapirs and also the stables, takini, etc. are supplied with it. The intake only works in the summer season, because the distribution pipeline of non-potable water is at freezing depth.

However, this source of water is limited by the low state of the water and its worse quality, which manifests itself especially in the summer. The operation of the zoo is thus faced with a lack of usable water, which must be replaced by potable water from the public water supply.

<u>Interest part of zoo area:</u>

Outdoor pool – elephants utility volume $V_{uti} = 64\ m^3$

Outdoor pool – tapirs utility volume $V_{uti} = 24\ m^3$

Indoor pool – elephants utility volume $V_{uti} = 14\ m^3$

Pond - giraffe utility volume $V_{uti} = 50\ m^3$

***Figure 1** – Outdoor pool for elephants*

***Figure 2** – Outdoor pool for tapirs*

***Figure 3** – Swan Lake*

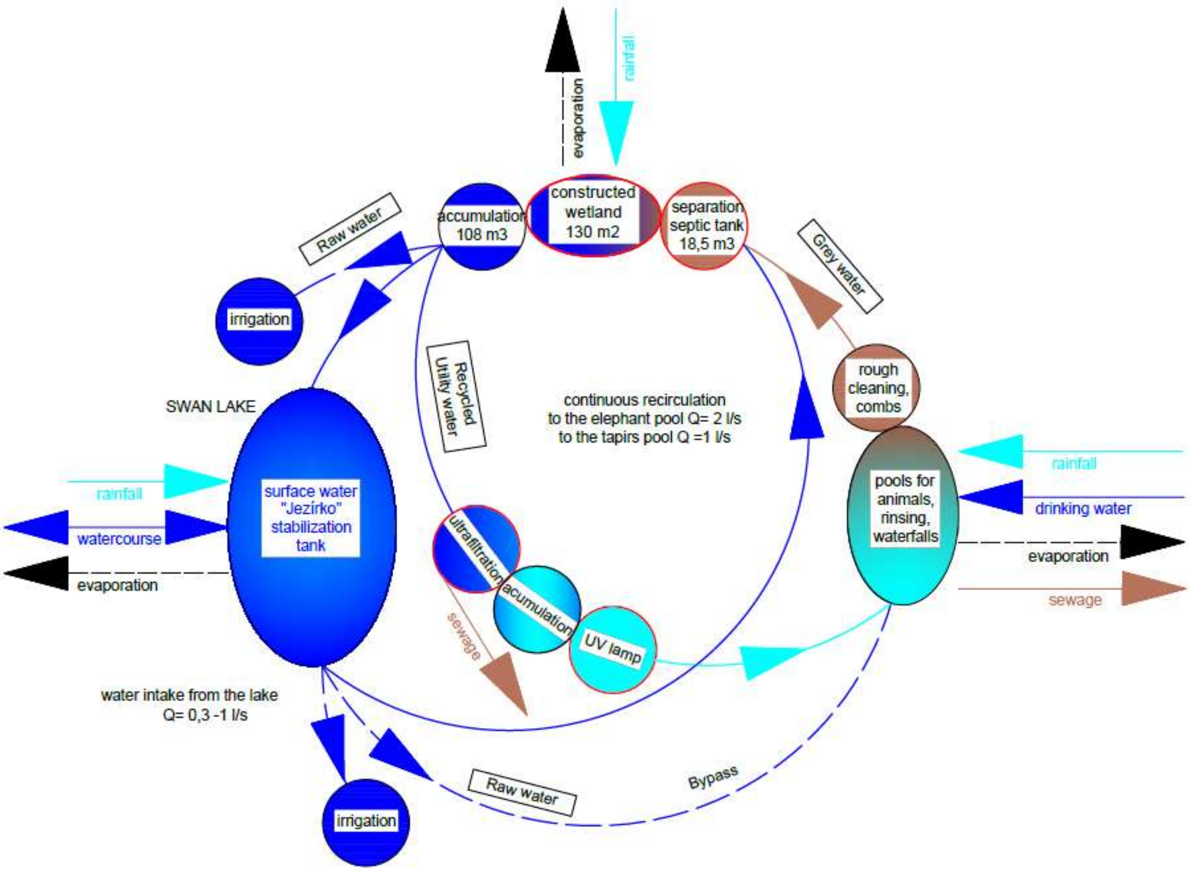
The outdoor pools for elephants and tapirs operate only in the summer season and are primarily supplied with non-potable water or potable water. The indoor elephant pool operates year-round and is supplied with potable water only. Water quality is ensured by regular replacement of the entire volume of water, which occurs approximately once a week depending on the conditions. The water drains into the public sewerage system.

3 General description

In the project is designed the system of water management of non-potable water in the part of Zoo Liberec. Purpose of the project is the accumulation and treatment of non-potable water with possibility of its recirculation for using in the elephant, tapirs and giraffe pavilion. Also there is considered with distribution of treated water to the non-potable water pipeline of Zoo and with preparation for connection of Zoo lower part.

