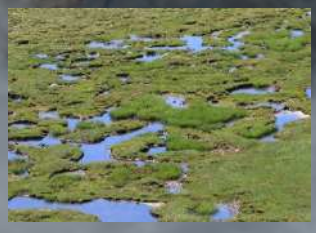
Chandertal

An Integrated Management Plan for Conservation and Wise Use



Wetlands INTERNATIONAL

Project Team

Dhruv Verma, Technical Officer – Wetlands Ecology (Project Manager)
Dr Ridhi Saluja, Technical Officer – Wetlands Ecology (Co-project Manager)
Harsh Ganpathi, Technical Officer - Water Management
Dushyant Mohil, Operations Manager
Dr Santosh Palmate, Technical Officer - Water Management
Kamal Dalakoti, Jr. Technical Officer – Remote Sensing and Geographical Information System
Dr Asghar Nawab, Programme Head – Aquatic Ecology
Suchita Awasthi, Program Coordinator – Integrated Management of Wetland Biodiversity and Ecosystem Services
Namita Sharma, Technical Officer - Communications
Dr Ritesh Kumar, Director (Project Lead)

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Chandertal

An Integrated Management Action Plan for wise use

2020

Cover Letter

Himachal Pradesh State Wetlands Authority

Executive Summary

1. Chandertal is a crescent-moon shaped distal high-altitude wetland of the Chandra-Bhaga glacier system. Perched at 4,300 m amsl elevation in the upper catchment of River Chandra and spanning 46 ha, the wetland is frozen for nearly 4 months, from December to March. Due to limited anthropogenic nutrient influx, the wetland has a near-pristine water quality with only traces of geogenic elements. Apart from providing habitation to diverse animals and plants species including the endangered Snow Leopard, the wetland forms an integral part of the Central Asian Flyway network, hosting several migratory birds such as Ruddy Shelduck, Garganey, and Gadwall. The peatland on the margins of the wetland is an important carbon store with an estimated stock of 17-120 kg/m^3. The wetland catchment and periphery are dotted with burrows of Himalayan Marmots and other faunal species. Although sightings of large mammals such as Snow Leopard, Tibetan Wolf, Blue Sheep and others have become infrequent due to anthropogenic disturbances, the wetland is a well-knit part of their range distribution. The picturesque landscape of Chandertal not only holds cultural relevance for local people but also interests many travel enthusiasts. The wetland is revered by many as a sacred and has been placed in several local legends and folklore. Local people hailing from remote villages of Lahaul and Spiti celebrate festivals such as Bees Bahado at the wetland, marking their socio-cultural linkages with Chandertal.

2. Chandertal forms the core of the Chandratal Wildlife Sanctuary designated in the year 2007 and governed as per the provisions of The Wildlife Protection Act, 1972. In 2005, the wetland was also accorded the status of Wetland of International Importance under the Ramsar Convention. The sanctuary is currently placed within the administration of the Spiti Wildlife Division of Himachal Pradesh Forest Department. The eco-sensitive zone comprising the wetland catchment, downstream stretches and other habitats fall under the jurisdiction of Lahaul Division administration.

3. Following trends can be discerned on the basis of an evaluation of ecological, hydrological, socioeconomic and institutional features of the wetland:

4. **Increasing warming of the basin and gradual predominance of precipitation in the form of rainfall:** Long term climate trends between 1991 and 2015 for the North Himalayan region show an overall warming signature with a significant increase in maximum and mean temperatures. A gradual predominance of summer monsoon over mid westerlies is also reported. Multi-model climate projections for Chandra basin (RCP 8.5 scenario) indicated that the basin would continue to become warmer with a decreasing trend of snowfall by the end of the century. In response to the projected changes, the basin is likely to retain only 40% - 45% of the areal extent of glaciers and corresponding volumes of glacier water retained are much lower at 29% - 34%, but the volume loss could be as high as 97% for low altitude glaciers.

5. **Shifting land cover patterns**: Between 2000 and 2018, the area under vegetation, especially alpine meadows has risen thus making the landscape conducive for increased vegetation in and around the wetland. The area under snow has declined from 5% of the total geographical area of the catchment in 2000 to 3% in the year 2018. A gradual greening of the catchment is also corroborated by the grazing patterns opted by Gaddi herders, who now have moved closer to the wetland.

6. **Intensified tourism:** Since 2000, the number of tourists visiting Chandertal has increased 20 folds, and the camping sites are located very close to the wetland. Irresponsible tourist behaviour is leading to solid-waste management challenges and disturbance to wildlife habitats.

7. **Increasing disturbances to wildlife habitat**: Intensified grazing, rapid spurt in tourism, and infrastructural development are a few major anthropogenic disturbances to regional wildlife and habitat of migratory waterbirds. A decrease in wildlife sighting has been observed in the region which can be attributed to increased competition for dietary resources between wild animals and livestock. Several elusive mammals remain unsighted due to high livestock densities, presence of guard dogs, and lack of wild prey.

Management Framework

8. Being recognised as a Wetland of International importance under the Ramsar Convention, maintenance of ecological character and ensuring wise use of Chandertal needs an integrated approach. The management planning of Chandertal therefore aims for '*maintaining Chandertal ecosystem in a healthy state and ensure sustenance of ecosystem services and biodiversity values'*. The purpose is to:
    - Sustain wetland and associated alpine habitats of migratory birds and keystone species to complement conservation efforts in the Upper Spiti landscape and high altitude stretches of Lahaul
    - Ensure water security in the Chandra sub-basin by sustaining base flows of the wetland
    - Provide income generation opportunities to local communities through wetland-based sustainable tourism
    - Maintain peatland carbon stocks as a contribution to climate change mitigation
    - Reduce disaster risks for settlements in downstream, especially Batal, Chhatru and other settlements of Lahaul Division

9. Overall objectives for management of Chandertal are to:
    - Maintain healthy habitats and viable population of dependent species in Chandertal
    - Ensure and promote wise-use of ecosystem services provided by Chandertal towards human society
    - Develop a participatory and integrated institutional arrangement for conservation and wise use of Chandertal

10. To achieve the goal and purpose, the management strategies have been translated into the following five management components:

Component	Objectives	Desired level to be achieved
Component I - Institutions and Governance	1.1: Maintaining naturalness of the wetland catchment	No human induced alternation with the direct catchment of Chandertal.
	1.2: Maintain compliance with relevant rules and regulations	Zero violations
	1.3: Ensure consideration of HAW values and functions in sectoral plans	All sectoral plans being implemented in Chandertal catchment and having a bearing

		on the wetland take into account wetland functioning.
Component 2- Wetlands Inventory Assessment and Monitoring	2.1: Systematic wetlands inventory, assessment and monitoring system (WIAMS) to inform management decisions and assess the effectiveness	Systematic data on wetland ecological, hydrological, socioeconomic and institutional features is available within 5 years.
Component 3: Communication, Education, Participation and Public Awareness	3.1: Enhance awareness on wetland values to promote stakeholder participation in wetlands management	Stakeholders, especially panchayat members are well-informed of management plan implementation Wetlands mitras play a lead role in the implementation of various management plan components
	3.2: Maintain and enhance the capacities of responsible staff members for integrated wetland management	DWC gains capacity to coordinate management plan implementation involving various line departments, agencies and stakeholders
Component 4. Water Regime and Habitat Management	4.1: Maintain water quality to sustain ecosystem processes and services	No anthropogenic nutrient enrichment
	4.2: Maintain peat carbon stocks in Chandertal catchment and Eco-sensitive zone	Peat bog (~ 7 ha) is maintained in wet condition and drying is prevented
	4.3: Reduce risks of GLOFs in Chandertal ESZ	A GLOF warning system is operational in Chandra-Bhaga sub-basin.
	4.4: Maintain and improve alpine habitats to support diverse wetland-dependent species	Grazing in alpine habitats is within regenerative capacity.
Component 5. Promotion of responsible wetland tourism supporting the local economy	5.1: Preserve cultural values and traditional practices aligned with wise use of Chandertal	Tourism in Chandertal also includes cultural and traditional values and practices.
	5.5: Preserve recreational and touristic value of Chandertal	Tourist behaviour is environmentally conscious. Number of tourists is reduced to within carrying capacity of the wetland.

11. Activities to meet three main objectives and thirteen sub-objectives have been clustered under five components: Institutions and Governance, Wetlands Inventory Assessment and Monitoring, Communication, Education, Participation and Public Awareness, Sediment, Water Regime and Habitat Management, Preservation and Integration of Cultural values in wetlands management and Tourism promotion and livelihood sustenance.

12. Component 1: Institutions and governance
    - Establishment of Lahaul and Spiti District Wetlands Management Committee for the management of Chandertal. The committee is envisaged to maintain an overview of implementation and monitoring of activities of the management plans, review of developmental projects in the region, convergence of existing schemes and actions

plans of line departments with Chandertal management plans, and updation of Ramsar Information Sheet every six years, to list a few.

- Enforcement of extant regulations ensuring that the provisions of Wildlife (Protection) Act, 1972 and Eco-sensitive Zone Notification are not violated.
- Constitution of 'wetland mitra', an informal, voluntary and non-statutory network of concerned citizens to foster and promote community engagement in wetlands conservation and management efforts.
- Capacity development through training workshops organised at various levels, involving specialized agencies on specific topics such as Managing High Altitude Wetlands, Monitoring High Altitude Wetlands, Wildlife monitoring techniques, Nature-based tourism, Conserving and managing peatlands, Mainstreaming ecosystem services and biodiversity values of HAW into sectoral development planning, and Maintaining Ramsar Site Designation Commitments.
- Mid-term and end-term review of management plan implementation to be undertaken to assess the extent to which stipulated objectives have been achieved with a high degree of resource efficiency and in participation with stakeholders.

13. Component 2: Wetland Inventory, Assessment and Monitoring
    - Establishment of the wetland monitoring system with wetland inventory, assessment, and monitoring protocol for various wetland features.
    - Animal diseases surveillance to assess risks to high altitude biodiversity of catching an infection from migratory livestock in the zoonotic or viral diseases such as Foot and Mouth Disease (FMD) and other
    - Development and publishing of ecosystem health card to assess and communicate wetland monitoring information to decision-makers and stakeholders. The health report card will summarize indicators along the major indices (water quality, catchment status, biodiversity status) which represent various ecosystem features of the lake, and are reported against respective thresholds set in line with management goals.
    - Commissioning research studies to address the knowledge gaps in assessing status and trends in wetland character, and using the outcomes to refine management. Specific research studies proposed include climate change risk assessment, characterization of hydrological regimes of Chandertal, a comprehensive inventory of plant and animal species, assessment of essential habitat features required for sustaining wildlife populations, the extent of peatlands and carbon storage, strategies for ensuring that peatlands are maintained in wet conditions, carrying capacity assessments, and community attitudes and perceptions on values of wetlands.

14. Component 3: Communication and outreach
    - Construction of wetland interpretation centre at Keylong providing facilities such as exhibits, viewing Gallery, mini hall for audio-visual facilities, souvenir shop for visitors, and medical facilities for handling emergencies
    - Placing signage indicating Chandertal as a Ramsar Site at all major entry points of the wetland, 7 Panchayat Offices and school premises inside wetlands.
    - The organisation of awareness programmes on the eve of World Wetlands Day (Feb 2), World Environment Day (June 5), International Day for Biological Diversity (May 22), and Bees Bahado as a means of reaching out to the public on the issues of wetland conservation and wise use. Public events on specific issues, as eco-tourism,

biodiversity, climate change and glacial dynamics are also to be organized as a means of engaging with stakeholders.

- Publications such as coffee table book covering various ecological, hydrological, and cultural dimensions of Chandertal, Do's and Don't's for visitors, management plan summary, wildlife and plant diversity of Chandertal.
- Development of a cultural inventory of practices and belief systems related to Chandertal and other HAW systems. This inventory will contribute to the stakeholder engagement strategy and community outreach programmes.

15. Component 4: Water regime and habitat management
    - Construction of a permeable water retention structure (of coir or any other natural material) at the outlet of peat trench to prevent drying out of peat area.
    - Shifting grazing to downstream stretches of the wetland or away from wet meadows and peatland in the catchment of Chandertal. to reduce grazing pressure in the wetland catchment

16. Component 5: Promotion of responsible wetland tourism supporting local economy
    - Training of camp owners and staffers to educate them on the values and ecological sensitivities of HAW.
    - Drafting of tourist dos and don'ts by DWC in consultation with Wetland Mitra and Tourist Camp owners.
    - Putting up a prototype of regulation of the number of vehicles and tourists permitted to drive up to Chandertal based on carrying capacity assessment.
    - Setting up an alternate camping site downstream of Chandertal for restricting the number of camps and ensuring adequate waste management infrastructure.
    - Feasibility study for a homestay programme to be taken up in close consultation with Wetland Mitra. Based on the recommendations of the feasibility assessment, pilot programmes will be taken up and performance assessed periodically.

17. Management plan implementation will entail a budget of Rs. 32.63 crores. Of this, the component of Communication and Outreach is allocated 66%, followed by the component of Wetland Inventory, Assessment and Monitoring with an allocation of 19%. The components on Institutions and Governance and Responsible Wetland Tourism have been allocated 7% and 6% of the budget respectively. The component on Water Regime and Habitat Management is allocated 1% of the budget as the cost of monitoring and research are already factored under component 2 of the budget.

