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COMMISSION OF THE EUROPEAN COMMUNITIES

March 2002

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Closure of Ash Field No.2 with Water Ponds

at

Balti Power Plant

Ida-Viru County

The Republic of Estonia

APPLICATION FOR ASSISTANCE
Under the ISPA
Financial instrument

COUNCIL REGULATION (EC) N° 1267/1999 of 21 June 1999
and COUNCIL REGULATION (EC) N°1266/1999 of 21 June 1999

ENVIRONMENT

MARCH 2002

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ANNEXES

ISPA
- APPLICATION FOR ASSISTANCE –

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5. MEASURE TYPE AND LOCATION

5.1 Title of measure: **Closure of ash field No.2 with water ponds at Balti Power Plant.**

5.2 Location:

Applicant State:	Estonia
Region(s):	Ida-Viru County
District(s):	Narva town
	(map, 1: 10 000, Annex VIb)

5.3 Type:

Single project	X
Stage of project	
Group of projects	
Other (*specify*)	

6. ELIGIBILITY AND OBJECTIVES

6.1 What are the objectives of the measure?

Financing under the ISPA initiative will be used to achieve three levels of objectives as outlined below:

Principal objective
The principal objective of the Project aims to aid the Estonian accession process by **closure of Ash Field No. 2 with water ponds, an oil shale ash depository as a source of past pollution** on the premises of Balti Power Plant near Narva in the North East of Estonia. This will lead to compliance with various relevant EU and Estonian National environmental legislation as described in Section 6.2 and 6.3. This will allow the state-owned national electricity generating company Eesti Energia AS (Estonian Energy Ltd.) to cancel the adverse environmental impact of an existing depository. Furthermore, it will lead to implementation of the Environmental Action Plan of Eesti Energia, that is to comply with the EU standards accepted by the Republic of Estonia.

Technical objective
Technical objective of the Project is the closure of Ash Field No. 2 with water ponds 2 in compliance with relevant EU and Estonian legislation.

Environmental objective
Environmental objectives are to cease adverse environmental impacts from Ash Field No. 2.

Objectives additional to those stated above include the development of skills and experiences within Estonia enhancing local capacity for dealing with sites of past pollution related to Estonia's unique energy sector. Estonia's energy sector is dominated by a form of fossil fuel known as oil shale. Large depositories of oil shale ash result from use of this material. The development of capacity for dealing with these depositories is imperative for the future environmental well being of North East Estonia as well as for compliance with EU and national legislation.

Measures to achieve these objectives include:

- Drainage and discharge of highly alkaline waters existing in the water ponds through a neutralisation plant, rendering them compliant with EU and National legislation;
- Appropriate engineering to prevent precipitation water accumulation and to ensure a safe area requiring minimal maintenance over time;
- Landscaping of the area including covering of the ash-stone in top soil and afforestation, and the creation of a wetlands area where currently a large lake sits;
- Founding of a inert waste landfill in compliance with relevant EU and National legislation for appropriate management of industrial waste from the Balti Power Plant;
- Ongoing monitoring and management of the area such that eventually it can be returned to unrestricted zoning by the local authorities.

Successful completion of these measures, representing the Technical Objectives of the project will lead to achievement of the Principal and Environmental Objectives.

6.2a) To which of the environmental priorities of the Accession Partnership/National Programme for the Adoption of the Acquis does the measure relate?

In the field of Environment the Estonian Accession Partnership has the three following priorities:

- Complete the transposition of the *aquis* and reinforce implementation;
- Ensure institutional strengthening in the area of environment, in particular at the local level, and;
- Integrate sustainable development principle into the definition and implementation of all policies.

Furthermore, with respect to Estonia the European Commission has set both **short** and **medium term priorities** for the Accession Partnership:

Short Term Environmental Priorities:

- Accelerate the transposition and enforcement in particular regarding water and waste management, air pollution, nature protection and industrial related directives;
- Further develop plans for financing investments (directive specific) based on estimations of costs of alignment and realistic sources of public and private finance on a yearly basis and continue to invest in the heavy investment directives regarding air, water and waste.

Medium Term Environmental Priorities:

- Complete the transposition of the *acquis*;
- Continue to implement the legislation according to predefined timetable in particular in regard to air, waste management, chemicals and radiation protection, nature protection, water sector and in industrial related legislation.

Contribution towards Accession Partnership
The planned measure will contribute towards the Accession Partnership by assisting transposition of the *acquis* through development of aspects of Directive 1999/31/EC and Framework Directive 75/442/ÈEC. Furthermore the project will contribute significantly to institutional development with respect to dealing with oil shale ash waste and their unique environmental impacts, particularly at a local level. Following successful completion of the program the concept of sustainability will be solidly integrated into the oil shale industries waste management strategies.

The project will also contribute significantly towards the **short term environmental priorities** as set by the European Commission particularly towards transposition and enforcement of directives concerning waste management and landfilling of waste.

Achievement of **Medium term environmental priorities** as set by the European Commission will in part be met as there will be a timetable for implementation of the measure contained herein. The measure is being developed specifically in order to comply with both Estonian national legislation and EU environmental (and other sectoral) legislation.

The list of transposed Directives in the waste sector by the end of 2001 is presented in the table below.

Directive	Completion of transposition
Waste Framework Directive 75/442/EEC	2000
Council Directive 1999/31/EC on the Landfill of Waste	2001
Hazardous Waste Directive 91/689/EEC, replacing 78/319/EEC	2000
Disposal of Waste Oils 75/439/EEC	2000
Disposal of Batteries 91/157/EEC amended by 93/86/EEC	2001
Packaging Waste 94/62/EEC	1999
Sludge and Soil 86/278/EEC	2000

Directives are not yet fully transposed include:
- Directive 89/369/EEC on the reduction of air pollution from new municipal waste-incineration plants;
- Directive 94/67/EEC on the incineration of hazardous waste;
- Directive 87/217/EEC on waste from use of asbestos and asbestos industry;
- Directive 78/176/EEC on waste from titanium oxide industry)

Estonia plans to fully transposition relevant waste legislation by the end of 2003.

b) How does the measure contribute to the achievement of the relevant priority?

With respect to achievement of the relevant priority Estonia has implemented Regulation No. 34 of the Minister of Environment in June 2001 regarding landfill of waste. Regulation 34 complies with Directive 1999/31/EC. On the basis of Article 69 (5) of Regulation 34, the competent state authority responsible for the ash field, Ida-Viru County Environmental Service issued the decision on closure of Ash Field No. 2 on December 2001.

The Project will contribute to the relevant priority by making the ash handling and disposal system of Balti Power Plant compliant with EU and National environmental and waste management legislation. Part of achieving this includes reclamation of Ash Field No. 2.

Once Ash Field No. 2 is closed and rehabilitated then:
- The ash field's adverse impact to the environment will cease;
- Highly alkaline waters present on the ash field will be safely neutralized and discharged;
- The construction of the neutralization plant for lowering the alkalinity will also be used to prevent discharge of alkaline waters from Ash Field No. 1 which is currently in use;
- Implementation of NEAP task No. 6.2.11 concerned with Policy Goal No. 6 of the NES regarding recultivation of abandoned industrial waste depositories by the year 2003 will be started.

6.3 a) How is the measure linked to the implementation of Community environmental legislation and policy?

The measure is linked to Community environmental policy through the implementation of relevant articles of:

- Council Directive 1999/31/EC on the landfill of waste;
- Framework Directive of Waste Management 75/442/EEC with amendments 90/656/EEC, 91/156/EEC and 91/692/EEC.

With regard to Directive 1999/31/EC on landfill of waste, the EU has invited Estonia to confirm that, as from 16 July 2009, the requirements of the Directive will be fully applied to waste which is landfilled. As regards landfilling of oil shale ash, the EU considers that Estonia's request for a transitional period is sufficiently limited in time taking into account that necessary technology still needs to be developed and put in place. The EU notes that the request relates to more than 90% of the hazardous waste generated in Estonia.

In order to limit the scope and the negative impact on the environment, the EU invites Estonia to confirm that it will take the necessary measures in order to ensure, during the transitional period, that this waste is only landfilled in appropriate sites that are in compliance with the general requirements set out in Article 4 of Directive 75/442/EEC and to regularly inform the EU on these measures, which need to be notified to the Commission by the date of accession.

The transposition of Council Directive 1999/31/EC is completed by Regulation No. 34 on Construction, Use and Closure down of Landfills of the Minister of the Environment on 23 June 2001. According to ministerial Regulation, Ida-Viru Environmental Service as the competent local authority claimed to close the site (fixed in Estonian Landfill register under code No. 051102) legally by 31st of Dec.2001.

In addition to the aforementioned Directive there is a indirect link of the measure with the:
- Water Framework Directive 2000/60/EC,
- Council Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment.
- Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment.

6.3 b) Relation of Project to National Environmental and Waste Management priority actions and linkages to EU Legislation

The project falls under a variety of priority areas concerning National environmental legislation and waste management.

National Waste Management Plan
Within the framework of the Accession Partnership, the Accession Strategy for the environment between the EU and the Estonian National Government, concluded on 24th September 1998 that all new investments should comply with the environment *acquis*. Thus the project is consistent with the NPAA, and the National Waste Management Plan (NWMP).

The NWMP is associated with Framework Directive of Waste Management 75/442/EEC with amendments 90/656/EEC, 91/156/EEC and 91/692/EEC; and Directive 1999/31/EC on landfill of waste. Within these Directives the Project represents part of the improvement of the situation with abandoned waste disposal sites, which have a priority at both National and Regional level.

The position of environmental *acquis* on oil-shale ash depositories is specified in the *European Union Common Position, Conf-EE 13/01, Brussels, 30 May 2001, Chapter 22: Environment* (Conf-EE 13/0). In which it is stated:

- As regards landfilling of oil shale ash, the EU considers that Estonia's request for transitional period is sufficiently limited in time taking into account that necessary technology still needs to be developed at place.

- In order to limit the scope and the negative impact on the environment, the EU invites Estonia to confirm that it will take necessary measures that this waste is only landfilled in an appropriate sites that are in compliance with the Article 4 of Directive 75/422 EEC on waste.
- EU can accept a transitional measure and agrees that for existing landfills, the requirements for liquid and corrosive waste under Articles 14(d) i) and 5a), (b) of the Directive 1999/31/EC only apply to oil-shale ash as from 16 July 2009.

National Environmental Strategy and National Environmental Action Plan
The National Environmental Strategy (NES) works in parallel with the National Environmental Action Plan (NEAP) for 2001-2003, adopted by the Government of the Republic of Estonia on 05. May 2001 (decision No. 25). The NEAP contributes to the implementation of the principles of sustainable development adopted by the National Environmental Strategy (NES). The National Environmental Action Plan lists and describes a number of different actions for every policy goal of NES.

The NES focuses on achieving of ten policy goals during 1998-2010. The Project corresponds to Policy Goal No. 3 and No. 6 of the NES concerning the reduction of negative environmental effects of the Energy Sector and elimination of past pollution caused by abandoned dumpsites and the recultivation disturbed landscapes. This goal contributes to reducing negative environmental effects of energy production contributing to a sustainable energy policy. Policy Goal No. 6 of the NES is further elaborated in the National Environmental Action Plan (NEAP). There are 24 actions accounting for 24% of the NEAP relevant to Policy Goal No. 6. Under the NEAP Action 6.2.11 Closing of Narva Power Plant Ash Field No. 2. Highest priorities are for actions concerning:
- Ensuring of safety of contaminated sites, and;
- Rehabilitation of abandoned sites.

The term "site" in the NEAP also covers all existing ash-fields of oil-shale fuelled power plants of Estonia.

Tasks under the NES for the year 2000 are partially implemented. Such as an inventory of past pollution sites originated from abandoned military sites, industrial enterprises and municipal landfills. Their environmental risks have been assessed. Also areas where past pollution of soil poses a direct risk to ground water and human health are localized.

Tasks to be completed by 2005 include:
- to decommission and rehabilitate abandoned quarries;
- to prevent migration of pollutants from currently operating industrial waste depositories and municipal landfill sites into the soil, and into surface and ground water;
- to recultivate abandoned industrial waste depositories and municipal landfill sites.

In order to achieve the goals of the NEAP, the NES, the NPAA and the NWMP it is necessary to prevent migration of pollutants into the environment from industrial waste disposal sites (enrichment waste, ash and semi-coke dumps) and municipal landfill sites. To recultivate areas disturbed by the mining industry; to create aesthetic artificial landscapes; and establish preconditions for restoration of soil fertility of the disturbed areas.

Estonia declared in the Conference on Accession to the EU that generation and disposal of shale ash would be diminished. The amounts of oil shale ash (th. tons) to be disposed according to Directive 1999/31/EC on the landfill of waste are in Table below.

Volumes of oil shale ash X 1000 tons										
Category:	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2001-2009**
Generated	4575	4575	4390	4390	4390	4230	4230	4060	4060	38900
Recycled	80	80	100	100	110	110	110	110	110	900
Disposed	4495	4495	4290	4290	4290	4120	4120	3950	3950	38000
Disposed re: Dir 1999/31/EC	**0**	**100**	**360**	**720**	**1200**	**2000**	**3200**	**3600**	**3950**	**15130**
Disposed according to existing technology	4495	4395	3930	3570	3090	2120	920	350	0	22870

6.4 a) The relationship of the Project with Community sectoral and/or integrated plans and programs.

As explained in Section 6.3 a) regarding the linkage of the measure to the implementation of Community environmental legislation and policy the development of the Project is based specifically on the following Community sectoral and/or integrated plans:

- Council Directive 1999/31/EC on the landfill of waste;
- Framework Directive of Waste Management 75/442/EEC with amendments 90/656/EEC, 91/156/EEC and 91/692/EEC.

With indirect links the following Community sectoral and/or integrated plans:

- Water Framework Directive 2000/60/EC,
- Council Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment.
- Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment

Therefore successful completion of the Project will assist Estonia in complying with these and (other) EU environmental legislation.

b) What priority does the measure have within the relevant plan?

Council Directive 1999/31/EC on the landfill of waste	
Purpose/priority	Relation of measure to purpose/priority
Close down of an unique waste depository	By covering of the area of an ash plateau with soil and planting trees and grass the blow away of the dried shale ash will be avoided.
Framework Directive of Waste Management 75/442/EEC with amendments	
Purpose/priority	Relation of measure to purpose/priority
Provide environmentally sound inert waste disposal for Narva Power Ltd.	Via construction of new landfill the inert and asbestos wastes will be properly disposed
The Water framework Directive 2000 /60EC	
Purpose/priority	Relation of measure to purpose/priority
Prevent deterioration and protect the status of aquatic ecosystems in Narva Reservoir	Via construction of a device that reduces high pH value of the discharged water

6.5 Does a master plan exist for investment in the sector concerned in the city or district?

Yes [X] No [ ]

Eesti Energia Ltd. plans to invest 27 M€ in the renovation of the ash handling and disposal system. Inside this program the majority of the investment will be for converting of the ash handling system from 'wet' to 'dry'.

6.6 Is the envisaged measure of a preventive or curative nature?

Preventive [X] Curative [X]

Implementation and successful completion of the Project will prevent ongoing adverse environmental impacts from the ash fields. Also it has a curative nature in that the ultimate objective will be to return the area to un-restricted zoning potential for the local authorities. In order to accomplish this the area must be rehabilitated until it does not pose a human or environmental threat.

7. DESCRIPTION

7.1 Overall project

The Project, Closure of Ash Field No.2 with water ponds is a single project. It does not involve discrete stages or groups of activities. The Works will be designed, developed, implemented and executed as a single activity.

7.1.1 Situation of Ash Field No. 2

Balti Power Plant
Balti Power Plant is the second largest (by power) power plant in Estonia, after the Eesti Power Plant. It was built four stages between 1959 and 1967. Its electrical capacity is 1390 MW and for producing heat is 505 MW. It creates power by the combustion of kukersite oil shale and produces approximately 2 million tons of oil-shale ash a year (1995 – 1999 average). The Balti Power Plant is also the single centralised supplier of heat and hot water for Narva and its population of 75,000.

In deciding to close down Ash Field No. 2 of the Balti Power Plant, Narva Power Ltd aims to cease the environmental impacts, hazards and problems of the ash field. Especially its frequent discharge of alkaline water to the cooling water channel which discharges into the Narva Reservoir at the Estonian-Russian border. This is to contribute to Estonia complying with various EU and Estonia legislation, as described in Section 6.

The greatest environmental risk for the area is the rupture and release of large volumes of highly alkaline waters from the ash fields into the Narva River. This risk is based on the structural stability of the ash field walls and is influenced by water volume on the fields and the influx of water. Control of these risks will reduce the risk of rupture and release and formed the basis of the options considered for closure of the ash field in the feasibility study.

Location
Ash Field No. 2 with water ponds lies in a relatively remote, industrially zoned area of East Viru County, 210 km east of Tallinn, Estonia's capital. The site is 5 km from the city of Narva (pop. 75 000) and the nearest residence is some 500 m away in the hamlet of Kõrgesoo. The immediate risks to human health and habitation are very small.

The ash field lies 1 km from the power plant itself. The ash field is large, 576 ha of which 406 ha is ash-stone and 170 ha a sedimentation lagoon (termed Lake Green). The ash-stone is largely calc-silicate in nature which in the presence of air solidify into inert compounds. The ash-stone does not pose any significant environmental or human health threat. The greatest nuisance is the possibilities of dust should it be left uncovered. The solid nature of the ash-stone heap creates engineering difficulties for grading and reforestation.

Ash and ash transport
Waste ash is either disposed on the disposal areas of the power plant itself (ash fields 1 & 2), or utilized in different kinds of industrial applications. Future production is anticipated to be less. Presently ash is only disposed into Ash Field No. 1. Ash Field No. 2 has not been used for ash disposal since 1987. Currently it is used as an evaporation area for the excess settled water from Ash Field No. 1. The total area of the two ash fields and their sludge ponds is 10.4 sq km.

Ash is transported from the power plant to the disposal areas by a wet transportation system. Oil-shale is not liquid by nature. It is a mixture of solid ash (extracted from boilers, superheaters, cyclones and electrostatic precipitators) and water with a ratio 1 : 15-20. Mixing of ash with water is needed to facilitate pumping the waste as slurry via iron pipes to the landfill. At the landfill ash is precipitated from the slurry and water is circulated back via special canals and pipelines to the power plant and used again for ash transportation.

The chemical composition of the ash is presented in Table 7.1.

Being in contact with hot ashes, transportation water saturates with salts and other inorganic compounds and becomes highly alkalic (pH = 12 - 13). The ash-water mixture is considered as hazardous waste due to the risk leachates pose to groundwater and the risk of alkalic water discharge to adjacent surface water bodies. However, after some years the ash deposited on the landfill is mineralized stable inorganic matter.

Table 7.1
Chemical composition of fly ash transported to the ash disposal areas

Component	Percentage, %
SiO_2	20,6
Fe_2O_3	4,4
Al_2O_3	5,7
CaO	55,8
MgO	6,7
K_2O	1,5
Na_2O	0,2
SO_3	4,8

The chemical composition of the ash is very similar to that of calcareous mixtures, mortars, plasters used in construction because of the high content of calcium oxide (lime) and silica (sand). Mixtures of minerals with similar kind of composition are capable in the presence of sufficient amounts of water and carbon dioxide (absorbed from air) to solidify forming inert compounds of silicates and calcareous substances. These properties of oil-shale ash have been used in practice in Estonia during the last 40 years for production of different construction materials, incl. additives to cement compositions.

Lake Green and evaporation ponds
Waters transported to the ash field are first contained in 12 evaporation ponds. Overflow from these goes into a large lake, Lake Green, of 170 ha. The evaporation cascade has a volume of 3.2 million m^3. Lake Green has a volume of 2.6 million m^3.

Annual precipitation is some 560 mm. Assuming 40% evaporation, excess water added to the system is thus 3.9 million m^3 – 1.5 million m^3 (precipitation - evaporation) is 2.4 million m^3.

Non-compliance of the old landfill regarding EU standards
Sampling and analysis of the water on Ash Field No.2 were conducted as part of a feasibility study. Ten samples were taken and analysis was conducted at the following accredited laboratories: Estonian Environmental Research Centre and Analytico Milieu B.V. (Netherlands). Furthermore all previous sampling conducted on the area were available for use.

Table 7.2 shows the chemical composition of waters on Ash Field No. 2 and compares them

with relevant EU and Estonian standards. Waters contravene both EU and Estonian standards only for pH. According monitoring data of Balti Power Plant the average content of suspended solids in Green Lake during 2001 – 2001 was 8 – 10 mg/l. The highly alkaline pH of the evaporation cascade and Lake Green, respectively pH 12 and pH 9.7, is significantly higher than the maximum permitted level of pH 9. As such these highly alkaline waters represent the most serious environmental threat or impact of the ash field.

Analysis shows that though phenols are present they are not in contravention of maximum permissible levels. Also, that there is no environmental threat from heavy metals. The planned separation of circulation water system from the storm runoff system in Balti Power Plant will alleviate the source of phenols and heavy metals.

Table 7.2

Comparison of chemical composition of waters on Ash field No. 2 to permissible limits under relevant EU and Estonia Standards

Compound	Max. permissible concentrations:		Evaporation cascade (average)[2]	"Lake Green" (average)[2]
	EU	Estonia[1]		
pH		**9**	**12,3**	**9,7**
BOD 7**		25.0 mg/l	14.0 mg/l	9.0 mg/l
Total solids			6000 mg/l	4500 mg/l
Conductivity			12 mSi/cm	6,5 mSi/cm
Turbidity			10 cm	8 cm
Colour			40°	100 °
COD (Mn)			21 mgO/l	37 mgO/l
Total hardness			2.3 mg-eq/l	2.5 mg-eq/l
N total**		10.0 mg/l	3.0 mg/l	1.7 mg/l
P total**		2.0 mg/l	0.073 mg/l	0.08 mg/l
PAH		0.01 mg/l	<0.20 µg/l	<0.20 µg/l
Phenols		0.1 mg/l	33 µg/l	10 µg/l
Resorcinol		15.0 mg/l	30 µg/l	34 µg/l
Oils			<10 µg/l	<10 µg/l
Cl			390 mg/l	340 mg/l
SO_4			770 mg/l	860 mg/l
HCO_3			46 meq/l	24 meq/l
Ca			4 mg/l	4 mg/l
Na			150 mg/l	83 mg/l
K			2600 mg/l	1800 mg/l
Fe			0.15 mg/l	0.15 mg/l
As		0.2 mg/l	0.01 mg/l	0.005 mg/l
Cr		0.5 mg/l	0.03 mg/l	0.04 mg/l
Cu		2.0 mg/l	0.04 mg/l	0.02 mg/l
Pb		0.5 mg/l	0.004 mg/l	0.02 mg/l

[1] Regulation No. 269 of the Government of the Republic of Estonia;
[2] Analysis conducted at: 02.11.2001

Geological assessment around Ash Field No. 2

A geological investigation was carried over the area during the feasibility study including general geological mapping, research of individual objects, monitoring reports and 21 drill holes totalling 129,4 meters drilled.

The ash layer of Ash Field No. 2 varies between 4 – 22 m. The ash bed consists of several layers. The top layer (0.5 – 1.5 m thick) is sand or sandy loam. Deeper the ash becomes increasingly more coherent with solidified layers having the characteristics of solid strata intercalated with non coherent layers. The character of the beds is variably coherent.

Whilst the internal structure of the ash-stone heap is variable it is stable. Also, the substratum under the ash field is not in jeopardy of failure or otherwise causing engineering problems. Considering closure options will result in a reduction of load there is not perceivable threat of a structural nature. Erosion may cause local problems.

On the bottom of Lake Green there is a layer of plastic loam. In the southern part a peat layer overlies it, which increases in thickness southward (to max. 5.4 m). Technogenic sediments up to 3.3 m thick consist of fill-up soil (disturbed loam, peat and soil) as well as ash deposits and lime sediments. The lime sediment are extremely soft, almost in suspension and geotechnically very weak.

The Kõrgesoo raised bog peat along a ditch track extending southwards from Lake Green has a thickness of 2.7 – 5.3 m. There is mainly silt below the peat.

Geotechnical properties of proposed industrial landfill site
An industrial waste landfill is planned on the northeastern corner of the present ash field, where the relative height of the ash-stone heap reaches 21 m (absolute elevations are 44 – 49 m). Approximately 20 ha of the field area will be needed. Expected capacity of waste volumes are 630,000 m^3 at a density of 1.5 t/m^3 over 25 years. The planned maximum elevation of the waste deposit is 57.5 m (the height of the ash-stone heap will increase by 8 m).

A hole was drilled to study the oil-shale ash under the proposed area.

The additional load of the waste deposit on the ash bed is up to 1.2 kg/cm^2 (120 kPa). This will not destabilize the ash-stone heap slopes.

Hydrogeological and pollution context of Ash Field No. 2
The lake (Lake Green) contains 2.6 million m^3 of water and the evaporation ponds 3.2 million m^3. pH increases from 9.7 in the lake to over 12 in the evaporation ponds. This represents the most significant environmental threat. Should rupture of the dam walls occur then millions of cubic meters of highly alkaline waters will be discharged.

The coefficient of hydraulic conductivity of the uncompacted ashes in a horizontal direction is 0.001 – 0.1 m/d. Vertically, the ash-stone heap as a whole (and the bottom clay layer that has been compressed under the weight of the ash bed) can be considered relatively watertight. Its coefficient of hydraulic conductivity is below 0.0001 m/d. Most of the seepage from lakelets of the ash fields occurs through the perimeter dams and the loose top layer of the ground under the dams.

The nearest surface water bodies are the Kõrgesoo ditch 100 m to the southwest, and the cooling water discharge channel of the Balti Power Station 100 m to the east. Both the ditch and the channel flow southwards into the Narva Reservoir. Sedimentation lagoon ("Lake Green") is surrounded by the Kõrgesoo raised bog, covered with a dense network of ditches, which are connected to the Narva Reservoir.

There are three main hydrostratigraphic layers present on the area of Balti Power Plant. From surface these are:
1. the aquifer of topsoil and of Ordovician strata;
2. the aquifer of Ordovician-Cambrian strata;

3. the aquifer of Cambrian-Vendian strata, which is further divided into two different aquifers.

Groundwater resources are contaminated in the sub-surface environment, with the contamination possibly extending to the Ordovician-Cambrian aquifer which is unconfined in places. The deeper Cambrian-Vendian aquifers are well protected and are not yet under threat. Water abstraction only occurs from this latter aquifer. Closure of the ash field will remove one of the largest impacts to the quality of groundwater resources in the area.

7.1.2 Nature Of Closing Down of the Ash Field

During the closing-down process the ash field will be disconnected from the ash discharge and handling system of the power plant. After that the optimal solution for closing down the ash field will be put into practice and the prerequisites for accomplishing the solutions of monitoring, aftercare and land use will be created. These measures will decrease and negate the environmental impacts and lead to sustainable control of the situation. Eventually it is hoped to change the designation and zoning of the whole area in the future.

7.1.3 Closure options

The situation and the historical background of the area and surroundings made it possible to generate number of options. These included: abandoning the area; not applying any engineered designs; covering of the ash field in accordance with the strictest requirements for hazardous waste landfill, and; directing the River Kulgu through "Lake Green". Analysis of options indicated that they did not correspond with the aims of the measure or the cost for benefits were too high.

Eventually a single option was chosen that fulfils all objectives as stated in this ISPA application:

- Principal objective

To aid the Estonian accession process by **closure of Ash Field No. 2 with water ponds, an oil shale ash depository as a source of past pollution** on the premises of Balti Power Plant near Narva in the north east of Estonia in compliance with EU and Estonian National environmental legislation.

- Technical objective

The closure of Ash Field No. 2 with water ponds 2 in compliance with relevant EU and Estonian legislation.

- Environmental objective

To cease adverse environmental impacts from Ash Field No. 2.

Summary

The proposed works will lead to compliance with relevant EU and Estonian legislation by

dealing with the problem of the volumes of highly alkaline water and by avoiding its reoccurrence. Also the area will be landscaped and should become available for land-use zoning in the foreseeable future by the local council. Furthermore it is intended to use a small area of the existing ash-stone heap as an industrial landfill. This will solve the disposal problems of industrial waste from the two power plants owned by Narva Power Ltd.

The works can be summarised into the following operations:

- Construction of a neutralization device with own pumping station for neutralizing water with high pH;
- Dismantling the piping of the circulation water;
- Draining of the evaporation cascade ponds;
- Turning "Lake Green" into a wetland with relict lakes;
- All waters directed through the neutralizing device before release to the environment;
- Forming water collection cuvettes on the bottoms of empty ponds;
- Digging openings through dams and installation of culverts;
- Reconstruction of existing water outlets;
- Acquisition and spreading of growth substrate;
- Landscaping with herbaceous plants;
- Design of the intended inert industrial waste landfill in compliance with EU and Estonian legislation;
- removing two ash dams separating ponds Nos. 7, 8 and 9;
- founding the first stage of the inert waste landfill.

Discussion

The evaporation cascades shall be drained. Conditions for drainage and effective management of precipitation water will be implemented. The ash-stone heap shall be covered with soil and covered either partially or completely with herbaceous plants suitable for the task of stabilisation of the field as well as fitting in with the surrounding area. In the case of partial landscaping, given time the remaining area will become covered by similar herbaceous plants via natural processes of re-cultivation.

Following dismantling of the dams and landscaping precipitation water will be directed along the stabilised surface of the ash-stone heap.

A neutralizing device will be built on the prepared site to reduce the pH of the water in the evaporation cascades and Lake Green. It will require 0.6 ha between the existing road and the cooling water channel of the power plant. The objective of the plant is to reduce the pH of the evaporation cascades and Lake Green from a pH of 10-12 to a level within legally acceptable limits: a pH of 9, within the time period of two years.

The evaporation cascade shall be treated first with Lake Green acting as an intermediate reservoir. No earthworks are required as the existing slope (0.6%) is sufficient to allow gravity feed. Following the treatment of the evaporation cascade, Lake Green will be treated and drained.

Following drainage of the ash field the dams shall be breached, reconstructed and cuvettes (ditches with flat banks) dug to prevent accumulation of precipitation waters. In required areas culverts shall also be installed to enhance drainage. Water outlets on the ash field will be preserved and reconstructed, deepening them from the collection side. These measures shall minimize the transport of non-coherent ash to the surface layer and avoid a pH increase of precipitation water resulting from contact with the ash layers.

Works shall be done during the drier summer months when water volumes are lowest.

The drained area and ash-field shall then be covered with top-soil. A suitable soil must meet the following requirements: no dust emission, resistant to erosion, providing good growth substrate for landscaping plants, and easily available. Production and use of a composite material is one

possibility. For example the mixture of refined oil-shale semicoke with peat which complies with limit values for soils in industrial areas.

Afforestation of the covered evaporation ponds will prevent erosion and transport of suspended solids from the ash-stone heap. These areas can be forested in zones of groves of trees (birch) with perennial herbaceous plants in the areas between. The area to be forested is estimated to be 118 ha. It would be practical to forest the softer ash rock areas located near the dams and in places that are sheltered from prevailing winds, so that a thicker layer of growth substrate can form.

After drainage is complete the area will be landscaped into a wetland. When the water in Lake Green reaches a mean level of 27 m, there will be two water bodies (with an average depth 1 – 1.5 m) and one area of soft substratum. The area of the larger relict lake will be ca. 99 ha and the smaller lake 24 ha. The area of the dry territory will be ca. 47 ha. In order to lower the existing water level from the existing mean level 28.3 m to 27 m, 1.8 million m^3 of water will have to be treated.

Conditions encouraging development of aquatic life will result. It is thought that acidic water from the existing wetland may invade the newly formed lakes from the south contributing to a further lowering of the pH.

Precipitation water draining from the ash field will be collected in the perimeter ditch and fed into the neutralization plant. In order to equalize the outflow during heavy precipitation and snow thaw, it will be necessary to have the possibility to discharge water from the ash field into the area of Lake Green. If monitoring shows that the quality of the ash water formed in the ash fields is adequate, this water can be discharged through the new wetland into the natural environment and not through the neutralization plant.

The development of an inert industrial waste landfill to solve the safe disposal of inert waste produced by the two power plants owned by Narva Power Ltd.

An industrial waste landfill area will be constructed in accordance with relevant EU and Estonian legislation in the North Eastern corner of the ash field. A possible location for landfill on the Ash Field No. 2 was indicated in a previous investigation by Maves Ltd[2]. The new industrial waste landfill will save the existing natural landscapes of the region from destroying any additional areas thereof, and will save natural resources necessary for the construction of the base of the new landfill, access roads and means of communication.

The lifespan of the landfill would be for at least 25 years and have a capacity of ca. 630,000 m^3 of waste (waste density in landfill 1.5 t/m^3). This would require an area of ca. 20 ha. A survey of the evaporation cascade ponds shows that the total area of ponds Nos. 7, 8 and 9 is 18.5 ha. The industrial waste landfill must also be suitable for asbestos waste. In order to deposit asbestos, a special depositing area must be founded guaranteeing the asbestos waste remains intact. The operator of the landfill will have to cover the waste during deposition or immediately after it. A Ministerial regulation is in process at the Ministry of Environment of Estonia during 2002 granting permission for this.

Drainage water collected from the landfill can be fed into the neutralization plant situated below the hill slope for treatment.

After the evaporation cascade ponds have been drained, removal of the dams separating

[2] Maves Ltd: *Narva Power Ltd. tööstusjäätmete prügilate sulgemine. I etapp* (Closure of the industrial waste landfills of Narva Power Ltd.. Stage I.). Tallinn.

ponds Nos. 7, 8 and 9 will be started. Subsequently preparations for founding the first depositing area of the landfill will begin. If the objectives of the Works are realised, only maintenance and environmental monitoring will be required. Subsequently the neutralizing plant can be used for waters from Ash Field No. 1.

Maintenance and Monitoring
During maintenance and monitoring water quality (pH level), water level in the relict lakes and the geotechnical stability of the ash-stone heap will be monitored. Additionally the stability of the ash field cover will be monitored and eroded areas restored as quickly as possible.

After the conditions of surface water quality formation in the ash field have been determined, monitoring can be limited to observations of water level and quality in the new wetlands. To facilitate monitoring the water surface in the relict lakes it will be necessary to replace the existing hydrostatic sensor of Lake Green (and the corresponding signals in the control unit) with a sensor that reacts to water surface higher than 27.0 m. Exceeding this level will give an emergency signal indicating that the land strip separating the small lakes is about to be breached.

The pH level of the water would have to be monitored in the eastern lake. The existing pH sensor and control unit of the ash disposal department must be used to monitor both pH and water level. At the same time, a portable pH indicator must be obtained and the pH level in the western lake measured once every three months (from below the ice in winter). The pH value will have to be measured in water bodies until a pH value of less than 9 is measured in both water bodies during at least one year.

Maintenance and monitoring of the proposed inert industrial waste landfill does not fall under the auspices of this project as it forms a necessary component of the daily operations of such a landfill.

Environmental advantages
Environmental advantages of the options are:
- **A substantial reduction in pollution load** to surface and ground water (once ash-field No.2 is remedied, about 50% of the total BPP ash deposit facilities will be removed from alkaline water generation).
- After covering and planting, a **biotope pertinent to the conditions of the ash-stone plateau** will appear.
- It is possible to organize **environmentally correct disposal of inert wastes generated in power plants** up to the end of their exploitation.

For more details about the locations of the neutralizer and inert waste landfill, see **Annex III.**

7.2 Stage of project: describe the stage or section concerned - explain how it relates to the complete project, and why it can be considered technically/financially independent and operational in its own right:

There are no discrete stages to the project that can be considered technically/financially independent and operational in their right.

7.3 Group of projects: give a full description of each project included in the group:

Not applicable, no project grouping.

7.4 Is the total cost of the measure less than 5 million EURO?

Yes ☐ No ☒

7.5 Is the measure likely to have a particular trans-border impact?

Yes ☐ No ☒

The closure of the ash-field will have not significant trans-border impact. Current ash waste and evaporation water handling results in some periodic discharge of highly alkaline waters to surface waters. Furthermore leaching and infiltration contaminate groundwaters. Despite this the impact of current activities are not significant in a trans-border context.

Never the less, Estonia and Russia have an agreement regarding co-operation in protection and sustainable use of transboundary waters. In this context it is necessary to end discharge of alkali water to the Narva Reservoir, which forms the border between Estonia and Russia.

The measures proposed under this Project will cease any trans-border pollution emanating from Ash Field No. 2 enabling Estonia to comply with the co-operation agreement with Russia.

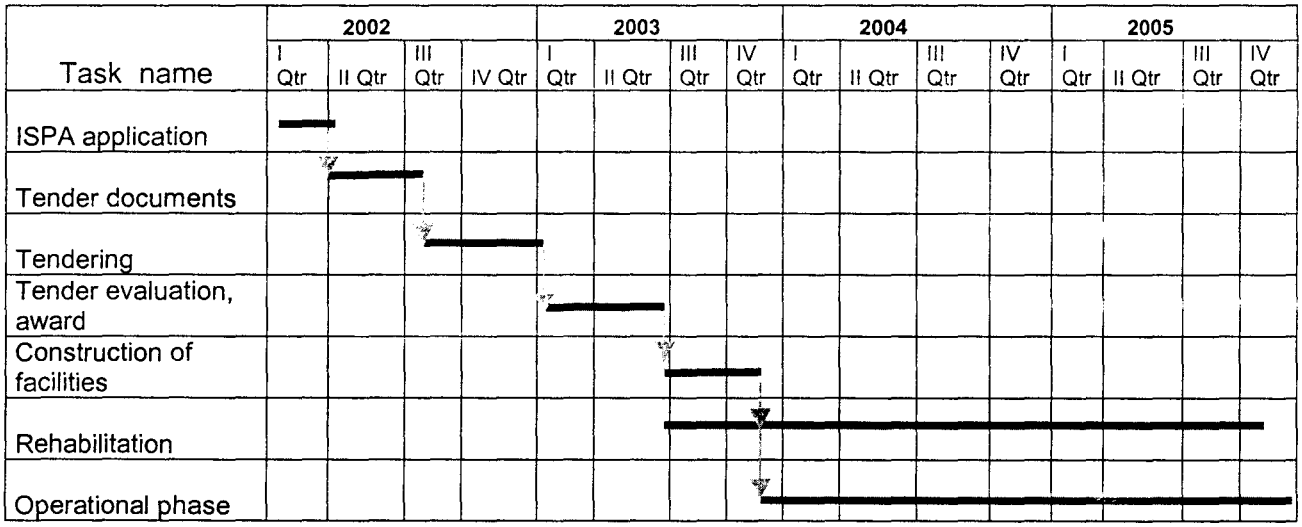
8. TIMETABLE

8.1 Give below the anticipated timetable of the measure:

	Start date	***Completion date***
Feasibility study:	2001	31/01/2002
Economic analysis:	15/01/2002	10/02/2002
Financial analysis:	15/01/2002	10/02/2002
Environmental impact assessment:	25/12/2001	31/03/2002
Site topography and related studies:	01/12/2001	31/01/2002
Tender documents:	01/04/2002	30/06/2002
Land acquisition:	n.a.[1]	
Construction of facilities:	01/09/2003	30/12/05
Operational phase:	1/12/2003	

[1] The ash-field No. 2 located on State owned land. No land acquisition is required.

Summary Schedule of works related to measure:



8.2 In the case of a stage of a project, give the anticipated timetable of construction of other related stages.

Not applicable.

9. COSTS (in EURO)

9.1 Cost breakdown

The breakdown of costs in the table below relates to the measure under application for ISPA Financing.

ITEM	TOTAL COSTS (MILL.EURO)	EXPENDITURES INCURRED BEFORE APPLICATION (MILL. EURO)
Planning/design/project preparation fees	0.15	0.15
Land purchase	n.a*.	n.a.
Site preparation	0	0
Main works:	**5.94**	0
Equipment procurement	0	0
Technical assistance	0	0
Supervision during implementation	**0.6**	0
Contingencies, 10 %	**0.6**	0
Tax/public levies	0	0
Other: *Environmental Permit costs for discharge of alkaline waters*	0.25	0.25
TOTAL (max)	7.54	0.4
ISPA project TOTAL	**7.14**	

*) n.a. Not applicable. VAT not included. All costs presented are nominal.

10. FINANCIAL & ECONOMIC ANALYSIS*

***The following text should be read in conjunction with the Annex IV "Financial and Economic Analysis ~ Closure of ash field No.2 with water ponds at Balti Power Plant".**

10.1 a) Financial analysis

The following financial analysis is according to Narva Power Ltd. Financial Statements

Narva Power Ltd. is a company owned 100% by state owned company Eesti Energia Ltd. In 2001 Narva Power Ltd. as Eesti Energia made an operating loss. Details for Eesti Energia are in Annual report 2001 (www.energia.ee/documents/549c04b170eba3a.pdf). It is prognosticated that the year 2002 will end with a loss also, but after that the company will start making profit.

All operating expenses are financed through user tariffs and fee income without of any support in the form of budget transfers or cross-subsidisation from other municipal services. The proposed investment programme and financing plan of Eesti Energia has been elaborated under the pre-condition that energy sector operations are both sustainable and affordable under self-financing conditions.

Eesti Energia and Narva Power Ltd. have identified the necessity to close down of some ash fields by turning to the "dry" ash transport and disposal technology. The ash field No. 2 of Balti Power Plant should be closed at first as it is in reserve. This will be synchronous with the tasks Nos. 3.1.8 and 6.2.11 of NEAP. According to the NEAP's consideration, there was foreseen to find financial support from EC (an ISPA grant).

In assessing the financing possibilities (un-bankable by commercial banks due to non-profit) it appeared highly advisable to ask the ISPA financing on 85 % level of the cost of the measure. This is because the measure covers two actions of NEAP – Closure of ash-field No. 2 of Balti Power Plant (No. 3.1.8) and liquidation of a source of past pollution (No. 6.2.11). And, on the other hand, according to NES, financial support will be provided by the state to cover the costs related to the elimination of past pollution (abandoned sites are the objects of past pollution). The latter item extra supports the necessity to finance the measure by ISPA in amount of 85% of the cost.

Financing	Percentage of investment	Million Euro
Local Financing	15	1.071
ISPA Grant	85	6.069
Total	100	7.140

A cash flow statement included calculation of the internal rate of return (IRR) and net present value (NPV) under "with ISPA grant" and "without ISPA grant" scenarios. (Details are in Annex 4) As the project appears non-profitable, there is no way to calculate and operate with the IRR.

As in the majority of rehabilitation projects, the NPVs' values are also under the current measure negative (see table below). ISPA's grant diminishes somehow the negative values.

Net Present Value analysis		
	Without ISPA grant	**With ISPA grant**
Measure	NPV – 5 % (EURO Millions)	NPV – 5 % (EURO millions)
	-5 648	-1 691
Measure	NPV – 8 % (EURO Millions)	NPV – 8 % (EURO millions)
	-4 916	-1 479
Measure	NPV – 10% (EURO Millions)	NPV – 10 % (EURO millions)
	-4 496	- 1 359

10.1 b) Is the measure expected to generate revenues through tolls or charges borne by users?

Yes ☐ No ☒

c) Explain how the "Polluter-Pays" principle is respected:
(Article 130r Treaty EC, and Article 15 Council Directive on waste 75/442/EEC)

In accordance with the prescription of Ida-Viru Environmental Service, Narva Power Ltd. is the responsible body to implement the closure of ash field No. 2 because; the ash-fields are inside the territory of BPP.

Estonian adherence to EU regulations (Article 130r Treaty EC, and Article 15 Council Directive on waste 75/442/EEC) concerning the "polluter pays" principle is stipulated in the Pollution Charge Act (RTI 1999, 24, 361) which requires a "pollution charge" to be levied. Article 6 of the Act specifies:
(1) The pollution charge shall be paid by the owner of an immovable object if pollutants or waste are released into the environment from the immovable object of the owner according to the wishes of the owner.
(2) If pollutants or waste are released into the environment from land used on the basis of a right of superficies by a superficiary or from land adjacent to a structure as a movable object by the owner of the structure, the obligation to pay the pollution charge shall also apply to such superficiary owner.
(3) For the purposes of this Act, release of contaminants into the environment means the discharge of hazardous substances on an immovable, on land used on the basis of a right of superficies or on land adjacent to a structure as a movable.

Liability for the Ash Field's are shared jointly between the State and Balti Power Plant. In this respect and in consideration that the majority of the ash and subsequent pollution occurred under the former Soviet regime, the Polluter Pays Principal is being duly respected in as much as it can.

d) If there is a charging system, to what extent:

Not applicable.

10.2 In the case of revenue-generating projects, indicate the estimated financial rate of return (with and without ISPA assistance):

Not applicable, because the measure will not generate revenue.

10.3 All projects must be sustainable in the long term

The sustainability of the project is manifest in several key areas. Presently BPP pays a pollution charge via an environmental permit. The cost of this permit is expected to increase with time. Therefore without implementation of the measure costs related to maintaining the present ash waste management strategy will increase. This is non sustainable both economically and environmentally.

Following completion of the measure there will be no more ongoing discharge of waters whose quality is in contravention of EU and National norms and standards. The present environmental permit covering such discharges will no longer apply. Currently costs for discharge of alkaline water into environment via the pollution charge is 32 000 EURO/y at a minimum.

Ongoing operation and maintenance costs of the measure are estimated at approximately 33 000 EURO. Nominally this will be covered by revenue from BPP within their unit charges for consumers. However, implementation of the project is not expected to increase the operational costs of the company as the pollution charge covering discharges of the waters will no longer be required.

Furthermore the preferred closure option is designed to require little or no ongoing maintenance, especially over time. Thus finances the company needs to direct into management of the ash field is eventually expected to cease. At this point the area should be available for general zoning by the local authorities.

Economic analysis

10.4 a) Socio-economic costs and benefits

Socio-economic benefits rise from the environmental benefits accrued. The environmental benefits of the measure are:

- Reduction in the pollution of groundwater's and soil.
- Setting up opportunities for biodiversity development in the Project area.
- Local temporary economy benefit from procurement of cover materials and from personnel employed during the covering and planting seasons and operational phase.
- In far future there may be re-valuation of land prices in areas nearby the ash-field, although this will be insignificant.
- The measure contributes to follow the Estonian Environmental Strategy, Estonia's accession into the EU, meeting EU regulations and sustainable management of border water-bodies.

EC's financial support for the closure of ash-field will help Eesti Energia to make savings and not to collect extra money for the investments from the electricity tariffs. An ISPA grant in an amount 85% will form approximately 7% of Eesti Energia's investments in year 2001.

10.4 b) If cost-benefit analysis has not been used, give reasons and describe alternative method:

There are conceptual difficulties associated with quantifying cost and benefits in the industrial waste treatment sector in general and oil shale ash depositories in particular. One can conclude the improvements to the local environment by ending the discharge of alkaline water and a drastic reduce of pollution tax for pH value exceeding the limit.

If the capital costs have to be funded by Narva Power Ltd. alone out of revenue, then financially the project is not justifiable, because there is no return on capital.

10.4 c) Please show results of economic the analysis in terms of the following indicators:

For the project a net present value (NPV) analysis was done to determine the NPV with and without an ISPA grant. This is for a measure that costs 7.14 Mill. EURO.

Discount Rate %	No Grant NPV Mill. EURO	ISPA Grant NPV Mill. EURO
5	- 5 648	- 1 691
8	- 4 916	- 1 479
10	- 4 496	-1 359

Without an ISPA grant the project is not financially justifiable as the NPVs are all negative, there is no return on capital.

With an ISPA grant the NPVs are not positive either, but their negative value is smaller. This is often common for an environmental project. Despite these projects are often non-profitable in financial terms, but they have positive environmental and social impacts.

Internal rate of return	IRR	Not Applicable
Net present value	NPV	Not Applicable
Benefit/cost ratio	B/C	Not Applicable

10.4 d) Please give details of main benefits identified in the analysis together with values assigned to them:

Not applicable.

11. FINANCING

11.1 Type of assistance sought from ISPA: (grant, repayable assistance, etc.)

Financing sought from the ISPA initiative is in the form of a Grant.

11.2 Amount of financial assistance requested

The requested amount of EURO 7 140 000 (seven million one hundred and forty thousand EURO) is based on the nominal costs of the investment programme, adjusted for inflation over the implementation period.

EURO	% eligible costs*
7.14 Mill.EURO	**85%**

*) according to position of Department of Investments in MoE.

The requested financial assistance will help:

- **Republic of Estonia** to implement two actions of NEAP – **Closure of ash-field No. 2 of Balti Power Plant (action No. 3.1.8) and liquidation of a certain object (source) of past pollution (action No. 6.2.11).**
- **Eesti Energia** to accelerate the renovation program (27 M€) of ash handling and disposal system i.e. to convert the handling system to "dry".
- **Balti Power Plant** to stop the pollution of adjacent water bodies by ending the discharge of highly alkaline water.

11.3 Financial Plan.

The capital cost of the project is summarised below.

