RESTORATION PLAN

Case Västerby

By

NOVIA University of Applied Sciences

In collaboration with

Estonian University of Life Science (Estonia) and
HZ University of Applied Sciences (The Netherlands)

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Summary

Restoration perspective

Region	Solution	Restoration	Proposed actions
North	#1 Multilayered buffer zone around the wetland	Water quality and erosion control	Core zone: Birch and reeds
		Absorb nutrients and enhance stability	Inner zone: Ash and willow
		Support wildlife and recreational trails	Outer zone: Pine, aspen, spruce
North	#2 Increased wetland size with permeable dam	Prevent nutrient runoff	
		Improve water retention in dryer period	Develop wet meadow in depression area
	#3 Sustainable forest management	Improve biodiversity	Retain dead wood Gradual harvest
Middle	#4 Water management	Reduce riparian erosion by slowing down the flow and stabilizing banks	Build underwater dams with willow and aspen branches and woody debris
	#5 Invasive species	Enhance biodiversity landscape	Selective cutting (gap) to allow polyculture/mixed forest
South	#6 Peatland	Restore current bog as peatland	Build a stone dam

Recreational perspective: Engage communities to preserve biodiversity while supporting sustainable recreational value with wooden trail and signs (reduce human impact but allow nature immersion).

Region	Solution	Recreation
North	#1 Wooden trail in the wetland	Promote birdwatching and amphibian observation
Middle	#2 Wooden trail and signs	Promote sustainable hiking, biking, skiing. Promote safe foraging for berries and mushrooms Promote botanical education
South	#3 Low impact wooden trail north of Storträsket	Volunteer program Educational tour Educational apps – AR

Critical component to success: involvement and continuous collaboration of key stakeholders

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1. INTRODUCTION

The Västerby outdoor recreation centre, located in Ekenäs, Raseborg in southern Finland is facing increasing ecological risks due to planned future logging activities. The potential for clear cutting, according to the Raseborg City Forest Plan (2024- 2034), raised concerns about further habitat degradation, loss of biodiversity and negative impacts on water quality. To lower those potential impacts, the municipality aims to implement forest management activities that will reduce nutrient runoff, maintain biodiversity and preserve ecosystem services.

To that end, the municipality of Raseborg partnered with Novia UAS to establish a scientific baseline and develop action plans for Västerby. A key focus of this initiative is not only to design effective restoration plans, but also to explore how stakeholders, residents, landowners, recreational users and environmental organizations can actively contribute to and support these efforts.

As a part of Novias restoration ecology course, which was held together with Estonian University of Life Science and HZ University of Applied Sciences, Novia decided to work on Västerby over the course of one week, generating solutions to propose potential ideas.

Initially, the students were split in six groups, and each studied the location and its geographical characters, recreational values, restoration targets, and properties. Then, they discussed the potential impacts of various activities and how they can implant theoretical knowledge into the practical scenarios considering the EU Nature Restoration Law, the EU Biodiversity Strategy for 2030, and the Habitats Directive and Birds Directive. The collaboration effort guided by senior lecturers, researchers and experienced project leaders aimed to generate innovative restoration strategies and demonstrate the value of stakeholder participation in sustainable forest management. The findings and proposals from this project are summarized in the following report.

2. BACKGROUND

The Västerby outdoor recreation centre of approximately 1500 ha is a diverse forest landscape with a unique land-use history. The area was a former agricultural land used before being converted into forest in the 1960s. This transformation has resulted in several habitat types including monoculture and mixed forest, open and closed forest, peatlands and wetlands. The soils are diverse, from clay to coarse sand mixed with clay. The area provide services like habitat for different species and recreational services for humans.

As it previously served as an agricultural land, it has left significant threats, including old drainage systems that disrupt the natural structure of the forest and nutrient runoff from previous land management, which has changed soil quality. Further, minor forest damages have occurred in the spruce stands. The spruce undergrowth is abundant in some places; most parts are composite with monoculture of coniferous forest and old dams in some areas disturbing the water flow. Due to these already identified issues that resulted in loss of biodiversity consequent to the lack of proper management, overuse of forest for recreational activities could also lead to habitat degradation, highlighting the need for sustainable practices to preserve this unique ecosystem for future generations.