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List of Abbreviations

amsl	Above Mean Sea Level
BSI	Botanical Survey of India
CAF	Central Asian Flyway
DEST	Department of Environment, Science and Technology
DWC	District Wetland Committee
ESZ	Eco-sensitive Zone
FMD	Foot and Mouth Disease
GEF	Global Environment Facility
GoHP	Government of Himachal Pradesh
GoI	Government of India
HAW	High-Altitude Wetlands
HIMCOSTE	Himachal Pradesh Council for Science, Technology & Environment
HPFD	Himachal Pradesh Forest Department
HPSWA	Himachal Pradesh State Wetland Authority
HPTD	Himachal Pradesh Tourism Department
IUCN	International Union for Conservation of Nature
LULC	Land Use and Land Cover
MCM	Million Cubic Metre
MEE	Management Effectiveness Assessments
MoEFCC	Ministry of Environment, Forest and Climate Change
NCF	Nature Conservation foundation
NPCA	National Plan for Conservation of Aquatic Ecosystems
PES	Payment for Ecosystem Services
R-METT	Ramsar Site Management Effectiveness Tracking Tool
UNDP	United Nations Development Programme
WIAMS	Wetlands Inventory, Assessment and Monitoring System
WII	Wildlife Institute of India
WWF	Worldwide Fund for Nature
ZSI	Zoological Survey of India

1. Introduction

1.1 Background

Nested within the upper part of River Chandra sub-basin and flanked by Pir Panjal and Zanskar mountain ranges, Chandertal is one of the significant High-Altitude Wetlands (HAW) of the north Indian state of Himachal Pradesh. The crescent-moon shaped wetland, from which it is believed to derive its name, spans 46 ha[1] at nearly 4,300 m amsl. A distal lake linked with the Chandra Bhaga glacier complex, Chandertal is an important element of the arid landscape, providing sustenance to diverse animal and plant species, including the iconic and globally vulnerable Snow Leopard *Panthera uncia*, which is the state animal of Himachal Pradesh. The peatlands on the margins of the wetland are an important carbon store. The wetland forms an integral part of the Central Asian Flyway (CAF) network, and is used by a range of migratory waterbird species in their sojourn from temperate to tropics for completing their lifecycle, such as Ruddy Shelduck, Garganey and Gadwall. Chandertal is a popular trekking destination visited by over 40,000 tourists annually. The Ministry of Environment, Forest and Climate Change (MoEFCC), in 2005, designated Chandertal as a Wetland of International Importance under Ramsar Convention site designation criterion 2 (owing to presence of high conservation value species such as Snow Leopard and Himalayan Marmot) and criterion 3 (role in sustaining biological diversity of high-altitude regions of western Himalayas). In 2007, the upper part of Chandra Sub-basin spanning 3,856 ha was declared as a Protected Area under The Wildlife (Protection) Act, 1972, with Chandertal being the core.

Despite the international recognition and legal protection, Chandertal faces multiple threats induced by adverse human activities and changing climate. The anthropogenic interference in the wetland ecosystem is primarily in the form of rapidly growing tourism and grazing pressure, which are leading to waste management challenges and disturbance to species. If not managed carefully, there is a high risk that the capability of Chandertal to provide wide ranging ecosystem services particularly water regime regulation and climate change mitigation and adaptation are undermined.

The GEF funded SECURE – Himalayas project of Government of India (GoI) and United Nations Development Programme (UNDP), which aims at securing livelihoods, conservation, sustainable use and restoration of high range Himalayan ecosystems, includes within its ambit, formulation of integrated management plan for significant wetlands as Chandertal. Wetlands International South Asia was entrusted to formulate the plan in close consultation with Himachal Pradesh Forest Department (HPFD), Himachal Pradesh State Wetlands Authority (HPSWA) and other relevant stakeholders.

This management plan outlines the commitment of the MoEFCC, GoI and Government of Himachal Pradesh (GoHP) towards wise use of Chandertal as a Ramsar Site and a high-altitude Himalayan wetland of high conservation significance.

[1] As per the Ramsar Information Sheet of 2005, the area of Chandertal is reported to be 49 ha. However, in the current management plan, the wetland area was estimated to be 46 ha (further details in Section 2.1 of the management plan)

Image 1: A panoramic view of the Crescent shaped Chandertal with Chandra Bhaga glacier complex at the background

1.2 Management Planning Purpose

'Wise use' is the central tenet of wetlands management. India, as a signatory of the Ramsar Convention, is committed to achieving wise use of all wetlands in her territory. The Ramsar Convention defines wise use of wetlands as 'the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development'. Ecological character is 'the combination of ecosystem components, processes and services that characterize a wetland' (Ramsar Convention Secretariat, 2010). Ecosystem Management of wetlands thus seeks to achieve the goal of 'maintenance of ecological character' or 'wetland wise use'. Wetlands management is 'a process of planning, decision making, organizing, leading, motivation and controlling the human resources, financial, physical, and information resources of the organization entrusted with wetland management to reach the goal of wise use in an efficient and effective manner' (Ramsar Convention Secretariat, 2010).

Though sounding counter-intuitive, wise use as a wetland management approach is much wider than use of a wetland. The phrase 'in the context of sustainable development' recognizes that development, which may be inevitable in some cases, is not an objective for every wetland. Wherever development is to take place, it has to be facilitated in sustainable ways by approaches elaborated in the Ramsar Convention. 'Ecosystem approaches' include the elements elaborated by the Convention on Biological Diversity – integrated management, stakeholders' participation in decision-making, transparency about trade-offs, and equitability of the outcomes. In totality, wise use is about 'maintaining the capability of the wetland' to support human well-being at present and in future, rather than 'use' or 'development' at present (Pritchard, 2018). This is critical for high altitude wetlands, which due to their high ecological sensitivity and fragility, may not be able to sustain high levels of anthropogenic interference.

HAW such as Chandertal are distinct types of wetland, having high sensitivity to climatic changes, limited human presence, unique biodiversity, hydrological regimes influenced by glacial action, and limnology reflecting the composition and weathering pattern of local geologies. Their functioning is influenced by a range of processes, including those related to the cryosphere (which influences the quantity and timing of the water inflows into the wetland), the climate system (high ultraviolet radiation levels, and high diurnal and seasonal variation in temperatures regulating the physical,

chemical and biological processes taking place within the wetland), the regional geomorphology (especially the topography and the rocks which structure the physical processes), and location with ecological networks (such as flyways, which determine the pattern of use of the wetland habitat by migratory species). Defining wise use strategies for Chandertal needs to be based on the understanding of multi-scalar drivers of change, and ensure that adverse change to ecological character, especially those related to anthropogenic causes are prevented.

Being inherently dynamic, the ecological character of HAW is always changing due to natural (such as ecological succession or seasonality) or human-induced (such as impeded natural outflows of a wetland) factors. The ambit of ecosystem management interventions is determined by an assessment of whether or not the ecological character change is 'adverse' and reducing the capability of the wetland ecosystem to provide ecosystem services and sustain biodiversity values. In the case of Chandertal, the ecological character is changing due to changing natural drivers and also adversely due to human-induced changes. Distinction between human induced adverse change and natural succession of wetlands need to be incorporated into management planning. Thus, management of Chandertal needs to be a mix of active interventions on anthropogenic drivers and monitoring or limited intervention on natural drivers to sustain the ecological character of Chandertal.

The process of development and implementation of management plans for wetlands need to be accompanied by governance improvements at basin level. Such an approach underpins Integrated Lake Basin Management framework which calls for achieving 'sustainable management of lakes through gradual, continuous and holistic improvement of basin governance, including sustained efforts for integration of institutional responsibilities, policy directions, stakeholder participation, scientific and traditional knowledge, technological possibilities, and funding prospects and constraints (Cookey, Darnsawasdi, & Ratanachai, 2016). Achieving a close relationship between planning and governance is critical considering multiple stakeholder and sectoral interests which underlie and to a large extent structure wetland biodiversity and ecosystem service values, and the need to secure people's involvement and participation in basin-scale management for considerably long periods of time.

Management planning for Chandertal also draws upon the six governance pillars for Integrated Lake Basin Management(Cookey et al., 2016), namely:

- Institutions: development of effective organisations and governance frameworks
- Policies: setting broad directions and specific rules
- Participation: expanding the circle of involvement
- Technology: possibilities and limitations
- Information: pursuing sources of knowledge and wisdom, and
- Finance: seeking for sustainable sources at an appropriate level

The broad approach for management planning is characterised by the following:

- Use of wetland ecological character and basin level land and water management interactions as a basis for setting management objectives and targets
- Integrating wetland management within planning for protected area management, climate change, rural development and other relevant programmes
- Balancing the needs of biodiversity conservation with securing livelihoods of dependent communities
- Promoting cross-sectoral institutional arrangements, the particular involvement of local communities and stakeholders in wetland management
- Integrated wetland inventory, assessment and monitoring system to support decision-making
- Periodic monitoring and evaluation with focus on achieving the goals and objectives rather than merely activities

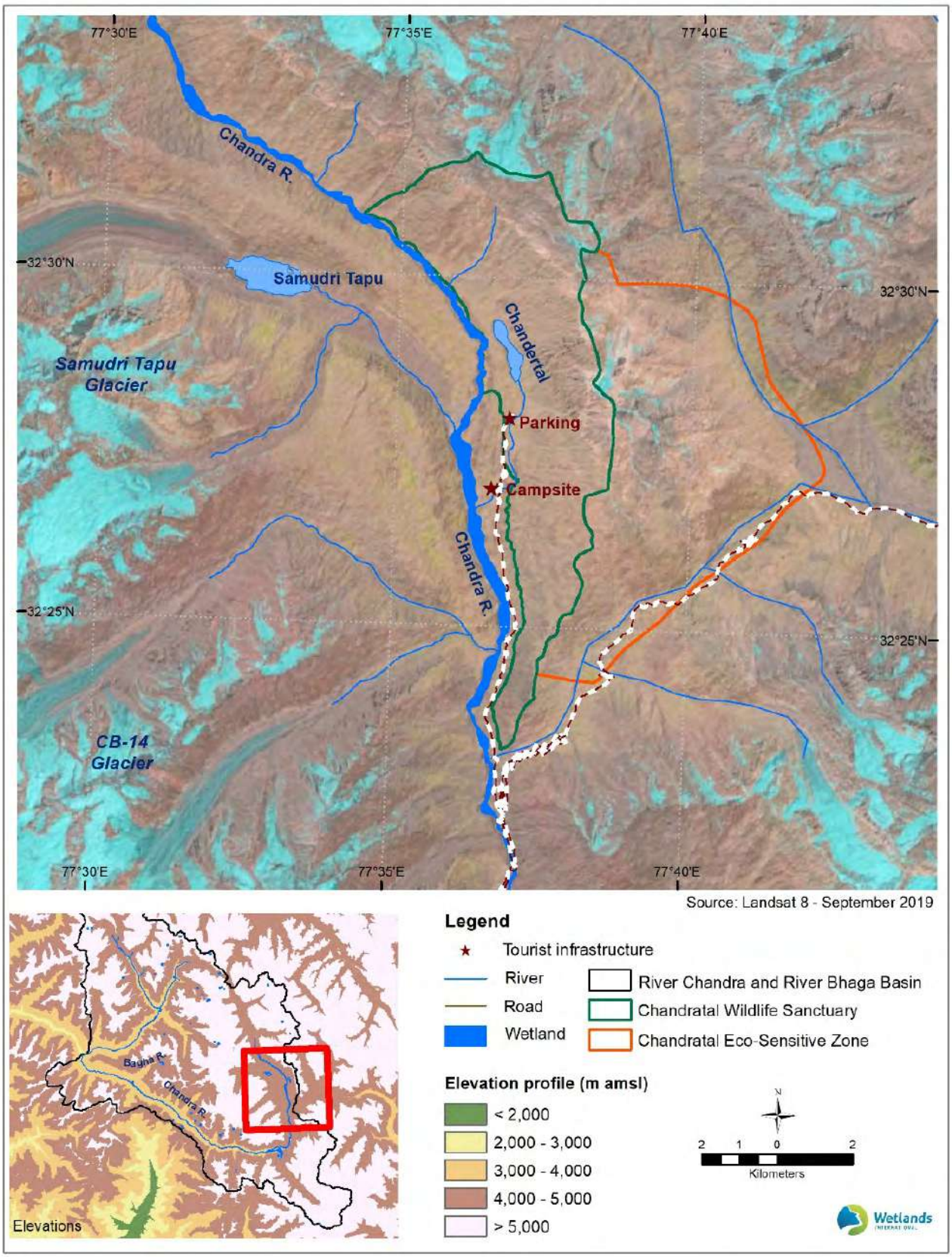
1.3 Management to Date

Management of Chandertal and its surroundings has primarily been guided by wildlife conservation. Under Project Snow Leopard, the Upper Spiti Landscape was identified as the first conservation landscape, key values being the habitat of Snow Leopard – the state animal of Himachal Pradesh. Launched by the MoEFCC in 2009, the Project Snow Leopard aims at 'safeguarding and conserving India's unique natural heritage of high-altitude wildlife populations and their habitats by promoting conservation through participatory policies and actions' and covers biologically important landscapes in the Himalayan High Altitude regions of Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttaranchal, Sikkim and Arunachal Pradesh.

Chandratal Wildlife Sanctuary was notified in 2007 by the Government of Himachal Pradesh (GoHP) the provisions of the Wildlife (Protection) Act, 1976, and in 2013 the boundary was rationalized and aligned with the Upper Spiti Landscape, thus spanning 3,856 ha. Chandertal wetland forms the core zone of the Chandratal Wildlife Sanctuary (Map 1). In 2013, an intent notification to extend the boundary of the protected area by an additional 1153 ha has also been issued. In 2016, an area of 6,150 ha was notified as the Chandratal Wildlife Sanctuary Eco-Sensitive Zone Notification (2016) under the Environment (Protection) Act, 1986 and rules thereof.

In 2018-19, the Himachal Pradesh Forest Department (HPFD) adopted the Management Plan for Chandratal Wildlife Sanctuary (2018-2028), thus meeting the statutory requirements under The Wildlife (Protection) Act. The key actions proposed include strengthening of the patrolling infrastructure of the Spiti sub-division, demarcation and protection of wildlife sanctuary boundary, regulating tourism, and communication and outreach.

The emphasis of management to date has been on regulating inflow of tourists, especially the camping sites, and patrolling the area to prevent infringement of provisions of The Wildlife Protection Act (1976). While the management plan for the sanctuary contains actions to ensure enforcement of the extant regulatory provisions, measures for assessing and addressing risks of adverse change and ensuring wetlands wise use remain unaddressed. The current plan defines management arrangements and actions required for achieving wetland wise use commitments, and is dovetailed and harmonized with the broader Chandratal Wildlife Sanctuary plan.