There is designed the waste water treatment plant and ultrafiltration water treatment plant, which is placed in the ISO container. The waste water treatment plant consists of separation filter, pulse shaft, constructed wetland with vertical flow and pumping shaft. The ultrafiltration water treatment plant consists of accumulation tanks of raw water and treated water and technology of water treatment. The waste water treatment plant (WWTP) is used for mechanical and biological pretreatment of non-potable water from pools, the ultrafiltration water treatment plant (UWTP) is designed for microbiological security of pretreated water on WWTP. The water after water treatment is possible to return back to the pools of animals without the risk of endangering their health and as well the water is saving.

Figure 4 – FIT4USE water recirculation scheme technology in Zoo Liberec



4 Complete water management system

This is a non-potable water management system. The purpose is the accumulation and treatment of non-potable water with the possibility of recirculation for use in the pavilion of elephants, tapirs and giraffes. The system also enables distribution to non-potable distribution system for the needs of the zoo grounds (irrigation, flushing, etc.). Preparations for connecting the lower part of the zoo to the conventinal waste water treatment systém (or NBS) with recirculation or distribution are also being considered.

The basic principle is waste water treatment with water accumulation, which will allow the water from the pools to be recirculated. This will maintain quality and minimize the need to subsidize water from sources. The goal is to reduce the consumption of non-potable water and water from the public water supply system, and the operation will become more independent of these sources.

The system includes the construction of a constructed wetland - vertical root filter with an accumulation space. The filter works on the principle of an aerobic biofilter, which is used for biological-mechanical water treatment and mainly removes organic pollution. A separation filter is used for mechanical pre-treatment before entering the vertical root filter, where undissolved substances are basically caught.

Part of the system is a containerized water treatment plant with an ultrafiltration unit, which is located behind the waste water treatment plant before distribution back to the zoo. This will ensure microbial safety (sanitization) and the removal of residual organic pollution or undissolved substances.

To support the biological processes improving the water quality in the Swan Pond, natural bacteria accelerating the decomposition processes in the deposited sediment and an aeration system ensuring aeration, oxygenation and mixing of the pond water will be applied to the pond during the growing season.

The energy consumption of the installed system, in particular the container with the ultrafiltration unit, complete wiring and control system, will be provided by a photovoltaic power plant located on the roof of the entrance building to Zoo Liberec.

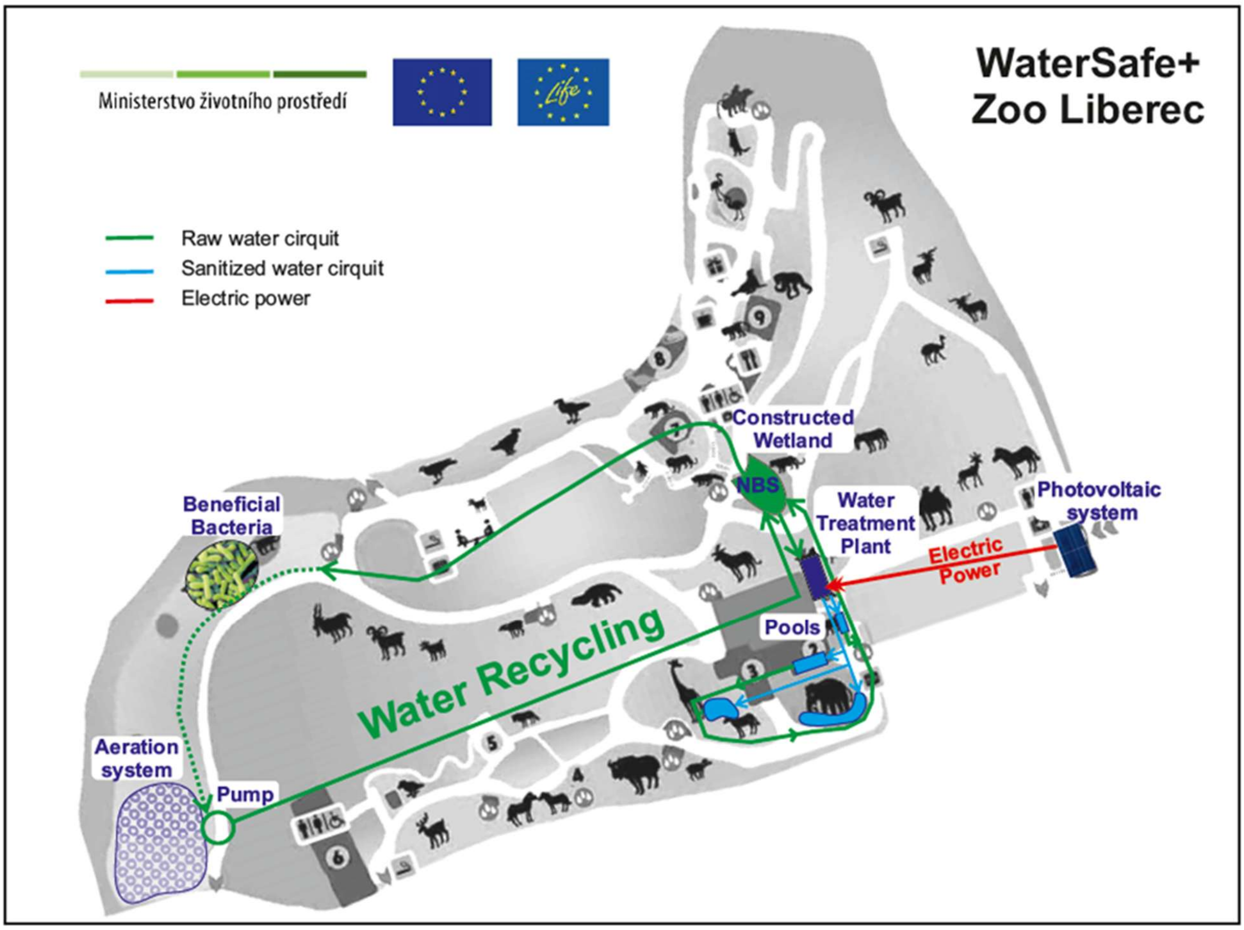
Summary of benefits:

- Recirculated waste water treatment for the needs of the elephant, tapir and giraffe pavilion (in the future the lower part of the zoo) has the effect of reducing the withdrawal from other water sources

- The use of preatreated water from the Swan Pond for distribution to the non-potable distribution system for the needs of the zoo grounds (irrigation, rinsing, water supply, etc.) has an effect on the reduction of withdrawal from other water sources

- Restriction of discharged polluted water into public sewage system

Figure 5 *- Location of the prototype at Liberec Zoo*



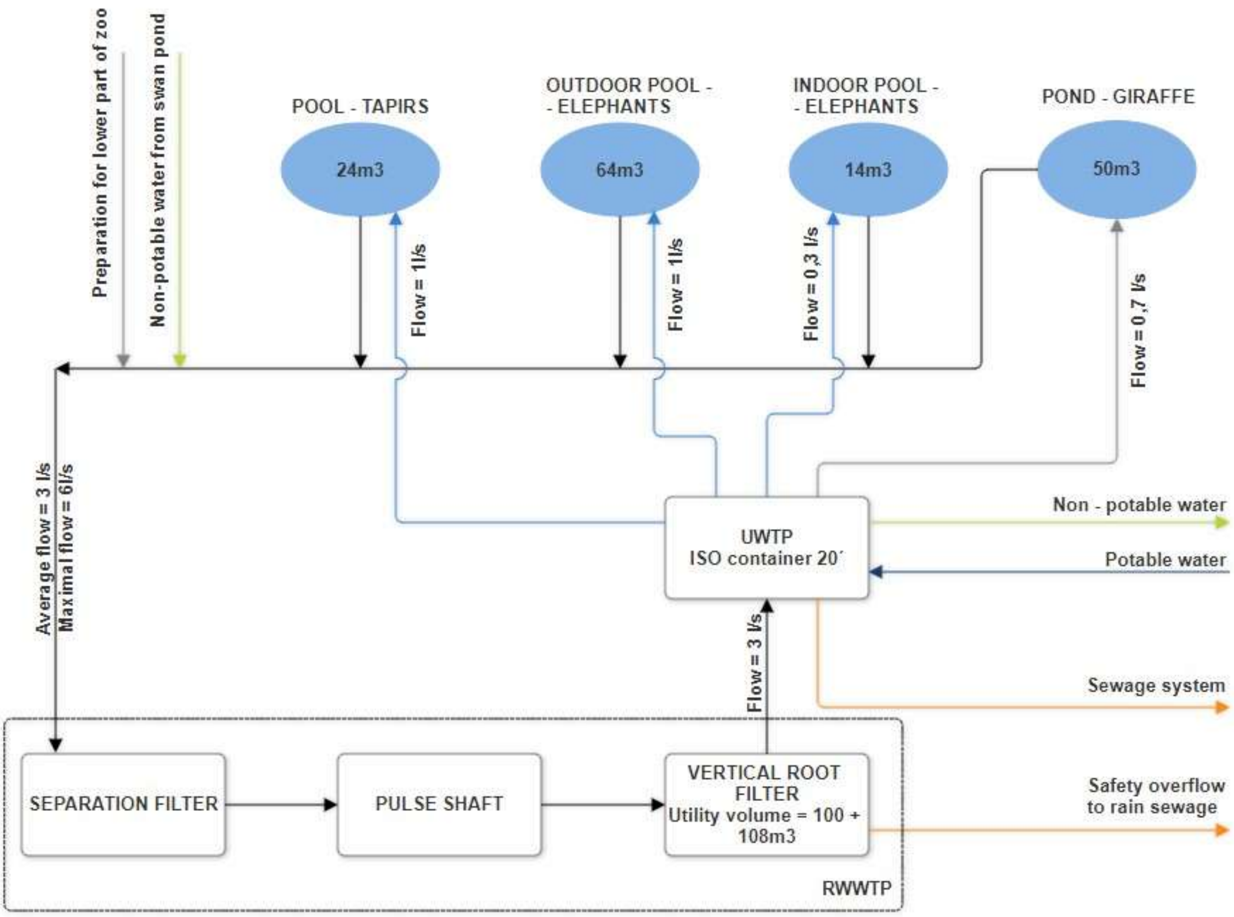
The overall situation of the circular water management system in in the real environment of Zoo Liberec Zoo Liberec is attached as Annex 1 and 2 to this report.