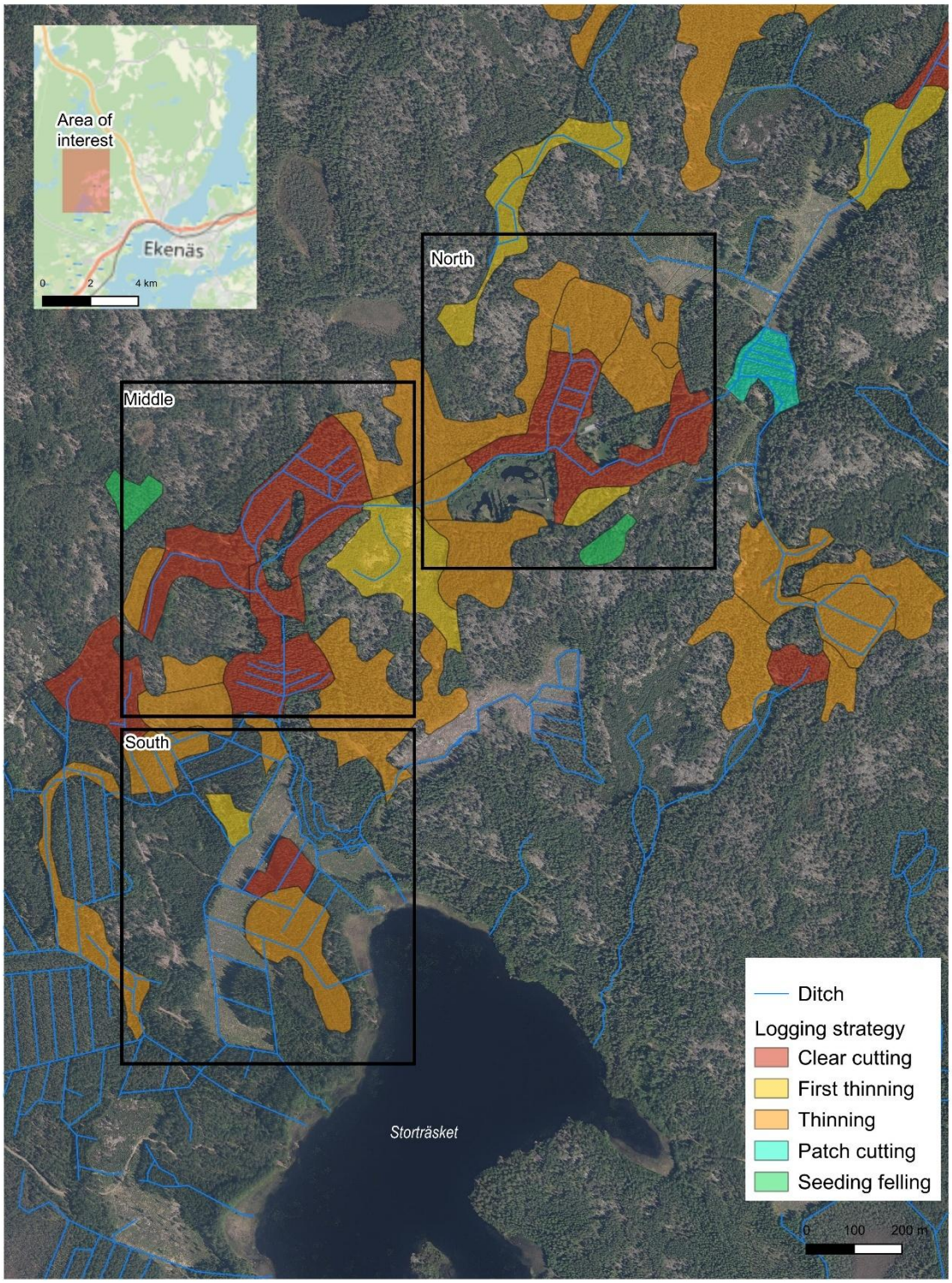
3. METHODOLOGY

The students from the three UAS were split into six groups (Table 1). Each of the six groups was assigned to one of three regions based on location (North, Middle, and South; Figure 1). Their task was to identify the current situation and potential problems in their assigned area and, as a group, discuss and develop a restoration plan. They reviewed existing literature and utilized SCALGO for their analysis.

Table 1. Student groups

Group	**Region**
1	South
2	Middle
3	North
4	Middle
5	South
6	North

Figure 1. Regions of interest for the students



Region of the Case Västerby project area attributed to student groups

Sources: National Land Survey, 2025
Raseborg Forest plan, 2024
SCC_20251218

4. RESULTS

The characteristics and issues are identified during field work within each region (North, Middle and South). Additionally, this section presents the proposed solutions developed by the groups to address these issues. Finally, the discussions led to creation of a list of indicators (table 5) and relevant stakeholders (table 6) to pursue restoration actions and two maps summarizing the solutions (Figure 2).

4.1 North Region (groups 3 and 6, table 2)

The group 3 highlighted a motto “everyone in mind”. A key feature is the creation of a multi-layered buffer zone system a core zone with deep-rooted birch and reeds for water protection and erosion control, an inner zone with species like European mountain ash and goat willow to absorb nutrients and enhance stability, and an outer zone blending into upland forest with Scots pine, aspen and Norway spruce, supporting wildlife and nature trails.

The group 6 identified that the most important aspects of the north area project are preventing nutrient runoff to protect water quality in local wetlands and enhancing biodiversity. They proposed the construction of a permeable dam to expand wetland size. Addressing forests threats such as bark beetles and root rot is also curtail for maintaining timber productivity and ecosystem stability. The restoration strategy emphasizes sustainable forest management by avoiding clear cutting in favor of gradual, continuous cover forest (CCF) which maintains forests cover, reduces environmental impacts, and supports both ecological and economic goals.

Table 2. Features of the North Region
Complement in Appendix A

Feature	**Group 3**	**Group 6**
Landcover		Production forest on former agricultural land, dominated by spruce and birch
Soil		Nutrient rich
Biodiversity		Limited due to monoculture forestry
Recreational goal	Nature trails for education, hiking trail (Figure 8), promote a thriving wetland for birdwatching and amphibian observation	no
Restoration goal	1.Gap cutting and smarter forestry practices; reduce the scale of clearcutting, introduce gap/group cutting, keeping clear cutting limited to areas and away from sensitive zones. (Figure 9) 2. Buffer zones with core (water protection), inner (nutrient absorption), outer (wildlife support) zones. (Figure 9) 3. Dams for water retention and nutrient filtering; install small rock dams and controllable dams, slow down stream flow and trap nutrients, improve water retention in drier periods. 4. Wetland restoration with native species	1.Avoid clear cutting and use shelterwood cuts (Figure 7) 2. Promote natural regeneration and moisture adapted species (Table 8) 3.Increase wetland size with permeable dam (Figure 6) 4. Create wet meadow habitat by raising water level 5.Gradual harvest, irregular cuts, retain deadwood 6. Consider climate adapted species (Table 8) 7. Leave old spruce trunks for bark beetles. 8. Planting species in wetland areas (Table 8)
Wetland status		Slight water level rise
Hydrology		Big depression area (Figure 5)
Identified issue	**Group 3**	**Group 6**
Invasive species		Not mentioned. Threats are bark beetle and root rot affecting spruce
Erosion	Mentioned	Not highlights as a major problem. But nutrient runoff is a significant concern, nutrient loading from former agricultural land
Nutrient runoff	Figure 8	
Water quality	Identified	

4.2 Middle region (groups 2 and 4, table 3)

Table 3. Features of the Middle Region
Complement in Appendix B

Feature	**Group 2**	**Group 4**
Land cover		98% forest, 2% recreation, bare rock, road (Figure 10)
Soil type		Clay, silt, peat, sand, bedrock (Figure 10)
Biodiversity		Low, monoculture dominant, mostly tree age 66-75 years (Figure 11)
Recreational goal	Wooden hiking trails and information boards, support for hiking, biking, and skiing.	Footpaths for hiking and nature walks, foraging for berries and mushrooms, educational and botany fieldwork
Restoration goal	Creating beaver dams using willow and aspen. (Figure 16) Adding woody debris to enhance water retention and habitat quality, selective cutting to promote mixed species	Mixed forest (Table 9) Combine technical and natural , stable banks (Figure 12, 13)
Identified issue	**Group 2**	**Group 4**
Invasive species		The area faces threats from several invasive species (Table 9)
Erosion		Problematic in streambeds due to soil type, rainfall and straight ditches (Figure 12)
Water retention	Existing small ditches flow into wetland and riparian buffer zones available (Figure 15)	

The group 2 identified that the area currently features small ditches that flow into existing wetlands. (Figure 14). Further, this group enhances the site's ecological value and recreational potential. The restoration plan emphasizes natural water management and habitat improvement. Proposed actions include constructing beaver dams with native willow and aspen, as well as introducing woody debris to support both water retention and diverse wildlife habitats. Selective cutting will be implemented to encourage mixed species forest structure. Additionally, the development of wooden trails and information boards will facilitate awareness for visitors like hikers, bike riders and skiing enthusiasts.