Map 1: Location of Chandertal within Chandratal Wildlife Sanctuary and Eco-Sensitive Zone

1.4 Approach and Method

The MoEFCC has laid down guidelines for wetland management planning under the National Plan for Conservation of Aquatic Ecosystems (NPCA). The guidelines recommend a diagnostic approach to management planning, wherein management actions are targeted to meet the objectives related to either maintenance of ecosystem services or biodiversity values, or addressing threats leading to adverse change in wetlands condition (Figure 1). These guidelines build on ecological character description and evaluation framework recommended within the Ramsar Convention. The management planning for Chandertal is based on these guidelines.

Figure 1. Management planning framework

The guidelines have been framed on a diagnostic approach – wherein the selection of management interventions is guided by knowledge of wetlands' features and factors governing these features, and their relationship with wider societal, conservation and development goals that wetland wise use is contributing to. Wetland features are the ecological, social and institutional attributes, which collectively characterize a wetland. Wetlands are dynamic systems, and thus their features undergo cyclical and temporal changes. Factors (natural as well as anthropogenic) cause the wetland to move along a certain trajectory.

The condition of a wetland with respect to its reference condition determines the nature of management intervention required. If the wetland condition is maintained close to the reference, management may be passive, and largely comprise monitoring activities in order to identify any potential adverse changes. When wetland condition becomes degraded (as observed by deviation from the reference condition), active management interventions to address the drivers of degradation can be required. With natural drivers of change, the scope of intervention may be very limited, but for anthropogenic drivers of adverse change, a range of interventions may be warranted in order to achieve wise use.

The management plan was framed by a multidisciplinary team. The planning process was initiated with a critical analysis of management interventions made under various programmes implemented in the Chandra River Sub-basin. Baseline status and trends in hydrological, geological, ecological and socio-economic features of wetland were established using existing datasets from published

information, technical reports provided by various line departments, stakeholder consultations and field visits. An essential part of the planning was detailed data collection from three field visits made to the Chandertal in 2019. The existing institutional arrangements were reviewed regarding their fit with the needs of integrated management. The planning framework is designed as a response to the existing as well as likely risks of adverse change in wetlands ecological character, and conform to the guidance of the MoEFCC on wetlands management planning.

1.5 Management Plan Structure

The management plan follows the format recommended by the National Plan for Conservation of Aquatic Ecosystems (NPCA), and is organized in three sections with eight chapters. Following the introduction, Section 1 of the plan (comprising Chapters 2, 3 and 4) contains a description and evaluation of the wetland, and assessing risk of adverse change in wetland character. Chapter 4 also assesses the current institutional arrangements in terms of capability of addressing the risk of adverse change and ensuring wetland wise use. Section 2 of the plan (containing Chapters 5 and 6) discuss the management framework (management goal, purpose, strategy and objectives and monitoring arrangements thereof). Section 3 (comprising Chapters 7 and 8) includes the detailed action plan, budget for five years and possible financing arrangements.

Image 2: Meeting with PRI representative, Khoksar Gram Panchayat

2. Description of Wetland Features

2.1 Wetland Extent

Chandertal is situated within the sub-basin of the River Chandra which is a tributary of River Chenab. The wetland is bound on the north by Zanskar mountains, on the west by River Chandra, and on the east by mountains of Kunzum la. In the south, the wetland opens into narrow gorge wherein an outflowing stream connects with river Chandra about 4 km downstream of the wetland.

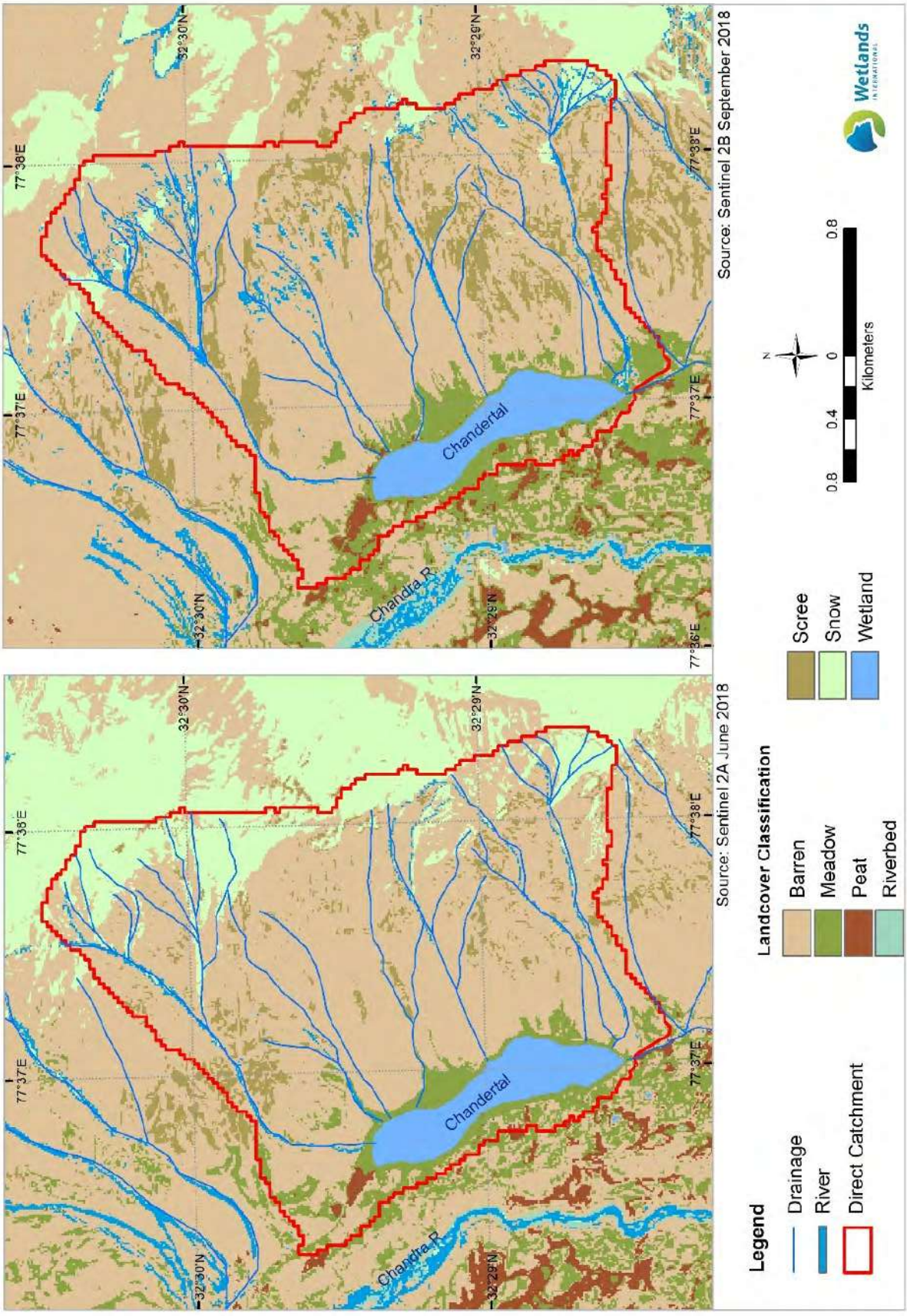
Samudra Tapu is the largest wetland of the sub-basin and lies left to the Chandra river and at the snout of glacier by the same name. Samudra Tapu is a proglacial lake and maintains an active interface with the glacier. Chandertal, on the other hand is a distal glacial lake, and would have been connected with glacial system in the geological past.

On the left bank of River Chandra is a peat bog developed in a trench about 600 m wide and 500 m long. This depression is also a point of snow accumulation which thaws during summer season creating favourable conditions for accumulation of carbon in the shallow peat system. Chandertal is located parallel to the trench, receiving glacial melt from at least 11 inlets.

Glacial lakes such as Chandertal which have well defined inflows and outflows are not likely to undergo drastic seasonal variations in wetland extent. Proglacial lakes such as Samudra Tapu are more likely to exhibit increase in extent over a period of time due to calving and damming effect.

The present extent of Chandertal was determined by supervised classification of Sentinel 2B satellite images of June and September 2018. The peak inundation is achieved in the month of July, after which the inundation gradually recedes by about 1-2 ha, the exposed area transforming into wet meadows (Map 2). In 2000, the wetland area as determined through analysis of Landsat 7 of June and September was 45 ha. There has been a significant variation in area of Samudra Tapu which is correlated with recession of parent glacier.

Image 3: Wet meadows formed on the northern edge of Chandertal



Map 2: Seasonal Variations in Chandertal

Image 4: Chandertal with Samundra Tapu and Chandra Bhaga Glacier system in the backdrop

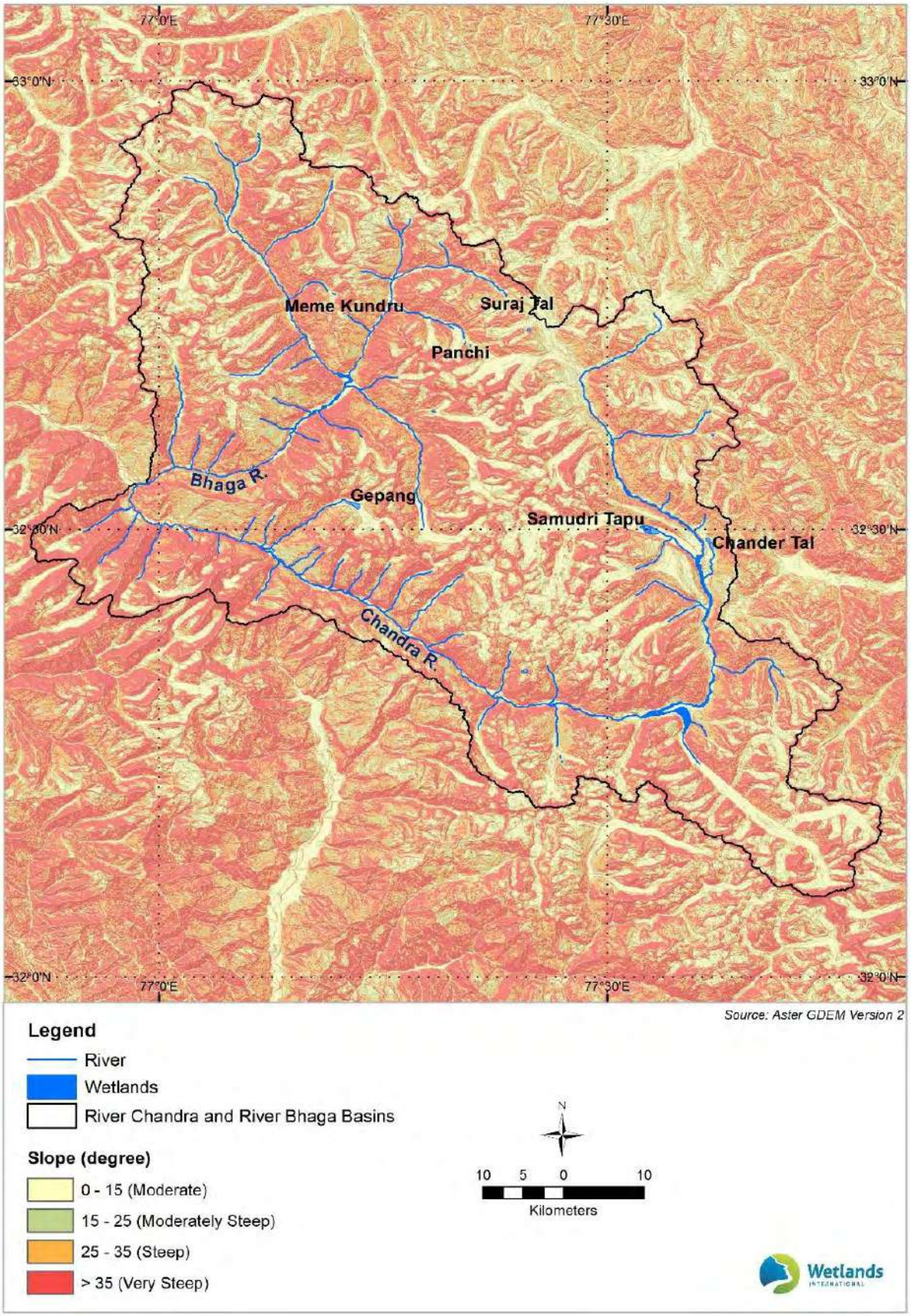
2.2 Wetland Catchment

The catchment of Chandertal is defined by the cryosphere to which it is linked and associated drainages. The Chandra Bhaga glacier complex which feeds Chandertal, Samudra Tapu and other glacial lakes of the basin is constituted by over 200 glaciers of which Bara Lacha La and Samudra Tapu are the major ones. The overall catchment area drained by these glaciers is 74,492 ha.

The northern end of the catchment is bound by Bara Lacha La glacier of Zanskar mountains, which is the source of the rivers, Chandra and Bhaga. The Chandra river flows down from the glacier and traverses from the middle of Samudra Tapu lake and Chandertal. The point of accumulation of outlets from both these HAWs was identified in the upper Chandra river to delineate the catchment.

Direct flows into Chandertal are received from 11 streams which originate from snow clad mountains in the east. The area of the direct catchment including the wetland is 760 ha marked by 77° 36' 15" E to 77° 38' 23" E Longitudes and 32° 30' 31" N to 32° 28' 16" N Latitudes. The western margins of the catchment are defined by a narrow ridge which separates River Chandra and the wetland. Similarly, ridges on the north and high-rise mountains on the east isolate the flow into the wetland from other parts of the catchment. The southern boundary is marked by the outflow point of the wetland. The catchment elevation ranges from 4,265 m to 5,500 m amsl with a slope varying from 0 to 61 degree. The direct catchment has higher slopes (>35 degree) from which originate major surface drainages from north eastern flank of the catchment (Map 3).

Analysis of Land Use and Land Cover (LULC) of direct catchment using Sentinel 2B images of September 2018 indicates that rocky moraines/barren surface (67 %) comprise the maximum area followed by alpine vegetation (20 %), wetland (7%), and glacial streams (3%) and snow (3%). When compared with Landsat 7 images of September 2020, the area under vegetation especially alpine meadows have increased while area under snow has declined (Table 1; Map 4).



