



## ACTION PLAN

# THE REVITALISATION OF TÜSKÉSRÉT, PÉCS



JÓZSEF BUNYEVÁ CZ - PÁL CS ONKA, JR.  
TOTAL LTD., PÉCS - HUNGARY

for

**SOUTH-TRANSDANUBIAN ENVIRONMENT PROTECTION AND WATER MANAGEMENT  
DIRECTORATE, PÉCS - HUNGARY**

**VERSION DRAFT 1.0**

**15.06.2011.**



## CONTENTS

1.	Introduction.....	3
1.1	Capitalisation of best practice in action plan .....	3
1.2	Interregional cooperation project SufalNet4EU in INTERREG IVC .....	4
1.3	Access to European co-finance through EU-Structural Funds .....	5
2.	Area-based development of closed landfill sites .....	5
2.1	Spatial planning features on national, regional and local level .....	5
2.2	Regional and local challenges and needs .....	7
2.3	Identification and selection of site .....	8
2.4	Multi stakeholder approach and engagement.....	10
2.5	Surroundings and adjacent use .....	12
2.6	Intended use of the site and fitness for use .....	13
2.7	Design and architecture of the site .....	13
3.	Site specific features of the identified and selected site .....	16
3.1	History .....	16
3.2	Ownership .....	18
3.3	Geology, geomorphology, precipitation .....	20
4.	Examination and characterisation of the site .....	22
4.1	Investigation of waste, water, soil and air .....	23
4.2	Risk assessment in terms of human health and ecological risks.....	29
5.	Aftercare of the site .....	31
5.1	Policies and legislation .....	31
5.2	Technical measures .....	32
5.3	Organisation .....	33
5.4	Financing.....	33
5.5.	Legal measures.....	37
6.	Implementation of the landfill redevelopment in this action plan.....	37
6.1	Social acceptance .....	37
6.2	Permits needed .....	37
6.3	Balance sheet and financing.....	38
6.4	Project organisation and exploitation .....	38
7	Identification of activities to be co-financed by EU .....	39
7.1	Operational Programme Structural Fund .....	39
7.2	European Investment Bank.....	39
7.3	Other European funding programmes .....	39

## Appendices

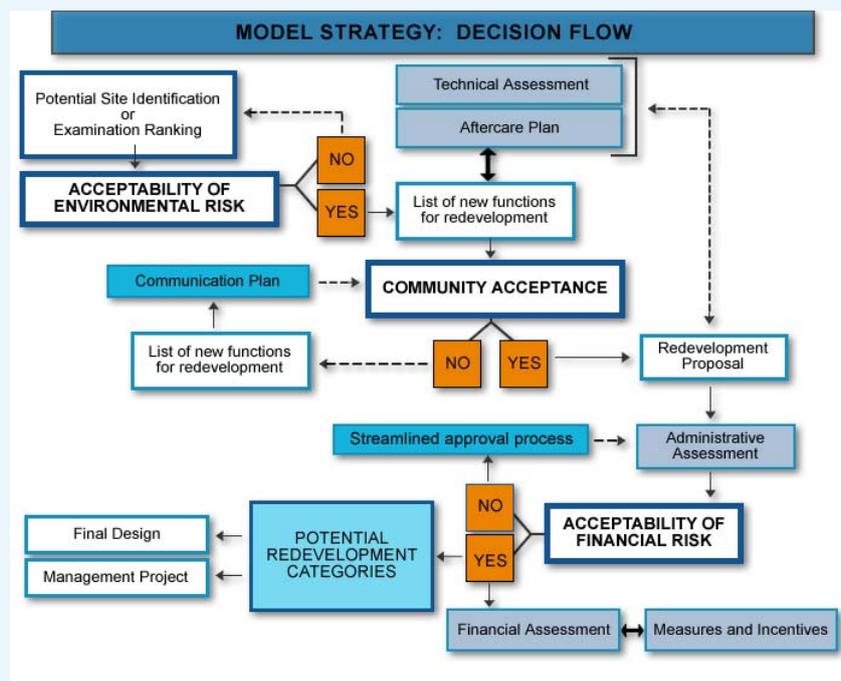


## 1. INTRODUCTION

### 1.1 Capitalisation of best practice in action

Closed landfills occupy a considerable amount of space in all European Union (EU) Member States. Estimated is that an area of 150.000 hectares of the EU is currently taken up by landfills – an area equivalent to that of Madrid, Rome and Paris combined. These landfills are often derelict and many even pose a risk to the environment. However, with careful consideration, they have the potential to provide new facilities for local communities. They can be used to create alternative locations for recreation, as parks or nature reserves, for companies or offices, business and even for housing.

SufalNet4EU wants to create solid action plans for the redevelopment of closed landfill sites all across Europe. The project is funded by INTERREG IV-C (ERDF), an organization that helps European regions form partnerships to work together on common projects.



SufalNet4EU is a capitalisation project that is specially designed to facilitate the sharing of best practices across European regions. Based on the Model Strategy above and developed in the first SufalNet project (2005-2007), the project will formulate well defined action plans for redevelopment of closed landfill sites all over the region. These action plans will be tailored to all regional needs and requirements through working closely with local authorities.

The Province of Noord-Brabant has been the lead partner of the SufalNet Project since 2005. This interregional cooperation project established an international network which shared



experiences and good practices on the redevelopment of former and abandoned landfills. In the framework of INTERREG III-C Programme (2005-2007), the SufalNet Project was developed to establish best practices in sustainable re-use of former landfills. During this period, 21 European partners compared policies, projects and instruments and developed an integrated strategy for landfill examination, aftercare and redevelopment. This model strategy is to be applied in the current Sufalnet4EU Project (2010-2011).

In 2009, the Province of Noord-Brabant submitted an application for a follow-up project in the framework of INTERREG IV-C. This application was accepted as one of the capitalisation projects. Objective of all European partners (now totalling 15) in SufalNet4EU is to provide regional and local authorities from various EU countries with specific instruments to redevelop closed and abandoned landfills, in their territories. Based on SufalNet's model strategy, the core activity is the development of 15 Regional Action Plans for redevelopment of one or more former landfill sites by the end of 2011. The implementation itself of the practices will start subsequently.

Because SufalNet4EU is a Capitalisation project, four conditions are met;

- a description of relevant practices in each region is provided;
- all relevant stakeholders are involved in the preparation of the regional action plans;
- relevant steps and actions to ensure implementation are defined
- and activities that could be eligible for the relevant Operational Programme of the EU Structural Funds are identified.

## 1.2 Interregional cooperation project SufalNet4EU in INTERREG IV-C

15 partners from 10 European countries are contributing to the SufalNet4EU project. The SufalNet4EU partners have discussed the steps to be taken towards developing action plans for their own landfill(s) in a series of meetings during 2010 and 2011. In total 4 plenary conferences and 9 working group meetings have been held in this series.

Towards achieving action plans, partners have been working in three thematic working groups focusing on:

- Redevelopment on a regional scale.
- Redevelopment into landscape and nature amenities.
- Redevelopment for economic functions.

Ideas, problems and solutions have been discussed in detail by sharing best practices and supporting each other in creating their individual action plans. These plans explore thoroughly the environmental, social, and economic implications and benefits of specific landfill re-use propositions. Redevelopment proposals are considered land use potential for residential, industrial and commercial sectors, parks and recreation areas and zones devoted to forestry, ecology and farming.



SufalNet4EU also aims to share information wherever possible. The action plans also provide a source of inspiration and serve as examples of best practice to other local, regional or national governments looking to redevelop former and abandoned landfills and their surroundings. SufalNet4EU's partners are promoting their experiences in landfill redevelopment widely to practitioners and policymakers on local, regional, national and EU-level as well. National Information sessions are held and the SufalNet4EU has been presented in external conferences and workshops too.

SufalNet4EU is working across 10 countries in Europe to transform neglected landfill sites into space that is valuable to the local community. Landfill redevelopment is a concern for many different stakeholders - from communities, land owners and municipalities - to project developers, government officials and politicians. Stakeholder involvement is an inherent part of the planning process. SufalNet4EU maximizes opportunities for communities to develop new amenities in a safe, risk free and economical way to improve their environment.

### 1.3 Access to European co-finance through EU-Structural Funds

All participating partners in the project have consulted with and have support from the Managing Authorities of the relevant EU Structural Funds in their area. This will also ensure that the action plans have the necessary financial backing for implementation in the future.

## 2. AREA-BASED DEVELOPMENT OF CLOSED LANDFILL SITES

### 2.1 Spatial planning features on national, regional and local level

The planning and permit obtaining procedures of developments, investments and interventions that have different aims, scope and content are regulated by Hungarian **legal acts and regulations**. The framework of this legal system is described in **Table 1.**, listing the main national and branch plans and programmes that are in force, and also giving the plan types that form the basis of obtaining permits for land use and investments.



**Table 1.** Main elements of the planning system in Hungary

<b>NATIONAL PLANS AND PROGRAMMES</b>
Middle term Economical Plan of Hungary (2003) Updated Convergence Plan of Hungary 2006-2010 National Concept of Territorial Development (2005) National Territorial Development Plan (2008) "New Hungary" Development Plan 2007-2013 Regional Operative Programmes 2007-2013
<b>BRANCH PLANS AND PROGRAMMES</b>
National Agricultural-Environmental Programme (1999) National Environmental Remediation Programme (2000) National Waste Management Plan (2000) National Concept of Water Management (2000-2015) - Programme for the Improvement of Drinking Water (2001) - National Feasibility Programme for Municipal Wastewater Collection and Treatment (2002) National Action Programme for Environmental Health (2002) National Public Health Programme (2003) National Environmental Protection Programme (2009-2014)
<b>DEVELOPMENT PLANS AND PLANS FOR URBAN PLANNING</b>
Plans for Territorial Development and Urban Planning
Municipal Structural Plans
<b>PERMIT PLANS FOR INVESTMENTS AND CONSTRUCTIONS</b>
Construction permits (construction, demolition, renovation) Water rights permits (for construction and for operation)
Environmental licence
Integrated Pollution Prevention Control (IPPC)
Other plans (landscape planning, opening of mines, licensing of industrial sites etc.)

The development of certain regions, the planning and permitting of land use and use of the environment have to be done within the scope of the **spatial development planning system**. This is a hierarchical system that is based on **spatial planning concepts, spatial planning programmes and development plans**. The requirements concerning the content of these, the procedure of artibration and acceptance are also prescribed by acts and regulations. The task of this planning system is to provide on national and regional level the following:

- a balanced development of the regions, in accordance with the regional policy, the main aims, the system of measures and institutions of the EU;
- the enhancement of social, economical and cultural development;
- the fulfilment of the goals of the comprehensive regional development policy;
- the harmonising of tasks related to national and regional territorial development.



**Spatial development plans** are meant to set the land use types of a certain territory, matching with the goals set by the regional development concepts. The system of national, regional and local development plans is described in **Table 2**.

**Table 2.** The system of development plans

PLANNING LEVEL	SCOPE OF PLANNING	PLAN TYPE
national	the territory of the country	National Development Plan (2003)
regional	designated regions (16 regions)	Development Plan of the Balaton Designated Touristic Region (2005) Development Plan of the Budapest Agglomerate (2005)
	counties (19 counties)	county development plans
local	municipalities (3150 municipalities)	municipal structural plans

The development plan sets the following:

- the land use types of the region;
- the geospatial order of the public utilities and infrastructural systems;
- the long term geospatial structure of the region;
- the optimal utilisation of the features of the regions;
- the development tasks related to the protection of the environment, the landscape and the nature;
- regional impact assessment (environmental, social and economical);
- regional tasks related to sports.

During the process of the elaboration, negotiation and acceptance of territorial development programmes, branch programmes and municipal structural plans, the national, regional and county development plans have to be taken into account.

## 2.2 Regional and local challenges and needs

The utilisation of the area of Tüskésrét in Pécs is set in the local development plan of the city of Pécs, accepted in 1986, that has been modified and updated several times since then. According to the plan that has been accepted in 2009, the planned land use types should be for the area that is nearly 400 hectares large:

- the recultivated slurry deposits and their surroundings should be used for open space / green area and recreation
- cultural, sports and leisure time facilities and infrastructure should be constructed



These planned functions and land use types are in harmony with the land use zoning and appropriation designated in the development plans of Baranya County and the National Development Plan. The land use appropriations set in the national, county and local (Pécs) level spatial development plans are described in **Table 3**.