The group 4 mentioned that the middle area is currently dominated by monoculture coniferous forest on nutrient rich former agriculture land, resulting in low biodiversity and increased

vulnerability to invasive species and erosion. Major challenges include streambed erosion, the presence of invasive species (such as knotweeds, goldenrods, and slugs), and limited recreational use. Main objectives are to transition the forest to mixed species, biodiverse landscape by introducing native trees and shrubs, stabilizing stream banks and promoting sustainable recreational like hiking and foraging.

4.3 South Region (groups 1 and 5, table 4)

Complement in Appendix C.

The group 5 highlighted that the southern part is located with lake Storträsket (Figure 16) and prompt attention to protect and restore the peatland. Due to the lake of Storträsket, the southern part is the main habitat for many species (Table 10) and has high biodiversity. The main vision is broad: protect and restore the peatland, reduce the nutrient runoff, promote biodiversity through the preservation of flora and fauna by enlarging the peat land, enhance ecosystem resilience and promote recreational value by designing a recreational trail with a minimum environmental impact. They hope the creation of a recreational trails will help to reduce human impact in the area but still allows visitors to immerse themselves in nature. Further, they have proposed raising the awareness of visitors through developing educational apps, workshops, educational tours, and volunteer programs.

Designing and building recreational trails (Figure 17) should be done with a high effort with several analyses. The plan of trail building should begin with baseline analysis and modelling is the following step. For the baseline analysis, we need to identify and analyse the landscape types, characteristics, biodiversity as well as human interactions and activities. This will take approximately two to three months. For the modelling, the trail would be modeled for at least one month, and different routes could be evaluated. After modelling, we must conduct testing to check the suitable materials and construction methods to ensure both environmental and human safety. An important point is needed to test how materials will last and perform under different weather conditions and seasons. The next key step is to build up the trail this will take around a year. During the construction phase should be considered about different circumstances and conditions throughout the year including the migration season of birds and the winter season where no construction could be completed. Then we need to do the future analysis of testing performance and how the weather conditions and seasons are influencing it. This will take nine months, and we need to continuously monitor for the next one and a half years to see how many visitors are using

the trail and settling of species. Finally evaluating the project takes about one month to conclude about the success of the project.

The group 1 highlighted an adoptive pathway for reduction of nutrient runoff. As a result, they have introduced four approaches to reduce nutrient runoff. The first approach includes the construction of a stone dam and increasing the vegetation with recommended different vegetation types along the lake Storträsket. (Figure 18, Table 11) The second approach is about planting more vegetation to overcome lake leakages and overflow. (Figure 19) And third and fourth approaches include enlarging wetlands, construction of dams and meandering the lake. (Figure 20, 21)

Table 4. Features of the South Region

Feature	**Group 5**
Land cover	Open, closed forests and wetlands 3.35 km2 size watershed
Soil type	Peat, clay, coarse sand with clay
Elevation	17.5 to 20m above sea level
Restoration goal	Restore and protect peat land. Promote biodiversity. Enhance recreational value by buildup recreational trails. Reduction of nutrient runoff by constructing stone dams, planting specific vegetation, and meandering the lake.
Recreational goal	Yes

4.4 Indicators

Table 5. List of Indicators

Ecological indicator	**Recreational and social indicators**	**Economic indicators**	**Long-term success indicators**
Size of the peatland Species diversity and abundance Presence of invasive species Water levels Turbidity in water bodies Water quality in streams	Number of visitors (sustainable amount)	Net income	System change