Total Capital Cost	7 140 000
ISPA Grant	6 069 000
Local Funding	1 071 000

Financial schedule detailing funding source and implementation timing:

Title of Project :*Closure of ash field No. 2 with water ponds at Balti Power Plant*

EUR Million

ISPA No :

Year	Total Cost	Private Sector(1)		Public Expenditure								Loans	
			%	Total Public Expenditure	%	ISPA	%	National Authorities					
								Central Government	Regional Authority	Local Authority	Bilateral Donor		%
	1	2	3= 2/1	4= 6+8+9+10+11	5= 4/1	6	7= 6/4	8	9	10	11	12	13
2003	0.96			0.96	100%	0.82	85%	0.14	0		0	0	0
2004	5.21			5.21	100%	4.43	85%	0.78	0		0		
2005	0.97			0.97	100%	0.82	85%	0.15	0		0		
Total	7.14	0	0	7.14	100%	6.07	85%	1.07	0		0	0	0

11.4 Has an application been made for assistance from any other Community source, or International Financial Institution, for this project or any part of this project?

Yes ☐ No ☒

11.5 Has an application been made for assistance from any other Community source, or International Financial Institution, for an earlier phase of this project?

Yes ☐ No ☒

11.6 In the case of projects for which earlier phases have been financed by PHARE, please indicate the date from which ISPA assistance is expected to take over:

There is no Phare financing involved in the Project.

12. EMPLOYMENT IMPACT OF PROJECT

12.1 Number of jobs created in construction phase

Directly	20
Indirectly	5
Expected duration in months	30

12.2 Number of jobs created in operational phase

Directly	2
Indirectly	0

Closing down the ash-field itself will not specifically create any jobs. In connection with the operation of neutralizer two jobs should be organized. The jobs' names are: neutralizer automation operator and acid purchaser.

13. COMPATIBILITY WITH OTHER COMMUNITY POLICIES

13.1 Public Procurement Policy

Please give details of contracts foreseen and estimated timetable for tendering of contracts.

Contract N° type & description	Estimated publication date of notice	Remarks
Construction Contract Open international tender without pre-qualified	01/02/2003	To be contracted under FIDIC Conditions of Contract for Plant and Design-Build, First Edition 1999
Estimated timetable for tendering, see schedule under 8.1 above.		

13.2 Competition Policy

Does this project involve State Aids (direct financial assistance to private industry)?

Yes ☐ No ☒

13.3 Other Policies

Please refer to any other Community policy of relevance to the project (e.g. agriculture, energy) and explain the connection:

Not applicable

13.4 Is the project the subject of a legal challenge within the courts/national jurisdiction?

Yes ☐ No ☒

14. CONSISTENCY WITH OTHER MEASURES FINANCED BY THE COMMUNITY

14.1 Other pre-accession Instruments

Is this measure complementary to any programme, project, or other measure financed or to be financed by a pre-accession Instrument?

Yes ☐ No ☒

14.2 Other:

Please give details of relationship between the project and other measures undertaken with contributions from the Community budget, or from the International Financial Institutions:

There are no other projects or measures currently involving Community or other International Financial Institute financing undertaken with regard to this project. However, Eesti Energia Ltd. is planning to change the present wet ash transport system to dry. A feasibility study is under preparation. According to Environmental Action Plan of Eesti Energia the project will start in spring 2002 and will end in July 2009 as the latest. Among other financing and support sources the ISPA initiative is also being considered.

15. MONITORING

15.1 Specify the indicators to be used for monitoring the physical progress of the construction of the project:

Physical Indicator	Unit	Value
Output of assembled alkaline water neutralizer:	m^3/h	500
New culverts through ash dams and reconstructed drain weirs	No.	13/2
Water level on lake let(Green Lake)	m	27 (absolute)
Soil spreading works on ash field: Option 2	m^3	386000
Planted / forested area: Option 2	ha	266/120
I phase of inert waste landfill	ha	2

16. ARRANGEMENTS FOR MANAGEMENT, MONITORING, CONTROL AND EVALUATION

16.1 What arrangements are in place for the monitoring and financial control of the measure?

- **body responsible for project management and supervision during construction**

The Narva POWER Ltd. plans to manage the project by hiring a competent project management/supervising entity.

- **system of reporting physical and financial progress**

The CENTRE of ENVIRONMENTAL INVESTMENTS inside administrative field of the Ministry of Finance has formed a sub-unit dealing with ISPA financed projects.

The system will follow the common rules in administrative procedures for the Estonian ISPA programme. After approval of project (measure) by the EU Commission, Financial Memorandum will be signed between the Minister of Finance from Estonian side and Head of EC Delegation in Tallinn from the EC side. Ministry of Finances informs line ministries (Ministry of Environment and Ministry of Economy) about Financial Memorandum.

Main elements of the system are:

- the Contractor whose obligation is to present regular reports to Implementing Unit (a sub-unit in Centre of Environmental Investments) on financial and physical progress;
- Employers representative (in most cases site supervision engineer) approves the report;
- Implementing Unit reviews the reports and will send it for endorsement to PAO;
- PAO endorses the reports and sends reports for endorsement to EC Delegation;
- EC Delegation endorses the reports:
- Line ministries inform MoF about progress.

The Central Finance and Contracting Unit (CFCU) is an unit that was established by a decree of the Minister of Finance in autumn 1997 to carry out the executive role in the framework of the decentralised implementation system of the European Commission's PHARE programme. CFCU has also been nominated as the Implementing Agency for ISPA horizontal technical assistance measures. Thus, CFCU is responsible for tendering and contracting of ISPA TA measures as well as for payments to be made.

A scheme of reporting documents movements of ISPA financed projects for Estonia is appended, **Annex VII**.

- **internal financial control**

The internal financial control follows the common rules in administrative procedures for the Estonian ISPA programme.

16.2 Are there any special arrangements applying to this measure?
(e.g. project management, specific monitoring committee)

Yes ☐ No ☒

17. PUBLICITY

17.1 Give full details of publicity to be given to the measure and ISPA's role in financing it:

As part of standard practice regarding a project of this nature and under the requirements of the ISPA initiative, an Environmental Impact Assessment (EIA) screening was conducted during the feasibility stage. During this process public hearings of the EIA program, the closure options of the ash-field No. 2, and the EIA report were held. The Appraisal Report was approved by Responsible Parties, i.e. MoE, ISPA Implementing Agency and Project Implementing Agency.

After an approval of the ISPA grant the Ministry of Environment will issue a press release with the appropriate facts. If deemed relevant at the time a press conference with participation from ISPA, Eesti Energia Ltd. and Narva Power Ltd. and the Ministry will be organised.

By starting with rehabiltation works explanating boards stating the EU ISPA financing of the project will be assembled at the entrance to the ash field No.2.

NAME and SIGNATURE: **Mr. Harri Õunapuu**
Minister of Finance

AUTHORITY: **Ministry of Finance**

STAMP:

ANNEX I

ENVIRONMENTAL INTEGRATION MEASURES

PART A – ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Directive No 85/337/EEC – OJ No L175, 5/07/1985, as amended by Directive No 97/11/EC – OJ No L 073, 14/03/1997.

1) Is consent from a government authority required for this project?

Yes [X] No [ ]

If yes, what is the competent authority?

The competent authority endorsing the EIA of the project is the Ministry of Environment (Ida-Viru Environmental Service).

2) Has consent already been given to the project?
(i.e. has the decision that will for the start of any construction works been taken?)

Yes [ ] (see below) No [X]

If yes, on which date? __|__|__|

If not, for which date is this decision scheduled?

According to Estonian legislation the final consent can be given after completing the technical design and inert waste landfill area development planning.

3) Is the project a class of development covered by:

Annex I of Directive 85/337
(go to question 4) [ ]

Annex II of Directive 85/337 (97/11)
(go to question 5) [X]

Not covered by Directive 85/337 (97/11)
(go to question 8) [ ]

4) When covered by Annex I:

Yes [ ] No [ ]

Not applicable.

5) When covered by Annex II, is an environmental impact assessment required for authorisation of this project?

Yes [X] No [ ]

- If not, explain why not and go to question 6.
- If yes, and consent has already been given, include the necessary documents.[3]

The EIA according to Estonian Act of Environmental Impact Assessment and Auditing was completed in March 2002. Ida-Viru Environmental Service of MoE will issue the necessary document.

The EIA verifies that the measure implemented according to Option 2 will not result with negative environmental impacts and terminates present adverse environmental impacts of the ash-field in reserve.

- If yes, but consent has not yet been given, has an environmental impact assessment already been carried out?

Yes [X] No [ ]

A non-technical summary of EIA is presented in ANNEX V.

6) Have the environmental authorities likely to be concerned by the project by reason of their specific responsibilities been designated and consulted?

Yes [X] No [ ]

Within the process of compilation of EIA Ida-Viru Environmental Service of MoE has been consulted on closure-down of Nakro Ltd and prospectives of industrial waste landfills in vicinity of the ash-field.

7) Has the request for development consent and the environmental impact assessment study been made available to the public, and has the public concerned been consulted?

Yes [ ] No [X]

No, because the ash-field No.2 is on the territory of Balti Power Plant. Only representatives from MoE and MoF have been consulted.

8) When not covered by the Directive, or in case of an Annex II project for which an EIA is not required, is the project likely to affect an environmentally sensitive area[4]?

Yes [ ] No [X]

PART B – ENVIRONMENTAL PLANNING, MANAGEMENT AND MONITORING

1) Indicate weather, apart from the Environmental Impact Assessment, any environmental integration measures are envisaged (e.g. Strategic environmental impact assessment or environmental audit)

Yes [X] No [ ]

If yes, please specify:

In 2001 Jaakko Pöyry Infra completed Environmental Status Assessment for Narva Power. According to Ida-Viru Environmental Services of MoE no other strategic EIAs and audits for Narva Power have been carried out.

2) Will the measure be subject to environmental management and/or monitoring?

Yes [X] No [ ]

For the measure a monitoring program is established, including water quality and level in Green lake and geotechnical stability of ash heap.

ANNEX I (c)

DECLARATION OF COMPETENT AUTHORITIES WITH RESPECT TO ENVIRONMENTALLY SENSITIVE AREAS (ESA's)

PROJECT NOT LOCATED WITHIN AN ESA

This is to confirm that the Ash Field No. 2, a part of the treatment area of the oil-shale ash of the Balti Power Plant and the sludge lagoon ("Lake Green") by the ash field are artificial landscapes and, consequently, include neither protected areas nor environmentally sensitive sites.

No areas of the following categories are located in the vicinity being potentially directly affected by the project:

a) areas protected by national legislation;
b) internationally important wetlands (sites fulfilling RAMSAR convention ornithological criteria) and other sites meeting the criteria which would require designation as Special Protected Areas under Directive 79/409/EEC;
c) areas to which the Bern convention on the conservation of European wildlife and natural habitats (Article 4) applies, in particular sites meeting the criteria of the Emerald network;
d) important breeding or resting areas of an animal species listed in Annex IV of Directive 92/43/EEC (article 12)

According to the conclusion of the assessment group formed by the Estonian Ministry of the Environment for coordinating the selection and designation of sites to be proposed as Estonian pSCI-s (proposed Sites of Community Interest), reached at its meeting (January 2002), no areas of the value referred to above were identified in the vicinity of Ash Field No.2.

Hanno Zingel
Director General
Department of Nature Protection
Ministry of Environment
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06.03.2002

ANNEX II

Environmental Strategy of Estonia
Summary

INTRODUCTION AND GENERAL PRINCIPLES

According to Article 53 of the Constitution of the Republic of Estonia every person is obliged to preserve the human and natural environment and to compensate for damages they cause to the environment.

Fifty years of development under conditions of unbalanced economic relations in a closed society has resulted in underdeveloped machinery and technology and irrational use of natural resources. As a result, conflict situations between the use and protection of the environment developed in a number of regions of Estonia and formed the preconditions for environmental crisis. Significant environmental stress was also caused by past pollution associated with the activities of the former Soviet army. Elimination of past pollution will take decades.

In 1989, the Supreme Council of Estonia adopted the Policy on Nature Conservation and Sustainable Use of Natural Resources which provided an assessment of the state of the environment. The policy also formulated policy goals and identified environmental problems and possible ways of achieving the goals under socioeconomic conditions based on state ownership. Though the regaining of independence in 1991 did not alter the environmental goals, it changed the conditions for achieving these goals. Instead of an economic system planned and controlled by the state, Estonia has moved towards a liberal free market economy. Privatisation of state owned land and technical assets is successfully being carried out.

Today, environmental requirements are taken into consideration when establishing new enterprises. The use of natural resources as well as environmental protection are regulated by administrative means. Application of resource and pollution charges has provided a solid
basis for integrating the principles of environmental protection into economic activities. Large investments financed from the national budget, by different enterprises, local municipalities and various funds, have been made to address the environmental problems;
foreign assistance has also been significant. The applied measures have contributed to the improvement of the situation.

The principles of Estonia's environmental policy are included in a number of legislative acts on nature management, nature conservation, etc.: Act on Nature Conservation, Forest Act, Act on Protected Natural
Objects, Act on the Protection of Marine and Freshwater Coasts, Shores and Banks, Act on Pollution Charges, Water Act, Earth?s Crust Act, Act on Packaging, Planning and Building Act, Act on Hunting Management, Fishing Act, Land Amelioration Act, Act on Sustainable Development, Health Protection Act, etc.

The environmental policy of the Republic of Estonia is implemented through executive action programmes following the elaboration of environmental strategy trends. Thus, development trends elaborated and directed by the Government and accepted by the public, which take into account the needs of the future generations without endangering the main requirements of the present generation, are followed. This means also that the environmental limitations have to be considered in economic activities.

As the technological basis of the Estonian economy is relatively outdated, sustainable use of natural resources is of utmost importance. Due to the fact that funding possibilities are considerably smaller than needed in nature conservation, the use of limited available financial resources should be well planned.

The above-mentioned considerations have led to the development of the Estonian National Environmental Strategy (NES). The Strategy is mainly based on the principles of the environmental policy of Estonia. The current situation and implementation of the ideas presented in the Policy of Nature Conservation and Sustainable Use of Natural Resources were critically analysed during the elaboration of the NES. In 1995, an additional assessment of environmental activities was made in Estonia the results of which are presented in Environmental Performance Review, Estonia (compiled by United Nations Economic Commission for Europe).

The NES specifies the trends and priority goals of environmental management and protection in a new political and economic situation and sets the main short-term and long-term tasks to be achieved by 2000
and 2010 respectively.

The NES proceeds from the main traditional goal of environmental protection which is to provide people with a healthy environment and natural resources necessary to promote economic development without causing significant damage to nature, to preserve diversity of landscapes and biodiversity while taking into account the level of economic development.

The priorities presented in the NES are taken into account when planning environmental activities, developing international cooperation and allocating national funds. In order to implement the main tasks set
in the NES, long-term action plans will be developed.

The Strategy follows the main international environmental initiatives: the World Nature Protection Strategy, Agenda 21, the Declaration of the Earth Summit (Rio de Janeiro, 1992), the Environmental Action Programme for Central and Eastern Europe (adopted at the Ministerial Conference in Lucerne in 1993 and revised at the Sofia Conference in 1995), the international agreements which have become valid for Estonia, and the White Paper drafting the principal requirements of integration of the associated countries of Central and Eastern Europe with the European Union.

MAIN PRICIPLES OF THE STRATEGY

The Strategy is based on internationally accepted principles, the historical traditions of Estonia and takes into account the current socioeconomic situation in the country.

The main principles of the NES are as follows:

to encourage economic development in environmentally sustainable direction, whereby the objective is to meet the needs of the present generation without compromising the interests of future generations.

This objective can be achieved by regulating environmental management and establishing environmental protection restrictions to a number of activities; to anticipate and prevent environmental damage by addressing the causes at the earliest possible stage as elimination of the consequences is considerably more expensive and sometimes even impossible; to exercise caution in environmental decision-making:
approval of planned activities where environmental impacts are not entirely clear should be avoided;
to integrate environmental requirements into the development strategies of other sectors and to consider these while using and protecting each individual environmental media and natural resource.

In addition, the interests of the natural environment as an integral system should also be taken into account;
to include environmental requirements in environmental legislation as well as in other socioeconomic legislation in a manner which avoids contradictions between the various requirements;
to regard the environment as the common wealth and concern of the population. The interests of the environment have to stand higher than party politics, current economic problems, business and propaganda interests.

In order to achieve the objectives of environmental protection and sustainable use of natural resources a social consensus between all groups of society must be reached;
to meet environmental requirements in the economic sector by applying the 'polluter/consumer pays' principle. Every user and polluter has to be fully responsible for their activities. Enterprises have to ensure that their activities meet environmental requirements. The value of natural resources used, all costs related to environmental protection and environmental damage incurred throughout the life cycle of a product (production, distribution, use, and final disposal) should be reflected in the product's price;
to cooperate with other countries in solving global and regional environmental problems and to restrain transboundary environmental effects;
to apply environmental protection measures at the political and/or administrative level that ensures the best possible results. Proceeding from the principle of shared responsibility, the state, local municipalities, enterprises and inhabitants have to cooperate in solving environmental problems within their sphere of influence;
to promote traditional nature conservation and nature management as well as public awareness concerning natural values.

Primary Principles of the Use of Natural Resources and Environmental Protection

Sustainable use of natural resources and efficiency of environmental protection is basically determined by the technologies used in production and environmental protection. Therefore, it is very important to:
- use the best available technology which ensures sustainable use of natural resources,

- reduces the burden upon the environment and does not entail excessive costs on the further development of the Estonian economy;
- apply the best available environmental practices.

The latter is a combination of measures which takes into account the experience of other countries and is aimed at achieving the best environmental results. While choosing these measures, attention should be paid to the following factors:
environmental risks caused by manufacturing and consumption of products as well as by waste treatment;
reduction of pollution or replacement of certain products/activities by other less polluting products/activities;
assumed environmental benefits and damages caused by substitute materials or activities;
development of science and changes in human knowledge;
limits of implementation;
associated socioeconomic effects.

It is preferable to apply the measures aimed at improving the state of the environment at the source of pollution. In order to reduce pollution at source, the following measures should be applied:
technology-orientated measures which substantially change the structure of the production and consumption process and are the closest to the principles of sustainable development;
volume-orientated measures which bring about a decrease in the use of raw materials, water and energy, thus reducing the overall volume of waste;
measures that reduce the emission of pollutants (treatment facilities, recycling systems, etc.).

Measures to be applied are determined by the specific details of the problems to be solved and goals to be achieved. In the short term the largest environmental benefits can be achieved by reducing emissions through the use of different treatment facilities and by reducing losses of raw materials as well as losses in energy production.

Introduction of environmentally sound technologies takes more time and needs larger financial resources than are currently available. In future preference should be given to the use of environmentally sound technologies.

Good results can be achieved even by applying such low cost measures as "good housekeeping" in everyday life and in production. The above measures can be introduced primarily by promoting public awareness and an environmentally sound way of thinking, thus improving the sustainability of current production and consumption patterns.

International Environmental Cooperation

Estonia's obligations under international agreements as well as internationally accepted principles and trends are followed in environmental protection, consumption of natural resources and in nature management. The main goals to be achieved in international relations are as follows:

to integrate internationally accepted environmental principles and best practices, in particular those accepted by the European Union, into environmental legislation and implementation;
to attract foreign investments for projects which ensure better use of natural resources as well as environmental improvement;
to promote regional cooperation in the Baltic Sea area and especially cooperation with other Baltic States.

Estonia has concluded more than 40 bilateral and multilateral environmental cooperation agreements with its neighbours and other European countries. In addition to several framework agreements, a number of agreements on fisheries, water and air protection, protection and sustainable use of border water bodies, elimination of sea pollution, and waste treatment have been concluded. Also, agreements on reduction of transboundary pollution and environmental impact assessment will be concluded. Cooperation in the protection of the Baltic Sea is
facilitated mainly through the framework of the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki 1992). Estonia also participates in the activities related to the
conventions developed under the auspices of the United Nations, the United Nations Economic Commission and the European Council.

The objective of cooperation between Estonia and the European Union is to modernise both the private and public sectors of the Estonian industry to ensure environmental protection primarily by introducing
environmentally sound technologies. The European Union recognizes that in order to achieve environmental goals, stricter norms and standards can be applied in Estonia if considered ecessary.

PRIORITY ENVIRONMENTAL PROBLEMS

Nearly 40 significant environmental problems were identified while analysing the information obtained on the state of the environment and the use of natural resources. In the process of prioritizing these problems the following criteria were taken into account: effects on human health, economic development, the possibilities to ensure sustainable development and to meet international obligations.

Soil fertility, water, forests, fish stock and mineral resources are crucially important for ensuring long-term development in Estonia. Though natural resources must be available for economic activities, they have to be used in a sustainable manner. Supplies of the existing natural resources are sufficient to meet internal demand and are in a relatively good state. Sustainable use of natural resources can be ensured by legislative acts as the legal basis for this has already been created.

The most important aspect taken into consideration, while prioritizing environmental problems both in Estonia and in the European Union, is the maintenance of human health. The environment affects human health primarily via polluted air, low quality drinking water and noise. In Estonia, relatively little research has been carried out in this field yet. In the towns of North-Estonia, there is a correlation between increasing morbidity and concentration of air pollutants. In the

industrial region of the northeastern part of Estonia the frequency of occurrence of respiratory illnesses is much higher than in other regions. The volume of harmful trace elements in agricultural products grown in the regions of Narva and Sillamäe is considerably higher (though in most cases it does not exceed the permitted norms) than in agricultural products grown around the city of Tartu. This is partly due to the natural characteristics of the soil and partly to the waste
generated in oil-shale processing in the northeast.

Drinking water is transported to about twenty settlements in Estonia by tankers as the aquifer used for drinking water in these settlements is polluted.

One of the problems in Estonia is polluted food products. The use of pesticides and mineral fertilizers has considerably decreased compared to the second half of the 1980s. The quality of the plant and animal
products processed in Estonia is coming close to the quality of products of biodynamic agriculture with regard to the content of pesticides and fertilizer components. More attention should be paid to controlling the quality of food products imported in larger quantities. For this purpose a relevant control system should be established.

The priority environmental problems in Estonia are:
pollution of ambient and urban air which has a negative impact on human health, ecosystems and buildings;
past pollution caused by industrial, agricultural and military activities which poses a threat to ground and surface water quality; damaged landscapes;
decrease in water quantity and quality due to irrational use of ground water resources;
irrational use, pollution and eutrophication of surface water bodies, deterioration of aquatic ecosystems, including a decrease in reproduction and deterioration of the quality of fish stock;
increase in environmental pollution caused by waste disposal and in areas contaminated by waste, inappropriate waste and hazardous waste management;
threats to biological and landscape diversity(including eco-network, nature reserves, protected species, and sites) as a result of economic activities and the land reform;
insufficient correspondence of built environment to environmental and health principles.

The main causes of environmental problems are as follows:
use of out-of-date technologies consuming large volumes of raw material and generating large quantities of waste;
low level of public awareness with a consumption-orientated mode of thinking;
underdeveloped environmental-technical infrastructure;
insufficiency of financial resources and management instruments.

The ongoing changes in socioeconomic and administrative systems have caused a lack of public interest in environmental problems. Transition to the market economy, liberal economic policy and open society have
introduced new consumption patterns. The abundance of goods and services and propagation of a western consumption-orientated way of living has resulted in an unsubstantiated increase in consumption. A further decrease in public awareness and adoption of new consumption patterns ignoring the principles of sustainable development and environmental considerations as well as further alienation from nature are anticipated.

ENVIRONMENTAL POLICY GOALS

The NES focuses on achieving the **ten** principal policy goals discussed below. As promotion of public awareness and introduction of environmentally sound technologies is a precondition for solving most of the existing problems, these are considered to be the priority goals of the NES. One of the priority goals is to reduce negative environmental effects of energy production which is a cause of major global and local environmental problems. Improvement of air quality, waste management and water protection as well as reduction of past pollution will help to ensure a healthy environment. Improvement of the built environment serves the same purpose. In addition, landscapes and biological diversity in Estonia should be preserved as much as possible.
In addition to priority environmental goals, attention is also focused on environmental media and natural resources.

1.Promotion of Environmental Awareness

Goal: to preserve and stimulate the Estonian tradition of environmental awareness, to promote public participation in environmental decision-making, active environmental protection and supervision; to encourage
future generations to adopt environmentally sound consumption habits and to support further development of environmentally sound consumption patterns.

In order to promote environmental awareness, it is necessary:
to shift public consumption preferences in a more sustainable direction by using mass media resources, economic tools and administrative instruments of environmental protection;
to make environmental information available to the public;
to shape public understanding of environmental values through education and training;
to involve the public in environmental decision-making processes;
to make decisions on the basis of reliable information which should also be available to the public;
to ensure control over implementation of adopted decisions and to make the results available to the public.

2.Clean Technologies

Goal: to use natural resources, raw materials and energy in a rational and sustainable manner, to reduce pollution and generation of waste.

For achieving the above goal it is necessary: to introduce the principles of a good housekeeping into production and everyday life;
to introduce environmentally sound technologies step by step;
to introduce the best environmental practices used in other countries;
to achieve a favourable public attitude and create economic incentives for the introduction of such practices.

Tasks by the year 2000:

to develop criteria, standards and normatives for assessing technological processes and products from the standpoint of sustainability;
to introduce the principles of a good housekeeping into production and everyday life;
to elaborate legislative acts regulating environmental, economic and social activities in order to promote clean, sustainable production;
to develop economic incentives promoting sustainable production;
to improve environmental management, primarily at the enterprise level;
to implement the best available technology and the best environmental practices in new and reconstructed enterprises;
to attach higher value to natural resources, to consider their consumption rate and damage caused to the environment in production costs;
to elaborate a labelling system for environmentally sound products.

Tasks by the year 2010:
to introduce the best available technology and best environmental practices into production and everyday life;
to consider environmental implications of the product in the product price throughout its life-cycle.

3.Reduction of Negative Environmental Effects of Energy Sector

Goal: to reduce the environmental impact of the energy sector, to direct energy policies towards energy efficiency technology development programmes, more extensive use of renewable energy resources and reduction of greenhouse gas emissions, to include all environment-related costs of energy consumption in the energy price.

In order to promote energy conservation, it is necessary:
to introduce new technologies to raise the efficiency of the energy sector starting from fuel supply through power generation and transmission to energy consumption;
to stimulate the use of less polluting fuels;
to encourage energy saving "from the producer to the consumer";
to support the use of renewable fuels and energy sources;
to reduce the negative impact of the oil-shale energy complex on the environment.

Tasks by the year 2000:
to reduce the negative effects of energy and heat production by introducing the principles of "a good housekeeping";

Tasks by the year 2005:
to elaborate development trends in electricity production, taking into account environmental requirements;
to introduce economic instruments that raise the efficiency of energy use;
to reduce dust and ash emissions by 25% from 1995 levels;
to terminate the use of high-sulphur fuel oil (sulphur content exceeding 2%).

Tasks by the year 2010:
to reduce emissions of pollutants in electricity
production to a level harmonized with the European Union.

4. Improvement of Air Quality

Goal: to reduce emissions of pollutants to air, focusing primarily on pollutants causing climate change and ozone depletion, and on pollution originating from transport.
In order to achieve improvements in air quality, it is necessary:
to support development of less polluting types and means of transport (railway, electric transport) and other means of public transport;
to ensure the importation of high-quality engine fuel;
to stimulate the consumption of cleaner fuels by differentiating the rates of excise taxes for motor fuels according to their quality and environmental hazardousness.
to impose restrictions established by international conventions on the use of ozone depleting substances and in order to achieve reduction of emissions of volatile organic compounds and heavy metals, emission of sulphur and nitrogen compounds, and stabilization and reduction of emissions of greenhouse gases (CO2, CH4, CxHy).

Tasks by the year 2000:
to terminate the sale of ozone depleting substances and impose considerable restrictions on the consumption of such substances;
to stabilize emissions of nitrogen compounds at the 1987 level and to aim for further emission reduction;
to establish a strict control system for checking the compliance of emissions of exhaust gases with the established emission standards;
to establish stricter requirements for imported and existing motor vehicles with regard to their emissions;
to reduce the emission of organic volatile compounds by 50% compared to the 1990 emission level;
to reduce the use of ethylized petrol by 80% compared to the 1995 consumption level;

Tasks by the year 2005:
to meet the EU air quality standards;
to reduce the emission of sulphur compounds by 80% compared to the 1980 emission level;
to reduce the emission of solid substances by 25% compared to the emission level of 1995;
to terminate the use of ethylized petrol;
to terminate the use of diesel fuel with a sulphur content in excess of 0.05%.

Tasks by the year 2010:
to ensure that emissions of polluting substances do not exceed European Union standards.

5. Reduction in Waste Generation and Improvement of Waste Management

Goal: to support sustainable use of raw materials, to reduce waste generation, to stimulate waste recycling, to reduce environmental pollution caused by waste, to reduce areas contaminated by waste, to improve waste management (especially hazardous waste management).

The choice of solutions for improving the waste management system should be based on the following list of priorities:
prevention of waste generation;

reduction of generated waste volumes and decrease in their hazardousness;
increase in the quantity and scale of recycled wastes:
reuse of waste; recycling of waste use of biological processes (composting);
energy production (combustion).
consideration of environmental safety and requirements in waste treatment;
environmentally safe disposal and final disposal of waste.

Tasks by the year 2000:
to stabilize waste generation in industry and in households at the 1995 level;
to appoint owners/operators for existing landfills and to close down landfills which do not have an owner/operator;
to increase the degree of waste recycling to 30% - 40%;
to establish new landfills and close down old disposal sites in accordance with the requirements of the European Union;
to dispose 40% of municipal waste in accordance with environmental and health protection requirements;
to introduce a hazardous waste management system;
to develop a programme for radioactive waste treatment and to ensure environmental safety of the existing disposal sites;
to achieve compliance monitoring concerning all waste generators.

Tasks by the year 2010:
to improve disposal methods and the use of oil-shale processing waste;
to increase the share of waste recycling to 50%;
to stabilize municipal waste generation at an annual level of 250 - 300 kg per person;
to optimize the number of municipal landfill sites (up to 150);
to treat, dispose and dump all wastes according to internationally accepted environmental and health protection requirements;
to reduce the share of hazardous waste in the total waste volume;
to construct a radioactive waste storage facility that meets European Union requirements;
to offer waste management services all over Estonia.

6.Elimination of Past Pollution

Goal: to eliminate past pollution caused by closed down sites and to recultivate disturbed landscapes.

To achieve this goal it is necessary:
to establish by law the liabilities of the site owner for environmental pollution and damage as well as the responsibility to eliminate past pollution in the case where ownership changes;
to eliminate past pollution posing a threat to the environment which has been caused by industrial and military activities;
to prevent migration of pollutants into the environment from industrial waste disposal sites (enrichment waste, ash and semi-coke dumps) and
municipal landfill sites;
to recultivate areas disturbed by the mining industry, to create aesthetic artificial landscapes and establish preconditions for restoration of soil fertility of the disturbed areas;

to curtail the expansion of areas prone to mining subsidence and decrease the volume of mining waste, apply open cast mining as much as possible.

Tasks by the year 2000:
to prepare an inventory of past pollution originated from abandoned military sites, industrial enterprises and municipal landfill sites and to assess their environmental risks;
to localize past pollution of soil in areas where it poses a direct risk to ground water and human health;
to recultivate areas disturbed by mining activities according to projects drawn up in compliance with established procedures.

Tasks by the year 2005:
to decommission and recultivate abandoned quarries;
to prevent migration of pollutants from currently operating industrial waste depositories and municipal landfill sites into the soil and into surface and ground water;
to recultivate abandoned industrial waste depositories and municipal landfill sites.

Tasks by the year 2010:
to ensure isolation of past pollution sites which are of enhanced environmental risk.

7. Better Use and Protection of Ground water Supplies

Goal: to ensure good quality ground water supplies as well as their sustainable use and protection.
To achieve this goal it is necessary:
to introduce sustainable ground water exploitation systems in regions of ground water deficit;
to minimize losses of ground water in extraction, distribution and consumption;
to improve ground water protection, to eliminate local past pollution and the existing pollution sources.

Tasks by the year 2000:
to reduce leakages in water supply systems by 50%.

Tasks by the year 2005:
to develop drinking water supply systems in small settlements (especially in the case of contaminated water intakes);
to ensure effective protection of the ground water formation area on the Pandivere Upland;
to eliminate the main sources of ground water pollution;
to localize areas with contaminated ground water;
to reduce the use of quality ground water in industry;
to increase the recycling of water.

Tasks by the year 2010:
to develop possibilities for the population to get quality ground water;
to eliminate leakages in water supply systems as far as technically and economically feasible;
to reduce the use of water per production unit.

8. Protection of Surface Water Bodies and Coastal Sea

Goal: to ensure ecological balance of surface water bodies and coastal seas, natural regeneration of fish stock and aquatic flora and fauna by rational use of water bodies.

To achieve this goal, it is necessary:
to introduce a countrywide scheme of rational use of water bodies;
to introduce rational use of water in industry and in households;
to ensure biological and, if necessary, chemical treatment of waste water contaminating the environment.

Tasks by the year 2000:
to bring the main municipal and industrial waste water treatment indicators (BOD, phosphorus etc.) in line with the recommendations of the Helsinki Commission (HELCOM) of the Convention on the Protection of the Baltic Sea Region Marine Environment.

Tasks by the year 2010:
to remove nitrogen compounds from the waste water of municipalities of over 5,000 inhabitants in accordance with the HELCOM recommendations in order to maintain ecological balance of water bodies sensitive to nitrogen content.

9. Preservation of Landscapes and Biodiversity

Goal: to ensure preservation of viable populations of local plant and animal species, natural and semi-natural communities and landscapes typical of Estonia.

Tasks by the year 2000:
to improve protection of plant and animal species, their habitats and landscapes in accordance with revised legislation, bearing in mind international agreements and European Union requirements;
to improve the existing network of nature reserves in accordance with EU recommendations in order to ensure protection of ecosystems;
to establish a network of forests protected according to nature conservation criteria thus ensuring preservation of all natural and semi-natural forest types and communities.

Tasks by the year 2010:
to establish a network of nature reserves corresponding to EU recommendations where zones of strict protection (strict nature reserves and special management zones) would cover up to 5% of the terrestrial area of Estonia.

10. Improvement of the Quality of Built Environment

Goal: to bring the state of the built environment into conformity with the principles of health protection and sustainable development.

Establishment and preservation of human and nature friendly built environment is both a slow and expensive process. To achieve this goal it is necessary to step by step and systematically direct the national economic, regional, agricultural, housing, etc. policies towards:
preservation of cultural landscape heritage;

promotion of country life as a life style;
encouraging industrial production in smaller towns and rural settlements;
promotion of energy and water saving in buildings;
promotion of construction requiring the use of less materials, including reduction of the use of non-renewable building materials;
prolongation of the lifetime of buildings and reduction of repair volumes;
demolishing of useless buildings or parts of buildings
and the recycling of demolition and construction waste;
reduction of noise levels;
promotion of construction of private houses;
increasing the number of green areas in towns and other settlements and attaching more value to the aesthetic aspects of the built environment.

Tasks by the year 2000:
to work out a renovation programme for large panel houses proceeding from the principles of sustainable development;
to draw up an action plan for exploitation, preservation and maintenance of agricultural landscapes.

Tasks by the year 2010:
to bring manufactured, marketed and utilized building materials into compliance with modern environmental and health protection requirements;
to work out modern building norms and regulations harmonized with those of the EU.

INSTRUMENTS FOR SUSTAINABLE USE OF NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT

Environmental Legislation

By the end of 1995 about 70% of all legal acts necessary to regulate the use of natural resources, environmental protection and spatial planning in Estonia had been adopted, were in the process of being adopted or drafted.

In future primary emphasis will be placed on efficient organization of the legislative process, systemisation of legal acts and implementation of necessary measures for integration to the EU.

To achieve this goal it is necessary:
to cover unregulated areas gradually with legal acts;
to integrate relevant environmental requirements into economic and social legislation;
to draw up and harmonize legal acts as required by the White Book by 1997;
to carry out analysis of legal acts in order to identify contradictions, variances and imbalances, and
to propose amendments to current legislation;
to establish environmental liabilities;
to approximate Estonian legislative acts to those of the EU and integrate them into an Environmental Code by 2005.

Institutions

For the purpose of the National Environmental Strategy, institutions include public or municipal institutions and organizations dealing with environmental management.

The present institutional system was developed in the late 1980s and early 1990s. In principle, it consists of an institutionally and geographically dispersed management system. Environmental management institutions follow administrative regulations valid in Estonia.

The environmental management system includes: Riigikogu (the Estonian Parliament) - the highest legislative body;
Government of the Republic of Estonia - supreme executive body.
Ministry of Environment - higher executive body on the territory of the Republic of Estonia carrying out national environmental policy and communicating with other states and international environmental organizations.

The administrative field of the Ministry includes:
environmental management, landscape and biodiversity protection at the national level - activities connected with land, construction and regional planning;
management and protection of natural resources and keeping of relevant registers;
organization of supervision of the use of natural resources, environmental protection and building activities as well as of the use of environmentally hazardous substances;
guidance in the field of weather forecasting and geodetics as well as in the organization of research in the fields of geology, building, nature, inland and marine waters;
management of cadastres for natural resources.

By 2000, the environmental administration and supervision system will be regulated at the national level. Establishment of five regional services instead of the current environmental departments in the county authorities will be considered. The Ministry of Environment will be reorganized. In future, the tasks of the Ministry will include legislation, coordination of implementation of environmental policy and development activities, international environmental cooperation and
communication with other ministries and the public. The various boards will be responsible for the implementation of the environmental policy.

The objectives of this Environmental Strategy can be achieved only in cooperation with other Ministries; consensus has to be reached in decision making and cooperation in the activities related to environmental protection within their areas of jurisdiction. It is
essential to prevent overlapping or unregulated spheres
of activities. The Ministries active in the areas of considerable impact on the environment (transport and communications, economy, agriculture) will establish structural units dealing with environmental issues. In
order to ensure smooth cooperation with the Commission f the European Union, clear division of functions between the Ministries of the Environment and Social Affairs (health protection) will be considered.

With the development of the Estonian economic and administrative system, the role of the municipalities will gradually increase. In the process of regulation and improvement of legislation, this means that more attention will be paid to precise specification of

obligations, rights and liabilities of municipalities. This in turn will require the establishment of environmental units at town and local government level.

In order to solve the problems on the spot, an environmental management system will be introduced at enterprise level, thus providing for a better occupational safety and working environment.

The demand for public participation and the growth of environmental awareness significantly increase the role of non-governmental and public organizations, citizens' associations and individual citizens in environmental protection. The state supports the implementation of this requirement.

Gradually, an independent ombudsman for pre-court and formal resolution of environmental disputes will be established as well as an environmental court within administrative court system.

Anticipative Instruments

The most significant anticipative instruments applied to prevent environmental damage are planning, environmental impact assessment and environmental auditing. Other measures include risk assessment, reduction and prevention as well as assessment of the efficiency of environmental management.

Spatial Planning

Planning together with environmental impact assessment is one of the most significant and complex instruments in shaping the environment.

Spatial planning is carried out at four levels. The purpose of strategic planning (state master plans, county plans, general plans of local municipalities and towns) is to balance territorial, economic, social and environmental as well as individual and general interests. The purpose of detailed planning is to prepare building and development activities while considering possible environmental impacts. While
influencing public opinion as well as training of administrative officers, specialists, interest groups and public, e.g. shaping public preferences, special attention is paid to the introduction of transparency and democratic requirements.

Cooperation between different planning and administrative institutions will be improved. When considering the international integration of the
Estonian economy and the issue of transboundary pollution, international and multinational planning is becoming gradually more and more important.

The balancing of environmental and economic interests is the main task in drafting the Estonian strategic plan (Estonia 2010) and county plans. The latter will be ready in 1998. Revision of earlier plans will be finalized in 1996.

Strategic plans for communes are a prerequisite for balanced development. The elaboration of these plans is supported by the state. They should be ready by 2005.

Environmental Impact Assessment and Environmental Auditing

The most effective measures in the prevention of environmental damage include consideration of environmental impacts at the earliest possible stage of the decision-making process, and the monitoring and assessment of these impacts.

Environmental Impact Assessment (EIA) is the obligatory assessment of the compliance of proposed activities with environmental requirements and principles of sustainable development in the preparation of decisions which have an impact on the environment and in order to assist in finding an optimum solution. EIA is also a mandatory part of the environmental permitting procedure in terms of use of nature, pollution and construction.

Until 1997, EIA will be carried out either by the Ministry of Environment or by Environmental Departments of County Governments depending on the size and environmental hazardousness of the facility. After the new EIA and Environmental Auditing Act which follows the EU directives and the principles of the convention on transboundary environmental impact has come into effect:
enterprises are responsible for carrying out EIA studies;
public participation in the EIA procedure is promoted through local authorities;
Ministry of Environment ensures that EIA procedure will be carried out before decision-making;
awareness of decision-makers, combined with public pressure, has to secure consideration of the EIA results.

The requirement for licensing of experts to perform EIA studies will be maintained as well as state control of EIA quality.

Environmental audit assesses whether the activities and management of an operating enterprise meet the requirements of environmental protection, good environmental practice and the main principles of sustainable development. Environmental auditing should develop into an integral part of the environmental management system at the enterprise level. Environmental auditing must be mandatory in privatization (it is recommended in the case of other changes of ownership), for environmentally hazardous facilities, and where there is systematic violation of environmental requirements and when applying for public investments and loans.

A new system for assessment and management of environmental risks will become an integral part of EIA and environmental auditing.

Regulatory Instruments / Environmental Quality Requirements and Standards

Environmental normatives, which establish quality requirements for environmental media, take primarily into consideration human health (environmental quality requirements) and limit values for pollution sources (emission normatives), are implemented in environmental
protection.

Environmental quality requirements (control values) in Estonia, as of January 1996, were established for ambient air, drinking water, ground water and soil. Quality requirements for noise, vibration, radiation and
sludge are being prepared.

Emission normatives have been established for wastewater and exhaust gases of vehicles. The latter as well as the valid normatives for the noise level of motor vehicles correspond with those of the EU. Emission normatives for pollutant concentration in wastewater will be harmonized
step by step with those of the EU, according to their environmental and economic importance and taking into account the specific character of the Baltic Sea Region. When establishing discharge limits for air and water pollution sources the EU emission normatives per production unit will be introduced step by step.

The number of substances to be controlled has been reduced and most of the normatives have become more realistic compared to those of the former Soviet Union. Many normatives are equal to, or more stringent than, those of the EU (e.g. relevant normatives on wastewater purification corresponding to HELCOM recommendations and securing the ecological balance of the Baltic Sea). The environmental standards valid in Estonia as of 1996 are outdated and need to be reviewed. Until now, standardization activities in the environmental sphere have been limited to checking environmental aspects of product standards. In future, work of environmental laboratories (sampling, methods of analysis) will be regulated by standards. The same applies to the introduction of environmental management systems in enterprises, undertaking of environmental audits, qualification requirements of auditors, assessment of effectiveness of environmental management, analysis of product life cycles, establishing of criteria for ecolabels and other matters of "good housekeeping".

Before 2010, about 350 various environmental standards of the International Standard Organisation (ISO) and the European Standard Committee (CEN) have to be introduced. International and regional cooperation in the field of ecolabels will be developed and a common Baltic ecolabel system established.

Environmental Permits

Environmental permits for research activities, the use of environmental media or for activities affecting the environment are issued by regional environmental departments and the Ministry of Environment. The most important among these are permits for geological survey (research), mining of mineral resources, water permits, air pollution and waste permits. The latter three permit types stipulate emission and discharge limits for enterprises. The permits are valid for up to five years.
In the case of mineral resources - up to 25 years and the provisions of the permit can be revised after five years. The process of issuing permits has to promote the introduction of cleaner technologies and sustainable use of natural resources. Thus, the current trend in issuing
permits is to rely more on the results of EIA and take into account the requirement for the introduction of the best available technology and best practices. Permits for fishing are issued by the Ministry of Environment, the governor and/or the local authority. Permits for hunting are issued by the operator of the hunting area. Felling permits for felling in state owned forests are issued by a forestry unit, in municipal forests - by the local authorities. Construction permits are issued by local or town authorities. Issuing environmental permits is a public procedure. Strengthening of supervision of compliance with the requirements established by permits is one of the priorities of the environmental management system. In the near future an integrated permit system has to elaborated.

This is one of the prerequisites for accession to the EU. The system ensures comprehensive consideration of environmental effects caused by the permit owner.

Supervision

Within the field of administration of the Ministry of Environment, liability for supervision rests with two boards (Land Board and Forestry Board), two inspectorates (Nature Protection Inspectorate, Marine Inspectorate), 16 nature reserve administrations, the Environmental Department of Narva and on the Environmental Departments of the county governments and Tallinn City. In the case the Board of Forestry is reorganized into a department of the Ministry of Environment, the Act on Administration will be amended and the Ministry will be vested with the right of enforcement in regard to third persons. In future, supervision will be mainly concentrated in two independent inspectorates: the Environmental Inspectorate (covering activities on the mainland and inland water bodies, as well as construction) and the Marine Inspectorate (covering the sea and inland border water bodies). Supervision of radiation protection will be conducted by the Radiation Centre. Inspectorates will be developed further into supervision bodies with the help of the staff of inspectors in Tallinn and in the counties (regions).

Economic Instruments of Environmental Management

The objective of using economic instruments of environmental management is to influence both producers and consumers to use natural resources in a rational way, to avoid pollution and waste generation as much as possible, to ensure better market conditions for environmentally sound products than for competing products which use more polluting and waste generating technologies. The main principles of using economic instruments are as follows:
all the environmental protection costs incurred throughout the life cycle (production, distribution, use, final disposal) of the product, environmental damage and the value of natural resources used should be included in the price of the product;
the revenue collected from the taxation of natural resources and environmental pollution will be used for solving environmental problems;
common rules proceeding from environmental requirements of free market principles are valid for different polluters and users of natural resources.
Economic instruments should include:
financial support from the state;
pollution charges the stimulative effect of which will be improved and exemptions not corresponding to free market requirements withdrawn;
charges for the use of natural resources;
differentiation of taxes for the purpose of environmental protection;
local taxes;
pledge system (pledges for recycling packages, car tires, car bodies, accumulators, batteries, motor oil, etc.);
environmental insurance (insurance for pollution risk).
State support is provided in the form of subsidies, dotations, soft loans, covering of loan interest, etc.

State support is based on cost-effect analyses and is granted to economically substantiated activities which are highly beneficial to the environment. In this case, the

state budget and non budgetary funds (Environmental Fund, Forest Fund, Fisheries Fund, etc.) will be used as financing sources.

In the short term, the state budget, the Environmental Fund and the Fund for Natural Resources will:
support local authorities in developing the technical infrastructure for environmental protection (at least 6% from the Public Investment Programme);
cover a part of the management costs of the existing waste water facilities in economically underdeveloped regions;
support treatment of hazardous and radioactive waste;
cover the costs related to elimination of past pollution (military pollution caused by the former Soviet army, past pollution on abandoned sites, past pollution transferred to state responsibility during the privatization process);
partially compensate for damage caused by protected species as well as for owner's lost revenue due to legal environmental protection restrictions.
At the same time, promotion of activities aimed at the prevention of waste generation and the introduction of environmentally sound technologies, including support to corresponding information and consulting centres, will take place.

The tax system in Estonia still has room for development in the field of promoting sustainable use of natural resources and environmental protection. In accordance with the socioeconomic development of the country and environmental requirements, the following measures will be gradually applied:
introduction of excise taxes differentiated according to adverse environmental impact and quality of the product (lead content in motor fuels, sulphur content in diesel and heating fuel, environmentally sound
cars);
introduction of excise taxes for environmentally hazardous products (disposable packages, detergents, fertilizers);
tax exemptions from income taxes, customs taxes and VAT.

In order to make the tax system more environmentally sound and to avoid increasing the general tax burden, the aim will be to introduce taxes which would be a source of income at the national and local levels and
would have a positive impact on the environment, and at the same time, would reduce income tax and VAT burdens. Such taxes could include an energy tax, tax for the use of roads, car tax, parking tax, waste tax, etc.

Environmental Information and Education

Assessment of the environmental status, existence and availability of information and active public support are the prerequisites for successful environmental protection.

Estonias natural resources have been relatively well studied. Information on their volume and status will be reviewed and made available to the public using modern tools. Gathering and dissemination of environmental information is oriented at:
identification of measures necessary to ensure sustainable use of natural resources and the solution of environmental priorities and problems;
providing public authorities and the population with qualitative and operative information and ensuring environmental safety;

providing necessary information for making decisions affecting the environment, supervision of implementation of these decisions and assessment of their effectiveness;
public participation and promotion of environmental awareness;
informing non-governmental and international environmental organizations.

In order to develop environmental values and to promote environmental education:
the role of the Ministry of Environment in educational work and in diversification of the forms and opportunities of advanced environmental training will be increased;
introduction of interdisciplinary environmental
education in secondary schools will start in 1997;
a general environmental protection course will be included in the curricula of universities, high schools and vocational schools; environmental education of landscape architects and spatial planners will be improved;
in order to increase the level of environmental education, a national network of advanced training will be established;
the level of education of environmental officers as well as local and municipal authorities will be improved;
the dissemination of information on environmentally sound technologies (clean technologies) will be organized;
a Public Relations Bureau will be established at the Ministry of Environment to promote public information;
the environmental aspect will be incorporated into consumer protection promotion in order to guide sustainable public consumption habits and nature conservation;
special attention will be paid to promoting public awareness of the unique values of biological diversity and the need for its protection;
international and national environmental documents will be made available and explained to the public.

