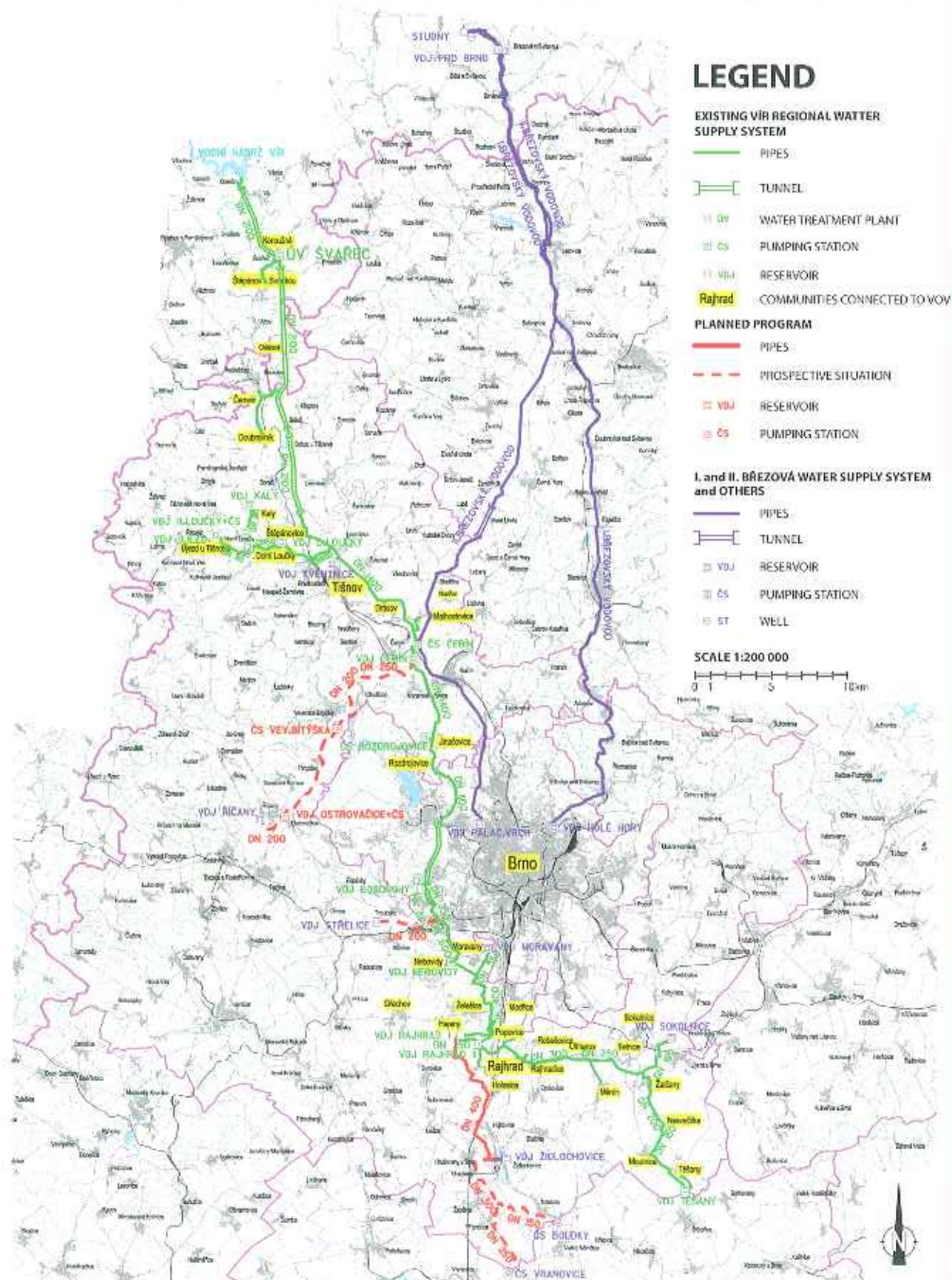


VÍR REGIONAL WATER SUPPLY SYSTEM

VÍR REGIONAL WATER SUPPLY SYSTEM



Introduction

The construction of the Vír regional water supply system (VOV) started in 1988, that is to say in the period when the necessity for water with a subsidized low price was increasing. At first, the investor of the construction was the State, but since 1994 the investor has been the corporation Vír regional water supply system. The corporation was formed by cities, villages and groups of villages that wanted to take water from the VOV. The finalization of the construction was continually stalled particularly for the want of finance, so the test run of at least the first part of the construction began only in January 2000.