4.5 Stakeholders

Table 6. List of potential stakeholders

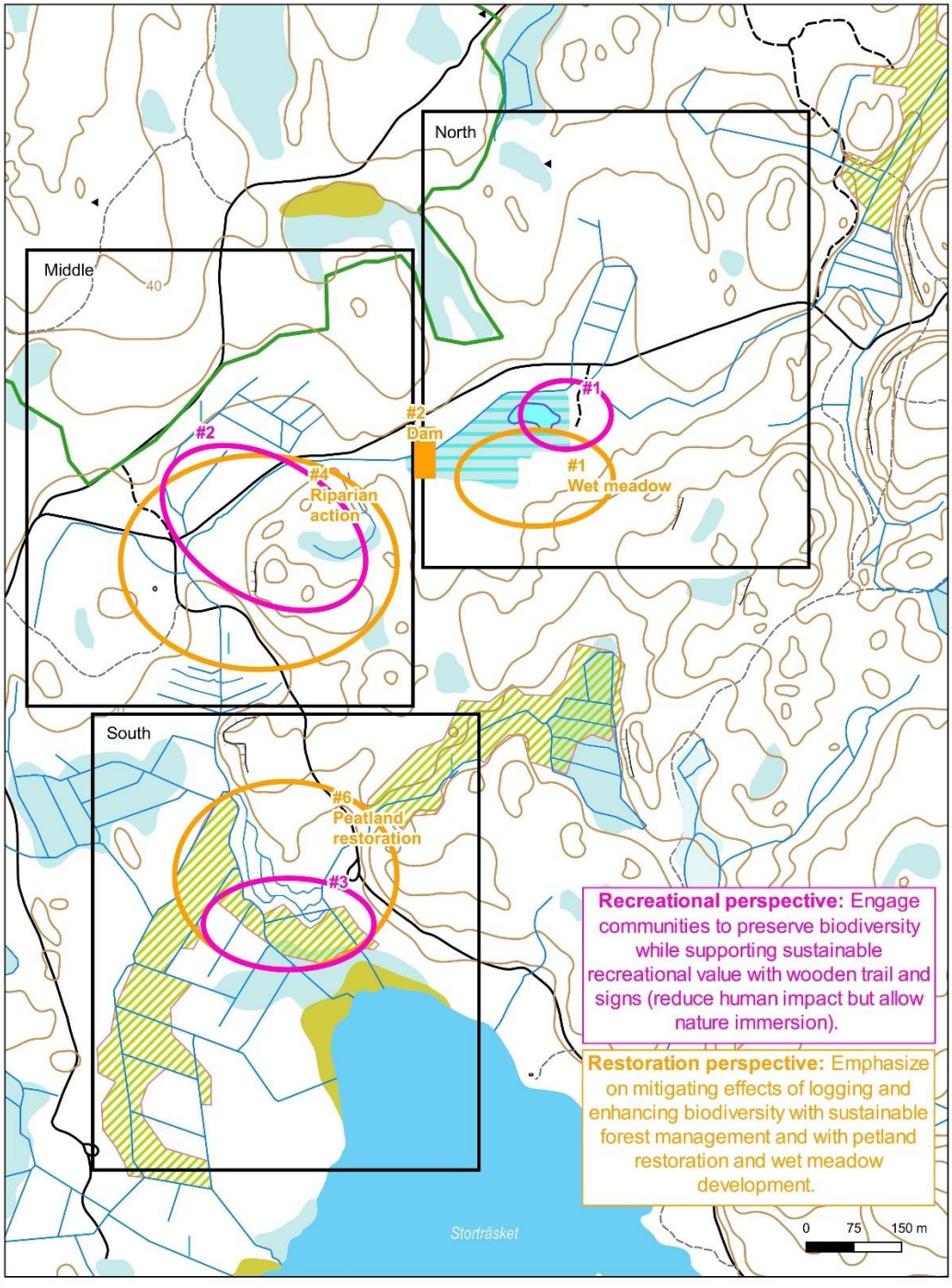
Government and public authorities	Municipality of Raseborg - Urban planners ELY (Centre for Economic Development, Transport and the Environment) SYKE LUVY Metsäkeskus Politicians
Educational and research institutions	Novia University of Applied Sciences Universities Research institutions Biologist Students
Non-governmental and environmental organizations	Birdlife Suomi - Finland Finnish Hunters' association Conservation organizations NGOs Conservationists
Community and local stakeholders	Volunteers Residents Agricultural stakeholders Forests managers Hunters
Recreational	Tourism business Tourists Recreational users/visitors Hikers Bikers Skiers Bird watchers

Table 7. Pivot table intersecting power and interest of potentially relevant stakeholders

High	Metsähallitus	Forest Centre	Raseborg Stad
Power	Birdlife	ELY LUKE	Locals Finnish hunter's association
Low		Novia	Tourist
	Low	**Interest**	***High***

4.6 Mapping of the recommended restoration and recreational actions

Figure 2: Mapping of restoration and recreation actions



Region of the Case Västerby project area attributed to student groups and proposed restoration and recreational solutions

Sources: National Land Survey, 2025
Raseborg Forest plan, 2024
SCC_20251218

5. Discussion

In the Middle Region, a high percentage of forest cover composed of aging trees limits ecological resilience. Proposed strategies like transmitting to a mixed species (polyculture) and stabilizing streambanks, an excellent aim for restoring ecological balance. As they point out, sustainable recreational opportunities like hiking, and cycling not only manage the landscape but also educate visitors about the importance of biodiversity and conservation. Engaging with the local communities is essential as their participation is critical for its long-term protection.

In the North Region, the threats like bark beetles attack and root rotting will increase due to monoculture nature. The suggestions for the construction of permeable dams to enhance wetland habitats are suited for mitigating the huge risks of nutrient runoff. And the suggestions on gradual continuous cover forestry (CCF) would influence the persistence of forest cover while reducing environmental impacts. This approach is best for enhancing both biodiversity and economic goals by sustaining timber production.

In the South region, the Lake Storträsket is one of the unique features and provides a critical habitat for various species that make it a significant destination for species and enhance the recreational value. The peatland restoration and biodiversity enhancement proposals are potentially significant for the area's ecological importance. The construction of stone dams, the planting of native vegetation in designated areas along with lake, and meandering the lake are highlighted proposals for sustaining the ecological integrity of south region. Further build up recreational trails with creation of educational apps and workshops improve nature value with enhancing visitors' knowledge about forest ecosystem and culture of conservation. Further this approach will maximize the visitors' responsibility for the forest nature.

Finally, as they mentioned, stakeholder collaboration is essential for pooling resources, knowledge, and expertise, leading to more effective and sustainable outcomes.

6. Conclusion

The restoration planning for Västerby was initiated to address the urgent ecological risks posed by clear cutting and unsustainable forestry practices. Fieldwork in the middle, north and south regions identified key challenges: loss of biodiversity due to monoculture forests, nutrient run off from former agricultural use, peatland degradation and increased vulnerability to invasive species.

Each group's restoration proposals directly respond to these problems. In the middle region, strategies include transforming monoculture stands into mixed-species forests, stabilizing streambanks, implementing natural water management with features like beaver dams and enhancing sustainable recreation through new trails and educational signage. In the north, the focus is on preventing nutrient runoff and protecting water quality by expanding wetlands, constructing permeable dams, and adopting continuous cover forestry and buffer zones which offer a clear alternative to clear cutting. In the south, restoration efforts center on enlarging and protecting peatlands, reducing nutrient inputs with stone dams and increased trails and educational programs to foster community engagement and conservation awareness.

Collectively, these integrated restoration and recreation strategies provide a sustainable path forward for Västerby. By addressing the root causes of ecological decline and offering practical alternatives to clear-cutting, the proposed plans will help restore biodiversity, improve ecosystem resilience and ensure that Västerby continues to provide valuable natural, recreational and educational benefits for the municipality and its residents. Ongoing collaboration, adapting management and stakeholder involvement will be essential to the long-term success of these efforts.