Public Participation

Giving people an opportunity to participate in solving local and national environmental problems and to make corresponding decisions is a prerequisite for increasing public participation in environmental matters.
In order to achieve this, the following measures will be taken: results of environmental impact assessment studies, physical planning schemes, procedure of applying for and issuing nature use and pollution permits will be made available to the public;
the right and opportunities of the population to influence decision-making will be taken into consideration and rendered possible;
establishment of nonprofit associations and other non-governmental structures dealing with environmental protection will be supported;
incentives to motivate the public, such as environmental competitions, bonuses, etc. will be used more actively.

Information and Accessibility

Accessible and reliable information necessary for decision-making is based on monitoring systems and is provided by the institutions dealing with environmental information.

Environmental monitoring will be carried out and coordinated by enterprises, local authorities and the state according to their competence. The Information Centre of the

Ministry of Environment will collect and analyse monitoring data and environmental information.
Thereafter, it will draw up information bulletins and systematically inform the Ministry, county and local authorities of emergency situations and important trends.

The public will be systematically informed about the state of the environment, given operative information about threats to the environment and ways of acting in emergency situations. Environmental information has to be available also on territories administered by military structures.

A system facilitating the use of environmental indicators will be introduced. Dissemination of environmental information through the Internet will increase.

Currently, cooperation and exchange of information with the European Environmental Protection Agency is being developed via the EIONET information network.

CONCLUSIONS

The introduction of Estonia's environmental policy through implementation of this environmental strategy means restoration and preservation of a living and cultural environment which ensures:
environmentally sustainable use of the nature historically traditional for Estonia;
preservation of biological and landscape diversity;
consideration of nature conservation requirements in privatization of assets and in carrying out land reform;
that the public is informed about the decisions taken, projects drawn up and work undertaken;
prevention of environmental damages;
finding solutions to environmental problems as close to the sources as possible.

These tasks are to be solved by the entire society - from the legislative powers to every single individual.

NEAP 2001-2003
SUMMARY

INTRODUCTION

In 1997, the Riigikogu approved the Estonian National Environmental Strategy, which defines ten priority goals of the Estonian environmental policy:

(1) stimulation of environmental awareness and environmentally friendly consumption patterns;
(2) promotion of clean technologies;
(3) reduction of the environmental impact of the energy sector;
(4) improvement of air quality, including reduction of transport emissions;
(5) improvement of waste management, reduction of waste generation, stimulation of waste recovery;
(6) clean-up of past pollution;
(7) sustainable use and protection of groundwater resources;
(8) protection of surface water and coastal sea; rational use of water bodies;
(9) preservation of landscape and biological diversity;
(10) modification of the built environment in line with human needs and environmental health requirements.

To attain these goals, the first Estonian National Environmental Action Plan (NEAP) was drawn up and submitted to the Government. The NEAP included both short-term (for 1998 - 2000) and long-term (2001 - 2006) actions. With its recorded decision of 26 May 1998, the Government of the Republic assigned the Ministry of Environment the task of organising the implementation of the NEAP and the relevant progress monitoring as well as arranging for the Plan to be revised periodically, with a three-year interval.

In accordance with the above decision, the Ministry of Environment has prepared annual progress reports on the implementation of the NEAP. The progress report on the year 2000 and summary information on 1998 - 2000 were submitted to the Government in May 2001 along with the revised NEAP. For drawing up the NEAP for 2001 - 2003, ten working groups were established, one for each priority goal of the National Environmental Strategy. The working groups were headed by experts from outside the Ministry and included the representatives of both the public sector (including other ministries) and the non-governmental sector, enterprises and the scientific community. The actions in the revised NEAP were drawn up on the basis of actions contained in the existing NEAP, taking into account the proposals from Working Group members and advisors and from the more than 250 participants in the Environmental Forum held in autumn 2000. In January 2001 the preliminary action tables of the revised NEAP were open for comments and proposals also on the Internet home page of the Ministry of Environment.

The main aim of the NEAP process is not only to draw up the Action Plan but also to implement the necessary actions defined therein so as to achieve the objectives set in the National Environmental Strategy. This is possible only in mutually considerate and supportive co-operation between all stakeholders, taking into account the feedback from implementation of the Plan. The Estonian National Environmental Action Plan for 2001 - 2003 was approved by the Government of the Republic on 5 June 2001 by its recorded decision No. 25.

PURPOSE OF THE NEAP

Development and updating of the NEAP is a continuous process of setting national environmental priorities and translating them into specific actions, considering the need for sustainable use of natural resources and the principles formulated in the Environmental Strategy. The NEAP reflects the priorities of the public in regard to environment-related actions, which were identified through broad discussions and consultations and through making the NEAP process public. The priorities take into account the costs of implementation of the actions along with the available resources and funding possibilities, as well as the division of responsibility for implementation of the actions. The NEAP is drawn up for a three-year period and, as such, reflects the changes in the Estonian society and economy.

The NEAP is a useful tool for environmental decision-making and for planning of environmental expenditures. The primary purpose of the NEAP is to present a consensus-based long-list of environmental actions of national priority, indicating also the funding possibilities and priority ranking of the actions.

The NEAP is also useful for: shaping the future allocation of resources from the State Budget, Public Investment Programme, Centre for Environmental Investments, local budgets, and also by enterprises and foreign donors; informing financing agencies of priority actions in the field of the environment; translating the actions into concrete projects.

The NEAP also provides a platform for intra-sectoral and inter-sectoral co-ordination at the programme and policy level and constitutes a tool for communication between the Government and stakeholders, providing: information on the broad agreement reached between different stakeholders in regard to needed environmental actions; a "reference book" for preparation of environmental programmes and projects as well as cross co-ordination of programmes between different agencies, organisations, enterprises and local authorities; a co-operation and consensus building platform for Estonian stakeholders and interest groups, stimulating the development of a democratic society.

METHODOLOGY

The NEAP of 2001 was drawn up following, in the main, the methodology used for developing the NEAP of 1998. The latter was revised and specified at expert meetings prior to the Forum. The methodology follows international experience gathered in the process of implementing the Environmental Action Programme for Central and Eastern Europe (approved in Luzern in 1993) and guidance generated in the development and implementation of National Environmental Action Programmes in a number of CEE countries. The methodology covers the entire NEAP life span from the development of the document to its implementation, monitoring and revision. The methodology has been reviewed and agreed by all parties involved in the formulation of the NEAP.

Management structure and timetable of preparation of the NEAP

The NEAP was drawn up in co-operation between the participants in the Environmental Forum, members of Working Groups, advisors, economic experts and the Management Team. The Environmental Forum was open for participation to all interested persons; information on the convening of each Forum, including the agenda, was disseminated in both the printed and electronic media.

The Forum was convened twice during the revision process of the NEAP - on 22 November 2000 and on 21 March 2001. Written invitations were sent to all participants in the previous Forums. The NEAP Management Team:
managed the drawing up of the NEAP;
co-ordinated the activities of the Working Groups and their communication with advisors and economic experts, ensured the meeting of deadlines, and informed the Working Groups of the work plan and of changes therein;
provided the Working Groups with methodological guidance materials;
organised the compilation of the consolidated NEAP, unification of its format, language editing, translation, publishing and public disclosure;
organised the submission of the NEAP to the Government for approval.

Ten Working Groups were established according to the ten priority goals of the Estonian environmental policy:
Stimulation of environmental awareness and environmentally friendly consumption patterns;
Promotion of clean technologies;
Reduction of the environmental impact of the energy sector;
Improvement of air quality, including reduction of transport emissions;
Improvement of waste management, reduction of waste generation, stimulation of waste recovery;
Clean-up of past pollution;
Sustainable use and protection of groundwater resources;
Protection of surface water and coastal sea; rational use of water bodies;
Preservation of landscape and biological diversity;
Modification of the built environment in line with human needs and human health requirements.

Each Working Group consisted of 8 to 15 experts. The composition of the Working Groups was approved by the Management Team after the Forum. It was possible to make changes in the composition of a Working Group in case some of the members failed to provide adequate contribution to the work, or in case a need to involve new experts emerged. Changes to the composition of a Working Group could be proposed by the leader or members of the Working Group or by the Management Team.

Responsibility for adequate fulfilment of the tasks of a Working Group lay with the Leader. Candidates for the position of the Leader were proposed by the NEAP
Management Team and approved by the Working Group concerned. The organisation of work within each Working Group was agreed between the Working Group members. The task of each Working Group was to define the actions necessary for attaining the goals of the Environmental Strategy and to select and prioritise these actions on the basis of criteria proposed by the Forum and discussed at the Seminar. In drawing up the Action Plan, the Working Groups had to follow the format provided by the Management Team and the foreseen deadlines, which were co-ordinated beforehand with the Working Group. The Working Groups co-operated with advisors and economic experts. Two Seminars of Working Group Leaders and experts were held during the preparation of the document, in order to ensure that uniform methods and principles are followed and to avoid overlapping of actions. Economic experts provided guidance to the Working Groups in estimating the costs of actions and in identifying the sources of financing; worked out the format of the table of actions along with the guidelines for filling in the table; continuously monitored the

process of drawing up NEAP within their assigned Working Groups and participated in Working Group meetings;
co-operated with the Working Groups in economic assessment of actions;
prepared the financial plan of the NEAP, including a summary table of financing needs, status of financing, and division of costs between different sources of
financing;
specified the methodology for progress monitoring of NEAP implementation.

Each Working Group was assisted by advisors whose task was to make proposals to the Working Groups in drawing up the Action Plan and to review the draft tables of actions. The advisors presented their proposals and amendments to the Leaders of Working Groups either directly or through the Management Team. The Working Groups were advised to involve advisors throughout the entire process of drawing up the Action Plan.

The NEAP Committee consisting of five representatives of non-governmental organisations and of five representatives of the Ministry of Environment (the Secretary General and Deputy Secretary Generals) reviewed the NEAP before its submission to the Government for approval.

The process of development of the NEAP November - December 2000 Short-term actions of the NEAP (1998) that had not been implemented during the foreseen period (1998 - 2000) were analysed to ascertain those that were still considered necessary, had lost their importance, had been completed, etc., and new actions were added as appropriate. Decisions to exclude or add actions (compared to the 1998 NEAP) or to transfer actions to the new NEAP were supported with motivations. Environmental actions proceeding from the international obligations of Estonia (conventions, international agreements, EU accession) and national (sectoral) plans and strategies were also reflected in the NEAP.
January 2001. The designed actions were consolidated into the format provided by the NEAP Management Team. The draft NEAP was presented to the NEAP Management Team, who forwarded it to the economic experts and advisors for their comments and amendments.
February - March 2001. Proposals made by advisors and economic experts, and also received as feedback from public disclosure of the draft NEAP, were analysed and taken into account in the document as appropriate. Decisions on taking account the proposals from advisors were made by the Working Groups. Each Working Group presented its section of the Action Plan at the Forum.
April 2001. Amendments agreed at the Seminar of Working Group Leaders and economic experts were incorporated in the NEAP. The final NEAP was prepared in accordance with the established format and requirements.

Informing of the public during the process of drawing up the NEAP

As the process of developing the NEAP and participation of various stakeholders therein were seen as equally important with the NEAP document itself, the public was consulted during the entire process of drawing up the NEAP, using a number of different ways and channels of communication. Participants in earlier Forums were informed directly, by means of electronic mail, of the commencement of drawing up the NEAP 2001 - 2003 and of the Environmental Forum held in November 2000, while the broader public was informed thereof through both the printed and electronic media. The invitation, agenda and registration form of the autumn and spring Forum were available to all interested persons also on the Internet home page of the Ministry of

Environment, which also presented the Terms of Reference and the management structure of NEAP preparation. The Environmental Forum: proposed new sub-goals and actions; supplemented the criteria for assessment of actions; approved the methodology for drawing up the NEAP; raised awareness of the need for environmental actions among the circles represented at the Forum and among the general public; and discussed the division of roles between different sectors and parties in implementation of the NEAP. The preliminary version of the NEAP was available to all interested persons, for submission of their comments and proposals, on the Internet home page of the Ministry of Environment for two weeks in January 2001. It was possible to receive this version also from the Department of Strategy and Planning of the MoE by electronic mail.
An overview of the NEAP action tables, with the received proposals incorporated, was presented to the Environmental Forum held in March 2001. Group work at the Forum focussed on discussing the various issues related to implementation of the NEAP: the roles of different parties in implementation of the NEAP and changes to be made to the process of developing the subsequent action plans and strategies. The NEAP document approved by the Government, along with other materials presented in this publication, is available to all interested persons on the MoE home page www.envir.ee under the link "National Environmental Action Plan".

Drawing up of the Action Plan tables

The actions listed in the NEAP were designed by the Working Groups in co-operation with the advisers, the Forum, economic experts and the Management Team. Designing of actions was based on the general principles underlying the Environmental Strategy. The policy goals of the Strategy were broken into policy objectives and the latter were translated into specific actions, which were set in clear time-frames and their relations with other actions in the NEAP were indicated. Drafting of the actions was a multi-stage iterative process of co-operation between different parties. The actions were presented in a uniform format that allows a comparison of the key aspects of the actions planned. Modification of the current NEAP as compared to the NEAP of 1998

In developing the format of the NEAP tables, economic experts and members of the Management Team used the model of the NEAP of 1998 as a basis, complementing it with a few additional aspects necessary for further analysis of the actions (expected outputs, motivation of need for the actions). These more detailed action tables also allowed a deeper insight in each action, as they required the Working Groups to be more specific in defining the actions. Many of the members of the Working Groups already had experience from drawing up the previous NEAP, which ensured a smooth process of gathering the necessary information. Also, as the

Working Groups were well informed about the information requirements, they were disciplined to address each individual action in detail, and later inquiries concerning each separate aspect could thus be avoided. Sufficient information provided before the filling of the tables, along with close co-operation with economic experts, helped the Working Groups to successfully perform the assigned tasks.

The requested information on expected outputs and on motivation of need for the actions enabled the Working Groups to carry out a prior assessment of individual
actions and to exclude many initially attractive actions. In the new table format, one and the same action was no longer classified as both a short-term and long-term action, since all actions were regarded as short-term actions. Instead, the estimated total cost of actions(yearly repeated actions

were marked as “continuous”) and the cost of actions for the coming three years were introduced and broken down into investments and running expenses.

It was decided not to include the component of labour expenses in the tables. As an outcome of the financial analysis, each Working Group prepared a cost calculation for each action within their scope, with labour costs being included in running expenses. The actions were no longer presented in the order of their relative weight but simply arranged in a logical order by policy objectives. This resulted in a better and more logical arrangement of actions, which, in its turn, provided a better precondition for cognition of the essence and logic of the National Environmental Strategy and Action Plan.

The prioritisation criteria were applied in accordance with the relevant methodology developed for drawing up the NEAP of 1998. The prioritisation methodology was specified at the expert meeting held prior to the Forum, and its final version took into account the proposals made by the Forum working groups. Each action was attached a relative weight using a special weighting and scoring system, which was previously specified at the Forum and the Seminar.

As a result of these modifications, the format of the NEAP tables became more transparent and detailed in respect of individual actions.

Implementation of the Action Plan and monitoring of implementation

The NEAP process is not limited to the drawing up of the Plan itself but includes among its integral components also the implementation of the Plan as well as monitoring of implementation progress to receive the feedback necessary for making environmental policy decisions, for further specification of the NEAP and for drawing up of the next NEAP. The preconditions for efficient implementation of the NEAP are as follows:

- well formulated projects;
- clear time-frames and responsibilities;
- realistic financial plan,
- identified sources of funding;
- sense of ownership by the parties concerned;
- continuation of the process management beyond finalisation of the document.

These preconditions for successful implementation have been gradually built in the NEAP. The NEAP process continues as a series of repeated cycles of implementation, monitoring and development/review.

Financial Plan

The funding needs of the actions included in the NEAP 2001-2003 are estimated at 11.81 billion EEK. The various actions of the NEAP will be financed with involvement of domestic as well as international budgetary and non-budgetary sources of funding, including the non-profit sector, enterprises' own funds and loans. Most of the NEAP actions will be carried out with combined funding from several different sources. The existing and/or potential sources of funding have been identified for each action. For the purposes of assessing the funding status of actions, it has been indicated whether the necessary financial resources are secured, targeted or sought.

In the case of actions with secured funding, financial resources will be either allocated from the state budget, foreign sources, under international agreements or in accordance with investment plans of enterprises. In the case of targeted funding, financial resources are likely to be allocated from the sources identified. As the state budget is adopted on an annual basis, budgetary funding of the actions planned for 2002 and 2003 cannot be regarded as secured.

Actions with sought funding include either actions whose funding is not secured or actions for which the funding sources are yet to be identified.

In total, investments constitute 90% and running expenses (including labour costs) 10% of the total cost estimated for the years 2001 - 2003. This ratio differs greatly between the Working Groups: in the case of actions designed by WG1, WG9 and WG10, running expenses form 97%, 96% and 92% of the total cost, respectively, while the actions designed by other Working Groups will be financed predominantly through investments.

Summary of the actions planned

The current NEAP consists of 507 actions, which are classified on the basis of the ten policy goals of the National Environmental Strategy (policy goals/Working Groups are listed in the Introduction). Remarkable differences became apparent during the comparison of the summary data of actions designed by different Working Groups (WG).

The actions in the NEAP tables are classified as economic, legal, technical, institutional, science-related or educational and training-related actions. However, such classification does not provide a good basis for an in-depth analysis of the actions. Therefore, economic experts in co-operation with the
Management Team developed a new classification, according to which the actions are classified as follows:
preventive actions;
prevention/avoidance of environmental damage and pollution (e.g. introduction
of cleaner production technologies in enterprises);
clean-up actions;
reduction or clean-up of unavoidable or already generated pollution; such actions mitigate or reduce the volume of pollutants or their impact on the environment (e.g. construction of waste water treatment plants);
restoring actions; elimination of pollution generated or damage caused in the past, or mitigation of the impact of such pollution or damage on the environment(e.g. rehabilitation of spoil dumps or closed landfills);
monitoring; actions related to measurement and mapping of the state of the environment (e.g. monitoring of ambient air quality);
regulative actions; legislative acts or actions otherwise associated with environmental management (e.g. development of an accreditation system).

This new classification reveals the substantive priorities of the NEAP and provides a new dimension for understanding the essence of the NEAP and for further analysis of the document.

The most expensive of the designed measures are the actions aimed at mitigating the negative environmental impact of the energy sector and at improving the quality of ambient air and the state

of surface water, while the total cost of the actions designed to promote environmental awareness, to create a more environmentally friendly built environment and to preserve landscapes and biodiversity constitutes only a small per cent of the total cost of all the actions in the NEAP. At the same time, the actions in the latter fields are relevant to prevent a continuous increase in expenditures required for improving the state of the environment in the future.

It is also important to emphasise that the actions included in the NEAP do not reflect the present distribution of financial allocations between different fields of activity, policy objectives and actions. Being the Working Groups' estimates for the costs of priority actions needed to meet the objectives set under their respective policy goals, they reflect rather the different magnitudes of funding that one is typically used to in the different fields of activity.

The NEAP includes a large number of different types of action, e.g. drafting of legislation; introduction of economic instruments; improvement of the state of the environment; drawing up of management plans; infrastructure projects; investments in clean technologies, education and in-service training institutional strengthening and in campaigns to promote environmental awareness, etc. Within each particular policy goal, the highest weights were attached to the following types of action:
WG1: improvement of availability of environmental information; improvement of the quality of, and promotion of, environmental education and in-service training;
WG2: drafting of legislation; development of economic instruments; testing and application of ecological solutions;
WG3: investments in reduction of emissions and in introduction of renewable and alternative energy sources;
WG4: actions associated with drafting of legislation and implementation of international agreements;
WG5: amendment of legal acts; establishment of new and closure of old landfills;
WG6: ensuring of safety of contaminated sites; rehabilitation of sites;
WG7: drafting of legislation; monitoring;
WG8: investments in water supply and waste water treatment;
WG9: raising of public awareness of nature conservation issues; management plans; maintenance works;
WG10: development of measures for shaping the built environment.

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WG10: development of measures for shaping the built environment.

ANNEX III

PIC Estonia Ltd.
Maves Ltd.
Merin Ltd.

Closure of ash field No. 2 with water ponds at Balti Power Plant.

Feasibility Study

Tallinn 31.01.2002

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1 Summary

Balti Power Plant is the second largest (by power) power plant in Estonia, after the Eesti Power Plant. It was built in 1959-67. It is powered by oil shale combustion, which produces approximately 2 million tons of oil-shale ash a year. Ash is disposed into the Ash Field No. 1 as slurry in water. The Ash Field No. 2 has not been used for ash disposal since 1987. It has been used as an evaporation area for the excess settled water from the lakelet of the Ash Field No. 1.

The Ash Field No. 2 is a technogenous landform of rectangular shape, with relative height 5 – 21 m and steep slopes. Its area is 576 ha, of which the ash-stone heap occupies 406 ha and the lakelet at the southern side 170 ha. The engineering structures of the ash field are 12 ponds of the evaporation cascade, water lines, lakelet (so-called "Lake Green"), perimeter ditch of the ash ash-stone heap and a hydro technical installation together with pumping station for the settled water.

Narva Power Ltd. has decided to close down the Ash Field No. 2 of the Balti Power Plant. The enterprise wants to rid itself from the environmental hazards and problems of the ash field, especially its frequent discharge of alkaline water to cooling water channel leading to the Narva Reservoir at the Estonian-Russian border.

Many options were discussed for this feasibility study. After the initial evaluation of different options for turning the ash field into an environmentally safe one, three options were selected.

The search for closing options and the assessment of the suggested ones was based on the fact that there was but little time (max. 2 years) for getting rid of millions of cubic metres of highly alkaline ash water in the evaporation ponds and "Lake Green". The only solution is to lead the ash water into a purification unit where the pH of the alkaline water is neutralized before discharging into surface water.

Option 0 means that the current ash water circulation at the installations of the ash field will be continued. The alkaline water of the ponds of the evaporation cascade is discharged into the environment periodically. This option contradicts the Decision of the Ministry of Environment's Environmental Service of East-Viru County, of 19 December 2001 on Closure of the Ash Field No. 2 of the Balti Power Plant.

Options 1 and 2 were developed in order to turn the ash field into an environmentally safe one, to keep that state and to employ the possibilities of its area. The basic idea of the environmental safety of both options is that as little rain water as possible should filtrate through the ash.

The result is that the pH of the water directed from the ash field into the natural environment will not exceed the maximum permitted level in the future.

Similar technical solutions will be used to realize both options:

1. A neutralizing plant for neutralizing water with high pH will be built;
2. The water from the ponds of the evaporation cascade will be discharged to the cooling water canal of the Balti Power Plant through the neutralizing plant;
3. "Lake Green" will be partially drained through the neutralizing plant, and turned into a wetland.

The future wetland will be formed by lowering the water level in "Lake Green" to the level of 27 m, two shallow lakes separated by a peat strip about 40-50 m wide will be formed then. After the effect of the ash water draining from the ash field upon "Lake Green" has stopped, the wetland will be subjected to the mitigating effects of both rainwater and the Kõrgesoo raised bog south of the lakelet.

Options 1 and 2 differ in the fact that Option 2 will solve the problem of safely disposing of the inert waste produced by the two power plants of Narva Power Ltd. in accordance with the EU directive 1999/31/EC on landfill of waste.

Option 1 call for landscaping the ash field, which will be drained and covered with a thin layer of topsoil, with herbaceous plants. After this, only monitoring and maintenance will be carried out in the former ash field.

Option 2 calls for landscaping the ash field, which will be drained and covered with topsoil, in zones for forest, herbaceous plants and an area for controlled inert waste landfill. Landscaping with alternating zones of herbaceous plants and forest creates the conditions for formation of the biotope characteristic to covered ash fields (meadow grass and silver birch). In Option 2, the first stage of the inert waste landfill will be laid.

During maintenance and monitoring, water quality (pH), water level in the lakes formed on the basis of the former "Lake Green", and the geotechnical stability of the ash-stone heap will be monitored. The task of the maintenance is to monitor the stability of the ash field cover and restoring the eroding areas as quickly as possible.

Discharge of alkaline water into bodies of water will be discontinued by this planned closure project. The volume of the water needing treatment will decrease in the future. Conditions for environmentally safe processing of the inert waste produced at the power stations near Narva will be created by founding a new controlled industrial waste landfill, which complies with modern environmental standards, to a small area of the closed ash field.

Options 1 and 2, as discussed in this study, are feasible.

2 Introduction

2.1 Background

Balti Power Plant is the second largest (by power) power plant in Estonia, after the Eesti Power Plant. It was completed, by different operational stages, in 1959-67. Its power for producing electricity is 1390 MW and for producing heat 505 MW. It is fuelled by kukersite oil shale; it produces waste (oil-shale ash) at the rate of 2 million tons a year (1995-99 average). Ash is disposed into the Ash Field No. 1 as slurry in water. The Ash Field No. 2 is not currently used for disposal; it is used periodically for treating settled water. The total area of the two ash fields and their sludge ponds is 10.4 sq km.

If compared to the Eesti Power Plant, the ash processing areas here are substantially larger for the same amount of ash. It is not practical to use ash fields with so large areas gathering rainwater.

Following the application of the Narva Power Ltd., the Ministry of Environment's Environmental Service of East-Viru County decided in late 2001 to close down the Ash Field No. 2.

Eesti Energia Ltd. has started a project with the aim of applying for the support of ISPA, the financing agency of the European Union, for closure of the Ash Field No. 2 of Balti Power Plant Ltd.

The aim of reorganizing the ash processing technology at the Narva Power Ltd. is to discontinue transporting ash as slurry in water. In future, ash transportation will take place as transport of solid powder or as dry ash removal. The general schedule for reorganizing the ash disposal has been presented among the documents of the environmental chapter of the accession negotiations with the EU. This project is one stage for decreasing the environmental impact of the ash processing at the Balti Power Plant. The aim is to complete the closure of the Ash Field No. 2 (planned ISPA project) by the end of the year 2005.

The document explaining the complete essence and purpose of this project, *Preparation of ISPA Application for the Project "Closure of Ash Field nr.2 with Water Ponds at Balti Power Plant) (ISPA Project Preparation, Environmental Projects (Solid Waste))* has been included as Appendix A of the Contract between AS MAVES and Narva Power Ltd. ***(see Appendix 0)***. According to the tasks presented in the project, first the technical feasibility study of closure options of the Ash Field No. 2 of the power plant will be carried out, reported in this document here.

The cooperating participants of the present study are Maves Ltd., PIC Estonia Ltd. and Merin Ltd., according to their joint tender presented to Narva Power Ltd.

During the project, written reports will be given monthly to the interested parties (to the supervision group):

Valdur Lahtvee, Eesti Energia Ltd, Environment Manager;

Arvo Tordik, Narva Power Ltd., Head of the Department of Environment Protection;
Rainer Rohesalu, Ministry of Environment, Head of the Department of Investments;
Ranno Mellis, Centre for Environmental Investments, coordinator for the ISPA programme.

2.2 Implementation

Visits to the area of the project and collecting material. Expert survey of the Ash Field No. 2 was carried out in October and November 2001. Management of the Narva Power Ltd. was met and the specialists of the ash disposal department of the Balti Power Plant were interviewed. In November 2001, the surveys of the ash field and projects kept at the Balti Power Plant were studied. In January, results of the environmental monitoring of the Balti Power Plant were studied.

Background information for the feasibility study was acquired mainly from the Balti Power Plant and Narva Power Ltd. In addition, documents of earlier studies were collected from the Environmental Service of East-Viru County, archives of Eesti Geoloogia, Eesti Ehitusgeoloogia and the National Land Board. The complete reference list is presented at the end of this document and more important background information is presented in the Appendices.

Starting the environmental impact assessment. Environmental impact assessment was launched as the following stage of the work, in accordance with the solution options presented at the first stage of the feasibility study. On this basis, cooperation is carried out with all interested parts, especially the Environmental Service of East-Viru County and the Department of Water and Waste of the Ministry of Environment.

Revision, unveiling and discussion of the options presented in the project. On 27 December 2001, presentation of the project and the public discussion of its programme for environmental assessment was held at Balti Power Plant, attended by the representatives of Eesti Energia Ltd., Narva Power Ltd., Balti Power Plant and the Environmental Service of East-Viru County. At the discussion, the current situation in the ash field was presented and several possible closure options were presented. On 11 January 2002, a discussion of the closure options of the Ash Field No. 2, as presented in the interim report in December, was held at Maves Ltd., attended by the experts and representatives of the Eesti Energia Ltd, Narva Power Ltd. and Ministry of Environment. Two main options (alternatives) of the project were suggested at the meeting. These two have been described in Section 5 of this report of the feasibility study. All options discussed within the project will not be discussed in detail in the presents document any more. An overview of the formation of variants has been presented in the interim reports in November and December. The representation of the options for closing the ash field and discussion of the technical and environmental feasibility was held on 17 January 2002 at the Balti Power Plant. The experts and representatives of Narva Power Ltd., the

Balti Power Plant and the Environmental Service of East-Viru County attended the discussion.

Supplementary studies. Within the scope of the present study, the following supplementary studies were carried out: supplementary topographic survey of the ash field; quality and chemical composition analyses of water samples from the water bodies in the area by various laboratories; hydro biological study of the water bodies; geological survey of the ash field and the lakelet; and a study of landscaping options.

The summary reports will be presented to the Customer as a separate volume. In the appendices of this report, the English summaries of studies, main graphic and factual information is presented.

The source material for the studies is stored in the archives of the general project manager, Maves Ltd. The more detailed material, such as manuscripts, extracts from projects and calculations has been stored in the archives of the consultants of respective aspects of the study.

3 Description Of Environmental Situation

3.1 Natural Conditions

3.1.1 Location And Bodies Of Surface Water

As a result of the construction of power plants, the landscape of this area has been transformed thoroughly. The natural situation before constructing the Narva Reservoir and founding the two large thermal power plants near Narva, the Balti and Eesti Power Plants, can be seen from a schematic map (see Map 3), drawn after the 1/25,000 scale topographic map of 1947. The Narva Reservoir was constructed in 1955-56. The founding of ash fields was started in the early 1960's. In addition to the Narva Reservoir, the part of the redirection channel of the Kulgu River close to the reservoir and the cooling water channel in its entire length are also depicted on the maps of 1960, but no ash fields are shown yet. The older ash field, No. 2, and its lakelet were founded in the early 1960's (the site was opened for ash deposition in 1964). The present situation of the area is presented on Map 1.

The absolute elevations of the area in the immediate vicinity of the Ash Field No. 2 and "Lake Green" are in the range of 25 – 29 m, the elevations in the ash field itself (according to the measurements of 1998) are in the range of 30 – 47 m and on the dam in the range of 33 – 49 m. Absolute elevations of the bottom of "Lake Green" are in the range of 25.2 – 28.5 m and the bottom of the lake descends towards west (towards the Kulgu River). In 2001, the absolute elevation of water level in "Lake Green" was in the range of 28.24 – 28.46 m; the result of the most recent measurement (12 Nov 2001) was 28.39 m.

In the area around "Lake Green", the level of surface water is determined by the water level in the Narva Reservoir, which is ca. 25 m above sea level. As the relief is plain and level, the influence of the water level in The Narva Reservoir extends through the two channels (the cooling water channel and the Kulgu Channel) to both sides of "Lake Green".

Both Ash Field No. 2 and "Lake Green" are situated on the North-Estonian Plateau, on the plain formed of local glacial lakes after the Ice Age. The ash field has been founded on the over moist mineral soil, on the left bank of the former Kulgu River. Before the power plant was founded, the Kulgu River flowed through what is now the territory of the plant, into the Narva River at the southern boundary of the city of Narva. At present, there is a lakelet extending below the southern slope of the ash field, the so-called "Lake Green", which has been formed on the swampy soil on the right bank of the lower course of the former Kulgu River. Because of the ash field, the Kulgu River has been redirected into the Narva Reservoir by a channel (see Map 1). "Lake Green" is surrounded by the Kõrgesoo raised bog from the south and by perimeter dams from the east and the west. Before the power plant was founded, peat was cut in the eastern part of the Kõrgesoo raised bog for heating the Kreenholm Factory in Narva; later this area was flooded by "Lake Green".

The nearest surface water bodies are the Kõrgesoo ditch ca. 100 m to the southwest, and the cooling water discharge channel of the Balti Power Station ca. 100 m to the east. Both the ditch and the channel flow southwards, into the Narva Reservoir. "Lake Green" is surrounded by the Kõrgesoo raised bog, covered with a dense network of ditches, which are connected to the Narva Reservoir.

About 0.5 km to the west of the ash field, on the left bank of the Kulgu River, there lays the Kõrgesoo village that consists of a few households; the closest households of the Arumäe village are located about 1 km from the north-western part of the ash field.

3.1.2 Geology

Description of the geological structure of the area is based on geological research carried out in this project **(see Supporting Materials No. 4)**, general geological mapping, research of individual objects and monitoring reports. A list of references is presented in the end of this report.

Topsoil thickness in the Ash Field No. 2 and near "Lake Green" (including technogenic sediments) is 4.4 – 22+ m; it consists of fill-up soil and oil-shale ash, peat, sandy loam, loam, silt, fine sand and sandy loam moraine. Below topsail, there are limestones of Lasnamäe (O_2ls) stratum.

The thickness of ash layer in the Ash Field No. 2 is 4 – 22 m; at the perimeter dams the thickness is up to 1.5 m higher. Ash bed consists of several layers. Often the character of the top layer (0.5 – 1.5 m thick) is that of sand or sandy loam; deeper, the solidified ash layer has the characteristics of coherent strata rocky ground (includes layers of different hardness and intermediate not coherent layers).

In the southern part of the ash field, the lowest ash layer (up to 1 m thick) is plastic [4]. The earth below the ash bed is peat (up to 0.5 m thick) in the southern part of the ash field, and soil under the northern part. Below both the peat and earth layers, there are limnoglacial sediments – sandy loam and loam, up to 3.8 m thick. Under these, there are glacial sediments, sandy loam moraine and gravel, up to 2.5 m thick. The limestone surface lays at absolute elevation of 19 – 26.9 m; it is higher in the northwestern part of the area and descending towards the southeast.

The earth under "Lake Green" was sounded from above the ice in January, within the frames of the present project. The deepest sounded soil layer is loam moraine, with binding to hard plastic consistency. On the top of the loam moraine, there is a layer of plastic loam in the bottom of the whole lake; the top surface of this layer lies at absolute elevation 25.5...22.5 m and descends towards the Kõrgesoo raised bog in the southeast. In the southern part of "Lake Green", there is peat on the top of the loam layer. The thickness of the peat layer increases towards the southeastern part of the lake, where the maximum thickness of the layer is 5.4 m.

Technogenic sediments consist of fill-up soil (disturbed loam, peat and soil), as well as ash deposits and lime sediments. The fill-up soil spreads in the northern part of "Lake Green" mostly north of the boundary of peat deposit. The thickness of the tehnogenic sediments layer is up to 3.3 m, decreasing towards south and southeast. This ground layer is geotechnically weak.

Ash deposit and lime sediments are missing only in the farthest southern and eastern parts of "Lake Green". The lime sediment is a very soft, almost a suspension and geotechnically weak soil. The thickness of ash deposit and lime sediment is largest near the middle section of the northern shore of the lake and near the pump house.

Sounding the possible ditch track extending southwards from "Lake Green" through the Kõrgesoo raised bog peat thickness of 2.7 – 5.3 m was measured. The peat deposit was observed to be of greatest thickness in the vicinity of "Lake Green", getting thinner towards the Narva Reservoir. According to the results of earlier surveys, the maximum thickness of the Kõrgesoo peat deposit is up to 8 m; the average thickness is up to 4.7 m. There is mainly silt below the peat.

Earth properties at the possible location of a new industrial waste landfill. An industrial waste landfill is being planned into the northeastern corner of the present ash field, where the relative height of the ash-stone heap reaches 21 m (absolute elevations are 44 – 49 m). In order to study oil-shale ash, the ash bed was sounded down to the natural earth under it (PA-24). The results of an earlier drill hole in the same area, CKB-1, were available, as well. In the ash bed, intermediate layers of ash alternate, their structure is from dusty up to fine-grained, less frequently medium-grained. The thickness of intermediate layers is 0.1 – 1 m. Dusty substance prevails. The ash layer at the top (thickness up to 0.8 m) is not coherent. Below this, ash layers of different phases of cohesion follow: weakly and strongly coherent layers alternate with one another. According to the results from drill holes, there is no intermediate layer of plastic ash here.

Below the bottom of the ash bed there is a compacted layer of soil (0.4 m thick), under this there is loam whose consistency ranges from stiff to hard plastic.

Ca. 20 ha of the ash field will be reserved for the inert waste landfill, calculated for depositing 630,000 m^3 of waste (density 1.5 t/m^3) in 25 years. The planned maximum elevation of the waste deposit is 57.5 m (the height of the ash-stone heap will increase by 8 m). Additional load of the waste deposit onto the ash bed is up to 1.2 kg/cm^2 (120 kPa) and this will not unstabilize the ash-stone heap slopes. The earlier fissures in perimeter dams have been caused by the occurrence of a plastic ash layer in the southern part of the ash-stone heap.

3.1.3 Hydrogeology

Groundwater. According to hydrogeological conditions, four hydrostratigraphic entities can be separated in the area of the Balti Power Plant. By depth, these four are: the aquifer of topsoil and of Ordovician strata; the aquifer of Ordovician-Cambrian strata; and the aquifer of Cambrian-Wendian strata, which is further divided into two different aquifers.

The water of topmost aquifer spreads in peat, sands, sandy loam and sandy loam moraine. The aquifer is mainly unconfined, but in places of clayey soils, it may be locally confined. In some areas, the topsoil aquifer is connected to the hydraulically deeper limestone aquifers. The aquifer is fed by precipitation and confined groundwater, also locally by the water filtrating from "Lake Green". The local network of ditches drains the topmost aquifer.

There is little information about the nature of the water contained in the ash bed. Information about the hydraulic conductivity of the ash layer is contradictory. This is caused by the relatively heterogeneous layer structure of the ash bed. The coefficient of hydraulic conductivity of the noncoherent and uncompacted ashes in horizontal direction is 0.001 – 0.1 m/d. According to laboratory tests (performed on samples taken from the ash fields of the Eesti Power Plant), the coefficient of hydraulic conductivity of the coherent ashes is 10^{-5} – 10^{-7} m/d. In vertical direction, the ash-stone heap as a whole (and the bottom clay layer that has been compressed under the weight of the ash bed) can be considered relatively watertight, its coefficient of hydraulic conductivity is below 0.0001 m/d. Most of the seepage from lakelets of the ash fields occurs through the perimeter dams and the loose top layer of the ground under the dams.

Dolomitized limestone (O_2ls–O_1vl) of Lasnamäe, Aseri, Kunda and Volhov strata (thickness of ca. 20 m) lies below topsoil. These strata contain the Lasnamäe-Volhov groundwater aquifer. Under clayley soils, the aquifer is confined; the water level is influenced by the water level in the Kõrgesoo peat deposit. The limestone aquifer is fed from the raised bog. Near "Lake Green", the elevation of the water level is at 26 – 27 m (in 2001) and descends towards northeast. Most groundwater aquifers in limestone at the ash field are protected from the pollution weakly to moderately; the aquifers at the north western part of the ash-stone heap unprotected because of the thin topsoil.

The relatively effective aquiclude layers between the Lasnamäe-Volhov groundwater aquifer and the Ordovician-Cambrian aquifer (O_1pk–Cm_1ts) are formed by glauconitic sandstone, dolomite, clay and argillite of Latorp and Packerort strata (O_1lt–O_1pk) with thickness of 5 – 6 m.

The total thickness of Ordovician-Cambrian sandstones is 20 – 25 m and they form a groundwater aquifer of the same name. The upper surface of Cambrian-Cambrian (O_1pk–Cm_1ts) groundwater aquifer in the area under observation lies at the depth of 28 – 32 m. In the area of the Ash Field No. 2, the absolute elevation of the water level is 24 – 27 m and it descends eastwards. The aquifer is moderately protected from the pollution from above.

Under the Ordovician-Cambrian sandstones there is a 50 – 80 m thick layer of Cambrian blue clay. Blue clay forms a good aquitard, and the Cambrian-Wendian aquifer (Cm–V) lying underneath it can be considered to be well protected from the pollution from above. The upper surface of the aquifer lies at the depth of 120 – 130 m below the ground. This aquifer is well protected from pollution and is the main groundwater resource of the East-Viru County.

3.2 Ash Field No. 2, Its Installations And Use

The Ash Field No. 2 is one of the elements of the ash hydrodisposal system of the Balti Power Plant. It is a technogenous landform of rectangular shape, with the relative height of 5 – 21 m and steep slopes. The total area of the ash field is 576 ha. Its area is 576 ha, of which the ash-stone heap occupies 406 ha and the lakelet at the southern side 170 ha. The installations of the ash field are:

- 12 water evaporation ponds with ash dams (the so-called evaporation cascade sections);
- water piping;
- a lakelet (the so-called "Lake Green");
- perimeter ditch of the ash-stone heap;
- hydrotechnical installation between the perimeter ditch and the lakelet (together with a pumping station for the settled water and a water gate).

From 1960 to 18 December 1987, ash slurry in water was pumped into the field, of which oil-shale ashes settled on the heap's surface. The ash field with the shape and height described above has formed from ashes settled from the ash slurry. The excessive (non-evaporated) ash water was directed into "Lake Green" at the southern slope of the ash-stone heap for further settling.

Since 1987, the ash field has been a backup for the ash disposal system. During this time no ash slurry has been conducted into the ash field. The evaporation cascade sections are used if there is an excess of circulation water in the Ash Field No. 1. At the same time, the Ash Field No. 2 itself collects large amounts of excessive rainwater. So far, discharge of excessive water has taken place via the lakelet ("Lake Green") of the Ash Field No. 2.

Water seeping out from ash fields (or discharged from sludge ponds of the evaporation cascade) is collected in the perimeter ditch, from which it is either recycled to the ash disposal system (if there is not enough water in the system) or simply pumped back into the sludge ponds of the ash field evaporation cascade. In November 2001, the rate of pumping the settled water from the perimeter ditch back into the ash field was 170 – 400 m^3/d. A schematic diagram of the ash water cycle is presented in Drawing 1.

Also, the pH value is slowly declining in the sludge ponds of the evaporation cascade, as indicated by measurements made in various ponds (see Appendix 4).

The lakelet of the Ash Field No. 2 – the so-called "Lake Green" – is bordered by the ash-stone heap in the north, earth dams in the east and in the west, and the Kõrgesoo raised bog in the south. "Lake Green" seems to "hang" above the surrounding natural ground, "clinging" to the two dams. The water level in "Lake Green" is ca. 3.5 m higher than the water level in nearby bodies of water (Map 2). The water in the lake has formed from the excess ash water and rainwater, which has been drained from the ash field. If no water is added, the water level of the lake will decrease slowly.

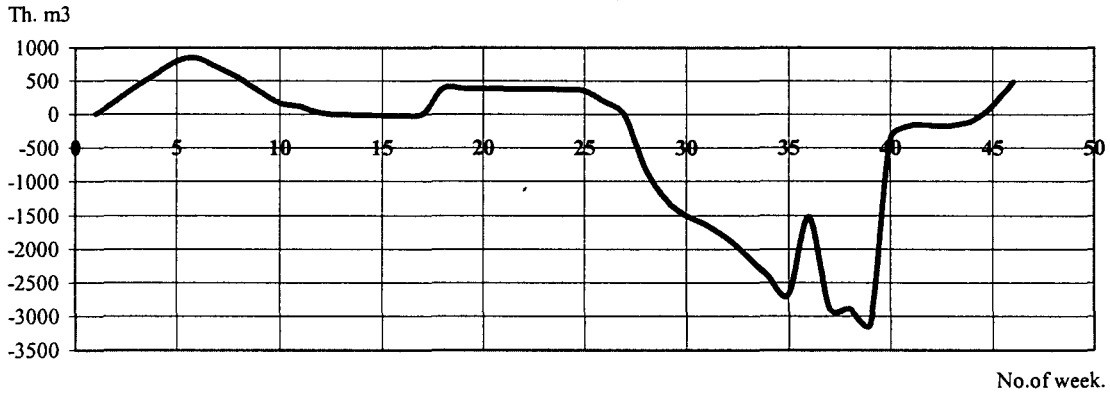
It is noteworthy that the pH value in "Lake Green" is 2 pH units lower than in the water of the sludge ponds in the ash field, and it is constantly stable: 10 – 10.2 pH units. Based on the results of water analysis, a possible explanation to this phenomenon is that the water is a solution whose composition is close to the carbonate buffer solution (0.05 m $KHCO_3$ and 0.05 m K_2CO_3). The pH value of this buffer solution is 9.93 (at 25 °C).

3.3 Water Volume In the Ash Field

The amount of the water collected in the ponds of the evaporation cascade (total volume of the ponds is 3.164 million m^3) is not stable. It depends on precipitation, the intensity of evaporation and, exceptionally, also on the situation in the Ash Field No. 1. For example, in April 1998 the water volume at the ash field was 2.9 million m^3; by November 2001, the water volume had increased to 3.12 million m^3, i.e. in 3.5 years the total increase was 0.22 million m^3. The personnel of the power plant regularly monitor the water level in all the ponds of the cascade and determine the approximate volume of ash water.

Drawing 2 presents differential variations of water volume in the evaporation cascade in 2001, based on the measurements. The drawing shows that during the weeks No. 43–46 in 2001, the water volume increased by ca. 450,000 m^3. According to the Estonian Institute of Meteorology and Hydrology (reply to the inquiry by PIC Estonia Ltd., 28 November 2001), the total amount of precipitation in Narva during this period was 108.0 mm. Taking into account the area of the ash field, the calculated volume added by the precipitation water is 440,000 m^3. These two results are very close to each other. Based on this result, it may be said that infiltration of ash water into the earth of the ash-stone heap is rather limited.

Drawing No. 2 Change of water volume in the ash field in 2001 by weeks.



The water volume situation of "Lake Green" is characterized as follows. If no water is discharged into "Lake Green" from the ash field, the fluctuation of its water volume will be a function of the balance between precipitation and evaporation. This becomes evident from the determination of water volume in spring and summer of 2000 (Table 1).

Table 1

Water Volume Fluctuation In the Lakelet ("Lake Green"), Spring–Summer, 2000

Date of measure-ment	Abs. elevation of water level, m	Exceeding of nominal volume, 10^3 m^3
17 May	28.25	255
19 June	28.31	357
10 July	28.35	425
16 August	28.19	153
02. 2 September	28.17	119

In mid-November 2001, the water volume in the lakelet was ca. 3.18 million m^3 (488,000 m^3 over the nominal volume, the elevation of the water level had reached 28.39 m already). The ash water volume in the perimeter ditch of the ash-stone heap is constant (ca. 72,000 m^3).

In years with heavy rainfall, the excessive water (alkaline, with high mineral content) has been discharged into the cooling water discharge channel by a temporary permission of the environmental authorities. Pollution taxes have been paid for the water discharge. The local Environmental Service has authorized wastewater discharge annually for the last 10 years, except in 1997, 2000 and 2001 (Appendix 1). The average volume of water discharged in 1991 – 2000 was 747,300 m^3/year.

It is not practical to keep the inefficiently large (having unnecessarily large rain-collecting area) ash fields in use. The Eesti Power Plant is able to manage with relatively smaller ash fields (taking into account that the ash volumes produced there are larger). Thus the closure of the Ash Field No. 2 is justified.

3.4 Water Quality, Environmental Impact And Risks

The environmental impact of the ash field is expressed mainly as the environmental impact of the water being in the field and in the lakelet, this impact directly depending on the water quality. The water of the evaporation cascade of the Ash Field No. 2 is a mixture of rainwater, ash slurry water settled in the Ash Field No. 1, the seepage water collected in the perimeter ditch, and water flowing there through regulators. Although the pH value of this water is high, its chemical composition differs from the water composition of the operating Ash Field No. 1. The water of the Ash Field No. 2 is soft and its total alkalinity is several times lower than the total alkalinity of the water of the Ash Field No. 1. At the same time, this water is chemically "salty", i.e. it has high a concentration of several ions – K^+, Na^+, chloride, sulphate and hydrocarbonate.

According to water monitoring tests of the Balti Power Plant, the ash fields of the Balti Power plant contaminate surface water. In the water of the nearby Narva Reservoir (whose volume is 70 times larger than that of the Ash Field No. 2), the cations and anions that have top concentration are the same as those in the water of the field. The hydrogeological observations by Eesti Geoloogia show that the concentration of the same ions has increased also in the topmost aquifers of groundwater in the vicinity of ash fields. Although both surface water and groundwater include the same ions as the water of the ash fields, the former waters are neutral (pH 7.0 – 7.7), as a rule. Also, observation results confirm a synchronous fluctuation of water level in "Lake Green" and in the O_2ls–O_1vl aquifer.

But in addition to ash fields, also other surface water and groundwater contamination sources or phenomena exist in the vicinity, which can affect water quality adversely, too. These include the landfill of Nakro Ltd., the municipal waste landfill of Narva and the settling of oil-shale ash particles emitted by stacks of power plants.

Table 2

Comparison Of Pollution Parameters And Content Of Hazardous Substances Determined In the Water Of Ash-stone heap And Lakelet (Samples taken on 02 November 2001) with their Maximum Permissible Concentrations.