In the time period until 2010 the VOV was being gradually finished with short disruptions by connecting localities situated along the route of the VOV trunk main. In this period the VOV was operating without the section of Bosonohy – Moravany as the construction of the section started in 2008 and finished in September 2010, that is 22 years after the construction of the VOV was started.

Progress of Preparing and Constructing the VOV

1983	Investment purpose of the construction
1985	Study of the construction complex, project design
1988	Initiation of the construction
1993	Establishment of the corporation VOV
1997	Interconnection of the II. Březová water supply system with the VOV at Čebín – U3
1999	Water supply from Moravany to Rajhrad
2000	Initiation of a test run (section of Vír – Švařec – Čebín)
	Linking up of Malhostovice and Drásov to the VOV
2001	Start of the Rajhrad – Těšany operation
2002	Start of the Čebín – Bosonohy operation
2004	Linking up of Štěpánov and Rebešovice to VOV
2005	Linking up of Modřice and Štěpánovice to VOV
2006	Installation of technology at the Švařec water treatment plant
2007	Linking up of Doubravník to the VOV
2008	Linking up of D. Loučky, Kaly, Újezd u Tišnova and Tišnov to the VOV
2009	Linking up of Rozdrojovice to the VOV
2010	Linking up of Chlébské and Černvín to the VOV
	Finalization of the section of Bosonohy – Moravany
	Linking up of Nebovidy and Moravany to the VOV





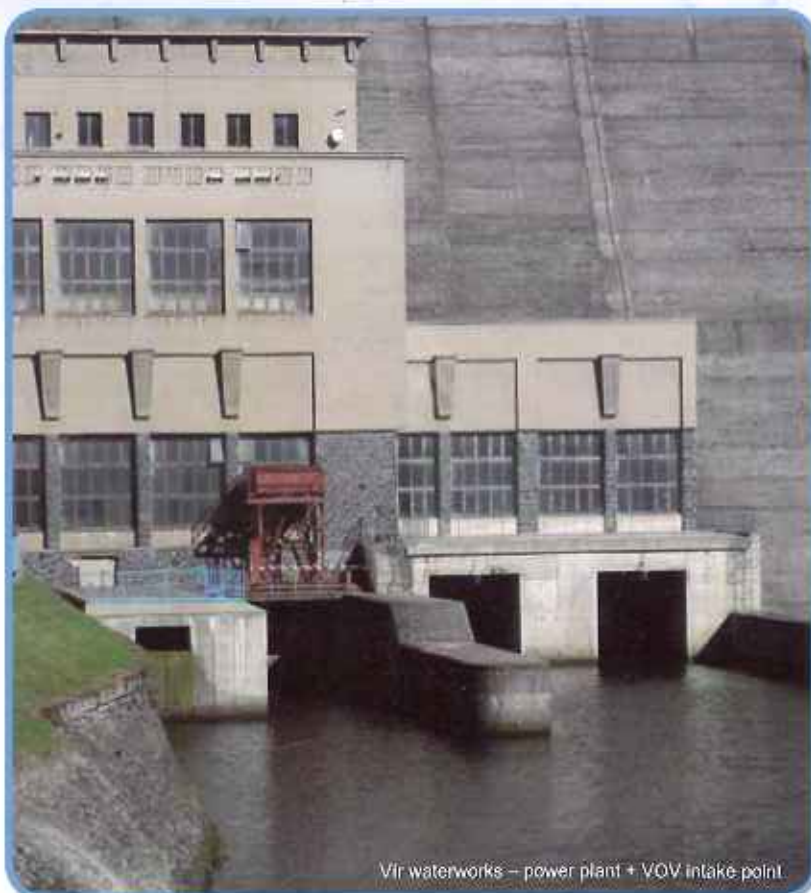
SOURCE



Vir waterworks – reservoir



Vir waterworks – air view



Vir waterworks – power plant + VOV intake point



Vir waterworks – stilling basin below



Source

The source of raw water

is a water dam on the Svratka River at the village of Vir. The dam's water hygienic protection zones were proclaimed as early as 1964 within the supply of the area of Bystřice n. Pernštejnem – Nové Město na Mor. – Žďár nad Sázavou with water from the water treatment plant situated near the dam. Raw water is relatively soft, little mineralized, with a low organic compound content. The content of heavy metals and other toxic compounds is only in trace concentrations. As there had been problems with water quality caused by the occurrence of blue-green algae, granular activated carbon filtration was added to the technology of the Švařec water treatment plant.