Course feedback was overwhelmingly positive with students appreciating the multidisciplinary teamwork, field visits, and the opportunity to apply restoration ecology principles in a real-world context. Participants reported gaining a deeper understanding of ecosystem complexity, biodiversity and the importance of stakeholder engagement in restoration planning. The diversity of backgrounds enriched group discussions and presentations and students valued learning about adaptive management and monitoring. Suggestions for improvements included clearer initial instructions, more background information about the area and more time for group coordination and planning. Overall, the course was seen as an effective and meaningful learning experience that highlighted both the challenges and rewards of ecological restoration.

Appendices

Appendix A – North Region

Table 8. Proposed species – group 06

moisture adapted species	climate adapted species	planting species for wetland
Grey alder (*Alnus incana*)	European beech	*Lotus corniculatus*
Black alder (*Alnus glutinosa*)	Douglas fir	*Primula farinosa*
Aspen (*Populus tremula*)		*Lythrum salicaria*
Birch (*Betula spp.)*		
Spruce (*Picea abies*)		
Rowan (*Sorbus aucuparia*)		

Figure 3. Current situation – group 06

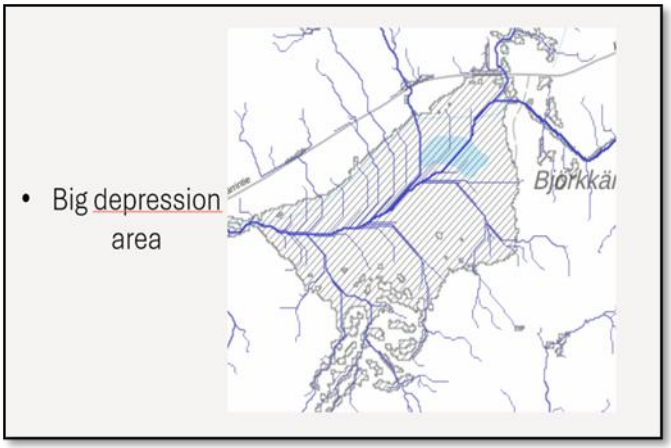


Figure 4. Current situation – group 06

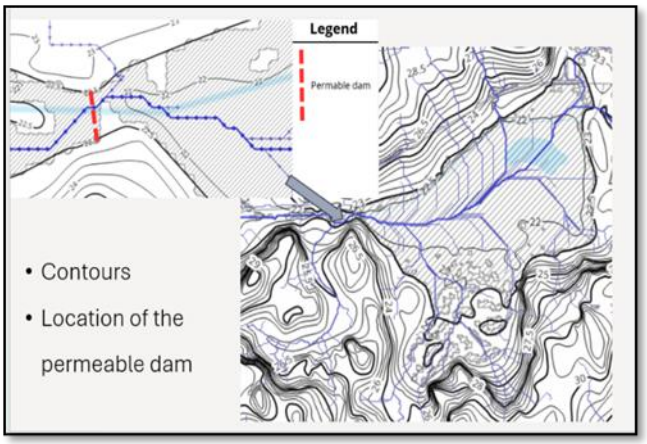


Figure 5. Changes in Wetland-North Region – group 06

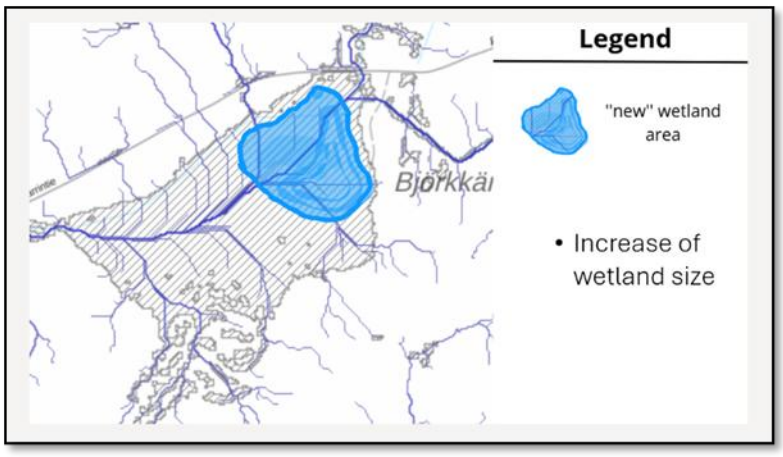


Figure 6. Proposal for preventing nutrient runoff – group 06

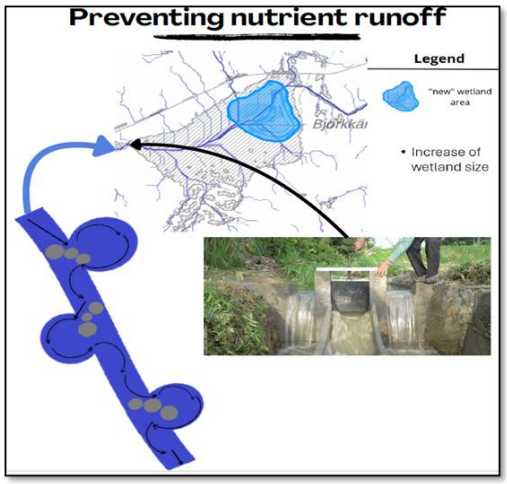


Figure 7. Proposed logging methods - group 06

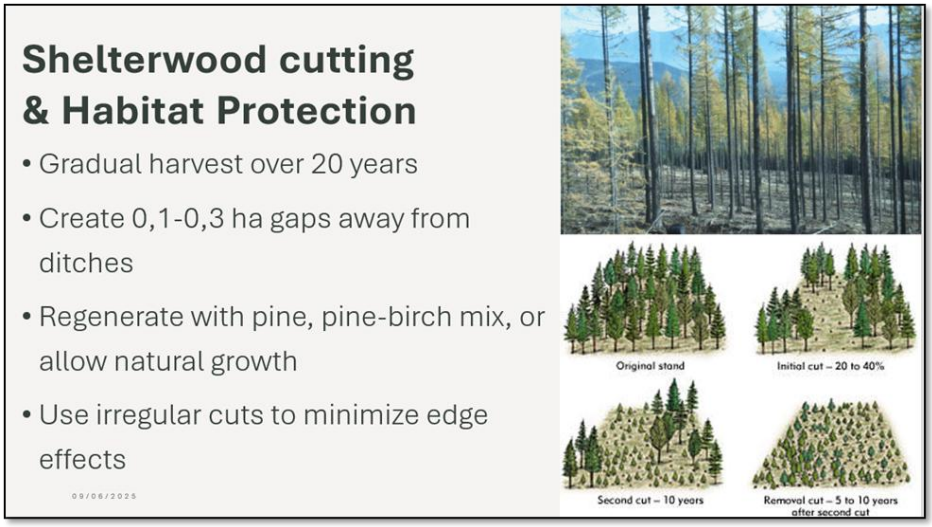


Figure 8. Current location (left) and proposed trail (right) – group 03

Figure 9. Proposed gap cutting (left) and proposed buffer zones (right) – group 03

