LAKE BLED

Section 1

Regenera Water Sports Pilot Site Vulnerability Assessment

Pilot Site	Lake Bled, Bled municipality
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Grant Agreement	101134336
Grant Acronym	Regenera
Full name	Sustainable and Regenerative Management of Physical Activity and Practice of Sport in Water Areas and Surrounds
Work Package	2
Deliverable	22
Submission Month	June 2025

This Vulnerability Assessment is a tool for informing adaptation, planning and enabling resource managers to evaluate the impacts of water sports on a water body. This assessment is designed to support sound decision-making by identifying which ecosystems or species are significantly affected by current and proposed activities. This

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assessment will help understand why an ecosystem or species may be vulnerable. Vulnerability has three principal components: sensitivity, exposure, and adaptive capacity.

Pleaseread this document in its entirety before conducting your assessment

Consider the following while conducting your assessment:

- Screening – do you feel that an ecological study may be necessary?
- Scoping - which impacts in the blue space need to be assessed?
- Baseline study – has a baseline study of the geographic, biological, socio-economic and cultural context already been conducted?
- Impact prediction - what are possible impacts, positive and negative of conducting this analysis, if any?
    - Mitigation - how can these negative impacts be mitigated?

Objectives of Vulnerability Assessment:

1. To evaluate the potential vulnerabilities and impacts of water sports and other human activities on blue spaceswithin the RegeneraWaterSport framework.
2. Evaluate exposure to known vulnerabilities and assign severity levels to those vulnerabilities. Recommend remediation or mitigation if and whenever needed.

Scope of Vulnerability Assessment:

To include activities such as boating (sailing, rowing etc), swimming, fishing, jet skis, hiking and walking trails within blue spacesand surrounds.

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Goal of vulnerability assessment:

Is to provide the necessaryknowledge to partners and stakeholders within the Regenera project to take appropriate actions against threats to the case study blue space environments.

Pleaseread this document in its entirety before conducting your assessment

Biosecurity

Invasive, non-native flora and fauna can have damaging effects on ecosystems of blue spaces.

Anyone using waterways can inadvertently spread species from one water body to another.

Please note following while conducting your assessment;

Check - all clothing and equipment thoroughly for any visible material (mud, leaves, animal matter). Closely inspect seams/seals on waders and boots.

Clean - hose down or pressure wash all equipment on site. If there are no facilities, carefully bag all equipment until such facilities are available. Washings must be left on site or disposed of carefully. Do not allow washings to enter other watercourses.

Dry - Hang boots, nets etc in an airy space as air drying is the best method of disinfection. Some non-natives can survive up to 2 weeks on damp surfaces and 2 days on dry surfaces.

Ensure items have been drying for 48 hours before using them on the next water way.

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1. Site Description

1.1 Lake name

Lake Bled

1.2 Location

Details	Map (Embed Image)
Lake Bled is located in the northwestern region of Slovenia, within the Upper Carniola (Gorenjska) region, and administratively part of the Municipality of Bled. The lake sits at an altitude of approximately 475 meters above sea level and lies at coordinates 46.3630° N, 14.0939° E. The lake is about 55 km northwest of Ljubljana (the capital), 35 km from Triglav National Park, and 7 km from Radovljica, the nearest town. Its setting is nestled between	

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the Karawanks mountain range to the north and the Julian Alps to the west, surrounded by a mix of forests, traditional settlements, and cultivated land. The iconic Bled Island and Bled Castle add significant cultural and visual value.	

1.3 Size and Depth

1.3.1 Size

Large	Medium	Small
2 ha or greater	0.5-2 ha	Under 0.2 ha
More than 30m depth	max 30 m depth	Less than 6m depth

Lake Bled covers a surface area of approximately 1.45 km² (145 hectares), categorizing it as a large waterbody under assessment guidelines. Its shape is oval, measuring about 2.12 km in length and 1.38 km in width at its widest point.

1.3.2 Depth

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- What is the mean depth of the lake? This may not be known as only well studied lakes usually have this information. Check known databases or ask local fishermen to get an estimate.

The maximum depth of Lake Bled is approximately 30.6 meters, recorded near the western shore. The mean depth is about 17.5 meters

1.4 Surrounding environment - flora, fauna, and geographical features

1.4.1 Flora

Please conduct a desktop study and field study, using local biodiversity databases to enhance your assessment e.g. National Biodiversity Data Centre to check for records within the vicinity of the lake. List all identifiable flora within 20 m of the lake shore.

Ideally conduct this survey in July and August.

- Record and list all flowering plants, trees, rushes, sedges, lichens, emergent plants, mosses, and aquatic plants etc.

- Are invasive species present (aquatic / land based)? Record and list.

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Common Name	Scientific Name	Habitat Type
Black Alder		Terrestrial
White Willow	*Salix alba*	Terrestrial
Crack Willow	*Salix fragilis*	Terrestrial
Purple Willow	*Salix purpurea*	Terrestrial
Field Maple		Terrestrial
European Ash	*Fraxinus excelsior*	Terrestrial
European Hornbeam	*Carpinus betulus*	Terrestrial
Pedunculate Oak	*Quercus robur*	Terrestrial
Narrow-leaved Ash	*Fraxinus angustifolia*	Terrestrial
Reed Canary Grass	*Phalaris arundinacea*	Terrestrial
Common Reed	*Phragmites australis*	Terrestrial
Yellow Iris	*Iris pseudacorus*	Terrestrial
Meadowsweet	*Filipendula ulmaria*	Terrestrial
Marsh Marigold	*Caltha palustris*	Terrestrial
Water Mint	*Mentha aquatica*	Terrestrial
Soft Rush	*Juncus effusus*	Terrestrial
Tussock Sedge	*Carex elata*	Terrestrial
Common Nettle	*Urtica dioica*	Terrestrial
Bogbean	*Menyanthes trifoliata*	Terrestrial
Lesser Water-plantain	*Baldellia ranunculoides*	Terrestrial
Marsh Lousewort	*Pedicularis palustris*	Terrestrial
Great Masterwort		Terrestrial
Yellow Bellflower	*Campanula lutea*	Terrestrial
Broad-leaved Marsh-orchid	*Dactylorhiza majalis*	Terrestrial

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Sword-leaved Helleborine	*Cephalanthera longifolia*	Terrestrial
White Helleborine	*Cephalanthera damasonium*	Terrestrial
Bird's-nest Orchid	*Neottia nidus-avis*	Terrestrial
Coralroot Orchid	*Corallorhiza trifida*	Terrestrial
Lesser Butterfly-orchid	*Platanthera bifolia*	Terrestrial
Globeflower	*Trollius europaeus*	Terrestrial
Carnic Lily	*Lilium carniolicum*	Terrestrial
Dusky Crane's-bill	*Geranium phaeum*	Terrestrial
Wild Sweet William	*Dianthus barbatus*	Terrestrial
Meadow Clary	*Salvia pratensis*	Terrestrial
Field Gentian	*Gentianella campestris*	Terrestrial
Burnt Orchid	*Neotinea ustulata*	Terrestrial
Fragrant Orchid	*Gymnadenia conopsea*	Terrestrial
Chalk Fragrant-orchid	*Gymnadenia odoratissima*	Terrestrial
Bohemian Early Purple Orchid	*Orchis ovalis*	Terrestrial
Toothwort	*Lathraea squamaria*	Terrestrial
Marsh Arrowgrass	*Triglochin palustris*	Terrestrial
Bog Cotton	*Eriophorum angustifolium*	Terrestrial
Water Crowfoot	*Batrachium* spp.	Aquatic

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FIELD STUDY

Common Name	Scientific Name	Habitat Type
Black Alder		Terrestrial
White Willow	*Salix alba*	Terrestrial
Purple Willow	*Salixpurpurea*	Terrestrial
Field Maple		Terrestrial
European Hornbeam	*Carpinus betulus*	Terrestrial
Reed Canary Grass	*Phalaris arundinacea*	Terrestrial
Common Reed	*Phragmites australis*	Terrestrial
Yellow Iris	*Iris pseudacorus*	Terrestrial
Meadowsweet	*Filipendula ulmaria*	Terrestrial
Marsh Marigold	*Caltha palustris*	Terrestrial
Water Mint	*Mentha aquatica*	Terrestrial
Soft Rush	*Juncus effusus*	Terrestrial
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Common Nettle	*Urtica dioica*	Terrestrial
Bogbean	*Menyanthes trifoliata*	Terrestrial
Lesser Water-plantain	*Baldellia ranunculoides*	Terrestrial
Marsh Lousewort	*Pedicularis palustris*	Terrestrial
Broad-leaved Marsh-orchid	*Dactylorhiza majalis*	Terrestrial
Sword-leaved Helleborine	*Cephalanthera longifolia*	Terrestrial
White Helleborine	*Cephalanthera damasonium*	Terrestrial
Bird's-nest Orchid	*Neottia nidus-avis*	Terrestrial
Coralroot Orchid	*Corallorhiza trifida*	Terrestrial

