



Complex asset protection assessment of wastewater treatment plants

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Abstract

Aim: Wastewater is generated in the daily activities of population. In order to ensure the continuous treatment of wastewater, we maintain wastewater network system and operate wastewater treatment plants. The position and condition of wastewater treatment plants plays an important role in maintaining the safety of society, since untreated wastewater may cause significant health and environmental problems if it is released untreated into the environment. The aim of this article is to examine the complex protection situation of wastewater treatment plants.

Methodology: This article is based on literature, on-site observation and analysis of images available on Google Maps.

Findings: Without the complex protection of the wastewater treatment plants, the continuous provision of wastewater treatment cannot be maintained.

Value: The article focuses on the situation of the fences as one element of the outdoor protection, which is part of the complex protection system of wastewater treatment plants.

Keywords: wastewater, wastewater treatment plant, complex protection, asset protection

Introduction

It is an integral part of our daily routine that we use water and generate wastewater in our activities. In order to avoid significant health risks and environmental

damage due to the release of untreated wastewater into the environment, we must provide wastewater treatment in a regulated and controlled way at wastewater treatment plants (hereinafter WWTPs). The generated wastewater reaches these sites in two ways; on the one hand, through the built-up and available sewerage systems, and on the other hand, where there is no sewerage system in place, it is temporarily stored in a domestic cesspit until it is transported to the plant by a suitable truck at the owner's request.

The technology of treatment and technical overview of WWTPs are not part of the article. In this article, we review the current situation of WWTPs in Hungary, the threats to which they are exposed, and we examine the fences that are part of the outdoor protection system as an element of the complex protection system.

Examination of the situation of WWTPs

The establishment and operation of a WWTP is determined by legal regulations. 'EU Council Directive 91/271/EEC concerning urban wastewater treatment sets targets for the restoration of surface water quality, the reduction of pollutant concentrations and the reduction of groundwater pollution. It states that local governments have the obligation to ensure proper wastewater treatment in a given city/town and to eliminate 'loose' drainage systems. The directive stipulates that municipalities with a population of at least 2,000 must provide a sewerage network ([URL1](#)). The law, therefore, gives the responsibility to local governments to carry out wastewater treatment, which includes the design, construction and operation of the sewerage network.

The terrorist attack in the United States on 11 September 2001, highlighted the need for critical infrastructure protection.

The Hungarian definition of critical infrastructure is defined in Decree 2080/2008 on the National Program for Critical Infrastructure Protection (VI. 30.). Government Resolution No. 1. Annex 3.2. according to this point '*Critical infrastructures are networks of interconnected, interactive and interdependent elements of infrastructure, facilities, services, systems and processes that are vital to the functioning of the country (population, economy and government) and play a meaningful role in the socially required minimum by maintaining legal order, public security, national security, economic viability, public health and the environment. Critical infrastructure is defined as networks, resources, services, products, physical or information technology systems, equipment, devices and their components whose failure, disruption, loss or destruction could have a direct or indirect, temporary or long-term serious impact on the economic*

and social well-being of citizens, public health, public security, national security, the functioning of the national economy and government. ‘(Laczik, 2011).

By definition, systems that are maintained to ensure the uninterrupted life of citizens can be considered vital.

In order to maintain its vital importance, the National Assembly made the law of Act CLXVI of 2012 Act on the Identification, Designation and Protection of Vital Systems and Facilities.

The law already uses the term of vital systems and facilities. Vital systems and facilities include water as a sector and canalization and treatment of wastewater as a related sub-sector.

The Government Resolution 541/2013 (XII. 30.) on the identification, designation and protection of vital water management system and water facilities among WWTPs defines the following in the 2.§ ‘(2) *It should be identified as a vital national component in the field of wastewater disposal and treatment* a) *a WWTP with a capacity exceeding the burden of contaminant of 250,000 resident equivalents and whose inoperability results in significant unfavorable status for surface water; b) the water utility system ensuring the drainage and treatment of public sewage of which the user equivalent is exceeds one hundred thousand as set out in the operating license of Vksztv.*’ (URL2).

The Government Decree 379/2015 (XII. 8.) on the List of Settlements and the Information List on the Municipal Sewage Drainage and Treatment Situation in Hungary and the impoundment of drainage agglomerations contains the definition of the population equivalent, according to which the nominal burden of each settlement consists of the following elements:

- *in place population,*
- *other population (vacationer, etc.),*
- *industrial release in the Directive 11. art.,*
- *industrial wastewater from economic activities (including small and medium-sized enterprises) released into, or intended to be released into the sewage system or a municipal WWTP,*
- *all remaining urban wastewater and sewage sludge generated in the agglomeration, whether or not collected by sewage networks.*’ (URL3).