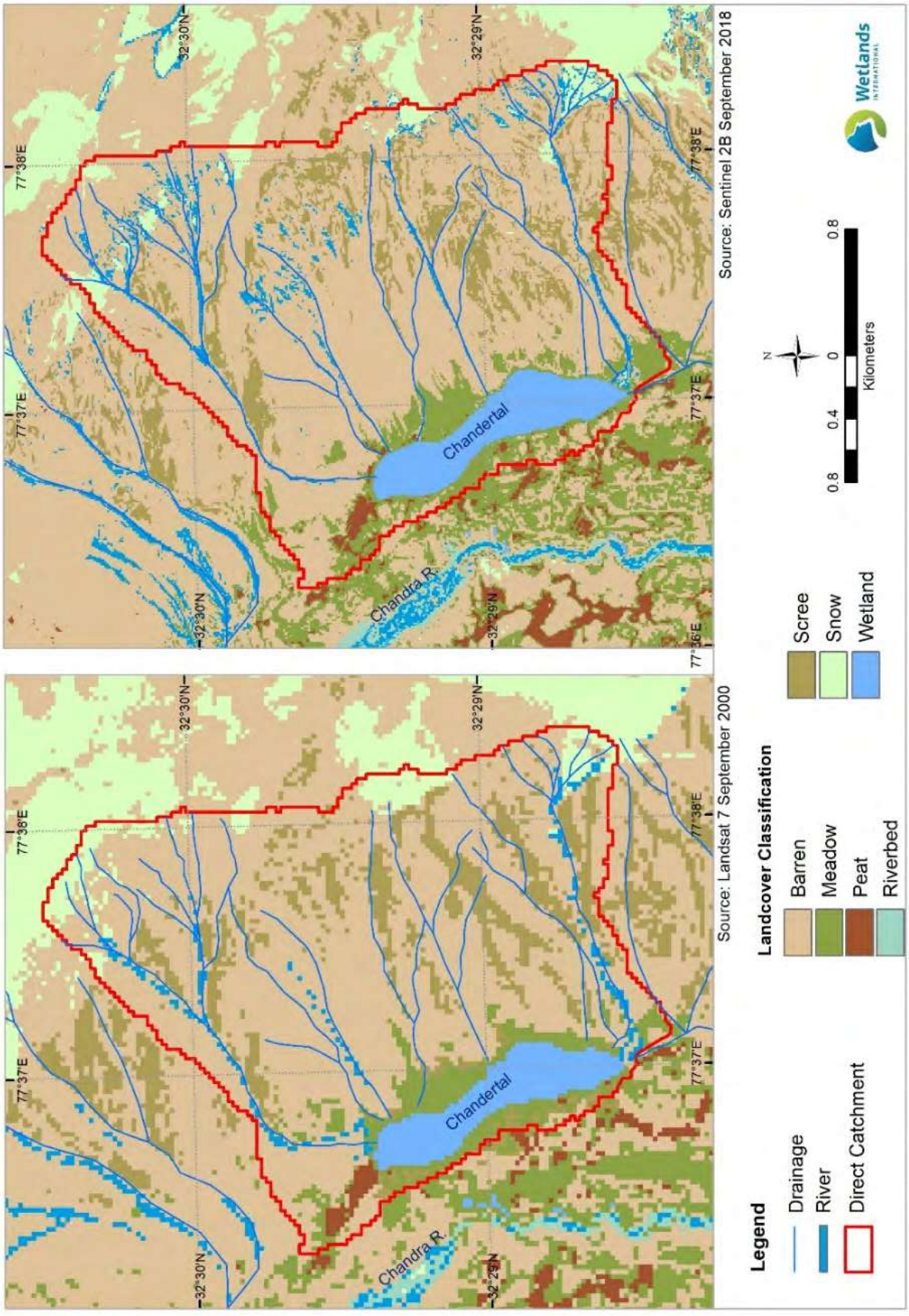
Map 3: Slope of River Chandra and River Bhaga sub-basins

A gradual greening of the catchment was also confirmed during interviews with Gaddi herders who now have moved closer to the wetland to graze upon the shoreline vegetation.

Table 1: Land Use and Land Cover of Direct Catchment

Land cover classes	**Sub-classes**	**Area (ha) in 2018**	**Area (ha) in 2000**
Alpine vegetation			
	Scree	95	100
	Meadow	61	55
Wetland			
	Lake	46	45
	Peat	7	7
Streams		22	22
Snow		20	37
Moraines		516	493
Total		**760**	**760**

Image 5: Migratory herders grazing their cattle in the meadows surrounding Chandertal



Map 4: Land Use and Landcover of Chandertal catchment

Box 1. Inventory of High-Altitude Wetlands of Chandra Bhaga sub-basin

As a part of the management planning for Chandertal, a probabilistic assessment of High-Altitude Wetlands distribution in Chandra Bhaga sub-basin was undertaken. MaxEnt (maximum entropy) a non-parametric model which relies on known occurrences to predict probabilistic distribution of HAW on the basis of geographic suitability indicators (Phillips et al., 2006, 2017; Phillips & Dudík, 2008) was used. The model iteratively computes the probability distribution of a response that maximizes entropy (i.e., closest to a uniform probability distribution) and has been used previously to map HAW of Sikkim.

The sub-basin was modeled using surface-corrected Aster digital elevation model (DEM) data to capture spatial topography, and temporal features driven by seasonal precipitation. Bioclimatic variables were also modeled to capture seasonality effect of precipitation and temperature. Existing wetlands were extracted from the remotely sensed Sentinel 2B imagery employing a Normalized Difference Water Index (NDWI) method and modeled to locate their spatial distribution in the MaxEnt Spatial analysis and modeling of the input variables was performed in ArcGIS software.

As training dataset, existing inventory of HAWs (Bhambri et al., 2018) of the sub-basin was extracted and digitized (128 presence records used for training and 54 presence records used for testing, following two-thirds and one-third ratios of test and training dataset). The training data was utilized as MaxEnt occurrence localities for delineating HAWs. It assumes that these known occurrences are of equal type and quality, and that environmental conditions at each locality are similar.

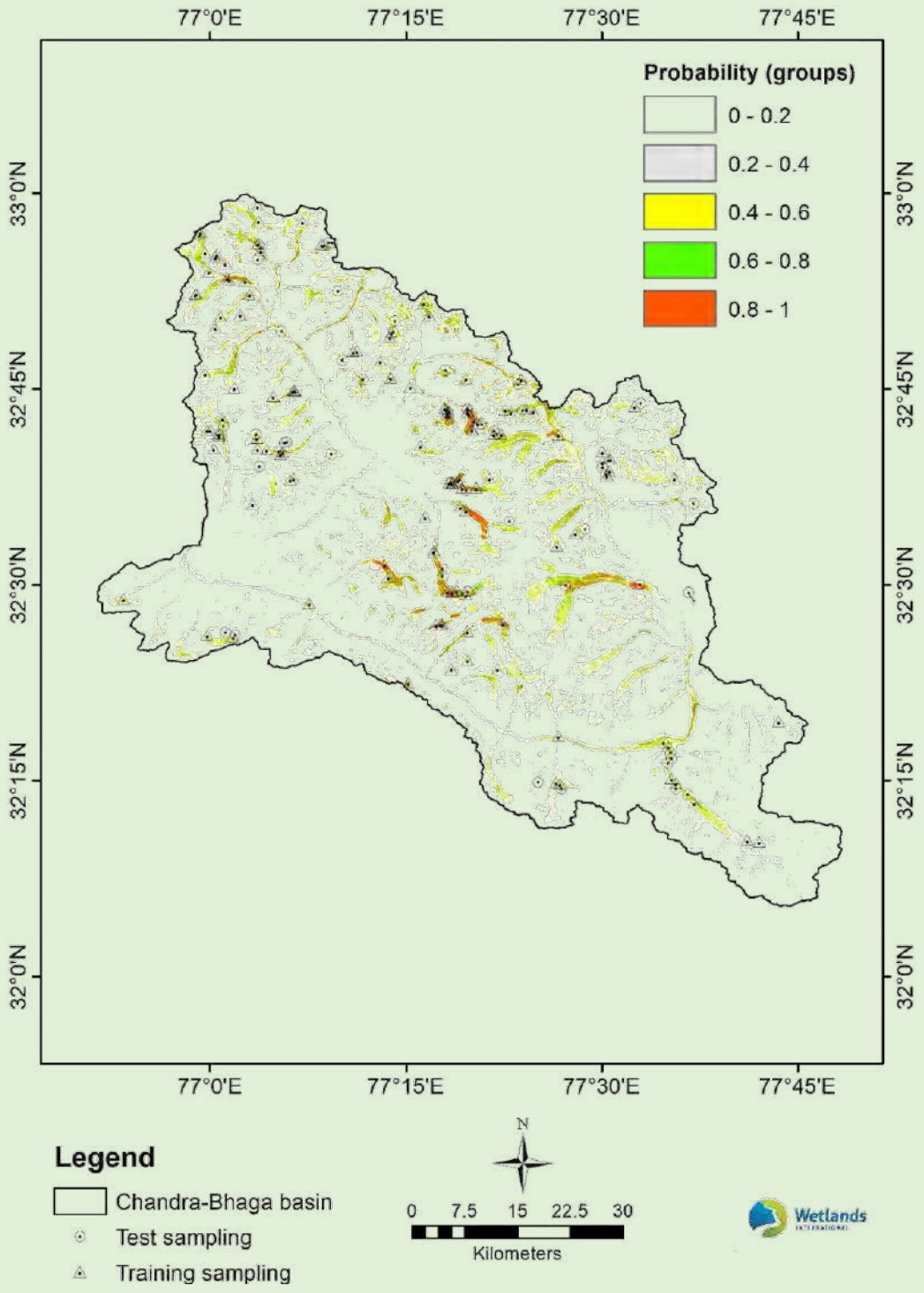
The environmental variables used for assessing HAW distribution in Chandra Bhaga basin are summarized in table below:

Table B.1: Environmental Variables Used in the Model

Data type	Variables	Source
Digital elevation data Aster (30 m resolution)	Elevation, slope percentage, aspect, topographic position index	https://lpdaac.usgs.gov/products/astgtmv003/
Satellite imagery Sentinel 2B	NDWI map (October 2019)	https://earthexplorer.usgs.gov/
Bioclimatic data	▪ BIO3 = Isothermality (BIO2/BIO7) (×100) where, BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp)), and BIO7 = Temperature Annual Range (BIO5-BIO6) where, BIO5 = Max Temperature of Warmest Month; and BIO6 = Min Temperature of Coldest Month ▪ BIO15 = Precipitation Seasonality (Coefficient of Variation)	https://www.worldclim.org/data/bioclim.html

The results of the model suggest that HAWs occupy an area of 6,583 ha (in the probability range of 0.8-1) in the sub-basin. At 0.6-0.8 probability range which also captures wet vegetation on the fringes of the wetland, the area is 8260 ha (Map 5).

Our assessments are significantly higher than those derived from images of 2011-13 (Bhambri et al., 2018 and Panigrahy, 2012). The previous inventories have exclusively focused on lakes while missing out on other wetland types such as peat, bogs and wet meadows.



Map 5: Probabilistic distribution of HAW in the Chandra Bhaga sub-basin

MaxEnt indicated a strong predictive potential of output probability distributions using environmental variables. Of the 7 predictor variables used, slope variable accounted for 75% of the model's predictive power, whereas NDWI and topographic position index measure also contributed significantly. These results emphasize the importance of local topographic features for determining HAW position. Relative contribution of variables used for modeling is given below:

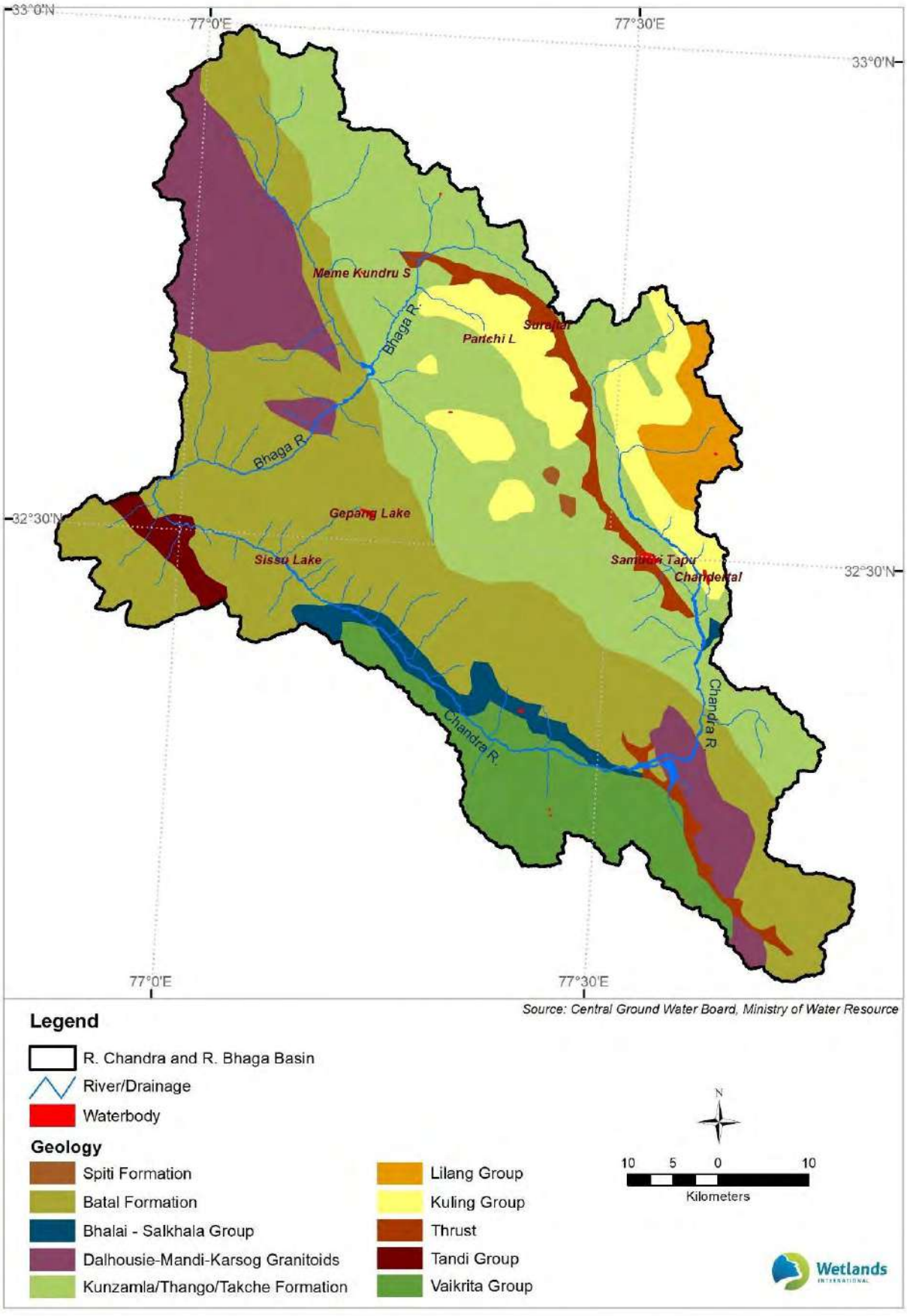
Table B.2: Variable Contributions

Variable	Percent contribution	Permutation importance
DEM Slope	73.2	79.9
NDWI	8.8	7.7
TPI	7	5.6
BIO 15: Precipitation Seasonality	5.8	3.7
DEM Elevation	2.9	1.4
DEM Aspect	2	1.4
BIO 3: Isothermality	0.4	0.2