**Table 3.** Land use appropriations set in the plans

DEVELOPMENT PLAN	LAND USE	AREA
National Development Plan (2003)	zone of areas needing regional landscape rehabilitation (open cast mines, slurry deposits)	Pécs
Baranya County Development Plan (2004)		
Municipal Spatial Development Plan and Local Building Regulation of Pécs County Town (2009)	open space /green area and recreation use of recultivated slurry deposits and their surroundings	Tüskésrét
	construction of cultural, sports and leisure time centre and infrastructure	

The local development plan of the city that is in force sets the land use types for the Tüskésrét area and its surroundings. This is shown in **Figure 1.**, where also the connection of Tüskésrét with the surrounding parts of the city can be observed.

### 2.3 Identification and selection of site

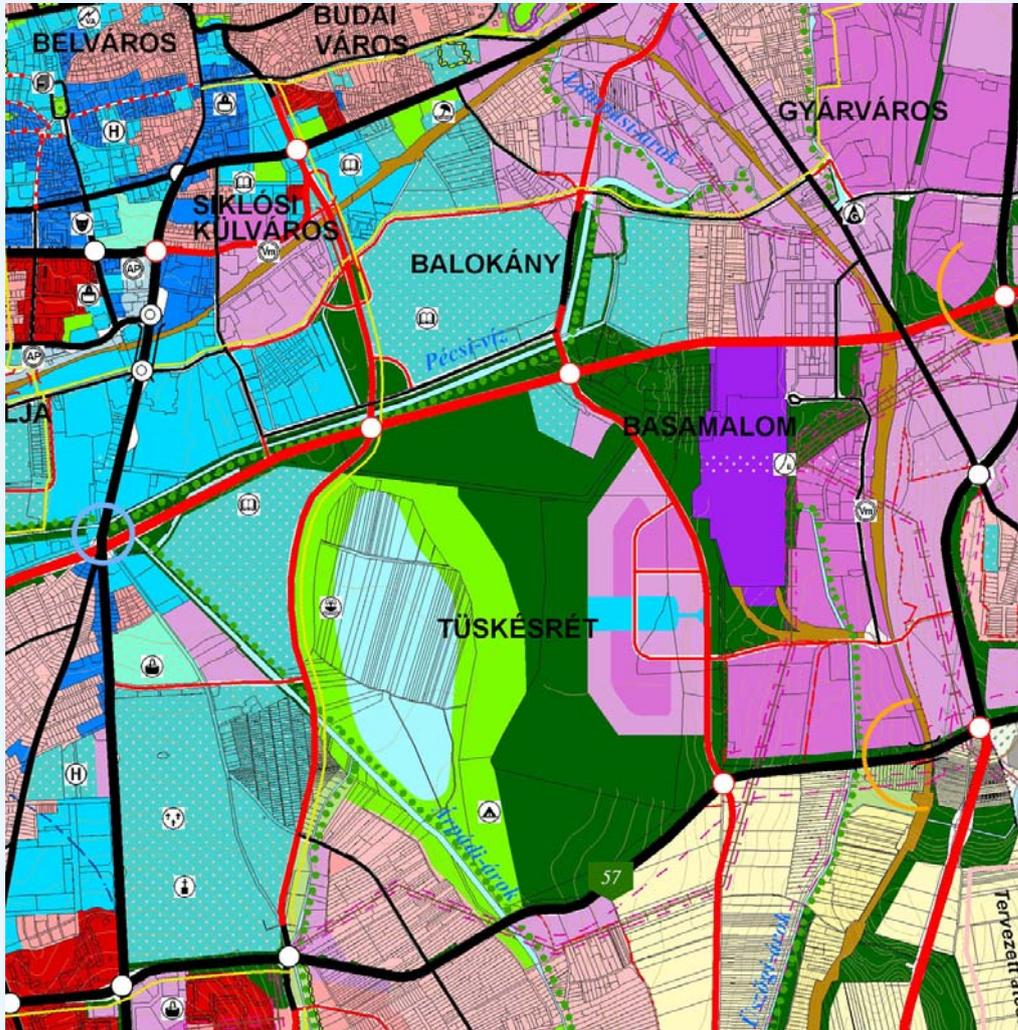
Tüskésrét is located in the centre of Pécs city, as shown in **Figure 1.**, where the slurry deposit areas that have already been recultivated and the areas to be recultivated in the future are indicated.

Since the starting of the Power Station of Pécs in 1958, Tüskésrét has been the site for the deposition of the formed slurry. From 1960 until present day the area used as a landfill measured 235 hectares and the amount of slurry (from slag and fly ash) deposited here is 35 million tons.

The planning of the rehabilitation Tüskésrét and the fitting of the area into the town structure of Pécs has started as early as 1986. The planned utilisation of the area of Tüskésrét in Pécs is set in the local development plan of the city of Pécs, accepted in 1986, in accordance with the operation of the Power Plant of Pécs. The utilisation that has been decided meant open space / green area and welfare use. The original plan has been revised according to new prescriptions in planning engineering methodology, in a several years long process, with the engagement of the stakeholders, decision makers and the general public, and accepted in November 2004. This plan is in effect now, with revisions every year to incorporate any changes made meantime. These changes have not effected the original planned utilisation and function of the area of Tüskésrét. This spatial plan with the originally planned use is shown in **Figure 1.**



Figure 1. Land uses in the surroundings of Tüskésrét (Thorny Meadow) Pécs



### Jelmagyarázat

#### Területfelhasználás

Color	Code	Description	Szintterület-sűrűség (m <sup>2</sup> /m <sup>2</sup> )
Red	1.1	Nagyvárosias lakóterület (Ln)	3.0
Pink	1.2	Kisvárosias lakóterület (Lk)	1.5
Light Pink	1.3	Kertvárosias lakóterület (Lke)	Bf. 210m felett 0.3 egyéb helyeken 0.6
Blue	2.1	Településközponti vegyes terület (Vt)	2.0
Light Blue	2.2	Központi vegyes terület (Vk)	3.0
Light Purple	3.1	Kereskedelmi-, szolgáltató gazdasági terület (Gksz)	2.0
Dark Purple	3.2	Zavaró hatású ipari gazdasági terület (Gip)	1.5
Light Green	3.3	Egyéb ipari gazdasági terület (Ge)	1.5
Light Cyan	5.1	Különleges kereskedelmi célú terület (Kke)	2.0
Light Green	5.2	Különleges közhasználatú építmenyi terület (Ki)	2.0
Light Green		10%-nál nem nagyobb beépítettségű	0.5
Light Green	5.3	Különleges bányászati terület (Kb)	0.1
Light Green	5.4	Különleges honvédelmi és belbiztonsági terület (Kho)	2.0
Light Green	5.5	Különleges, hulladék elhelyezésére szolgáló terület (Kh)	0.05
Light Green	5.6	Különleges városüzemeltetési célokat szolgáló kertészeti terület (Kk)	0.05
Light Green	5.7	Különleges közlekedési terület (Kkő)	1.0
Light Green	6.2.0	Kötőpályás közlekedési terület (KÖK)	
Light Green	7.0	Közpark terület (Z)	
Light Green	8.1.0	Védelmi rendeltetésű erdőterület (Ev)	
Light Green	8.2.0	Egészségügyi - szociális - turisztikai rendeltetésű erdőterület (Ee)	
Light Green	8.3.0	Gazdasági rendeltetésű erdőterület (Eg)	
Light Green	9.1.0	Mezőgazdasági kertes terület (Mke)	
Light Green	9.2.0	Mezőgazdasági általános terület (Má)	
Light Green	9.3.0	Mezőgazdasági korlátozott használatú terület (Mko)	
Light Green	10.	Vizgáldalkodási terület (VG)	

#### Közlekedés

Meglévo	Tervezett	Description
Red line	Red line	Gyorsforgalmi út
Black line	Red line	Országos főút
Black line	Red line	Települési főút, országos mellékút
Black line	Red line	Belterületi avítóút, külterületi feltáró út

#### Intézmények

Icon	Igazgatási központ
Icon	Oktatási központ - egyetem
Icon	Művelődési központ
Icon	Egyházi központ
Icon	Kórház
Icon	Kereskedelmi (bevásárló) központ
Icon	Piac
Icon	Vásárváros
Icon	Turisztikai központ
Icon	Turisztikai alközpont
Icon	Kilátó
Icon	Arborétum, botanikus kert
Icon	Szafaripark
Icon	Strand
Icon	Termálközpont
Icon	Kemping
Icon	Temető
Icon	Kegyeleti park



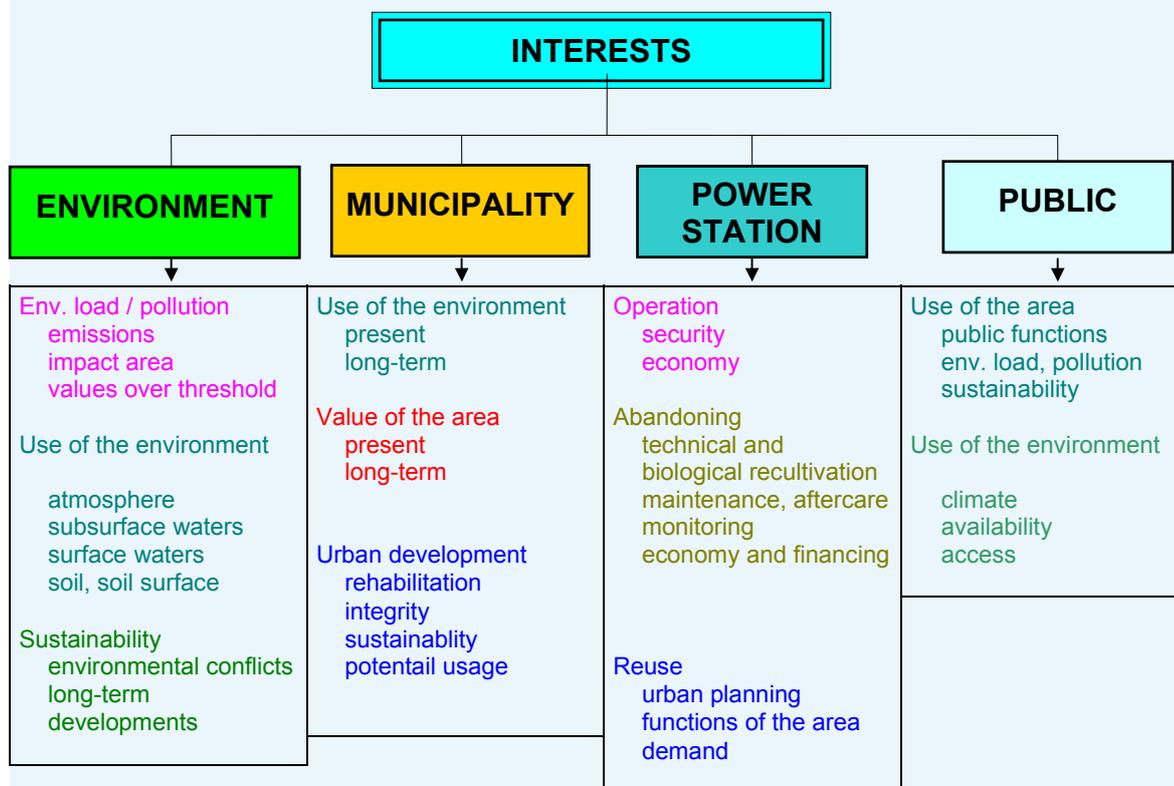
## 2.4 Multi stakeholder approach and engagement

The planning of the rehabilitation Tüskésrét and the fitting of the area into the town structure of Pécs has started as early as 1986. The planned utilisation of the area of Tüskésrét in Pécs is set in the local development plan of the city of Pécs, accepted in 1986, in accordance with the operation of the Power Plant of Pécs. The utilisation that has been decided meant open space / green area and welfare use. The original plan has been revised according to new prescriptions in planning engineering methodology, in a several years long process, with the engagement of the stakeholders, decision makers and the general public, and accepted in November 2004. This plan is in effect now, with revisions every year to incorporate any changes made meantime. These changes have not effected the original planned utilisation and function of the area of Tüskésrét. This spatial plan with the originally planned use is shown in **Figure 1**.

### 2.4.1 Stakeholders and interests in the overall development of Tüskésrét

The main stakeholders and interests involved in the utilisation and development of Tüskésrét is shown in **Figure 2**.