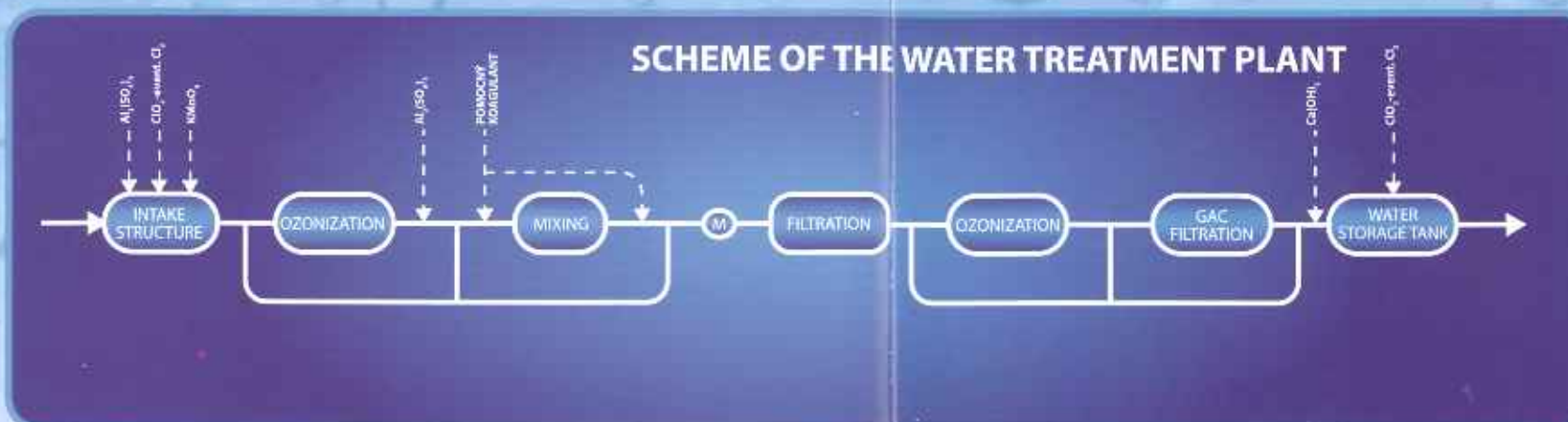
Raw water intake

The intake device is installed on the dam of the Vir water reservoir. The water can be taken in from three horizons according to the momentary best quality of the water in the tank. The water is taken at the depth of 15 m, 30 m and 50 m under the level of the maximum water level in the tank, which is 469.00 m above sea level. Stainless steel pipes are lead from abstraction points to analyzers measuring oxygen and pH concentrations, turbidity and temperature of the water in the tank. These data are transferred to the control room at the Švařec water treatment plant. The intake pipe of raw water which takes water to a separate part of the waterworks' stilling basin is at the same time the inlet to the Francis turbine of the Vir power plant.

The raw water trunk main

starts in the intake point in a separate part of the stilling basin. From this place a fibreglass pipe DN 1600 of length of 620 m is lead to the portal of the Vir raw water tunnel. The raw water tunnel is 4, 171 m long, with an internal diameter of 2,104 mm, including the lining. The delivery pipe DN 1400 to the Švařec water treatment plant, which is 411 m long, is connected in the portal of Koroužné to the armour-plated outlet of the tunnel.





The Treatment of Water

The Švařec water treatment plan

The Francis turbine of 210 kW output is installed in the intake structure. In the ozonization structure chlorine dioxide or ozone is dosed into the overflow in the intake structure as an oxidizing agent; as coagulant aluminium sulfate is used. Furthermore, it is possible to dose potassium permanganate in order to remove manganese from raw water. In case of preozonation, the coagulant is dosed downstream of this unit. Other steps of the technological process are slow mixing and contact filtration through sand filters. It is also possible to filtrate through granular activated carbon.