Thus, not all WWTPs are identified as a vital element of the system by legislation. For those elements identified by the legislation, the protection of the plant must be ensured according to specific requirements. However, for WWTPs identified as non-essential, the operator is responsible for determining the protection requirements. In our view, a single set of defined requirements for protection is necessary in both cases.

A WWTP might be threatened by different illegal activities as follows:

- burglary,
- vandalism,
- internal theft,
- illegal wastewater disposal (draining),
- terrorist attack.

For an identified treatment plant, the greatest risk is a terrorist attack, while for an unidentified treatment plant, both internal and external crime can pose a significant risk. It is also important to note that such sites store significant quantities of chemicals for the treatment process. Thus, intrusion by unauthorized persons through a weak fence may provide an opportunity for criminal activity using the chemicals on the sites. A similar incident has already occurred in the US, where an attempt was made to poison drinking water systems in a hacking attack ([URL4](#)). Protecting drinking water systems is therefore a matter of course for everyone. At the same time, we believe that it is important to focus on the proper protection of wastewater treatment plants, which are an important part of the system but do not receive the attention they require. We therefore believe that a threat/risk assessment should be carried out for both identified and unidentified treatment plants, and that the results of this assessment should be considered as a decisive factor in the development of a complex asset protection system.

Complex property protection of the WWTP

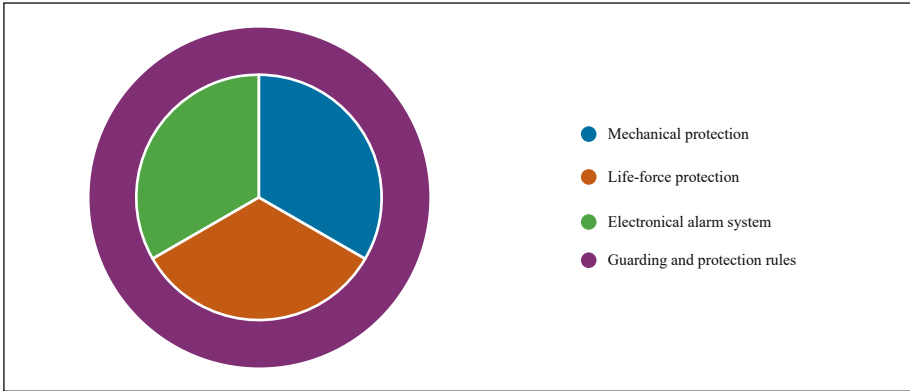
The protection required by law must extend to the assets of the facility and to the smooth operation process of the wastewater treatment process.

The protection of the WWTP can be ensured by a complex security system.

Possible elements of a complex security system as follows:

- mechanic protection,
- electronic sensors and alarm systems,
- protective manpower,
- protective regulations and measures,
- and insurance.

Figure 1: *Relationship between defense resources and applied regulations*



Source: Berek, 2016.

The figure shows the four elements of asset protection and the relationship between resources and policies. The insurance is not marked in the figure, because insurance can be provided for mechanical protection, devices of electronic sensor and alarm systems, protective manpower, but it is not possible to take out insurance for policies and regulations of the protection. The size of the circular sector is not always the same, because the proportion can be decided on the basis of their level of vulnerability determined by risk assessment.

It largely depends on the features of the object we need to provide security. As it was mentioned before there are identified and unidentified WWTPs among the facilities and their complex protection can only be achieved if we define the proportions between the elements.

In this article, we examine only the mechanical protection part of the complex property protection system of the WWTPs, the other elements will be reviewed in the following articles.

Mechanical Protection

It is one of the oldest forms of protection. Research has shown that it was already used in the Iron Age ([URL5](#)). The fence was used to enclose an area and clearly indicate to others what was private property.

Today, mechanical protection has become an essential part of the complex property protection, covering several areas:

- outdoor protection,
- building security,
- object protection.

We only examine the role and situation of the fence, which is one element of the outdoor protection, in case of several WWTPs.

Outdoor protection

Outdoor protection is the first element of the mechanical protection. It is an effective preventive tool, because it already prevents or complicates the intrusion of a criminal who intends to commit illegal act against a sewage treatment plant.

The element of the outdoor protection as follows:

- fences,
- gates,
- bars,
- pits,
- banks.

The fence can mark – in most cases this is the case – the plot boundary, which is the boundary of the protection at the same time. There are many types of fences available, and they typically differ in materials they are made of. Their structural build-up is similar.