**Figure 2.** Scope of interests at Tüskésrét





- **Environmental issues:** in order to carry out the remediation tasks, the improvement of the water quality of the polluted groundwaters, and the securing of the deposited slurry and sludge (which is non hazardous industrial waste) is top priority. To enhance the environmental security of the area, the first steps should be taken in order to perform the landscaping of the surfaces of the area and to improve ground water quality, to ensure long-term urban development of area in accordance with the existing spatial plans. The recultivation of the abandoned/closed slurry cassettes has to be performed:
  - the environmentally sound and secure storage of the deposited slag and ash
  - the minimalisation of the pollutions, and the protection of the subsurface waters,
  - the decreasing of the environmental risks for the planning of sustainable usage of the environment and the area
- **The Municipality of Pécs city:** the development of Tüskésrét may influence the „face” of the city and the area for decades or even centuries, which developments comprise long-term, important elements, such as improvements in environmental, environmental health and well-being factors, welfare and commercial projects, and developments and investments aiming to increase employment. The main interest of the city is to realise the planned multidirectional developments according to the local development plan of the city in the Tüskésrét area with the changed functions and importance, to integrate the area to the municipal structure concerning environmental, commercial and social aspects. This can be grounded by establishing the planned area usages and traffic infrastructure.
- **Pannon Hőerőmű Zrt. - Power Station of Pécs:** would like to settle the issue of landscaping and remediation tasks prescribed by the Environmental Inspectorate at the area. The realisation of the recultivation works laid down in the accepted construction and recultivation plans establish the foundation for the environmental, technical and biological criteria of the future land usage set up by the local development plan of Pécs. It should be stressed that the establishment of the lake is firstly to obtain the cover soil needed for the recultivation and to serve as a controlling utility for the quality of the subsurface waters, which is of outmost importance for the long-term sustainable use of the environment of Tüskésrét.
- By the rehabilitation of Tüskésrét, the **general public**, the inhabitants of Pécs will gain an extensive area and its establishments available for community use. The lake will not only serve as a source of cover soil for the recultivation of the cassettes, but may form the basis of future community developments. The power station, the town and the inhabitants all benefit from the areas adjacent to the lake that may be used for recreation purposes, the already recultivated areas which can be designated for multipurpose use, together with the territory next to the power station serving commercial and industrial functions.

#### 2.4.2 Communication strategy, involvement of the stakeholders

For the realisation of the planned developments, it is essential to employ an appropriate communication strategy. For this the Communication Plan SufalNet4EU (April 2010) provides a



guideline. Also the revision and clarification of the Tüskésrét planning scheme will be carried out. At an early stage, during the elaboration of the local development plan the professional bodies, civil organisations and the public have been informed. During the project course, further communication events have been and will be held, to investigate and collect opinions and suggestion. In this sense

- a GUIDE has been elaborated, which collects and presents earlier but valid concepts for land use, development plans and decisions. This Guide can form the basis of public communications (local newspapers, radios, TV, internet).
- short information materials have been prepared and disseminated (newspaper article, brochure, leaflet) to presents antecedents, concepts/ideas, possibilities and development schemes.
- professional bodies (authorities, chambers of commerce and engineers, the Pécs Committee of the Hungarian Academy of Science, the University of Pécs) have been partially informed, but in coming phases of planning the opinions and suggestions of these organisations will be surveyed (circulars, roundtable discussions, conferences, scientific presentations)
- in order to investigate the opinion of the public, a communications expert company (Ferling PR Ltd.) will be involved. The broad involvement of the general public in the planning and decision making of the utilisation of Tüskésrét can be assured by publishing the information material in the press and the internet, by organising public forums and by assuring two-way communication (channels of feedback, contact info, accepting letters and internet messages etc.)
- on-site visits, demonstrations (open day: end Sep.- beginning Oct. 2011) will provide hand-on experiences to professionals and local inhabitants, which will contribute to the successful realisation of the programme.

## 2.5 Surroundings and adjacent use

The utilisation of the slurry deposit areas of Tüskésrét and its surroundings have been grounded by several studies, expert's reports and plans. The land use plans of Tüskésrét and its surroundings have been elaborated and integrated into the local development plans of Pécs based on these plans and studies. The studies were examining the expected groundwater levels, the expected concentrations and spatial occurrence of pollutants (total dissolved solids, sulphates etc.) following the recultivation. The system based on the lake and its facilities that will provide the long-term remediation of the polluted ground water has been designed taking these results into account.

The studies that prepare the planning of the land use of the area make it clear that the environmental and landscape engineering goals can be connected well in the area with the urban planning objectives and interests.

- The multi-purpose utilisation of the already recultivated terrain surfaces, the commercial use of the area adjacent to the Power Plant serves the interest of the city and the Power Plant at the same time (power generation, use of the existing industrial railway tracks etc.).



- The construction of a main road network can provide appropriate, uninterrupted access of the area from several directions, and its connection to the city structures.
- With the development of Tüskésrét, lying in the heart of the city of Pécs, the adjacent areas will be improved and grow in significance, from environmental, technical, commercial and social aspects.

Following the complex rehabilitation of the Tüskésrét area a new possibility would arise for the city to realise the goals and functions set out in the accepted local development plans (2006). The planned land use will take into account and match with the characteristics of the surrounding areas.

## 2.6 Intended use of the site and fitness for use

The main aims of the utilisation of the slurry deposit site are:

- the **physical and biological recultivation of the abandoned slurry deposits and those still in in operation of the Power Plant**, according to the permit plans. Once the terrain surface and the water drainage of the area have been constructed, the criteria needed for the commercial and industrial utilisation of the area lying to the west of the Power Plant will be established.
- the **construction of a lake** for the control of the quality and quantity of the subsurface water resources of the area, and also to provide a local source of soil for the terrain reconstruction involved in the physical recultivation technology. The lake would also provide for a favourable influence on the local climate of the city, and for the basis of the recreational functions planned in Tüskésrét.
- the **construction of orderly terrain** for any kind of further land use. The abandoned slurry cassettes that will be covered and recultivated are about 42 hectares, which add up to a total of 150 hectares of open space (parks, green areas) and other land use areas (institutions, industries, commercial) that will be available for future utilisation and development projects (e.g. sports stadium, sports hall, sport fields etc.)

It is clear that the future development concepts and investments outlined in the development plans can only be realised efficiently and in accordance with the set out aims on a planned, scheduled, hierarchical, long-term (10 to 25 years) basis.

## 2.7 Design and architecture of the site

Tüskésrét's planned overall development can only be realised in several consecutive steps, the phases of which are shown in **Tables 4. and 5.** The first and most important step that is also part of the project is the recultivation and landscaping of Tüskésrét to make reuse of the area possible. This requires the following main tasks:



**Table 4.** Overall development of Tüskésrét (Phases 1-2.)

ESTABLISHMENT	ISSUE	TASKS
<b>1. LANDSCAPING OF TÜSKÉSRÉT ENVIRONMENTAL REHABILITATION</b>		
- recultivation of the closed slurry cassettes	- technical and biological recultivation - rainwater drainage system - utilisation as industrial area	- realisation of the approved plans - preparation of the utilisation as industrial area
- construction of a lake	- construction and management of the lake - soil extraction and utilisation - technical and environmental aspects of the construction	- acquiring ownership of the land parcels - planning, decision making, obtaining water rights permits - implementation, construction
- landscape reconstruction	preparation of the area for - various uses and functions - sufficient roads - establishment of investments and facilities	- planning, decision making, obtaining permits (spatial planning) - implementation, landscaping, planting of vegetation, water drainage, other technical facilities
<b>2. CONSTRUCTION OF A ROAD SYSTEM</b>		
- construction of main roads	- North-South (Búza tér-FEMA) - East-West (Industrial Park-Leather Factory)	- planning, decision making, obtaining permits (programme, construction plans) - implementation, construction
- construction of inner roads	- system/network of inner roads at Tüskésrét	- planning, decision making, obtaining permits (programme, construction plans) - implementation, construction



**Table 5.** Overall development of Tüskésrét (Phases 3-4.)

ESTABLISHMENT	ISSUE	TASKS
<b>3. IMPLEMENTATION OF THE PLANNED FUNCTIONS AND FACILITIES</b>		
- sport, recreation	- leisure time centre, stadium-sports hall, ice dome, swimming pool, race tracks, water sports club...	- planning, decision making, obtaining permits (programme, construction plans) - implementation, construction
- industrial and commercial facilities	- buildings, facilities	- exploration of potential and realistic possibilities - planning, obtaining permits - implementation
- other facilities	- motel, hotel, camping and service facilities	- planning, decision making, obtaining permits (programme, construction plans)
- industrial fair	- buildings, parking lots, facilities	- implementation, construction
<b>4. ORGANISATION OF ENVIRONMENTAL MONITORING AND RELATED RESEARCH</b>		
- organisation of environmental monitoring	- lake water quality - climate of the town - vegetation, ecosystems	- research, education (Uni. Pécs) - system of analyses and evaluation
- obtaining and installing of equipment and instruments		- obtaining and installing of equipment and instruments - operation
- presentations, demonstrtrions	- present state - state following the development - analysis, evaluation, prognosis - sustainability - monitoring of succession / renaturalisation of the area	- organisation of presentations, demonstrtrion programmes - construction and operation of study paths / ecological walkways



### 2.7.1 Environmental rehabilitation and landscaping of Tüskésrét

- **Physical and biological recultivation of the** abandoned but still open **slurry cassettes** of the Power Station according to the permit plans. With the formation of the surface and water collection of the slurry cassettes to be recultivated, the basis for the planned commercial and industrial utilisation can be established, West of the Power Station.
- The establishment of a **lake** to ensure possibilities for quantitative and qualitative controlling of the subsurface waters in the area, and to secure locally the quantity of soil needed for the landscaping, recultivation and green area development. The lake established according to the approved plans will enhance the climate of the town and also form the basis of the development of a recreational centre around the lake.
- The **formation of an orderly terrain** (about 350 hectares) is the criterium of any further development. The abandoned open slurry cassettes (42 hectares) will be covered and recultivated, and so altogether 160 hectares of green areas (parks, green patches) and other areas (for institutions, commerce and industry) will be available for further use (e.g. sports stadium, sports hall, race tracks etc.).

### 2.7.2 Construction of traffic infrastructure and road systems

- a **main road system** to make possible easy access to the area from multiple directions and to fit it to the urban structure of Pécs. The planned roads in the local development plan are: North-South (Búza square-FEMA) and East-West (Eastern Bypass Road-Industrial Park-Leather Factory) which ensure
  - the improvement of the traffic situation and to de-burden the historical inner city
  - the enhancement of the connections between the boroughs of Pécs
  - the connection to the services and elements of the project development institutions of the EKF2010 programme (Zsolnay-Balokány cultural and touristic quarter);
  - access of Tüskésrét, increasing its development potential and usage value.
- an **inner road system**, which will realise connections between parts of Tüskésrét, the various functions and establishments