The water treatment plant was designed and built for the maximum capacity of 2,300 l/s. When the test run of the treatment plant was started 10 sand filters were fitted out, 10 sand filters were not fitted out at all, and the maximum capacity was 1,150 l/s. In 2005 6 filters were filled with granular activated carbon, which is used for filtration if the water quality of raw water in the Vír reservoir worsens in the period of occurrence of blue-green algae. At the present operation of sand filters as well as filters with activated carbon, the maximum capacity of the treatment plant is 1,840 l/s.

Water is deviated from the filters either to storage tanks, (limewater is dosed to the overflow for the adjustment of pH), or to disinfecting ozonization (in this case the limewater is dosed to the overflow downstream of the cooling tanks). Chlorine dioxide, a disinfecting agent, is dosed to the overflow into the storage tanks.

The Švařec water treatment plant is capable of substituting fully the II. Březová water supply system and covering completely the demand for water in the supplied area in case of a severe breakdown of the water supply system or of its planned operational shutdown.

In the water treatment plant there is an automatic booster station installed in order to deliver water to the village of Kroužné, including Švařec, and also to the village of Štěpánov nad Svratkou.



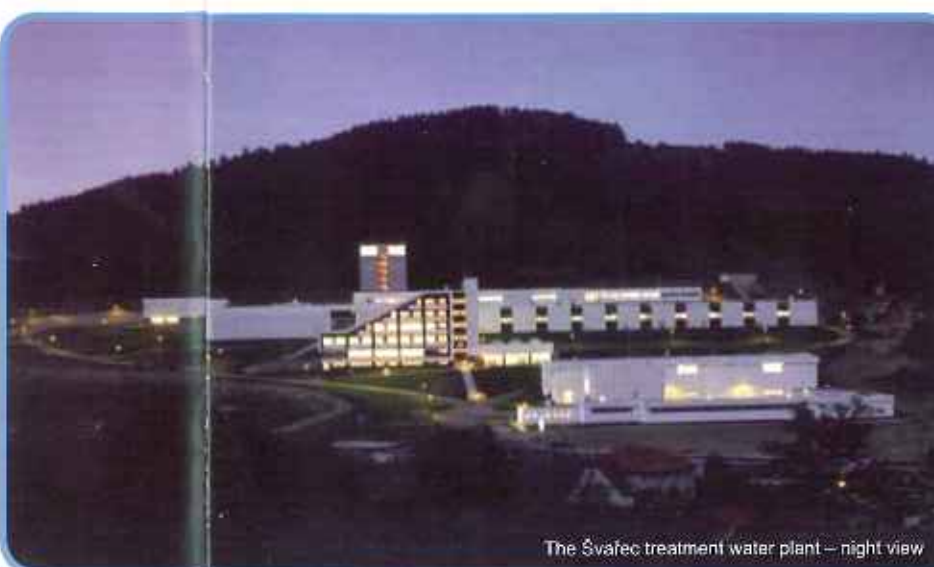
Švařec treatment water plant – view from chemistry building



The Švařec treatment water plant – big tanks



The Švařec treatment water plant – inlet of raw water to the filters



The Švařec treatment water plant – night view





THE TREATMENT OF WATER



Švařec water treatment plant – turbine in the intake structure



Švařec water treatment plant – disinfection of water



Švařec water treatment plant – ozonization



Švařec water treatment plant – sludge treatment – thickening tanks



Švařec water treatment plant – passage among filters



Švařec water treatment plant – filters





THE DELIVERY OF WATER



The Běleč I. portal – connection of the trunk main to the armour-plate of the tunnel