The types of fences can be based on their material as follows:

- wood,
- stone,
- concrete,
- brick,
- aluminum,
- wrought iron,
- wire mesh,
- steel mesh,
- plastic.

The resilience of fences depends on:

- type,
- height.

Therefore, in the following part of this article we will only examine the fences. Their obstructive and delaying ability can be determined, which is *'to have a concrete base and a height of 1.8-2.8 m'* (Berek, 2016), and *'to increase its height and reliability, barbed wire or blade wire can be used to stretch it in rows or to extend and fasten it spirally.'* (Berek, 2016).

Among the fences, we have reviewed those that can be seen on the boundaries of some WWTPs (in the capital, in metropolitan areas and in rural areas). The fences of the WWTPs were examined based on the images shown on Google Maps and, for some WWTPs, the images taken on site, which are presented in the following sections. The classification used in the study is based on the data presented in the previous paragraph. A good rating is given if the fence examined is considered to meet all criteria listing above. A satisfactory rating is given if one of the above data is missing (e.g. not all fence sections have a concrete base) and a poor rating is given if more than one data is missing (e.g. no base for fence sections, no barbed wire in several rows on top of the fence).

The following sites have been studied by using Google Maps.

North Pest WWTP

Picture 1: *Top-view of the sewage treatment plant*



Source: [URL6](#).

Based on the image above, it can be stated that the area of the WWTP is large, the boundary of it has been marked with a long fence.

Picture 2: Fence section on the west side of the sewage treatment plant



Source: [URL7](#).

The picture above shows different types of fences at the facility, including a section of fence made of wire mesh (on the right side of the picture) and metal elements on a concrete base (on the left side of the picture). The other sides of the plant are also closed by fence made of wire mesh. A row of barbed wire is attached to the top of the fences, but they do not have concrete base. It seems that the part of the fence made of wire mesh can be easily dismantled and it would not take long. There is a road viable by car on the west and south sides of the fence, these roads provide possibility for a potential perpetrator to move easily and quickly in. We can state that the obstructive and delaying effect of the fence is low. Based on the results of the study, we consider it expedient to rebuild the fence section made of wire mesh, this upgrade could increase the effective protection of the WWTP.

FCSM Zrt. South Pest WWTP

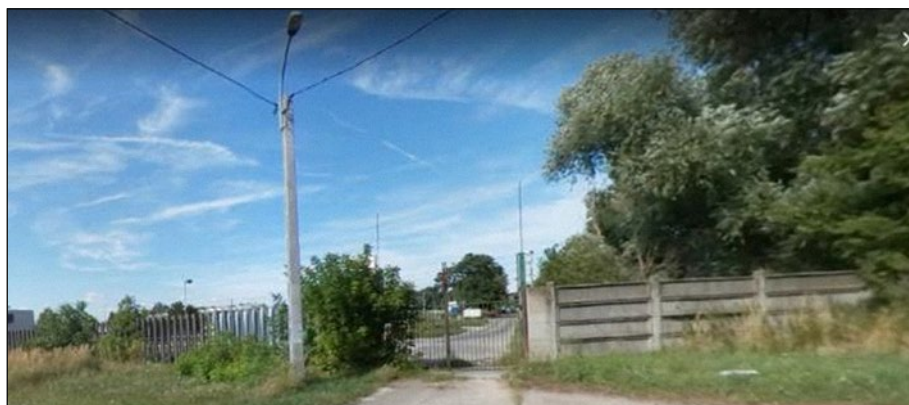
Picture 3: Top-view of the WWTP



Source: URL8.

The image above illustrates well the extensive size of the WWTP, therefore its boundary can only be marked by the construction of a long fence.

Picture 4: The south gate of the WWTP



Source: URL9.

The picture above shows two types of fences, one type is on the northern and western boundaries that was made of vertical concrete elements on a concrete basis (on the left side of the picture), the other type is on the north-east and south-west boundaries, where the fence was made of horizontally matched massive concrete rectangles (on the right side of the picture). Barbed wire is attached to the top of the fence in three rows. The fence obstructive and delaying ability is good.

The following WWTPs were examined by using Google Maps and the images we took on the sites.

Vác WWTP

Picture 5: *Top-view of the WWTP*



Source: [URL10](#).

The picture above shows well the size of the WWTP, which is determine the length of the fence marking the boundary.

Picture 6: *The North side of the WWTP*



Source: Picture taken by authors.