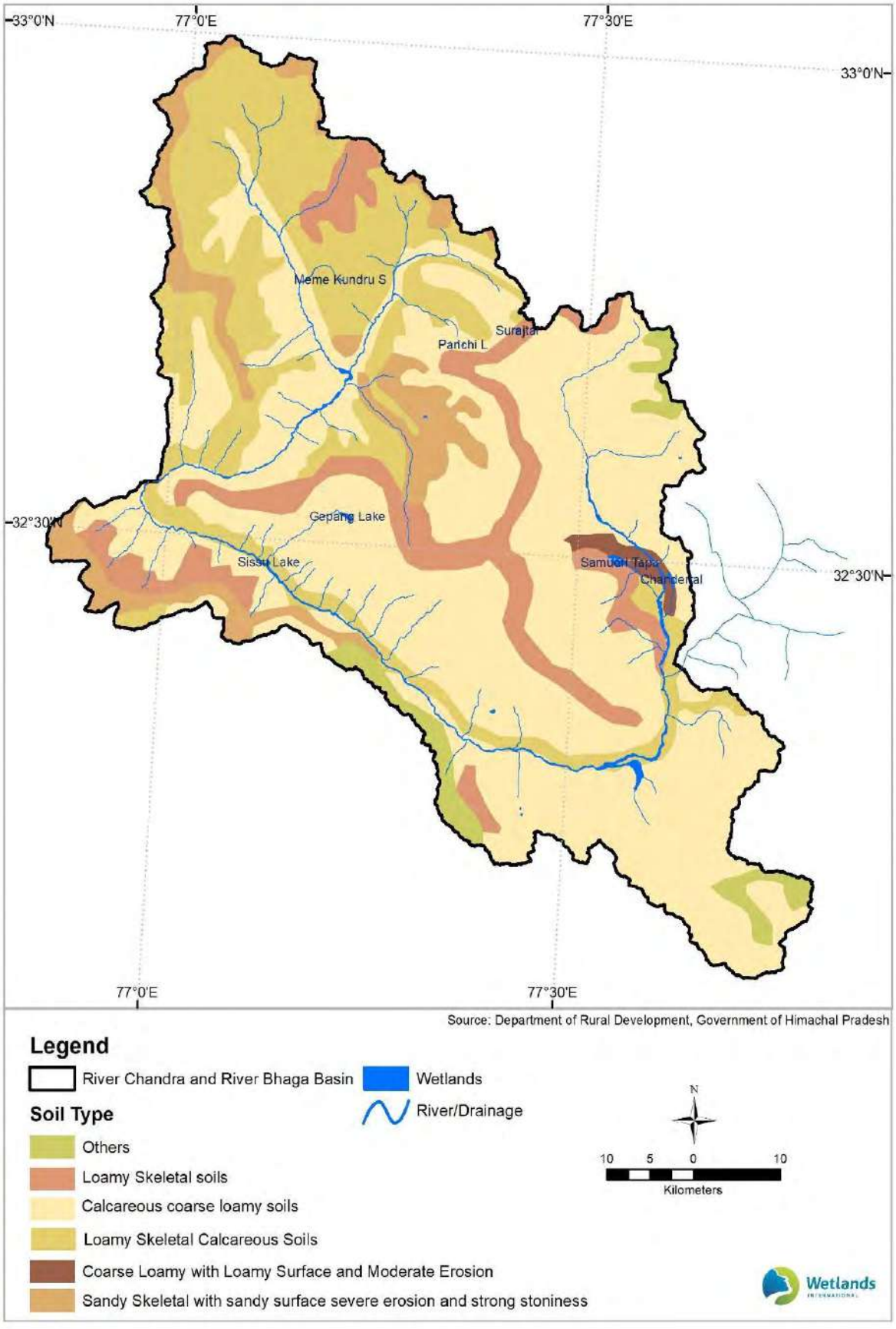
2.3 Geo-morphological Set up

The geo-morphological set up of the Chandra Bhaga sub-basin is highly heterogeneous and represents geological features from Pre-Cambrian to Cenozoic eras. The set up represents a highly rugged, inaccessible terrain traversed by valleys and hill ranges. The geology of the sub-basin can be divided into two major geomorphological units, structural hills and valley fills. The structural hills are underlain by rocks belonging to Pre-Cambrian, Paleozoic, Mesozoic and Cenozoic eras. The most dominant rocks in the area are quartzite, shale, conglomerates and limestones, which have imprints of aquatic biodiversity having origin from Tethys Sea. The rocks have been classified under Batal and Kunzam La Formation (Sharma et al., 2016) (Map 6). The rock types and geomorphic systems such as fissured formations in hard rocks and deposited porous formations in the valleys play a major role in landscape hydrology and are considered as major hydrogeological units (Kujur, 2013). Chandertal is classified as a glacier erosion lake which is formed in the moraines left behind by the receding glacier.

Valley fills include both fluviatile deposits and moraines (Kujur, 2013). The debris layer is highly heterogeneous, with from silt measuring a few millimeters to big boulders (Mandal et al., 2014). In Chandertal catchment, moraine deposits, debris flow deposit, flood and avalanche deposits have been recorded (Bakke et al., 2016) (Map 7). Along the wetland periphery, major soil type recorded during the field assessments are sandy and silt loam. Physico-chemical analysis of soil showed mild alkalinity in the soil (pH around 8) and organic carbon in the range of 0.42% to 0.78%.



Map 6: Geology and geo-morphology of River Chandra and River Bhaga basin



Map 7: Soil types within River Chandra and River Bhaga basins

2.4 Climate System

The wetland catchment falls in temperate and cold arid zones of Himachal Pradesh. Two weather systems *viz.* summer monsoon and mid-latitude westerlies influence the regional climate (Finkel et al., 2003). Wet precipitation is recorded in summer (July–September); however, winter (November–February) experiences a significant amount of solid precipitation due to the influence of westerlies (Bakke et al., 2016; Sharma et al., 2013).

Data on climate system of the sub-basin was obtained from NASA Power which provides single point daily satellite sensed grided data. During 1970 - 2020, the total annual average precipitation of the Lahaul Spiti district was observed to be ~980 mm (figure 2). Temperatures range from a minimum of -22°C in January-February to about 11 °C in July (figure 5). While subzero temperatures are recorded in beginning of October, the wetland generally freezes in the month of November and continues to remain frozen till March. The average solar radiation is 17 MJ m^{-2} (figure 6).

HAWs, especially those having large open water areas, tend to have a higher rate of heat and radiation absorption, thus making the surrounding regions relatively cooler or warmer than the other parts of the landscape. HAWs also influence cloud-formation, precipitation and evaporation. The climate moderation capability of Chandertal is one of the crucial factors sustaining meadows along the wetland shoreline, a fact also corroborated by herders during field interviews.

Trend analysis of climate data for Western Himalayas has indicated a gradual predominance of summer monsoon over mid latitude westerlies (Negi, Kanda, Shekhar, & Ganju, 2018). Long term climate trends observed over Northern Himalayan region (1991-2015) show an overall warming signature with significant increase in maximum and mean temperatures. Our attempt to partition the available precipitation data into summer monsoon and mid latitude westerlies did not show such trends (figure 3), however, this needs to verified with robust data. In general, a rainfall driven system is likely to undergo higher variability as compared with a snow driven one, which in turn influences the behavior of wetland fringes.

Multi-model climate projections for Chandra sub-basin (RCP 8.5 scenario) indicated that the sub-basin would continue to become warmer with a decreasing trend of snowfall by the end of the century. In response to the projected changes, the sub-basin is likely to retain only 40% - 45% of the areal extent of glaciers and corresponding volumes of glacier water retained are much lower at 29% - 34%, but the volume loss could be as high as 97% for low altitude glaciers (Tawde, Kulkarni, & Bala, 2019).

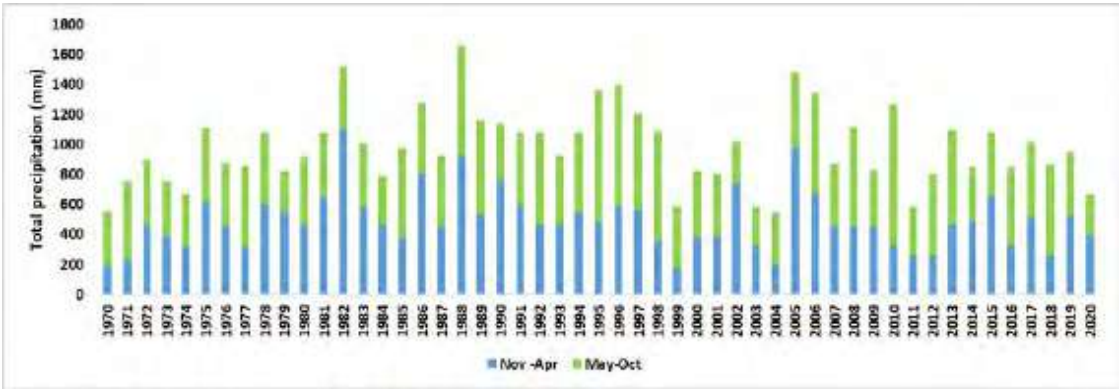


Figure 2: Total annual precipitation in Chandra Bhaga sub-basin (Data Source: NASA POWER)

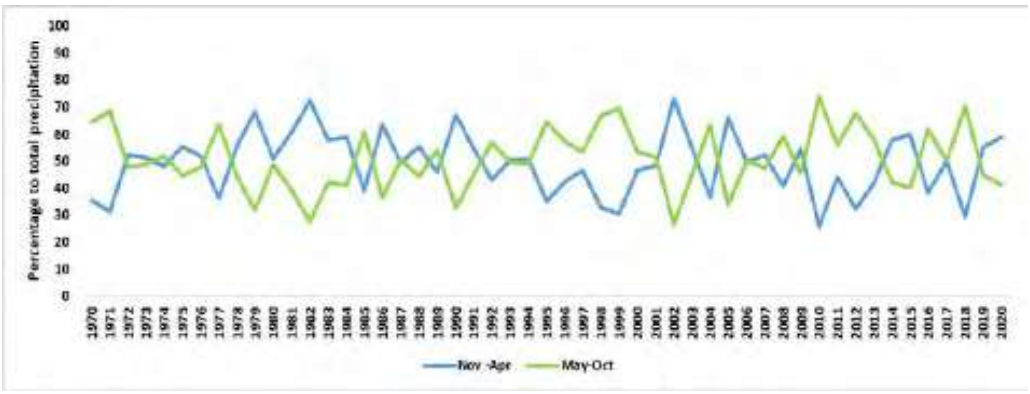


Figure 3: Summer and winter precipitation proportions in Chandra Bhaga sub-basin (Data Source: NASA POWER)

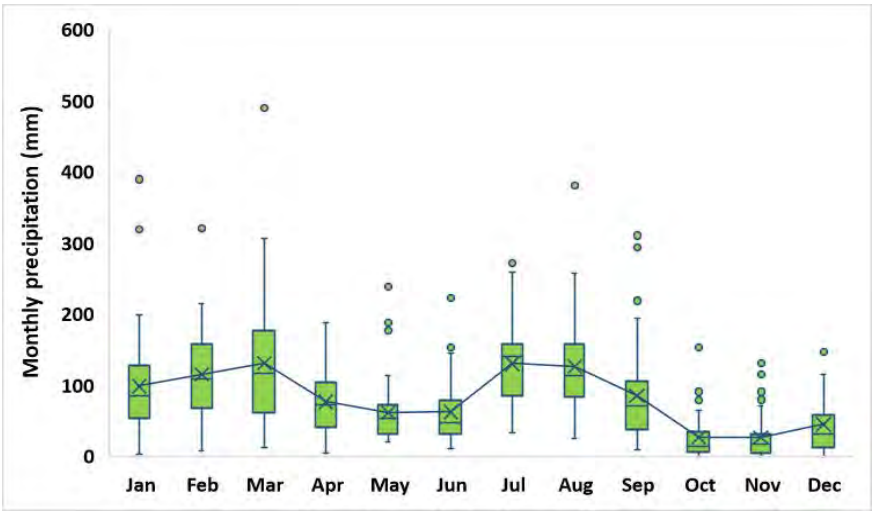


Figure 4: Monthly precipitation in Chandra Bhaga sub-basin (Data Source: NASA POWER)