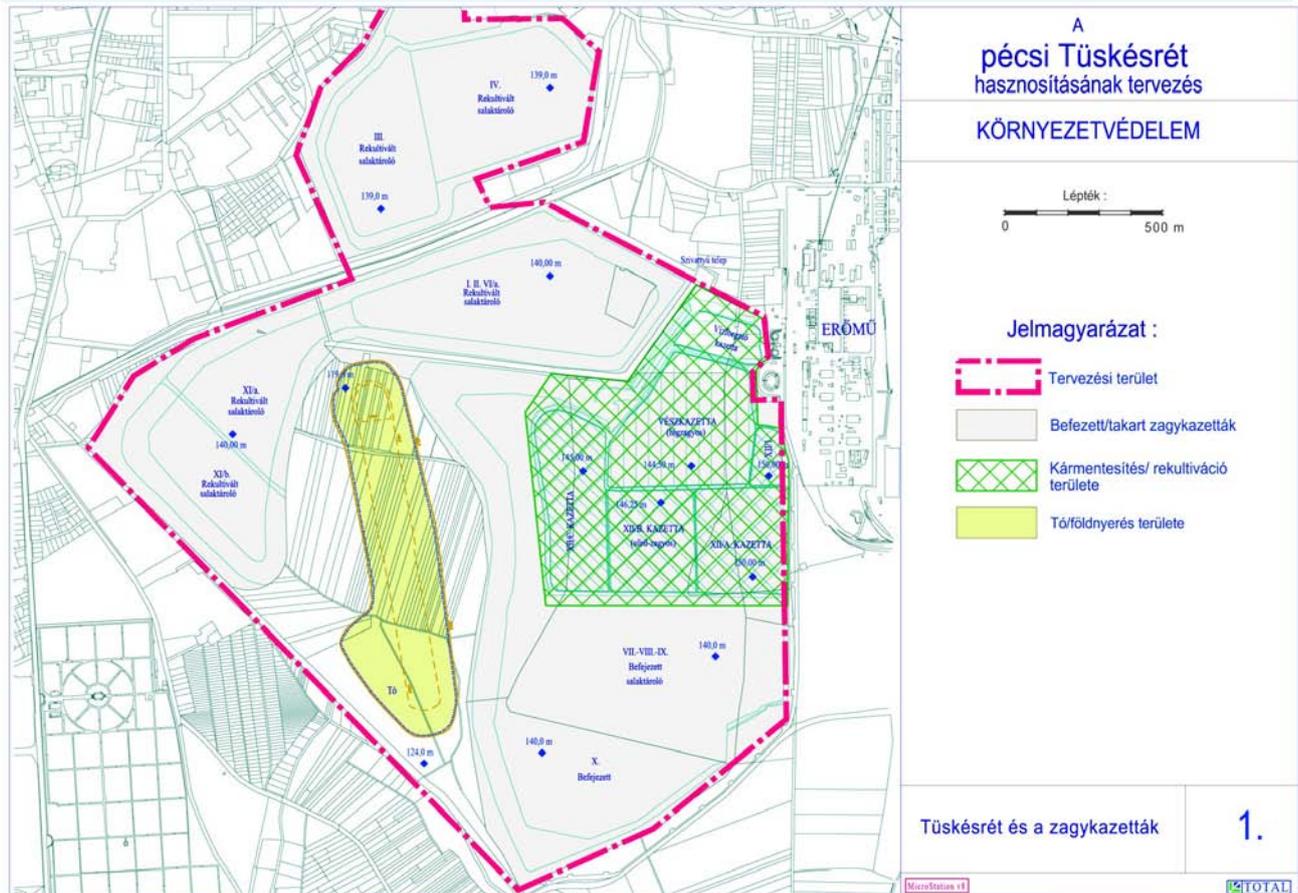
## 3. SITE SPECIFIC FEATURES OF THE IDENTIFIED AND SELECTED SITE

### 3.1 History

The area of Tüskésrét has been designated to slurry deposition in the founding documents of the power station (1958). This area was far from the city centre then, and didn't seem to be of any other use. The cassettes (named I-XI.) had been built together, side by side, so an artificial hill of considerable size developed by time, making place for the future lake. The location of the slurry cassettes can be seen in **Figure 3**.



Figure 3. The planning area of Tüskésrét, Pécs



yellow: area of soil excavation, green: open cassettes,  
grey: closed cassettes, pink line: area of Tüskésrét

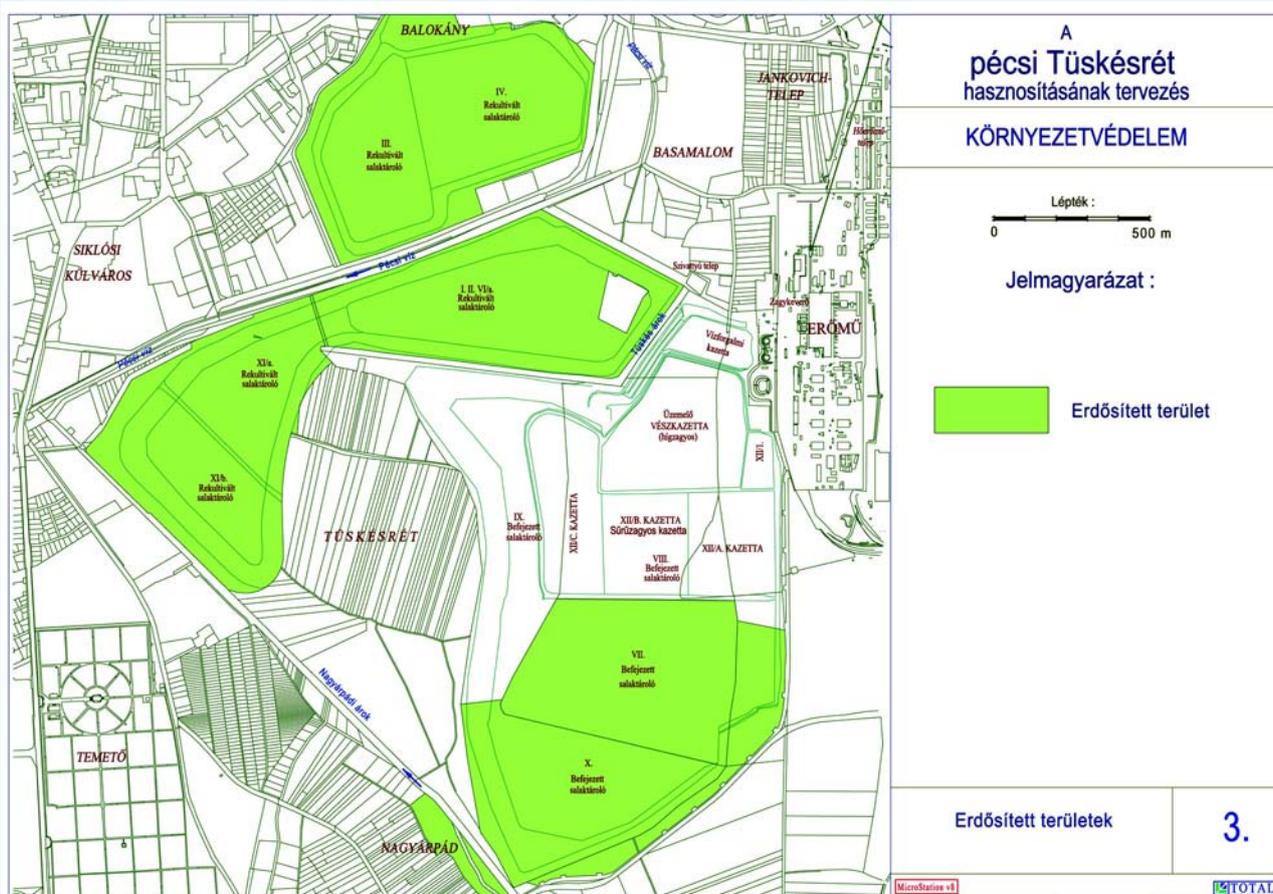
The construction of the cassettes followed the so-called lowland built reservoir technology, which meant the area was surrounded by a strong earth dam. The basin that was formed by the dam had been then filled by the slurry, a fly ash - slag mixture that was transported by a large amount of water (7-10 parts water to 1 part solids). When the top of the basic dam was reached, a new dam was built on top of the filled surface, about 5-10 metres inwards from the rim. After finishing the dam, the new basin was filled, and then a yet newer dam was built. This had been repeated until the allowed height had been reached, usually 20 metres, depending on the terrain. The height of each dam was usually 2,5 metres, and eventually a gradually narrowing earth dam system was built as the slurry cassette.

The building of new cassettes, the filling up of existing ones and the recultivation of the filled cassettes was taking place simultaneously, because the operation of the power station called for the availability of slurry deposition sites. After a cassette was finished, the top of it was sealed with 20-30 centimetres of soil, creating an even surface. This was then planted with trees using



different techniques. At some cassettes even the gradual earth dam was planted with trees, where at some of them this took place as a natural process. Today the majority of the cassette surfaces is covered by fairly large trees, creating a closed forest. Thus in the past 50 years the closed, recultivated and forested cassettes became an integral part of the urban landscape. The recultivated and forested cassette surfaces can be seen on **Figure 4**.

**Figure 4.** Vegetation cover



green: areas covered by vegetation (forest)

The technical and biological recultivation of the slurry cassettes causes inevitable environmental load. However, with this the area can be suitable for multipurpose utilisation, meeting the prescriptions of the local municipal structural plan.

### 3.2 Ownership

The plots of land that lie under the slurry cassettes were acquired by the state from the private owners. In the land register the rights of usage of the Town Council and the Power Station were entered, then after the political change in 1989, the rights of the Municipality and the Pécs Power

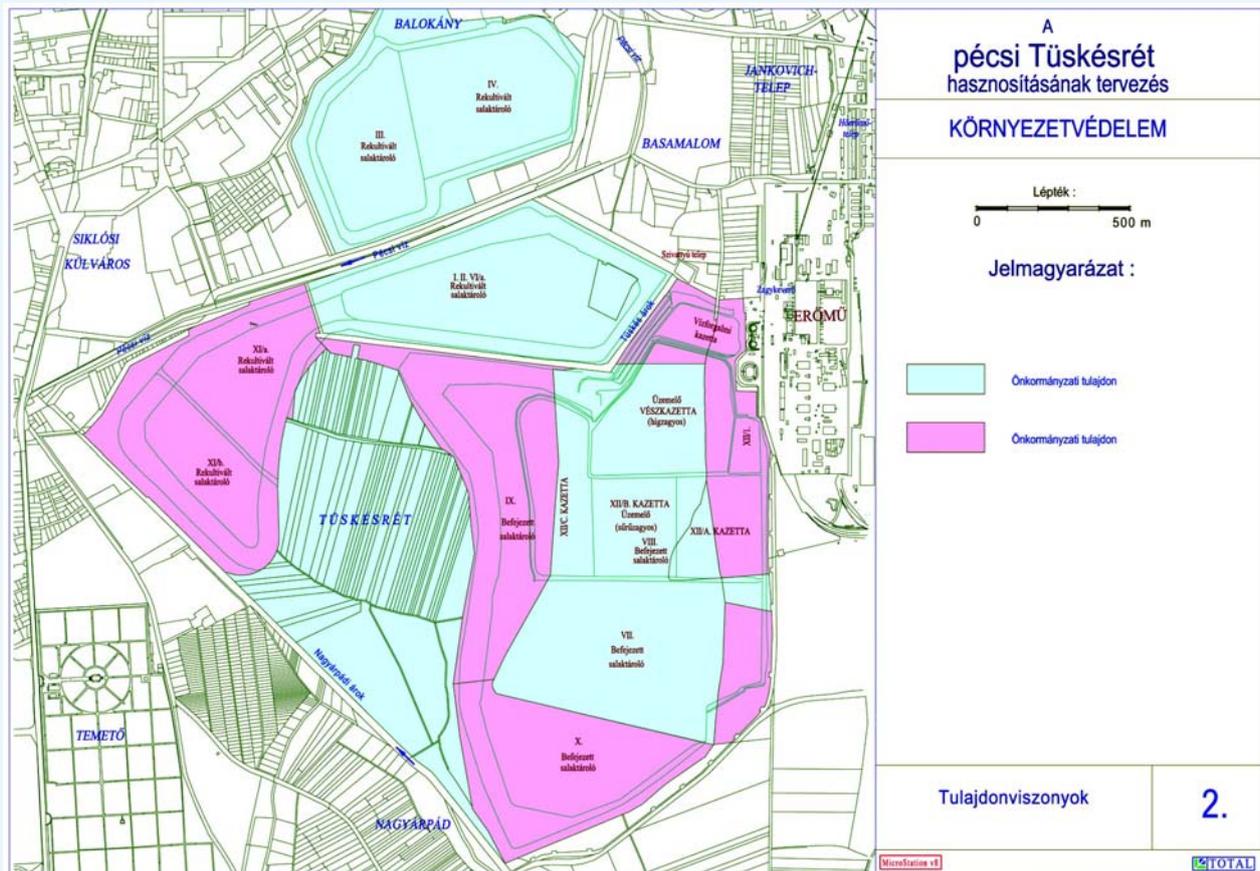


Station Inc. In some cases the smaller land parcels were united to form one large parcel to cover the whole cassette.

Before 1989 these areas belonged to the ownership of the state, and the Power Station and the Town Council set the criteria of usage for slurry deposition in agreements. At this time it was not very important to define usage (by whom, how), since the owner was the state.

After privatisation of the site in 1990, the area partially became the property of the Municipality of Pécs, partially that of the Pécs Power Station Inc. So presently (in 2010) the area of the site is of mixed ownership, the outer boundaries of the present cassettes cover several land parcels. The ownership is settled (see **Figure 5.**) and the cooperation of the parties is given, so there are no obstacles of this kind in the way of the developments.