5 Operational technical solution

The operational technical solution is shown in the complete technological scheme, which is part of technological part of project documentation – see Annex 3 to this report.

The process of water treatment and recirculation in Zoo Liberec is shown in the following block diagram in Figure 5.

Figure 6 - *Process flow diagram*



5.1 Sources of the water system

The system is supplied mainly by water from the Swan Pond, into which a large amount of rainwater from the zoo area is connected. In the future, rainwater from the roofs of the pavilions will also be piped directly into the water management system. Potable water serves as a backup source.

Because the quality of the water in the Swan Pond shows pollution values that are particularly evident in summer, it is initially connected to the water management system the separation filter and vertical root filter. Water intake will take place automatically according to actual needs.

Balance of water inflow from the Swan Pond:

Inflow from Swan Pond – continuous refill of accumulation AK1….. 0.1 l/s = 8.6 m3/day

Inflow from Swan Pond – maximal refill of accumulation AK1……… 1 l/s = 86 m3/day

5.2 Waste water treatment plant (WWTP)

Description of the function and operation of WWTP objects (separation filter, vertical root filter, accumulation space of WWTP):

The separation filter is used as mechanical pretreatment before inlet to the vertical root filter. Undissolved substances will be caught there. The vertical root filter is divided into two separate functional surfaces for operational needs. It is designed as a hydro-insulated natural reservoir containing aggregates of various thicknesses and fractions, with integration into the surrounding terrain.

The inlet to the separation filter is by means of a flexible hose, which makes it possible to change the inlet between two independent surfaces of the separation filter. The inflow will spill onto the surface of the filter and flow vertically through it. It drains through the collection bottom pipe. In particular, sediment will settle on the surface of the filter, which will be removed by the operator. In the case of a condition of impaired seepage capacity, or for a certain period of time, the second filter surface will be engaged and the clogged filter surface will be cleaned. The cleaning of the filter will consist of the temporary removal of the plastic grates from the surface and the removal of the sediment, including a partial layer of the top filling of fraction 2/4 sand. The removed sand will be added and the plastic grates will be returned. The sand can be washed and reused in a suitable place. It is advisable to perform the cleaning only after a certain period of time after the filter has been shut down. The cleaning period will depend on the specific conditions and pollution produced. The prediction is the renewal of ½ filter (i.e. one area of 15 m2) per year. If necessary, the collection pipeline will be flushed using inspection chimneys.

The pulse shaft is equipped with a mechanical pulse discharger. It converts a continuous inflow into a volumetric outflow and thus enables optimal distribution of water on the surface of the vertical root filter.

The vertical root filter is a waterproofed natural reservoir that is integrated into the surrounding terrain. Its content is composed of aggregates of various strengths and fractions, and the surface is planted with wetland vegetation - see Annex 4 to this report.

Functionally, it is a non-flooded sprinkled aerobic biofilter that serves for biological-mechanical treatment of wastewater. Part of the vertical root filter is the water accumulation space in its lower, jointly waterproofed part. This space is composed of accumulation PP blocks and partially aggregate.

The vertical root filter requires only an occasional check of the seepage capacity, and possible flushing of the distribution pipe can be done using inspection chimneys. The operator removes weeds and mows grass on the airy slope of the embankment. In winter, preferably in February, it is necessary to mow the wetland plants.

The vertical root filter can also be operated in the winter, it is assumed that the treated function is only partially impaired. At least the indoor elephant pool is expected to operate during the winter. In the case of a complete shut down of the pools, the constant quality of the accumulated water will be maintained by a small recirculation circuit of internal recirculation through the discharge pipe opening into the pulse shaft. The sprinkler function of the filter must also be maintained for watering the plants.

The pumping shaft is part of the vertical root filter. It is used to place pumps that pump water from the accumulation part of the vertical root filter further into the system. At the same time, the shaft is intended for height regulation or volume of water in the vertical root filter accumulation part and also allows to regulate the level in the filter space serving as an operational reserve storage volume.

In the pumping shaft, it is possible to change the level height using a flexible hose. In normal operation, the level will be maintained at the level of flooding of the full storage capacity - elevation 395.10 = utility volume 108 m3. Minimal storage volume of 8 m3 must be preserved for recirculation and cannot be used for utility distribution without recirculation. The level or the volume can also be reduced as needed. In order to use the operational reserve volume, the level will be raised up to elevation 396.02 = an additional accumulated volume of 40 m3. This will result in a temporary flooding of the filter, which is not a problem. This state will be able to be used, for example, when one of the pools is completely drained. This saves water that would otherwise flow into the existing rain sewage system.