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Lesser Butterfly-orchid	*Platanthera bifolia*	Terrestrial
Globeflower	*Trollius europaeus*	Terrestrial
Carnic Lily	*Lilium carniolicum*	Terrestrial
Dusky Crane's-bill	*Geranium phaeum*	Terrestrial
Wild Sweet William	*Dianthus barbatus*	Terrestrial
Meadow Clary	*Salvia pratensis*	Terrestrial
Field Gentian	*Gentianella campestris*	Terrestrial
Burnt Orchid	*Neotinea ustulata*	Terrestrial
Fragrant Orchid	*Gymnadenia conopsea*	Terrestrial
Chalk Fragrant orchid	*Gymnadenia odoratissima*	Terrestrial
Bohemian Early Purple Orchid	*Orchis ovalis*	Terrestrial
Toothwort	*Lathraea squamaria*	Terrestrial
Marsh Arrowgrass	*Triglochin palustris*	Terrestrial
Bog Cotton	*Eriophorum angustifolium*	Terrestrial
Water Crowfoot	*Batrachium* spp.	Aquatic

INVASIVE SPECIES

Common Name	Scientific Name	Habitat Type
JapaneseKnotweed	*Fallopia japonica*	Terrestrial
Giant Hogweed	*Heracleum mantegazzianum*	Terrestrial
Himalayan Balsam	*Impatiens glandulifera*	Terrestrial
Black Locust	*Robinia pseudoacacia*	Terrestrial
Tree of Heaven	*Ailanthus altissima*	Terrestrial

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Canadian Waterweed	*Elodea canadensis*	Aquatic
Eurasian Watermilfoil	*Myriophyllum spicatum*	Aquatic
Carolina Fanwort	*Cabomba caroliniana*	Aquatic
Water Hyacinth	*Pontederia crassipes*	Aquatic
Giant Salvinia	*Salvinia molesta*	Aquatic

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Which describes the land best next to the water body table?

Tick all that apply

	Present	Moderate	Abundant
Bog/Moorland		X	
Forest			X
Grassland		X	
Crops-tillage/ other	X		
Urban	X		
Other (describe) (tourism parks)		X	

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1.4.2 Fauna

Pleaseconduct a desktop study and field study. Use local biodiversity databases e.g. National Biodiversity Data Centre to check for records within the vicinity of the lake.

- Check lake shore for evidence of use by mammals (e.g. otters, mink, water voles etc.).
- Record and list aquatic invertebrates, Dragonflies, Damselflies and other insects, amphibians and reptiles.
- Birds – wintering and breeding.
- Are invasive species present (both aquatic and land-based)?

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DESK STUDY

Group	Common Name	Scientific Name
Mammal	European Otter	*Lutra lutra*
Mammal	Red Fox	
Mammal	Roe Deer	*Capreolus capreolus*
Mammal	Brown Hare	*Lepus europaeus*
Mammal	Eurasian Badger	*Meles meles*
Mammal	Common Shrew	*Sorex araneus*
Mammal	European Mole	*Talpa europaea*
Amphibian	Common Frog	*Rana temporaria*
Amphibian	Common Toad	*Bufo bufo*
Amphibian	Smooth Newt	*Lissotriton vulgaris*
Amphibian	Alpine Salamander	*Salamandra atra*
Reptile	Grass Snake	*Natrix natrix*
Reptile	Viviparous Lizard	*Zootoca vivipara*
Reptile	Sand Lizard	*Lacerta agilis*
Bird	Mute Swan	*Cygnus olor*
Bird	Mallard	
Bird	Eurasian Coot	*Fulica atra*
Bird	Great Crested Grebe	*Podiceps cristatus*
Bird	Grey Heron	*Ardea cinerea*
Bird	Common Kingfisher	*Alcedo atthis*

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Fish	Common Chub	*Squalius cephalus*
Fish	European Perch	*Perca fluviatilis*
Fish	Northern Pike	*Esox lucius*
Fish	Common Carp	*Cyprinus carpio*
Fish	Tench	*Tinca tinca*
Fish	Roach	*Rutilus rutilus*
Fish	Rudd	*Scardinius erythrophthalmus*
Fish	Lake Trout	*Salmo trutta lacustris*
Fish	Rainbow Trout	*Oncorhynchus mykiss*
Fish	Wels Catfish	*Silurus glanis*
Fish	Zander	*Sander lucioperca*
Crustacean	Signal Crayfish	*Pacifastacus leniusculus*
Mollusk	Freshwater Mussel	*Anodonta anatina*
Mollusk	Great Pond Snail	*Lymnaea stagnalis*

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FIELD STUDY

Group	Common Name	Scientific Name
Mammal	European Otter	*Lutra lutra*
Mammal	Red Fox	*Vulpes vulpes*
Mammal	Roe Deer	*Capreolus capreolus*
Amphibian	Common Frog	*Rana temporaria*
Amphibian	Smooth Newt	*Lissotriton vulgaris*
Reptile	Grass Snake	*Natrix natrix*
Bird	Mute Swan	*Cygnus olor*
Bird	Mallard	*Anas platyrhynchos*
Bird	Eurasian Coot	*Fulica atra*
Bird	Great Crested Grebe	*Podiceps cristatus*
Bird	Grey Heron	*Ardea cinerea*
Bird	Common Kingfisher	*Alcedo atthis*
Fish	Common Chub	*Squalius cephalus*
Fish	European Perch	*Perca fluviatilis*
Fish	Northern Pike	*Esox lucius*
Fish	Common Carp	*Cyprinus carpio*
Fish	Tench	*Tinca tinca*
Fish	Roach	*Rutilus rutilus*
Fish	Rudd	*Scardiniuserythrophthalmus*
Fish	Lake Trout	*Salmo trutta lacustris*
Fish	Rainbow Trout	*Oncorhynchus mykiss*

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Fish	Wels Catfish	*Silurus glanis*
Fish	Zander	*Sander lucioperca*
Crustacean	Signal Crayfish	*Pacifastacus leniusculus*
Mollusk	Freshwater Mussel	*Anodonta anatina*
Mollusk	Great Pond Snail	*Lymnaea stagnalis*

INVASIVE SPECIES

Group	Common Name	Scientific Name
Crustacean	Signal Crayfish	*Pacifastacus leniusculus*
Fish	Rainbow Trout	
Fish	Wels Catfish	*Silurus glanis*
Fish	Zander	*Sander lucioperca*
Mammal	American Mink	*Neovison vison*

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Riparian Zone Survey	The lake's perimeter is dominated by mixed vegetation types including reed beds, willow stands, and patches of mown grasslands interspersed with tourism infrastructure (e.g., walking paths, cafes, docks). Vegetation structure is best preserved on the western and southwestern shores, with natural buffering vegetation up to 20 meters wide in some places. These zones include alder willow assemblages and sedge dominated herbaceous layers.
Aquatic plant survey	Submerged aquatic vegetation observed during the field survey included Canadian waterweed (*Elodea canadensis*), hornwort (*Ceratophyllum demersum*), and curled pondweed (*Potamogeton crispus*), all present in shallow, sheltered coves. Emergent plant species found along the immediate shoreline consisted of yellow iris (*Iris pseudacorus*), common reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*), tussock sedge (*Carex elata*), water mint (*Mentha aquatica*), and bulrush (*Schoenoplectus lacustris*). Floating species documented in calmer zones of the lake included white water lily (*Nymphaea alba*) and yellow water lily (*Nuphar lutea*). Among the identified species, hornwort was found to be especially

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	widespread in the southern and western inlets.

1.4.3. Is shoreline vegetation abundant yes / no (circle most applicable)

1.4.4. Are aquatic plant types abundant yes / no (circle most applicable)

1.4.5 Are there any geographical features of note within a 20km vicinity of the water body?

Mala Osojnica, a forested hill rising to approximately 685 meters above sea level, is located 1.7 km southwest of Lake Bled. The area consists of moderately sloped alpine terrain with mixed deciduous and coniferous forest cover. Several minor surface streams and groundwater springs originate from the surrounding hills and contribute to the lake's hydrology, particularly from the western side.

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Lake Bled is part of the upper Sava River catchment. Water inflows include natural springs, such as the Mala Zaka Spring, and intermittent runoff from surrounding upland areas.
Outflow from the lake occurs via the Jezernica River, a short surface stream that connects to the Radovna River system, which in turn joins the Sava River downstream.

Triglav National Park is situated approximately 10.5 km west of Lake Bled and is accessible via regional roads 209 and 907. While not directly hydrologically connected, the broader park landscape forms part of the lake's extended ecological and tourism corridor.

1.4.6 Water Quality

- Desk Top study- use local databases, for example, EPA.

- If appropriate, carry out assessments as per local requirements. Ensure to demonstrate pollution levels and e coli levels.

Lake Bled has been subject to regular monitoring by the Slovenian Environment Agency (ARSO) since 1975. Historical data indicate that the lake experienced eutrophic to hypereutrophic conditions in the 1970s. Remediation efforts, including the diversion of the Radovna River (1964), the installation of a deep-water siphon (1980–81), and upgrades to the sewage system (1982–1985), have significantly improved water quality. Since 1983, Lake Bled has been classified as mesotrophic according to OECD criteria.