Pollution parameter/ hazardous substance*	Maximum permissible concentrations of hazardous substances and pollution. The Regulation No. 269 of the Government of the Republic of Estonia	At the ash-stone heap	In the lakelet ("Lake Green")
pH	**9**	**12,3**	**9,6**
BOD 7**	25.0 mg/l	14.0 mg/l	9.0 mg/l
Suspended solids**	35.0 mg/l	48 mg/l	62 mg/l
N total**	10.0 mg/l	3.0 mg/l	1.7 mg/l
P total**	2.0 mg/l	0.073 mg/l	0.08 mg/l
PAH	0.01 mg/l	<0.20 µg/l	<0.20 µg/l
Phenols	0.1 mg/l	41 µg/l	10 µg/l

Pollution parameter/ hazardous substance*	Maximum permissible concentrations of hazardous substances and pollution. The Regulation No. 269 of the Government of the Republic of Estonia	At the ash-stone heap	In the lakelet ("Lake Green")
Resorcinols	15.0 mg/l	54 µg/l	34 µg/l
As	0.2 mg/l	0.01 mg/l	0.005 mg/l
Cr	0.5 mg/l	0.03 mg/l	0.04 mg/l
Cu	2.0 mg/l	0.04 mg/l	0.02 mg/l
Pb	0.5 mg/l	0.004 mg/l	0.02 mg/l

*) Results of the analyses are presented in Appendix 2.
**) Special water use permit shows whether Section 17 of the Regulation No 269 has been taken into account.

The content of suspended solids in the above-mentioned single samples is larger than the average values of water monitoring made by the plant. These results can substantially depend on sampling conditions as well. As to the rest, the results coincide with the water monitoring results of the plant. The main environmental problem is the high alkalinity of water.

The water of evaporation ponds and the lakelet is poor of nutrients, especially of phosphorus (see Appendix 5).

During the survey of hazardous substances in East-Viru County, ordered by the Ministry of Environment in 2001, only mono- and dibasic phenols were found in all hazardous substances in the lakelet of ash-field No. 2 and the cooling water channel. Also the water monitoring by the plant and the analyses made for this project have indicated the presence of phenols in the circulation water of ash fields.

Phenols are being introduced into the circulation water from the industrial area of the Balti Power Plant. In the future, the treatment of precipitation water of the industrial area should be separated from the circulation water system of ash disposal; also, local facilities of wastewater treatment should be used in the areas of possible precipitation water contamination. This recommendation was also expressed in a recent environmental audit of Narva Power Plants.

According to the information available, the content of heavy metals in the water of ash fields is not an environmental hazard. Neither does the content of heavy metals exceed the corresponding guide values of the soil (see Appendix 6).

The most serious environmental risk of the ash field and lakelet water is its possible breakout from reservoirs and reaching the Narva Reservoir as an impact load (the difference in water level elevations is ca 10 m). In this hypothetical breakout, millions (up to 6.3 million) cubic metres of water with high pH value and containing 25,000 tons of dissolved mineral salts would be immediately discharged into the reservoir.

4 Closure Of the Ash Field No. 2

4.1 Objectives

The reason why the Balti Thermal Power Plant is willing to close its Ash Field No. 2 is to rid itself from the environmental hazards and problems connected with the existence of the ash field. The volume of water needing treatment will decrease.

The reasons to close the Ash Field No. 2 are the following:

- based on the production capacity of the power plant, the area of the Ash Field No. 1 is sufficient for the treatment of ash water;
- the alkaline precipitation water accumulating in the evaporation cascade and sludge ponds has to be discharged periodically. However, such practice can be tolerated only in emergency and cannot be continued in the future;
- regular discharge of wastewater also calls for regular application for the special permit, plus paying high pollution taxes;
- the available technical solution for wastewater treatment does not ensure that the discharged excess water meets the environmental quality standards;
- wastewater treatment has to be correlated with the increasingly stricter EU and Estonian environmental standards.

4.2 The Nature Of Closing Down the Ash Field

As the result of closure, the Ash Field No 2 physically ceases to exist as an element of the ash disposal system of the power plant. The technical solution for closing down the ash field and its later maintenance, with the aim to suppress and control its environmental impact, creates a possibility to change the designation of the whole area in the future.

During the closing-down process:

- the ash field will be disconnected from the ash discharge system of the power plant;
- the best solution for closing down the ash field will be put into practice;
- the prerequisites for accomplishing the solutions of monitoring and later maintenance will be created.

Presumable results of the closure:

- the ash field will not contaminate surface water any more;
- the area with contaminated groundwater will stop expanding;
- the field will not turn a dust emission source;
- the possibility to use the field area as a landfill for inert industrial waste will become real;
- the issues of practical treatment of the water in the lakelet ("Lake Green") or its future use can be solved.

By accomplishing the measures outlined in this project, which will be put into practice at the Ash Field No. 2 (incl. the construction of a neutralization station for the water drained from both ash fields), the discharge of alkaline wastewater into the Narva Reservoir will

cease. This will fulfil one of the environmental objectives of the company Eesti Energia Ltd.

This will result in a landscaped area needing minimum maintenance and not loading the environment any more. As this concerns a large area covered with different objects – a technogenic ash-stone heap and a lake, it can be predicted that the subterranean environment of the ash-stone heap will change into a nearly natural state only in far future. This situation would be achieved by stages. A general schedule would be the following:

1. realizing the engineering and technical solutions for the ash-stone heap and "Lake Green" worked out in this project, by the year 2005;
2. ensuring that the use of the surrounding areas is in accordance with the established environmental requirements (e.g. solving the use of the Ash Field No. 1 of the Balti Power Plant, and closing down the waste landfill of Nakro Ltd.), plus the period of the environmental monitoring of these solutions (by 2009);
3. keeping in force the solutions accomplished in the ash field No 2 (its after-maintenance) until the impact caused by their technogenic origin disappears. During this period the covered ash field will adopt the plant associations used for its protection and the water in "Lake Green" or its derivatives and the shore areas of the lake become close to the surrounding natural environment and will not greatly affect the surrounding biotopes (this period can last up to 2010-2015);
4. a specific biotope will stabilize in the recultivated area (approx. 2025);
5. utilization of the possibilities of the area accommodated into the surrounding landscape proceeding from the needs and development schemes of the area. During this period the environmental condition of the area will not set any restrictions to its takeover into civil circulation and its possibilities can be reckoned with in planning and zoning the area (approx. 2030).

Therefore, the process will be a long one – 20-30 years. The above terms are approximate and can either shorten to some extent or grow substantially longer, depending on the quality parameters set for the area. The pace of bringing the area close to its natural state will depend on the chosen closing alternative – especially the expenses made on landscaping.

The engineering solutions quite quickly accomplishable will only open the possibility of controlled and prognosticated proceeding of natural processes in the given area. Concerning the takeover of the area into civil circulation, this period can start even before the fusion of the technogenic territory into the ecosystem of the area has ended. This is caused by local developments, first of all of the power stations belonging to the company Narva Power Ltd., but also by the developments in Narva and the land needs arising in connection with these developments.

4.3 Predicted Problems In Effluent water Treatment

4.3.1 Possibilities Of Alkaline Effluent water Treatment

Depending on the quantity (see Section 3.3) and quality (see Section 3.4) of the effluent water, up to 5 million m^3 of water with high alkalinity and salt content (4-5 g/dm^3) has to be drained off from the field.

There are two options for drainage – either discharging the water into a water body without treatment, or treating it in a treatment device with a considerable treatment effect and capacity. Discharging alkaline effluent water into environment can only be tolerated if there are no other options or in emergency situations in the course of overfilling the evaporation ponds and lakelet. Even then, a slow discharge of water would be correct from the environmental point of view, in order to guarantee that the water would be diluted in the cooling water channel before it reaches the Narva Reservoir.

The Balti Power Plant has an effluent water treatment device, which operates on the principle of reverse osmosis; it has already been used in the chemical department of the plant in 1999–2000. Unfortunately, the device is not operable at the moment. Although the Balti Power Plant is making efforts for returning the reverse osmosis treatment device (to some degree improved) into use, there is no absolute guarantee until it will start operating again.

Based on the known capacity (100 m^3/h) of this reverse osmosis treatment device it would take years to drain the Ash Field No 2. In reality, the existing treatment device could be used for treating excessive water, which forms in the Ash Field No 1.

In order to treat the excessive alkaline water, it would be possible to construct a water neutralizer, in which the water of the evaporation cascade sections and "Lake Green" can be neutralized to pH 9 with acid. The amount of the necessary hydrochloric acid has been assessed in Drawing 3. All in all, the total amount of 9,500 t of hydrochloric acid would be necessary to drop the pH value of the water in all ponds to 9.

If, according to the schedule of this project, the work is to be completed by 2005, it is inevitable to discharge most of the alkaline water from the ash field and "Lake Green" into the cooling water channel in 2002–2003. The only possibility to ensure that the discharged water meets the requirements would be to install a treatment device (neutralization station) for the discharged water.

4.3.2 Prognosis Of Excess Water Volume

The water volume, which becomes excessive in the ash fields annually, is assessed below. This volume of water should be discharged from the closed water circulation system at present, and in the years following the closure of the Ash Field No. 2 (evaporation cascade drained and the surface of "Lake Green" lowered to 27.00 m), and after 20 – 30 years when the ash field will be covered with vegetation.

Appendix 7 includes the water balance of ash fields, presented by the Balti Power Plant (BPP), characterizing the present water treatment. The water balance has been calculated on the bases of the methods of SNiP norm. A consultant has compiled an additional water balance calculation:

- situation 1 when the Ash Field No. 2 has been emptied of water (drained) and the surface of the lakelet ("Lake Green") has been lowered to 27.00 m (forming two marshy lakes) and the disposal of ash slurry to the Ash Field No. 1 still continues;
- situation 2 when the Ash Field No. 2 has fully overgrown with grass, "Lake Green" has turned into a wetland (incl. lakes with water level of 27.00 m) and the disposal of ash slurry to the Ash Field No.1 still continues.

In comparative calculations, values of evaporation from corresponding areas have been used from an investigation by Tartu University (consultant) ***(Appendix 8)***:

- from an ash field without vegetation: BPP – 230 mm, consultant – 370 mm;
- from an ash field with vegetation: BPP – 460 mm, consultant – 500 mm after landscaping the area as grassland.

Table 3

Water Volume To Be Discharged Into Cooling Water Channel

Situation and designation of ash field	Ash water balance (on basis of BPP's data) Million m^3/year	Ash water balance (on basis of Tartu University data) Million m^3/year
Current situation		
Ash Field No. 1 (with ash slurry)	0.8677 [1)]	0.400
Ash Field No 2 (water in evaporation ponds)	–0.402 + 0.790 [2)] = 0.388	0.290
Total	**1.2557**	**0.690**
Situation 1		
Ash field No. 1 (with ash slurry)	0.8677	0.400
Ash Field No. 2 (empty ponds and wetland)	1.8378	1.200
Total	**2.7055**	**1.600**
Situation 2		
Ash field No. 1 (with ash slurry)	0.8677	0.400
Ash Field No. 2 (ash area is landscaped as grassland and wetland)	0.812	0.600
Total	**1.6797**	**1.000**

Notes to the table:

1) Including precipitation water directed to the Ash Field No. 1 and other effluent water from the territory of the plant – 0.560 million m^3/year. This water will have to be treated separately;

2) Negative balance results from the situation when water from the ash field is used as process water in the power plant, purifying it in the reverse osmosis treatment device with the capacity of 0.790 million m^3/year. If the device is not used, the excessive water volume will be 0.388 million m^3/year.

5 Alternative Options Of Closure

5.1 Selection Of Options

In this section, several options have been presented, no matter if they are realistic or not.

5.1.1 Forming A Maintenance-Free Area

This means that the southern slope of the ash hill will be graded into "Lake Green" situated near by. The principle is that grading or the disposed additional ash fills up "Lake Green". The area graded against the Kõrgesoo raised bog will be covered with soil and verdure. This option causes the following problems:

- During the fill-up, ca. 3 million m^3 of water will be forced out from "Lake Green". In order to discharge this water into the natural environment, a special permit will be necessary. Knowing the quality of the water, it can be difficult to obtain the permit.
- "Lake Green" is situated on a flooded swamp (peat thickness up to 5 m). Filling this lake up and landscaping the area is technically complicated and time-consuming.
- Filling "Lake Green" up with ash is hardly an environmentally soundly solution, because an ash field with the area of 1.8 km^2 will replace the lake. This ash must be covered with suitable material, as well.
- If ash is used to fill up the lake, the quality of the lake water getting into contact with (fresh) ash will worsen more – its pH will increase.
- There is a thick peat bed below "Lake Green", which can sink incalculably during the fill-up (down to the mineral soil, if the peat is well decomposed). Thus the resulting landscape cannot be predicted precisely.
- peat is a (future) natural resource and burying it under ash will not be reasonable.

5.1.2 Abandoning of the Area

In this case, no preceding or consecutive engineering activities or monitoring will be carried out. Pumping of the water collected into the perimeter ditch back to the evaporation cascade will be terminated. Dry parts of the ash field will grow their own vegetation.

The main problem stemming from abandoning the Ash Field No. 2 and "Lake Green" would be the fact that the dams dividing the ash field into sections can break at the maximum water volume and the water would discharge uncontrollably into the

surrounding area or into "Lake Green". It would result in the contamination of neighbouring water bodies. At the same time, the Balti Power Plant will still be responsible for the environmental pollution originating from the object. It can be predicted that the local Environmental Service will not grant a special water use permit to the power plant, if abandoning of the area is declared.

5.1.3 Covering The Ash Field In Accordance With the Requirements For Hazardous Waste Landfill

According to the closure requirements for landfills, a watertight covering should be designed and set up to the graded and *gently sloping* ash field; the covering will have to include a clay and membrane layer, and a draining and a humus layer. Approximately 4.1 million m^2 of covering materials would be necessary in this case. If the field were graded and covered, there would be neither precipitation water contamination problem nor the need for maintenance. Only the task of transforming "Lake Green" would remain. However, if relatively pure precipitation water is directed into "Lake Green", most probably the pH of its water will decrease. When preparing for the covering, there will be problems with the ash-stone heap, which is essentially rock. Also, the engineering solution for the option is complicated. How to form the 1:4 slopes so that the covering layers would remain in place?

Considering all the existing environmental investigations and the preliminary assessment of the environmental impact, the covering of the ash-stone heap with a watertight layer is unnecessary, from of the viewpoint of its environmental result. The monitoring carried out so far shows that no relevant additional water contamination in the Ash Field No. 2 takes place.

The estimated cost of the work would exceed all reasonable limits (the cost of a square metre of similar landfill covering projects is from 350 EEK upwards). A detailed elaboration of the option with the cost of closure operations exceeding 1 billion EEK is not practical.

5.1.4 Directing the Kulgu River Through "Lake Green"

At its old course, the Kulgu River flowed into the Narva River in the town of Narva. The aim of this option is to use the water of the Kulgu River for the water exchange in "Lake Green" in order to decrease the pH value of the latter. After examining the situation and considering the elevation marks, this option turns out to be impossible. Directing the Kulgu River through "Lake Green" would be possible only if a new riverbed, 1.5 – 3.5 m deep, is dug into the bottom of the lakelet, leading to the cooling water channel of the power plant. Culvert regulators should be built in order to let the water pass through both the western and eastern perimeter dams. It is possible to form shallow wetlands as extensions to the riverbed at suitable places. The water level in this bed should be generally a few centimetres higher (during annual floods up to 0.5 m higher) than the

level of the Narva cooling water channel whose level nearly equals that of the Narva Reservoir. The earthworks volume for the riverbed would amount to 80,000 m^3; if including the minimum wetland volume, it will be 150,000 m^3. The dried lake bottom, which is covered with ash sediments, would need landscaping, as well. The advantage of this option would be the improvement of the water exchange of the wetland and enriching the water in nutrients in order to develop the aquatic life.

The accomplishment of this option would be complicated due to the weak soils in the new course of the Kulgu River. Possibly the realization of this option may be considered again in the future.

5.1.5 Transformation Of the Ash Field And Preservation Of "Lake Green"

The aim of this option is to stop the considerable environmental impact of the highly alkaline water of both the ash-stone heap and "Lake Green". The option is based on the presumption that precipitation water, which for a short time comes into contact with the stabilized and petrified ash that has been deposited in the Ash Field No. 2 for more than ten years, leaches salts in minimal quantities (<1 g/dm^3), so that the pH of the water will not exceed the permitted level and that the water can be discharged after treatment.

"Lake Green" will be preserved in its present state – in order to stabilize its water level, precipitation water drained from the ash field will be directed here.

The main disadvantage of this option is the cost of maintaining the current water level in "Lake Green" (in essence a reservoir). Continuous maintenance of dams is necessary, for the outbreak of water from the reservoir can damage other facilities in the area. An artificial water body of this kind is not necessary in the vicinity of the Narva Reservoir, and it would probably not turn into an ecologically valuable water body.

5.1.6 Option 0 For Preventing the Increase Of Environmental Risks Of the Ash Field

Option 0 (no-action alternative) means minimum work necessary to stop the increase of environmental risks stemming from the object. It means that from time to time the settling ponds are emptied; these ponds are the most important environmental risk. The objective of draining the cascade is to prevent the breaking of the dams around the ponds and the water from discharging into the Narva Reservoir as an impact load. "Lake Green" at the southern side will not be considered an environmental risk. It is assumed that the pH value of the water in the lakelet will quickly decrease to the permissible level for discharging precipitation water into the natural environment.

The accomplishment of this option would be in contradiction with valid requirements for discharging effluent water into water bodies – it can be considered only in case of emergency or if more expensive options run into financing difficulties.

5.1.7 Option 1: Ash Field Landscaping And Forming "Lake Green" Into A Wetland

The aim of this option is to stop the considerable environmental impact of the highly alkaline water from both the ash-stone heap and "Lake Green". The option is based on the presumption that precipitation water, which for a short time comes into contact with stabilized and solidified ash that has been deposited in the Ash Field No. 2 for more than ten years, leaches salts in minimal quantities (< 1 g/dm^3), so that the pH of the water will not exceed the permitted level and that the water can be discharged after treatment.

In order to accomplish this aim, the following methods will be used:

- a neutralizing plant for neutralizing the water with high pH will be built;
- the water from the ponds of the evaporation cascade will be discharged into the cooling water channel of the Balti Power Plant through the neutralizing plant;
- "Lake Green" will be partially drained through the neutralizing station and turned into a wetland;
- the drained ash field will be partially covered with verdure, creating conditions for vegetation formation across the whole ash field in the more distant future.

5.1.8 Option 2: Ash Field Landscaping, Forming "Lake Green" Into A Wetland And Construction Of An Inert Waste Landfill

The aim of this option is exactly the same as of Option 1. However, in addition to eliminating the environmental impact of water, the question of deposing inert waste of the company Narva Power Ltd. will be solved, as the ash-stone heap will be free of water. The creation of a landfill site for inert waste collected from the power stations (including asbestos waste) will be added to the four realization points presented for Option 1.

5.1.9 Selection Of Options

For further detailed discussion, Options 1 and 2 were chosen together with the participants of the project. A detailed assessment of options is presented in the October and November intermediate reports of the feasibility study of the project. The feasibility of Options 1 and 2 has been discussed with the supervision group of the project, management of the Balti Power Plant and the managers of the concerned units.

5.2 Explanations For Options 0, 1 And 2

5.2.1 Option 0

In order to keep the water in the ponds of the evaporation cascade at a safe level, thousands of cubic metres of water with unknown content and characteristics will have to be discharged into the natural environment (into surface water bodies). Essentially, this would mean continuing the current practice of treating the water of the Ash Field No 2. The Balti Power Plant has explained this practice to the authorities issuing effluent water discharge permits as a quick and resolute solution.

There is no evidence that the "new" water, which will gather into the cascade after it is drained from the present precipitation water, would be more acceptable to the environment – at least by its pH value. Thus Option 0 is and remains the method of quick discharge of effluent water with known contamination level into the natural environment, and with all the corresponding consequences. It is unthinkable to continue the practice of discharging the untreated effluent water into the natural environment for a long time, considering the fact that ecological requirements are becoming increasingly stricter. Re-starting the treatment device based on reverse osmosis would increase the probability of decreasing the volume of untreated water discharged into the environment. However, the small capacity of the treatment device and huge quantities of water to be treated will not yield a quick solution to the problem.

Option 0 makes it possible to continue the pumping of ash water from the Ash Field No. 1 into the evaporation cascade of the Ash Field No. 2.

5.2.2 Option 1

The aim of this option is to help to get rid of the existing volume of highly alkaline water and to avoid its reappearance in the future.

Most important in accomplishing this option is the fact that the evaporation cascade will be drained, conditions will be created for draining the precipitation water and the ash-stone heap will be covered with soil and covered either partially or completely with herbaceous plants. In case of partial landscaping, it is expected that the rest of the ash-stone heap will be slowly and spontaneously covered with both woody plants (birch) and herbaceous plants.

Due to opening the dams of the ash-stone heap and landscaping, most of the precipitation water is expected to drain along the stabilized surface of the ash-stone heap. Only the precipitation water that has soaked through the stabilized covering, contacting dry ash rock, will be contaminated to some extent. As the volume of the precipitation water that contacts ash rock decreases, the share of water contaminated with leached-out salts (up to 5 mg/l) in the outflow will presumably be small. As a result, the contamination level of the precipitation water draining from the ash field (including its pH value) will decrease.

In order to rid the water bodies located in the Ash Field No. 2 of millions of cubic metres of water whose pH is 10 – 12, a water neutralization plant has to be constructed. The neutralization plant for treating highly alkaline water will be situated near the pumping station already in existence (see Drawing 3). In order to construct the plant, an area of ca. 0.6 ha between the existing road and the cooling-water channel of the power plant will have to be filled up. The plant will be equipped with devices (tanks, piping, shed) and equipment (electrical and automatic equipment) necessary for neutralization (see Drawing 8). The Drawing 3 presents approximate quantities of the concentrated hydrochloric acid necessary to decrease the pH value of water in the filled ponds from 12 to 9.

This option calls for a many-featured water treatment. After the neutralization plant is completed, the gradual draining of the ponds of the evaporation cascade through the existing outlets into "Lake Green" will be started (Drawing 4). The slope (0.6%) of the ash field from northeast to southwest is sufficient to drain the water from the ponds using gravity flow. "Lake Green" will act as an intermediate reservoir between the neutralization plant and the cascade ponds. After the cascade ponds have been drained, the water level in "Lake Green" will be lowered to the point where the lagoon will be divided into smaller bodies of water (the estimated point – 27 m). The pH of the water drained from "Lake Green" will be decreased in the neutralization plant.

After the ash field is drained of water, the dams located in the field will be reconstructed in order to avoid further accumulation of precipitation water in the ponds. This will be achieved by digging draining cuvettes (ditches with flat banks) behind the dams in low places where the water can accumulate. In order to drain the cuvettes, the dam will be dug through. In wider dams, on which it is possible to move in a vehicle, culverts will be installed for water drainage. Also, the water outlets No. 1 and No. 2 on the ash field will be preserved and reconstructed, deepening them from the collection side. The above methods will be used to minimize the transport of non-coherent ash to the surface layer and to avoid the pH increase of precipitation water resulting from that.

It will be practical to drain the evaporation cascade ponds in summer when the water level in them is at the lowest (Drawing 2). However, as the low water period is brief, there is a risk that various works in the field (draining ponds, opening dams, installing culverts, reconstructing outlets) will accumulate in time.

The drained ponds and dams not used for vehicle traffic will be covered with earth. As to the covering – finding a suitable type of covering soil can present problems, as the earth has to meet the following requirements: no dust emission, resistant to erosion, providing good growth substrate for landscaping plants, and easily available. Production and use of a composite material is not excluded. For example: one possible composite material, which is in accordance with the limit values for the soil in industrial areas, could be the mixture of refined oil-shale semicoke with peat.

After draining the evaporation cascade through "Lake Green", its transformation into a wetland will be started. In this area, the wetland will turn into a landscaping element; i.e.

into an area with small water bodies – relict lakes – and with a higher ground that can be passed on foot. When the water in "Lake Green" reaches the level of 27 m, there will be two water bodies (with average depth 1 – 1.5 m) and one area with soft instead of the existing lagoon. The area of the larger relict lake will be ca. 99 ha and the area of smaller lake will be 24 ha. The area of the dry territory will be ca. 47 ha (Drawing 5). In order to lower the existing water level from 28.3 m to 27 m, 1.8 million m^3 of water will have to be discharged into the environment.

Lowering the water level will indent the southern shore of the lake, new coves with better conditions for aquatic life will come into existence. The importance of the southeastern section of the existing eastern perimeter dam, as a separator of the lake's water from the wetland will decrease. On the contrary, it is possible that the acidic water from the existing wetland will have some access to the water of the "newly-formed lakes", contributing to the lowering of the pH of the water in the relict lakes.

After transforming the lagoon into a wetland, the precipitation water drained from the ash field will be collected in the perimeter ditch and led into the neutralization plant. The schematic diagram of water treatment is presented in Drawing 5. After the cascade ponds have been drained, the water level in "Lake Green" will be lowered to the point where the lagoon will be divided into smaller bodies of water (estimated as 27 m). In order to equalize the outflow during heavy precipitation and snow thaw, it will be necessary to have the possibility to discharge water from the ash field into the area of "Lake Green". If monitoring shows that the quality of the ash water formed in the ash fields is adequate, this water can be discharged through the new wetland into the natural environment and the neutralization plant will serve only the Ash Field No. 1.

After the listed operations with the Ash Field No. 2 are accomplished, the constructed neutralization plant can be used for neutralizing the water collected from the Ash Field No. 1. Most significant tasks connected with the Ash Field No. 2 and the wetland formed from "Lake Green" will be maintenance and environmental monitoring.

In accomplishing Option 1, the following operations carried out on the basis of the project can be predicted:

- building a neutralization plant for neutralizing the water with high pH;
- dismantling the piping of the circulation water;
- draining the evaporation cascade ponds;
- turning "Lake Green" into a wetland with relict lakes;
- forming water collection cuvettes on the bottoms of empty ponds, digging openings through dams and installation of culverts;
- reconstruction of existing water outlets;
- acquisition and spreading of growth substrate;
- landscaping with herbaceous plants.

5.2.2.1 Technical Means For Maintenance And Monitoring

During maintenance and monitoring, water quality (pH level), water level in the relict lakes formed on the basis of the former "Green Lake" and the geotechnical stability of the ash-stone heap will be monitored. An additional task of maintenance is to monitor the stability of the ash field cover and to restore the eroded areas as quickly as possible.

Monitoring the ash field. Since the active ash disposal was discontinued, the ash-stone heap formed of oil-shale ash has had time to stabilize (carbonise) down to a certain depth and, due to the cementing qualities of the ash, to solidify and become compressed (average density 1.35 t/m^3). The water "stored" on the ash-stone heap has loaded the ash-stone heap structure over the years – at maximum water level with the load of 6500 Pa. When draining the evaporation cascade ponds, this pressure will cease. This would produce conditions, under which to stop monitoring the stability of the ash-stone heap. Geotechnical sounding performed by AS REI in 1995 indicated that there were fissures in the southern part of the ash-stone heap and it was discovered that there was a 0.5 m thick layer of "plastic ash" at its "bottom", in its deepest layer. After draining the ponds, the following geotechnical or inspection surveys should be considered: drilling test holes in the vicinity of the holes drilled in 1995 in order to check the following parameters of the ash rock: moisture content, density, porosity, consistency. Also, thickness of the "plastic ash" layer and its essential geotechnical parameters must be measured.

It is known from literature that rainwater can possibly leach salts (mainly hydrogen carbonates) from ash – according to analyses, ca. 4 – 5 g/dm^3 that increases the water pH. Although the quantity of leachable salts decreases, the exact time till the precipitation water that has had contact with ash rock can be considered "sufficiently clean", i.e. with pH below 9, will still remain unknown.

The monitoring data available show that the settled water led from the Ash Field No. 1 to the Ash Field No. 2 causes no significant additional contamination. Here the contaminated water is diluted approximately twice. Monitoring the water drained from the ash field makes it possible to determine the dynamics of the actual contamination of precipitation water.

After the conditions of surface water quality formation in the ash field have been determined, monitoring can be limited to observations of water quality in the new wetland only.

In order to monitor the water surface in the relict lakes of the new wetland it would be practical to replace the existing hydrostatic sensor of "Lake Green" (and the corresponding signals in the control unit) with a sensor that reacts to water surface higher than 27.0 m. Exceeding this level will give an emergency signal indicating that the land strip separating the small lakes is about to be flooded. The pH level of the water would have to be monitored in the eastern lake. The existing pH sensor and control unit of the ash disposal department must be used to monitor both pH and water level. At the same time, a portative pH indicator must be obtained and the pH level in the western lake

measured once in three months (in winter – from below the ice). The pH value will have to be measured in water bodies until the value pH<9 have been measured in both water bodies for at least one year.

5.2.3 Option 2

The aim of this option is to get rid of the existing volume of highly alkaline water, to avoid its reappearance in the future, and the ash-stone heap will be used to solve the disposal problems of industrial waste from the two power plants owned by Narva Power Ltd.

By this option, all solutions for treating the water collected from the ash-stone heap and for the wetland formation described in Option 1 will be applied. Option 2 is a further development of the previous option that helps Narva Power Ltd. to solve the safe disposal of inert waste produced by its two power plants. From the waste processing point of view, this means that an inert waste landfill will be found on the ash-stone heap of the Ash Field No. 2.

It is possible to avoid both the erosion and transport of suspended solids from the ash-stone heap with foresting the evaporation ponds in zones and groves and planting perennial herbaceous plants in the areas between them. It may even be considered to leave a part of the territory to form its own vegetation. The area to be forested is assessed to be 118 ha. It would be practical to forest the softer ash rock areas located near the dams and in places that are sheltered from prevailing winds, so that a thicker layer of growth substrate can be formed there (Drawing 7).

An industrial area will be planned in the northeastern corner of the ash field. As an alternative, an industrial waste landfill area (inert waste landfill) with the time of use for at least 25 years and capacity of ca. 630,000 m^3 of waste (waste density in landfill 1.5 t/m^3) can be founded here (Drawing 7). This would need an area of ca. 20 ha. Monitoring the area of evaporation cascade ponds shows that the total area of three ponds – Nos. 7, 8 and 9 – is 18.5 ha. It is important that the industrial waste landfill should also be able to receive asbestos waste. In order to deposit asbestos waste as hazardous waste to the inert waste landfill, a special depositing area has to be founded where the preservation of asbestos waste in intact shape would be guaranteed. The operator of the landfill will have to cover the waste during the depositing process already or immediately after it. There is a Minister's regulation in process at the Ministry of Environment of Estonia in 2002 granting permission for this.

For treatment, the drain water collected from the landfill can be led into the neutralization plant situated below the hill slope.

After the evaporation cascade ponds have been drained of water, the removal of the dams separating ponds Nos. 7, 8 and 9 will be started, and preparations for founding the first depositing area according to the layout of the landfill will begin.

In accomplishing Option 2, the following operations carried out on the basis of the ISPA project can be predicted:

- building a neutralizing plant for neutralizing the water with high pH level;
- dismantling the piping of the circulation water;
- draining the evaporation cascade ponds;
- turning "Lake Green" into a wetland with relict lakes;
- forming water collection cuvettes on the bottoms of empty ponds, digging openings through dams and installation of culverts;
- reconstruction of existing water outlets;
- acquisition and spreading of growth substrate;
- foresting in zones and planting herbaceous plants in the area between the zones (partial foresting and planting can also be considered);
- working out the general layout of the inert waste landfill for the reserved industrial area;
- removing two ash dams separating ponds Nos. 7, 8 and 9;
- founding the first stage of the inert waste landfill.

A possible location of the depositing area in the Ash Field No. 2, which will be closed in the future, has been indicated in previous investigation by Maves Ltd., *Narva Power Ltd. tööstusjäätmete prügilate sulgemine. I etapp* (Closure of the industrial waste landfills of Narva Power Ltd.. Stage I.).

5.2.3.1 Technical Means For Maintenance And Monitoring

Monitoring the ash field and water in "Lake Green" can be differentiated.

Monitoring the ash field is similar to that in Option 1.

According to Option 2, "Lake Green" will cease to exist as a single body of water. Two separate bodies of water will form, each having the water level $\leq$ 27 m. In order to monitor the water surface, it would be practical to replace the existing hydrostatic sensor of "Lake Green" (and the corresponding signals in the control unit) with a sensor which reacts to water surface higher than 27.0 m. Exceeding this level will be an emergency signal indicating that the land strip separating the small lakes is about to be flooded. The pH level of the water would have to be monitored in the eastern lake. The existing pH sensor and control unit of the ash disposal department must be used to monitor both pH and water level. A portative pH indicator must be obtained and the pH level in the western lake measured once in three months (in winter – from below the ice). The pH value will have to be measured in water bodies until the value pH<9 have been measured in both water bodies for at least one year.

5.3 Organizing the Maintenance

The Head of the ash disposal department will organize the treatment of the ash fields of the Balti Power Plant. His/her team dealing with ash transportation and disposal and led by a foreman will deal with the maintenance of the closed Ash Field No. 2 in the future. So, a single team will have a complete picture of the area and be able to solve integrated tasks. The organization of maintenance will be similar for both main options.

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Appendix 1

IDA-VIRU KESKKONNATEENISTUS
FAX 16/11 2001 11:17

Hr Madis Metsur

Järgnevatel aastatel vastavalt BEJ taotlusele, kui vältimatu hädaabinõu on keskkonnatalituse poolt lubatud reguleeritud leelisvete väljalaske äravoolu kanali kaudu Narva veehoidlasse:

1991.a ärastati 1187 tuh.m3
1992. a – 1195 tuh.m3
1993. a – 769 tuh.m3
1994. a – 243 tuh.m3
1995. a – 400 tuh.m3
1996. a – 650 tuh.m3
15.07.1998.a kuni 31.03.1999,a - 3 028 827 m3

IZLISHKI VODÕ V SISTEME ZOLOOTVALOV STANTSII NA 13.07,1998.a SOSTAVILI 2574tuh.in3.

V.Ossipuk

Appendix 2

VEEPRROOVIDE ANALÜÜSI TULEMUSED 02.11.2001

Akt	Tüüp	Proovi-võtu kp.	Ettevõte	Proovivõtu koht	Näitaja	Väärtus	Ühik	Meetod
4875	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I Drenaazivesi	Benseen	<0.10	µg/l	BEN_PGF
4875	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Etüülbenseen	<0.10	µg/l	EB_PGF
4875	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Ksüleenid	<0.10	µg/l	XYL_PGF
4875	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Nafta (GC),P	<10.0	µg/l	OIL_PGF
4875	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Tolueen	<0.10	µg/l	TOL_PGF
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	2,3-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	2,5-dimetüülresortsiin	<10.0	µg/l	PHEN2_HPLC
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	2,6-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	3,4-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	3,5-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	5-met.resortsiin	<10.0	µg/l	PHEN2_HPLC
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Fenool	33.0	µg/l	PHEN1_HPLC
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	PAH (sum)	<0.20	µg/l	PAH_CHMS
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Resortsiin	<10.0	µg/l	PHEN2_HPLC
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	o-kresool (sum)	<2.00	µg/l	PHEN1_HPLC
4876	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	p,m-kresool (sum)	41.9	µg/l	PHEN1_HPLC
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Sademe iseloom	hägu		
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Värvus	40°	°	
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Läbipaistvus	10cm		
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Lõhn	tugev mõrkjas		
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Kuivjääk	5390	mg/l	RE_D105
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	Hõljuvaine	48	mg/l	PS_C
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	pH	12.3		PH_L20
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	BHT7	14	mgO/l	BOD7_NE
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	KHTMn	21	mgO/l	CODMN_NT
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	NH4-N	0.70	mg/l	NH4N_NS
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I	NO2-N	0.002	mg/l	NO2N_NSD

4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	o-kresool (sum)	<2.00	µg/l	PHEN1_HPLC
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	p,m-kresool (sum)	<2.00	µg/l	PHEN1_HPLC
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Sademe iseloom	t.hägu,pr.helbed		
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Värvus	100°	°	
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Läbipaistvus	8cm		
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Lõhn	mõrkjas		
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Kuivjääk	4230	mg/l	RE_D105
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Hõljuvaine	62	mg/l	PS_C
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	pH	9.60		PH_L20
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	BHT7	9.0	mgO/l	BOD7_NE
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	KHTMn	37	mgO/l	CODMN_NT
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	NH4-N	0.10	mg/l	NH4N_NS
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	NO2-N	0.002	mg/l	NO2N_NSD
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	NO3-N	0.03	mg/l	NO3N_NS
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	N üld	1.7	mg/l	NKJ_NTM
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	PO4-P	0.030	mg/l	PO4P_NS
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	P üld	0.080	mg/l	PTOT_NS
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Cl	338	mg/l	CL_NT
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	SO4	860	mg/l	SO4_FTS
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	HCO3	24.3	mg-ekv/l	ALK_NP45
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Karedus	2.5	mg-ekv/l	CAMG_NT
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Ca	4	mg/l	CA_NT
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Mg	0.2	mg/l	MG_NT
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Na	83	mg/l	NA_NEF
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	K	1800	mg/l	K_NEF
4881	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Fe	0.15	mg/l	FE_NST
4882	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	As	0.005	mg/l	AS_NG
4882	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Cr	0.04	mg/l	CR_NG
4882	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Cu	0.02	mg/l	CU_NG
4882	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Mo	0.010	mg/l	MO_NG
4882	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Pb	0.02	mg/l	PB_NG
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Sademe iseloom	puudub		

4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		NO3-N	0.76	mg/l	NO3N_NS
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		N üld	3.0	mg/l	NKJ_NTM
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		PO4-P	0.036	mg/l	PO4P_NS
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		P üld	0.073	mg/l	PTOT_NS
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Cl	390	mg/l	CL_NT
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		SO4	770	mg/l	SO4_FTS
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		HCO3	45.8	mg-ekv/l	ALK_NP45
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Karedus	2.3	mg-ekv/l	CAMG_NT
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Ca	4	mg/l	CA_NT
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Mg	0.1	mg/l	MG_NT
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Na	150	mg/l	NA_NEF
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		K	2625	mg/l	K_NEF
4877	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Fe	0.16	mg/l	FE_NST
4878	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		As	0.01	mg/l	AS_NG
4878	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Cr	0.03	mg/l	CR_NG
4878	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Cu	0.04	mg/l	CU_NG
4878	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Mo	0.014	mg/l	MO_NG
4878	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	I		Pb	0.004	mg/l	PB_NG
4879	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII	Roheline jarv	Benseen	<0.10	µg/l	BEN_PGF
4879	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		Etüülbenseen	<0.10	µg/l	EB_PGF
4879	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		Ksüleenid	<0.10	µg/l	XYL_PGF
4879	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		Nafta (GC),P	<10.0	µg/l	OIL_PGF
4879	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		Tolueen	<0.10	µg/l	TOL_PGF
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		2,3-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		2,5-dimetüülresortsiin	<10.0	µg/l	PHEN2_HPLC
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		2,6-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		3,4-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		3,5-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		5-met.resortsiin	<10.0	µg/l	PHEN2_HPLC
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		Fenool	<2.00	µg/l	PHEN1_HPLC
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		PAH (sum)	<0.20	µg/l	PAH_CHMS
4880	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	VII		Resortsiin	<10.0	µg/l	PHEN2_HPLC

4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Värvus	120°	°	
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Läbipaistvus	30cm		
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Lõhn	nõrk mõrkjas		
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Kuivjääk	308	mg/l	RE_D105
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Hõljuvaine	9	mg/l	PS_C
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	pH	7.83		PH_L20
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	BHT7	1.8	mgO/l	BOD7_NE
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	KHTMn	20	mgO/l	CODMN_NT
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	NH4-N	0.10	mg/l	NH4N_NS
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	NO2-N	0.013	mg/l	NO2N_NSD
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	NO3-N	1.10	mg/l	NO3N_NS
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	N üld	3.4	mg/l	NKJ_NTM
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	PO4-P	0.011	mg/l	PO4P_NS
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	P üld	0.039	mg/l	PTOT_NS
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Cl	11.0	mg/l	CL_NT
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	SO4	38	mg/l	SO4_FTS
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	HCO3	3.4	mg-ekv/l	ALK_NP45
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Karedus	4.4	mg-ekv/l	CAMG_NT
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Ca	58	mg/l	CA_NT
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Mg	18	mg/l	MG_NT
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Na	6.0	mg/l	NA_NEF
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	K	7.0	mg/l	K_NEF
4883	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Fe	0.83	mg/l	FE_NST
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	2,3-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	2,6-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	3,4-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	3,5-dimetüülfenool	<2.00	µg/l	PHEN1_HPLC
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	5-met.-2-et.resortsiin	<10.0	µg/l	PHEN2_HPLC
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	5-met.resortsiin	<10.0	µg/l	PHEN2_HPLC
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Fenool	<2.00	µg/l	PHEN1_HPLC
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	PAH (sum)	<0.20	µg/l	PAH_CHMS
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	Resortsiin	<10.0	µg/l	PHEN2_HPLC

4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	o-kresool (sum)	<2.00	µg/l	PHEN1_HPLC
4884	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Kulgu jõgi	p,m-kresool (sum)	<2.00	µg/l	PHEN1_HPLC
4885	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Nakro kraav	As	0.01	mg/l	AS_NG
4885	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Nakro kraav	Cr	0.05	mg/l	CR_NG
4885	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Nakro kraav	Cu	0.01	mg/l	CU_NG
4885	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Nakro kraav	Mo	0.015	mg/l	MO_NG
4885	Pinnavesi	02-Nov-01	AS Balti Elektrijaam	Nakro kraav	Pb	0.01	mg/l	PB_NG

Appendix 3

Prognooshinnang veetaseme muutusele

Balti Elektrijaama 2. tuhavälja alumises tiigis

2. tuhavälja alumise tiigi veetaseme muutuste prognoosimisel on eeltingimusteks, et 2. tuhaväli suletakse ja vee juurdevool tuhavälja tiiki lakkab. Sellistes tingimustes võivad tiigi jäägid täieneda põhiliselt sademete arvelt ning äravoolu komponendid moodustuvad aurumisest veepinnalt ja infiltratsioonist põhjaveekihtidesse.

Hüdrogeoloogilises läbilõikes on veehoidla piirkonnas 3 m paksune turbakiht, mille all kohati lasuvad voolav saviliiv ja liivsavi ning üleujutatud liiv, paksusega 4 m. Nende all lasub Lasnamäe-Kunda veekihi lõheline ja karstunud lubjakivi.

Keskmine vertikaalne filtratsioonikoefitsient on üleujutatud kvaternaari kihtkonnas k = 0,008 m/ööp., ordoviitsiumi lubjakivides – 27 m/ööp., kus see muutub väga suures ulatuses – alates 5 m/ööp. kuni 130 m/ööp. (Podžarskaja, 1955). Põhjaveevoolu suund on Narva veehoidla poole: kvaternaarisetetes kallakusega I_Q = 0,00034 ja Lasnamäe-Kunda veekihis – I_O = 0,00067 (joonis 1, vk. 7, 8, 10 ja 11). Sellistes tingimustes suundub tiigi filtraat vertikaalselt kvaternaari veekihist lasuvasse Lasnamäe-Kunda veekihti kallakusega

$$I_v = \frac{\Delta h}{\Delta l} = \frac{2832-2780}{26{,}6-19} = \frac{0{,}46}{7{,}6} = 0{,}060$$

kus Δh – tiigi ja vk. 10 (O_2ls-=$O_{2\text{-}1}$kn) veetasemete vahe;

Δl – kvaternaarikihi paksus tiigi all.

Kvaternaarisetetes on horisontaalne põhjaveevool kivimite madalate filtratsiooniomaduste ja väikese kallakuse tõttu väga piiratud. Infiltratsioonivee äravool veehoidlasse hakkab toimuma Lasnamäe-Kunda veekihis.

2. tuhavälja alumise tiigi pindala F = 1684100 m². Tiigi veetaseme alanemise prognoosimisel kasutati Narva Ilmajaama pikaajaliste vaatluste keskmisi andmeid: sademed O = 605 mm/aastas, aurumine Narva veehoidla pinnalt A = 495 mm/aastas. Seega:

aastane sademetevee juurdevool alumisse tiiki:

$$W_O = F \cdot O = 1684100 \cdot 0{,}605 = 1018880 \text{ m}^3$$

aastane aurumine veepinnalt:

$$W_A = F \cdot A = 1684100 \cdot 0{,}495 = 833630 \text{ m}^3$$

aastane infiltratsioon:

$$W_i = K \cdot I_v \cdot F \cdot 365 = 0{,}008 \cdot 0{,}06 \cdot 1684100 \cdot 365 = 295054 \text{ m}^3$$

Juurdevoolu ja äravoolu bilansi komponentide vahe ΔW näitab tiigi veetaseme tõusu või langust.

$$\Delta W = W_O - (W_A + W_i) = 1018880 - (833630 + 295054) = -109804 \text{ m}^3$$

Aastane veetaseme alanemine arvutatakse valemist:

$$\Delta h = \frac{\Delta W}{F} = \frac{-109804}{1684100} = -0{,}065 \, m/aastas$$

Miinusmärk näitab veetaseme alanemist tiigis 6,5 cm võrra aastas.

Saadud tulemuste põhjal ületab keskmise veerikkusega aastal äravool juurdevoolu ning selle tulemusel peaks trend olema veetaseme alanemisele. Faktilised tiigi veetaseme seire andmed on liiga lühiaegsed ja nende põhjal trendidest rääkida ei ole võimalik (joonis 2), kuid joonisel 3 toodud tuhaväljadest lõuna pool asuvate vaatluskaevude vaatlusread näitavad põhjaveetaseme tühist alanemist nii kvaternaarisetetes (vk. 7, 11) kui ka Lasnamäe-Kunda veekihis (vk. 8, 10).

Appendix 4

ANDMED BALTI ELEKTRIJAAMA TUHAMÄE NR 2 ALUMISE SETTETIIGI (ROHELINE JÄRV) PROOVIPUNKTIDES MÕÕDETUD VEETEMPERATUURI, VEE pH JA ELEKTRIJUHTIVUSE KOHTA

Objekt: **Balti elektrijaama tuhaväli nr 2**
Roheline järv (alumine settetiik)

Proovi liik: **Pinnavesi, ühekordne**

Proovivõtja: **Rein Järvekülg**

Kuupäev: 02.11.2001

Analüüsis: **Rein Järvekülg**
Eesti Loodushoiu Keskus
Tartu, Kesk 44-15

Nr	Proovipunkti asukoht*	Veetemp. (°C)	pH	Vee elektri-juhtivus (µSi/cm)
1	Väljavoolutoru tuhamäe peal (NE-serv)	3,4	13,5	13570
2	Vasakult ülalt kolmas aurustumistiik	2,7	13,1	12900
3	Parempoolse alumise aurust. tiigi väljavool	3,7	11,0	7640
4	Drenaažikanal pumbamaja lähedal (E-serv)	3,1	13,3	12480
5	Rohelise järve NE-nurk (pumbamaja läh.)	4,1	10,1	5930
6	Rohelise järve E-serv	3,9	9,9	5930
7	Rohelise järve S-serv	3,1	10,0	5920
8	Rabakraav Rohelise järve S-serval tammi taga	4,5	7,7	1924
9	Kulgu jõgi (kanali osa, Rohelise järvest SWW)	3,6	7,8	458
10	Arumäe oja (enne suubumist Kulgu jõkke)	4,1	8,4	438

*** Proovivõtu täpsed kohad on märgitud joonisel 1**

BALTI ELEKTRIJAAMA TUHAVÄLJA NR.2 SETTETIIGI (ROHELINE JÄRV) VEE KEEMILINE ANALÜÜS

Objekt: Balti elektrijaama tuhaväli nr 2
Roheline järv (alumine settetiik)

Proovi liik: Pinnavesi, ühekordne

Proovivõtja: Rein Järvekülg

Proovivõtt: 02.11.2001

Analüüsitud: 05.11-08.11. 2001

Analüüsis: Malle Viik
EPMÜ Zooloogia ja Botaanika Instituut
Hüdrobioloogia osakond
Jõgedebioloogia labor

Proovi-võtu koht	Elektri-juhtivus mS	pH	KHT mg/l	$N_{üld}$ mg/l	NO_2-N mg/l	NO_3-N mg/l	NH_4-N mg/l	PO_4-P mg/l	$P_{üld}$ mg/l
			Test "Dr. Lange"	NTOT-NC	NO_2N-NSD	NO_3N-NS	NH_4N-NS	PO_4P-NS	PTOT-NC
7	5,3	9,6	148	1,9	0,000	0,000	0,076	0,01	0,07
6	5,4	9,6	134	1,8	0,000	0,000	0,089	0,008	0,07

* Proovivõtu täpsed kohad on märgitud joonisel 1

Appendix 6

Eesti Elektrijaama tuhaanalüüs (Eesti prügimägede sulgemine ja järelhooldus. Eesti tööstus- ja energiatootmisjäätmete kasutamine prügimägede kaitsekonstruktsioonides. Taaskasutusselgitus, 1999. Viatek OY, AS Maves)

	Jäme fraktsioon -tsüklon mg/kg		Peen fraktsioon - elektrifilter mg/kg		Piirarv elutsoonis[x)] mg/kg	Piirarv tööstustsoonis[x)] mg/kg
	lahustunud sisaldus	kogusisaldus	lahustunud sisaldus	kogusisaldus		
	NEN-7341	EPA 3051	NEN-7341	EPA 3051		
Ag	<0,02	0,3	<0,02	0,4		
Al	1,4	33650	1,6	20990		
As	<0,1	36	<0,1	11	10	50
B	<2	171	37	50		500
Ba	31	138	33	121	750	2000
Be	<0,02	0,8	<0,2	0,7	10	50
Bi	<0,1	0,1	<0,1	0,03		
Ca	12670	18860	65866	304000		
Cd	<0,03	0,7	<0,03	0,24	5	20
Co	<0,03	4,6	<0,03	3,6	50	300
Cr	0,7	53	13	20	300	800
Cu	1,3	9,1	1,4	11	150	500
Fe	3,2	19990	<3	23240		
K	9945	35550	5625	9310		
Li	1,1	23	6,2	14		
Mg	<10	19270	14	31987		
Mn	<0,05	328	<0,05	452		
Mo	1,4	7,9	2,9	3,5	5	200
Na	50	933	258	534		
Ni	0,1	24	<0,1	16	150	500
P	<20	1420	<20	110		
Pb	<0,02	93	0,02	28	300	600
Rb	2,2	89	2,3	19		
Sb	<0,02	0,01	<0,02	<0,005	20	100
Se	<5	<1,3	<5	<1,3	5	20
Sr	143	206	131	288		
Th	<0,02	5,1	<0,02	3,7		
Ti	<0,5	780	<0,5	750		
Tl	0,2	2,2	<0,1	0,2	5	20
U	<0,01	3,8	<0,01	2,7	50	500
V	<0,2	57	1,9	28	300	1000
Zn	<1	110	<1	53	500	1500
SO_4	15500	29000	32000	45000		

[x)] Ohtlike ainete piirnormid pinnases ja põhjavees (RTL 1999, 105, 1319)

ПРОГНОЗ

Баланса воды по золоотвалу № 1 и золоотвалу №2 Балтийской ЭС

Данные для расчета :

$Э_{выр}$ - выработка электроэнергии за год, млн. кВтч $Э_{выр}$ =2000 млн.кВтч
$Q_{отп}$ - отпущенное потребителю тепло, млн.кВтч $Q_{отп}$ = 750 млн.кВтч
$V_{топл}$ - расход натурального топлива, млн. т $V_{топл}$ = 3,2 млн. т
$V_{золы}$ – количество образовавшейся золы, тыс. т $V_{золы}$ = 1431 тыс. т
$V_{золы\ з.}$ – количество золы, поданной на золоотвал, тыс. т $V_{золы\ з.}$ = 1350 тыс. т
$W_{связ.}$ – количество связанной золой воды на золоотвале, тыс. т

$W_{связ.} = 0,635 * V_{золы\ з.} = 857,3$ тыс. т

$W_{доп.исп}$ – дополнительные испарения от подогрева пульпы на 5°С, тыс. т

$W_{доп.исп} = 0,00085*5*25*V_{золы\ з.} = 143,4$ тыс.т

$H_{ос}$ – высота годового количества осадков (среднестатистическая для г.Нарва), мм в.ст.