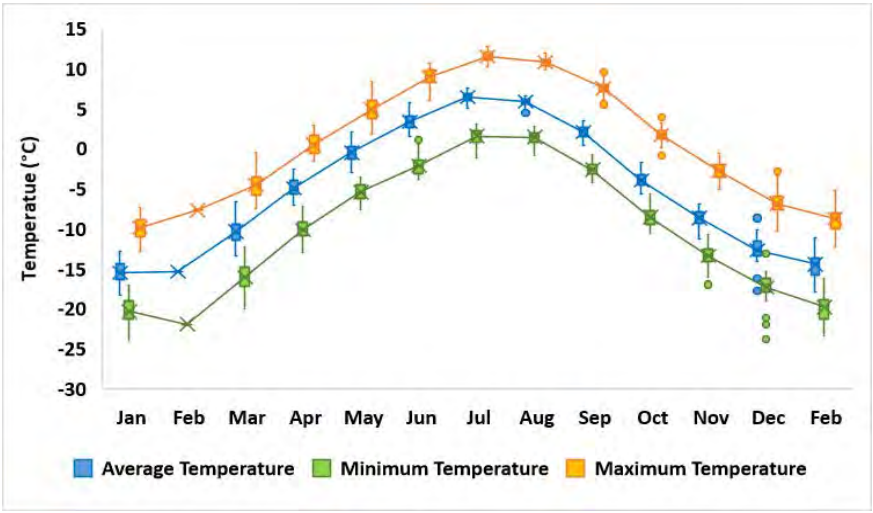


Figure 5: Monthly temperature variations in Chandra Bhaga sub-basin (Data Source: NASA POWER)

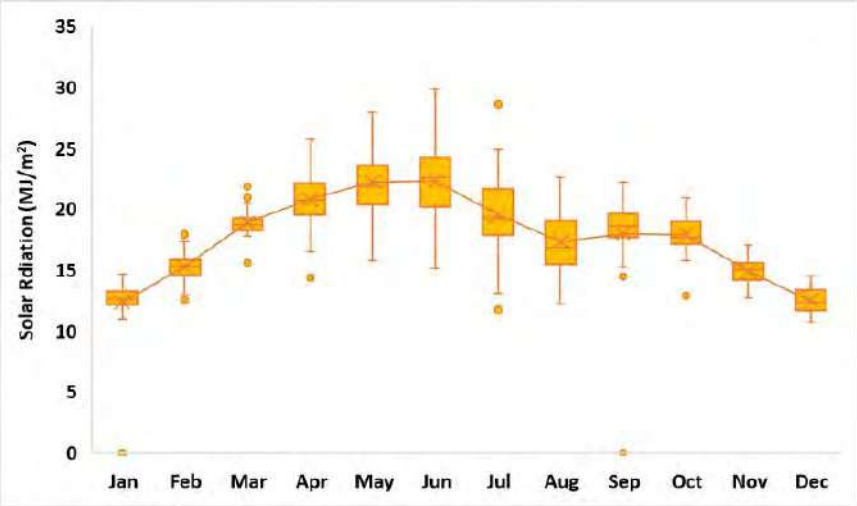


Figure 6: Monthly solar radiation in Chandra Bhaga sub-basin (Data Source: WRIS)

2.5 Hydrological Regimes

Chandertal receives surface inflows from precipitation and stream run-off from its direct catchment. The peak inundation of 46 ha is usually achieved in the months of July and August, after thawing of snow and ice. The water level gradually recedes by up to 50 cm by September-October on account of evaporation and reduction in inflows. Water from Chandertal flows out from a single outlet southward to finally meet into River Chandra after flowing for a distance of ~3.6 km. From this point, River Chandra flows in a U-shaped valley for another 90 km to meet River Bhaga at Tandi. Rivers Chandra and Bhaga coalesce to form River Chenab which is the name of the river beyond this point.

Wetland drainage network mainly originates from eastern part of the catchment as compared to Northern and Western sides. Bathymetric assessments done in 2015 indicate a maximum depth of 29m located in the southern portion of the wetland (Map 8). The northern end of the wetland is considerably shallower as compared with the rest indicating deposition of sediments (Bakke et al., 2016). Several active slope processes were recorded along the eastern shore of the wetland wherein the tributaries discharge into the wetland (Bakke et al., 2016).

A water balance of the wetland catchment has been constructed using run-off received from the inlets and direct precipitation on the surface (Figure 7). Groundwater information is scarce and has been omitted from the analysis. Defined by flow regime and bathymetric profile, it is estimated that the wetland stores ~5.72 MCM of water during high flow season (Summer-monsoon season), and ~5.71 MCM during the dry season (post monsoon-winter season) (Figure 8). There is no significant change in wetland storage during the winter season as the wetland is frozen. The water level rises notably during post-winter and slowly declines during pre-winter.

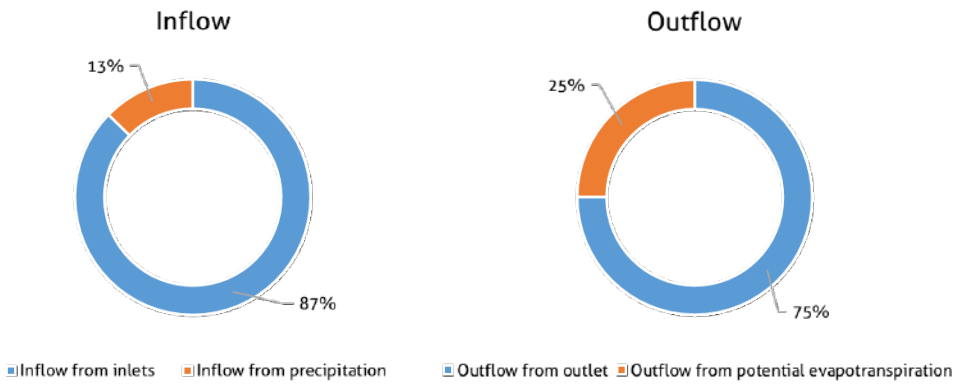


Figure 7: Percentages of water inflows and outflows in Chandertal catchment

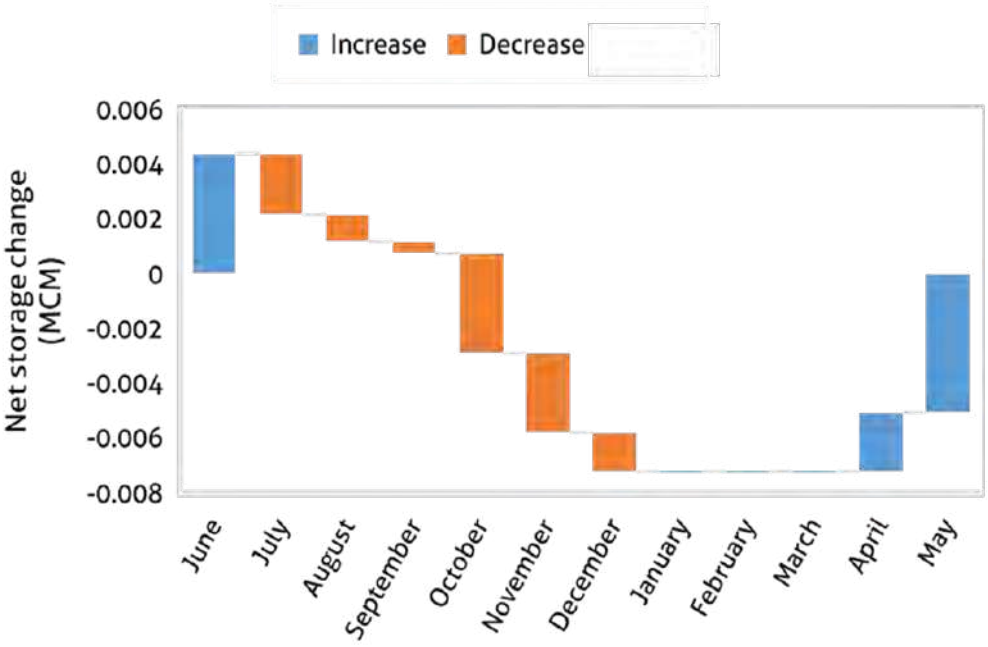
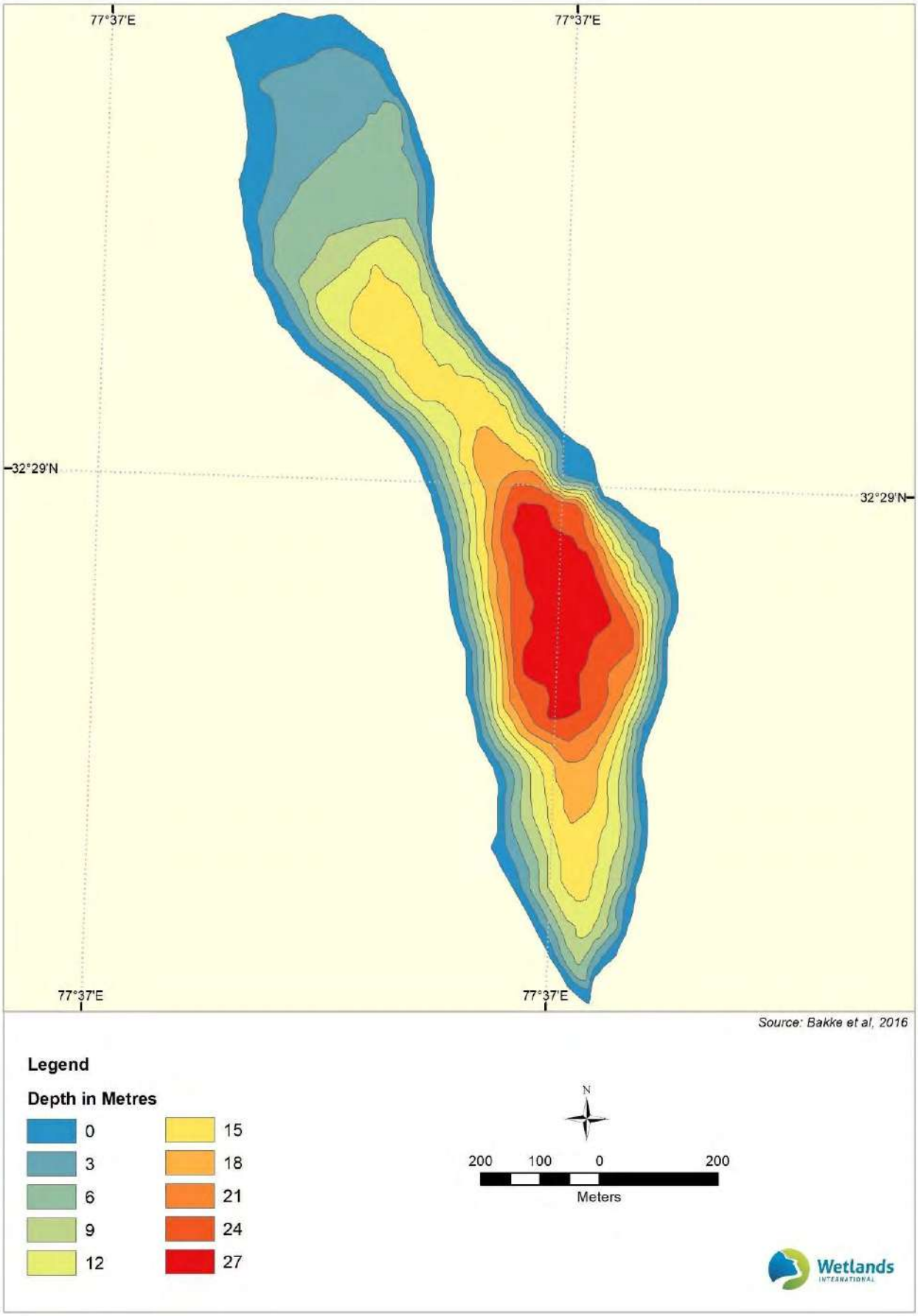


Figure 8: Monthly net storage change in Chandertal (modeled)



Map 8: Chandertal Bathymetry

Water chemistry of Chandertal is mainly controlled by weathering processes such as carbonate and silicate weathering, oxidation of pyrite, dissolution of sulphate minerals along with small contribution from atmospheric precipitation, and anthropogenic activities (Singh et al., 2016). Based on nutrient status, Chandertal has been classified as an ultra-oligotrophic high-altitude wetland (Singh et al., 2014). During the field assessments in 2019, water quality was assessed at eight sampling locations around the wetland including the inlet and the outlet sections. The water was alkaline in nature with a pH range of 7-8.5 and the surface water temperature ranging between 10-13 °C. Hardness of the water ranged from 92 to 240 NTU, indicating high amount of dissolved Calcium and Magnesium salts as a result of rock weathering from the nearby areas. The wetland has high amounts of dissolved oxygen ~ 8 mg/L indicating pristine aquatic habitat. The water was found to have a turbidity less than 10 NTU and visibility exceeded two meters below the water surface. Chloride, Fluoride, Phosphorous, Ammonia Nitrate and faecal pollution were recorded well within the limits of drinking water standards.

While the available information on water chemistry renders some insights into geophysical processes, key ecological processes such as density or thermal stratification have not been assessed thus far. The stratification phenomenon is characteristic of HAW, especially for deep wetlands, and are crucial for understanding sediment and nutrient distribution patterns, as well their relationship with microorganism led processes such as bioturbation.