Parameters of WWTP:

- Accumulation volume — 108 m^3 (minimum 8 m^3 volume for recirculation must be maintained)
- Accumulation min.utility volume — 100 m^3
- Operational reserve accumulation volume — 40 m^3
- Total maximum accumulation volume — 148 m^3

5.3 *Ultrafiltration unit*

The technology of the container ultrafiltration water treatment plant is based on the wastewater treatment plant and forms an integral part of the complex water recycling system on the site Zoo Liberec.

Due to the requirement for maximum operational safety and microbial safety of the water at the level of bacteria and viruses due to the breeding of different types of animals, it was decided to design ultrafiltration treatment plant for pre-treated water from the WWTP. The water treated by the ultrafiltration treatment plant can then be returned to the animals' pools without risk to their health and thus achieve a high water saving in the Zoo area.

5.3.1 *Parameters of ultrafiltration technology*

Maximum influent parameters for the ultrafiltration container water treatment plant:

- Maximum flow rate Qmax: 10.8 m3/h
- Chemical oxygen demand CODMn: 110 mg/l
- Non-dissolved solids NL: 30 mg/l

Runoff parameters:

- Recovery: min. 90%
- Output water: microbially safe water
- Suspended solids NL: 3 mg/l
- Estimated quantity

Wastewater: approx. 5 m3/d (depends on operating conditions) - to be determined on the basis of test operation)

5.3.2 *Description of the proposed container water treatment technology*

Treated water from the WWTP (part of the pulse shaft) flows into the pumping shaft, which is structurally part of the WWTP. The water is pumped by submersible pumps to storage tank AN1, which is designed as precast concrete tank.

From the storage tank AN1 water is pumped to the process line of the container ultrafiltration water treatment plant by horizontal feed pump. The water passes through an automatic disc filter with a porosity of 130 µm to the InLine coagulation plant, where coagulant solution and NaOH for pH adjustment are dispensed using metering pumps. The amount of water is detected by a pulse water meter and the resulting pH is checked by a pH probe. The water then enters the ultrafiltration unit equipped with three modules with IN-OUT membranes.

Probes - pH, conductivity, redox – and pulse flow meter are fitted on the treated water pipe after ultrafiltration. At the same time, it is possible to alternatively dose biocide into the pipeline with the dosing pump.

The product from the ultrafiltration unit is fed into the storage tank AN2 with a volume of 24,5 m3. Drinking water is also fed into the storage tank AN2 via an electromagnetic valve.

The storage tank AN2 serves as a water storage for backwashing of the ultrafiltration and as a water storage for the consumer unit. From the storage tank AN2, water is pumped by the ATS to the distribution via a pulse flow meters.

A Swan pond is used as a supplementary water source, in which the water level is measured by a strain gauge and the flow through the existing pump is detected by a pulse water meter. The water supply from the Swan pond to the system is provided by a solenoid valve.

In the event of a failure in the ultrafiltration system, the system can alternatively be operated via bypass. A manual disc filter and a UV lamp are located on the bypass.

***Figure 7** - Container water treatment plant*

5.3.3 Description of the technological section

The ultrafiltration line is located in a 20' insulated container (see Annex 5 of this report) and its design forms a separate unit with interactions with downstream parts of the water system Zoo Liberec.

Functional part I includes the water pumping system from the WWTP to the storage tank AN1, and necessary metering and control elements

Functional Part II comprises a feed pump for a water pre-treatment system consisting of disc filter filtration and INLine coagulation (includes the necessary elements instrumentation and control)

Functional Part III represents the ultrafiltration unit, which is a separate functional unit.

Functional part IV consists of the water treatment plant, storage tank AN2 for treated water and an automatic pressure station (ATS), which ensures the transport of water to the consumption area.

Functional part V consists of a control system with digital touch screen (PLC) located in the control cabinet of the technology.

***Figure 8** – Ultrafiltration unit*

5.4 Storage tank (AN1+AN2)

Two storage tanks - AN1 and AN2 - are proposed in the technology of the container water treatment plant. The AN1 and AN2 storage tanks form one precast concrete underground tank (See Annex 6). Storage AN1 and AN2 are created by means of a partition. Each storage area is provided with a separate entrance. Precast concrete tanks are highly durable and reliable tanks that are used for water storage. They are made of C40/50 waterproof, environmentally resistant concrete XA1.

Parameters of the storage tank AN1

- Internal dimensions L x W x H: 2 800 x 900 x 2 780 mm
- Usable volume Used: 5.9 m3
- Material: precast concrete

Parameters of the storage tank AN2

- Internal dimensions L x W x H: 2 800 x 3 300 x 2 780 mm
- Usable volume Used: 22.5 m3
- Material: precast concrete

5.5 Pools

The outdoor pool for elephants, the outdoor pool for tapirs and the indoor pool for elephants are designed similarly. The drains of these pools will primarily be connected to the surface, which will maintain the full volume of the tank, which is a solution for continuous recirculation. In both elephant pools, the inlet itself is equipped with a vertical grid to keep larger floating dirt and elephant excrement, which the staff will remove. Tapirs have no grid due to different faecal production.