$H_{ос} = 623$ мм = 0,623 м

$H_{исп.\ вод}$ – высота годового количества испарений с водной поверхности, мм в. ст.

$H_{исп.\ вод} = 580$ мм = 0,58 м

$H_{исп.\ раст}$ – высота годового количества испарений с суши при наличии растительности,

$H_{исп.раст} = 460$ мм = 0,46 м

$H_{исп.\ суши}$ – высота годового количества испарений с суши, $H_{исп.суши} = 230$ мм = 0,23 м
$S_{сбора}$ – площадь водосбора золоотвала №1, $S_{сбора} = 5087$ тыс. м^2
$S_{в.пов}$ – площадь испарения, покрытая водой на золоотвале №1, $S_{в.пов} = 1590$ тыс. м^2
$S_{раст}$ – площадь испарения с суши, покрытой растительностью на золоотвале №1,
$S_{раст} = 150$ тыс. м^2
$S_{суши}$ - площадь испарений с суши на золоотвале №1, $S_{суши} = 3347$ тыс. м^2
$W_{ос}$ – количество осадков, выпавших на территории золоотвала №1

$W_{ос} = S_{сбора} * H_{ос} = 3169$ тыс. м^3

$W_{исп.\ вод}$ – количество воды испарившейся с водной поверхности золоотвала №1

$W_{исп.вод} = S_{в.пов} * H_{исп.вод} = 922$ тыс. м^3

$W_{исп.раст}$ – количество воды, испарившейся с суши при наличии растительности

$W_{исп.раст} = S_{раст} * H_{исп.раст} = 69$ тыс. м^3

$W_{исп.суши}$ – количество воды, испарившейся с суши

$W_{исп.суши} = S_{суши} * H_{исп.суши} = 770$ тыс. м^3

$S_{сб2}$ – площадь водосбора золоотвала №2, $S_{сб2} = 5890$ тыс.м^2
$S_{в.пов2}$ – площадь испарения, покрытая водой, $S_{в.пов2} = 4400$ тыс.м^2
$S_{раст2}$ – площадь испарения суши с растительностью, $S_{раст2} = 200$ тыс.м^2
$S_{суши2}$ – площадь испарений с суши, $S_{суши2} = 1290$ тыс.м^2
$W_{ос2}$ – количество осадков выпавших на золоотвале №2, $W_{ос2} = 3669$ тыс.м^3
$W_{исп.вод2}$ – количество воды, испарившейся с водной поверхности золоотвала №2

$W_{исп.вод2} = 2552$ тыс.м^3

$W_{исп.раст2}$ – количество воды, испарившейся с суши при наличии растительности,

$W_{исп.раст2} = 92$ тыс.м^3

$W_{исп.суши2}$ – количество воды, испарившейся с суши, $W_{исп.суши2} = 297$ тыс.м^3
$W_{хво}$ – сброс от хим. Водоочистки в ГЗУ, $W_{хво} = 360$ тыс.м^3
$W_{доп}$ – другие дополнительные сбросы в системуГЗУ, $W_{доп} = 200$ тыс.м^3
$W_{с.оч}$ – потребление воды при сероочистке (2000час по 25 м3/час), $W_{с.оч} = 50$ тыс. м^3

$W_{бр.}$ – дополнительное испарение при работе брызгальной установки (золоотвал №2), $W_{бр.} = 200$ тыс.м^3

$W_{оч.}$ – количество воды, очищаемое на установке «обратный осмос» (золоотвала №2), $W_{оч.} = 790$ тыс. м^3

$W_{ф1}$ – объем фильтрации через ограждающие дамбы канала осветленной воды в отводящий канал циркуляционной воды , $W_{ф1} = 50$ тыс. м^3

$W_{ф2}$ – объем фильтрации через ограждающие дамбы пруда золоотвала №2 в окружающую среду, $W_{ф2} = 140$ тыс.м^3

Баланс золоотвала №1:

$$B_1 = W_{ос}-W_{исп.вод}-W_{раст}-W_{суши}-W_{связ}-W_{доп.исп}+W_{хво}+W_{доп.}-W_{с.оч}-W_{ф1} = 867{,}7 \text{ тыс.м}^3$$

Баланс золоотвала №2:

$$B_2 = W_{ос2} - W_{исп.вод2} - W_{раст2} - W_{сушн2} - W_{бр.} - W_{оч} - W_{ф2} = -402 \text{ тыс.м}^3$$

ВОЗМОЖНЫЕ ВАРИАНТЫ РЕШЕНИЯ ПРОБЛЕМЫ ПОЛОЖИТЕЛЬНОГО БАЛАНСА ВОД НА ЗОЛООТВАЛЕ №1 БАЛТИЙСКОЙ ЭС

Вариант №1

1. Остается существующая технология золошлакоудаления (гидрозолоудаление с соотношением 1: 25.
2. Вода от хим. Водоочисток направляется не в систему ГЗУ, а в подготовленные емкости или пруды, в которых в определенной пропорции производится смешивание с осветленной водой золоотвала №1. После нейтрализации (возможно и дополнительной очистки) вода направляется на технологические нужды станции или непосредственно сбрасывается в природные водоемы. При соотношении смешивания 1: 1 в течение года будет выведено 720 тыс.м^3 (360 тыс.м^3 + 360тыс.м^3.
3. Уменьшение и полная ликвидация других дополнительных сбросов в систему ГЗУ. Сокращение на 200 тыс.м^3 поступлений в систему.
4. В результате выполнения этих мероприятий ликвидируется положительный баланс золоотвала №1 (720 тыс.м^3 + 200 тыс. м^3 = 920 тыс.м^3 > 867.7 тыс.м^3).
5. Установка " обратный осмос " и брызгальная система золоотвала №2 обеспечивают отрицательный баланс воды на золоотвале №2, решая задачи рекультивации этого объекта.
6. Дополнение к варианту: устройство брызгальной системы на золоотвале №1, работающей на дренажной воде ?, или как один из вариантов, работа на воде после смешения вод ХВО (если ее нельзя сразу сбрасывать, надо очищать).

Вариант 2

1. Реконструкция системы ГЗУ с изменением технологии гидрозолоудаления (уменьшение соотношения золошлаков и воды до 1: 3-5).
2. Изменение технологии складирования золошлаков на золоотвале.
3. Вследствие уменьшения количества воды в обороте уменьшится потребный объем прудов осветления (как верховых, так и низового). Часть территории золоотвала можно вывести из непосредственного технологического цикла.
4. Создание изолированной системы прудов с улучшенными качествами воды на этой территории.
5. Создание эффективной брызгальной системы на этих прудах (производительностью по испарению до 200 – 300 тыс. м^3 в год).
6. Постепенный перевод установки " обратный осмос" на работу с водой испарительных прудов золоотвала №1 (по мере высвобождения мощностей при решении рекультивации золоотвала №2).
7. Дополнительно: ликвидация дополнительных сбросов в систему ГЗУ. Увеличение испарений с водной поверхности за счет более полного обводнения освободившихся территорий золоотвала №1 (примерно 100 тыс.м^3 в год).
8. До решения проблемы с избытком воды на золоотвале №1 излишки воды должны перебрасываться на золоотвал №2 или сбрасываться в природу (в последнем случае необходимо устройство сбросного узла).

Вариант 3

Синтез вариантов 1 и 2.

Vee aurumisest tuhaväljalt
(Väljavõte)
Dr. Ain Kull TÜ Geograafiainstituut.

Piirkonna veebilansi koostamisel tuleb arvestada sademete hulga, äravoolu (sh. infiltratsiooni) ja aurumisega. Infiltratsiooni osakaal veebilansis on suur hea veeläbilaskvusega pinnase (nt. kruus, liiv) puhul kuid väheoluline plaatja struktuuriga pinnase (nt savi, tuhk) ja tiheda või tihendatud tehnogeense pinnase korral. Aurumise puhul eristatakse kahte komponenti a) auramist aluspinnalt (vesi, muld, pinnas) ehk evaporatsiooni ning b) auramist taimedelt ehk transpiratsiooni. Taimkattega kaetud alade puhul käsitletakse evaporatsiooni ja transpiratsiooni koos ning nimetatakse evapotranspiratsiooniks.

Evapotranspiratsioon sõltub aurumiseks vaba vee olemasolust ning selle aurustamiseks olevast energia hulgast (potentsiaalne evapotranspiratsioon) ja arvukatest teguritest mis mõjutavad potentsiaalse evapotranspiratsiooni realiseerumist. Peamisteks evapotranspiratsiooni mõjutavateks mikrometeoroloogilisteks teguriteks on õhuniiskus, tuule kiirus, õhutemperatuur, päikesekiirguse intensiivsus, taimestikuga seotud parameetritest avaldavad enim mõju võrastruktuur, taimestiku kõrgus, lehepinnaindeks (LAI), pinnaseparameetritest on oluline veemahutavus, närbumisniiskus, jt.

Evapotranspiratsiooni arvutamise aluseks on 1996-2001.a. Tartumaal Sipe oja valglas erinevates taimekooslustes läbi viidud uuringute käigus loodud mudelarvutused. Uuritavateks kooslusteks olid lammisoo tarna kooslusega, pajustik, rohumaa, lehtpuumets, okasmets.

Balti Elektrijaama tuhaväljal erinevate taimekoosluste puhul võimaliku evapotranspiratsiooni arvutamiseks on kasutatud Eesti Meteoroloogia ja Hüdroloogia Instituudi ilmajaamade andmeid (eelistatult Narva ilmajaam). Puuduvate meteoroloogiliste ja mikroklimaatiliste parameetrite saamiseks on ekstrapoleeritud Sipe valglas automaatilmajaamaga mõõdetud andmeid.

Pinnase puhul on eeldatud, et mullaveevaru on väike, aktiivse vettmahutava kihina on palja pinnase korral käsitletud pealmist 15 cm paksust kihti, rohttaimestikuga kaetud pinnase puhul 20 cm ja kõrghaljastuse ning rohurinde esinemisel 25 cm paksust pealmist kihti.

Hinnang on antud järgmistele variantidele: a) taimestamata tuhaväli, b) tarna kooslus, c) pajustik, d) rohumaa, e) rohttaimestikust alusrindega kase-paju segamets. Lisaks on hinnatud erinevate koosluste koos kasutamisest tingitud mõju evapotranspiratsioonile. Aluseks on võetud aasta keskmiste sademete hulk 642 mm (Narva ilmajaama andmetel) ja keskmine õhutemperatuur 4,7 kraadi

	Evapotranspiratsioon
Taimestamata tuhaväli	377 mm
Tarna kooslus	*532 mm*

Pajustik	*471 mm*
Rohumaa	508 mm
Rohttaimestikust alusrindega kase-paju segamets	*559 mm*

Kuna evapotranspiratsioon on suurim hea õhuvahetuse (tekkiva niiskuse ärakanne), intensiivselt transpireerivate taimede ja hästi soojeneva aluspinna (tume orgaanika, varis) korral, siis kõigi nende tingimuste optimeerimiseks on otstarbekas kasutada erinevaid kooslusi ning kasutada ära (mikro)reljeefist tulenevaid võimalusi. Näiteks on otstarbekas rajada tuhavälja põhja- ja loodepoolsesse külge kõrgem ning tihedam puistu mis ei varjutaks seega päikesekiirgust teistes kooslustes, madalamates lohkudes suurendaks evapotranspiratsiooni tarnalodude rajamine. Tasastel, kiiremini kuivavatel ja põuale tundlikumates piirkondades on otstarbekas rajada tiheda rohurindega (kõrrelistest) varju pakkuvaid kuid hõredaid kaasikuid. Tuhavälja nõlvadele on otstarbekas rajada tihedad paju-kasepuistud ning jalamine hea puhverdusvõimega lodud. Erinevate koosluste sobiv kombineerimine võib kogu ala evapotranspiratsiooni suurendada kuni 10% võrreldes iga koosluse enda evapotranspirtasiooni väärtusega (Sipe valgla erinevate lammialade näitel).

Huvitav on ka tarna koosluste pH Sipel: Tarna kooslusega lammisoo pinnase moodustas kehvalt ja keskmiselt lagunenud turvas ja sügavamas kihis jütja suure järvelubja sisaldusega. Vee keskmine pH juuretsoonis on 7,9, maksimaalseks väärtuseks on suvel mõõdetud 8,89. Konduktiivsuse keskväärtus on 1104 $\mu S/cm^2$. Muld on veega küllastunud.

Seda saad ehk kasutada. Lisaks puhverdab iga kooslus pHd väga tugevasti. Seega ülejääv vesi, mis valgub või voolab ära, ei ole enam kokku puutunud reaktiivse kihiga ja ei kujuta endast ohtu loodusele. Viimane küll minu spekulatsioon, kuid seda kinnitab selgelt Ahtme näide.

Jaak

Appendix 9

Table 1. TerrAttesT 2[22] Results of Surface Water Analyses

Characteristics	Reporting Limits µg/l	Requirements for Waste Water Discharged into Water Bodies or into Soil (VVm 31.07.2001 nr. 269) Limits, µg/l	Date	Sampling Points: Green Lake (VII) WAC7802	Outlet of Channel WAC7803	NAKRO Ditch 1 WAC7804	NAKRO Ditch 2 WAC7805	NAKRO Landfill WAC7806
				µg/l				
PH		**6-9***	09.01.2002	9,7	12,0	12,0	13,0	7,6
Conductivity (mS/m)			09.01.2002	510	800	1100	1300	1100
METALS AND OTHER ANORGANIC COMPOUNDS								
Arsenic (As)	3	**200***	09.01.2002	12	26	54	-	11
Antimony (Sb)	5	**500***	09.01.2002	-	-	-	-	-
Barium (Ba)	1		09.01.2002	-	21	10	260	-
Beryllium (Be)	1		09.01.2002	-	-	-	-	-
Cadmium (Cd)	0.4	**200***	09.01.2002	-	-	-	-	-
Chromium (Cr)	2	**500***	09.01.2002	4	11	8	-	210
Chromium (VI) Cr^{6+}		**100***	23.01.2002					
Cobalt (Co)	1		09.01.2002	-	-	3	-	-
Copper (Cu)	3	**2000***	09.01.2002	5	8	6	-	-
Mercury (Hg)	0.04	**50***	09.01.2002	-	-	0,09	-	-
Lead (Pb)	3	**500***	09.01.2002	-	-	-	-	-
Molybdenum (Mo)	2		09.01.2002	70	85	71	49	-
Nickel (Ni)	2	**1000***	09.01.2002	-	7	47	8	13
Selenium (Se)	5		09.01.2002	-	-	-	-	-
Tin (Sn)	5	**500***	09.01.2002	-	-	-	-	-
Vanadium (V)	2		09.01.2002	27	71	200	7	4
Zinc (Zn)	5	**2000***	09.01.2002	-	-	56	-	9
AROMATIC COMPOUNDS								
MONO AROMATIC HYDROCARBONS								
Benzene	0.2		09.01.2002	-	2,2	-	1,1	-
Ethylbenzene	0.2		09.01.2002	-	-	-	-	-
Toluene	1		09.01.2002	-	3,8	-	-	-
o-Xylene	0,2		09.01.2002	-	0,4	-	-	-
m/p-Xylene	0,2		09.01.2002	-	0,9	-	-	-
Xylenes (sum)	S		09.01.2002	-	1,3	-	-	-

Characteristics	Reporting Limits µg/l	Requirements for Waste Water Discharged into Water Bodies or into Soil (VVm 31.07.2001 nr. 269) Limits, µg/l	Date	Sampling Points				
				Green Lake (VII) WAC7802	Outlet of Channel WAC7803	NAKRO Ditch 1 WAC7804	NAKRO Ditch 2 WAC7805	NAKRO Landfill WAC7806
				µg/l				
Styrene	0,1		09.01.2002	-	-	-	-	-
1,2,4-Trimethylbenzene	0,1		09.01.2002	-	-	-	-	-
1,3,5-Trimethylbenzene	0,1		09.01.2002	-	-	-	-	-
n-Propylbenzene	0,1		09.01.2002	-	-	-	-	-
Isopropylbenzene	0,1		09.01.2002	-	-	-	-	-
n-Butylbenzene	0,1		09.01.2002	-	-	-	-	-
sec-Butylbenzene	0.2		09.01.2002	-	-	-	-	-
tert-Butylbenzene	0.1		09.01.2002	-	-	-	-	-
p-Isopropyltoluene	0.2		09.01.2002	-	-	-	-	-
PHENOLS								
1-BASIC PHENOLS								
o-Cresol	0,05		09.01.2002	-	0,13	-	0,14	22
m-Cresol	0,05		09.01.2002	-	-	-	-	51
p-Cresol	0,05		09.01.2002	-	21	**1700**	8,2	**1000**
Cresoles (sum)	S		09.01.2002	-	21	**1700**	8,3	**1100**
2,4-Dimethylphenol	0,01		09.01.2002	-	-	-	-	-
2,5-Dimethylphenol	0,01		09.01.2002	-	-	-	-	-
2,6-Dimethylphenol	0,01	**100****	09.01.2002	-	-	-	-	-
3,4-Dimethylphenol	0,01		09.01.2002	-	0,03	-	0,02	-
Phenol	0,05		09.01.2002	-	12	**530**	17	**770**
o-Ethylphenol	0,01		09.01.2002	-	-	-	0,01-	-
m-Ethylphenol	0,01		09.01.2002	-	0,07	0,6	0,09	-
Thymol	0,01		09.01.2002	-	-	-	-	-
4-Ethyl/2,3 ; 3,5 Dimethyl phenol	0,01		09.01.2002	-	0,33	3	0,80	2
PAHs								
Naphthalene	0,1		09.01.2002	-	-	-	-	6,2
Acenaphthylene	0,05		09.01.2002	-	-	-	-	-
Acenaphthene	0,1		09.01.2002	-	-	-	-	-
Fluorene	0.01		09.01.2002	-	-	-	-	-
Phenanthrene	0.02		09.01.2002	-	-	-	-	-

Characteristics	Reporting Limits µg/l	Requirements for Waste Water Discharged into Water Bodies or into Soil (VVm 31.07.2001 nr. 269) Limits, µg/l	Date	Sampling Points				
				Green Lake (VII) WAC7802	Outlet of Channel WAC7803	NAKRO Ditch 1 WAC7804	NAKRO Ditch 2 WAC7805	NAKRO Landfil WAC7806
				µg/l				
Anthracene	0.01		09.01.2002	-	-	-	-	-
Fluoranthene	0.01		09.01.2002	-	-	-	-	-
Pyrene	0.1		09.01.2002	-	-	-	-	-
Benzo(a)anthracene	0,02		09.01.2002	-	-	-	-	-
Chrysene	0,02		09.01.2002	-	-	-	-	-
Benzo(a)pyrene	0,1		09.01.2002	-	-	-	-	-
Benzo(b)fluoranthene	0,02		09.01.2002	-	-	-	-	-
Benzo(k)fluoranthene	0,02		09.01.2002	-	-	-	-	-
Benzo(ghi)perylene	0,1		09.01.2002	-	-	-	-	-
Indeno(123cd)pyrene	0,1		09.01.2002	-	-	-	-	-
Dibenzo(ah)anthracene	0,1		09.01.2002	-	-	-	-	-
PAHs (sum 10 Dutch VROM)	S		09.01.2002	-	-	-	-	6,2
PAHs (sum 16 US EPA)	S	**10***	09.01.2002	-	-	-	-	6,2
HALOGENATED HYDROCARBONS								
VOLATILE HALOGENATED HYDROCARBONS								
Trichloromethane(chloroform)	-	**1000***	09.01.2002	-	-	-	-	-
Tetrachloromethane(tetra)	0,5	**1500***	09.01.2002	-	-	-	-	-
1,2 Dichloroethane	0,1	**3***	09.01.2002	-	-	-	-	-
1,1,1-Trichloroethane	0,5		09.01.2002	-	-	-	-	-
1,1,2-Trichloroethane	0,2		09.01.2002	-	-	-	-	-
Trichloroethanes (sum)	S		09.01.2002	-	-	-	-	-
1,1,1,2-Tetrachloroethane	0.1		09.01.2002	-	-	-	-	-
1,1,2,2-Tetrachloroethane	0.1		09.01.2002	-	-	-	-	-
Tetrachloroethanes (sum)	S		09.01.2002	-	-	-	-	-
Trichloroethene	0.1	**100***	09.01.2002	-	-	-	-	-
Tetrachloroethene	0.2	**100***	09.01.2002	-	-	-	-	-
1,2-Dichloropropane	0.1		09.01.2002	-	-	-	-	-
1,3-Dichloropropane	0.1		09.01.2002	-	-	-	-	-
1,2,3-Trichloropropane	0.1		09.01.2002	-	-	-	-	-
1,1-Dichloropropene	0.1		09.01.2002	-	-	-	-	-

Characteristics	Reporting Limits µg/l	Requirements for Waste Water Discharged into Water Bodies or into Soil (VVm 31.07.2001 nr. 269) Limits, µg/l	Date	Sampling Points				
				Green Lake (VII) WAC7802	Outlet of Channel WAC7803	NAKRO Ditch 1 WAC7804	NAKRO Ditch 2 WAC7805	NAKRO Landfill WAC7806
				µg/l				
cis 1,3-Dichloropropene	0.1		09.01.2002	-	-	-	-	-
trans 1,3-Dichloropropene	0.1		09.01.2002	-	-	-	-	-
1,3-Dichloropropenes (sum)	S		09.01.2002	-	-	-	-	-
Dibromomethane	0,1		09.01.2002	-	-	-	-	-
1,2-Dibromoethane	0,1		09.01.2002	-	-	-	-	-
Tribromomethane (Bromoform)	0,1		09.01.2002	-	-	-	-	-
Bromodichloromethane	0,1		09.01.2002	-	-	-	-	-
Dibromochloromethane	0,1		09.01.2002	-	-	-	-	-
1,2-Dibromo-3-chloropropane	0,05		09.01.2002	-	-	-	-	-
Bromobenzene	0,1		09.01.2002	-	-	-	-	-
CHLORINATED BENZENES								
Monochlorobenzene	0.1		09.01.2002	-	-	-	-	-
1,2-Dichlorobenzene	0.5		09.01.2002	-	-	-	-	-
1,3-Dichlorobenzene	0.1		09.01.2002	-	-	-	-	-
1,4-Dichlorobenzene	0.2		09.01.2002	-	-	-	-	20
Dichlorobenzenes (sum)	S		09.01.2002	-	-	-	-	20
1,2,3-Trichlorobenzene	0.01		09.01.2002	-	-	-	-	-
1,2,4-Trichlorobenzene	0.01		09.01.2002	-	-	-	-	-
1,3,5-Trichlorobenzene	0,01		09.01.2002	-	-	-	-	-
Trichlorobenzenes (sum)	S	**50***	09.01.2002	-	-	-	-	-
1,2,3,4-Tetrachlorobenzene	0.005		09.01.2002	-	-	-	-	-
1,2,3,5/1,2,4,5-Tetrachlorobenzene	0.005		09.01.2002	-	-	-	-	-
Tetrachlorobenzenes (sum)	S		09.01.2002	-	-	-	-	-
Pentachlorobenzene	0.01		09.01.2002	-	-	-	-	-
Hexachlorobenzene	0.02	**5***	09.01.2002	-	-	-	-	-
CHLORINATED PHENOLS								
o-Chlorophenol	0.1		09.01.2002	-	-	-	-	-
m-Chlorophenol	0.01		09.01.2002	-	-	-	-	-
p-Chlorophenol	0.01		09.01.2002	-	-	-	-	-
Monochlorophenols (sum)	S		09.01.2002	-	-	-	-	-

Characteristics	Reporting Limits µg/l	Requirements for Waste Water Discharged into Water Bodies or into Soil (VVm 31.07.2001 nr. 269)	Date	Sampling Points				
				Green Lake (VII) WAC7802	Outlet of Channel WAC7803	NAKRO Ditch 1 WAC7804	NAKRO Ditch 2 WAC7805	NAKRO Landfill WAC7806
		Limits, µg/l		µg/l				
2,3-Dichlorophenol	0.01		09.01.2002	-	-	-	-	-
2,4/2,5-Dichlorophenol	0.01		09.01.2002	-	-	-	-	-
2,6-Dichlorophenol	0.01		09.01.2002	-	-	-	-	-
3,4-Dichlorophenol	0.01		09.01.2002	-	-	-	-	-
3,5-Dichlorophenol	0.01		09.01.2002	-	-	-	-	-
Dichlorophenols (sum)	S		09.01.2002	-	-	-	-	-
2,3,4-Trichlorophenol	0.01		09.01.2002	-	-	-	-	-
2,3,5-Trichlorophenol	0.01		09.01.2002	-	-	-	-	-
2,3,6-Trichlorophenol	0.01		09.01.2002	-	-	-	-	-
2,4,5-Trichlorophenol	0.01		09.01.2002	-	-	-	-	-
2,4,6-Trichlorophenol	0.01		09.01.2002	-	-	-	-	-
3,4,5-Trichlorophenol	0.01		09.01.2002	-	-	-	-	-
Trichlorophenols (sum)	S		09.01.2002	-	-	-	-	-
2,3,4,5-Tetrachlorophenol	0.01		09.01.2002	-	-	-	-	-
2,3,4,6/2,3,5,6-Tetrachlorophenol	0.005		09.01.2002	-	-	-	-	-
Tetrachlorophenoles (sum)	S		09.01.2002	-	-	-	-	-
Pentachlorophenol	0,005	**0,2***	09.01.2002	-	-	-	-	-
4-Chloro-3-methylphenol	0,01		09.01.2002	-	-	3	-	280
PCBs								
PCB 28	0.01		09.01.2002	-	-	-	-	-
PCB 52	0.01		09.01.2002	-	-	-	-	-
PCB 101	0.01		09.01.2002	-	-	-	-	-
PCB 118	0.01		09.01.2002	-	-	-	-	-
PCB 138	0.01	**0,05***	09.01.2002	-	-	-	-	-
PCB 153	0.01		09.01.2002	-	-	-	-	-
PCB 180	0.01		09.01.2002	-	-	-	-	-
PCBs (sum. 6)	S		09.01.2002	-	-	-	-	-
PCBs (sum. 7)	S		09.01.2002	-	-	-	-	-
CHLOROANILINES								

Characteristics	Reporting Limits µg/l	Requirements for Waste Water Discharged into Water Bodies or into Soil (VVm 31.07.2001 nr. 269) Limits, µg/l	Date	Sampling Points				
				Green Lake (VII) WAC7802	Outlet of Channel WAC7803	NAKRO Ditch 1 WAC7804	NAKRO Ditch 2 WAC7805	NAKRO Landfill WAC7806
				µg/l				
2,3-Dichloroaniline	0.02		09.01.2002	-	-	-	-	-
2,4-Dichloroaniline	0.02		09.01.2002	-	-	-	-	-
2,5-Dichloroaniline	0.01		09.01.2002	-	-	-	-	-
2,6-Dichloroaniline	0.01		09.01.2002	-	-	-	-	-
3,5-Dichloroaniline	0.2		09.01.2002	-	-	-	-	-
Dichloroanilines (sum)	S		09.01.2002	-	-	-	-	-
CHLORONITROBENZENES								
o/p-Chloronitrobenzene	0.05		09.01.2002	-	-	-	-	-
m-Chloronitrobenzene	0.05		09.01.2002	-	-	-	-	-
Monochloronitrobenzenes (sum)	S		09.01.2002	-	-	-	-	-
2,3-Dichloronitrobenzene	0.1		09.01.2002	-	-	-	-	-
2,4-Dichloronitrobenzene	0.1		09.01.2002	-	-	-	-	-
2,5-Dichloronitrobenzene	0.1		09.01.2002	-	-	-	-	-
3,4-Dichloronitrobenzene	0.1		09.01.2002	-	-	-	-	-
3,5-Dichloronitrobenzene	0.02		09.01.2002	-	-	-	-	-
Dichloronitrobenzenes (sum)	S		09.01.2002	-	-	-	-	-
MISCELLANEOUS CHLORINATED HYDROCARBONS								
2-Chlorotoluene	0.1		09.01.2002	-	-	-	-	-
4-Chlorotoluene	0.1		09.01.2002	-	-	-	-	-
Chlorotoluenes (sum)	S		09.01.2002	-	-	-	-	-
1-Chloronaphthalene	0.02		09.01.2002	-	-	-	-	-
PESTICIDES								
CHLORINE PESTICIDES								
4,4-DDE	0.01	**0,05***	09.01.2002	-	-	-	-	-
2,4-DDE	0.01		09.01.2002	-	-	-	-	-
4,4-DDT	0.1		09.01.2002	-	-	-	-	-
4,4-DDD/2,4-DDT	0.02		09.01.2002	-	-	-	-	-
2,4-DDD	0.01		09.01.2002	-	-	-	-	-
DDT/DDE/DDD (sum)	S		09.01.2002	-	-	-	-	-
Aldrin	0.02	**0,05***	09.01.2002	-	-	-	-	-

Characteristics	Reporting Limits µg/l	Requirements for Waste Water Discharged into Water Bodies or into Soil (VVm 31.07.2001 nr. 269) Limits, µg/l	Date	Sampling Points				
				Green Lake (VII) WAC7802	Outlet of Channel WAC7803	NAKRO Ditch 1 WAC7804	NAKRO Ditch 2 WAC7805	NAKRO Landfill WAC7806
				µg/l				
Dieldrin	0.02	**0,05***	09.01.2002	-	-	-	-	-
Endrin	0.01	**0,05***	09.01.2002	-	-	-	-	-
Drins (sum)	S		09.01.2002	-	-	-	-	-
alfa-HCH	0.1		09.01.2002	-	-	-	-	-
beta-HCH	0.1		09.01.2002	-	-	-	-	-
gamma-HCH	0.1		09.01.2002	-	-	-	-	-
delta-HCH	0.1		09.01.2002	-	-	-	-	-
HCH (sum.)	S		09.01.2002	-	-	-	-	-
Alfa-endosulfan	0.01		09.01.2002	-	-	-	-	-
Alfa-endosulfansulphate	0.02		09.01.2002	-	-	-	-	-
Alfa-chlordane	0.01		09.01.2002	-	-	-	-	-
Gamma-chlordane	0.01		09.01.2002	-	-	-	-	-
Chlordanes (sum)	S		09.01.2002	-	-	-	-	-
Heptachlor	0.01		09.01.2002	-	-	-	-	-
Heptachloroepoxide	0.02		09.01.2002	-	-	-	-	-
Hexachlorobutadiene	0.02	**1000***	09.01.2002	-	-	-	-	-
Isodrin	0.1	**2***	09.01.2002	-	-	-	-	-
Telodrin	0.1		09.01.2002	-	-	-	-	-
Tedion	0.1		09.01.2002	-	-	-	-	-
PHOSPHOR PESTICIDES								
Azinphos-ethyl	0.1		09.01.2002	-	-	-	-	-
Azinphos-methyl	0.02		09.01.2002	-	-	-	-	-
Bromophos-ethyl	0.1		09.01.2002	-	-	-	-	-
Bromophos-methyl	0.1		09.01.2002	-	-	-	-	-
Chloropyrophos-ethyl	0.1		09.01.2002	-	-	-	-	-
Chloropyrophos-methyl	0.1		09.01.2002	-	-	-	-	-
Cumaphos	0.02		09.01.2002	-	-	-	-	-
Demeton-S /Demeton-O (ethyl)	0.1		09.01.2002	-	-	-	-	-
Diazinon	0.2		09.01.2002	-	-	-	-	-
Dichlorovos	0.1		09.01.2002	-	-	-	-	-

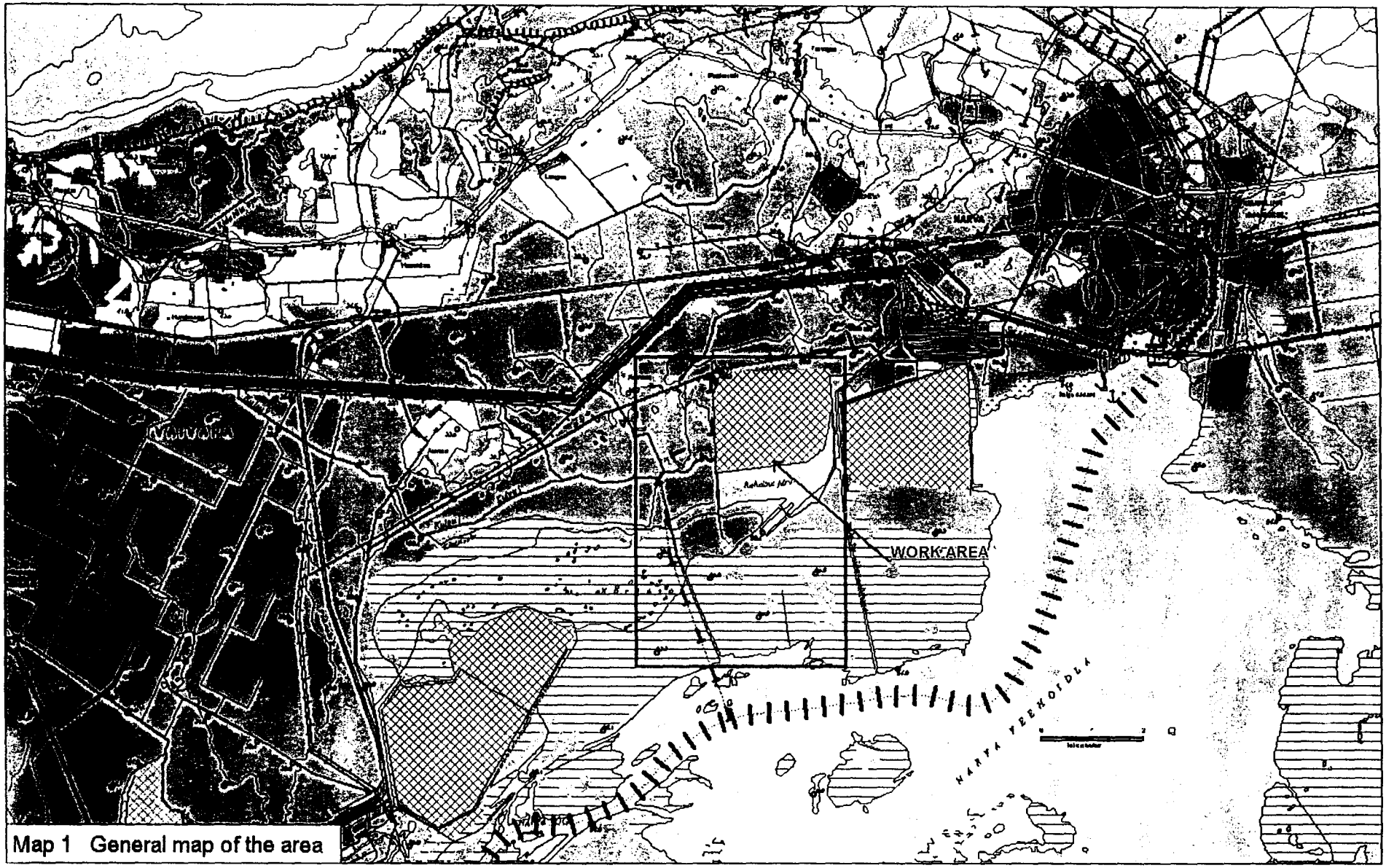
Characteristics	Reporting Limits µg/l	Requirements for Waste Water Discharged into Water Bodies or into Soil (VVm 31.07.2001 nr. 269)	Date	Sampling Points				
				Green Lake (VII) WAC7802	Outlet of Channel WAC7803	NAKRO Ditch 1 WAC7804	NAKRO Ditch 2 WAC7805	NAKRO Landfill WAC7806
		Limits, µg/l		µg/l				
Disulfoton	0.02		09.01.2002	-	-	-	-	-
Fenitrothion	0.2		09.01.2002	-	-	-	-	-
Fenthion	0.1		09.01.2002	-	-	-	-	-
Malathion	0.1		09.01.2002	-	-	-	-	-
Parathion-ethyl	0.1		09.01.2002	-	-	-	-	-
Parathion-methyl	0.1		09.01.2002	-	-	-	-	-
Pyrazophos	0.2		09.01.2002	-	-	-	-	-
Triazophos	0.1		09.01.2002	-	-	-	-	-
NITROGEN PESTICIDES								
Ametryne	0.05		09.01.2002	-	-	-	-	-
Atrazine	0.05		09.01.2002	-	-	-	-	-
Cyanazine	0.1		09.01.2002	-	-	-	-	-
Desmetryne	0.05		09.01.2002	-	-	-	-	-
Prometryne	0.05		09.01.2002	-	-	-	-	-
Propazine	0.05		09.01.2002	-	-	-	-	-
Simazine	0.05		09.01.2002	-	-	-	-	-
Terbuthylazine	0.05		09.01.2002	-	-	-	-	-
Terbutryne	0.05		09.01.2002	-	-	-	-	-
MISCELLANEOUS PESTICIDES								
Bifenthrin	0.1		09.01.2002	-	-	-	-	-
Carbaryl	0.1		09.01.2002	-	-	-	-	-
Cypermethrin A	0.1		09.01.2002	-	-	-	-	-
Cypermethrin B,C en D	0.1		09.01.2002	-	-	-	-	-
Cypermethrin (sum)	S		09.01.2002	-	-	-	-	-
Deltamethrin	0.01		09.01.2002	-	-	-	-	-
Dinoseb	0.5		09.01.2002	-	-	-	-	-
Dinitro-ortho-cresol(DNOC)	0.5		09.01.2002	-	-	-	-	-
Linuron	0.1		09.01.2002	-	-	-	-	-
Permethrin A	0.1		09.01.2002	-	-	-	-	-
Permethrin B	0.1		09.01.2002	-	-	-	-	-

Characteristics	Reporting Limits µg/l	Requirements for Waste Water Discharged into Water Bodies or into Soil (VVm 31.07.2001 nr. 269)	Date	Sampling Points				
				Green Lake (VII) WAC7802	Outlet of Channel WAC7803	NAKRO Ditch 1 WAC7804	NAKRO Ditch 2 WAC7805	NAKRO Landfill WAC7806
		Limits, µg/l		µg/l				
Permethrins (sum)	S		09.01.2002	-	-	-	-	-
Propachlor	0.02		09.01.2002	-	-	-	-	-
Trifluralin	0.01		09.01.2002	-	-	-	-	-
MISCELLANEOUS HYDROCARBONS								
Biphenyl	0.01		09.01.2002	-	-	-	-	-
Nitrobenzene	0.2		09.01.2002	-	-	-	-	-
Dibenzofuran	0.1		09.01.2002	-	-	-	-	-
PHTHALATES								
Dimethylphthalate	0.2		09.01.2002	-	-	-	-	-
Diethylphthalate	0.5		09.01.2002	-	-	-	-	-
Di-isobutylphthalate	3		09.01.2002	-	-	-	-	-
Dibutylphthalate	3		09.01.2002	-	-	-	-	-
Butylbenzylphthalate	0.5		09.01.2002	-	-	-	-	-
Bis(ethylhexyl)phthalate	3		09.01.2002	-	-	-	-	-
Di-n-octylphthalate	0.5		09.01.2002	-	-	-	-	-
Phthalates (sum)	S		09.01.2002	-	-	-	-	-
MINERAL OIL								
C10-C16	50		09.01.2002	-	-	-	-	340
C16-C22	50		09.01.2002	-	-	75	-	1100
C22-C30	50		09.01.2002	-	-	59	-	420
C30-C40	50		09.01.2002	-	-	120	-	500
Mineral oil (sum C10-C40)	S	**5000****	09.01.2002	-	-	250	-	2400

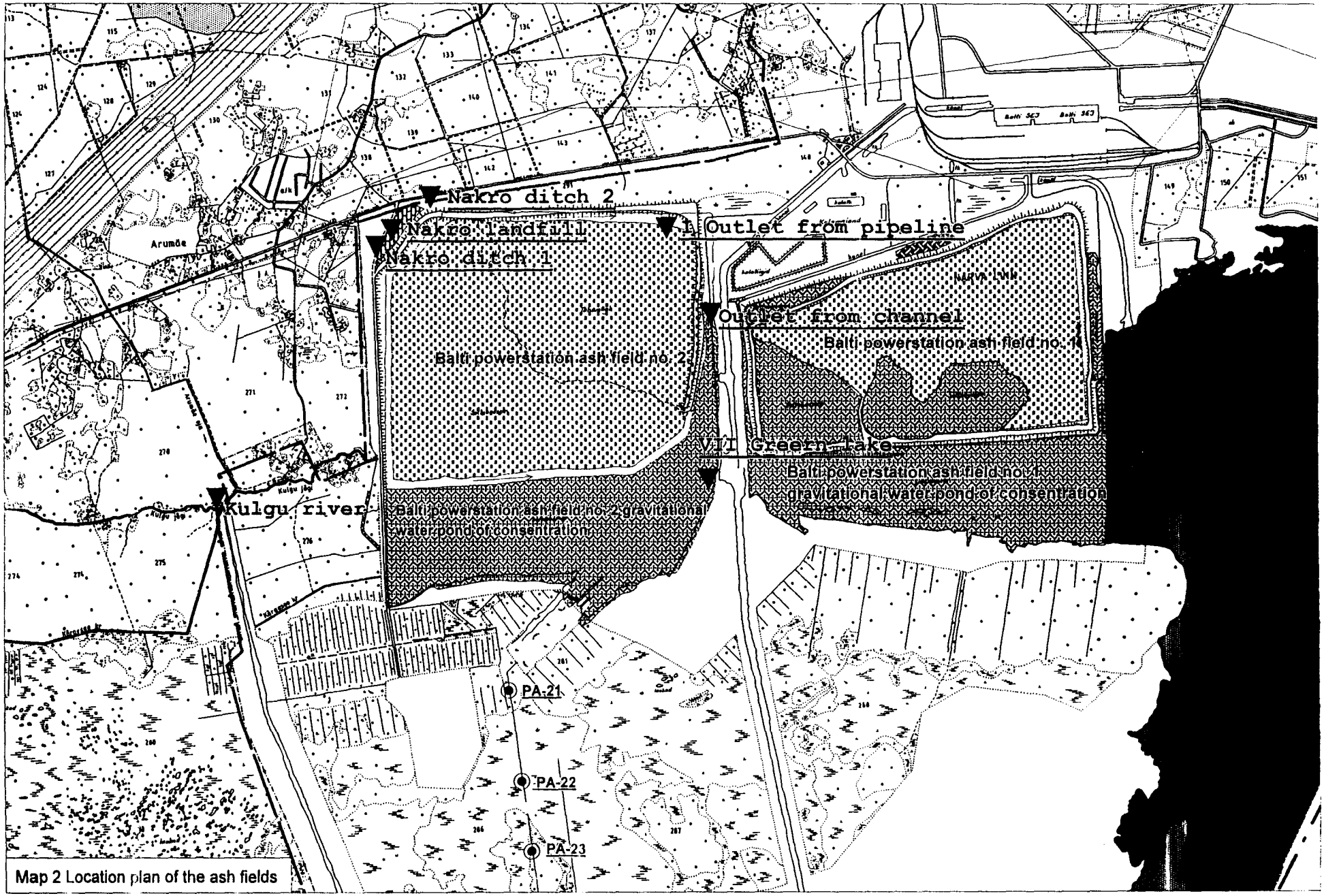
*– "Procedure for Discharging of Waste Water into Water Bodies or into Soil". By the appendix 1 of Regulation No. 269 of 31 July 2001 of the Government of the Republic of Estonia after 31 December 2001 the content of dangerous substances of discharged waste water by the sewerage or first hand into Water Bodies or into Soil must not exceed the presented limits.

*– "Procedure for Discharging of Waste Water into Water Bodies or into Soil". By the appendix 2 of Regulation No. 269 of 31 July 2001 of the Government of the Republic of Estonia after 31 December 2001 the content of dangerous substances of discharged waste water by the sewerage or first hand into Water Bodies or into Soil must not exceed the presented limits.

"-" –The components may be presented at a concentration level below the listed limits.