Despite these improvements, occasional increases in phytoplankton biomass, reflected by elevated chlorophyll-a concentrations, have been observed. These fluctuations suggest ongoing nutrient pressures within the lake's catchment area. Monitoring of inflows has shown recent increases in phosphorus concentrations, particularly in the Mišca stream.

Bacteriological assessments indicate that E. coli and intestinal enterococci levels remain low throughout most of the year. However, temporary spikes have been recorded near popular swimming areas following heavy rainfall. The lake's eastern

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shoreline, which hosts most of the public beaches and hotel infrastructure, is the most vulnerable to localized water quality decline during the summer season. Measures are in place to mitigate diffuse pollution sources, including vegetative buffers, improved wastewater management in tourist zones, and public awareness campaigns. Despite these efforts, continued pressure from high visitor numbers during peak months presents an ongoing challenge to long-term water quality maintenance.

1.4.7 Local Human population

- See local Census reports.
- Where is/are the main population(s) relative to the site being surveyed?

The town of Bled is situated directly adjacent to the lake's northeastern shore and represents the primary population centre in the area. According to the Statistical Office of the Republic of Slovenia, the Municipality of Bled had an estimated population of 8,171 in 2024. The urban area is composed of residential housing, hospitality infrastructure, cultural heritage sites, and tourism facilities.

Human activity around the lake is heavily influenced by tourism, with visitor numbers exceeding 600,000 overnight stays annually, peaking during the summer months. Recreational uses include swimming, rowing, walking, cycling, and paddleboarding. The population increases significantly during the high season due to both international tourism and domestic visitors, resulting in increased pressure on public services, waste management systems, and local water quality.

Smaller villages and hamlets in the wider area, such as Ribno, Zasip, and Selo pri Bledu, also contribute to the catchment's human footprint. While these communities are less densely developed, they are functionally integrated into Bled's tourism economy and infrastructure network.

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1.4.8. List Designated Sites

List all (Natura 2000) sites that are hydrologically connected to the waterbody and include streams and rivers that form these hydrological connections. All connected sites within 15 km of the lake should be listed.

Site Code	Site Name	Approx. Distance (km)
SI3000272	Triglav National Park	~10 km west
SI5000006	Pokljuka Plateau	~7 km northwest
SI5000010	Jelovica Plateau	~13 km southwest
SI3000231	Radovna Valley	~12 km northwest
SI3000243	Sava River Corridor	~3 km east (downstream)

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2. Identify Vulnerabilities

Consider the following:

Erosion and Habitat Disturbance	Boat traffic and high-speed water activities (e.g., water skiing, wakeboarding) can cause shoreline erosion and disturb aquatic habitats.
Water Pollution	Fuel spills, litter, and waste from boats and visitors can degrade water quality, affecting aquatic life.
Noise Pollution	Noise from motorboats, jet skis, and human activity can stress and displace wildlife, especially sensitive species.
Invasive Species Introduction	Boats and equipment can introduce non-native species, which may outcompete native species and disrupt ecosystems.
Disturbance to Wildlife	Increased human presence and activities can disturb nesting birds and other wildlife, leading to behavioural changes and habitat abandonment.
Overfishing and Aquatic Disturbance	Recreational fishing can lead to overfishing, reducing fish populations and disrupting food webs.
Physical Habitat Damage	Anchoring, docking, and launching boats can damage aquatic plants and habitats, reducing biodiversity.
Climate Change Exacerbation	Water sports can contribute to climate change through emissions from boats, affecting water temperatures and levels.
Aesthetic and Recreational Value Loss	Pollution and habitat destruction can reduce the lake's natural beauty and its value for recreation and tourism.

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Different environmental pressures may arise from the recreational and tourism-based use of Lake Bled, including pollution, shoreline erosion, the introduction and spread of invasive species, habitat degradation, and biodiversity stress. Popular activities such as swimming, paddleboarding, kayaking, and rowing may lead to wave-induced erosion and the physical disturbance of sensitive shoreline vegetation and reed beds. Increased boat traffic, including electric and occasional combustion-powered vessels, contributes to localized noise pollution and poses a risk of fuel or lubricant leakage, which can be harmful to aquatic flora and fauna.

Human presence near nesting areas—particularly waterfowl breeding sites—has the potential to disrupt reproductive success, while repetitive access to the lake's edge results in the trampling of riparian vegetation and compaction of shoreline soils. The transportation of recreational equipment, including boats, waders, and paddleboards, carries a high risk of inadvertently introducing non-native plant fragments or aquatic organisms, exacerbating the spread of invasive species such as Canadian waterweed and signal crayfish. Additionally, popular walking trails and informal footpaths contribute to habitat fragmentation, erosion, and the gradual reduction of natural shoreline buffers.

Fishing pressure on species such as perch and pike, if unregulated, may disrupt aquatic food webs and reduce the availability of prey for birds such as grebes and herons. The cumulative effects of these activities, especially during peak tourist season, place sustained pressure on the lake's ecosystem and require coordinated management to prevent long-term ecological degradation.

2.1 Identify Vulnerabilities Table

Please complete the following table:

Risk Score 1-5
5 being the highest risk and 1 being the lowest

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Ecological Impact	Species of Concern	Hazard	What Will Be Harmed	Control Measures	Risk Score (1-5)
Flora Sensitivity	*Iris pseudacorus*, *Phragmites australis*, *Nymphaea alba*	Trampling, oil/fuel spills from nearby activities	Aquatic and riparian plant communities	Establish shoreline buffer zones; refuel off-site	3
Fauna Sensitivity	*Lutra lutra*, *Cygnus olor*, *Fulica atra*, amphibians (*Bufo bufo*, *Rana*)	Human disturbance, noise, visual intrusion	Nesting sites, breeding areas	Maintain exclusion zones during sensitive periods. enforce minimum approach distances	5
Habitat Disruption	Reed beds, spawning areas, shoreline vegetation	Vegetation removal for infrastructure or path creation	Habitat connectivity, ecosystem functions	Preserve native vegetation; create protected shoreline zones	5
Physical Habitat Damage	Reed beds, littoral macroinvertebrates	Anchoring, launching, dock expansion	Shoreline stability, benthic habitats	Restrict anchoring in sensitive zones; designate official boat access points	3

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Noise Pollution	Waterfowl, amphibians, otters	Motorboat use, jet skis	Nesting behavior, species stress response	Time-of-day restrictions. promote nonmotorized activities	3
Collision Risk	Amphibians, waterfowl chicks	Boat and participant collisions	Wildlife injury/mortality, shoreline nesting areas	Slow-speed zones; wildlife briefings for recreational users	4
Invasive Species Spread	Native aquatic flora/fauna	Boat/equipment contamination; unregulated access	Native biodiversity, ecosystem stability	Clean-in/cleanout protocols. LNT awareness; monitoring	5
Chemical Pollution	Aquatic flora and fauna	Fuel spills, sunscreen, greywater discharge	Water quality, food web integrity	Use eco-safe products; training in proper fuel handling; no discharge zones	3
Sedimentation	Fish spawning areas, aquatic macrophytes	Erosion from trampling and unregulated shoreline use	Substrate conditions, plant rooting zones	Install erosion control measures; define formal lake access trails	3
Water Pollution	*Cyprinus carpio*, aquatic invertebrates	Runoff from agriculture, roads, and boating activity	Water clarity, oxygen balance, plankton dynamics	Riparian buffer zones; stormwater treatment; eco-certified boating practices	3

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Fishing Pressure	*Perca fluviatilis*, *Esox lucius*, *Tinca tinca*	Overfishing, habitat disturbance	Species population balance, breeding success	Enforce catch limits. introduce no fishing zones; promote catch-and release	3
Aesthetic/Rec Pressure	Shoreline vegetation, cultural landscape	Littering, trail widening, informal fires	Natural landscape quality, sensitive plants	Education; formalize recreational paths; LNT signage	2
Climate Stress Amplifier	Cold-water species (*Salmo trutta lacustris*), macroinvertebrates	Motorboat emissions, habitat thermal loading	Water temperature, stratification effects	Promote low emission boating; reduce heat absorbing infrastructure along shore	3

2.2 Environmental vulnerability

2.2.1 *Biodiversity*

Is the site specially designated? Are there protected species?Are there nesting birds, do birds use the blue spacefor overwintering etc?

Lake Bled lies within a sensitive alpine environment surrounded by protected Natura 2000 sites and ecologically valuable landscapes. Though not directly designated itself, the lake supports a range of protected species under the EU Birds Directive and Habitats Directive.

Commonly observed species include mute swan, mallard, great crested grebe, coot, grey heron, Eurasian wren, and European robin, all of which rely on the lake's shoreline, reedbeds, and nearby forests for nesting or feeding. Nesting swans have been recorded along the quieter northern shoreline, and occasional sightings of Eurasian teal and other migratory waterfowl occur in winter.