The pools are equipped with a bottom drain, which will be used in case of total discharge and subsequent cleaning or partial release of water from the bottom and is controlled by a valve. It is possible to carry out a partial release of water from the bottom at specified intervals as a release of sedimented impurities from the bottom and will depend on the operating conditions.

The cycle of completely draining the pools for complete cleaning will be significantly longer than before.

The existing drains and inflows are preserved at the pools, except for the drains from the elephant pool, which will be replaced with new ones. The possibility of discharge into the public sewage system will be through a new valve with connection.

The giraffe pond is managed according to its own project documentation.

The preparation of the lower part of the zoo will concern the supply of these pools (reservoirs):

- Sea lion – outdoor pool 250 m^3 (utility volume)
- Sea lion – indoor pool 12 m^3 (utility volume)
- Penguins pool 13 m^3 (utility volume)

5.5.1 *Operating modes*

Operationally, continuous recirculation of all pools and giraffe ponds is assumed, with a possible combination of complete draining for cleaning purposes. The amount recirculated or the replacement interval will depend on the specific pollution conditions that the operation will show and will depend on several factors.

When replacing entire volumes of water, the accumulation volume of the filter (possibly also the operational reserve) can be used so that there is no loss of water to the rain sewage system by overflow. The amount of recirculated water can be set for each pool or pond separately using a manual control valve. The operator of the system will be the zoo, where the authorized person will deal with this manipulation as needed.

Estimated water consumption - upper part:

- Outdoor pool - elephant utility volume 64 m^3 (0.74 l/s - exchange 1x a day)
- Pool - tapirs utility volume 24 m^3 (1.0 l/s - exchange 3.6 times a day)
- Indoor pool – elephants utility volume 14 m^3 (0.16 l/s - exchange 1x a day)
- Pond – Giraffe utility volume 50 m^3 (0.58 l/s - exchange 1x a day)

Total – upper part of zoo 2.48 l/s

Estimated water consumption - lower part:

- Outdoor pool - sea lions utility volume 250 m^3 (2.89 l/s - exchange 1x a day)
- Indoor pool – sea lions utility volume 12 m^3 (0.14 l/s - exchange 1x a day)
- Pool - penguins utility volume 13 m^3 (0.15 l/s - exchange 1x a day)

Total – lower part of zoo 3.18 l/s

Note: Sea lions and penguins will not be allowed at the same time

5.5.2 Design limit states

A – Daily recirculation of the upper part of the zoo

3 l/s includes usage per day:

- Continuous recirculation - tapir pool 1 l/s
- Continuous recirculation - elephant outdoor pool 1 l/s
- Continuous recirculation - elephant indoor pool 0,3 l/s
- Continuous recirculation - giraffe pond 0,7 l/s

B - Adding water to the lower part of the zoo

3 l/s includes usage per day:

- Lower part of the zoo refill of water approx. 2/3 of the volume from the WWTP accumulation (refill 2 l/s = 173 m^3/d). Current accumulation + intake of 1 l/s from swan pond is considered.

Pumped 86 m^3/d from the accumulation under the vertical root filter → saving water from boreholes.

- Continuous recirculation of tapir pool 1 l/s.

5.6 Automated control system

The control and management of the proposed system will be located in the UWTP container. The container will be heated and air-conditioned by an air-conditioning unit and will be connected to the utility water supply and the waste water supply and drainage. An LV earth line will be laid from the adjacent building in the Zoo Liberec to supply the technological and construction part (air conditioning and lighting of the building). The main switchboard is also connected by cable from the existing switchboard in Zoo Liberec and is installed on the inner wall of the containerised ultrafiltration water treatment plant. The cables of the individual electrical wiring and electrical connections of the individual elements of the Watersafe+ system will be routed in the ground, in common trenches for pipe laying. The cable is laid in a trench at a depth of at least 80 cm below the terrain and placed in a PVC protector and in a 20 cm thick sand backfill.

The electrical switchboard contains the following basic units:

- construction electro
- technological electro
- control PLC

Minimum requirements for PLC control:

- Touch panel at least 10´´ with a resolution of at least 800 x 600
- Automatic and manual operation of all components
- Connection to ZOO fiber optic cable
- Technological diagram on the home screen with top bar fully graphicised
- Current status (on/off) color coded for all components
- 3 user levels
- Data backup 24/7 with 1 year capacity
- Remote monitoring by a technologist of the technology supplier
- Remote management including remote control of components
- Status display last hour, 24 hour, 48 hour
- Graphs - flow rates and all measured variables, all on separate screens
- Alarms with 1 year history
- Service alerts for component replacement or service
- Motor hours
- Electricity consumption
- Data statistics, output to excel
- Output to a 24´´ monitor on the container window (visibility for Zoo visitors)
- Output to the technology supplier's control room with monitoring service.