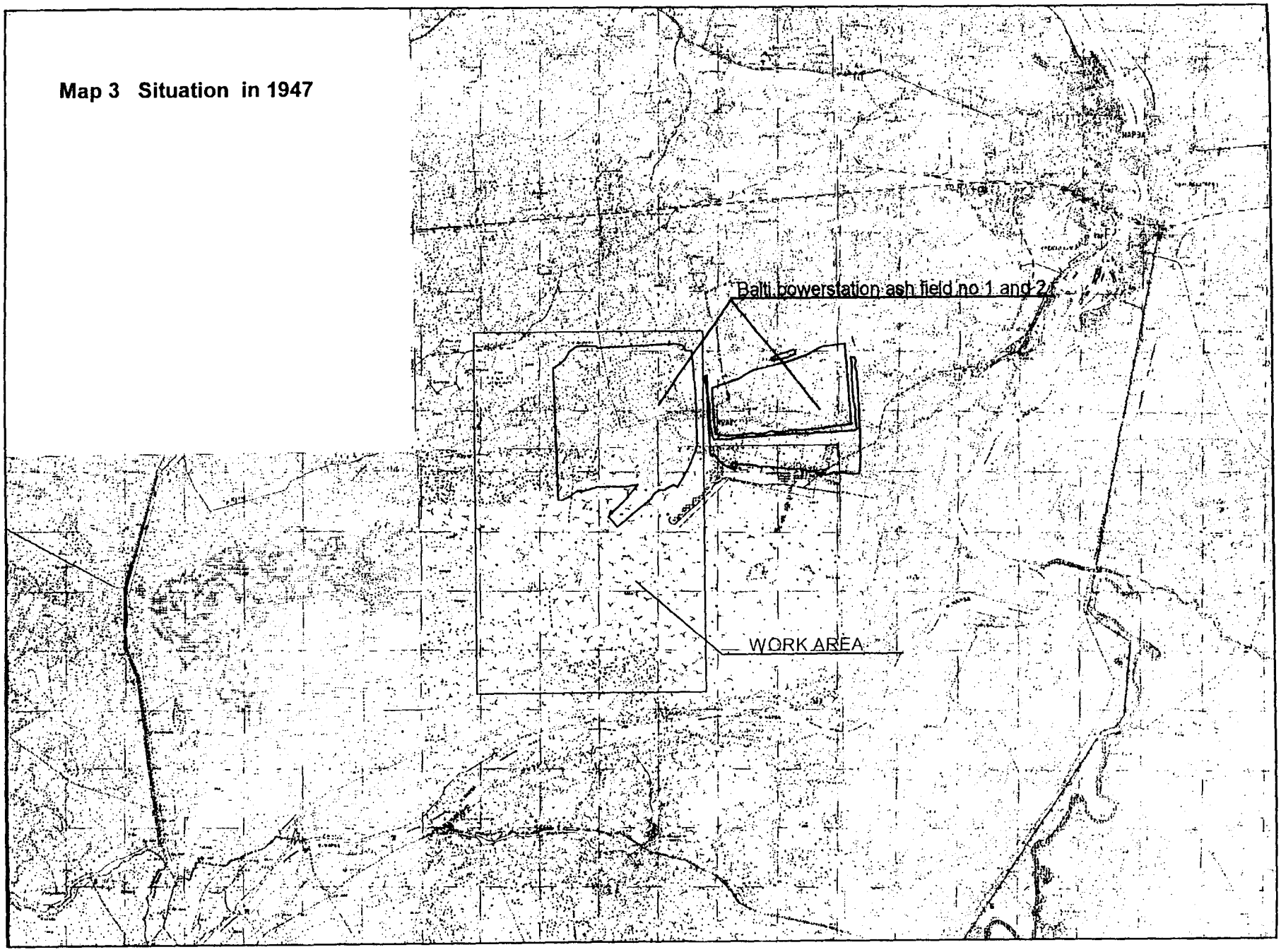


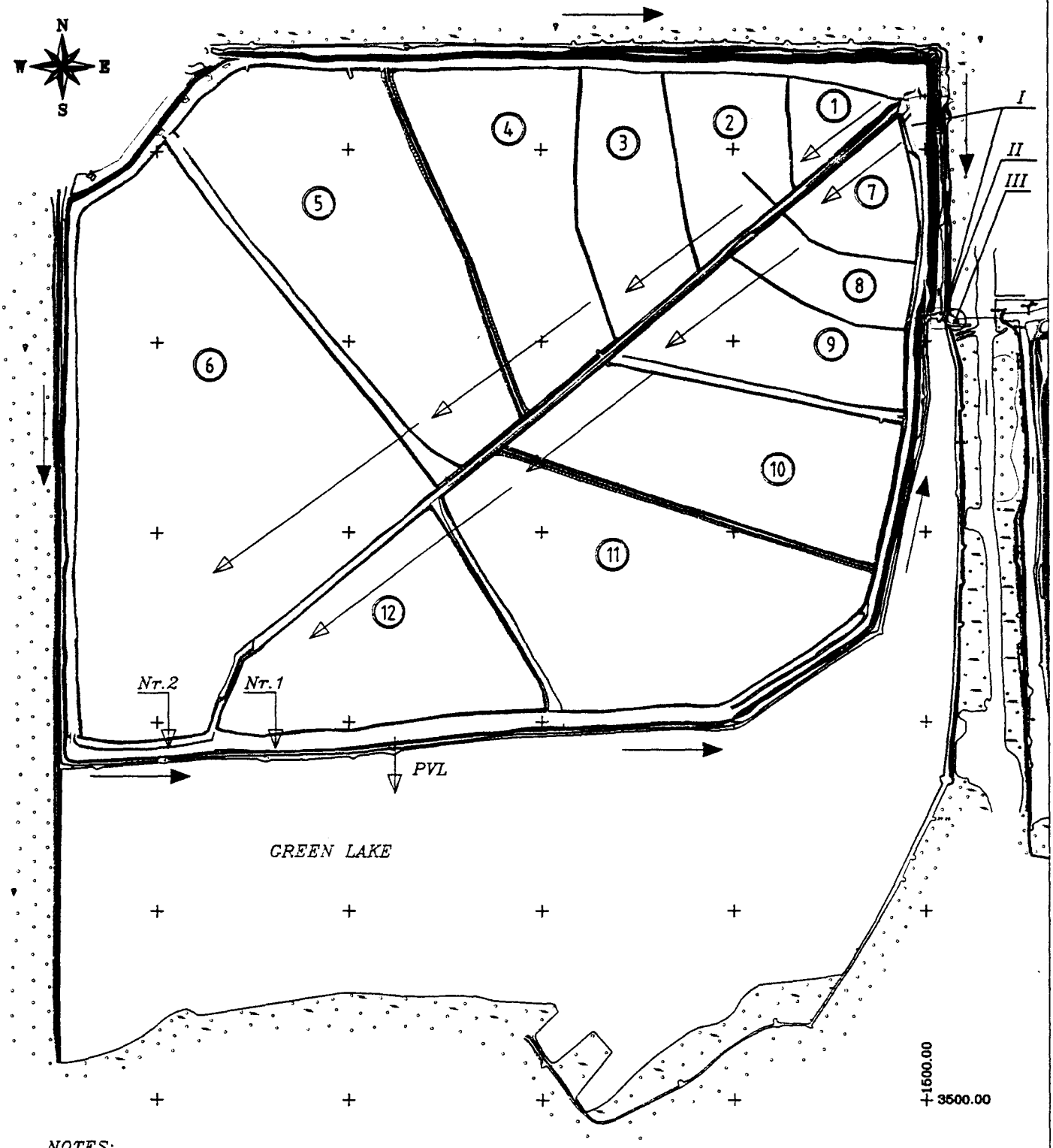
Map 1 General map of the area



Map 2 Location plan of the ash fields

Map 3 Situation in 1947





NOTES:

Nr.1 Nr.2	EXISTING DRAIN WEIRS	I	– CIRCULATION PIPELINE
PVL	DRAIN WEIR FROM SURROUNDING DITCH TO THE GREEN LAKE	II	– HYDROENGINEERING COMPLEX
		III	– PUMPING STATION
→	FLOW DIRECTION ON THE ASHFIELD	(8)	– EVAPORATION POND
→	FLOW DIRECTION IN THE SURROUNDING DITCH		

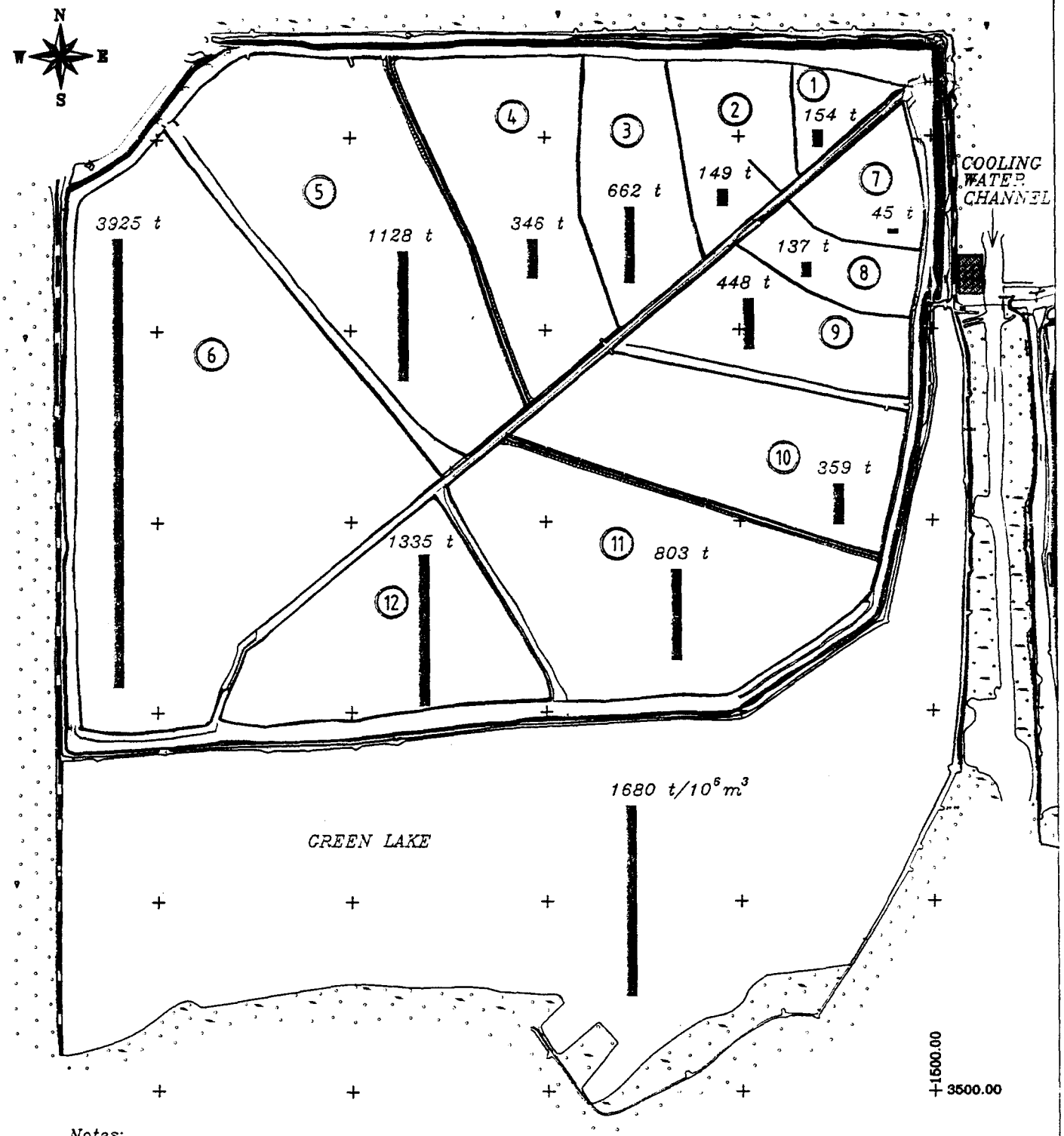
NARVA POWER LTD.

01050

PM	J.TEDER			CLOSURE OF ASH FIELD No.2 WITH WATER PONDS AT BALTI POWER PLANT	STAGE	DRWG. NO.	TOTAL
CHECKED					FS	1	
DESIGNED	E.TÕNUPÄRT				M 1:15000		
			2002				

DIRECTIONS OF WATER FLOW IN EVAPORATION PONDS ON ASHFIELD No. 2

PIC Estonia Ltd.
Toompuiestee 17a
10137 Tallinn
tel 660 5432



Notes:

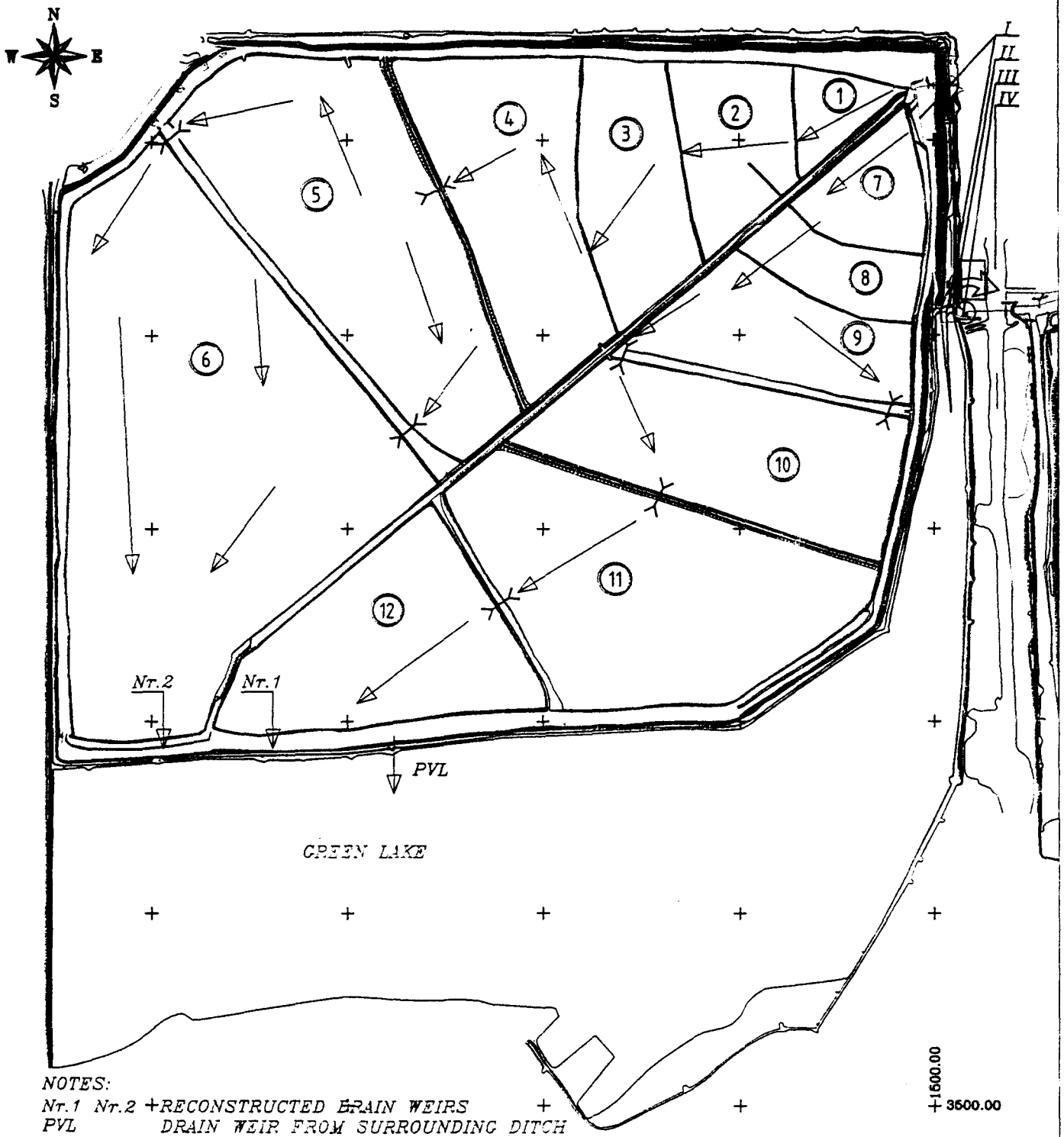
RESERVED AREA FOR pH NEUTRALIZER (0.6 HA)

(8) *No.OF THE EVAPORATION POND*

NARVA POWER LTD.					01050		
PM	J.TEDER			CLOSURE OF ASH FIELD No.2 WITH WATER PONDS AT BALTI POWER PLANT	STAGE	DRWG. NO.	TOTAL
CHECKED					FS	3	
DESIGNED	E.TÕNUPÄRT				M 1:15000		
			2002				

DEMAND OF CONCENTRATED HYROCHLORIC ACID FOR NEUTRALIZING OF WATER DOWN TO pH 9 FROM FILLED EVAPORATION PONDS

PIC Estonia Ltd.
Toompuiestee 17a
10137 Tallinn
tel 660 5432



NOTES:

Nr.1 Nr.2 + RECONSTRUCTED DRAIN WEIRS

PVL DRAIN WEIR FROM SURROUNDING DITCH TO THE GREEN LAKE

FLOW DIRECTION ON THE ASHFIELD

FLOW DIRECTION FROM GREEN LAKE TO CHANNEL

CULVERTS THROUGH THE DAMS

(8) No. OF THE EVAPORATION POND

RESERVED AREA FOR pH NEUTRALIZER (0.6 HA)

I – DISMANTLED PIPELINE

II – HYDROENGINEERING COMPLEX

III – PUMPING STATION

IV – COOLING WATER CHANNEL

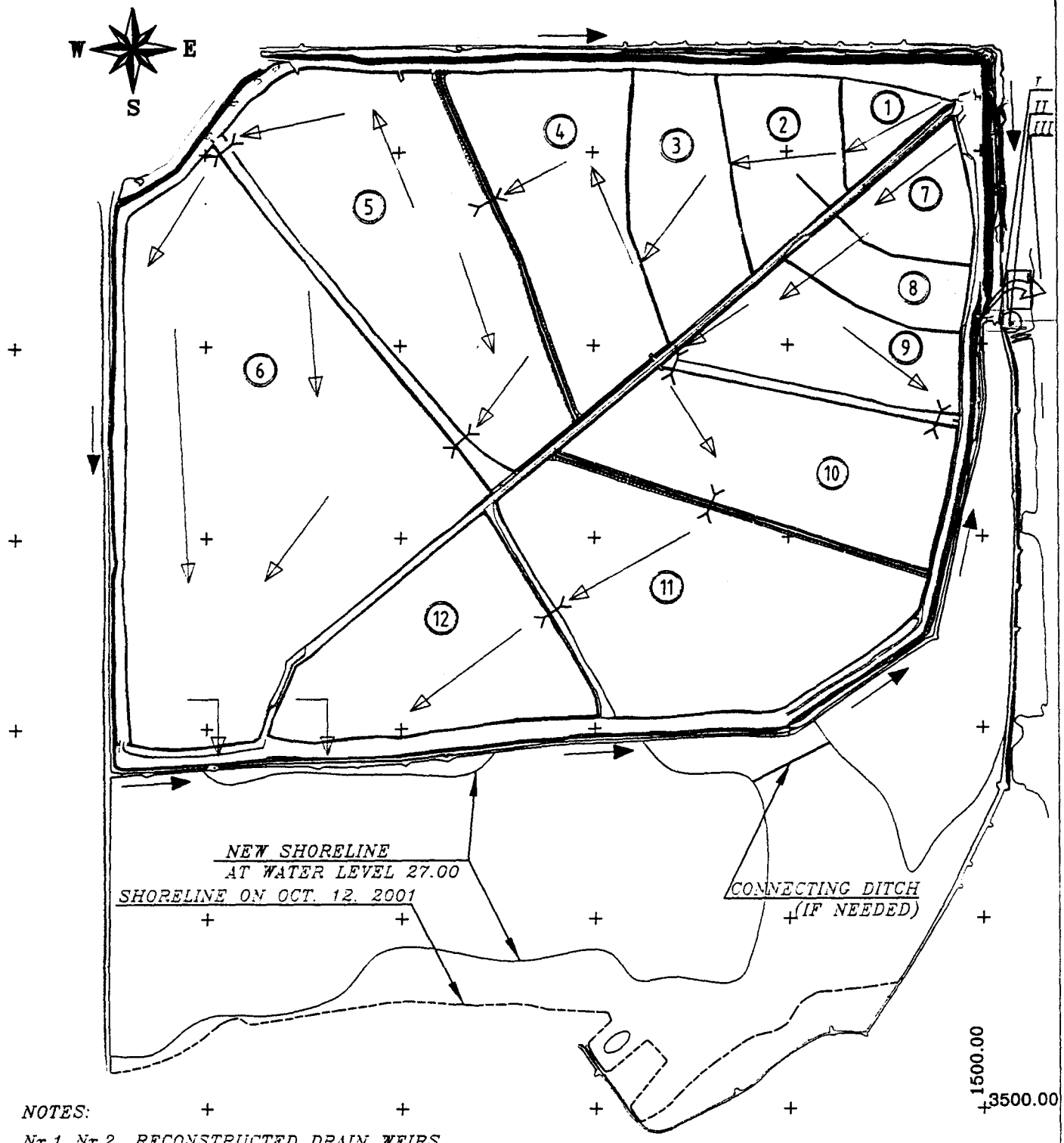
NARVA POWER LTD.

01050

				CLOSURE OF ASH FIELD No.2 WITH WATER PONDS AT BALTI POWER PLANT	STAGE	DRWG. NO.	TOTAL
PM	J.TEDER				FS	4	
CHECKED							
DESIGNED	E.TÕNUPÄRT						
			2002		M 1:15000		

EMPTYING OF EVAPORATION PONDS WITHOUT GRADING OF DAMBS AND SERVICE ROADS

PIC Estonia Ltd.
Tammuiestee 17a
10137 Tallinn
tel 660 5432



NOTES:

Nr.1 Nr.2 RECONSTRUCTED DRAIN WEIRS

FLOW DIRECTION ON THE ASHFIELD

FLOW DIRECTION IN THE SURROUNDING DITCH

FLOW DIRECTION FROM SURROUNDING DITCHN TO CHANNEL

RESERVED AREA FOR pH NEUTRALIZER

I – HYDROENGINEERING COMPLEX

II – PUMPING STATION

III – COOLING WATER CHANNEL

CULVERTS THROUGH THE DAMS

(8) No. OF THE EVAPORATION POND

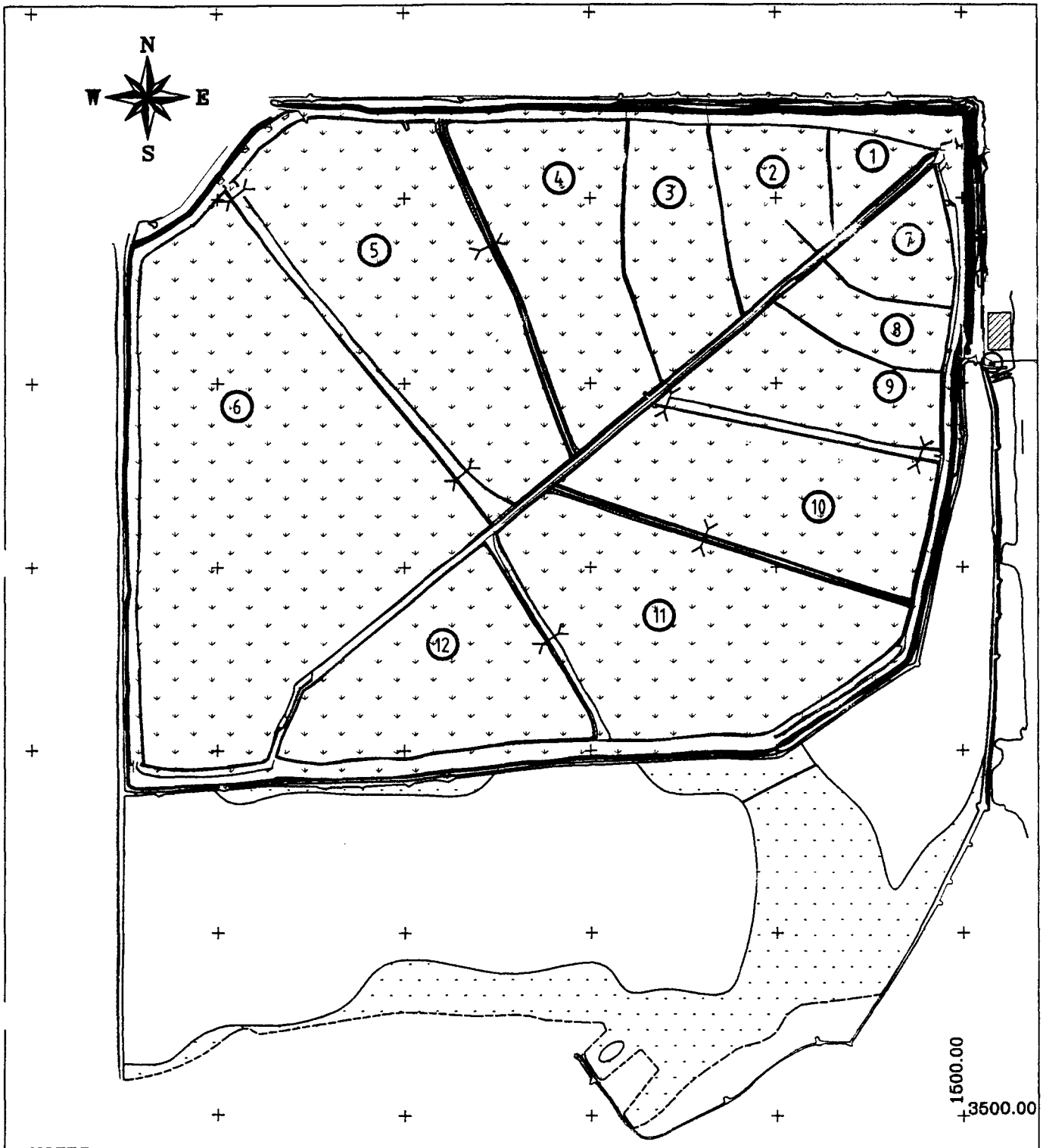
NARVA POWER LTD.

01050

PM	J.TEDER			CLOSURE OF ASH FIELD No.2 WITH WATER PONDS AT BALTI POWER PLANT	STAGE	DRWG. NO.	TOTAL
CHECKED					-		
DESIGNED	E.TÕNUPÄRT				FS	5	
			2002		M 1:15000		

DISCHARGE OF RAINWATER AFTER FORMATION OF WETLAND AND EMPTYING OF PONDS ON ASHFIELD

PTC Estonia Ltd.
Toompuiestee 17a
10137 Tallinn
tel 660 5432



NOTES:

AREA FOR pH NEUTRALIZER

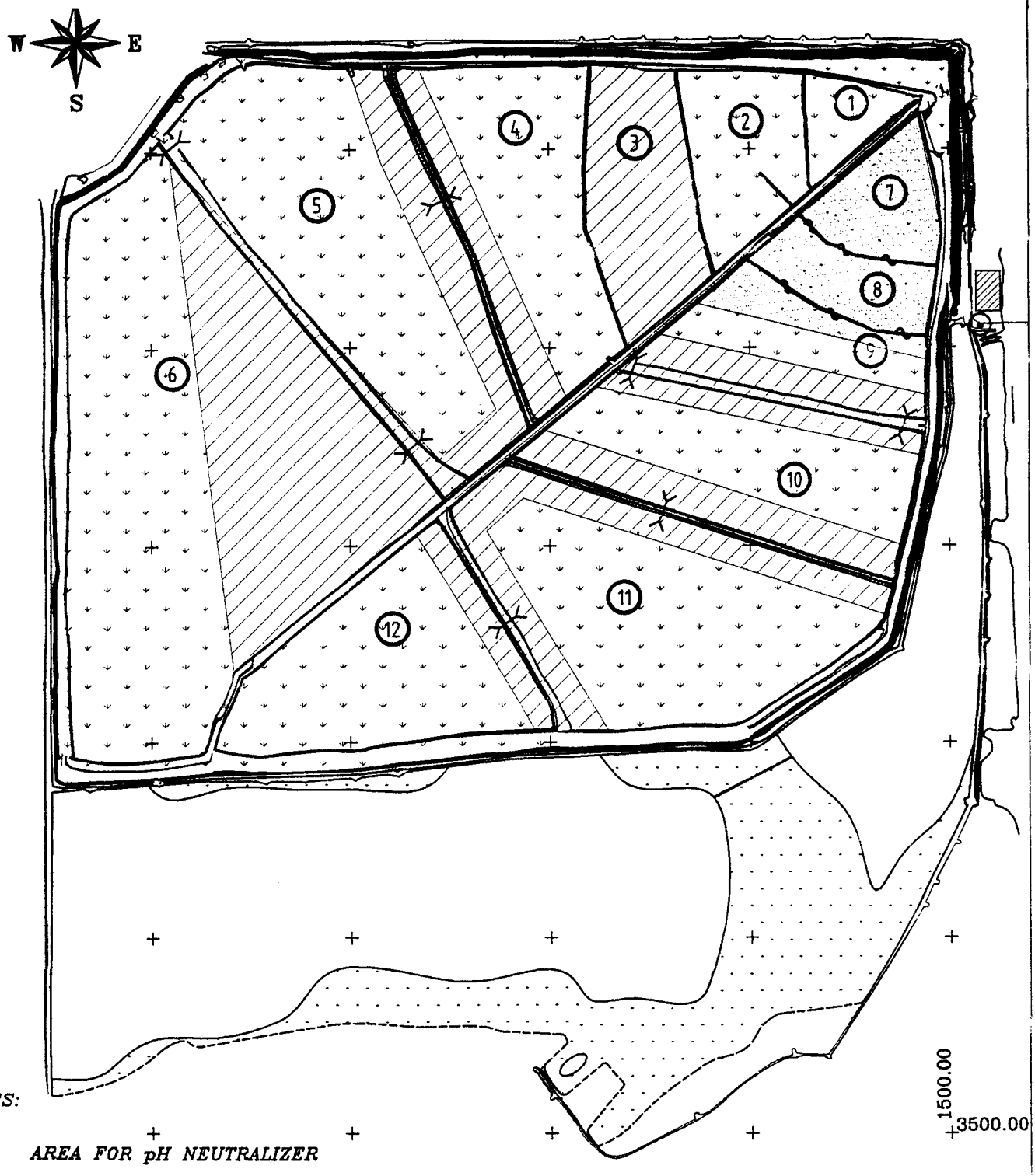
GREEN AREA

RECOVERED SWAMP AREA

CULVERTS THROUGH THE DAMS

No. OF THE EVAPORATION POND

NARVA POWER LTD.					01050		
PM	J.TEDER			CLOSURE OF ASH FIELD No.2 WITH WATER PONDS AT BALTI POWER PLANT	STAGE	DRWG. NO.	TOTAL
CHECKED					FS	6	
DESIGNED	E.TÕNUPÄRT				M 1:15000		
			2002				
AREA DEVELOPMENT AFTER EMPTYING OF WATER PONDS AND FORMATION OF WETLAND. OPTION 1					PIC Estonia Ltd. Toompuiestee 17a 10137 Tallinn tel 660 5432		



NOTES:

- *AREA FOR pH NEUTRALIZER*
- *GREEN AREA*
- *AFFORESTATION AREA*
- *AREA RESERVATION FOR INERT WASTE LANDFILL*
- *RECOVERED SWAMP AREA*
- *LANDFILL ACCESS ROAD*
- *REMOVABLE DAMBS*
- *CULVERTS THROUGH THE DAMS*
- (8) *No. OF THE EVAPORATION POND*

NARVA POWER LTD.

01050

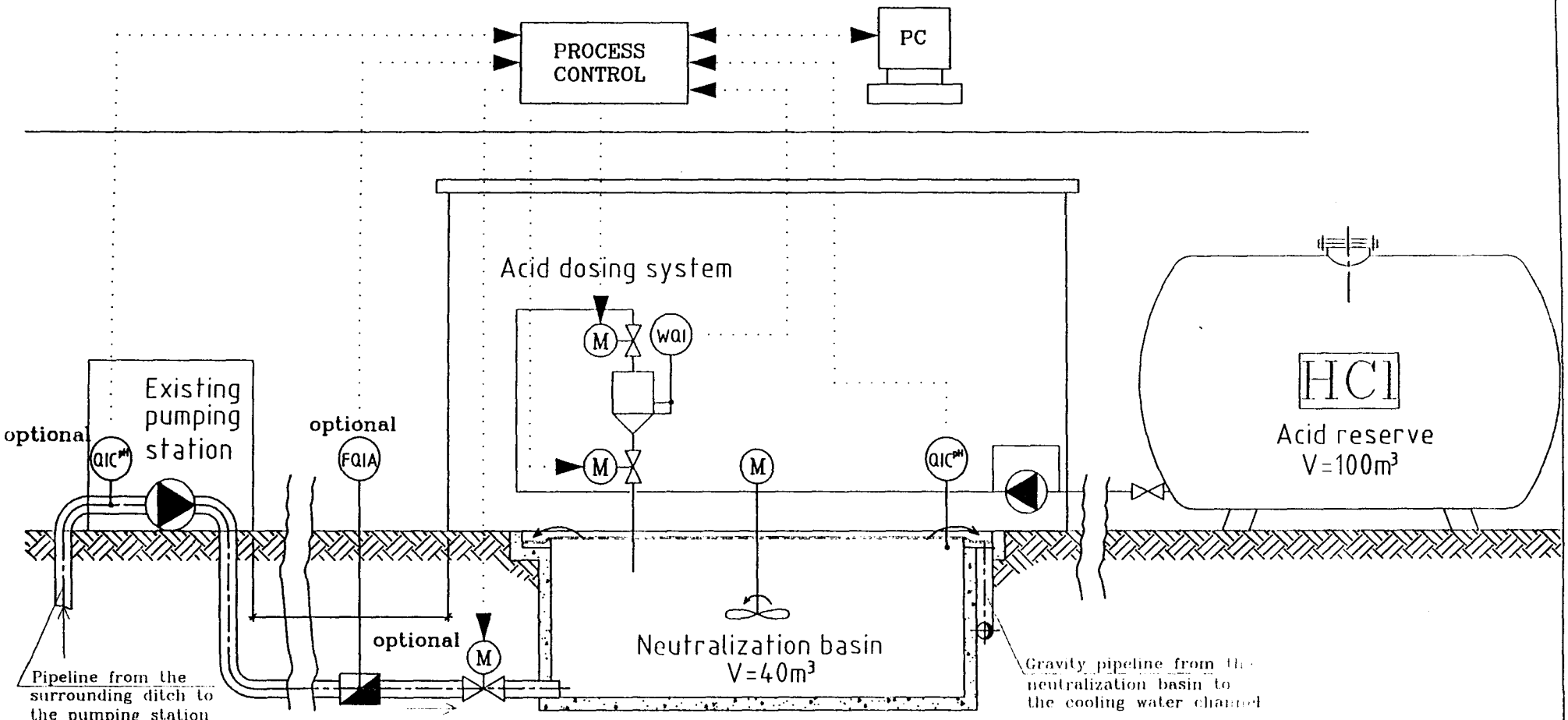
PM	J.TEDER			CLOSURE OF ASH FIELD No.2 WITH WATER PONDS AT BALTI POWER PLANT	STAGE	DRWG. NO.	TOTAL
CHECKED					FS	7	
DESIGNED	E.TÕNUPÄRT						
			2002		M 1:5000		

AREA DEVELOPMENT AFTER EMPTYING OF WATER PONDS AND FORMATION OF WETLAND. OPTION 2

PIC Estonia Ltd.
Toompuiestee 17a
10137 Tallinn
tel 660 5432

PROCESS DIAGRAM

GREEN LAKE OR SURROUNDING DITCH → EXISTING PUMPING STATION → NEUTRALIZATION UNIT → COOLING WATER CHANNEL



NARVA POWER LTD.					01050		
PM	J.TEDER			CLOSURE OF ASH FIELD No.2 WITH WATER PONDS AT BALTI POWER PLANT	STAGE	DRWG NO.	T01
CHECKED					FS	8	
DESIGNED	E.RIKMANN				M		
			2002				
LAYOUT OF NEUTRALIZATION UNIT					PIC Estonia Ltd. Toompuiestee 10137 Tallin Tel 660 54		

CLOSURE OF ASH FIELD NO. 2 WITH WATER PONDS AT BALTI POWER PLANT

FINANCIAL AND ECONOMIC ANALYSIS

1 Introduction

This report contains a financial and economic analysis – in accordance with the EU Guide to Cost Benefit Analysis of Major Projects – for closing an ash field No. 2 with water pond at Balti Power Plant in Narva. The report should be read as a supplement, providing more detailed information, to Sections 10, 11 and 12 of the ISPA application form.

The purpose of this report is to explain the method of analysis, present the main findings, and provide some recommendations concerning financing of the closure of ash field No.2.

In order to conduct a financial analysis for the proposed project, a financial model has been constructed focusing on the affordability of the fees required for scenarios with an ISPA-grant of 85% of the proposed investment and without ISPA grant. The incremental fee required for cost recovery in the two scenarios has been calculated. The incremental fee calculated is based on the assumption that accumulated capital in the end of period is only covering reinvestment requirements.

All information is collected through a combination of desk research and field research including study of the existing information and reports on the subject, interviews with relevant parties, officials and institutions, questionnaires and analysis of statistics on the issue.

Performing the financial analysis an excel spread sheet has been developed. The detailed results of the calculations are presented in Annex 4.1.

2 Financial Analysis ~ Closure of ash field No. 2

Data input for the cash flow analysis of the closure of the ash field No.2 includes calculation of the investment costs, operational costs and revenues. The assumptions underpinning these calculations are described in the sections below and followed by a presentation of the cash flow analysis.

2.1 Assumptions

The analysis of the closure of the ash field No.2 in the following sections is based on several important assumptions:

General

Exchange rate	1 EURO = 15.6466 EEK; 1 EEK = 0.0639 EURO
VAT	18%
Average annual household income	4462.8 EURO/year

Depreciation

Infrastructure and buildings	25 - 40 years
Machinery	3 - 25 years
Equipment	3 - 10 years

2.2 Investment Costs

There are 2 options to make the closure. The first one includes the closure of the ash field No. 2. The second option includes in addition to the closure the development a inert waste landfill onto the territory of ash field No. 2. The total investment costs of the first option is 5,65 million EURO out of which the ISPA component comprises EURO 4,80 million. The option 2 has an investment costs up to 7,14 million EURO of which the ISPA component comprises 6,07 million EURO. It has been planned to start with an investment in year 2003.

Financing of the Investment

The project is financed as follows:

Option 1

Financing	Million Euro	Percentage of total investment
Local Financing	0,85	15
ISPA Grant	4,80	85
Total	5,65	(100)

Option 2

Financing	Million Euro	Percentage of total investment
Local Financing	1,07	15
ISPA Grant	6,07	85
Total	7,14	(100)

In assessing the financing possibilities of the 0-scenario, this is likely to be deemed un-bankable by commercial banks due to the financial risks in implementing the project without the relief from ISPA grant. This supports and justifies full ISPA support for the project.

The investment costs cover setting up the neutralizer, dismantling the circulation water pipeline; building the drains and cuvettes, reconstructing the water outlets no. 1 and 2, changing the monitoring system, covering the ash field and creating a green area. The option 2 includes a new landfill, compiling general plan and evaluating the environmental impact of the object. There is included also building the first stage of the landfill.

Investment costs are summarised in appendix.

2.3 Operational Costs

The operational costs cover variable and fixed costs. The former include day-to-day running costs (e.g. labour, power, water and electricity) and maintenance costs (i.e. buildings, machinery and equipment). The latter include some labour costs and closure and monitoring costs.

2.4 Revenues

The project is non-profitable. The closures are rarely projects which generate revenues, not to mention profit. In the case of building a new landfill in the area then there is a way to make this project profitable.

2.5 Cash Flow

A cash flow statement for the Closure of ash field No.2 has been produced and includes calculation of the internal rate of return (IRR) and net present value (NPV) under a "with ISPA grant" and "without ISPA grant" scenario.
As the project is non-profitable, then there is no way to calculate the internal rate of return (IRR). IRR was found for the company Narva Power Ltd including the project.

The cash flow analysis excludes VAT and pollution tax as well as depreciation and includes reinvestments; NPV is calculated using a 5%, 8% and 10% discount rate.

The table below summarises results of the cash flow analysis.

	Without ISPA Grant		With ISPA Grant	
	IRR (%)	NPV ~ 5% (EURO Millions)	IRR (%)	NPV ~ 5% (EURO millions)
Narva Power LTd	127	653 334	129	658 092
Project, option 1	-	- 5 440	-	-1 660
Project, option 2	-	-5 648	-	-1 691

An ISPA grant would have an impact on the NPV and IRR.

3 Financial Analysis - Narva Power Plant Ltd

A cash flow statement, profit/loss statement and balance sheet prognosis for fifteen years has been produced for Narva Power Ltd.

The cash flow statement, profit/loss statement and balance sheet for Narva Power Ltd are included in appendixes.

4 Economic Analysis

Closure of ash field No.2 will have significant economic and environmental benefits.

A cost-benefit analysis (CBA) of the Closure of ash field No.2 has not been carried out and there has been no attempt to calculate the economic IRR, NPV or benefit/cost ratio (B/C). Following the EU "Guide to cost benefit analysis of major projects" there are well known conceptual difficulties associated with quantifying cost and benefits in the refuse and waste treatment sector. There will, however, be social, economic and environmental benefits arising from the Project.

- Local economies will benefit from personnel employed during the construction and cover-making phase.
- There will be improvements to the local environment by ending the discharge of pollutants.
- There will be a reduction in the pollution of groundwater's and soils, as well setting up new opportunities for biodiversity development in the Project area.
- In far future there may be revaluation of real estate and land prices in areas served by the Project, although this will be insignificant.
- The Project will facilitate the following of Estonian Environmental Strategy, Estonia's accession into the EU, meeting EU regulations and sustainable management of border water-bodies.

5 Conclusions and Recommendations

Apart form the financial viability of the Closure of ash field No.2 the landfill will make significant contributions to improvements in the state of environment, health and living standards. And in addition to generating revenues by the version 2 the use of charges will ensure the Closure of ash field No.2 is consistent with EU regulations (Article 130r Treaty EC and Article 15 Council Directive on waste 75/442/EEC) in as far as the "polluter pays" principle is respected.

ESTIMATED COSTS OF WORKS

WORK'S ITEM	Cost items for the cost of work	Amount	Amount's unit	Unit cost,EEK	Cost in EEK	Cost in Euros
1.Construction of neutralizer unit with treatment output 500 m^3/h						
	Design	1500	h	300	450000	28754
	construction:					
	Repair of access road.	3000	m	400	1200000	76677
	Elevation of ground	20000	m3	120	2400000	153355
	0,6 ha area preparation	6000	m2	40	240000	15335
	Concrete casting	40	m3	5000	200000	12780
	Shelter	150	m2	1000	150000	9585
	Acid storage tank	100	m3	600000	600000	38339
	Piping	50	m	400	20000	1278
	Propeller pumping station	1	piece	700000	700000	44738
	Automation	1	Set	650000	650000	41534
	Remote security control	1	Set	350000	350000	22364
	Electricity	1	Set	40000	40000	2556
	Contingency	10	%		475000	30351
					7475000	**477739**
2.Dismantling of circulation pipeline	Cutting and transportation of scrap metal	1020	m	300	**306000**	**19553**
3. Construction of culverts through dams	New culverts Ø 0,5 m and total length 45 m	13	Pieces	4300	55900	3572
	Construction				800000	51118
					855900	**54690**

4. Reconstruction of existing drain weirs Nos. 1 and 2						
	Transport of materials and parts				20000	1278
	Soil works/removal/placement	6000	m^3	37	222000	14185
	Formation of water collection cuvettes				149000	9521
	Removal of existing culverts' pipes	100	m	400	40000	2556
	Enforcement of distch slopes and bottoms with concrete plates	825	m^2	430	354750	22668
					785750	**50208**
5. Rearrangement of water monitoring	New water level sensors	2	piece	8000	16000	1022
	Assembling of sensors				30000	1917
					46000	**2939**
6. Cover of ash-field:						
6.1. Need of cover material (plant growth substrate)	Option 1	520000	t	72	37740000	2392332
	Option 2	494000	t	72	35568000	2272716
6.2 Transportation (From Kiviõli to Narva)	Option 1	40000	Truckload	833	33300000	2128258
	Option 2	38000	Truckload	833	31600000	2019608
6.3. Spreading of substrate with bull dozers	Option 1	16000	bulldozer/h	260	4160000	265815
	Option 2	15200	bulldozer/h	260	3952000	252524
6.4 Planting with Meadow grass	Option 1	4000000	m^2	1	4000000	255591
7. Plantation of silver birch in zones	Option 2	118	ha	6000	708000	45240
7.1 Plantation of grass between zones	Option 2	2620000	m^2	1	2620000	167412

8. Preparatory works on ash field for construction of inert waste landfill	200000	m²	2	**400000**	**25559**
9. General plan for landfill and the EIA	780	h	300	**234000**	**14952**
10. Construction of inert waste landfill I phase	20000	m²	400	**8000000**	**511182**
11. Landfill construction contingency 5%				400000	25559
Sub-total for Option 1	Million EEK and EURO			**88.4**	**5.65**
Sub-total for Option 2	Million EEK and EURO			**92.95**	**5.94**
12. Supervision during implementation	Million EEK and EURO			**9.39**	**0.6**
13. Contingencies for implementation	Million EEK and EURO			**9.39**	**0.6**
TOTAL FOR IMPLEMENTATION OF MEASURE WITH OPTION 2	Million EEK and EURO			**111.7**	**7.14**

NPV Calculations, The Project (1), th. EUR

Sensitivity - Base

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Operating profit	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Depreciation	0	0	0	-22	-203	0	0	0	0	0	0	0	0	0	0	0	0
Net profit	0	-288	-288	-310	-235	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Investments	0	0		-560	-5,087	0	0										
NPV arvutus	0	-288	-288	-848	-5,119	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
NPV1	-5,710																
NPV2	-4,972																
NPV3	-5,248																
IRR	#DIV/0!																
Operating margin	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Net profit margin	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Sensitivity - I scenario
NO GRANT

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Operating profit	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Depreciation	0	0	0	-22	-203	0	0	0	0	0	0	0	0	0	0	0	0
Net profit	0	-575	-575	-575	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64
Investments	0	0	0	-560	-5,087	0	0	0	0	0	0	0	0	0	0	0	0
NPV1	-5,440																
NPV2	-4,347																
NPV3	-4,746																
Operating margin	0%	0%	0%	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Net profit margin	0%	0%	0%	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Sensitivity - II scenario
ISPA GRANT 85%

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Operating profit	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Depreciation	0	0	0	-22	-203	0	0	0	0	0	0	0	0	0	0	0	0
Net profit	0	-288	-288	-310	-235	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Investments				-84	-763	0	0										
NPV1	-1,660																
NPV2	-1,336																
NPV3	-1,453																
Operating margin	0%	0%	0%	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Net profit margin	0%	0%	0%	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

NPV3 - discount factor	8%
NPV1 - discount factor	5%
NPV2 - discount factor	10%

NPV Calculations, The Project (2), th. EUR

Sensitivity - Base																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Operating profit	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Depreciation	0	0	0	-22	0	0	0	0	0	0	0	0	0	0	0	0	0
Net profit	0	-288	-288	-310	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Investments	0	0		-560	-4,803	-577	0	0									
NPV1	-5,939																
NPV2	-5,153																
NPV3	-5,447																
IRR	#DIV/0!																
Operating margin	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Net profit margin	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Sensitivity - I scenario NO GRANT																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Operating profit	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Depreciation	0	0	0	-22	0	0	0	0	0	0	0	0	0	0	0	0	0
Net profit	0	-575	-575	-575	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64
Investments	0	0	0	-560	-4,803	-577	0	0	0	0	0	0	0	0	-0	0	0
NPV1	-5,648																
NPV2	-4,496																
NPV3	-4,916																
Operating margin	0%	0%	0%	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Net profit margin	0%	0%	0%	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Sensitivity - II scenario ISPA GRANT 85%																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Operating profit	0	-288	-288	-288	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Depreciation	0	0	0	-22	0	0	0	0	0	0	0	0	0	0	0	0	0
Net profit	0	-288	-288	-310	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
Investments				-84	-720	-87	0	0									
NPV1	-1,691																
NPV2	-1,359																
NPV3	-1,479																
Operating margin	0%	0%	0%	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Net profit margin	0%	0%	0%	0%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

NPV3 - discount factor	8%
NPV1 - discount factor	5%
NPV2 - discount factor	10%

NPV calculations (th. EUR)

Sensitivity - Base																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Revenues	156,823	161,881	171,594	192,803	229,632	236,702	244,093	251,885	260,216	269,339	279,731	292,332	309,072	334,059	376,397	457,066	626,397
Costs	145,060	142,720	151,283	160,360	169,982	178,481	187,405	196,775	206,614	216,944	227,792	239,181	251,140	263,697	276,882	290,726	305,263
Operating profit	11,763	19,162	20,311	32,443	59,650	58,221	56,688	55,110	53,603	52,395	51,939	53,151	57,932	70,362	99,515	166,340	321,134
Depreciation	-23,221	-24,465	-25,743	-27,022	-28,300	-29,578	-30,856	-32,135	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413
Net profit	-11,622	-5,502	-5,772	5,042	30,876	28,150	25,352	22,462	19,644	18,436	17,969	19,738	24,519	36,949	66,102	132,927	287,721
Investments	0	-42,757	0	-961	-5,205	-977	0	0	0	0	0	0	0	0	0	0	0
NPV1	731,545																
NPV2	477,492																
NPV3	561,835																
IRR	127%																
Operating margin	8%	12%	12%	17%	26%	25%	23%	22%	21%	19%	19%	18%	19%	21%	26%	36%	51%
Net profit margin	-7%	-3%	-3%	3%	13%	12%	10%	9%	8%	7%	6%	7%	8%	11%	18%	29%	46%

Sensitivity - I scenario NO GRANT																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Revenues	156,823	161,881	171,594	192,803	229,632	236,702	244,093	251,885	260,216	269,339	279,731	292,332	309,072	334,059	376,397	457,066	626,397
Costs	145,060	142,720	151,283	160,360	169,982	178,481	187,405	196,775	206,614	216,944	227,792	239,181	251,140	263,697	276,882	290,726	305,263
Operating profit	11,763	19,162	20,311	32,443	59,650	58,221	56,688	55,110	53,603	52,395	51,939	53,151	57,932	70,362	99,515	166,340	321,134
Depreciation	-23,221	-24,465	-25,743	-27,022	-28,300	-29,578	-30,856	-32,135	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413
Net profit	-11,622	-5,502	-5,772	5,042	30,876	28,150	25,352	22,462	19,644	18,436	17,969	19,738	24,519	36,949	66,102	132,927	287,721
Investments	0	-42,757	0	-961	-5,205	-977	0	0	0	0	0	0	0	0	0	0	0
NPV1 (5%)	653,334																
NPV2 (10%)	385,815																
NPV3 (8%)	472,346																
IRR	127%																
Operating margin	8%	12%	12%	17%	26%	25%	23%	22%	21%	19%	19%	18%	19%	21%	26%	36%	51%
Net profit margin	-7%	-3%	-3%	3%	13%	12%	10%	9%	8%	7%	6%	7%	8%	11%	18%	29%	46%

Sensitivity - II scenario ISPA GRANT 85%																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Revenues	156,823	161,881	171,594	192,803	229,632	236,702	244,093	251,885	260,216	269,339	279,731	292,332	309,072	334,059	376,397	457,066	626,397
Costs	145,060	142,720	151,283	160,360	169,982	178,481	187,405	196,775	206,614	216,944	227,792	239,181	251,140	263,697	276,882	290,726	305,263
Operating profit	11,763	19,162	20,311	32,443	59,650	58,221	56,688	55,110	53,603	52,395	51,939	53,151	57,932	70,362	99,515	166,340	321,134
Depreciation	-23,221	-24,465	-25,743	-27,022	-28,300	-29,578	-30,856	-32,135	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413	-33,413
Net profit	-11,622	-5,502	-5,772	5,042	30,876	28,150	25,352	22,462	19,644	18,436	17,969	19,738	24,519	36,949	66,102	132,927	287,721
Investments	0	-42,757	0	-144	-781	-147	0	0	0	0	0	0	0	0	0	0	0
NPV1 (5%)	658,092																
NPV2 (10%)	389,589																
NPV3 (8%)	476,481																
IRR	129%																
Operating margin	8%	12%	12%	17%	26%	25%	23%	22%	21%	19%	19%	18%	19%	21%	26%	36%	51%
Net profit margin	-7%	-3%	-3%	3%	13%	12%	10%	9%	8%	7%	6%	7%	8%	11%	18%	29%	46%

Financial Ratios

	Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
OPERATING MARGIN	OPERATING PROFIT / REVENUES	8%	12%	12%	17%	26%	25%	23%	22%	21%	19%	19%	18%	19%	21%	26%	36%	51%
NET PROFIT MARGIN	NET PROFIT / REVENUES	-8%	-4%	-4%	2%	13%	11%	10%	8%	7%	6%	6%	6%	7%	11%	17%	29%	46%
CURRENT RATIO	CURRENT ASSETS / CURRENT LIABILITIES	0.9	0.4	0.8	1.2	2.1	2.9	3.8	4.6	5.3	6.0	6.7	7.3	8.1	8.9	10.1	12.2	16.2
QUICK RATIO	CURRENT ASSETS - INVENTORIES / CURRENT LIABILITIES	0.7	0.3	0.7	1.2	2.0	2.9	3.7	4.5	5.2	5.9	6.6	7.2	8.0	8.8	10.0	12.0	16.0
DEBT RATIO	TOTAL LIABILITIES / TOTAL ASSETS	13%	20%	22%	22%	20%	19%	18%	17%	16%	15%	14%	13%	12%	11%	9%	8%	6%

Closure of ash field No. 2 with water ponds at Balti Power plant
Financial analysis of Narva Power Plant Ltd.