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The Eurasian otter (Lutra lutra), protected under EU law, has been occasionally spotted along inflow streams and riparian areas.

Human activity such as boating, shoreline recreation, and vegetation clearance can interfere with vital ecological processes like nesting, migration, and reproduction. Disturbances during key life stages may reduce breeding success or cause species to abandon habitat entirely. Over time, this can lead to declines in local biodiversity and the weakening of ecosystem resilience.

2.2.2 Invasive species

Are any invasive species present (flora / fauna) or is there a danger of them being brought to site on equipment? What, if any, are the relevant local considerations, regulations or advice in this respect?

Lake Bled and its surrounding area have been affected by several invasive species that pose a threat to native biodiversity, water quality, and ecosystem functioning.

The aquatic plant Canadian waterweed (Elodea canadensis) is well established in parts of the lake and competes with native submerged vegetation, often forming dense mats that reduce light penetration and oxygen levels. Its presence disrupts native macrophyte communities and may interfere with recreational use such as rowing and swimming.

Another key concern is the spread of the signal crayfish (Pacifastacusleniusculus), which has been recorded in Slovenian watercourses and is suspected to occur in or near Lake Bled. This species is aggressive, displaces native crayfish, and can cause significant damage to benthic habitats through burrowing and overgrazing.

On land, Japaneseknotweed (Fallopia japonica) has been identified along some access roads and disturbed areas near the lake. Its rapid growth and strong root systems contribute to soil destabilization and crowd out native plant species.

The risk of further introduction and spread is heightened by high visitor numbers and water-based activities. Boats, paddles, fishing gear, and footwear can transport plant fragments, seeds, and small invertebrates between water bodies if not properly

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cleaned. Inadequate biosecurity practices, particularly during the tourist season, increase the likelihood of further ecological disruption.

2.2.3 Erosion

Is there a possibility of back water splash, erosion of shore at bank, sedimentation, etc?

Erosion is a growing concern along the shores of Lake Bled, particularly in areas of high recreational use. Frequent foot traffic, informal trails, and the absence of vegetation buffers in developed zones contribute to shoreline destabilization. Sections of the eastern and southern banks—where tourism infrastructure is concentrated—are especially vulnerable to bank wear and surface runoff, leading to the gradual loss of soil and shoreline integrity.

Wave action from boats and repeated launching of watercraft also contributes to littoral zone disturbance, particularly where natural reed beds have been cleared or degraded. Over time, these processes reduce water clarity due to suspended sediment and degrade habitat quality for aquatic organisms, amphibians, and nesting birds.

Additionally, the construction of footpaths, retaining walls, and lakeside amenities has altered natural drainage and led to localized sediment deposition in shallow parts of the lake. Without sufficient vegetation to slow runoff, heavy rain events exacerbate the problem by washing soil and pollutants directly into the lake basin.

If unmanaged, continued erosion will result in habitat fragmentation, reduced water quality, and the loss of shoreline biodiversity. This also threatens the long-term stability of trails and infrastructure used by visitors.

2.2.4 Water quality

Local considerations as to appropriate assessments needed - consider the following,

1. Disturbance of lake bottom, (e.g. rising sediment)
2. Accidental introduction of invasive species
3. The use of fuel, (e.g. leaks from engines, cleaning agents etc.)

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Current Considerations:

Water quality in Lake Bled is currently assessed as good, based on regular monitoring conducted by the Slovenian Environment Agency (ARSO). During the summer months, there is an observable increase in nutrient input caused by stormwater runoff, pedestrian activity, and the use of tourism-related facilities. Elevated phosphorus concentrations have been recorded near the Mišca stream inflow, indicating land-use pressure from surrounding areas. Occasional exceedances of E. coli levels have been reported in designated bathing zones, particularly following heavy rainfall events. These are attributed to surface runoff, overuse of sanitary infrastructure, and contamination from wildlife. Recreational activity in shallow zones contributes to sediment agitation, leading to temporary reductions in water transparency due to nutrient resuspension.

Future Considerations:

Projected increases in air temperature and longer warm periods may result in more frequent and prolonged algal blooms. These conditions could also intensify thermal stratification, potentially lowering oxygen concentrations in deeper lake layers and negatively affecting aquatic fauna. Planned or unregulated construction in the catchment may increase the extent of impervious surfaces, thereby contributing to higher volumes of diffuse pollution and stormwater runoff. Without additional buffer zones, runoff management, and visitor impact mitigation, the lake's long-term water quality is expected to deteriorate.

2.2.5 Conduct a Chemical Analysis.

Conduct Quality Testing & Toxicity Testing. can be carried out as per local guidance.

Lake Bled's water quality is monitored by the Slovenian Environment Agency (ARSO) in accordance with the Water Framework Directive (2000/60/EC) and national regulations. The monitoring includes assessments of chemical parameters to evaluate the lake's ecological status. gov.si

Phosphorus Concentration: In recent years, the average annual total phosphorus concentration in Lake Bled has been approximately 12.6 µg P/L, with observed values

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ranging between 10 and 16 µg P/L. These levels indicate a moderate nutrient status, although occasional peaks suggest periods of increased nutrient input, potentially leading to eutrophication.

Water Transparency: The lake's water transparency has improved over the decades, with current average values between 4.45 and 8.3 meters. However, fluctuations occur due to seasonal variations and increased recreational activities, which can disturb sediments and reduce clarity.

Microbiological Quality: Monitoring of bathing waters in Lake Bled has shown that E. coli concentrations generally remain within acceptable limits for recreational waters. However, following heavy rainfall events, short-term increases in E. coli levels have been recorded, likely due to surface runoff and overflows from nearby infrastructure.

Heavy Metals in Sediments: Sediment analyses have detected elevated levels of heavy metals such as zinc (up to 970 ppm) and lead (up to 160 ppm) in nearshore areas, indicating historical inputs from sewage and urban runoff. These concentrations exceed typical background levels and may pose risks to benthic organisms. researchgate.net

Overall Assessment: While Lake Bled maintains a generally good chemical status, ongoing monitoring is essential to manage nutrient inputs, prevent eutrophication, and ensure the safety of recreational waters. Implementing measures to control runoff, enhance wastewater treatment, and manage recreational activities will support the lake's ecological integrity.

2.2.6 Water Use

1. Is the water being used for cleaning?

Yes, in limited recreational contexts. Water from Lake Bled is occasionally used for rinsing small boats, paddleboards, and recreational equipment, especially during events. However, official regulations discourage direct cleaning with detergents or chemicals in or near the lake to protect water quality. Dedicated cleaning facilities are encouraged.

2. Is the lake being used as a public water supply?

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4. No, Lake Bled is not used as a direct source of public drinking water. The surrounding municipality sources its potable water primarily from regulated groundwater systems in the Upper Carniola region. However, the lake holds symbolic and tourism-related value and contributes indirectly to water-related services and local eco-perception, warranting protective measures to preserve its quality.

2.3 Human Impact

2.3.1 Is there evidence of overcrowding

Consider high foot traffic and noise affecting flora and fauna, disturbance, erosion etc.

Yes. Lake Bled experiences significant overcrowding during peak tourist seasons, especially in July and August. Popular with both international and domestic visitors, the lake can see thousands of people along its walking trails, beaches, and boat rental points on a daily basis. Overcrowding is especially evident on the northeastern shore near the public beach area, hotels, and Bled Island access points.

The effects of overcrowding include:

-Trampling and compaction of shoreline vegetation.

-Noise disturbance to nesting waterfowl and other wildlife.

-Increased littering and plastic waste, especially near food vendors.

-Pressure on toilet and hygiene infrastructure.

-Localized water pollution from sunscreen runoff and accidental litter.

2.2.7 Waste management (litter, human waste, fast food) Fill in the following table

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Occurrence of Litter table

Tick all that apply

	None	Present	Moderate	Abundant
Litter in the water		X		
Litter in the vicinity			X	

1. What infrastructure is currently in place?(e.g. buildings, piers, pontoons)
2. Is pollution possible from chemicals in concrete or wood?
3. Is there new infrastructure being planned?

Major infrastructures include:

-Bled Promenade: A paved path that encircles the lake and is heavily used by walkers, joggers, and cyclists.

-Tourist Infrastructure: Includes piers, boat rental stations, food kiosks, and lakeside cafés concentrated on the eastern and northern shores.

-Rowing and Water Sports Facilities: The western shoreline houses Slovenia'snational rowing centre, hosting international competitions and training sessions.

-Swimming Areas: Official swimming zones with safety measures exist but are sometimes overwhelmed by crowds.

-Hotels & Private AccessPoints: Many hotels have semi-private docks and accessto the water.

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Discharge of greywater or pollutants is strictly prohibited. Municipal regulations mandate that any lakeside activity must prevent runoff and sediment disturbance. However, enforcement during peak periods remains inconsistent.

The Municipality of Bled, in cooperation with the Slovenian Rowing Federation, is planning several infrastructure upgrades under the Next-Generation EU and Green Transition initiatives, including:

-Improved Wastewater Management: Including upgrades to facilities near Zaka Bay and additional buffer systems around key inflow streams.