Appendix B – Middle Region

Figure 10. Soil profile (left) and forest cover (right) – group 02

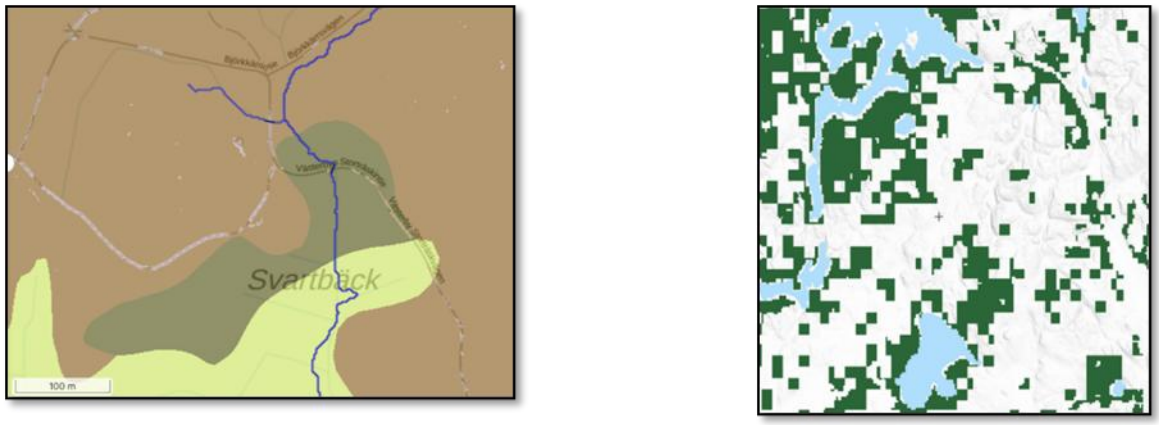


Figure 11. Biodiversity value – group 02

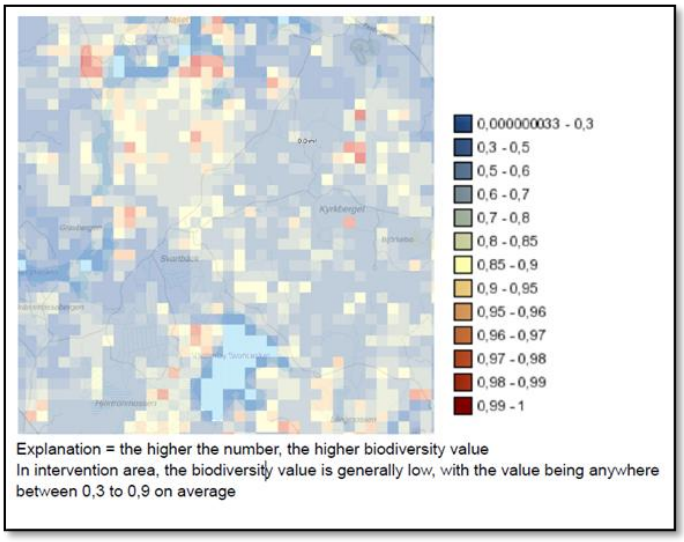


Table 2. Identified Species – group 04

Invasive Species	Targeted Species and Shrubs
Zigzag elm fly = elm forests at risk	Norway Spruce (*Picea abies*)
Nootka lupine	Scots Pine (*Pinus sylvestris*)
Spanish slug, black-headed slug	Willows (*various Salix* species)
Sand lizard	Silver Birch (*Betula pendula*)
Aleutian ragwort	Alder Buckthorn (*Frangula* species)
Himalayan knotweed	Common Alder (Alnus glutinosa)
Japanese knotweed	Common Ash (*Fraxinus excelsior*)
Canadian goldenrod	Aspen (*Populus tremula*)
tall goldenrod	Juniper (*Juniperus communis*)
early goldenrod	Siberian Larch (*Larix sibirica*)
	Wych Elm (*Ulmus glabra*)
	Target Bushes and Shrubs
	Wild Roses (various Rosa species)
	Rowan (*Sorbus aucuparia*)
	Raspberry (*Rubus idaeus*)
	Elderberry (*Sambucus nigra*)
	Hazel (*Corylus avellana*)
	Gooseberry (*Ribes uva-crispa*)
	Dewberry (*Rubus caesius*)
	Bird Cherry (*Prunus padus*)
	Bittersweet (*Solanum dulcamara*)
	Black Currant (*Ribes nigrum*)
	Mezereon (*Daphne mezereum*)
	Blueberries (various species, commonly *Vaccinium myrtillus*)
	Heather (*Calluna vulgaris*)
	Red Currant (*Ribes rubrum*)
	Fly Honeysuckle (*Lonicera xylosteum*)

Figure 12. Current situation of stream (left) and landscape characters (right) – group 04