**Figure 5.** Ownership



owners: blue: municipality, pink: power station



### 3.3 Geology, geomorphology, precipitation

#### Terrain

The area of the whole Tüskésrét that includes the slurry landfill is nearly 400 hectares, where the area of the planned lake (the lake basin and the surrounding slopes) is about 70 hectares. This area is the deepest lying part of the town, with an altitude of 120-125 metres above Baltic Sea (maBS). The originally high levels of groundwater made it unsuitable (or at least unfeasible) for agricultural use.

With the formation of slurry cassettes the terrain characteristics were changed for good. The crest of the cassettes are 18-20 metres higher (140-145 maBS) at some points than the original terrain elevation (120-130 maBS), their surface is even.

#### Geological features

At and around the area of Tüskésrét several geological and hydro-geological borings have been drilled, and the geological mapping of the area has been prepared based on the findings. The granite bedrock is covered by Miocene argillaceous limestone and porous limestone layers. In the Southern - South-Eastern part the argillic and clayey layers are in majority, the limestone formation has not taken place. The Miocene limestone is reaching the ground surface at the Northern rim of Tüskésrét, whereas at the Southern rim it lies at a depth of 300 metres.

The Miocene layers are covered by Pannonian beds, most of them are clayey. In this layer there are two sandy aquifers, which are barren ground. Following the Pannonian layers the Pleistocene-Holocene layers are represented by 20 metres of sand, 0,5-2,0 metres of fine-medium sand and pebbly sand. These are followed by the upmost surfacing layers of 2-4 metres thickness, comprising clay, muddy clay and loess. These formations are characterised by brown, dark brown, grey or black colours, which indicate organic substances that originated in a bog or marsh. The thickness of the top covering layer is varied between 2 to 10 metres.

The area of Tüskésrét lies the lowest in Pécs, the sediment for the streams arriving here from the North, East and South formed a very varied upper Pleistocene and Holocene layer series, where sand, pebbly sand, and sandy pebble layers can be found near the surface. The basin is being continuously filled with mixed sediment, because the streams bring material from the mountains and hills.

#### Hydro-geological features

The thickness of the upper geological layers of the Tüskésrét area varies between different values, near the surface, until a depth of 3-4 metres, mud and clay can be found, with low permeability values:  $l_p = 15\% - 32\%$ ;  $k \approx 10^{-5} - 10^{-7}$  cm/sec.



Below them aquifers can be found with a thickness of 0,5-3,0 m, in the form of fine sand, medium sand and sandy pebbles. Below the cassettes I., II. and VI/a. these layers can not be found, because here up to a depth of 11,6 metres only fat clay and medium clay exist.

Several springs can be found North-east of Tüskésrét, in the lowlands lying West of Jankovich-telep, which is 0,5 metre lower than the lowest point of Tüskésrét. The drainage of these waters is not solved, the old canals and ditches are filled with mud. The sewage from the neighbouring houses also enters this area through the porous layers.

The landfill is filled with fly ash and slag coming from the liquid slurry technology of the power station, which can be characterised by loose structure, low cohesion between the particles, rough particle surface, large pore space, low bulk density and uneven particle size distribution, and owing to this, larger permeability values ( $k = 10^{-2}$ - $10^{-5}$  cm/s).

The geological, hydro-geological and hydrological investigating borings found here a thick impermeable bedrock, with overlying Neogene strata and confined water, capped by Quaternary formations holding the groundwater. The confined water lying at greater depths and on the bedrock of the basin is hydro-geologically separated, so the utilisation of these waters is not at risk from the nearby wells of the meat processing plants (slaughterhouse and poultry plant).

#### Wildlife

The botanical, zoological and ecological features of the surroundings of the Power Station have been examined by the researchers of the University of Pécs in 1995-1996. The findings have been evaluated and documented. The examined area was a circle with a radius of 15 kms around the Power Station, including the Tüskésrét. Based on these findings, the area of the slurry landfill can be described as the following:

- **Botany.** The vegetation coverage around the power station is disturbed and degraded, in most places only plant communities of secondary succession can be observed. The typical plant communities in the area of the operating cassettes are weeds, moor meadows, reeds and shrubs.

The report summarises the findings: the slurry landfills and their surroundings do not have significant botanical value. There are some interesting biotopes but these are also degraded and damaged.

- **Zoology.** There were 118 protected animal species found in the survey of 1995-1996. The former zoological surveys were very incidental and focused only on some groups. This indicates the potential value of the area.
- **Ecology.** The area and vicinity of the slurry cassettes are not valuable from an ecological point of view, that is a built, artificial environment. The industrial facilities (e.g. the power station) block an important fauna corridor, and only a narrow passage is left by the stream



Pécsi-víz.

In and around the slurry landfill spontaneous vegetation can be found, and further off from the industrial activity the area is rich in birdlife, nearly all protected bird species can be found here occasionally. The cassettes and waters that are recultivated and covered by vegetation serves as a resting spot for numerous species, and also as feeding and nesting place for a few bird species. There are 118 protected vertebrate species and 132 protected plant species registered by the survey of 1995-1996 in the area of Tüskésrét.

The survey showed that the slurry deposition hasn't caused serious disturbance and damage to the wildlife in the area. With the stopping of the slurry technology the biological recultivation can be possible and the habitat can be more close to the natural environment.

#### 4. EXAMINATION AND CHARACTERISATION OF THE SITE

The area of Tüskésrét has been designated to slurry deposition in the founding documents of the power station (1958). The construction of the cassettes followed the so-called lowland built reservoir technology, which meant the area was surrounded by a strong earth dam. The basin that was formed by the dam had been then filled by the slurry, a fly ash - slag mixture that was transported by a large amount of water (7-10 parts water to 1 part solids). When the top of the basic dam was reached, a new dam was built on top of the filled surface, about 5-10 metres inwards from the rim. After finishing the dam, the new basin was filled, and then a yet newer dam was built. This had been repeated until the allowed height had been reached, usually 20 metres, depending on the terrain. The height of each dam was usually 2,5 metres, and eventually a gradually narrowing earth dam system was built as the slurry cassette.

The building of new cassettes, the filling up of existing ones and the recultivation of the filled cassettes was taking place simultaneously, because the operation of the power station called for the availability of slurry deposition sites. After a cassette was finished, the top of it was sealed with 20-30 centimetres of soil, creating an even surface. This was then planted with trees using different techniques. At some cassettes even the gradual earth dam was planted with trees, where at some of them this took place as a natural process. Today the majority of the cassette surfaces is covered by fairly large trees, creating a closed forest. Thus in the past 50 years the closed, recultivated and forested cassettes became an integral part of the urban landscape. The recultivated and forested cassette surfaces can be seen on **Figure 4**.

The technical and biological recultivation of the slurry cassettes causes inevitable environmental load. However, with this the area can be suitable for multipurpose utilisation, meeting the prescriptions of the local municipal structural plan.

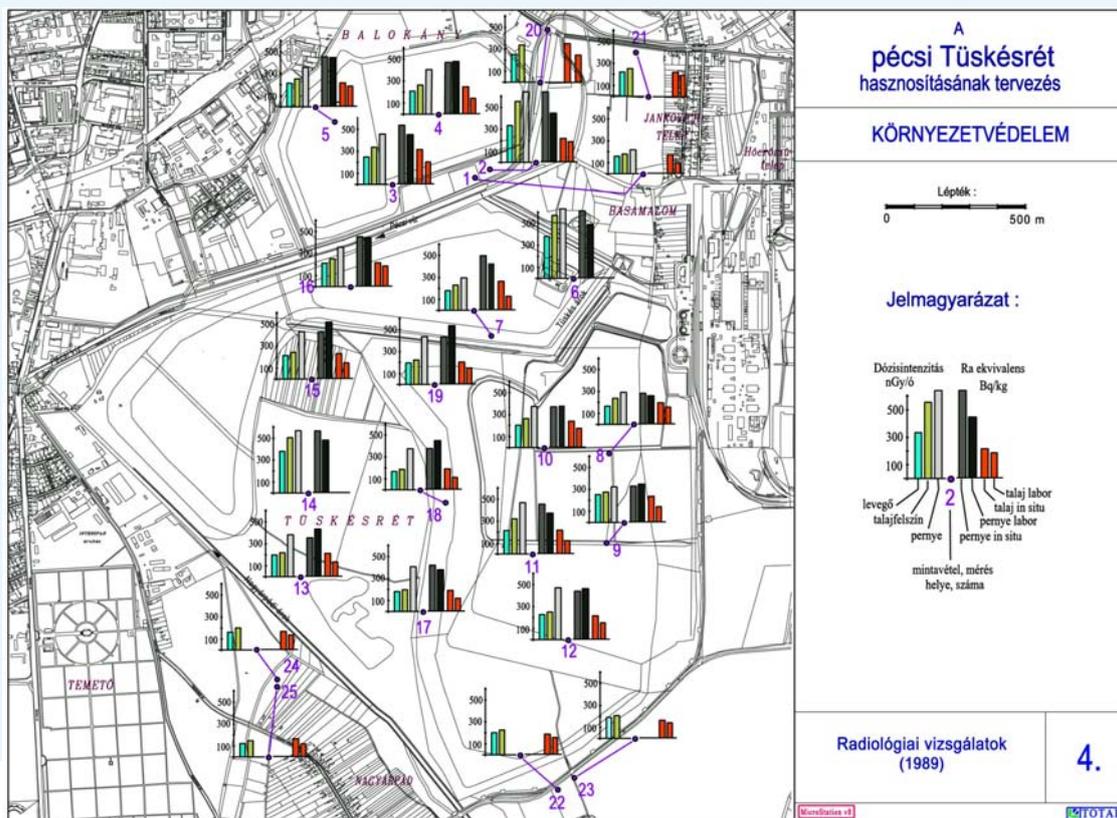


#### 4.1 Investigation of waste, water, soil and air

The composition of the deposited slag, fly ash and slurry, and the physical, chemical and toxicological properties of the leachate, the soil, the groundwater and surface waters have been analysed and determined throughout the past decades at Tüskésrét. The investigations needed to establish the full recultivation and utilisation of the area, the impacts and impacted areas have been assessed, and the measures to minimise the impacts have been determined. The results of the assessment can be summarised as:

- Assessment of the slurry.** The environmental impact of the slurry technology could be judged by the extensive investigation of the composition and hazards of the dry fly ash and the slag, and the thin and thick wet slurry made from these. The physical, chemical, ecotoxicological, toxicological and bacteriological analyses proved that the slag, ash and slurry are not to be considered hazardous waste. The conditions of the utilisation of the ash and slag in *construction industry* and the *sealing and urban utilisation* (buildings, recreation, green area) of the slurry landfill have also been determined by the investigation of the radiological properties. These were conducted on the soil surface, inside the deposited slurry body and in the air in 1988. The findings of the on-site and laboratory investigations is shown in **Figure 6**.

**Figure 6.** Radiological assessment (1989)





The findings show that

- the Ra-equivalent of the ash varies between 400-650 Bq/kg, so it may be used for road constructions industrial buildings without limitations, and for construction of living houses where it is diluted to reach values less than <math><370\text{ Bq/kg}</math>.
- the Radon emission is minimal, which means that the deposited ash and the ash used in construction do not emit Radon gas in an extent that poses a hazard e.g. in dwellings.

By the evaluation of the specific activity and the dose intensity it can be said that

- with a sealing of 30 cms of solid soil the surface of the cassettes can be made suitable for non-permanent human presence, since the dose intensity values go below the threshold level.
- load above threshold level are not expected on the surface of the recultivated cassettes, in case of proper building cover. This has been proven by investigations on the pavement and in the buildings built on the recultivated slurry landfill of Pécs Waterworks, where a sewage sludge granulation plant has been built.
- based on the opinion of the public health authority, the building authority has prescribed an earth cover of 1 m thickness to seal the closed slurry cassettes. This way the multipurpose utilisation of the area can be planned and solved.