-Smart Monitoring Stations: For crowd detection, ecological parameters, and water quality.

-Additional Bike Lanes & Green Corridors: To distribute foot traffic away from the most ecologically vulnerable areas.

2.2.8 Consider the carbon Footprint of tourists/locals-where are people coming from? Reference any available data.

Tourism-related transport is the primary contributor to the lake's carbon footprint. Based on 2023 estimates:

- Annual Visitors: ~600,000 overnight stays; day-trippers exceed 1 million.
- Main Transport Mode: Private vehicle or tourist buses. Fewer than 10% arrive via rail.
- Estimated Annual Transport CO_2 Emissions: Approx. 65,000–70,000 tonnes CO_2 eq., factoring in accommodation and local travel.

Efforts are underway to encourage sustainable tourism, including:

- Electric shuttle buses from Ljubljana and nearby towns.
- Park & Ride systems to limit downtown congestion.
- Discounted eco-tourism packages in cooperation with local hotels.

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2.4 Socio-economic considerations

2.4.1 What role do water sports play in attracting tourists to the area?

List relevant companies/organisations etc.

Water sports are a key draw for Lake Bled's tourism economy. The lake is renowned internationally for its rowing regattas, triathlons, and open-water swimming events. The Slovenian Rowing Federation, based in Zaka Bay, regularly hosts:

-National and international rowing competitions,

-Triathlon events,

-Recreational activities: kayaking, paddleboarding, diving and swimming

-Water sports tourism supports local businesses such as boat rental agencies, training camps, hotels, and restaurants, and it significantly contributes to off-season tourism (April–October).

2.2.9 Cultural aspect of the lake

What is the significance for local people and community?

Yes, the economic contribution of Lake Bled to the region is substantial. According to municipal data:

- Tourism accounts for over 60% of local revenue during peak months.
- In 2024, the Municipality of Bled recorded more than 600,000 overnight stays — the lake being the central attraction.
- Water-based recreation drives demand for: o Accommodation (hotels, guesthouses, and apartments) o Catering and hospitality services o Event management, sports logistics, and guided tours. Outdoor retail (clothing, gear, rentals)

The town's economy is tightly interwoven with lake-based recreation, with many residents employed directly or indirectly in tourism and water sport services.

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2.2.10 Historical aspects

Are there any archaeological sites in the vicinity or in the water body itself?

Lake Bled is a site of significant national and cultural importance:

- Bled Island (Blejski otok) is home to a historic church, dating back to the 15th century, and is accessible only by "pletna" boats — traditional wooden vessels rowed by local oarsmen. This is a protected cultural tradition.
- The Bled Rowing Regatta dates back to 1905 and remains a prestigious event.
- The Church Bell of Wishes and the "Legend of the Sunken Bell" are folklore elements tied to the lake's heritage.
- Local water uses customs — including blessings, pilgrimages, and wedding boat rides — are rooted in centuries-old practices and continue today as touristic rituals.

The cultural heritage linked to water use is officially protected under Slovenia's Register of Cultural Heritage and integrated into tourism promotion strategies.

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3. Exposure Assessment

3.1 Consider seasonal variations

Impact on flora and fauna on busy and quiet times - summer vs. autumn. What is the impact on foraging, breeding, migration seasonally?(word count 200 min.)

Lake Bled experiences distinct seasonal variations in both human activity and environmental sensitivity. These fluctuations significantly influence the degree of ecological exposure the lake faces throughout the year. The most intense period of human activity occurs during the summer months, particularly from June to August. This is the height of the tourist season, when the lake becomes a major destination for both international and domestic visitors. During this time, activities such as swimming, paddleboarding, kayaking, and recreational boating are at their peak. The number of swimmers can reach into the thousands on a daily basis, especially in designated beach areas on the eastern and northern shores. Paddleboard and kayak rentals also see substantial use, with individuals frequently entering shallow coves and reed beds. Moreover, summer is when Lake Bled hosts its most prominent sporting events, including national and international rowing regattas and triathlons, resulting in concentrated traffic in areas like Zaka Bay. The combination of warm water temperatures, elevated nutrient input from human activity, and limited water circulation in sheltered areas increases the risk of algal blooms and places stress on aquatic vegetation and wildlife.

In contrast, the spring and autumn months offer a moderate level of activity and somewhat reduced environmental pressure. From April to May and again from September through October, the lake remains popular with sports teams, school groups, and offseason tourists. Rowing training sessions are common during these periods, along with moderate levels of paddleboarding and walking. The ecological impact during these transitional seasons is lower compared to summer but still notable, particularly due to trail use, fishing, and episodic rainfall events that may increase sediment and nutrient inflows. Importantly, many bird species use these months for nesting or migration, increasing the sensitivity of certain zones, particularly reed beds and quieter coves.

During the winter season, spanning from November to March, human activity on and around the lake declines substantially. The colder temperatures and occasional surface freezing limit water-based recreation. While rowing and swimming cease almost entirely, some tourism remains present due to the scenic views, the Christmas market, and hiking opportunities. Lakeside foot traffic persists year-round, though at a significantly lower volume. From an ecological standpoint, winter offers the most relief

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for the lake's biotic communities, providing a crucial recovery period following the intense use during the warmer months. However, persistent tourism infrastructure and year-round accommodation options ensure that a baseline of human activity is always present.

3.2 Consider human activities

Specific activities and the potential to cause harm, water pollution, disturbance of vegetation, erosion (word count 200 min.)

A wide range of human activities takes place on and around Lake Bled throughout the year, contributing both to the local economy and to ecological pressures on the lake's environment. The most prominent and defining activity is rowing, which is deeply ingrained in the lake's identity. Lake Bled is home to the Slovenian Rowing Federation and regularly hosts international regattas, training camps, and recreational sessions. These events draw athletes and support teams from across Europe, concentrating activity in Zaka Bay and the lake's central corridor. While the infrastructure is well-managed, the intensity of movement during these events—combined with support boats and onshore spectators—can increase turbidity, disturb bottom sediments, and generate noise that affects aquatic and shoreline species.

Recreational swimming is another major use, particularly from June to September, when water temperatures rise to comfortable levels. Public beaches, especially along the northeastern and eastern shores, attract both tourists and locals. Swimmers often congregate in large numbers, sometimes exceeding the carrying capacity of these zones. Sunscreen runoff, litter, and physical disturbance of shallow water vegetation can lead to localized ecological stress, particularly in areas with limited water exchange. While designated swimming areas exist, enforcement of their use is inconsistent, and many visitors enter the lake from informal points along the shoreline.

Paddleboarding and kayaking have grown increasingly popular in recent years, with numerous rental stations operating during the warm months. These activities are generally low impact, but if conducted without guidance, users may unknowingly enter reedbeds or nesting areas, especially in quieter southern or western coves.

Sightseeing via "pletna" boats—traditional wooden vessels rowed manually by trained operators— remains one of the most iconic and sustainable forms of activity on the

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lake. These boats follow well-established routes to and from Bled Island and have minimal ecological impact, though their frequency increases markedly in peak season. On land, the walking trail encircling the lake is used daily by visitors and residents alike. While the path is paved in most sections, some areas still allow for informal access to the shore, leading to trampling of vegetation and potential erosion. Finally, fishing—though relatively controlled—is practiced year-round. While it offers recreational and cultural value, the use of non-native bait species and the potential spread of invasive species via fishing gear remain concerns. In combination, these human activities create a dynamic but sensitive balance that requires active management to maintain the lake's ecological integrity.

3.3 Intensity of water sports

Frequency and volume (word count 200 min.)

The intensity of water sports activity at Lake Bled is among the highest in Slovenia, particularly during the extended spring-to-autumn season when conditions are ideal for both training and competition. The lake serves as a national and international hub for rowing, hosting events sanctioned by World Rowing and other major sporting bodies. These regattas draw hundreds of athletes, support staff, and spectators, resulting in days of high-density use on the water. Even outside of competition periods, the lake is used daily by rowing teams for training, especially in Zaka Bay and along a designated corridor that runs the length of the lake. These sessions typically occur in the early morning and late afternoon and involve multiple shells and support boats operating in close proximity. Swimming reaches peak intensity during the summer months, particularly in July and August, when daytime temperatures regularly exceed 25°C. The eastern and northern shores host the most popular swimming areas, including public beaches and hotel adjacent docks. On warm weekends, thousands of people may enter the lake in a single day. Although swimming is permitted only in designated areas, many individuals access the lake from informal locations, increasing the likelihood of ecological disruption. The use of sunscreens and other body products adds to the pollutant load during this period, while wave action from swimmers contributes to sediment disturbance along the shore. Paddleboarding and kayaking represent more individualized forms of recreation but are nonetheless widespread. Numerous local vendors offer rentals, with usage rising sharply between May and September. While these watercrafts are non-motorized and generally pose lower risks, users often navigate into environmentally sensitive areas, including reedbeds and coves used by nesting birds

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and amphibians. Without clearly marked exclusion zones or regular ecological guidance, the risk of habitat disturbance remains present.