The picture above shows that the material of the fence is wire mesh, on its top there are two rows of barbed wire stretched between reinforced concrete columns, the height is appropriate. The right height is provided by a constructed gabion base instead of a concrete one. The name gabion is used for baskets made of metal grids and filled with stones, which ensures the stability of a slope or riverbed due to their weight. The name gabion comes from the Italian word 'basket', but the names 'stone basket' and 'stone box' are also used in several languages ([URL11](#)). The raise is necessary due to the proximity of the Danube. The fence is similar on the western side, while it is made of concrete panels on the eastern and southern sides. The obstructive and delaying effect of this section of fence is good.

Rétság WWTP

Picture 7: *Top-view of the WWTP*



Source: [URL12](#).

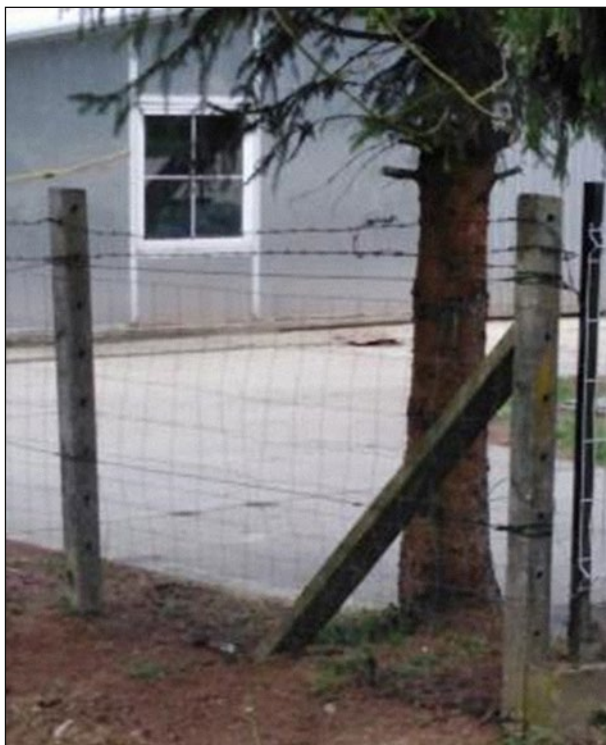
As it can be seen on the picture the size of the WWTP is not large, thus the length of the fence marking the boundary is not long either.

Picture 8: *One element of the fence on the northern section of the WWTP*



Source: Picture taken by authors.

Picture 9: *One element of the fence on the northern section of the WWTP*



Source. Picture taken by authors.

The pictures above show that the fence is made of steel mesh on the north side, which has a concrete base but has no rows of barbed wire on top. Wire mesh stretched between concrete columns on the south (and other) sides without a concrete base. The steel mesh is placed on a concrete base, but there is no barbed wire on top. Barbed wire is attached in two rows above the wire mesh, the wire mesh has no base. The obstructive and delaying effect of the fence is suitable.

Table 1: Outdoor protection assessment of WWTPs (URL13, URL14, URL15, URL16, URL17)

Nr.	Name of the plant	Type of the fence	Obstructive and delaying effect
1.	Őcsény-Decs WWTP (URL13)	wire mesh between reinforced concrete columns, without base	poor
2.	Jászfényszaru WWTP (URL14)	wire mesh between reinforced concrete columns, without base	poor
3.	Tapolca City WWTP (URL15)	wire mesh between reinforced concrete columns, without base	poor
4.	Sátoraljaújhely Zemplén Water Ltd. WWTP (URL16)	latticed steel panels with doubled barbed wire on the top with a concrete base towards the street on the west side of the site, wire mesh between reinforced concrete columns, without base on the other sides	satisfactory
5.	Tata WWTP (URL17)	wire mesh between reinforced concrete columns, without base	poor

Source: The information gained from the fences of five WWTPs is based on images displayed on Google Maps.

Based on the information of the table, we conclude that the explored fences constitute the weak link of the complex assets based protection due to their obstructive and delaying effect. We highly recommend to increase this effect in order to meet the requirements of its basic function.

Conclusion

In this article, we studied the fences as essential element of the physical outdoor protection of WWTPs in the capital, some urban and rural areas. We have generally assessed that the fences established to protect the examined objects are obsolete and need to be replaced or it is necessary to increase the obstructive and delaying effect of fences in order to deter or impede intrusion and potential criminal activities.

WWTPs are part of critical infrastructure, because they have serious health and environmental consequences in case of untreated wastewater released into the environment due to operational failures or disruptions caused by terrorist attack, sabotage or other criminal activities.

Surface and groundwater can be contaminated causing ecological disaster and damaging surrounding agricultural areas making impossible further cultivation.

In our view, the presented examples well illustrate the need to develop the fences that make up the physical outdoor protection of WWTPs.

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