5.7 Solar system

The Watersave+ prototype also includes renewable power source in the form of a solar power system. The original assumption was that the photovoltaic system would power a small ultrafiltration unit with a capacity of 0.3 l/s and an electricity consumption of 2.5 kW. Based on the zoologist's request to ensure the sanitation of all recirculated water, the capacity of the UWTP was increased to 3 l/s (max 6 l/s), with a power consumption of 28.3 kW, well above the original assumption.

Therefore, a PV system with higher capacity but without battery storage was designed for the needs of Zoo Liberec. On the security side, the system will be connected to the zoo's power grid to prevent outages in case of adverse light conditions, especially in the winter period, which will subsidize the total consumption of the Zoo from March to October, from which the entire Watersave+ circuit, including UWTP, will be powered.

Solar power sources with a capacity of up to 50 kW are not subject to building permits in the Czech Republic, so this part of the prototype is not part of the project documentation for the construction procedure and a separate project plan will by prepared for it.

5.7.1 Description of the PV system

The source of energy (power) are photovoltaic cells suitably grouped and enclosed in photovoltaic panels - JA Solar 465 Wp oriented southeast at an angle of 10°. When solar radiation of the required intensity is incident, these panels generate a DC voltage and current of a magnitude proportional to the intensity of the incident radiation.

The panels are connected in series in strings and equipped with TIGO optimizers, which set a safe low voltage (1 VDC) at their output when the STOP button of the PV plant is pressed. It makes any service or firefighting intervention safe.

Furthermore, the strings are connected to the DC part of the inverter via surge protectors type SPD 1+2, also via the DC part of the RFVE with fuses, and also with combined lightning and surge arresters type SPD 1+2. The connecting cables of the strings are of 6 mm2 cross-section, single-core with double insulation.

The Huawei SUN2000-30KTL-M3 inverter provides automatic conversion of DC voltage to line voltage. The magnitude and frequency of the output AC voltage is automatically regulated according to the connected line voltage. The power is further transferred from the inverter via a 1-CYKY-J 5x35 cable to the main HR switchboard.

If the power generation exceeds the consumption of the consumption point (building), there will be overflows through the corresponding metering point with a 4Q meter in the meter switchboard to the distribution grid.

The system includes the installation of a PV STOP safety button for possible disconnection of the PV plant from the grid, which will be placed in a visible and accessible location. In the HR switchboard, an outlet will be added to connect the power from the AC part of the RFVE.

The PV plant will be monitored via the inverter application or via the optimizer application.

5.7.2 Basic parameters

Modul DC name plate = Power:	37,7 kW
Number of frames	81
Dimensions of solar panels	1x1 m
Annual production	35,14 MWh
Performance ratio	84,8%
kWh/kWp	933

Figure 9 *- Design of photovoltaic system on the roof of the main entrance to Zoo Liberec*

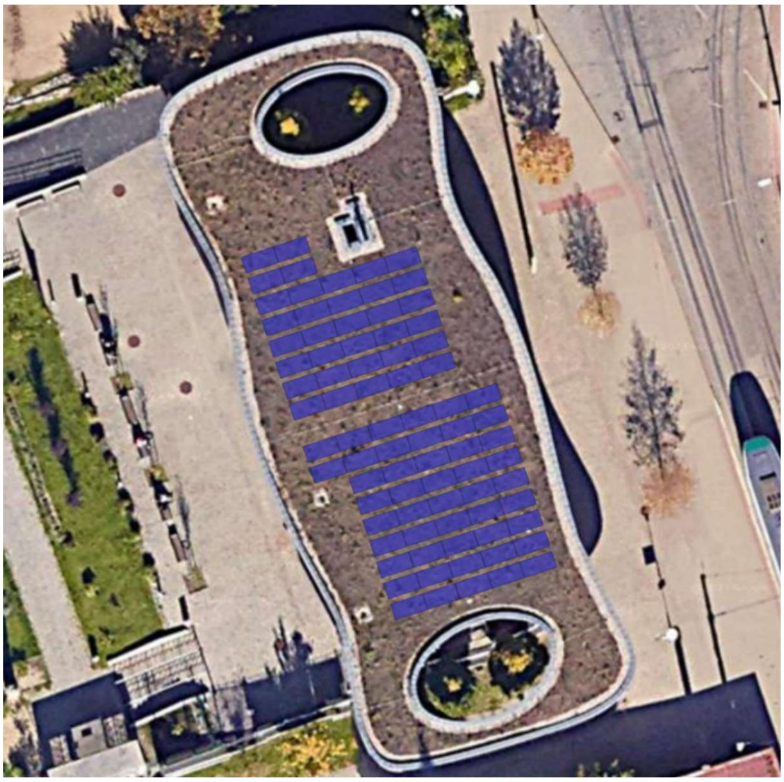
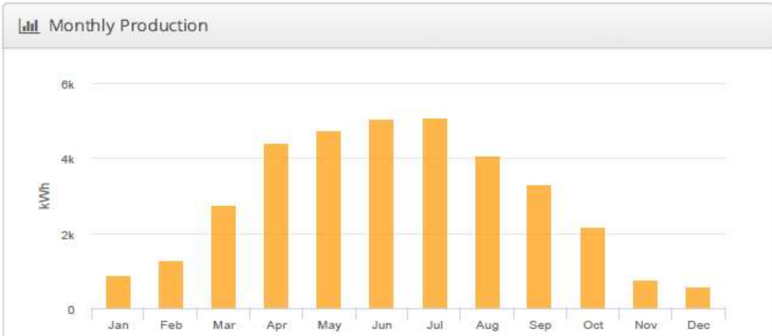