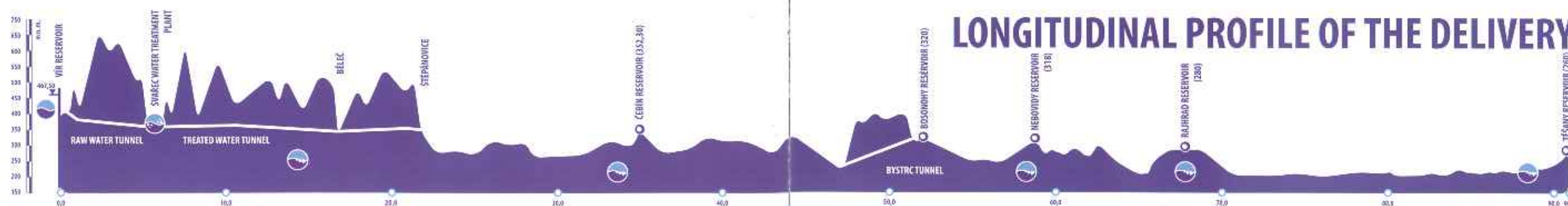
The Štěpánovice portal

The Delivery of Water

The trunk main of the treated water delivers water to all the supplied area. In the major part of the route it is constructed as a pipe network, in the section of Švařec – Běleč – Štěpánovice as a pressure tunnel, and in the section of Bystrc – Bosonohy the pipes are placed in a transit tunnel.

► The section of Švařec - Štěpánovice

The section between the Švařec water treatment plant and the portal of the treated water tunnel of Švařec is made of a fibreglass pipeline DN 1400, which is 668 m long. The rest of the section is constructed as a pressure tunnel with ferroconcrete lining with an internal diameter of 2,104 m. The section of Švařec – Běleč I. is 10,830 m long and the section of Běleč I. – Štěpánovice is 5,015 m long. The interconnection of the portals of Běleč I. and Běleč II. with an underpass under Křepťovský potok is made of a pipeline DN 1400, which is 97 m long. In the tunnel section there are two ventilation bore-holes: the drilling of Chlébské, from which the village of Chlébské is connected, and the drilling of Brusná, from which Lomnice will be connected. A side transit tunnel is constructed at the village of Černvír, from which the villages of Černvír and Doubravnik are connected.





THE DELIVERY OF WATER



Újezd u Tišnova reservoir



Horní Loučky reservoir



Horní Loučky pumping station



Kaly reservoir



Air valve chamber of Štěpánovice



Dolní Loučky reservoir

► The section of Štěpánovice – Čebín is 13,381 m long and it is constructed of a fibreglass pipeline DN 1400 mm. On the route there are seven air valves, nine blow-off valves, U2 Lomnička and U3 Čebín valve houses. The pipeline of II. Březová water supply system passes through the U3 valve house, which is connected here to the VOV pipeline through the VOV reservoir in Čebín. This way it is possible to deliver water to the supplied area either by the VOV pipeline to the locality of Bosonohy, or by a pipeline of the II. Březová supply system to reservoirs on Palacký vrch in Brno. On this section of the trunk main there are gradually linked localities of Štěpánovice, Dolní Loučky (and also Kaly and Újezd u Tišnova), Tišnov and Malhostovice (and also Drásov and Nuzířov).





THE DELIVERY OF WATER



Rozdrojovice pumping station



the Čebín reservoir – view



the Čebín reservoir – air view



the Čebín reservoir – air view

● Čebín reservoir

is two-chambered with a capacity of 8,500 m³, the elevation of the maximum water level is 352.30 m above sea level and its function, among others, is the mixing of water from II. Březová supply system with water from the VOV. By this mixing the hardness of the mixture of these two waters is adjusted. The underground spring water from Březová ranges from moderate to high in hardness water from the Švařec water treatment plant is soft with minimal content of free carbon dioxide. If mixing of both the waters was uncontrolled, the resulting mixture would become aggressive to the metal pipeline. For this reason part of free carbon dioxide is first removed by ventilation on a multi-stage cascade on the intake of II. Březová water supply system to the reservoir. The resulting mixture of both the waters is now in balance and does not endanger the metal material.

In case of a breakdown it is possible to shut down the reservoir and to transport water by a by-pass (the VOV and II. Březová supply system trunk mains).

► Čebín – Bosonohy water treated trunk main

In this section a fibreglass pipeline is used: DN 1400 in the section of Čebín – Medlánky, which is 9,130 m long, and DN 1100 in the section of Medlánky – Bystrc, which is 3,095 m long. The village of Rozdrojovice is linked up on this route and there is also an accidental interconnection with the supply main DN 600 from the Palacký vrch reservoir to Bystrc. The underpass of the VOV under the Svratka River is formed by an inverted syphon. The pipeline of the inverted syphon, including the section from the inverted syphon to the Bystrc tunnel portal, is made of ductile iron DN 1000 and it is 183 m long. In the section of Bystrc – Bosonohy the trunk main pipeline HOBAS DN 1100 is laid in a transit tunnel with ferroconcrete lining, which is 4,160 m long with internal diameter of 2,810 mm. In the tunnel there are also two raising pipelines DN 300 laid which deliver water from the Bosonohy reservoir to the Kohoutovice and Myslivna reservoirs. The pipeline DN 1100, which is 415 m long, connects the Bosonohy tunnel portal and the Bosonohy reservoir.