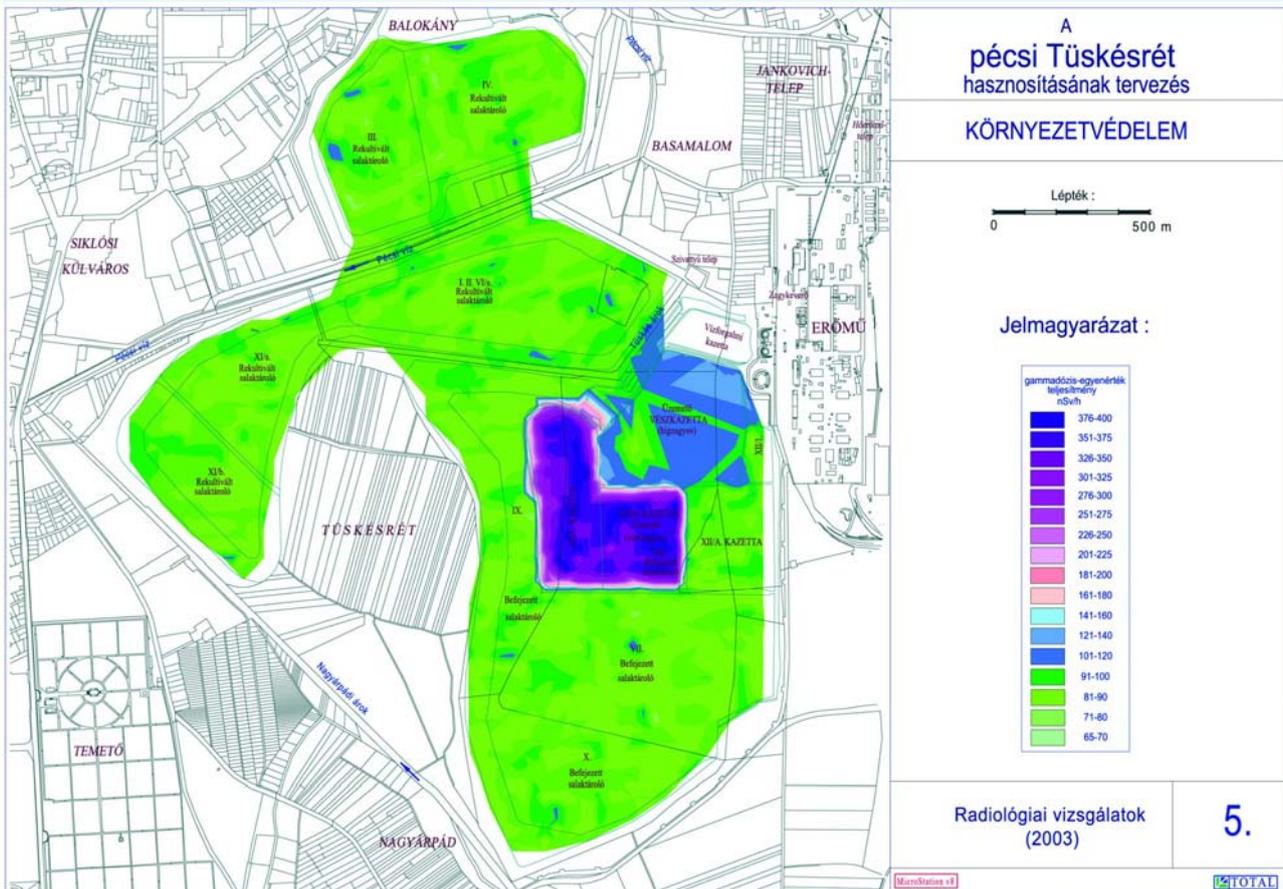
To plan the closing of the slurry technology, the radiological assessment of the already closed, thin slurry cassettes and the operating thick slurry cassettes had been performed in 2003. The findings corresponded with the previous results, and gave important data for future planning. The results show the following:

- the radioactivity of the thick slurry is ten times that of the background soil. The activity rises in the following order: slag, thick slurry, fly ash.
- the investigations at various depths in the thick slurry cassettes show a homogenous distribution concerning radioactivity. The migration of daughter elements in the soil is not probable, as experiment show.

The results of the radiological assay of the Tüskésrét area and the cassettes is shown in **Figure 7**.



Figure 7. Radiological assessment (2003)



- Water analysis.** The monitoring of the subsurface waters of Tüskésrét, and the impact of the slurry landfill's waters on the ground waters in the area is performed by a monitoring system consisting of nearly 30 wells, operated by the Power Station. The location of the wells and sampling points were planned in a way to make it possible to follow changes in the water quality on the whole area of Tüskésrét. The weekly water level measurements in the monitoring wells is accompanied by water quality analysis in samples from the wells and samples from the nearby surface waters (Pécsi víz, Nagypárádi árok, Tüskés árok, drainage canals) twice a year. These data are available from 1992.

The presently operating and the planned monitoring wells and sampling points are shown in **Figures 8. and 9.**



Figure 8. Subsurface sampling points and monitoring wells

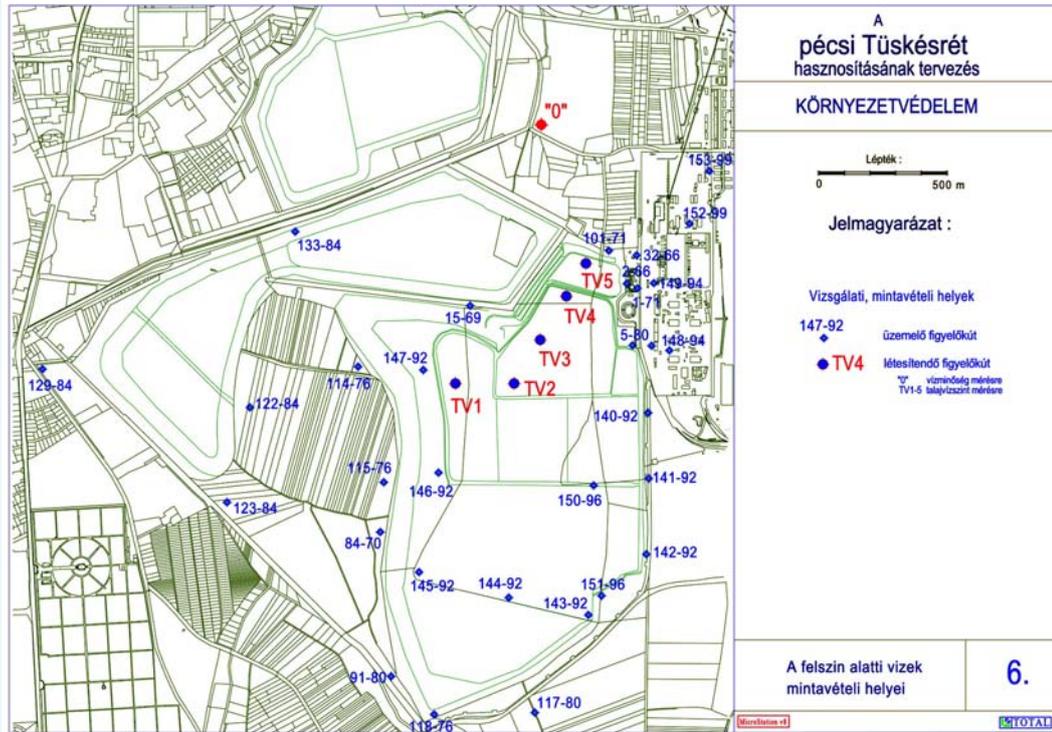
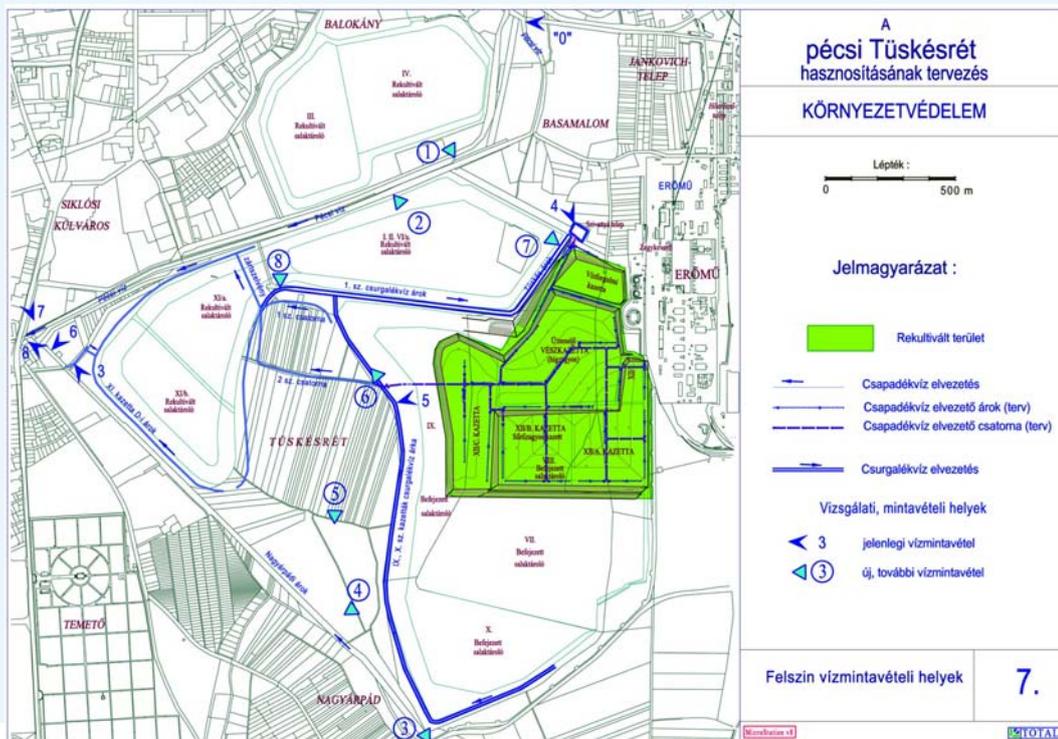


Figure 9. Surface sampling points





**Ground water levels in the area.** The original terrain is a mild slope of 4-5 metres declining from South to North. The surface waters of the adjacent areas of higher elevation percolate to the direction of Tüskés-árok and the meeting of Pécsi-víz and Nagyárpádi vízfolyás, running in the middle of Tüskésrét. The original direction of the flow regime changed from South-North to East-West, due to the impact of the thick slurry deposition.

**Pollution of the ground water.** The water analysis results show that some main pollutants have reached significantly high concentrations:

- variations in total salt content show the effect of slurry deposition. The ground water beneath the open cassettes have a salt content of 2-3000 mg/l and exceed the typical values of 800-1000 mg/l salt concentrations of unpolluted ground waters. The concentrations change in time, but are similar, with the highest values found by the side of the Power Station in the operating cassettes.
- the variations in time and space of the sulphate ion concentrations are similar to that of the salts. The highest concentrations (1-3000 mg/l) can be observed in the groundwater under the open cassettes, which exceed the typical values of 100-200 mg/l salt concentrations of unpolluted ground waters, and the so-called triggering level (700 µg/l). It could be observed too, that in the area of the planned lake, the concentrations increased between 1991 and 2000, then decreased. The concentration of 2000 was 1000-1800 mg/l, which decreased to 200-1000 mg/l in 2005. This favourable process continues, as results from 2009. show.
- the concentration of heavy metals (As, Cd, Cu, Hg, Mo, Zn) can be evaluated from data from the last years. It can be observed that the pollution is localised to the open cassettes and their near environment, and a connection can be made with the previously extensively used thin wet slurry technology.

In the period of 2000-2009 the groundwater levels are shown in **Figure 10.**, the total salt concentrations are shown in **Figure 11.**, and the sulphate-concentrations are shown in **Figure 12.**

This means that after the discontinuation of the slurry technology in 2004, the feeding of pollutants was stopped, so the gradual improvement of the water quality of the polluted ground waters can be expected due to the diluting effect of the ground waters arriving from the neighbourhood of Tüskésrét.

**Surface water quality.** The research results show that the water quality of Pécsi-víz is affected mostly by loads originated outside Tüskésrét, while impact of the slurry landfill is clearly seen on the water quality of Tüskés-árok. Nagyárpádi stream reaches Tüskésrét with normal (natural) water parameters, and its pollutant content is slightly increased here due to the percolation of leachates, but even like this it dilutes its recipient Pécsi-víz.