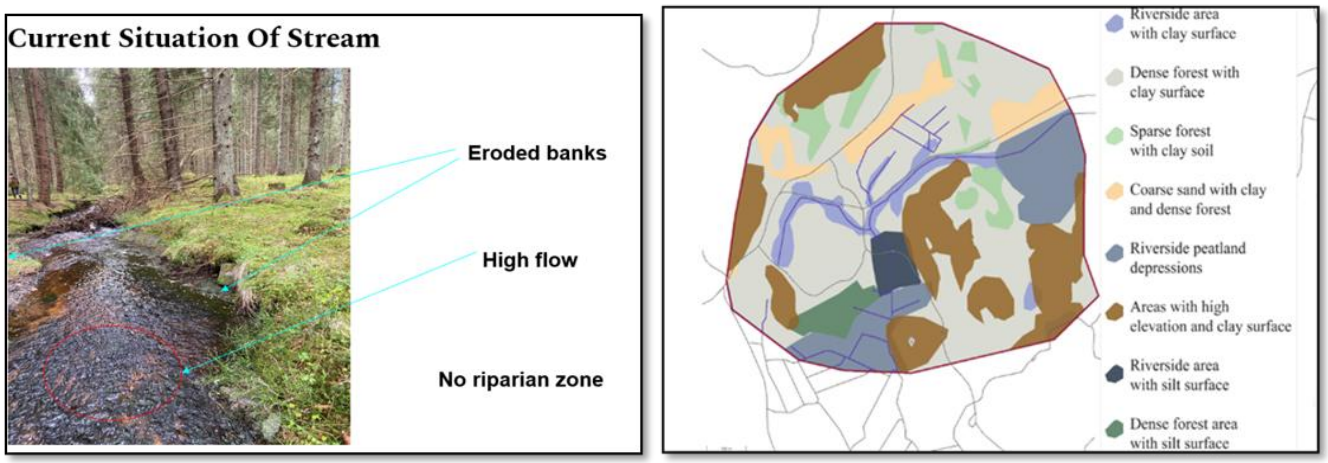


Figure 13. Existing plan for logging (left) and recommendations (right) – group 04

Figure 13. Proposed action plan – group 04

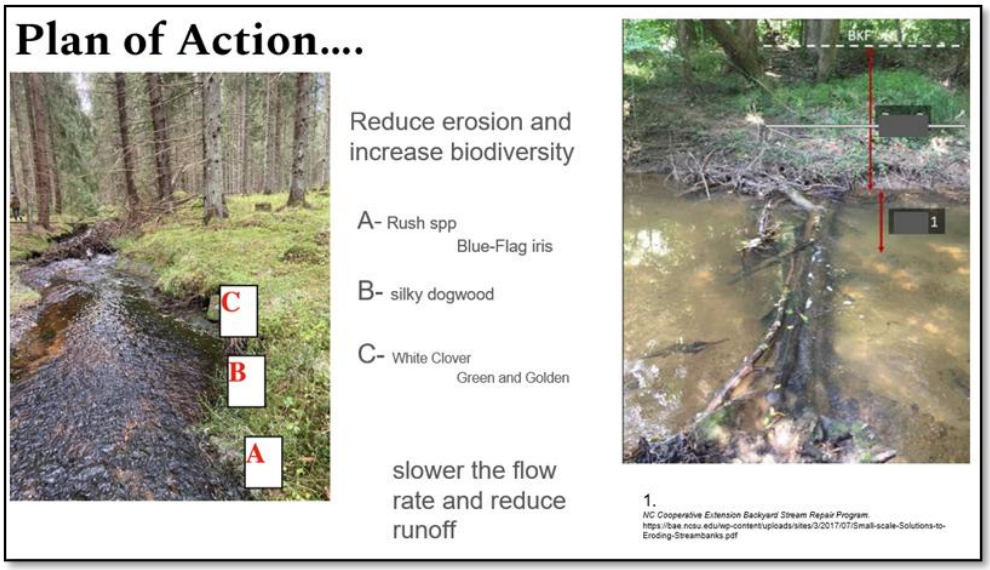


Figure 13. Desired situation – group 02

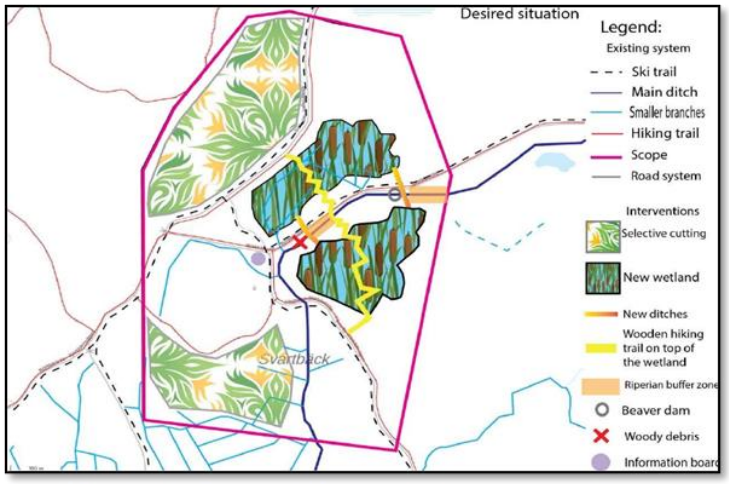


Figure 14. Desired situation – group 02

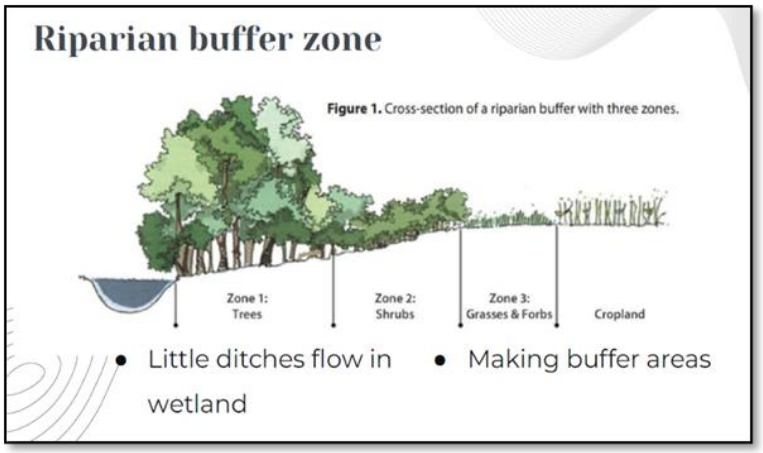
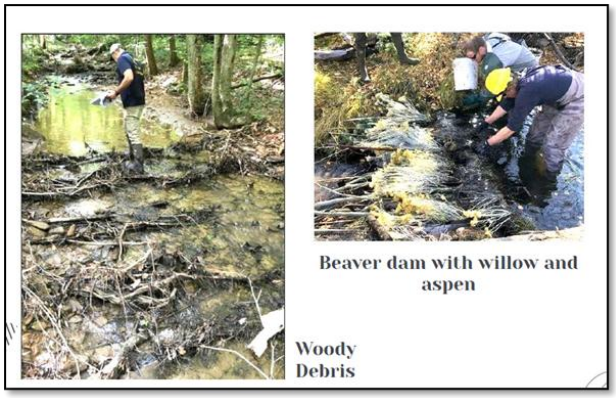