THE DELIVERY OF WATER



the Bosonohy reservoir – measuring



the Bosonohy reservoir – pumping station



the Bosonohy reservoir – view

● The Bosonohy reservoir

is two-chambered with a total capacity of 6,550 m³ (3700 and 2850 m³) and is filled by the branch of the Čebín treated water trunk main, which passes through the valve chamber. The elevation of the maximum water level is 320.00 m above the sea level. It is possible to chlorinate further the water by dosing of chlorine dioxide. There is also a pumping station for pumping into the Kohoutovice and Myslivna reservoirs. There is a supply main DN 350 laid from the reservoir, which is made of ductile iron and is 1,455 m long. On the main there is the existing main DN 250 Bohunice – Bosonohy connected. The supply main DN 350 will be extended in 2012 to Kamenný vrch (investment of the city of Brno).

► The Bosonohy – Leskava reservoir trunk main

is made of a ductile iron pipeline DN 800, it is 1,943 m long and it has a branch DN 400 for future linking of the supply main DN 400 to Kamenný vrch. The construction of the supply main will start in 2012 as an investment of the city of Brno.

► Leskava – Nebovidy trunk main

is 4,470 m long and was constructed of a DN 600 pipeline in the period from 2008 to 2010. In this section the main is constructed of a ductile iron pipeline that is 3,965 m long. Running parallel to the high-pressure gas line the main is made of a fibreglass pipeline, which is 422 m long. Trunk mains to Nebovidy and to the upper part of Moravany link to this section of the main before the entrance to the Nebovidy reservoir. Before, water was delivered to these localities by pumping.





THE DELIVERY OF WATER



The Nebovidy reservoir – entrance



The Nebovidy reservoir – view



The Nebovidy reservoir – valve

● The Nebovidy reservoir

started to operate in 2010, it is constructed as two-chambered (capacity of the chambers is 2,500 and 1,600 m³; 4100 m³ altogether) and the elevation of the maximum water level is 318.00 m above the sea level. The function of the reservoir is to take water to the Želešice, Rajhrad I., Rajhrad II., and Těšany reservoirs, that is to say to localities that were supplied before by provisional pumping from the Moravany reservoir.

► The Nebovidy – (Moravany) – Rajhrad trunk main

has two sections that were constructed in two stages. The first section was constructed in advance in 1988 together with the Rajhrad I. and Rajhrad II. reservoirs that is before the test run of the VOV for supplying the city of Rajhrad by pumping water from Brno water supply network (from the Moravany reservoir) was started. The total length of the section is 9,102 m and the pipeline used is of ductile iron: DN 350 of the length of 1,895 m (the branch from the trunk main to the Moravany reservoir) and DN 400 of the length of 7,207 m (the remaining section that leads to the Rajhrad I. reservoir). The village of Želešice was linked to this trunk main.

The second section of the trunk main that covers the section of Nebovidy – Moravany is made of a ductile iron pipeline DN 600. It is 2,214 m long and it was constructed in the period from 2009 to 2010.



The Nebovidy reservoir – view





THE DELIVERY OF WATER



The Rajhrad I. reservoir – valve



The Rajhrad I. reservoir – pumping station

○ The Rajhrad I. reservoir

is a two-chambered reservoir with a capacity of $2 \times 450 \text{ m}^3$. The elevation of the maximum water level is 280.00 m above the sea level. In the valve chamber of the reservoir there is a pumping station situated which serves for the villages of Hajany and Ořechov with the possibility of further chlorination of water with chlorine dioxide. This reservoir functions as storage of water for the branch of Rajhrad – Těšany and for fulfilment of the Rajhrad II. reservoir.

Further, the trunk main to Židlochovice will be linked to it.