Figure 10. Groundwater levels

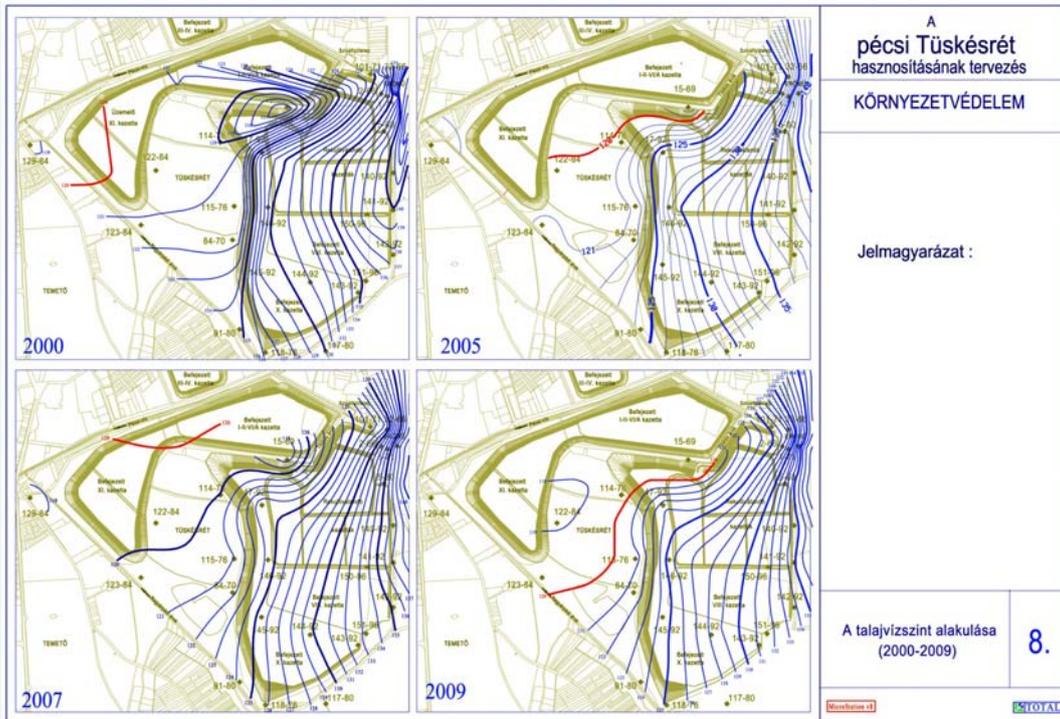


Figure 11. Total salt concentrations

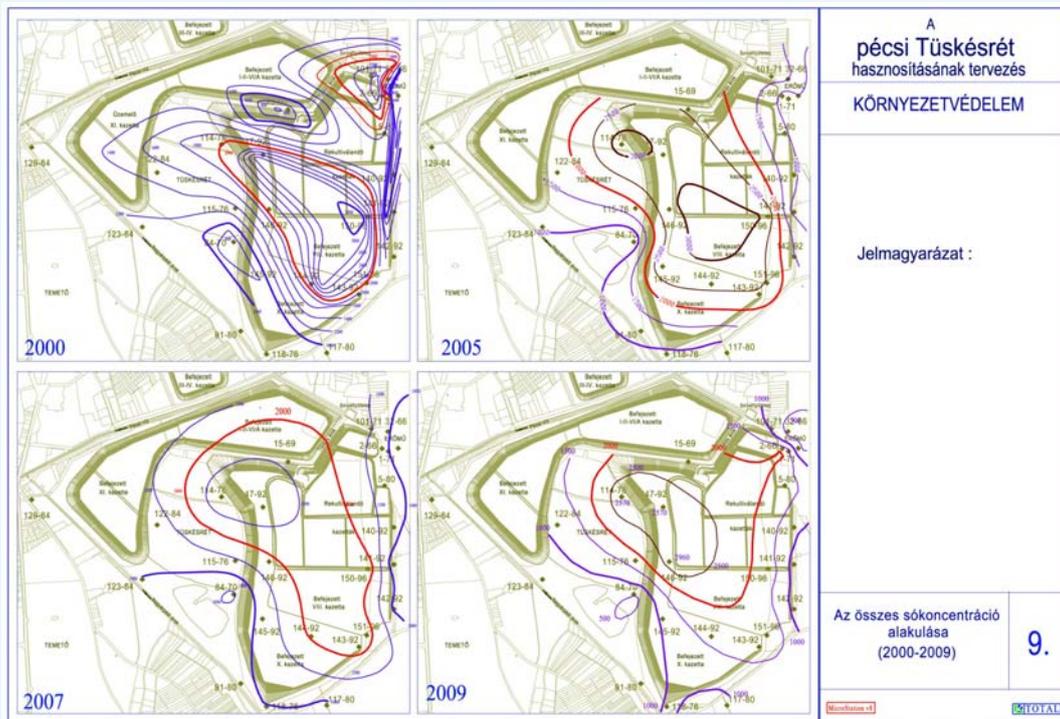
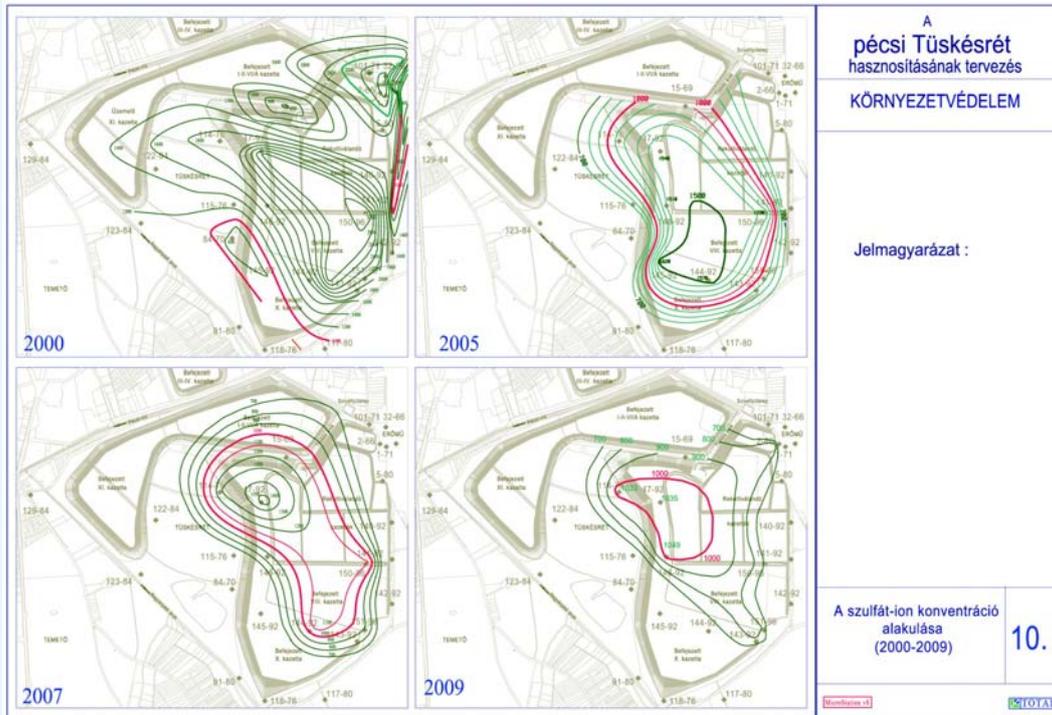




Figure 12. Sulphate ion concentrations



The water quality of the little lake formed at the soil extraction site is effected by the quantity and quality of the ground waters arriving from South and the slurry cassettes on the East.

#### 4.2 Risk assessment in terms of human health and ecological risks

The risk assessment of the environment was performed using a simplified model, owing to the characteristics of the area, the processes, the complexity and extension of the activity. Thus the risks have been estimated based on the main factors and their relative changes in quantity and quality. The factors that have been taken into account are:

##### 4.2.1 The characteristics of the source of the hazard (slurry deposition):

1. **the hazardousness of the pollutant**, from the presence of the dissolved salts and toxic compounds leaching from the deposited waste (slurry and tailings), like sulphate, chloride, sodium, calcium, heavy metals etc.
2. **the amount of the pollutant**, taking into account the area occupied by and the mass of the deposited waste (slurry and tailings)
3. **the method of deposition**, the state of condition of the deposited waste (slurry and tailings)



#### 4.2.2 The characteristics of the area of the landfill, the recipient and the dispersion

4. the **method of deposition**, the underneath sealing and top coverage of the deposited waste (slurry and tailings)
5. the **sensitivity of the area towards pollution**, namely the sensitivity of the landfill area towards surface pollution, the transportation of the pollutants in the soil layers, its percolation in subsurface water
6. the **terrain, relief and water runoff features** of the area
7. the **presence of pollutants in the waters**, in the surface and subsurface waters and their concentration

#### 4.2.3 Hazard posed to humans and the human environment

8. **hazards posed to the water bases**, the entering of discharges and pollution originating from the deposited waste (slurry, slag, ash) into the water bases
9. **hazards posed to humans**, the number of citizens endangered directly or indirectly by the pollution

The relative quantitative and qualitative values of the factors were assigned points on a scale of "very high" (1 point) to "very low" (5 points).

The evaluation of the risks of the closed, non-operational (but not yet recultivated) slurry cassettes and the already recultivated cassettes has been done, **Table 6.** compares both sites, and shows the changes in risks in all 3 factors.

**Table 6.** The changing of the risks

EVALUATED FACTOR	CLOSED SLURRY LANDFILL	RECUITIVATED SLURRY LANDFILL	CHANGE
I. Source of the hazard	high (2)	medium (3)	+1
II. Area, recipient and dispersion	very high (1)	low (4)	+3
III. Hazard posed to human environment	high (2)	very low (5)	+3

It can be said that

- the risk of entering of pollutants into the environment and their dispersion (factor II.) changed from very high (1) to low (4)



- the risks that the human environment is posed to (factor III.) the risks changed from high (2) to very low (5)
- the planned technical interventions significantly decrease the environmental risks.

#### 4.3.4 The communication of risks

The risks connected to the environmental pollution effects of the slurry technology and the landfill has been well known to the stakeholders (the power station, the municipality, the authorities, engineering companies and experts) since the 1990's. The elaborated and accepted plans of technical interventions, and the multipurpose utilisation plans of Tüskésrét make it possible to inform and to get to know the opinion of the public, the NGO's and other experts on the topic.

## 5. AFTERCARE OF THE SITE

### 5.1 Policies and legislation

In Hungary – in harmony with EU legislation - the planning, the content of the approval permit applications, the permit procedure and the participating authorities of various developments and investments are regulated by acts and regulations. In this sense the planned developments of Tüskésrét have been included in the local development plan of the city of Pécs, which has been approved by the general assembly of Pécs in 2004 (decree no. 475/2004. (11. 18.)). The plan has been modified a number of times, last in Sept. 2010., and is in power. The modifications have not altered the usage of Tüskésrét. Thus in the area that is nearly 400 hectares large:

- the recultivated slurry cassettes and their environs can be utilised for green areas and recreation
- the establishments installed in the area will provide cultural, sports, recreation functions
- planned establishments: cultural centre, a sports centre, recreation centre

These land use ideas and functions are in accordance with the Baranya county level and national level legislation, such as zoning system and land use guidelines. The land use zones that are in power now can be seen in **Figure 1**.

The basis of further planning and establishing is the accepted local development plan, but at the designing of detailed plans, the respective regulations have to be taken into account: the content of the approval permit applications, the procedure of permit issuing, the participating organisations are varied according to the type of the plan (e.g. building, water rights, environmental authorities).



## 5.2 Technical measures

The main steps and tasks of the utilisation of Tüskésrét are shown in **Table 4. and 5.** The first step of this is the landscape reconstruction of Tüskésrét and construction of roads, which can be followed by the realisation of the planned functions and establishments.

In case of the slurry landfill the collection and treatment of the leachates, and the drainage of precipitation has to be solved, while the percolation of pollutants to the groundwater has to be minimised, since the terrain and the geological structures cause the groundwater to move towards the West, in the direction of the water bases (P-area) that provide the drinking water supplies of the town.