Investments (th. EEK)

Year	2000	2001	2002	2003	2004	2005	2006	2007
Total investments				**15,029**	**81,445**	**15,294**		
Investment sources								
Investment loan				0	0	0	0	
Grant								
Local grant							0	0
Own capital of the company				15,029	81,445	15,294		
Municipality								
Total	**0**	**0**	**0**	**15,029**	**81,445**	**15,294**	**0**	**0**

Investments (th. EUR)

Year	2000	2001	2002	2003	2004	2005	2006	2007
Total investments				**961**	**5,205**	**977**		
Investment sources								
Investment loan				0	0	0	0	
Grant								
Local grant							0	0
Own capital of the company				961	5,205	977		
Municipality								
Total	**0**	**0**	**0**	**961**	**5,205**	**977**	**0**	**0**

Working Capital Requirements (th. EEK)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Income	2,453,754	2,532,893	2,684,867	3,016,716	3,592,957	3,703,574	3,819,221	3,941,142	4,071,503	4,214,246	4,376,840	4,574,007	4,835,924	5,226,886	5,889,332	7,151,533	9,800,977
Operating costs	626,896	668,087	708,172	750,663	795,702	835,487	877,262	921,125	967,181	1,015,540	1,066,317	1,119,633	1,175,615	1,234,395	1,296,115	1,360,921	1,428,967
Labour costs	1,642,803	1,564,993	1,658,893	1,758,426	1,863,932	1,957,128	2,054,985	2,157,734	2,265,621	2,378,902	2,497,847	2,622,739	2,753,876	2,891,570	3,036,148	3,187,956	3,347,354
Customer receivables	44,981	208,183	220,674	247,949	295,312	304,403	313,909	323,929	334,644	346,376	359,740	375,946	397,472	429,607	484,055	587,797	805,560
Average Days Credit	7	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Inventories	81,546	63,322	67,122	75,418	89,824	92,589	95,481	98,529	101,788	105,356	109,421	114,350	120,898	130,672	147,233	178,788	245,024
As a % of Net sales	3%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Supplier Payables	37,793	54,911	58,206	61,698	65,400	68,670	72,104	75,709	79,494	83,469	87,643	92,025	96,626	101,457	106,530	111,857	117,449
Average Days on Credit	22	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Accrued Expenses	23,403	98,057	103,941	110,177	116,788	122,627	128,758	135,196	141,956	149,054	156,507	164,332	172,549	181,176	190,235	199,747	209,734
Tax liabilities	50,841	43,037	45,820	48,357	51,258	53,821	56,512	59,338	62,305	65,420	68,691	72,125	75,732	79,518	83,494	87,669	92,052

Working Capital Requirements (th. EUR)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Income	156,823	161,881	171,594	192,803	229,632	236,702	244,093	251,885	260,216	269,339	279,731	292,332	309,072	334,059	376,397	457,066	626,397
Operating costs	40,066	42,699	45,260	47,976	50,855	53,397	56,067	58,871	61,814	64,905	68,150	71,558	75,135	78,892	82,837	86,979	91,328
Labour costs	104,994	100,021	106,023	112,384	119,127	125,083	131,337	137,904	144,800	152,040	159,642	167,624	176,005	184,805	194,045	203,748	213,935
Customer receivables	2,875	13,305	14,104	15,847	18,874	19,455	20,062	20,703	21,388	22,137	22,992	24,027	25,403	27,457	30,937	37,567	51,485
Average Days Credit	7	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Inventories	5,212	4,047	4,290	4,820	5,741	5,918	6,102	6,297	6,505	6,733	6,993	7,308	7,727	8,351	9,410	11,427	15,660
As a % of Net sales	3%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Supplier Payables	2,415	3,509	3,720	3,943	4,180	4,389	4,608	4,839	5,081	5,335	5,601	5,881	6,176	6,484	6,809	7,149	7,506
Average Days on Credit	22	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Accrued Expenses	1,496	6,267	6,643	7,042	7,464	7,837	8,229	8,641	9,073	9,526	10,003	10,503	11,028	11,579	12,158	12,766	13,404
Tax liabilities	3,249	2,751	2,916	3,091	3,276	3,440	3,612	3,792	3,982	4,181	4,390	4,610	4,840	5,082	5,336	5,603	5,883

15.6466

Sources and Uses of Funds (th. EEK)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Starting Balance Cash Fund	**10,000**	**5,885**	**228,030**	**697,523**	**1,500,847**	**2,396,326**	**3,283,161**	**4,145,244**	**4,983,483**	**5,802,174**	**6,612,318**	**7,438,460**	**8,333,243**	**9,409,500**	**10,913,667**	**13,400,039**
SOURCES OF CASH																
- Operating profit 2	-111,114	-84,996	84,829	490,525	448,161	404,177	359,485	315,903	297,006	289,878	308,837	383,635	578,122	1,034,270	2,079,858	4,501,858
- Depreciation	382,798	402,798	422,798	442,798	462,798	482,798	502,798	522,798	522,798	522,798	522,798	522,798	522,798	522,798	522,798	522,798
- Change in customer receivables	29,188	-204,881	-27,275	-47,362	-9,092	-9,505	-10,021	-10,715	-11,732	-13,364	-16,206	-21,527	-32,134	-54,448	-103,743	-217,763
- Change in other receivables	41,660	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Change in prepaid expenses	756	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Change in inventories	-3,400	17,824	-8,296	-14,406	-2,765	-2,891	-3,048	-3,259	-3,569	-4,065	-4,929	-6,548	-9,774	-16,561	-31,555	-66,236
- Change in supplier payables	481	19,932	3,492	3,702	3,270	3,434	3,605	3,785	3,975	4,173	4,382	4,601	4,831	5,073	5,327	5,593
- Change in customer prepayments	-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Change in taxes due	5,765	-10,986	2,737	2,901	2,563	2,691	2,826	2,967	3,115	3,271	3,435	3,606	3,787	3,976	4,175	4,383
- Change in accrued expenses	-1,917	82,455	6,236	6,611	5,839	6,131	6,438	6,760	7,098	7,453	7,825	8,217	8,627	9,059	9,512	9,987
- Change in other short term depts	405,594	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Cash Flow from Operations	**749,797**	**222,145**	**484,522**	**884,769**	**910,774**	**886,834**	**862,083**	**838,240**	**818,691**	**810,144**	**826,142**	**894,782**	**1,076,258**	**1,504,167**	**2,486,372**	**4,760,621**
Cash Flow from Financial Sources																
TOTAL SOURCES	**749,797**	**222,145**	**484,522**	**884,769**	**910,774**	**886,834**	**862,083**	**838,240**	**818,691**	**810,144**	**826,142**	**894,782**	**1,076,258**	**1,504,167**	**2,486,372**	**4,760,621**
USES OF CASH																
- Investments	669,007	-	15,029	81,445	15,294	-	-	-	-	-	-	-	-	-	-	-
TOTAL USES	**669,007**	**-**	**15,029**	**81,445**	**15,294**	**-**										
CASHFLOW BEFORE DEBT SERVICE	**80,790**	**222,145**	**469,493**	**803,324**	**895,480**	**886,834**	**862,083**	**838,240**	**818,691**	**810,144**	**826,142**	**894,782**	**1,076,258**	**1,504,167**	**2,486,372**	**4,760,621**
- Principal Repayment of Other Loans	84,905	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service	**84,905**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CASH FLOW AFTER DEBT SERVICE	**-4,115**	**222,145**	**469,493**	**803,324**	**895,480**	**886,834**	**862,083**	**838,240**	**818,691**	**810,144**	**826,142**	**894,782**	**1,076,258**	**1,504,167**	**2,486,372**	**4,760,621**
Ending Balance Cash Fund	**5,885**	**228,030**	**697,523**	**1,500,847**	**2,396,326**	**3,283,161**	**4,145,244**	**4,983,483**	**5,802,174**	**6,612,318**	**7,438,460**	**8,333,243**	**9,409,500**	**10,913,667**	**13,400,039**	**18,160,660**
Balance	5,885	228,030	697,523	1,500,847	2,396,326	3,283,161	4,145,244	4,983,483	5,802,174	6,612,318	7,438,460	8,333,243	9,409,500	10,913,667	13,400,039	18,160,660

Sources and Uses of Funds (th. EUR)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Starting Balance Cash Fund	**639**	**376**	**14,574**	**44,580**	**95,922**	**153,153**	**209,832**	**264,929**	**318,503**	**370,827**	**422,604**	**475,404**	**532,591**	**601,377**	**697,510**	**856,419**
SOURCES OF CASH																
- Operating profit 2	-7,101	-5,432	5,422	31,350	28,643	25,832	22,975	20,190	18,982	18,527	19,738	24,519	36,949	66,102	132,927	287,721
- Depreciation	24,465	25,743	27,022	28,300	29,578	30,856	32,135	33,413	33,413	33,413	33,413	33,413	33,413	33,413	33,413	33,413
- Change in customer receivables	1,865	-13,094	-1,743	-3,027	-581	-607	-640	-685	-750	-854	-1,036	-1,376	-2,054	-3,480	-6,630	-13,918
- Change in other receivables	2,663	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Change in prepaid expenses	48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Change in inventories	-217	1,139	-530	-921	-177	-185	-195	-208	-228	-260	-315	-418	-625	-1,058	-2,017	-4,233
- Change in supplier payables	31	1,274	223	237	209	219	230	242	254	267	280	294	309	324	340	357
- Change in customer prepayments	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- Change in taxes due	368	-702	175	185	164	172	181	190	199	209	220	230	242	254	267	280
- Change in accrued expenses	-123	5,270	399	422	373	392	411	432	454	476	500	525	551	579	608	638
- Change in other short term depts	25,922	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Flow from Operations	**47,921**	**14,198**	**30,967**	**56,547**	**58,209**	**56,679**	**55,097**	**53,573**	**52,324**	**51,778**	**52,800**	**57,187**	**68,785**	**96,134**	**158,908**	**304,259**
Cash Flow from Financial Sources			**921**	**10,411**	**1,955**											
TOTAL SOURCES	**47,921**	**14,198**	**31,888**	**66,958**	**60,164**	**56,679**	**55,097**	**53,573**	**52,324**	**51,778**	**52,800**	**57,187**	**68,785**	**96,134**	**158,908**	**304,259**
USES OF CASH																
- Investments	42,757	-	961	5,205	977	-	-	-	-	-	-	-	-	-	-	-
TOTAL USES	**42,757**	**-**	**961**	**5,205**	**977**	**-**										
CASHFLOW BEFORE DEBT SERVICE	**5,163**	**14,198**	**31,927**	**61,752**	**59,187**	**56,679**	**55,097**	**53,573**	**52,324**	**51,778**	**52,800**	**57,187**	**68,785**	**96,134**	**158,908**	**304,259**
- Principal Repayment of Other Loans	5,426	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service	**5,426**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CASH FLOW AFTER DEBT SERVICE	**-263**	**14,198**	**31,927**	**61,752**	**59,187**	**56,679**	**55,097**	**53,573**	**52,324**	**51,778**	**52,800**	**57,187**	**68,785**	**96,134**	**158,908**	**304,259**
Ending Balance Cash Fund	**376**	**14,574**	**46,501**	**106,332**	**155,108**	**209,832**	**264,929**	**318,503**	**370,827**	**422,604**	**475,404**	**532,591**	**601,377**	**697,510**	**856,419**	**1,160,678**
Balance	376	14,574	44,580	95,922	153,153	209,832	264,929	318,503	370,827	422,604	475,404	532,591	601,377	697,510	856,419	1,160,678

Balance Sheet projections (th. EEK)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ASSETS																	
CURRENT ASSETS																	
Cash and Bank	10,000	5,885	228,030	697,523	1,500,847	2,396,326	3,283,161	4,145,244	4,983,483	5,802,174	6,612,318	7,438,460	8,333,243	9,409,500	10.913.667	13,400,039	18,160,660
Customer Receivables	44,981	15.793	220,674	247,949	295,312	304.403	313,909	323,929	334,644	346,376	359,740	375,946	397,473	429,607	484.055	587,797	805,560
Other Short Term Receivables	222,286	180,626	180,626	180,626	180,626	180,626	180,626	180,626	180,626	180,626	180,626	180,626	180,626	180.626	180,626	180,626	180,626
Prepaid Expenses	47,802	47,046	47,046	47,046	47,046	47,046	47,046	47,046	47,046	47,046	47,046	47,046	47,046	47,046	47,046	47,046	47,046
Inventories	81,546	84,946	67,122	75,418	89,824	92,589	95,481	98,529	101,788	105,356	109,421	114,350	120.898	130,672	147.233	178,788	245,024
Total Current Assets	**406,615**	**334.296**	**743.498**	**1.248.562**	**2.113.654**	**3.020.991**	**3.920.222**	**4,795.374**	**5,647,587**	**6.481.579**	**7,309,152**	**8,156,428**	**9,079.286**	**10,197,452**	**11.772.627**	**14,394,296**	**19,438,916**
FIXED ASSETS																	
Long term financial investments	127	400,171	400,171	400,171	400,171	400,171	400,171	400,171	400,171	400,171	400,171	400,171	400,171	400,171	400,171	400.171	400.171
Acquisition Noncurrent Physical Assets	4,284,994	4,553,830	4,553,830	4,568,859	4,650,304	4,665,598	4,665,598	4,665,598	4,665,598	4,665,598	4,665,598	4,665,598	4,665.598	4,665,598	4,665,598	4,665,598	4,665,598
Depreciation of fixed assets	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-4,135,387	[illegible]	[illegible]	-4,553,830	[illegible]	-4,553,830	[illegible]	[illegible]	[illegible]
Total Fixed Assets	**3,939,728**	**4,255,103**	**3,824,176**	**3,388,278**	**2,998,796**	**2,523,163**	**2,012,236**	**1,481,309**	**930,382**	**511,939**	**511,939**	**511,939**	**511,939**	**511,939**	**511,939**	**511,939**	**511,939**
TOTAL ASSETS	**4,346,343**	**4,589,399**	**4,567,674**	**4,636,840**	**5,112,450**	**5,544,154**	**5,932,458**	**6,276,683**	**6,577,969**	**6,993,518**	**7,821,091**	**8,668,367**	**9,591,225**	**10,709,391**	**12,284,566**	**14,906,235**	**19,950,855**
LIABILITIES AND OWNERS' EQUITY																	
CURRENT LIABILITIES																	
Supplier Payables	37,793	38,274	58,206	61,698	65,400	68,670	72,104	75,709	79,494	83,469	87,643	92,025	96.626	101,457	106.530	111,857	117,449
Customer prepayments	14	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-
Tax Liabilities	50,841	56,606	45,620	48,357	51,258	53,821	56,512	59,338	62,305	65,420	68,691	72,125	75,732	79,518	83,494	87,669	92,052
Accrued Expenses	23,403	21,486	103,941	110,177	116,788	122,627	128,758	135,196	141,956	149,054	156,507	164,332	172,549	181,176	190.235	199,747	209,734
Other liabilities	346,966	781,726	781,726	781,726	781,726	781,726	781,726	781,726	781,726	781,726	781,726	781,726	781,726	781,726	781,726	781,726	781,726
Total Current Liabilities	**459,017**	**898,092**	**989,492**	**1,001,958**	**1,015,172**	**1,026,844**	**1,039,100**	**1,051,969**	**1,065,481**	**1,079,669**	**1,094,566**	**1,110,208**	**1,126,632**	**1,143,877**	**1,161,985**	**1,180,998**	**1,200,961**
NONCURRENT LIABILITIES																	
Debts to parent company	84,905	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Noncurrent Liabilities	**84,905**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL LIABILITIES	**543,922**	**898,092**	**989,492**	**1,001,958**	**1,015,172**	**1,026,844**	**1,039,100**	**1,051,969**	**1,065,481**	**1,079,669**	**1,094,566**	**1,110,208**	**1,126,632**	**1,143,877**	**1,161,985**	**1,180,998**	**1,200,961**
OWNERS' EQUITY																	
Capitalstock (par value)	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500.000	500,000	500,000
Premium	3,504,512	3,504,512	3,504,512	3,504,512	3,504,512	3,504,512	3,504,512	3,504,512	3,504,512	3,636,996	4,187,923	4,738,[illegible]	5,289,777	5,840,704	6.391.631	6,942,558	7,493,485
Retained Earnings	0	-202,091	-313,205	-426,330	-369,630	92,766	512,798	888,846	1,220,202	1,507,976	1,776,853	2,038,[illegible]	2,319,309	2,674,816	3.224.809	4,230,950	6,282,679
Net Profit for the Financial Year	-202,091	-111,114	-113,125	56,700	462,396	420,032	376,048	331,356	287,774	268,877	261,749	280,[illegible]	355,506	549,993	1.006.141	2,051,729	4,473,729
Total Owners' Equity	**3,802,421**	**3,691,307**	**3,578,182**	**3,634,882**	**4,097,278**	**4,517,310**	**4,893,358**	**5,224,714**	**5,512,488**	**5,913,849**	**6,726,525**	7.558,159	**8,464,593**	**9,565,513**	**11,122,581**	**13,725,237**	**18,749,894**
TOTAL LIABILITIES AND OWNERS' EQUITY	**4,346,343**	**4,589,399**	**4,567,674**	**4,636,840**	**5,112,450**	**5,544,154**	**5,932,458**	**6,276,683**	**6,577,969**	**6,993,518**	**7,821,091**	**8,668,367**	**9,591,225**	**10,709,391**	**12,284,566**	**14,906,235**	**19,950,855**

Balance Sheet projections (th. EUR)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ASSETS																	
CURRENT ASSETS																	
Cash and Bank	639	376	14,574	44,580	95,922	153,153	209,832	264,929	318,503	370,827	422,604	475,404	532,591	601,377	697,510	856,419	1,160,678
Customer Receivables	2,875	1,009	14,104	15,847	18,874	19,455	20,062	20,703	21,388	22,137	22,992	24.027	25,403	27,457	30,937	37,567	51,485
Other Short Term Receivables	14,207	11,544	11,544	11,544	11,544	11,544	11,544	11,544	11,544	11,544	11,544	11,544	11,544	11,544	11,544	11,544	11,544
Prepaid Expenses	3,055	3,007	3,007	3,007	3,007	3,007	3,007	3,007	3,007	3,007	3,007	3,007	3,007	3,007	3,007	3,007	3,007
Inventories	5,212	5,429	4,290	4,820	5,741	5,918	6,102	6,297	6,505	6,733	6,993	7,308	7,727	8,351	9,410	11,427	15,660
Total Current Assets	**25,987**	**21,365**	**47,518**	**79,798**	**135,087**	**193,077**	**250,548**	**306,480**	**360,947**	**414,248**	**467,140**	**521,291**	**580,272**	**651,736**	**752,408**	**919,963**	**1,242,373**
FIXED ASSETS																	
Long term financial investments	8	25,576	25,576	25,576	25,576	25,576	25,576	25,576	25,576	25,576	25,576	25,576	25,576	25,576	25,576	25,576	25,576
Acquisition Noncurrent Physical Assets	273,861	291,043	291,043	292,003	297,209	298,186	298,186	298,186	298,186	298,186	298,186	298,186	298,186	298,186	298,186	298,186	298,186
Depreciation of fixed assets	-22,075	-44,668	-72,209	-101,028	-131,126	-162,502	-195,156	-229,089	-264,299	-291,043	-291,043	-291,043	-291,043	-291,043	-291,043	-291,043	-291,043
Total Fixed Assets	**251,795**	**271,951**	**244,409**	**216,550**	**191,658**	**161,260**	**128,605**	**94,673**	**59,462**	**32,719**	**32,719**	**32,719**	**32,719**	**32,719**	**32,719**	**32,719**	**32,719**
TOTAL ASSETS	**277,782**	**293,316**	**291,928**	**296,348**	**326,745**	**354,336**	**379,153**	**401,153**	**420,409**	**446,967**	**499,859**	**554,010**	**612,991**	**684,455**	**785,127**	**952,682**	**1,275,092**
LIABILITIES AND OWNERS' EQUITY																	
CURRENT LIABILITIES																	
Supplier Payables	2,415	2,446	3,720	3,943	4,180	4,389	4,608	4,839	5,081	5,335	5,601	5,881	6,176	6,484	6,809	7,149	7,506
Customer prepayments	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax Liabilities	3,249	3,618	2,916	3,091	3,276	3.440	3,612	3,792	3,982	4,181	4,390	4.610	4,840	5,082	5,336	5,603	5,883
Accrued Expenses	1,496	1,373	6.643	7,042	7,464	7,837	8,229	8,641	9,073	9,526	10,003	10.503	11,028	11,579	12,158	12,766	13,404
Other liabilities	22,175	49,961	49.961	49,961	49,961	49.961	49,961	49,961	49,961	49,961	49,961	49,961	49,961	49,961	49,961	49,961	49,961
Total Current Liabilities	**29,337**	**57,399**	63,240	**64,037**	**64,881**	**65,627**	**66,411**	**67,233**	**68,097**	**69,003**	**69,956**	**70,955**	**72,005**	**73,107**	**74,264**	**75,480**	**76,755**
NONCURRENT LIABILITIES																	
Debts to parent company	5,426	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Noncurrent Liabilities	**5,426**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL LIABILITIES	**34,763**	**57,399**	**63,240**	**64,037**	**64,881**	**65,627**	**66,411**	**67,233**	**68,097**	**69,003**	**69,956**	**70,955**	**72,005**	**73,107**	**74,264**	**75,480**	**76,755**
OWNERS' EQUITY																	
Capitalstock (par value)	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956	31,956
Premium	223,979	223,979	223,979	223,979	223,979	223,979	223,979	223,979	223,979	232,446	267,657	302,868	338,078	373,289	408,500	443,710	478,921
Retained Earnings	0	-12,916	-20,01[illegible]	-27,247	-23,624	5,929	32,774	56,808	77,985	96,377	113,562	130,290	148,231	170,952	206,103	270,407	401,536
Net Profit for the Financial Year	-12,916	-7,101	-7,23[illegible]	3,624	29,552	26,845	24,034	21,178	18,392	17,184	16,729	17,941	22,721	35,151	64,304	131,129	285,923
Total Owners' Equity	**243,019**	**235,918**	**228,687**	**232,311**	**261,864**	**288,709**	**312,743**	**333,920**	**352,312**	**377,964**	**429,903**	**483,054**	**540,986**	**611,348**	**710,863**	**877,203**	**1,198,337**
TOTAL LIABILITIES AND OWNERS' EQUITY	**277,782**	**293,316**	**291,928**	**296,348**	**326,745**	354,336	**379,153**	**401,153**	**420,409**	**446,967**	**499,859**	**554,010**	**612,991**	**684,455**	**785,127**	**952,682**	**1,275,092**

ANNEX V

Summary Of the Environmental Impact Assessment (EIA) Report

Planned activities

The aim of the planned activities is to close down a part of the treatment area of the oil-shale ash of the Balti Power Plant – the ash field No. 2 and the sludge lagoon ("Lake Green") by the ash field.

The scope of the environmental impact assessment defined by the Environment Memorandum and the EIA Program. The state of the aquatic environment, aquatic life and landscapes in the region, as well as the environmental impact of the planned activities upon the aquatic environment and landscapes are being dealt with. The area under observation is surrounded by the industrial territory of the Balti Power Plant in the north, the cooling water discharge channel in the east, the Narva Reservoir in the south and the Kulgu Channel in the west.

The Balti Power Plant is the second largest (by power) power plant in Estonia, after the Eesti Power Plant. It is powered by oil shale combustion, which produces approximately 2 million tons of oil-shale ash a year. Ash is disposed into the ash field No. 1 as slurry in water. The ash field No. 2 has not been used for ash disposal since 1987. It has been used as an evaporation area for the excess settled water from the sludge lagoon of the ash field No. 1. The area of the ash field No. 2 is 406 ha and the area of the sedimentation lagoon ("Lake Green") on the southern side of the field is 170 ha.

The ash fields of power plants may be considered to be old pollution, as they have been created as the result of the large-scale production founded during the Soviet period. Renovating the oil shale power industry so that it becomes environmentally friendly is very expensive. The project of closing down the Ash Field No. 2 will provide useful know-how for solving environmental problems in the course of organizing the ash processing technology at the AS Narva Elektrijaamad (Narva Power Ltd).

Environmental situation

The topmost aquifers of groundwater have been contaminated. Using the aquifer of Ordovician-Cambrian strata in the communal water supply system is unpromising, as the pollution may possibly spread into this aquifer, too. The only groundwater aquifer that can be used, and which is well protected by a layer of clay, is situated in the aquifer of Cambrian-Wendian strata.

The surface water bodies are affected by various contamination sources. The most serious danger for the Narva Reservoir is the possible breakout discharge of the alkaline ash water from the ash fields. The impact of controlled discharge of alkaline wastewater upon the aquatic life should not reach the Narva Reservoir (outside the cooling water channel).

Contaminating the aquatic environment is sustained by discharging the polluted precipitation water of the industrial area into the ash disposal system. The industrial waste landfill of AS Nakro and the domestic waste municipal landfill of Narva are the local sources of contamination.

The intake structure of the communal water supply system has been developed in accordance with the present environmental impact of the AS Narva Elektrijaamad. The contaminated topmost aquifers of groundwater are not used in the area. The surface water intake structure of the city of Narva is supplied with the water from Narva River, upstream from the influence zone of the cooling water intake structure of the Eesti and the Balti Power Plant.

Local contamination originating from the industrial waste landfill of AS Nakro may influence the quality of the water in shallow wells in small villages situated nearby.

The impact of the Balti Power Plant upon aquatic life, which has been determined irrefutably, is the perishing of young fish in the area of the inlet of the cooling water intake structure. The possible breakout discharge of the alkaline ash water may result in considerable negative impact upon the environment.

The landscapes in the vicinity have been turned into artificial ones and there are neither any valuable areas that may need protection nor any sensitive sites in the neighbourhood.

Closure options

The search for closing options and the assessment of the suggested ones was based upon the fact that in two years it will be necessary to get rid of the highly alkaline ash water in the sludge lagoons of the ash field evaporation cascade and in sedimentation lagoon ("Lake Green").

When comparing different options, the following environmental aims were taken into account:

- excluding the possible breakout discharge of the alkaline ash water from the ash field No. 2;
- stopping the discharge of alkaline ash transport water into water bodies;
- stopping the contamination of groundwater;
- stopping the spreading of dust from the ash field;
- ecologically sustainable use of landscapes and natural resources.

Criteria for achieving these aims are the following:

- the alkaline wastewater pools are closed;
- the alkalinity of the discharged alkaline water is below pH 9;
- there are no phenols in the water samples taken from the ash field and the sludge lagoon;
- the ash field is landscaped;
- no new natural areas are devastated.

Several closing options were considered in the course of the feasibility study and EIA. Preliminary assessments of environmental impacts were also carried out for each option. The only solution that guarantees the attainment of environmental goals is treating the alkaline ash water in the purification unit before discharging it into a water body.

After the initial evaluation of different options for turning the ash field into an environmentally safe one, three options were selected.

Option 0 means that the current practice will be continue (the plans for closing down the ash field will be abandoned). The periodical draining of the alkaline water from the evaporation cascade lagoons into the Narva Reservoir via the cooling water discharge channel will be continued. This option is not in accordance with either environmental aims or environmental legal acts.

Options 1 and 2 were developed in order to turn the ash field into an environmentally safe one, to keep this state and to employ the potential of the area.

In order to achieve the realization of both options, similar technical solutions will be used in the initial phases of the project:

- a neutralizing plant for neutralizing the water with high pH level will be built;
- the water from the evaporation cascade lagoons of the ash field will be discharged into the cooling water channel of the Balti Power Plant through the neutralizing plant;
- the ash field will be covered with recultivation material, as well as with verdure;
- "Lake Green" will be partially drained through the neutralizing plant, and turned into a wetland.

Option 1 provides that the ash field will be drained and covered with a thin layer of topsoil, and with herbaceous plants.

Option 2 provides that the ash field will be turned into an area landscaped with herbaceous plants and forested. Landscaping with alternating zones of herbaceous plants and forest creates the conditions for formation of the biotope characteristic to covered ash fields (meadow grass and silver birch). In Option 2, the first stage of the industrial waste landfill will be built.

During maintenance and monitoring, the water quality (pH), the water level in the lakes formed on the basis of the former "Lake Green", and the geotechnical stability of the ash mound will be monitored. The task of maintenance is to monitor the stability of the ash field cover and to restore the eroding areas as quickly as possible.

Discharging alkaline water into water bodies will be discontinued by this planned closure project. The volume of the water needing treatment will decrease in the future. Conditions for environmentally safe processing of the industrial waste produced at the power stations near Narva will be created by founding onto a small area of the closed ash field a new controlled industrial waste landfill, which complies with modern environmental standard.

This way, the cost of waste treatment will be lower and the contamination of environment, as well as the possible risk of environmental disasters will be reduced.

Options 1 and 2, as discussed in this study, are feasible.

Assessment of the environmental impact of the options

Option 0 is dangerous for the environment. The main problem is the possible breakout of large amounts of alkaline ash water into water bodies, as well as the necessity to regularly discharge the alkaline water.

Options 1 and 2 solve the problem with alkaline water and create the necessary conditions for improvements in the state of the water bodies of the area. The large waste field will be covered with verdure and, as time passes, a safe artificial landscape will form here; later on, people may visit it freely.

Option 2 provides that the inert industrial waste and asbestos of the AS Narva Elektrijaamad will be deposited at one waste landfill, which meets all the necessary requirements. It will mean closing down the existing industrial waste landfills. The creation of a landfill site for industrial waste in the already existing ash field is ecologically sustainable, as no new natural territories will be devastated.

Public participation

Public hearing of EIA programme, the closure options of the ash field No. 2 and EIA report were held.

Recommended option

As the result of evaluating and weighing various options, Option 2 was chosen as the preferred one, as the above-mentioned option provides the most integrated solution for improving the environmental situation in the region.

In the course of carrying out the preferred alternative (Option 2) all the possible risks and environmental impacts discovered with the help of EIA will be eliminated:

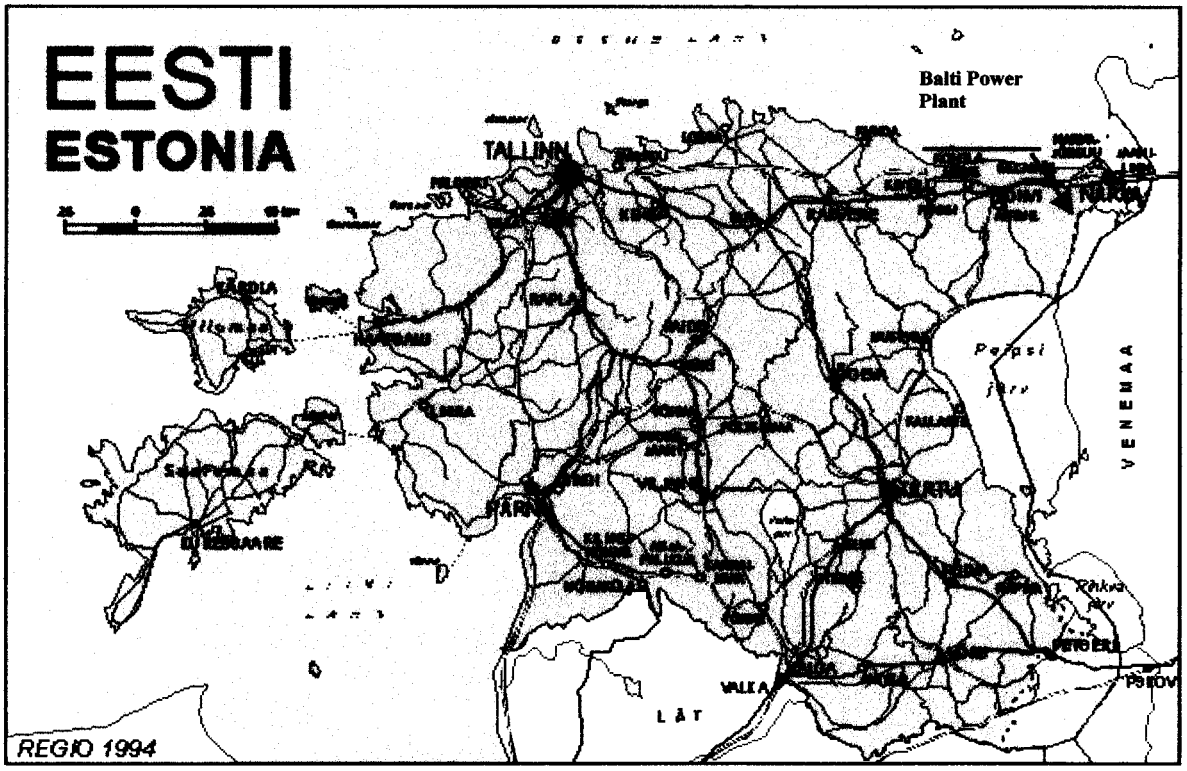
- the ash field region will be made safe for people; in the future, people can freely visit the area;
- the risk of the possible breakout of alkaline water from the ash field No. 2 into the Narva Reservoir will be eliminated;
- the periodical draining of alkaline water into the Narva Reservoir will cease;
- the contamination of groundwater in the region will cease; the area containing polluted groundwater will not increase any more;
- covering the ash mound with verdure will eliminate the problem of ash dust spreading from the ash field No. 2;
- the creation of a new landfill site for industrial waste in the ash field No. 2 will save the existing natural landscapes of the region from destroying any additional areas thereof, and will save natural resources necessary for the construction of the base of the new landfill, access roads and means of communication.

If the preferred alternative is carried out, the environmental situation will be improved. Closing down the ash field No. 2 on the basis of the preferred alternative will be in accordance with the legal acts of the Republic of Estonia in the field of environment protection and agrees with the environment strategy, Environmental Action Plan (NEAP) for 2001 – 2003. and National Waste Management Plan of Estonia, as well as with the environmental objectives of Eesti Energia AS. The planned activities are

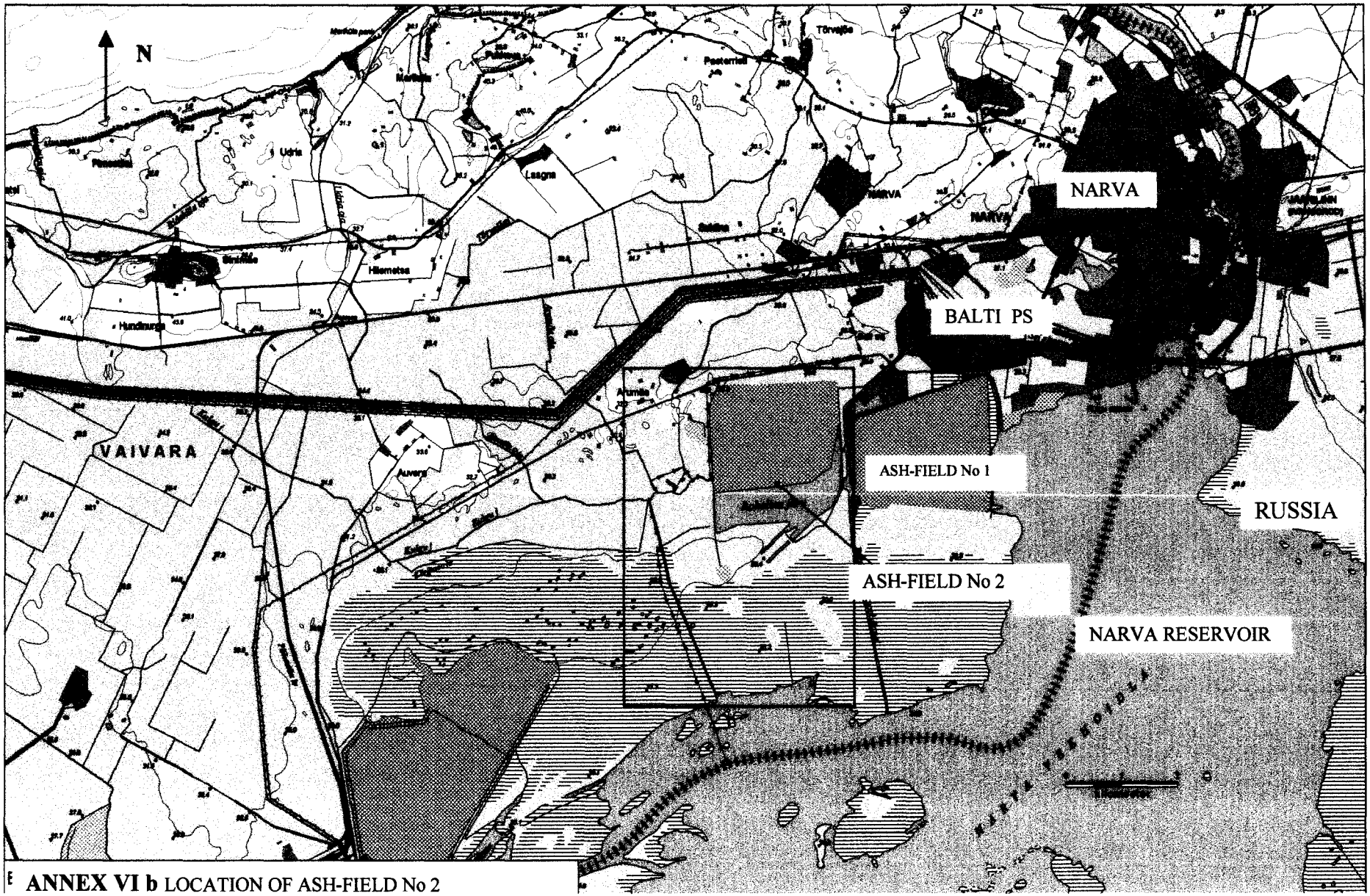
in accordance with the time schedule for introducing new technology in the field of oil-shale ash treatment, which was agreed upon in the course of the negotiations for joining the European Union.

Carrying out the preferred alternative will solve the problem of safely disposing of the industrial waste produced by the power plants of AS Narva Elektrijaamad in accordance with the EU directive 1999/31/EC on landfill of waste.

In order to achieve future improvements in the environmental state of the region, the very best possible ash treatment technology must be used in the ash field No. 1 of the Balti Power Plant, and the industrial waste landfill of AS Nakro will have to be closed down.



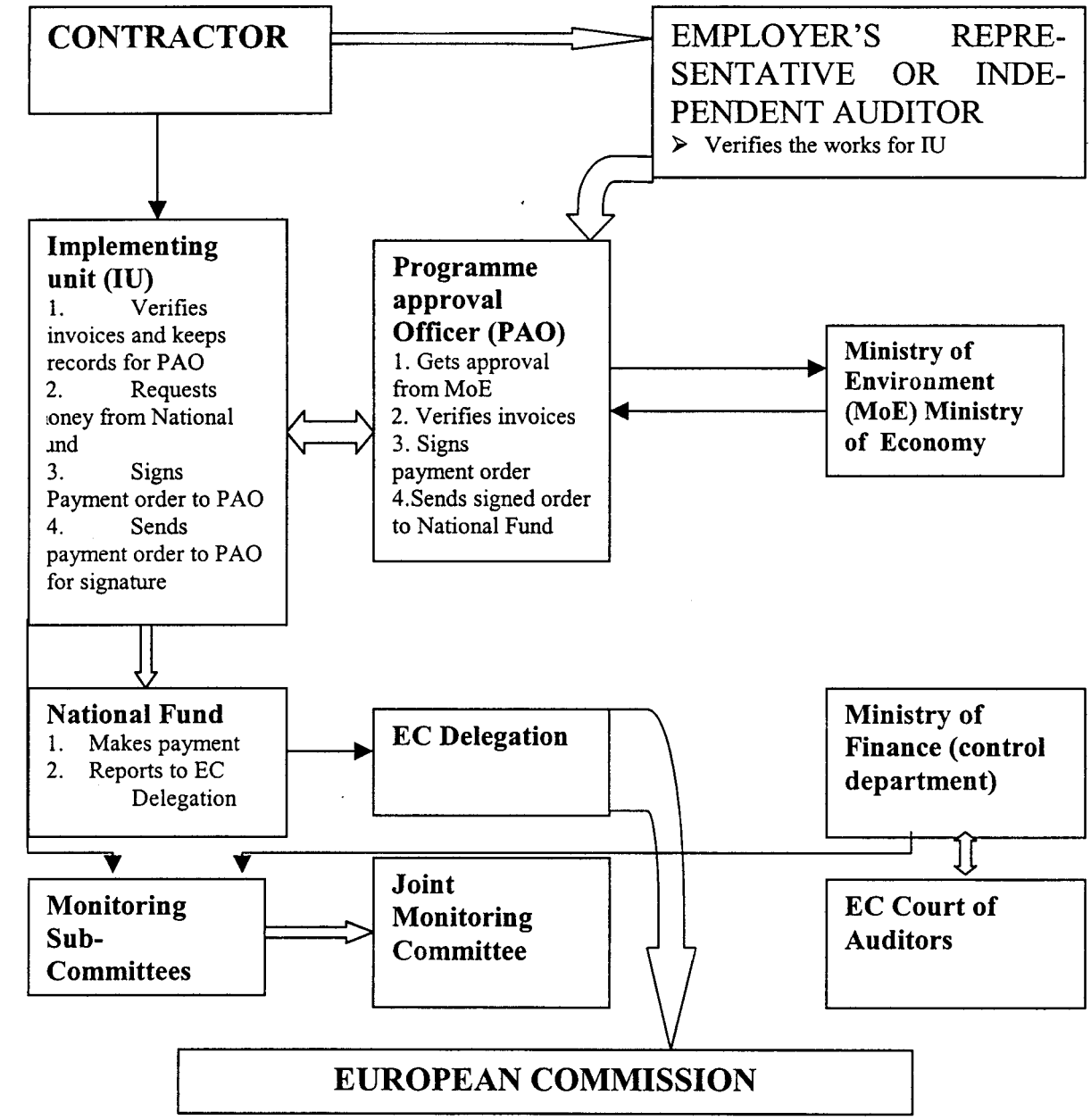
Annex VI[a] Map of Estonia.
Location of Balti Power Plant



ANNEX VI b LOCATION OF ASH-FIELD No 2

ANNEX VII

ISPA Reporting Scheme



APPRAISAL REPORT

Balti Power Plant

Preparation of ISPA application for the Project:

'Closure of Ash Field Nr. 2 with water ponds at Balti Power Plant'

Tallinn, March 2002

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Preface

The main objectives of this assessment is to review the existing situation at the Balti Power Plant based on a technical feasibility study, an Environmental Impact Assessment Screening, and an economic and financial analysis. And therefore assess whether the chosen solutions and recommendations of the studies are viable. At the same time, the Appraisal is expected to recommend changes to the chosen solutions if /when needed and to update the cost information in order to facilitate decision making of prospective financiers of the project.

The current Appraisal Report concerns the feasibility study, economic and financial analysis, and the Environmental Impact Assessment Screening at the Balti Power Plant completed in January, 2002 and performed by PIC Estonia, Maves Ltd, and Merin Ltd[1].

The feasibility study and environmental impact screening were conducted during site visits made in October and November, 2001. Experts were able to review the situation at Balti Power Plant and the ash field and collect necessary information. The following supplementary studies were carried out: topographic survey of the ash field; quality and chemical composition analyses of water samples from the water bodies in the area by various laboratories; hydro biological study of the water bodies; geological survey of the ash field and the lakelet; and a study of landscaping options. The mission received the full support and cooperation of the management of Balti Power Plant - the electricity company and one of the liable parties (with the State).

[1] Narva Power Ltd, 2002: *Closure of ash field No. 2 with water ponds at Balti Power Plant: Feasibility Study*. Unpublished feasibility study by PIC Estonia, Maves Ltd, Merin Ltd Tallinn, Estonia.

Max Smith
Tallinn, March 2001

1 Funding and Proposer

1.1 The ISPA grant

Date of request for the ISPA grant: **March 2002**

Total project investment value: **7.14 million EURO**
Total ISPA investment value: **6.07 million EURO**

1.2 Financing structure and amounts

Source	Sum	
	Million EURO	**Share %**
ISPA[2]	6.07	85
Central Government (and Balti power Plant)	1.07	15
TOTAL	**7.14**	**100%**

1.3 The Proposer

The Republic of Estonia, the Ministry of Environment
Mr. Rainer Rohesalu
Investment Department
Toompuiestee 24
15127 Tallinn
tel. +372 631 2333

[2] ISPA finances will be channeled through the Environmental Investment Center - which is the Implementing Agency of Estonia's Environmental projects under the auspices of ISPA of the Estonian Ministry of Finance. This organization is separate from the KIK – Keskonnainvesteeringute Keskus, the environmental investment arm of the Estonian Ministry of Environment.

2 Context

2.1 Local and National Context

Since the start of restructuring of the political and economic systems in the countries in Central and Eastern Europe in 1989, the EU Commission has on behalf of the member states of the European Union provided support and assistance to the restructuring of the economies.

At present Estonia is undertaking various measures to comply with the *acquis communautaire* to further its aims under the accession process. Part of this process will be aided by the implementation of the ISPA initiative (Instrument for Structural Policies for Pre-Accession) managed by the EU Commission (DG XVI). The ISPA initiative covers the environment and transport sectors.

The overall objectives of ISPA in the environment sector are:
- Assisting the countries in meeting the environmental *acquis*
- Assisting the countries in adapting to EU environmental legislation

The ISPA priorities are:
- Wastewater
- Drinking water
- Solid waste management
- Air pollution

ISPA is planned to be implemented in the period 2000-2006 with an annual budget of 1 Billion Euro to be distributed among the 10 candidate countries and between the transport and environment sectors. ISPA will normally finance up to 75% of public or equivalent expenditure for specific projects.

Within the negotiation process of EU approximation, Estonia and EU Commission have provisionally closed Environment chapter and have agreed common position in June 2001.

2.2 Relation of Project to Estonian national environmental action plans

The Project falls under a variety of priority areas concerning environmental legislation and waste management.

National Environmental Strategy and National Environmental Action Plan.
The National Environmental Strategy (NES) works in parallel with the National Environmental Action Plan (NEAP) for 2001-2003, adopted by the Government of the Republic of Estonia on 05. May 2001 (decision No. 25). The NEAP contributes to the implementation of the principles of sustainable development adopted by the National Environmental Strategy (NES). The National Environmental Action Plan lists and describes a number of different actions for every policy goal of NES.