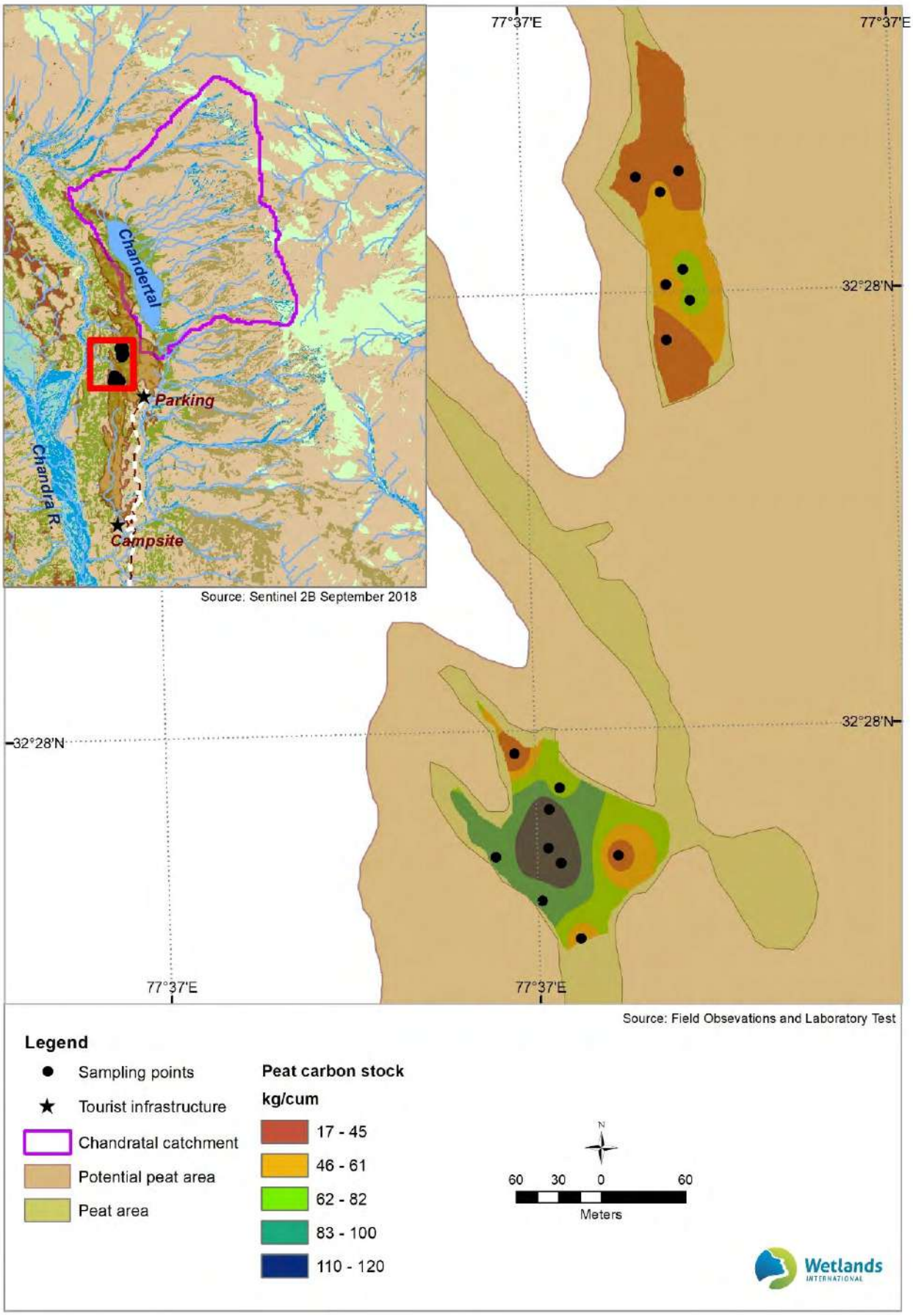
Image 6: Water testing at Chandertal

2.6 Wetland Carbon

Chandertal has shallow peat bog formations in a trench located towards west. Peat is defined as dead and partly decomposed plant material accumulated under waterlogged conditions for prolonged duration. These are transitional systems (ecotones) with accumulated peat between upland terrestrial (meadows) and inundated water-logged areas. In the direct catchment, nearly 1% of the total area is under peat-bog cover. Such systems trap high amounts of carbon within the decaying vegetation, and serve as carbon sinks. In addition, these systems play a crucial role in regulating water cycles, purifying water and hosting regional biodiversity of high conservation significance.

The identified peat-bog near Chandertal was assessed for carbon stocks and depth profile based on methodology suggested by the Ramsar Secretariat (Barthelmes and Joosten, 2018). As shown in Map 9, sampling to determine depth profile and carbon stock of the area was conducted in two peat-bog clusters. Depth of the organic layer varied from 0.1m to 1m. Samples collected from the strata 15-30 cm depth were analysed in the laboratory for bulk density, organic carbon and other major parameters. Laboratory analysis showed high organic carbon content in the soil (6.3-7.2%) with bulk density 1.90g/cc. It is estimated that the carbon stock in the examined peat locations can range from 17-120 kg/m^3. Similarly, other macro-nutrients (N, P and K) were recorded in high concentrations. Nitrogen, Phosphorus and Potassium were recorded in the range of 517-592 kg/ha, 39.8 – 44.2 kg/ha, and 300-315 kg/ha, respectively. Notably, the presence of peat bogs in the Chandertal peat trench region has also been reported in some recent paleontological studies such as (Rawat et al., 2015).

Image 7: Peat-bog ecosystem around Chandertal



Map 9: Peat carbon stock around Chandertal

2.7 Biota

The wetland catchment, situated in the Kunzum mountain ranges exhibits characteristic features of Trans-Himalayan biogeographic zone. It consists of highland ranges of alpine meadow and pasture, peat-bog systems, de-glaciated wetlands, rivers and rocky moraines. Given these unique ecological features, Chandertal has been declared as a Ramsar site in 2005 for criteria based on species and ecological communities, and a Wildlife Sanctuary in 2013 as per The Wildlife Protection Act, 1972.

As per Champion & Seth classification, the vegetation in Chandertal catchment can be categorized as alpine scrub. The area has seasonal herbaceous growth (May-September) along the wetlands; however, slopes are relatively barren with scanty alpine vegetation. During floral assessment in the wetland catchment, more than 27 plant species were recorded with dominance of *Poa* and *Potentilla* spp. Other abundant plant species were *Bistorta affinis, Polygonum spp, Thymus linearis, Geranium collinum* and *Leontopodium himalayanum* (Table 2). Besides these high-altitude plants, alpine grasses and sedges were also recorded along the wetland shore and associated peatland. Many of these plant species also hold medicinal values for the Amchi System of Medicine (Aswal and Mehrotra, 1994; Sharma et al., 2011). Field discussions with communities especially pastoralists indicated that meadows around Chandertal have gradually increased, a fact that has also be corroborated by LULC assessments reported in previous section.

Table 2: Plants recorded around Chandertal and its catchment

Plant species recorded	Shoreline	Scrubland	Alpine meadows
Aconitum violaceum	X		
Agaricus sp	X		
Anaphalis nepalensis	X	X	X
Anaphalis nubigena	X		X
Bistorta affinis	X	X	
Carex setosa	X	X	X
Erigeron acris var. multicaulis	X		
Eritrichium nanum	X		
Gentiana carinata	X		
Gentiana tubiflora	X		
Geranium collinum	X	X	
Kobresia nepalensis	X	X	X
Leontopodium himalayanum	X		X
Lloydia longiscapa	X		
Lomatogonium carinthiacum	X	X	
Oxytropis lapponica	X	X	
Poa koelzii	X	X	X
Polygonum spp.	X	X	X
Potamogeton spp.			X
Potentilla argyrophylla		X	
Potentilla atrosanguinea		X	
Primula spp.	X		
Ranunculus aquaticus	X		X
Sibbaldia cuneata	X		X
Stippa spp.		X	X
Taraxacum officinale	X	X	X
Thymus linearis	X		

	
Alpine meadows	Alpine sedges
	
Himalayan marmots in Chandertal region	Lesser sand Plover sighted in Chandertal trench
	
Ruddy Shelduck pair in shallow peat-bog located in the trench	Amphipods samples from Chandertal

Image 8: Biodiversity recorded at Chandertal during field assessments

Habitat mosaic around the wetland also plays a crucial role in hosting a range of high-altitude biodiversity and trans-boundary migratory birds. Trans-Himalayan mammals such as Snow Leopard, Himalayan Wolf, Tibetan Ibex, Himalayan Marmot, and Woolly Hare have been recorded in the landscape around (ZSI, 2018) (Table 3). However, recent studies and key informant interviews have reported a decline in sightings of elusive mammals due to high livestock densities, presence of guard dogs and lack of wild prey (Kumar and Paliwal, 2015). Interactions with local communities also highlighted that disturbance due to tourism is adversely impacting wildlife in the area.

Table 3: Mammals recorded in region around Chandertal and their conservation status

Mammals of Chandertal (Singh and Thakur, 2019; ZSI, 2018)	**IUCN Red List status (2019)**	**WPA Schedule (1972)**
Snow leopard	*EN*	*I*
Tibetan wolf	*LC*	*I*
Red fox	*LC*	*II*
Brown bear	*LC*	*I*
Himalayan weasel	*LC*	*II*
Mountain weasel	*NT*	*II*
Stone marten	*LC*	*II*
Himalayan ibex	*LC*	*I*
Blue sheep	*LC*	*I*
Royle's pika	*LC*	*IV*
Woolly hare	*LC*	
Himalayan marmot	*LC*	*II*

Alike other HAW, Chandertal is an important destination for migratory waterbirds. The area supports habitat for high altitude birds and other migrants such as Snow Cock (*Tetraogallus himalayensis*), Chukor (*Alectoris chukar*), Black Winged Stilt (*Himantopus himantopus*), Ruddy Shelduck (*Tadorna ferruginea*), Garganey (*Spatula querquedula*), Gadwall (*Mareca strepera*), Horned Lark (*Eremophila alpestris*), Lesser Sand Plover (*Charadrius mongolus*), Black Redstart (*Phoenicurus ochruros*), Kestrel (*Falco tinnunculus*) and Alpine Chough (*Pyrrhocorax graculus*) (ZSI, 2018). Although there are no historic records of population status of waterbirds from the wetland, breeding pairs of Gadwall, Garganey and Ruddy Shelduck have been recently recorded (Mehta and Thakur, 2017; Thakur and Mehta, 2015; 2016) and sighted during the field visit in 2019. The current management plan of Chandratal Wildlife Sanctuary reports a total of 27 bird species, including the occurrence of the Curlew Sandpiper (*Calidris ferruginea*). During the field visit, most waterbird sightings were from the wetland shoreline and alpine meadow parts. The same parts are also used by pastoralists for grazing and tourists, and hence, there is a need for careful management of these habitat pockets particularly to ensure habitat suitability for resident and migrating biodiversity.

During the present field assessments observations were made on invertebrate fauna such as spiders, beetles, butterflies and damselflies, and amphipods. These taxa groups need further investigations from the region around Chandertal wetland.

Studies on cyanobacterial diversity of Chandertal has reported presence of 20 species belonging to 20 genera in the wetland. Their distribution pattern within the wetland highly correlated with high pH and low temperatures. In this cold-water ecosystem, mat-forming cyanobacteria of orders *Chroococcales, Oscillatoriales* and *Nostocales* are the conspicuous members (Singh et al., 2014).

2.8 Ecosystem services

The Lahaul Spiti district in which Chandertal is located is mostly inhabited by tribal communities. Nearest village panchayats are Lossar and Hansa in Spiti division, and Koksar in Lahaul division with population of 320 and 78 persons, respectively (Map 110). The primary source of livelihood is daily wage labour or farming. Over a period of time, tourism and allied activities have become major source of income.

The management planning team conducted consultations with different stakeholders' groups including community members, pastoralists, camp operators, PRIs, tourists and government departments to gauge their perceptions on wetlands values and threats. Findings showed that local inhabitants accord a higher cultural and religious significance to Chandertal and revere it as an integral part of their life and culture. However, the cultural association is reported to be gradually declining, especially amongst youngsters.

The wetland is seen as a major economic asset of the region that generates tourism-based livelihoods. Tourism at Chandertal is a major revenue generator for local residents with many working as tourist guides, camp workers, tour operators and shop keepers. However, the rate of increase in tourism is alarming. During 2010-2018, key informant interviews suggested that the number of tourists visiting Chandertal has increased from nearly 2,000 to 40,000 (Figure 9). As of 2019, the camp site at Chandertal accommodates nearly 150 tents for tourists. Concomitant is an increase in solid waste pollution and disturbance to wildlife. In addition, lack of tourist interpretation, business outsourcing and disintegrating cultural values contribute to irresponsible tourism at Chandertal. Map 11 shows tourism infrastructure and facilities around Chandertal.