Figure 10 *– Monthly production of the photovoltaic system for Zoo Liberec*



Month	GHI (kWh/m^2)	POA (kWh/m^2)	Shaded (kWh/m^2)	Nameplate (kWh)	Grid (kWh)
January	24.5	31.5	27.0	936.0	881.4
February	34.2	40.2	38.1	1,332.3	1,273.5
March	74.4	82.6	81.5	2,882.5	2,744.9
April	124.5	133.5	132.5	4,709.5	4,408.8
May	142.7	148.0	146.9	5,220.3	4,778.2
June	155.5	158.5	157.4	5,596.6	5,075.8
July	156.2	160.3	159.2	5,670.4	5,096.1
August	121.9	127.4	126.4	4,485.1	4,053.8
September	92.9	102.4	101.5	3,595.9	3,309.1
October	58.1	68.6	66.4	2,332.7	2,166.9
November	21.5	25.5	23.3	813.4	755.7
December	17.1	22.1	18.7	647.2	597.9

5.8 Aeration system

The uptake of oxygen and its efficient dispersion throughout Swan Lake is important for microorganisms that keep the ecosystem in balance and consume nutrients present in water body, created mostly by anthropogenic activities.

The concentration of dissolved oxygen in the water naturally fluctuates seasonally, and throughout the day and night. In summer, for example, the concentration of dissolved oxygen in water decreases with the increasing water temperature.

In general, the surface layer of the water is supersaturated with oxygen due to the presence of photosynthetic organisms, while there is a lack of oxygen at the bottom of the reservoir, due to the decomposition of organic matter and nutrients present in mud sediments.

These conditions create a competitive environment in which cyanobacteria and algae typically begin to dominate, as they are able to move vertically in the water between the rich oxygen layer at the surface and the rich nutrient layer at the bottom. The overgrowth of cyanobacteria leads to a formation of oxygen-free zones in the body of water, an imbalance in the ecosystem and the death of acquatic life.

Optimal aeration can support the decomposition of organic matter and nutrients, reduce the growth of cyanobacteria and algae and improve living conditions for fish and other organisms.

For the Swan Pond in Zoo Liberec an aeration system is designed consisting of two blowers, each of which is connected to 6 end diffusers in one line.

5.8.1 Technical design of the aeration system

Assembly of components :

- Connection to 230 V
- The length of the pipelines about 25 m
- 2 pcs Membrane blower SECOH JDK-S-500
- 12 pcs Aeration element HD 340

Membrane blower SECOH JDK-S-500

- oil-free operation
- diaphragm damage signalling
- lower power consumption
- new magnet protection system
- safety and safety features to protect the blower in case of rupture of the diaphragms
- quiet operation, low vibration

- use in outdoor and indoor environments
- long service life of diaphragms and moving parts
- Alloy packing - improves cooling efficiency and extends the life of the diaphragms

Parameters of the blower :

- Air flow:
  - at 0 mbar 700 l/min
  - at 50 mbar 655 l/min
  - at 100 mbar 600 l/min
  - at 150 mbar pressure 545 l/min
  - at 200 mbar 500 l/min
- Voltage / frequency 230V / 50Hz
- Power consumption at 200 mbar 450 W
- Noise level 58 dB
- Weight 18 kg
- Width 335 mm
- Depth 240 mm
- Height 238 mm

Parameters of the aeration element HD 340

Aeration elements with high sealing capacity. Due to their reliability they are mainly used in wastewater treatment plants (WWTPs). Of course, they are also used for aeration in garden ponds. Their clear advantage is that they do not clog like conventional air stones.

Regular use of maximum air flow for short periods of time helps to keep the diffuser in good condition in the long term. Membrane life up to 10 years.

- Weight 0,85 kg
- Overall diameter 340 mm
- Active diameter 220 mm, 310 mm
- Plate height 46 mm
- Total height 76 mm
- Outer thread 3/4"

Attachments

Annex 1 – Overall situation of the Liberec ZOO, 1:1500

Annex 2 – WWTP with water recirculation technology – Construction situation, 1:500

Annex 3 – Technological scheme

Annex 4 – Vertical root filter,1:50

Annex 5 – Ultrafiltration unit – 3D view

Annex 6 - UWTP - SECTION A-A, 1:30