"Pletna" boat operations are less ecologically disruptive due to their traditional design and manual propulsion. Nevertheless, their sheer volume—often with dozens of crossings per day during the tourist season—does place a burden on certain parts of the lake, particularly around Bled Island. Motorized boats are rare, as strict regulations limit their use, but exceptions are made for safety and support craft during official events. Overall, the high frequency and diversity of water-based activities mean that Lake Bled faces sustained and cumulative exposure to physical, chemical, and biological impacts from April through October, requiring well-defined zoning, regulation, and monitoring protocols.

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3.4 Table for Vulnerability Assessment

Consider vulnerability of lake due to specific activity during specific times of the year.

Risk 1-5

1-low risk

5 -high risk

Activity	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Angling	1	1	2	3	3	4	5	5	3	2	1	1
Water sports	1	1	2	3	4	5	5	5	4	3	1	1
Shore-based activity walks hikes	2	2	2	3	4	5	5	5	4	3	2	2

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4. Sensitivity Assessment

4.1 Ecosystem sensitivity

Overall, based on the information you have provided so far, describe how the overall ecosystem system is affected by the conduct and standards of water sports, and tourism created by these activities. (word count 200 min.)

The ecosystem of Lake Bled is significantly shaped—and increasingly strained—by the standards and practices of both water sports and the tourism infrastructure that supports them. While water-based activities are central to the lake's identity and economy, the way these activities are conducted plays a decisive role in determining their long-term ecological footprint. Unlike wilderness environments with limited access, Lake Bled is a fully integrated recreational landscape, with high daily turnover in summer months and year-round foot traffic from both tourists and sport participants. This concentrated, tourism-driven use places continuous pressure on its natural systems.

Water sports at Lake Bled, particularly rowing, swimming, and paddleboarding, are often presented as low-impact forms of recreation. However, their cumulative effect—when driven by a high-volume, competition-oriented, and commercially facilitated tourism model—can lead to widespread disruption. The proliferation of rental services, event staging, lakeside hospitality venues, and unsupervised entry points amplifies the ecological burden. Even non-motorized activities can degrade aquatic vegetation, disturb breeding waterfowl, and stir up sediments that release trapped nutrients into the water column. These effects are compounded when equipment is used carelessly or when ecological guidance and enforcement are lacking.

The tourism industry surrounding water sports also affects the lake's ecosystem indirectly. Lakeside accommodations, paved footpaths, viewing platforms, and public infrastructure fragment riparian habitats and encourage high footfall in sensitive areas. While some development has been implemented with sustainability in mind, informal access points continue to emerge due to demand. In many areas, native shoreline vegetation has been trampled or replaced with manicured grass, weakening the natural filtration buffer that would otherwise mitigate runoff and pollution. Seasonal spikes in tourism also increase waste production, vehicle traffic, and nutrient inflows—especially during and after large sporting events.

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Moreover, the standards by which tourism and sports activities are managed vary significantly. While some events implement environmental monitoring and exclusion zones, others do not. Without a unified, enforceable code of conduct for all stakeholders—including athletes, visitors, operators, and event planners—the ecosystem remains vulnerable to piecemeal degradation. Long-term sustainability will depend on implementing high environmental standards not just for sport-specific behaviour on the water, but also for the broader network of tourism infrastructure and practices that make these activities possible.

4.2 Species sensitivity

Describe how various flora and fauna are affected.

The rich biodiversity of Lake Bled includes a range of sensitive species that are increasingly impacted by the conduct and scale of water sports and the tourism industry built around them. While many of these species are adapted to coexist with low levels of disturbance, the intensity, frequency, and often unregulated nature of human activities place growing stress on both animal and plant populations.

Bird species such as the great crested grebe (*Podiceps cristatus*), mute swan (*Cygnus olor*), and Eurasian coot (*Fulica atra*) rely heavily on the lake's reed beds and near-shore vegetation for nesting. These areas, however, are the very zones often accessed by paddleboarders, kayakers, swimmers, and photographers. When water sports are conducted without strict spatial boundaries or minimum approach distances, nesting attempts are frequently disturbed, leading to lower reproductive success and potential site abandonment. Similarly, repeated exposure to noise and movement disrupts natural feeding and mating behaviours.

Amphibians, such as the common toad (*Bufo bufo*) and smooth newt (*Lissotriton vulgaris*), are also vulnerable to shoreline disturbance. These species require quiet, vegetation-rich shallows to lay eggs and for their larvae to develop. Informal swimming access, launching of watercraft, and sediment disturbance from waves can physically damage egg masses or alter the water chemistry in ways that are harmful to developing amphibians. In tourist heavy months, sunscreen, oils, and litter can further degrade water quality, posing additional risks to these species, whose permeable skin makes them acutely sensitive to pollutants.

Native fish populations, including lake trout (*Salmo trutta lacustris*), perch, and roach, rely on submerged vegetation and undisturbed sediment layers for spawning. The wake and turbulence generated by rowing shells and paddleboards, particularly during competitive events or mass recreational use, can disrupt spawning beds and reduce

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oxygenation. The situation is further complicated by the presence of invasive species like signal crayfish, whose spread is often accelerated by uncleaned equipment moving between water bodies.
Aquatic and riparian plants such as common reed (*Phragmites australis*), yellow iris (*Iris pseudacorus*), and white-water lily (*Nymphaea alba*) form the structural foundation of the lake's ecological zones. These species are particularly sensitive to trampling, erosion, and pollution—factors that are amplified by unmanaged tourism infrastructure, informal accesspaths, and insufficient enforcement of environmental guidelines.
In summary, both flora and fauna at Lake Bled are directly and indirectly affected by how water sports and related tourism are conducted. Without high environmental standards, clear zoning, and consistent enforcement, even low-impact recreational activities can lead to significant ecological degradation over time.

4.3 Habitat sensitivity

Describe how the aquatic and riparian habitats are affected.

Lake Bled contains several highly sensitive habitat types that support a diverse range of species and ecological functions. These include shallow littoral zones, reed beds, submerged macrophyte meadows, spring-fed inflow areas, and riparian vegetation along the shoreline. The pressure exerted on these habitats stems not only from natural seasonal dynamics but increasingly from tourism and recreational activities, especially those associated with water sports.

The littoral zone is one of the most ecologically valuable and simultaneously most threatened areas in the lake. It serves as a breeding ground for fish and amphibians, a foraging site for birds, and a structural habitat for aquatic invertebrates and plants. However, this shallow water region is also where swimmers, paddleboarders, and kayakers tend to enter the lake, particularly during summer when accesspoints are crowded or poorly managed. Repeated physical intrusion into this zone disturbs sediment, uproots vegetation, and can degrade water quality by resuspending nutrients that promote algal growth. Theseimpacts are often unintentional but are amplified by the absence of consistent ecological zoning and enforcement.

The reed beds along the western and southern shores are another critical habitat, functioning as nesting areas for birds and refuges for juvenile fish. Thesehabitats are extremely sensitive to physical damage. Human access,whether intentional or

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accidental, compresses the root systems, prevents new growth, and can create gaps that expose nests to predators. Although signs and educational material are occasionally present, the lack of physical barriers means that even well-meaning visitors may unknowingly cause long-term harm.

The lake's spring-fed inlets, particularly those near Mlino and the smaller tributaries, are delicate microhabitats that support cold-water aquatic life and maintain water quality by contributing high-oxygen, low-nutrient inflows. These inlets are especially vulnerable to runoff from paved paths, littering, and the cumulative effect of nearby tourism infrastructure such as benches, trails, and viewing points. Erosion and sedimentation in these zones can easily tip the balance of the ecosystem, leading to habitat loss for specialized aquatic species.
Even the open water zone, though less structurally complex, is sensitive to sustained use. Rowing regattas and daily recreational boating cause wake disturbances and can affect water clarity, particularly when support vessels pass repeatedly over the same areas. Over time, these effects contribute to declining habitat quality, even in deeper sections of the lake.