○ The Rajhrad II. reservoir

is two-chambered with capacity of $2 \times 1,000 \text{ m}^3$. The elevation of the maximum water level is 255.00 m above sea level. Water is delivered into it through a ductile iron pipeline DN 350, which is 1,328 m long. The reservoir functions as storage for Rajhrad and Holasice, and it is also interconnected with the water supply system of Modřice.

► The VOV Rajhrad trunk main – Těšany

has delivered, since 2001, water from the VOV to the region of "bitter water", which was one of the worst water supplied areas in the Czech Republic. The trunk main between the Rajhrad I. and Těšany reservoirs with a length of 25,125 m is constructed of ductile iron of profile of DN 300, DN 250, DN 200 and DN 150. The villages of Popovice, Rajhradice, Rebešovice, Otmarov, Měnin, Telnice, Sokolnice, Žatčany, Nesvačinka, Moutnice and Těšany are linked to the main.

○ The Těšany reservoir

is the VOV termination reservoir. The reservoir is earth two-chamber with capacity of $2 \times 250 \text{ m}^3$. The elevation of the maximum water level is 260.00 m above sea level. The start of operation of the section of Leskava – Moravany in 2010 has facilitated the gravity water supply from the Švařec water treatment plant right to this reservoir.



The Rajhrad II. reservoir – entrance



The Těšany reservoir – view





The Control of the VOV Operation

is done from the central water management control room of the operator Brněnské vodárny a kanalizace, a.s. (BVK) in Pisárky, as well as the control of the whole Brno water supply system. In order to control the main technological units of the VOV (water intake from the Vír reservoir, the Švařec treatment plant, the Čebín reservoir, the Bosonohy pumping station and reservoir, the Rajhrad I. and II. reservoirs, and the Těšany reservoir) all of the VOV technological structures are interconnected with the control room by data radio network.

The decentralized control system that consists of programmable automatic machines SIMATIC S7 and of operator's workplace is used at the Švařec water treatment plant. The networks are interconnected by Ethernet.

The interconnection to the operational control rooms of the other operator Vodárenská akciová společnost, a.s. (Tišnov, Židlochovice) was also constructed.

The owners and operators of the VOV

The owner of the VOV

is the Vír regional water supply system, the corporation of towns, villages and groups of villages, Zelný trh 13, 602 00 Brno. Members of the corporation are towns, villages and groups of villages that take or will take water from the VOV. The corporation was established on the 30th of December 1993 as an interest group of body corporates.

The operators of the VOV

The Vír regional water supply system forms together with both Březová water supply systems the Brno water supply network. That is why the operator of the major part of the VOV is **Brněnské vodárny a kanalizace, a.s.** Hybešova 16, 657 33 Brno (the value of the operated property is circa 4 million Czech crowns).

The operator of singular parts of the VOV is **Vodárenská akciová společnost, a.s.**, Soběšická 156, 638 01 Brno (the value of the operated property is circa 14 million Czech crowns).

The Linking of Individual Localities to the VOV

In the time period from 2000 a total of 34 localities, including the city of Brno, were linked to the VOV. Three of the localities are in the Vysočina Region, and the rest of them in South Moravian Region. In 2011 the linking of Lomnice u Tišnova will be initiated.

For illustration see the VOV layout on the inside of the cover.

Further Expansion of the VOV

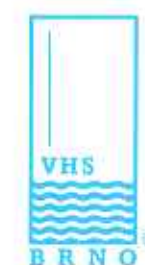
The linking up of other localities will depend on the development of needs in the supplied area and on financial possibilities of both the VOV corporation and new users. The VOV can readily cover with its capacity such demand.

As regards the linking up of other areas which will require the expansion of the VOV, the principal condition will be again acquirement of the means. The VOV corporation has prepared to start in 2010 the construction of the 4th stage of the VOV – the linking of Židlochovicko to the VOV. The preparations for the linking of Střelicko continue. It will be also possible to deliver water to Žďársko and Hustopečsko.



energie
STAVEBNÍ A BĀŇSKÁ

IMOS



BRŇENSKÉ VODÁRNY A KANALIZACE
akciová společnost

PÖYRY

SUTERRA

SIEMENS

DORG
TRUBNÍ SYSTÉMY
spol. s.r.o.

SAINT-GOBAIN
PAM CZ

KUNST

HOBAS

Tenza

VH atelier
spol. s r.o.

VRV

WOMBA

IS
BRNO

M.T.C
spol. s r.o.