The water protection can be assured with the drainage of the rain water, the watertight sealing of the caps of the slurry cassettes, and the treatment of the leachates. The recultivation and multipurpose utilisation of Tüskésrét consist of the following steps of technical intervention:

### 5.2.1 Recultivation and construction of the lake

The technical (physical) recultivation of the landfill involves the extraction of 5-600 thousand cu.m. cover soil from the area of the planned lake, and after transportation the soil shall be spread in 1 metre thickness to seal the top of the **open cassettes**, see **Figure 3.**

The soil extraction process will also result in the formation of a groundwater **lake**, which will be 28 hectares large, 5 metres deep, 1200 metres long, 220-340 metres wide, with a volume of 989 thousand cu.m. This lake will serve as the key element in the regulation of the quality of the subsurface waters of Tüskésrét. See **Figure 3.**

- **Primary function of the lake:** the water quality regulation of the area that has been polluted due to the slurry technology, gradual improvement of the water quality by the groundwater lake. The lake will produce a suction effect on the subsurface waters, and the polluted groundwater lying under the slurry cassettes will be diluted by fresh waters flowing into the area from the South. The water leaving the lake will this way also meet the requirements of discharging to live water recipients.
- **Other functions of the lake:** the nearly 28 hectares water surface will have a planned beneficiary effect on the present (desert-like) climate and ventilation processes of the town. The lake lies in the middle of the planned recreation area of the town, and the improvements in water quality make it possible to contribute actively to the leisure and sports functions.

### 5.2.2 Other technical aftercare measures

#### Treatment of the leachates

The leachates of the recultivated slurry landfill has to be collected by drains, and pumped to the treatment site where the treatment can be performed (250 cu.m./day).



### Minimising of the infiltration of rainwater

The minimising of the infiltration of rainwater to the deposited slurry can be assured by covering the open surfaces by 1 metre thick layer of soil sealing, following the landscaping. This is also favourable for the biological recultivation. The total amount of soil needed is 550 cu.m. Following this the biological recultivation has to be performed.

### Drainage of rain water

In order to minimise the infiltration of rainwater to the slurry, the drainage of the rain water has also to be built. This involves 2243 metres of closed pipelines and 3640 metres of open ditches.

### 5.2.3 Implementation of the planned functions and facilities

Following the recultivation and the construction of the lake, the planned functions and facilities can be realised by the multipurpose utilisation of the area.

## 5.3 Organisation of the tasks

The landscaping and environmental rehabilitation of Tüskésrét is a special task consisting of several steps, which is expected to include

### 5.3.1 Tasks of the Power Station

- landscape reconstruction and covering of the still open slurry cassettes, construction of the water drainage and leachate treatment systems, disposal to the recipient
- construction of the ground water lake, extraction and transportation of the soil, landscaping around the lake
- setting up and operation of the monitoring system of surface and subsurface water quality

### 5.3.2 Tasks of the Municipality

- construction and management of the engineering structures of the lake
- management and operation of the area (lake and recultivated surfaces)
- planning, permit obtaining and organising of the multipurpose utilisation of Tüskésrét

## 5.4 Financing

Tüskésrét's planned overall development can only be realised in several consecutive steps, the phases of which are shown in **Tables 4. and 5.** The first and most important step that is also part of the project is the recultivation and landscaping of Tüskésrét to make reuse of the area possible. This requires the carrying out of the following main tasks:



### Environmental rehabilitation and landscaping of Tüskésrét, including

- Physical and biological recultivation of the abandoned but still open slurry cassettes of the Power Station according to the permit plans.
- the establishment of a lake to ensure possibilities for quantitative and qualitative controlling of the subsurface waters in the area, and to secure locally the quantity of soil needed for the landscaping, recultivation and green area development.
- the formation of an orderly terrain on about 350 hectares. The abandoned open slurry cassettes (42 hectares) will be covered and recultivated, and so altogether 160 hectares of green areas (parks, green patches) and other areas (for institutions, commerce and industry) will be available for further use.

### Construction of traffic infrastructure and road systems, including

- a **main road system** to make possible easy access to the area from multiple directions and to fit it to the urban structure of Pécs
- an **inner road system**, which will realise connections between parts of Tüskésrét, the various functions and establishments

#### 5.4.1 Estimated costs of the realisation

Environmental rehabilitation, landscape revitalisation and complex community utilisation of Tüskésrét will take place in a planned, focused and scheduled manner. The contents and costs of these are:

#### Recultivation of Tüskésrét comprises

- the construction of a lake (27,7 ha), by excavating the soil together with the necessary water engineering technology, according to plans;  
The costs are in **Table 8**. The total costs reach 1,38 billion HUF (4,93 million €).
- recultivation of the abandoned, open cassettes of the power station, according to plans (brown field development);  
The estimated costs are in **Table 9**. The total costs reach 1,87 billion HUF (6,93 million €).
- elaboration of further plans (that of roads, junctions, bridges, parks at 35 hectares) contribute to a cost of 160 million HUF (614 thousand €).

The total costs of the recultivation and preparation of Tüskésrét for further developments are estimated to be **3,38 billion HUF (12,1 million €)** net costs.



**Table 8.** Main features and costs of the construction of the lake

DESCRIPTION	unit	lake version (phase I.)
<b>MAIN PARAMETERS</b>		
water surface	hectare	27,7
water volume	cu.m.	989 000
ratio of area/volume		0,0280
ratio of mass/area		35,7
length of the shore	m	2 770
length of the lake	m	1 200
width of the lake	m	220 ... 340
<b>SOIL WORK</b>		
cut	cu.m.	1 084 000
fill	cu.m.	130 000
<b>total</b>	<b>cu.m.</b>	<b>1 214 000</b>
<b>COSTS</b>		
costs of construction	million HUF	1 378
costs of operation	million HUF/year	8,3

**Table 9.** Cost estimation of the recultivation of the slurry cassettes

DESCRIPTION	Cost item	Total costs
	thousand HUF	thousand HUF
<b>A. CONSTRUCTION, LANDSCAPING</b>		
<b>1. Costs of recultivation</b>		
1.1 Demolishing works	5 000	
1.2 Surface forming, soil cover	1 470 200	
1.3 Surface water collection	152 214	
1.4 Planting of vegetation	17 000	
<b>1. Recultivation total</b>		<b>1 644 414</b>
<b>2. Costs of remediation</b>		
2.1 Remediation of leachates	229 000	
2.2 Monitoring system	3 000	
<b>2. Remediation total</b>		<b>232 000</b>
<b>A. CONSTRUCTION, LANDSCAPING TOTAL</b>		<b>1 876 m HUF</b> <b>6,93 m EUR</b>
<b>B. PLANNING, PERMIT OBTAINING</b>		<b>60 m HUF</b> <b>0,214 m EUR</b>



**Traffic infrastructure and construction of road systems** include the planning, public, authority and professional reconciliation, permit application, based on further decisions. The specific and total costs of the traffic infrastructure can be found in **Table 10**. The actual costs will be determined by the planning and permit procedures yet to come.

**Table 10.** The costs of realisation with specific costs

Description	Specific costs	Amount	Net costs (million HUF)	Net costs (thousand €)
main road (6 m wide)	250 th.HUF/m	3 000 m	750	267,9
inner road (3 m wide)	150 th.HUF/m	6 000 m	900	321,4
parking lots	20 th.HUF/sq.m	10 000 sq.m	200	71,4
junctions	25 million HUF/pc	4 pcs	100	35,7
planting of parks, forests	1 000 HUF/sq.m	158,5 ha	1 585	566,1

#### 5.4.2 Benefits of the realisation

Pécs is the capital of the South Transdanubian Region, with monuments that are part of the World Heritage, having regional governmental, research and education functions, 20 thousand university and college students, several international corporations. At the same time, possibilities for active relaxation, recreation and entertainment within the city are rather poor. So the planned developments serve the benefit of Pécs in the following way:

- right „next door” to the inner city, the planned recreation centre (about 160 ha of parks and greens) and the connected establishments will make a whole (or several) day stay for resting possible.
- the establishments and institutions planned on the recultivated slurry cassettes will bear regional functions (e.g. a sports stadium, sports hall, swimming pool, ice hall, heliport etc.) and make possible investment projects in the magnitude of **billions of HUF (millions of EUR)**.
- the settling of advanced, clean technologies at the commercial area, and the criteria for education and research can be grounded. A further 50 hectares of land will await investors with developments in the magnitude of **billions of HUF (millions of EUR)**

The planned development of Pécs, the opening of the airport at Pécs-Pogány, and the construction of the national highway in the area significantly increases the accessibility and the



development of the city itself. So the brown field development project has a strong multiplying effect on the benefits. The financial benefits cannot be judged at this moment, due to the lack of detailed plans.

#### 5.4.3 The distribution of costs

**Pannon Power Station Inc. (PH Zrt.):** plays a key role in the revitalisation of Tüskésrét. These include:

- the establishment of the lake according to plans involves a total cost of 1,38 billion HUF (4,93 million €), of which 1,30 billion HUF (4,64 million €) will be paid by PH Zrt., 0,8 billion HUF (286 thousand €) by the Municipality of Pécs.
- the recultivation and landscaping of slurry deposits, to prepare for further use. The costs of these works will be covered by the PH Zrt., which sums a 1,88 billion HUF (6,93 million €).

#### Municipality of Pécs

- at the construction of the lake, the water engineering technological equipment and the tidying of the environment will be covered by them. Total costs 0,8 billion HUF (286 thousand €).
- The construction of the main and inner road infrastructure, estimated costs 1,95 billion HUF (6,95 million €);
- parks and greens (158,8 ha) require a cost of 1,59 billion HUF (5,7 million €);
- elaboration of further plans (that of roads, junctions, bridges, parking lots) pose a cost of 100 million HUF (360 thousand €).

The involvement of private investors would only start after the acquiring of the permits. For this the detailed development plan of the area should be prepared and accepted. This task belongs to the Municipality, and involves a cost of 50 million HUF (180 thousand €).

#### 5.5. Legal measures

*to be specified in Draft 2.*

### 6. IMPLEMENTATION OF THE LANDFILL REDEVELOPMENT IN THIS ACTION PLAN

#### 6.1 Social acceptance

*to be specified in Draft 2.*

#### 6.2 Permits needed

*to be specified in Draft 2.*



### 6.3 Balance sheet and financing

*to be specified in Draft 2.*

### 6.4 Project organisation and exploitation

The first step in the realisation of the overall development of Tüskésrét is the rehabilitation of the environment and the landscape of the area within the scope of the Sufalnet4EU project. This way the basis for further developments, investments, planning, obtaining permits, construction and building of facilities will be established, with the involvement of investors and NGO's.

The development of the area should be organised and coordinated by the Municipal Development Company Ltd., owned by the municipality of Pécs. The tasks of the company include:

- ensuring the cooperation of commercial parties, investors, the university, research institutes, civil organisations and the public in the process of the realisation, starting from the planning till the establishment and the instalment.
- preparation of the materials needed for the decision making, and the technical and permit documentation needed for the building and the project proposals for funding.
- coordinating and controlling the process and tasks of the implementation, utilisation, operation and aftercare of the area and of the establishments.
- ensuring transparency and public engagement in the preparatory work and grounding of the decisions.
- ensuring the information and data background for the grounding of the decisions of the municipality, the representation of the interest of the city of Pécs, the acceptance and inclusion of other programmes affecting the area

Further points of consideration:

- Integration of IMDS goals into Tüskésrét development project (and the Action Plan)
- preparation for the landscape rehabilitation of the Power Station's abandoned slurry cassettes and the construction of the lake (obtaining permits, updating of the preliminary budget and costs calculations)
- information dissemination and negotiations with the public and the professionals
- reconciliation of the planning and organisational criteria, and preparation for the realisation
- ensuring the cooperation of commercial parties, investors, the university, research institutes, civil organisations and the public
- ensuring the information and data background, preparation of the materials needed for the decision making, writing funding proposals etc.
- coordinating and controlling the process and tasks of the implementation, utilisation, operation and aftercare.
- ensuring transparency and public engagement



## 7. IDENTIFICATION OF ACTIVITIES TO BE CO-FINANCED BY EU

EU funding: 3 billion HUF (10,7 million €) financial support should be needed (e.g. 80%)

- Appropriate programme: under examination by the Municipality (JESSICA?)
- Integrated Municipal Development Strategy (IMDS) is being modified (summer 2011.)
- Tüskésrét development project will be integrated / fitted into the IMDS
- The Municipality will provide input on this topic, that will be incorporated into the Action Plan.

### 7.1 Operational Programme Structural Fund

*to be specified in Draft 2.*

### 7.2 European Investment Bank

*to be specified in Draft 2.*

### 7.3 Other European funding programmes

*to be specified in Draft 2.*

## APPENDIX 1.

...