The NES focuses on achieving of ten policy goals during 1998-2010. The Project corresponds to Policy Goal No. 3 and No. 6 of the NES concerning the reduction of negative environmental effects of the Energy Sector and elimination of past pollution caused by abandoned dumpsites and to recultivate disturbed landscapes. This goal contributes to reduce negative environmental effects of energy production contributing to a sustainable energy policy. Policy Goal No. 6 of the NES is further elaborated in the National Environmental Action Plan (NEAP). There are 24 actions accounting for 24% of the NEAP relevant to Policy Goal No. 6. Under the NEAP Action 3.1.8 Closing of Narva Power Plant Ash Field Nr. 2. Highest priorities are for actions concerning:

- Ensuring of safety of contaminated sites, and;
- Rehabilitation of abandoned sites.

The term "site" in the NEAP also covers all existing ash-fields of oil-shale fuelled power plants of Estonia.

Tasks under the NES for the year 2000 are partially implemented. Such as an inventory of past pollution sites originated from abandoned military sites, industrial enterprises and municipal landfills. Their environmental risks have been assessed. Also areas where past pollution of soil poses a direct risk to ground water and human health are localized.

Tasks to be completed year 2005 include:

- to decommission and rehabilitate abandoned quarries;
- to prevent migration of pollutants from currently operating industrial waste depositories and municipal landfill sites into the soil and into surface and ground water;
- to recultivate abandoned industrial waste depositories and municipal landfill sites.

National Programme for the Adoption of the Acquis, and
National Waste Management Plan

Within the framework of the Accession Partnership, the Accession Strategy for the environment between the EU and the Estonian National Government, concluded on 24th September 1998 that all new investments should comply with the environment *acquis*. Thus the project is consistent with the National Programme for the Adoption of the Acquis (NPAA), and the National Waste Management Plan (NWMP).

The NWMP is associated with Framework Directive of Waste Management 75/442/EEC with amendments 90/656/EEC, 91/156/EEC and 91/692/EEC; and Directive 1999/31/EC on landfill of waste. Within these Directives the Project represents part of the improvement of the situation with abandoned waste disposal sites, which have a priority at both National and Regional level.

In order to achieve the goals of the NEAP, the NES, the NPAA and the NWMP it is necessary to prevent migration of pollutants into the environment

from industrial waste disposal sites (enrichment waste, ash and semi-coke dumps) and municipal landfill sites. To recultivate areas disturbed by the mining industry; to create aesthetic artificial landscapes; and establish preconditions for restoration of soil fertility of the disturbed areas.

2.3 Links with Community and Environmental Legislation Policy

Policy Goal No.6 of the NEAP is supported by the European Union Common Position Conf-EE 13/01, Chapter 22; Environment, signed in Brussels on the 30th of May 2001. The measure is linked to Community environmental policy through the implementation of relevant articles of:
Council Directive 1999/31/EC on the landfill of waste.

The transposition of this directive is completed by the Regulation of the Minister of the Environment on 23 June 2001 No. 34 on Construction, Use and Closure down of Landfills. According to ministerial Regulation, Ida-Viru Environmental Service as the competent local authority claimed to close the site (fixed in Estonian Landfill register under code No. 051102) legally by 31st of Dec.2001.

In addition to the aforementioned Directive there is a indirect link of the measure with the:

- Water Framework Directive 2000/60/EC,
- Council Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment.
- Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment.

The position of environment *acquis* on oil-shale ash depositories as specified in the Common Position Conf-EE 13/01, Chapter 22: Environment states:

- Concerning landfilling of oil shale ash, the EU considers that Estonia's request for transitional period is sufficiently limited in time taking into account that necessary technology still needs to be developed.
- EU can accept a transitional measure and agrees that for existing landfills, the requirements for liquid and corrosive waste under Articles 14(d) i) and 5a), (b) of the Directive 1999/31/EC only apply to oil-shale ash as from 16 July 2009.

With regard to Directive 1999/31/EC on landfill of waste, the EU has invited Estonia to confirm that, as from 16 July 2009, the requirements of the Directive will be fully applied to waste which is landfilled. As regards landfilling of oil shale ash, the EU considers that Estonia's request for a transitional period is sufficiently limited in time taking into account that necessary technology still needs to be developed and put in place. The EU notes that the request relates to more than 90% of the hazardous waste generated in Estonia.

In order to limit the scope and the negative impact on the environment, the EU invites Estonia to confirm that it will take the necessary measures in order to ensure, during the transitional period, that this waste is only landfilled in appropriate sites that are in compliance with the general requirements set out in Article 4 of Directive 75/442/EEC on waste and to regularly inform the EU on these measures, which need to be notified to the Commission by the date of accession.

Expenditure related to the Project have been estimated at general level in the Estonian NWMP. According to the document's estimate, the encapsulation of all ash-fields by implementing of the stringiest norms of closure down of hazardous waste dumpsites is inexpedient. However, the negative impact of ash-fields-dumpsites should be finished as soon as possible. Thus, the measure relates directly to the Council Directive 1999/31/EC on the landfill on Waste, Article 13.

2.4 Institutional set up

The ash disposal sites in question are considered a joint liability of the state and AS Narva Elektrijaamad (Narva Power). From its initial commissioning in the 1950s the Balti Power Plant was operated State as a State Enterprise. Subsequent to Estonian independence in 1991 Balti Power Plant is operated by the 100% State-owned company Eesti Energia.

Due to this past association with the state and during which period the bulk of the ash field was created the project will be implemented in a public-private partnership. The Estonian Republic is represented by the Ministry of Environment and the Ministry of Finance. .

Proposing party and co-financing
The Ministry of Environment (MoE) has proposed the project for co-financing from ISPA. The Environmental Investment Department of the MoE will be involved in preparation of the project as it has responsibility for ISPA matters at the MoE. The Environmental Investment Centre (EIC/KIK) under the Ministry of Finance as Implementing Agency for Estonia's Environmental projects of ISPA will be involved in project implementation.

Implementation
Closure of Ash Field Nr. 2 with water ponds in Balti Power Plant will be implemented by AS Narva Elektrijaamad.

[3] Estonian name is: Keskonnainvesteeringute Keskus; the financial investment arm of the Estonian Ministry of Environment.

2.5 Responsible Parties

Proposer
The Republic of Estonia, the Ministry of Environment
Mr Rainer Rohesalu
Investment Department
Toompuiestee 24
15127 Tallinn.

ISPA Implementing Agency
The Republic of Estonia, the Ministry of Finance
Mr Harri Õunapuu
Minister of Finance
Suur-Ameerika 1
15006 Tallinn.

Project Implementing Agency
AS Narva Elektrijaamad
Mr. Arvo Tordik
Environmental Department
Sepa 4
20306 Narva.

The above-mentioned persons are competent and experienced and entirely capable of handling the implementation of the planned investments.

2.6 Legal issues and requirements

Liability for the site is shared between the owner of the site, Narva Power Plant and the Republic of Estonia. Narva Power Plant is 100% owned by the - 100% state company Eesti Energia Ltd.

Eesti Energia Ltd. is guided by environmental policies and activities declared in Estonian NES, NEAP, environmental acts of the Republic of Estonia and their implementing regulations as well as International environmental documents ratified by the State Assembly (agreements, conventions, protocols, EU directives, etc.). The primary environmental task of Eesti Energia is to end discharge of ash-fields alkaline water surpluses into Narva Reservoir. If the ash-field No. 2 as an object of past pollution will be rehabilitated, then the discharge of surplus alkaline water will be stopped.

2.6.1 Procurement plan

Procurement of works and services is based on EU and Estonian legislation – Public Procurement Law and respective documents and rules. According to this, open tendering procedures should be followed to secure equal opportunities and transferability.

3 Technical aspects

3.1 Principal Objectives

The principal objective of the Project aims to aid the Estonian accession process by closure of Ash Field No. 2 with water ponds, an oil shale ash depository on the premises of Balti Power Plant. This will lead to compliance with various relevant EU and Estonian National environmental legislation as described in Section 2.

Technical objective of the Project is the closure of Ash Field No. 2 with water ponds 2, the Balti Power Plant, in compliance with relevant EU and Estonian legislation (see Section 2.3).

Environmental objectives are to cease adverse impacts from Ash Field No. 2. Successful completion of the technical aspects of the Project shall lead to successful completion of the overall and environmental objectives.

3.2 Project Background and Concept

Balti Power Plant
Balti Power Plant is the second largest (by power) power plant in Estonia, after the Eesti Power Plant. It was built four stages between 1959 and 1967. Its electrical capacity is 1390 MW and for producing heat is 505 MW. It creates power by the combustion of kukersite oil shale and produces approximately 2 million tons of oil-shale ash a year (1995 – 1999 average). The Balti Power Plant is also the single centralised supplier of heat and hot water for Narva and its population of 85,000.

Eesti Energia Ltd. has started the project with the aim of applying for the support from ISPA for closure of the Ash Field No. 2 of Balti Power Plant Ltd. Following the application of the Narva Power Ltd., the operating agent of the power plant, the Ministry of Environment's Environmental Service of East-Viru County decided in late 2001 to close down the Ash Field No. 2.

In deciding to close down Ash Field No. 2 of the Balti Power Plant, Narva Power Ltd aims to cease the environmental impacts, hazards and problems of the ash field. Especially its frequent discharge of alkaline water to the cooling water channel which discharges into the Narva Reservoir at the Estonian-Russian border. This is to contribute to Estonia complying with various EU and Estonia legislation, as described in Section 2.

Ash and ash transport
Waste ash is either disposed on the disposal areas of the power plant itself (ash fields 1 & 2), or utilized in different kinds of industrial applications. Future production is anticipated to be less. Presently ash is only disposed into Ash Field No. 1. Ash Field No. 2 has not been used for ash disposal since 1987. Currently it is used as an evaporation area for the excess settled water from

Ash Field No. 1. The total area of the two ash fields and their settling ponds is 10.4 sq km.

Ash is transported from the power plant to the disposal areas by a wet transportation system. Oil-shale ash is not liquid by nature. It is a mixture of solid ash (extracted from boilers, superheaters, cyclones and electrostatic precipitators) and water with a ratio 1 : 15-20. Mixing of ash with water is needed to facilitate pumping the waste as slurry via iron pipes to the landfill. At the landfill ash is precipitated from the slurry and water is circulated back via special canals and pipelines to the power plant and used again for ash transportation.

The chemical composition of the ash is presented in Table 1.

Being in contact with hot ashes, transportation water saturates with salts and other inorganic compounds and becomes highly alkalic (pH = 12 - 13). The ash-water mixture is considered as hazardous waste due to the risk leachates pose to groundwater and the risk of alkalic water discharge to adjacent surface water bodies. However, after some years the ash deposited on the landfill is mineralized stable inorganic matter.

Table 1

Chemical composition of fly ash transported to the ash disposal areas

Component	Percentage, %
SiO_2	20,6
Fe_2O_3	4,4
Al_2O_3	5,7
CaO	55,8
MgO	6,7
K_2O	1,5
Na_2O	0,2
SO_3	4,8

The chemical composition of the ash is very similar to that of calcareous mixtures, mortars, plasters used in construction because of the high content of calcium oxide (lime) and silica (sand). Mixtures of minerals with similar kind of composition are capable in the presence of sufficient amounts of water and carbon dioxide (absorbed from air) to solidify forming inert compounds of silicates and calcareous substances. These properties of oil-shale ash have been used in practice in Estonia during the last 80 years for production of different construction materials, incl. additives to cement compositions.

Lake Green and evaporation ponds
Waters transported to the ash field are first contained in 12 evaporation ponds. Overflow from these goes into a large lake, termed Lake Green of 170

ha. The evaporation cascade has a volume of 3.2 million m^3. Lake Green has a volume of 2.6 million m^3.

Annual precipitation is 620 mm. Excess water added to the system is 0,7-1,3 million m^3.

Feasibility study
In late 2001 Narva Power awarded a contract to a consortium of three Estonian companies to undertake technical and environmental feasibility studies regarding closure of Ash Field No. 2 with water ponds at Balti Power Plant. The contract was awarded following tendering for the Project in mid 2001. The three companies are: Maves Ltd, as principal project manager for the Project; PIC Estonia; and Merin Ltd. Full details regarding addresses and contact persons are presented in Appendix 1.

The Feasibility Study was completed in January 2002 and forms the basis of this Project Appraisal Report. Work within the Feasibility Study included:
- supplementary topographic survey of the ash field;
- chemical analyses of water samples from the water bodies in the area by various laboratories;
- hydro biological study of the water bodies;
- geol-technical survey of the ash field and the lakelet;
- geological and hydrological assessment of the surrounding and underlying area;
- a study of landscaping options, and;
- an screening of environmental impacts and risks.

Financial and economic analysis was completed in February 2002 by Eesti Veevärk Ltd.

3.2.1 Background reports

Previous studies relevant to closure of the Balti Power Plant ash field include:

- H. Arro j.t. Balti Elektrijaama tuhaväljade keskkonnaalaste probleemide lahendamisvõimalustest tiheda pulbi tehnoloogia rakendamisega. Orienteeruv hinnang. Lep. 018L aruanne. TTÜ STI, Tallinn 2000. [Study on Possibilities to Overcome Environmental Problems of As Fields Using Thick-Slurry Technology for Ash Deposition];
- Qualitative Environmental Liability Analysis. Electrowatt-Ekono. 2000 ;
- Narva Power Plants And Oil Shale Mining: Phase II Environmental Site Assessment. Module IVa Balti Ash Disposal Area No: 2 reclamation. Soil and Water Ltd. 2001;
- Narva Power Plants And Oil Shale Mining: Phase II Environmental Site Assessment. Module II Groundwater Quality. Soil and Water Ltd. 2001;

- Narva Power Plants And Oil Shale Mining: Phase II Environmental Site Assessment. Module III Surface Water Quality. Soil and Water Ltd. 2001;
- R.Kuusik jt. Süsinikdioksiidi sidumine põlevkivituhaga (Carbon Dioxide Binding by Oil Shale Ash). Tallinna Tehnikaülikool, Tallinn 2000.

3.3 Situation of Ash Field No. 2

Location
Ash Field No. 2 with water ponds lies in a relatively remote, industrially zoned area of East Viru County, 210 km east of Tallinn, Estonia's capital. The site is 5 km from the city of Narva (pop. 85 000) and the nearest residence is some 500 m away in the hamlet of Kõrgesoo. The immediate risks to human health and habitation are very small. A location map is attached in the Feasibility Report.

The ash field lies 1 km from the power plant itself. The ash field is large, 576 ha of which 406 ha is ash-stone and 170 ha a sedimentation lagoon (Lake Green). The ash-stone is largely calc-silicate in nature which in the presence of air solidify into inert compounds. The ash-stone does not pose any significant environmental or human health threat. The greatest nuisance is the possibilities of dust should it be left uncovered. The solid nature of the ash-stone heap creates engineering difficulties for grading and reforestation.

Non-compliance of the old landfill regarding EU standards
Sampling and analysis of the water on Ash Field No.2 were conducted as part of the feasibility study. Ten samples were taken and analysis was conducted at the following accredited laboratories: Estonian Environmental Research Centre and Analytico Milieu B.V. (Netherlands). Furthermore all previous sampling conducted on the area were available for use.

Table 2 shows the chemical composition of waters on Ash Field No. 2 and compares them with relevant EU and Estonian standards. Waters contravene both EU and Estonian standards only for pH. According monitoring data of Balti Power Plant the average content of suspended solids in Green Lake during 2000 - 2001 was 8 – 10 mg/l. The highly alkaline pH of the evaporation cascade and Lake Green, respectively pH 12 and pH 9.7, is significantly higher than the maximum permitted level of pH 9. As such these highly alkaline waters represent the most serious environmental threat or impact of the ash field.

Analysis shows that though phenols are present they are not in contravention of maximum permissible levels. Also that there is no environmental threat from heavy metals. The planned separation of circulation water system from the storm runoff system in Balti Power Plant will alleviate the source of phenols and heavy metals.

Geological assessment around Ash Field No. 2
A geological investigation was carried over the area during the feasibility study including general geological mapping, research of individual objects, monitoring reports and 21 drill holes totalling 129,4 meters drilled.

The ash layer of Ash Field No. 2 varies between 4 – 22 m. The ash bed consists of several layers. The top layer (0.5 – 1.5 m thick) is sand or sandy loam. Deeper the ash becomes increasingly more coherent with solidified layers having the characteristics of solid strata intercalated with non coherent layers. The character of the beds is ,variably coherent.

Table 2

Comparison of chemical composition of waters on Ash field No. 2 to permissible limits under relevant EU and Estonia Standards

Compound	Max. permissible concentrations:		Evaporation cascade (average)[2]	"Lake Green" (average)[2]
	EU	Estonia[1]		
PH		**9**	**12,3**	**9,7**
BOD 7**		25.0 mg/l	14.0 mg/l	9.0 mg/l
Total solids			6000 mg/l	4500 mg/l
Conductivity			12 mSi/cm	6,5 mSi/cm
Turbidity			10 cm	8 cm
Colour			40°	100 °
COD (Mn)			21 mgO/l	37 mgO/l
Total hardness			2.3 mg-eq/l	2.5 mg-eq/l
N total**		10.0 mg/l	3.0 mg/l	1.7 mg/l
P total**		2.0 mg/l	0.073 mg/l	0.08 mg/l
PAH		0.01 mg/l	<0.20 µg/l	<0.20 µg/l
Phenols		0.1 mg/l	33 µg/l	10 µg/l
Resorcinol		15.0 mg/l	30 µg/l	34 µg/l
Oils			<10 µg/l	<10 µg/l
Cl			390 mg/l	340 mg/l
SO_4			770 mg/l	860 mg/l
HCO_3			46 meq/l	24 meq/l
Ca			4 mg/l	4 mg/l
Na			150 mg/l	83 mg/l
K			2600 mg/l	1800 mg/l
Fe			0.15 mg/l	0.15 mg/l
As		0.2 mg/l	0.01 mg/l	0.005 mg/l
Cr		0.5 mg/l	0.03 mg/l	0.04 mg/l
Cu		2.0 mg/l	0.04 mg/l	0.02 mg/l
Pb		0.5 mg/l	0.004 mg/l	0.02 mg/l

[1] Regulation No. 269 of the Government of the Republic of Estonia;
[2] Analysis conducted at: 02.11.2001

Whilst the internal structure of the ash-stone heap is variable it is stable. Also, the substratum under the ash field is not in jeopardy of failure or otherwise causing engineering problems. Considering closure options will result in a reduction of load there is not perceivable threat of a structural nature. Erosion may cause local problems.

On the bottom of Lake Green there is a layer of plastic loam. In the southern part a peat layer overlies it, which increases in thickness southward (to max. 5.4 m). Technogenic sediments up to 3.3 m thick consist of fill-up soil (disturbed loam, peat and soil) as well as ash deposits and lime sediments. The lime sediment are extremely soft, almost in suspension and geotechnically very weak.

The Kõrgesoo raised bog peat along a ditch track extending southwards from Lake Green has a thickness of 2.7 – 5.3 m. There is mainly silt below the peat.

Geotechnical properties of proposed industrial landfill site
An industrial waste landfill is planned on the northeastern corner of the present ash field, where the relative height of the ash-stone heap reaches 21 m (absolute elevations are 44 – 49 m). Approximately 20 ha of the ash field will be needed. Expected capacity of waste volumes are 630,000 m^3 at a density of 1.5 t/m^3 over 25 years. The planned maximum elevation of the waste deposit is 57.5 m (the height of the ash-stone heap will increase by 8 m).

A hole was drilled to study the oil-shale ash under the proposed area (Drill hole PA-24).

The additional load of the waste deposit on the ash bed is up to 1.2 kg/cm^2 (120 kPa). This will not destabilize the ash-stone heap slopes.

Hydrogeological and pollution context of Ash Field No. 2
The lake (Lake Green) contains 2.6 million m^3 of water and the evaporation ponds 3.2 million m^3. pH increases from 9.7 in the lake to over 12 in the evaporation ponds. This represents the most significant environmental threat. Should rupture of the dam walls occur then millions of cubic meters of highly alkaline waters will be discharged.

The coefficient of hydraulic conductivity of the uncompacted ashes in a horizontal direction is 0.001 – 0.1 m/d. Vertically, the ash-stone heap as a whole (and the bottom clay layer that has been compressed under the weight of the ash bed) can be considered relatively watertight. Its coefficient of hydraulic conductivity is below 0.0001 m/d. Most of the seepage from lakelets of the ash fields occurs through the perimeter dams and the loose top layer of the ground under the dams.

The nearest surface water bodies are the Kõrgesoo ditch 100 m to the southwest, and the cooling water discharge channel of the Balti Power Station

100 m to the east. Both the ditch and the channel flow southwards into the Narva Reservoir. Sedimentation lagoon ("Lake Green") is surrounded by the Kõrgesoo raised bog, covered with a dense network of ditches, which are connected to the Narva Reservoir.

There are three main hydrostratigraphic layers present on the area of Balti Power Plant. From surface these are:
1. the aquifer of topsoil and of Ordovician strata;
2. the aquifer of Ordovician-Cambrian strata;
3. the aquifer of Cambrian-Vendian strata, which is further divided into two different aquifers.

Groundwater resources are contaminated in the sub-surface environment, with the contamination possibly extending to the Ordovician-Cambrian aquifer which is unconfined in places. The deeper Cambrian-Vendian aquifers are well protected and are not yet under threat. Water abstraction only occurs from this latter aquifer. Closure of the ash field will remove one of the largest impacts to the quality of groundwater resources in the area.

3.4 Concept of rehabilitation of Ash Field No.2

The rehabilitation concept is for the area to be landscaped. It should also require only minimum maintenance and provide no further negative impacts on the natural or human environment. Landscaping should result in a similar ecological balance as is found in the natural surrounds of the area. Eventually the area should be available for zoning by the local authorities for general recreational (or other) land use.

Considering the scale of the problem and size it is predicted that the time required for successful rehabilitation will take up to 20 – 30 years. This will allow enough time for the subterranean environment of the ash-stone heap to approximate a natural state.

The ash-stone heap and evaporation ponds, once drained, shall be covered with soil and afforested to prevent erosion and transport of suspended solids. Use of herbaceous plants will stabilise and blend the are in in with the surrounding area.

The Lake Green will be drained, then landscaped into a wetland with the intention is to have several small water bodies (relict lakes) with higher ground that can be passed on foot.

3.5 Options to close Ash Field No.2

Many options concerning closure of Ash Field No. 2 were considered during the feasibility study. The main constraint is that there are millions of cubic meters of highly alkaline water on the site and only two years to get rid of it in order to adhere to the timetable for actions under the NES.

The only solution is feed the ash water through a purification unit until the pH of the alkaline water complies with EU and Estonian legislation before discharge to the environment.

After the initial evaluation of different options for turning the ash field into an environmentally safe site, three options were selected. Respectively these are Option 0, Option 1, and Option 2

3.5.1 Option 0

Option 0 is a 'do nothing' scenario. Whereby the current ash handling system is continued. Ash will be continued to be disposed in a slurry to the ash fields, with periodic discharge of highly alkaline water to the environment. This base option contradicts the Decision of the Ministry of Environment's Environmental Service of East-Viru County, of 19 December 2001 on Closure of the Ash Field No. 2 of the Balti Power Plant. It also fails to comply with EU and Estonian environmental legislation.
The only benefit of this option is the 'quick' solution to the problem of maintaining a safe water level.

The area will not be landscaped and shall not be available for use in the foreseeable future.

3.5.2 Option 1

Summary
A feasible option that leads to compliance with relevant EU and Estonian legislation by dealing with the problem of the volumes of highly alkaline water and by avoiding its reoccurrence. Also the area will be landscaped and should become available for land-use zoning in the foreseeable future by the local council.

Option 1 can be summarised into the following operations:
- Construction of a neutralization plant for neutralizing water with high pH;
- Dismantling the piping of the circulation water;
- Draining of the evaporation cascade ponds;
- Turning "Lake Green" into a wetland with relict lakes;
- All waters directed through the neutralizing plant before release to the environment;
- Forming water collection cuvettes on the bottoms of empty ponds;
- Digging openings through dams and installation of culverts;
- Reconstruction of existing water outlets;
- Acquisition and spreading of growth substrate;
- Landscaping with herbaceous plants.

Discussion
The evaporation cascades shall be drained. Conditions for drainage and effective management of precipitation water will be implemented. The ash-

stone heap shall be covered with soil and covered either partially or completely with herbaceous plants suitable for the task of stabilisation of the field as well as fitting in with the surrounding area. In the case of partial landscaping, given time the remaining area will become covered by similar herbaceous plants via natural processes of re-cultivation.

Following dismantling of the dams and landscaping precipitation water will be directed along the stabilised surface of the ash-stone heap.
A neutralizing plant will be built on the site to reduce the pH of the water in the evaporation cascades and Lake Green. It will require 0.6 ha between the existing road and the cooling water channel of the power plant. The objective of the plant is to reduce the pH of the evaporation cascades and Lake Green from a pH of 10-12 to a level within legally acceptable limits: a pH of 9, within the time period of two years.

The evaporation cascade shall be treated first with Lake Green acting as an intermediate reservoir. No earthworks are required as the existing slope (0.6%) is sufficient to allow gravity feed. Following the treatment of the evaporation cascade, Lake Green will be treated and drained.
Following drainage of the ash field the dams shall be breached, reconstructed and cuvettes (ditches with flat banks) dug to prevent accumulation of precipitation waters. In required areas culverts shall also be installed to enhance drainage. Water outlets on the ash field will be preserved and reconstructed, deepening them from the collection side. These measures shall minimize the transport of non-coherent ash to the surface layer and avoid a pH increase of precipitation water resulting from contact with the ash layers.

Works shall be done during the drier summer months when water volumes are lowest.

The drained area and ash-field shall then be covered with top-soil. A suitable soil must meet the following requirements: no dust emission, resistant to erosion, providing good growth substrate for landscaping plants, and easily available. Production and use of a composite material is one possibility. For example the mixture of refined oil-shale semicoke with peat which complies with limit values for soils in industrial areas.

Afforestation of the covered evaporation ponds will prevent erosion and transport of suspended solids from the ash-stone heap. These areas can be forested in zones of groves of trees (birch) with perennial herbaceous plants in the areas between. The area to be forested is estimated to be 118 ha. It would be practical to forest the softer ash rock areas located near the dams and in places that are sheltered from prevailing winds, so that a thicker layer of growth substrate can form.

After drainage is complete the area will be landscaped into a wetland. When the water in Lake Green reaches a mean level of 27 m, there will be two water bodies (with an average depth 1 – 1.5 m) and one area of soft substratum. The area of the larger relict lake will be ca. 99 ha and the smaller lake 24 ha.

The area of the dry territory will be ca. 47 ha. In order to lower the existing water level from the existing mean level 28.3 m to 27 m, 1.8 million m^3 of water will have to be treated.

Conditions encouraging development of aquatic life will result. It is thought that acidic water from the existing wetland may invade the newly formed lakes from the south contributing to a further lowering of the pH.

Precipitation water draining from the ash field will be collected in the perimeter ditch and fed into the neutralization plant. In order to equalize the outflow during heavy precipitation and snow thaw, it will be necessary to have the possibility to discharge water from the ash field into the area of Lake Green. If monitoring shows that the quality of the ash water formed in the ash fields is adequate, this water can be discharged through the new wetland into the natural environment and not through the neutralization plant.

If the objectives of Option 1 are realised, only maintenance and environmental monitoring will be required. Subsequently the neutralizing plant can be used for waters from Ash Field No. 1.

Maintenance and Monitoring
During maintenance and monitoring water quality (pH level), water level in the relict lakes and the geotechnical stability of the ash-stone heap will be monitored. Additionally the stability of the ash field cover will be monitored and eroded areas restored as quickly as possible.

After the conditions of surface water quality formation in the ash field have been determined, monitoring can be limited to observations of water level and quality in the new wetlands. To facilitate monitoring the water surface in the relict lakes it will be necessary to replace the existing hydrostatic sensor of Lake Green (and the corresponding signals in the control unit) with a sensor that reacts to water surface higher than 27.0 m. Exceeding this level will give an emergency signal indicating that the land strip separating the small lakes is about to be breached.

The pH level of the water would have to be monitored in the eastern lake. The existing pH sensor and control unit of the ash disposal department must be used to monitor both pH and water level. At the same time, a portable pH indicator must be obtained and the pH level in the western lake measured once every three months (from below the ice in winter). The pH value will have to be measured in water bodies until a pH value of less than 9 is measured in both water bodies during at least one year.

Organizing of the Maintenance
The Head of the ash disposal department will organize the treatment of the ash fields of the Balti Power Plant. His/her team dealing with ash transportation and disposal and led by a foreman will deal with the maintenance of the closed Ash Field No. 2 in the future. So, a single team will have a complete picture of the area and be able to solve integrated tasks.

3.5.3 Option 2

Summary
This option is exactly the same as Option 1 concerning treatment of contaminated water on the ash field, the formation of the wetlands and the ongoing maintenance requirements. The difference between Option 1 and Option 2 concerns the intention in the latter to use a small area of the existing ash-stone heap as an industrial landfill. This will solve the disposal problems of industrial waste from the two power plants owned by Narva Power Ltd.

Option 2 can be summarised into the following operations:
- Construction of a neutralization plant for neutralizing water with high pH;
- Dismantling the piping of the circulation water;
- Draining of the evaporation cascade ponds;
- Turning "Lake Green" into a wetland with relict lakes;
- All waters directed through the neutralizing plant before release to the environment;
- Forming water collection cuvettes on the bottoms of empty ponds;
- Digging openings through dams and installation of culverts;
- Reconstruction of existing water outlets;
- Acquisition and spreading of growth substrate;
- Landscaping with herbaceous plants;
- Design of the intended inert industrial waste landfill in compliance with EU and Estonian legislation;
- removing two ash dams separating ponds Nos. 7, 8 and 9;
- founding the first stage of the inert waste landfill.

Discussion
All solutions described in Option 1 will be applied. Option 2 includes the development of an inert industrial waste landfill to solve the safe disposal of inert waste produced by the two power plants owned by Narva Power Ltd.

An industrial waste landfill area will be constructed in accordance with relevant EU and Estonian legislation in the north eastern corner of the ash field. A possible location for landfill on the Ash Field No. 2 was indicated in a previous investigation by Maves Ltd[4].

The creation of a new landfill site for industrial waste in the Ash Field No. 2 will save the existing natural landscapes of the region from destroying any additional areas thereof, and will save natural resources necessary for the construction of the base of the new landfill, access roads and means of communication.

The lifespan of the landfill would be for at least 25 years and have a capacity of ca. 630,000 m^3 of waste (waste density in landfill 1.5 t/m^3). This would require an area of ca. 20 ha. A survey of the evaporation cascade ponds shows that the total area of ponds Nos. 7, 8 and 9 is 18.5 ha. The industrial

[4] Maves Ltd: *Narva Power Ltd. tööstusjäätmete prügilate sulgemine. I etapp* (Closure of the industrial waste landfills of Narva Power Ltd.. Stage I.). Tallinn.

waste landfill must also be suitable for asbestos waste. In order to deposit asbestos, a special depositing area must be founded guaranteeing the asbestos waste remains intact. The operator of the landfill will have to cover the waste during deposition or immediately after it. A Ministerial regulation is in process at the Ministry of Environment of Estonia during 2002 granting permission for this.

Drainage water collected from the landfill can be fed into the neutralization plant situated below the hill slope for treatment.

After the evaporation cascade ponds have been drained, removal of the dams separating ponds Nos. 7, 8 and 9 will be started. Subsequently preparations for founding the first depositing area of the landfill will begin.

Maintenance and Monitoring
Monitoring the ash field is the same as in Option 1 including the organisation of the maintenance team. Maintenance and monitoring of the proposed inert industrial waste landfill does not fall under the auspices of this project as it forms a necessary component of the daily operations of such a landfill.

3.5.4 Feasibility of Options

Options 1 and 2, as discussed in this study, are technologically, economically and environmentally feasible.

It is not feasible to remediate the area back to its original topographic and biotropic landform pre-dating construction of the power plants (beginning 1959) and the formation of the ash fields (beginning 1960s). Therefore discussion concentrates on the applicability of the options presented and their compliance to EU and Estonian legislation. As well as ideas concerning the long term structural viability and possibly uses of the area.

3.6 Recommended Option

The recommended option is Option 2. Closing down the Ash Field No. 2 according to Option 2 will be in accordance with the legal acts of the Republic of Estonia concerning environment protection. Furthermore it complies with the environment strategy, environmental action schedule and waste management strategies of Estonia. Additionally, it accomplishes the environmental objectives of Eesti Energia AS. The planned activities are in accordance with the time schedule for introducing new technology in the field of oil-shale ash treatment, which was agreed upon in the course of the negotiations for joining the European Union.

Carrying out Option 2 will solve the problem of safely disposing of the industrial waste produced by the power plants of AS Narva Elektrijaamad in accordance with the EU directive 1999/31/EC on landfill of waste.

3.7 Opinion about the technical aspects of the project and design

The discussion in this section refers to both Option 1 and Option 2. Option 0 is a 'do-nothing' base scenario and will not be otherwise discussed. The feasibility and supplementary studies do not include specific designs, capacities, technical or engineering information regarding constructions necessary to carry out the works required during the project. However the only significant construction necessary is the neutralisation plant for reducing the pH of waters on the ash field.

Discussion
The ash-field No 2 is not classified as a 'hazardous waste' landfill. The ash is stabilised since 1987. The only hazardous component is the high alkaline water. Thus there is no reason to close the ash-stone heap with a watertight layer as required for a hazardous landfill. Though this solution would solve the problem of possible precipitation water infiltration and contamination, as well as reduce maintenance needs. However, the cost of the watertight covering and the excess engineering to reduce the slopes of the ash-stone heap to hold it far exceed benefits.

The capacity of Ash-Field No. 1 is believed sufficient to handle ash waste disposal from the Balti Power Plant. Furthermore Narva Power Ltd has plans to change from a wet transport system to a dry one significantly reducing the area needed for waste disposal. Following this change the waste ash will be landfilled on the Ash Field No. 1.

Some 5 million m^3 of water with high alkalinity and salt content (4-5 g/dm^3) has to be treated. There are two possible options. One involves the existing reverse osmosis plant currently not operational. The other involves construction of a neutralizing plant. The reverse osmosis plant when operational has a capacity of 100 m^3/hour. It would thus take years to drain the ash-field.

As the ash-field must be drained by 2005, the only viable option is to construct a neutralizing plant of sufficient capacity. The amount hydrochloric acid necessary is estimated to be 9,500 t over two years. This would be sufficient to lower the pH of water in all ponds to 9.

Conclusion
Thus considering the nature of the landfill requiring to be closed, the volumes of water required to be treated and the minimal amount of engineering and construction works necessary to carry them all out the technical aspects outlined are feasible. Little part of closed Ash-Field area will be used for industrial waste landfill. The works will result in a landscaped area needing minimum maintenance and not loading the environment any more.

3.8 Public awareness activities

On 27 December 2001, presentation of the project and the public discussion of EIA programme was held at Balti Power Plant, attended by the representatives of Eesti Energia Ltd., Narva Power Ltd., Balti Power Plant and the Environmental Service of East-Viru County.

On 11 January 2002, a discussion of the closure options of the Ash Field No. 2, as presented in the interim report in December, was held at Maves Ltd., attended by the experts and representatives of the Eesti Energia Ltd, Narva Power Ltd. and Ministry of Environment. Two main options (alternatives) of the project were suggested at the meeting

On 17 January 2002 the public representation of the options for closing the ash field and discussion of the technical and environmental feasibility was held at the Balti Power Plant. The experts and representatives of Narva Power Ltd., the Balti Power Plant and the Environmental Service of East-Viru County attended the discussion.

On 19 March EAI public hearing of EIA report will be held at Balti Power Plant.

4 Work Schedule

A general schedule of intended works is presented in table 4.

Table 3

General schedule of proposed activities

Year of completion	Activity
2005	The engineering and technical solutions for the ash-stone heap and "Lake Green" are complete: draining, neutralization, cuvettes, culverts, water outlets and dam breaches, construction of industrial landfill – ISPA project
2009	Aspects not directly related to the project but that adversely impact on the environment and on monitoring of the success of the project are resolved: use of Ash Field No. 1 of the Balti Power Plant; and closing down the waste landfill of Nakro Ltd. The period is sufficient to judge environmental performance improvement of these solutions
2010 – 2015	Ongoing maintenance and upkeep of works until the impact caused by the ash fields technogenic origin disappears. The covered ash field will adopt the plant associations used for its protection. The wetland and shore areas approximate the surrounding natural environment and do not greatly affect the surrounding biotopes
2025	Specific biotope will stabilize on the recultivated area. Closure of industrial waste landfill. Rehabilitation of industrial landfill site.
2030	The area is now available planning and zoning in accordance with the needs and development schemes of the area. The environmental condition of the area will not set any restrictions to civil use of the area

The process is expected to be a long one – 20-30 years. The above schedule are approximate and can either shorten to some extent or grow substantially longer depending on the quality parameters set for the area. The pace of bringing the area close to its natural state will depend on the option chose, and in particular expenses for landscaping.

5 Analysis of Environmental Impacts

The scope of the environmental impact assessment screening was defined by the Environment Memorandum and the EIA Program. The state of the aquatic environment, aquatic life and landscapes in the region, as well as the environmental impact of the planned activities upon the aquatic environment and landscapes are covered. The area under observation is surrounded by the industrial territory of the Balti Power Plant in the north, the cooling water discharge channel in the east, the Narva Reservoir in the south and the Kulgu Channel in the west.

The greatest environmental risk for the area is the rupture and release of waters from the ash fields into the Narva River. This risk is based on the structural stability of the ash field walls and is influenced by water volume on the fields and the influx of water. Control of these risks will reduce the risk of rupture and release and forms the basis of the options considered for closure of the ash field in the feasibility study.

5.1 Environmental situation in the area

Groundwater
The topmost aquifers have been contaminated. The lower Ordovician-Cambrian may also be contaminated and is not used for abstraction. The groundwater aquifer that is used as it is well protected by a layer of clay is the deeper Cambrian-Vendian aquifers.

Surface waters
Surface water bodies are affected by various contamination sources. Discharge of contaminated precipitation water of the Balti Power Plant industrial area into the ash disposal system and subsequently to the environment. Also, the industrial waste landfill of AS Nakro and the domestic waste municipal landfill of Narva are other sources of contamination.

The most serious danger for the Narva Reservoir is the possible rupture and large scale discharge of the alkaline ash water from the ash fields. The impact of controlled discharge of alkaline wastewater upon the aquatic life should not reach the Narva Reservoir (outside the cooling water channel).

Water abstraction
The intake structure of the communal water supply has been developed in accordance with environmental impacts of the AS Narva Elektrijaamad. The contaminated topmost aquifers of groundwater are not used. The surface water for the city of Narva comes from Narva River upstream from the influence zone of the the Eesti and the Balti Power Plants.

Local contamination originating from the industrial waste landfill of AS Nakro may influence the quality of the water in shallow wells in small villages situated nearby.

Impacts and effects
The effects of the Balti Power Plant upon aquatic life results in the deaths of young fish in the area of the inlet of the cooling water intake structure. This impact is outside of the scope of closing of Ash-Field No 2. To date no large rupture of the dams has occurred.

The landscape in the vicinity have been turned into an artificial one. There are neither any valuable areas that may need protection or any sensitive sites in the neighbourhood.

5.2 Environmental impacts of the three options selected

Option 0 means that current practices will continue. This option is not in accordance with either EU or Estonian environmental objectives or legislation. The main threat of a possible breakout of large amounts of alkaline ash water into water bodies remains.

Options 1 and 2 were developed to turn the ash field into an environmentally safe area, to maintain this state and to allow unrestricted use of the area over time. Both Options will turn the ash field into a landscaped area with alternating zones of herbaceous plants and forest creating conditions for formation of the biotope characteristic to covered ash fields (meadow grass and silver birch).

These options solve the problem of alkaline water. Discharging alkaline water into water bodies will be discontinued. The volume of the water needing treatment will also decrease.

Further, in Option 2 only, the first stage of an industrial waste landfill will be built which complies with modern environmental standards. It will mean closing down the existing industrial waste landfills. The creation of a landfill site for industrial waste in the already existing ash field is ecologically sustainable, as no new natural territories will be devastated.

During maintenance and monitoring water quality (pH), the water level in the lakes formed in the former Lake Green, and the geotechnical stability of the ash mound will be checked. The task of maintenance is to monitor the stability of the ash field cover and to restore eroding areas as quickly as possible.

This way, the cost of waste treatment will be lower and the contamination of environment, as well as the possible risk of environmental disasters will be significantly reduced.

Both Option 1 and 2 will benefit the environmental quality of the area. Both will result in the rehabilitation of the ash field to an extent whereby it can be used for general zonation over time. Both are feasible.

5.3 Environmental impacts of Option 2: the preferred option

As the result of evaluating and weighing various options, Option 2 was chosen. Option 2 provides the most integrated solution for improving the environmental situation in the region.

In the course of carrying out Option 2 all the possible risks and environmental impacts highlighted by the EIA Screening will be eliminated:

- The ash field region will be made safe for people. In the future, people can freely visit the area;
- The risk of the possible breakout of alkaline water from Ash Field No. 2 into the Narva Reservoir will be eliminated;
- The periodical draining of alkaline water into the Narva Reservoir will cease;
- The contamination of groundwater in the region will cease. The area containing polluted groundwater will not increase;
- Covering the ash mound with verdure will eliminate the problem of ash dust spreading from Ash Field No. 2;
- The creation of a new landfill site for industrial waste in the Ash Field No. 2 will prevent further loss of the existing natural landscapes.

If Option 2 is carried out as described the environmental situation will improve.

6 Financial and economic analysis

This section contains a financial and economic analysis for closing Ash Field No. 2 with water ponds at Balti Power Plant. It was conducting in accordance with the EU Guide to Cost Benefit Analysis of Major Projects.

The purpose of this report is to explain the method of analysis, present the main findings, and provide some recommendations concerning financing of the closure of ash field No.2.

In order to conduct a financial analysis for the proposed project, a financial model has been constructed focusing on the affordability of the fees required for scenarios with an ISPA-grant of 85% of the proposed investment and without ISPA grant. The incremental fee required for cost recovery in the two scenarios has been calculated. The incremental fee calculated is based on the assumption that accumulated capital in the end of period is only covering reinvestment requirements.

All information is collected through a combination of desk research and field research including study of the existing information and reports on the subject, interviews with relevant parties, officials and institutions, questionnaires and analysis of statistics on the issue.

Performing the financial analysis an excel spread sheet has been developed. The detailed results of the calculations are presented in appendixes.

6.1 Financial Analysis - Closure of ash field No. 2

Data input for the cash flow analysis of the closure of the ash field No.2 includes calculation of the investment costs, operational costs and revenues. The assumptions underpinning these calculations are described in the sections below and followed by a presentation of the cash flow analysis.

6.1.1 Assumptions

The analysis of the closure of the ash field No.2 in the following sections is based on several important assumptions:

Table 4

Assumptions regarding financial and economic analysis

General	
Exchange rate	1 EURO = 15.6466 EEK; 1 EEK = 0.0639 EURO
VAT	18%
Average annual household income	4462.8 EURO/year
Depreciation	
Infrastructure and buildings Machinery Equipment	25 - 40 years 3 - 25 years 3 - 10 years

6.1.2 Investment Costs

There are 2 options to carry out the closure. The first one includes only closing the existing Ash Field No. 2. The other option includes also building a new landfill onto the territory of Ash Field No. 2. The total investment costs of the first option is 6,85 million EURO out of which the ISPA component comprises EURO 5,82 million. Option 2 has an investment costs up to 7,14 million EURO of which the ISPA component comprises 6,07 million EURO. It has been planned to start with an investment in year 2003.

6.2 Financing of the Investment

The project is financed as follows:

Table 5

Option 1 – Project financing

Financing	Million Euro	Percentage of total investment
Local Financing	1.03	15
ISPA Grant	5,82	85
Total	6.85	(100)

Table 6

Option 2 – Project financing

Financing	Million Euro	Percentage of total investment
Local Financing	1,07	15
ISPA Grant	6,07	85
Total	7,14	(100)

In assessing the financing possibilities of the 0%-scenario, this is likely to be deemed un-bankable by commercial banks due to the financial risks in implementing the project without the relief from ISPA grant. This supports and justifies full ISPA support for the project.

The investment costs cover setting up the neutralisation point, taking down the circulation water network; building the drains, reconstructing the water ejection no. 1 and 2, changing the monitoring system, covering the ash field and creating a green area. The Option 2 includes preparation of new landfill, compiling general plan and evaluating the environmental impact. There is included also building the first stage of the landfill.

6.2.1 Operational Costs

The operational costs cover variable and fixed costs. The former include day-to-day running costs (e.g. labour, power, water and electricity) and maintenance costs (i.e. buildings, machinery and equipment). The latter include some labour costs and closure and monitoring costs.

6.2.2 Revenues

The project is non-profitable. Closures are rarely projects which generate revenues, not to mention profit.

6.2.3 Cash Flow

A cash flow statement for the Closure of ash field No.2 has been produced and includes calculation of the internal rate of return (IRR) and net present value (NPV) under a "with ISPA grant" and "without ISPA grant" scenario.

As the project is non-profitable, then there is no way to calculate the internal rate of return (IRR). IRR was found for the company Narva Power Plant Ltd including the project.

An ISPA grant would have an impact on the NPV and IRR. IRR of the project (both Options 1 and 2) cannot be calculated as the project is non-profitable.

AS a rule, the project is usually approved when NPV is positive (it means there are positive cash flows). The project has negative NPVs even with ISPA assistance, but the negatives are smaller. This is often the case of environmental projects. The project should be approved as the benefits are social and economical, not financial.

6.3 Financial Analysis ~ Narva Power Plant Ltd

A cash flow statement, profit/loss statement and balance sheet prognosis for fifteen years has been produced for Narva Power Plant Ltd.

6.4 Economic Analysis

Closure of ash field No.2 will have significant social, economic and environmental benefits.

A cost-benefit analysis (CBA) of the Closure of Ah Field No.2 has not been carried out and there has been no attempt to calculate the economic IRR, NPV or benefit/cost ratio (B/C). Following the EU "guide to cost benefit analysis of major projects" there are well known conceptual difficulties associated with quantifying cost and benefits in the refuse and waste treatment sector. There will, however, be social, economic and environmental (dis) benefits arising from the Project as summarised below:

- Local economies will benefit from personnel employed during the construction and operation phase.
- There will be significant improvements to the local state of environment and human health by reducing the environmental pollution.
- There will be a reduction in the pollution of groundwater's and soils, as well limiting the potential damage to biodiversity in the Project area.
- There may be revaluation of real estate and land prices in areas served by the Project although this will be insignificant.
- The Project will facilitate Estonia's accession into the EU, meeting EU regulations on environmental standards, and ultimately having a positive impact on macroeconomic growth.

6.5 Conclusions and Recommendations

As it is seen from the financial analysis and investment costs, the difference between Options 1 and 2 is quite small. Also the NPV-s of these 2 Options are quite close. As such considering the added benefits of developing the industrial waste landfill without having to impact on an area otherwise without such impacts it is recommend to implement Option 2.

In Estonia waste management plans must be completed by 2009. Accordingly building a new landfill on the area of previous ash field fits with the plans of Ministry of the Environment.

It is permissible for companies to built their own inert waste landfills. In the region of Ida Virumaa there is already a landfill of dangerous waste built by the state and there is also a landfill for domestic waste.

Apart form the financial viability of the Closure of ash field No.2 the landfill will make significant contributions to improvements in the state of environment, health and living standards. And in addition to generating revenues by the Option 2 the use of charges will ensure the Closure of ash field No.2 is consistent with EU regulations (Article 130r Treaty EC and Article 15 Council Directive on waste 75/442/EEC) in as far as the "polluter pays" principle is respected.

7 Recommendations

Following assessment of the feasibility study, the supplementary studies and the financial and economic analysis the project is considered viable. It fulfils both national and EU legislative requirements. It fulfils the environmental objectives of the Republic of Estonia, the EU and Narva Power Ltd. Liability for the waste is shared between the state and Narva Power Ltd. The project also falls in a project pipeline suitable for the granting of ISPA funds.

The required endorsement of the relevant state bodies, the Ministry of Environment and the Ministry of Finance has been obtained. The institutional structures necessary to manage the project, both administratively and financially exist within both Ministries. Procurement and tendering of works shall proceed in accordance with both Estonian and EU public procurement criteria.

Of the options proposed, the recommended option is Option 2. In which the Ash Field and water ponds will be rendered environmentally safe, landscaped and recultivated such that over time use of the are is unrestricted. Also an industrial waste landfill will be developed.

The landfill is important because it solves the problem of industrial waste created on the premises of Balti Power Plant. It does so without incurring excessive cost, especially in comparison to the only other viable option, Option 1. The construction of the landfill will occur on an area already industrially zoned and devastated and therefore does not require alteration of an area of natural biotropes. Furthermore it will reduce the impacts of transporting the industrial waste, which will be necessary if the landfill does not go ahead.

Option 1 also fulfils the environmental and economic criteria of the project basis. However, it does not provide an alternative for management of the industrial waste created on the premises of Balti Power Plant. For this reason it represents a second choice option.

Implementation and execution of the works proposed under Option 2 represent a cost effective manner by which to remove the environmental burden and threat of the Ash Field. Following completion of the works the area will be available for unrestricted use by the governing administrative body of the region. For these reasons Option 2 is recommended for implementation and an ISPA application completed to achieve this end.

Appendix 1 List of contact persons for Project Background Information

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