Figure 15. Repairing riverbanks – group 02



Appendix A – South Region

Figure 16. History of Storträsket – group 05

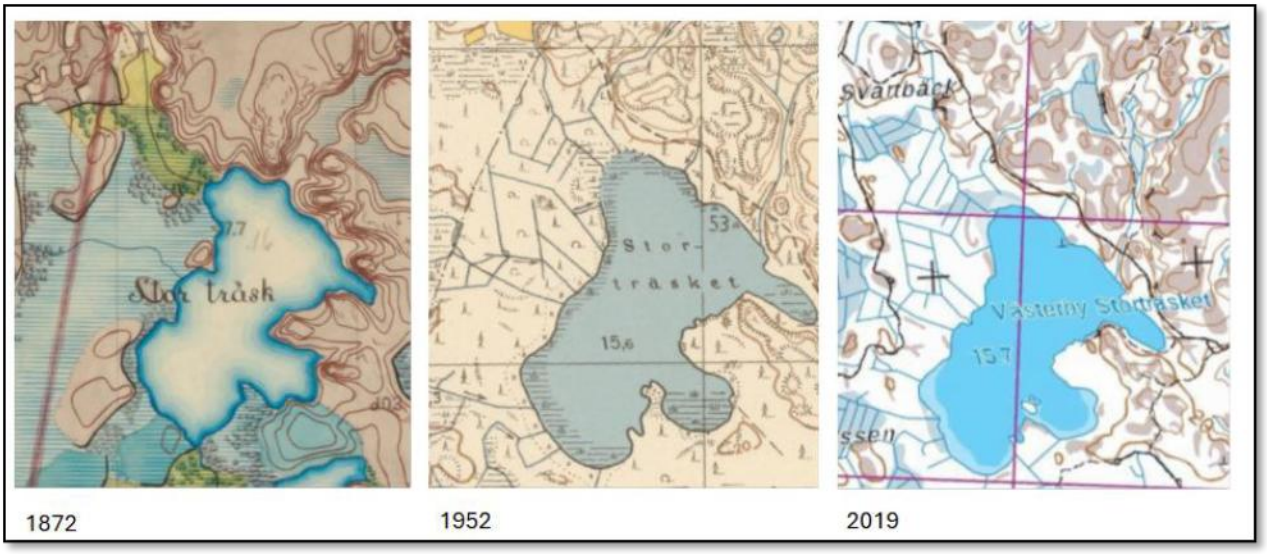


Figure 17. Proposer recreational trail – group 05

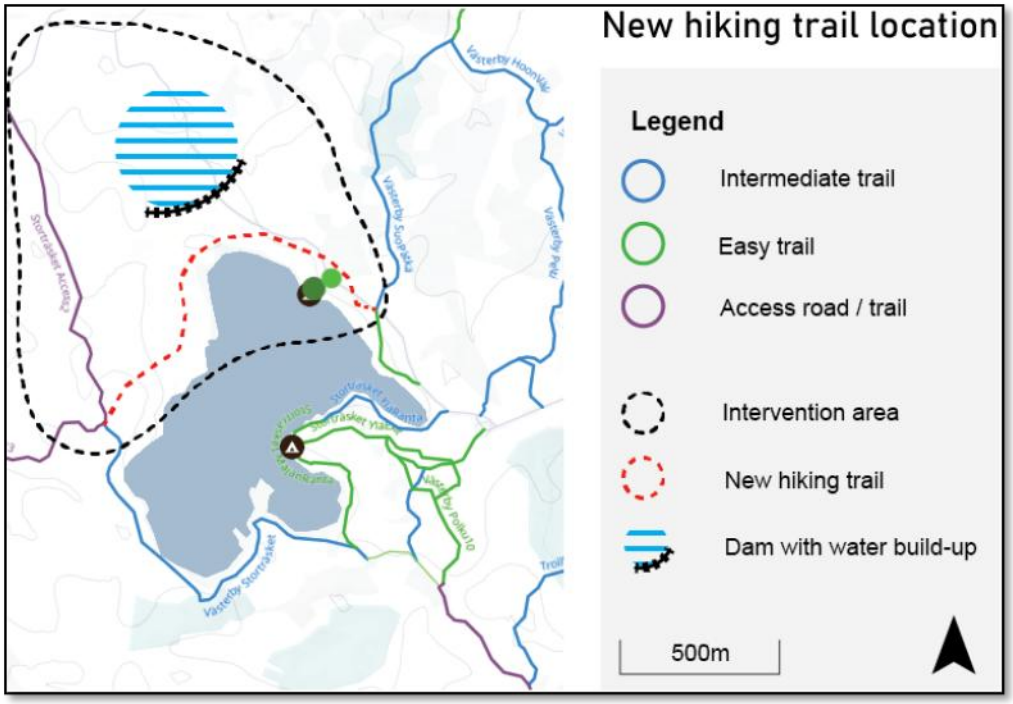


Table 10. Identified Species - group 05

Plants	Birds
Betula (pubescens, nana)	Golden plover
Alnus incana, Alnusgutinosa	Yellow wagtail
Pinus sylvestris	
Salix	
Carex	
Typha	
Menyanthaceae	
Succisa pratensis	
Scutellaria	
Potentilla palustris	
Galium	
Lysimachia thyrsiflora	
Filipendula ulmaria	
Angelica sylvestris	
Iris	
Cirsium	
Calamagrostis	
Phragmites australis	
Myrica gale	
Equisetum fluviatile	
Rubus saxatilis	
Maianthemum bifolium	
Orthilia secunda	
Climacium	

Table 10. Identified Species - group 01

For Approach 01	For Approach 02	For Approach 03
Meadowsweet *Filipendula ulmaria*	Sedges Cyperaceae	Marsh marigold *Caltha palustris*
Dark-leaved willow *Salix myrsinifolia*	Common reeds Phragmites	Yellow Loosestrife *Lysimachia vulgaris*
Silver birch *Betula pendula*		
Mosses Sphagnum		

Figure18. Approach 01

Figure 19. Approach 02

Figure 20. Approach 03

Figure 1. Approach 04