4.4 Species Sensitivity Table

Fill in and tick all that apply

	Species	High impact	Medium impact	Low impact
Water skiing – not present				
Fishing	**Lake trout, signal crayfish (invasive), aquatic invertebrates**	**X**		

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Swimming	**Common toad, smooth newt, aquatic invertebrates, macrophytes in shallow zones**		**X**	
Windsurfing – not present				
Boating - engine	**Lake trout, perch, Eurasian coot, great crested grebe, mute swan, aquatic vegetation including Nymphaea alba and Potamogeton spp.**	**X**		
Boating - rowing	**Lake trout, perch, Eurasian coot, great crested grebe, mute swan, aquatic vegetation including Nymphaea alba and Potamogeton spp.**		**X**	

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Paddleboarding	**Great crested grebe, mute swan, reedbeds (Phragmites australis), shoreline amphibians and birds**	**X**		
Canoeing	**Lake trout, perch, Eurasian coot, great crested grebe, mute swan, aquatic vegetation including Nymphaea alba and Potamogeton spp.**		**X**	
Cycling	**Terrestrial plants like Iris pseudacorus, Salix alba, Viburnum opulus, and fauna such as European hedgehog and small mammals**		**X**	
Trail Running	**Terrestrial plants like Iris pseudacorus, Salix alba, Viburnum opulus, and**		**X**	

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	fauna such as European hedgehog and small mammals			
Road Running	**Reedbed-nesting birds, shoreline vegetation, amphibian spawning sites**		**X**	
Walking	**Reedbed-nesting birds, shoreline vegetation, amphibian spawning sites**		**x**	

4.5 Habitat Sensitivity Table

Fill in and tick all that apply

	Habitat	High impact	Medium impact	Low impact
Water skiing – not present				
Fishing	**Shallow vegetated zones**	**X**		
Swimming	**Shoreline, reedbeds**			

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Windsurfing – not present				
Boating - engine	**Littoral zone, open water**	X		
Boating - rowing	**Open water, transit lanes**		X	
Paddleboarding	**Reedbeds, shallow habitat**	X		
Canoeing	**Reedbeds, littoral zone**	X		
Cycling	**Riparian buffer zones**		X	
Trail Running	**Forested margins**		X	
Road Running	**Urban-adjacent paths**			X
Walking	**Shoreline vegetation**	X		

4.6 Proposed Future Developments

Any proposed new developments need to be assessedcarefully for the effects on the local habitats. Ensure all local guidelines are followed and, where necessary, national and European.

4.6.1 Are there any proposed future developments which may impact the vulnerability of the local habitat/species that you are aware of?

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Yes, several proposed and ongoing developments may influence the ecological vulnerability of Lake Bled's habitats and species. These include both infrastructure projects and tourism management initiatives.

- Expansion of soft mobility infrastructure: The Municipality of Bled is actively expanding pedestrian and cycling paths around the lake to reduce car traffic. While this improves sustainability and reduces air pollution, it also increases access to sensitive shoreline areas. Without proper barriers and routing, these new paths could contribute to trampling of riparian vegetation and disturbance of nesting sites.

- Tourism zoning and visitor quota system: A proposed system of regulating daily tourist numbers and introducing lake use zones aims to reduce overcrowding during peak months. If implemented thoroughly, this system would mitigate ecological stress but may initially lead to concentrated use of "open" zones, requiring careful habitat mapping and zoning.

- Eco-certification for commercial operators: Bled is considering stricter licensing requirements for "pletna" boat operators, water sports rentals, and hospitality businesses around the lake. These would include environmental standards on equipment cleaning, fuel handling, and waste disposal. This development is positive, though compliance and enforcement mechanisms need to be robust.

- Upgrades to regatta facilities and grandstands: Planned renovations to sporting infrastructure on the western shore could increase visitor capacity and frequency of international events. These upgrades pose moderate risk during construction and may raise long-term human activity levels in nearby natural zones, particularly near reedbeds and amphibian breeding habitats.

- Renewable energy shoreline lighting pilot: A project involving low-impact LED lighting is under consideration to replace conventional lighting along walking paths. While it may improve energy efficiency, light pollution remains a concern for nocturnal species such as the European otter and bats. Shielding and motion-activated designs should be prioritized.

- Habitat restoration pilot zones: Several small-scale ecological restoration efforts are being discussed, including replanting native vegetation, installing reedbed protection fencing, and restoring natural shoreline gradients. These offer strong positive potential, though they must be scaled and maintained long term to be effective.

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In summary, while many of the proposed developments aim to support sustainable tourism and protect Lake Bled's natural value, careful planning and ecological oversight will be essential to prevent unintended harm.

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4.6.2 Screening Table for Proposed Developments

Fill in all that apply

Screening Questions	Assessment	Risk- high, medium or low
The size and design of the whole project	**Most projects are small to medium in scale. Larger ones include regatta infrastructure upgrades and trail expansion.**	**Medium – localized impact, scalable**
Cumulation with other existing and/or approved projects.	**Cumulative effects expected from combined increase in tourism access, trail use, and sporting activity.**	**Medium – gradual ecological pressure**
The use of natural resources, in particular land, soil, water & biodiversity	**Projects such as shoreline trails may disturb soils, vegetation, or shoreline stability.**	**Medium – avoidable with mitigation**
Pollution	**Some risk of fuel spills and dust from construction phases (infrastructure, lighting projects).**	**Low to Medium – depending on implementation**

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Potential of works to impact directly or indirectly on sites designated for nature conservation (NHA/SAC/SPA)	**Lake Bled is not within a Natura 2000 site but is ecologically significant and near protected habitats. Follow local and national guidelines.**	**Low – if guidelines are followed**
The production of waste.	**Trail and infrastructure projects will produce waste; mitigation plans (reuse/recycling) expected to be part of local compliance.**	**Low**
What is the expected onset, duration, frequency and reversibility of the building?	**Projects vary; most are short- to medium-term (1– 2 years). Ecological impact depends on timing (e.g. breeding season).**	**Medium – especially if works coincide seasonally**
Will it be difficult to avoid, reduce, repair or compensate for the effects of the development?	**With appropriate zoning and seasonal planning, most impacts are manageable. Adaptive capacity of the lake is moderate but not unlimited.**	**Medium**

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5. Summarisation & Utilisation of Findings:

5.1 Adaptive Capacity of the Blue Space

Adaptive capacity of a lake refers to its ability to adjust to changes, disturbances, or stressors while maintaining its essential functions, processes, and resilience. This concept is crucial for understanding how a lake can cope with environmental variations, including climate change, pollution, invasive species, and human activities.

Consider the following key factors, two sentence answers:

5.1.1 Biodiversity

Is there a diverse range of species which can enhance the resilience of a lake by providing various functions and interactions that support ecosystem stability?

Lake Bled supports a range of aquatic plants, amphibians, fish, and waterbird species that contribute to ecological resilience. However, increasing recreational pressure and habitat disturbance threaten this diversity, reducing the ecosystem'sability to buffer stress.

5.1.2 Water Quality

Maintaining good water quality helps support a healthy ecosystem. Lakeswith high water quality are better able to support diverse aquatic life, resist invasions by harmful species,and recover from pollution events. Is there a local database for the lake water quality (EPA)?Are further studies needed?

Lake Bled's water quality is regularly monitored by the Slovenian Environment Agency and generally meets bathing and ecological standards. However, further studies on sediment disturbance, sunscreen contamination, and nutrient load from tourism may be needed to ensure long-term stability.

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5.1.3 *Connectivity*

Is the lake connected to other water bodies, wetlands, where exchange of species and genetic material can take place? Will this enhance biodiversity and resilience?

Connectivity around Lake Bled is moderately limited due to urban infrastructure, tourism pathways, and steep banks that restrict species movement between aquatic and riparian zones. There are no specific corridors or structures like fish passages in place, and habitat fragmentation is a growing concern.

5.1.4 *Climate Resilience*

What is the ability of the lake to buffer against climate change, such as changes in temperature, precipitation, (and ice cover)?

Lake Bled shows limited climate resilience, with increasing summer temperatures contributing to algal blooms and reduced oxygen levels in deeper zones. Changes in precipitation and more intense tourist seasons further stress the system during vulnerable periods.

5.1.5 *Management Practices*

Are sustainable management and conservation practices in place? What are the local, national and European rules and regs? Are they being followed?

The Municipality of Bled has introduced several practices including boating regulations, designated access zones, and reedbed protection efforts. Enforcement remains a challenge, but local authorities are actively working to improve compliance through updated policies and increased monitoring.

5.1.6 *Community Engagement*

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Are there local community groups involved in lake management? Have the groups got the knowledge to support monitoring efforts, and implement adaptive practices tailored to local conditions?

Community engagement exists through cleanup initiatives, nature education programs, and some participation in local planning discussions. While involvement is growing, it is still largely event-based and not yet a structured part of lake management.

5.2 Impacts

5.2.1 Short term impacts

What are the immediate issues identified on water quality, disturbance, litter, pollution etc, that may be caused by water sports?

The most immediate issues caused by water sports on Lake Bled involve localized water quality degradation, physical disturbance of habitats, and minor but recurring pollution events. Activities such as paddleboarding, kayaking, and swimming often take place in shallow zones, where sediment is easily stirred, leading to temporary turbidity and nutrient release that can promote algal growth. Swimmers contribute to chemical input through sunscreen and body care products, while unregulated equipment washing introduces oils and residues into the lake. During peak times, increased activity results in litter along informal accesspaths and floating waste near popular entry points— particularly plastic packaging, drink containers, and cigarette butts.

Wildlife disturbance is another immediate concern. Waterbirds such as swans, grebes, and coots are frequently displaced from resting or nesting sites due to the proximity of paddlers or swimmers entering reed zones, sometimes unknowingly. Amphibians and invertebrates, particularly in shoreline vegetation, are also impacted by trampling and noise. Though these issues are not catastrophic on their own, they occur frequently and compound ecological stress during the busy summer season. Without adequate zoning, enforcement, and public education, these short-term impacts risk becoming entrenched and reducing both ecosystem health and the long-term quality of recreational experiences on the lake.

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5.2.2 Long term impacts

What are the cumulative identified issues on water quality, erosion, habitat damage, invasives etc?

Cumulatively, Lake Bled is experiencing a pattern of ecological stress that includes declining water quality, shoreline erosion, habitat fragmentation, and the spread of invasive species. Repeated physical disturbances from swimming, paddleboarding, and informal accesshave led to the compaction of shoreline soils and damage to reedbeds, which serve as key buffer zones and nesting habitats. The loss of these natural barriers has made the shoreline more vulnerable to erosion, especiallyduring high-use periods and storm events.

Nutrient input from surface runoff, combined with sediment resuspension caused by recreational activity, contributes to eutrophication risks. While algal blooms are not yet severe, they are becoming more frequent and could escalate under warmer, drier summers. The introduction and spread of non-native species like the signal crayfish further compound ecological imbalance, outcompeting native invertebrates and destabilizing aquatic food webs. These changes are not isolated but interconnected—habitat degradation makes it easier for invasives to spread, while erosion and vegetation loss intensify water quality issues.

If left unmanaged, these cumulative impacts threaten to fundamentally alter the lake's ecological character. They reduce biodiversity, strain ecosystem services, and jeopardize the long-term viability of Lake Bled as both a natural resource and a recreational destination.

5.3 Mitigation

1. **Biodiversityprotection** - Are protected zones, noise regulation, light pollution, water quality (bunded areas) in place?
2. **Erosion control** - stabilising shoreline (sometimes this can cause more issues), Are vulnerable shorelines being protected? Is there restricted accessto vulnerable areas?

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3. **Pollution control** – are fuelling best practices guidelines to be followed, adequate facilities for waste disposal, nature-friendly sunscreens (LNT principles), Signage?
4. Is there an **Invasive Species Management Plan**? Is there adequate policing to ensure that its actions are supported appropriately? E.g. washing of clothing.

1.	Lake Bled currently has limited formal biodiversity protection zones, though efforts have been made to reduce human-wildlife conflict through signage and minor physical barriers in reedbed areas. Noise and light pollution remain under-regulated, but proposals for LED shielding and designated quiet zones have been introduced to improve conditions during nesting and migration periods. Continued enforcement and expansion of buffer zones would greatly improve biodiversity resilience around the lake.
2.	Some areas of Lake Bled's shoreline have been stabilized using natural vegetation reinforcement and controlled trail routing. However, large portions of the shoreline remain exposed to trampling and wave action, especially during peak tourist months. Access to ecologically sensitive zones such as shallow bays and reedbeds is not consistently restricted, posing a risk to shoreline integrity over time.
3.	Best practices for fuelling and engine use are partially followed, especially by licensed operators, but guidelines are not always clearly communicated to visitors using private equipment. Waste disposal facilities are present but sometimes overwhelmed, and signage promoting nature-friendly behaviour such as LNT (Leave No Trace) and reef-safe sunscreen use is limited. Improved signage and clearer operator obligations are needed for more effective pollution control.
4	There is no unified invasive species management plan specifically for Lake Bled, though national regulations cover some prevention practices. Public education about equipment cleaning and species transport is minimal, and enforcement of precautionary biosecurity (e.g., mandatory washing stations) is currently lacking. A formalized plan supported by active on-site policing would significantly reduce the risk of further introductions.

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5.4 Non-Technical Summary

Lake Bled, one of Slovenia'smost iconic and visited freshwater bodies, is subject to multiple environmental pressures arising from intense recreational use, seasonal tourism, and its sensitive alpine setting. This assessment identified key vulnerabilities across ecological, physical, and social dimensions that threaten the long-term sustainability of this blue space.

The lake's rich biodiversity, including protected species such as the Eurasian otter and nesting waterfowl, is vulnerable to disturbances from water sports, shoreline development, and invasive species. Activities like swimming, rowing, and boating—though largely non-motorised—still contribute to localized erosion, habitat fragmentation, and pollution when unmanaged.

The assessment revealed a moderate to high ecological sensitivity in several areas, particularly reed beds, spawning grounds, and riparian zones. Invasive aquatic and riparian species (e.g.,Canadian waterweed and signal crayfish) further stress native habitats and increase the risk of biodiversity loss.

While Lake Bled maintains a mesotrophic status due to past remediation efforts, phosphorus runoff, stormwater input, and visitor-driven waste continue to challenge water quality—especiallyduring peak summer months. Faecalcontamination from surrounding recreational zones remains a concern during heavy rainfall events. Socio-economic pressures are also significant. The area depends heavily on tourism for income, employment, and regional development. However, this same dependence amplifies risks to ecological integrity, necessitating a careful balance between economic benefit and environmental protection.

The findings highlight the need for strengthened biosecurity protocols, zoning regulations to limit shoreline pressure, educational outreach to promote responsible recreation, and habitat protection measures tailored to sensitive species and locations.

Ultimately, Lake Bled's vulnerability stems from the complex interplay between its ecological value and its human popularity. Effective management must involve all stakeholders—local authorities, tourism operators, conservation bodies, and the public— in order to safeguard the lake for both current and future generations.

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5.4.2 Provide the key actions in layman's terms, take care to highlight the most critical measures to be implemented. (200 words min).

Lake Bled is one of Slovenia's most treasured natural areas, but its beauty and biodiversity face growing pressure from tourism, recreation, and environmental change. To keep the lake healthy and enjoyable for future generations, we need to take specific, practical steps that anyone can understand and support.

First and foremost, we must reduce the pressure from visitors. This doesn't mean stopping people from enjoying the lake—it means managing where and how people access it. Creating designated entry points for swimming and boating helps prevent erosion and protects fragile shoreline plants. Encouraging visitors to stay on marked paths and use proper facilities can greatly reduce damage to natural habitats.

Education is another key pillar of action. Many people don't realize that their everyday activities—like leaving trash, using sunscreen in the water, or feeding ducks—can harm the lake. By putting up clear signs and launching awareness campaigns, we can show visitors how to enjoy the lake responsibly. One example is the "clean-in, clean-out" rule for boats and paddleboards, which helps stop the spread of invasive species.

Protecting nature-rich zones is also critical. Certain parts of the lake, such as reed beds and nesting areas for birds, should have restricted access, especially during the breeding season. These habitats are vital for animals to survive and reproduce. Marking and fencing off these areas, or creating seasonal buffer zones, will allow wildlife to thrive without disturbance.

Water quality monitoring must continue year-round. Rain can wash pollutants from roads and farms into the lake. Using plant buffers around the lake edge and maintaining proper waste systems are simple but effective ways to keep the water clean. Local businesses and hotels should be part of this effort too.

By working together—residents, tourists, local authorities, and nature lovers—we can keep Lake Bled safe, clean, and beautiful.

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Section 2

Regenera Water Sports Pilot Site SWOT Analysis – Lake Bled

Strengths	Weaknesses
High aesthetic and cultural value; internationally recognized as a natural landmark. Existing regulatory protection within the wider Natura 2000 framework and Triglav National Park proximity. Regular water quality monitoring by Slovenian Environment Agency (ARSO) and active management efforts. Presence of diverse flora and fauna, including protected species like Eurasian otter and mute swan. Active stakeholder involvement including sports federations and municipal authorities. Good infrastructure for controlled recreational use (designated swimming and boating areas). Public interest and awareness due to the site's popularity.	Localized habitat degradation due to trampling, erosion, and unregulated shoreline access. Introduction and establishment of invasive species (e.g., Elodea canadensis, signal crayfish). Increased pressure on water quality during peak tourist season, including bacterial spikes after rain. Limited biosecurity enforcement for recreational users (boats, fishing gear, etc.). Fragmentation of habitats due to informal footpaths and tourism infrastructure. Insufficient seasonal restrictions on recreational activities to protect nesting or spawning areas. Need for clearer communication of environmental regulations to tourists.
Opportunities	**Threats**
Expansion of environmentally friendly water sports infrastructure (electric boats, defined access). Development of environmental education programmes targeting tourists and local youth. Strengthening biosecurity protocols and awareness campaigns ('clean in / clean out'). Restoration of riparian zones through native plant reintroduction and erosion control.	Long-term ecological stress from climate change: rising water temperatures, altered rainfall patterns. Erosion of public shoreline, loss of reed beds and spawning habitats due to uncontrolled access. Conflict between mass tourism and ecosystem conservation (e.g., noise, overcrowding). Risk of further invasive species introduction through unmanaged equipment transport.

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Creation of volunteer monitoring and citizen science initiatives for biodiversity. Linking conservation efforts to eco certification for tourism businesses (e.g., Green Key, EU Ecolabel). Collaboration with Triglav National Park and Natura 2000 for integrated landscape level planning.	Reduced breeding success of sensitive bird species from human disturbances. Urban development and increased infrastructure along lake margins may undermine habitat value. Potential rollback of environmental protections under shifting political priorities.

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