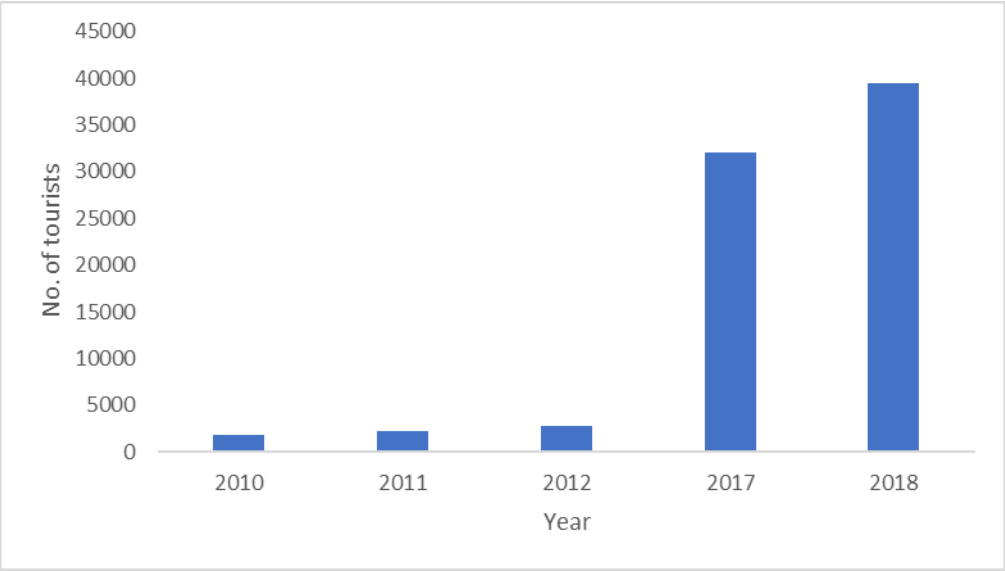
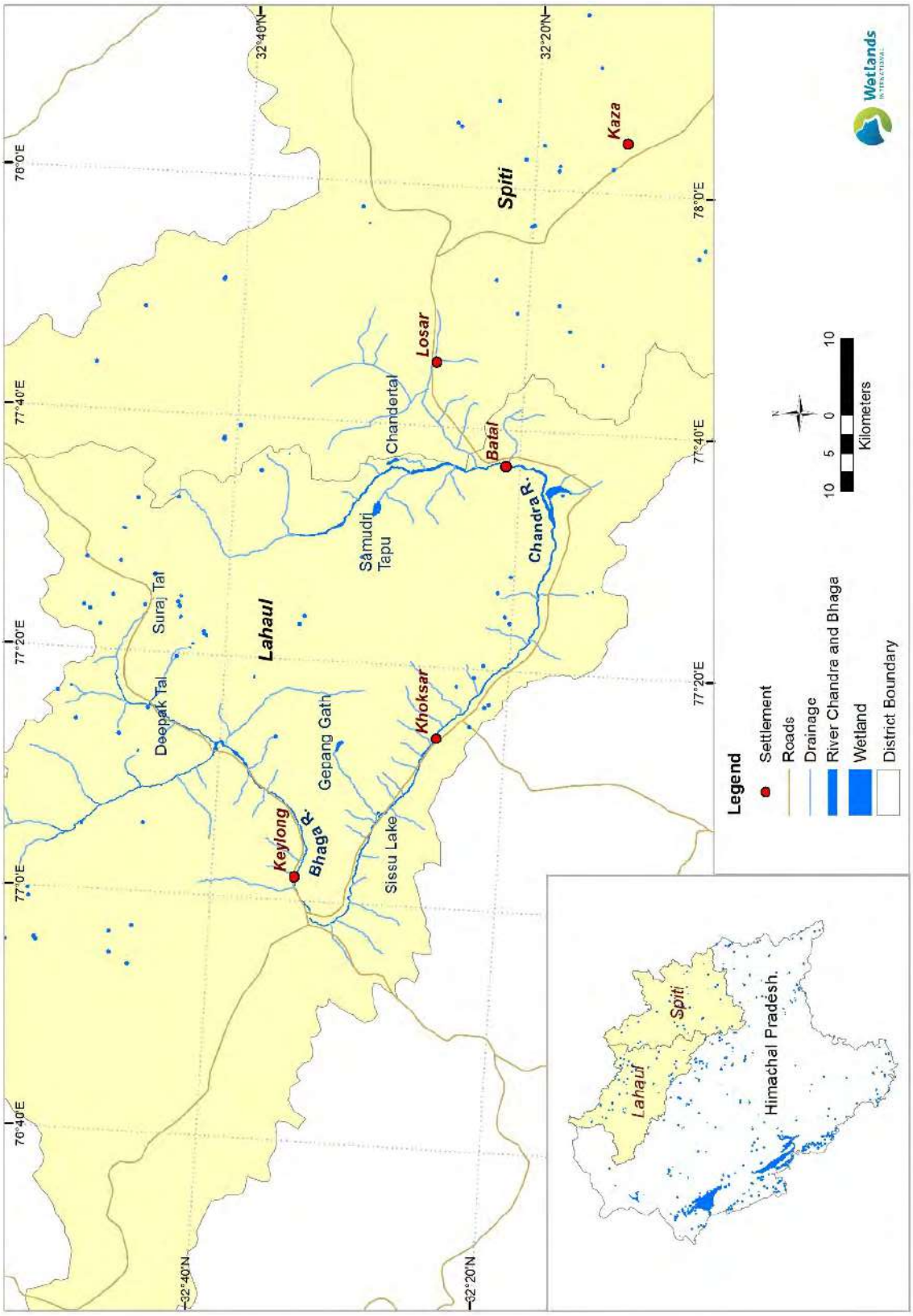


Figure 9: Number of tourists visiting Chandertal (data source: visitors register at check-post near Chandertal and pers comm. with forest officials & local CSOs)



Map 10: Major settlements around Chandertal in Lahaul and Spiti sub-divisions

Image 9: High number of tourist camps in the vicinity of Chandertal are deleterious to the fragile ecosystem

Also, alpine vegetation around Chandertal was identified as a major source of fodder for livestock belonging to the Gaddi community, for which pastoralism is the primary occupation. Rapid spurt in tourism and infrastructure development have severely jeopardised the wild habitat characteristics (HPFD, 2018; Suryawanshi et al., 2013). In addition, there is an emerging risk of wild diseases in the landscape as a large number of livestock animals can potentially be carriers of zoonotic diseases such as Foot and Mouth Disease (FMDB).

Image 10: Buddhist stone stacks and prayer flags on the shores of Chandertal

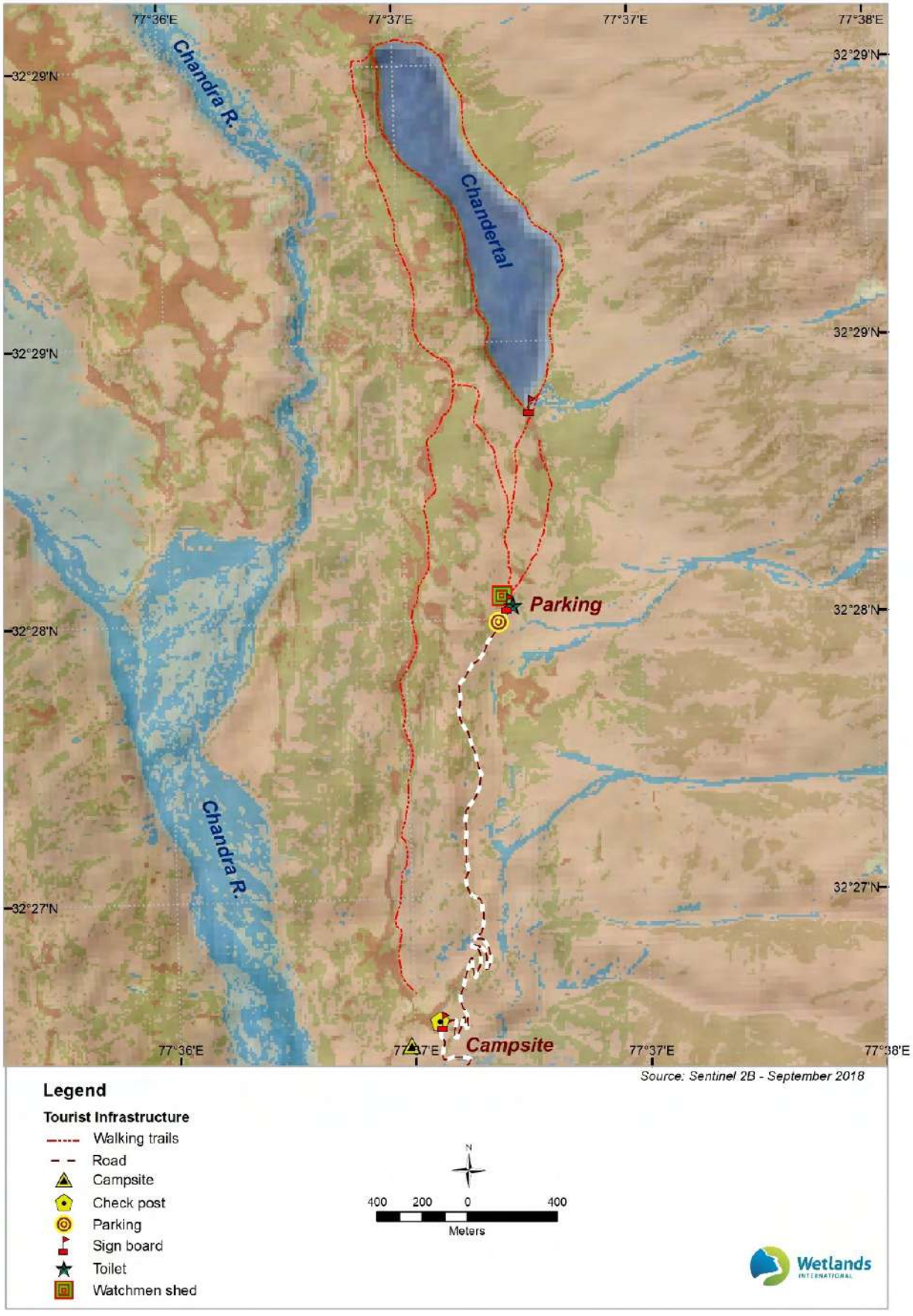
Although the cultural services are well acknowledged by the people around, there is a significant lack in awareness about the regulatory, provisioning and support services of the wetland and surrounding high range ecosystems (Figure 10). Services such as maintenance of hydrological regime and micro-climate regulation have not been recognised by the communities. Forest officials and elderly people, however, underpin the pivotal role of the wetland in sustaining populations of high-altitude biodiversity, including habitat for rare and endangered medicinal plants used in Amchi medical system (Sharma et al., 2011). Besides socio-ecological values of the wetland, local inhabitants also highlighted that mass grazing, rapid tourism and changing climate are major drivers of adverse change.

Ecosystem Services	Villagers	Tour operators	Tourists	Grazers	CSO	Researchers	Forest officials
Source for drinking water	1↔	3↔	1↔	3↔	1↔	1↔	1↔
Water for Livestock	1↔	2↔	2↔	3↔	2↔	2↔	2↔
Cultural significance	3↔	3↔	2↔	2↔	2↔	2↔	3↔
Tourism based livelihood	3↑	3↑	2↑	1↓	2↑	2↑	3↑
Recreational value	2↑	3↑	3↑	1↔	3↔	3↔	2↑
Buffer from high flows	1↔	1↔	1↔	1↔	1↔	2↔	1↑
Biodiversity habitat	2↓	1↓	1↔	2↓	2↓	2↓	3↓
Religious significance	3↔	3↔	2↔	2↔	2↔	2↔	2↔

Present Significance	Perceived trend in significance in last 5 years	
High	↑	Increasing
Moderate	↓	Decreasing
Low	↔	No change

Figure 10: Significance and trends of Ecosystem services of Chandertal

Image 11: Newly constructed toilet and guard room at Chandertal parking.



Map 11: Tourism infrastructure and facilities around Chandertal

3. Evaluation of Wetland Features

India, as a signatory of the Ramsar Convention, is committed to achieving wise use of all wetlands in her territory. Wise use of wetlands is defined in the text of Ramsar Convention as 'the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development'. Ecological character is 'the combination of ecosystem components[2], processes[3] and services[4] that characterize the wetland at any given point in time.' Management of wetlands thus seeks to achieve the goal of 'maintenance of ecological character' or 'wetland wise use'.

Though sounding counter-intuitive, wise use as a wetland management approach is much wider than the use of a wetland. The phrase 'in the context of sustainable development' recognizes that development, which may be inevitable in some cases, is not an objective for every wetland, particularly in highly ecologically sensitive and fragile ecosystems as HAW. Wherever development is to take place, it has to be facilitated in sustainable ways using approaches elaborated in the Convention (managing at basin scale, mainstreaming in urban developmental planning, participatory management amongst others). 'Ecosystem approaches' include the elements elaborated by the Convention on Biological Diversity – integrated management, stakeholders' participation in decision-making, transparency about trade-offs, and equitability of the outcomes. In totality, wise use is about 'maintaining the capability of the wetland' to support human well-being at present and in future, rather than 'use' or 'development' at present.

Changes to ecological character of wetlands outside natural variation may signal that uses of the site are unsustainable, and may lead to the breakdown of its ecological, biological and hydrological functioning (Ramsar Convention 1996, Resolution VI.1). Assessing and responding to risks of human induced adverse change in ecological character is therefore fundamental to achieving wise use of a wetland.

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[2] The living (biotic) and non-living (abiotic) constituents of wetland ecosystem. These include: geomorphic setting (landscape, catchment, river basin); climate (precipitation, wind, temperature, evaporation, humidity); physical setting (area, boundaries, topography, shape, bathymetry, habitat type and connectivity); water regime (inflow, outflow, balance, surface – groundwater interactions, inundation regime, tidal regime, quality); wetland soil (texture, chemical and biological properties); and biota (plant and animal communities).

[3] Processes that occur between organisms and within and between populations and communities, including interactions with non-living environment, that result in existing ecosystem state and bring about changes in ecosystems over time. These include: physical processes (water stratification, mixing, sedimentation, erosion); energy – nutrient dynamics (primary production, nutrient cycling, carbon cycling, decomposition, oxidation – reduction); processes that maintain animal and plant population (recruitment, migration); and species interaction (competition, predation, succession, herbivory).

[4] Benefits obtained by humans from ecosystems, categorized as: provisioning (fisheries, use of aquatic vegetation for economic propose, wetland agriculture, biochemical products); regulating (maintenance of hydrological regimes) and cultural (recreation and tourism, spiritual, scientific and educational value). Supporting services have been included in definition of ecosystem processes.

For wetland managers to be able to implement management that ensures maintenance of ecological character, it is important to identify and retain the site's essential ecological functions which underpin the wetland's ecosystem services and biodiversity. Implicit within this recommendation is the need to identify key elements of ecological character, maintaining which would constitute wise use of the site. The extent to which ecological character is maintained and adverse human-induced changes are prevented is reflected in these key features. Furthermore, a social-ecological systems perspective for defining and assessing ecological character enables consideration of the interactions social actors and institutions have with biophysical components of wetlands.

The Ramsar Convention's Guidelines for ecological character description are contained in Ramsar Resolution X.15. These elements have also been formally and systematically included in the 2015 revision of the Ramsar Information Sheet (RIS) Format, which needs to be updated every six years. This chapter also responds to this need of information.

This chapter of the management plan presents an evaluation of ecological character of Chandertal, based on assessment of wetland features presented in the previous chapter. A description of ecological character is provided herein, highlighting key elements, maintenance of which may be the focus of management. Status and trends in these elements have been discussed in the further sections. This is followed by an analysis of threats and risks of adverse change in ecological character. The chapter concludes with a listing of knowledge gaps.

3.1 Ecological character

Chandertal is a crescent-moon shaped distal high-altitude wetland of the Chandra-Bhaga glacier system. Perched at 4,300 m amsl elevation in the upper catchment of river Chandra and spanning 46 ha. The wetland is frozen for nearly 4 months, from December to March. The surrounding catchments have alpine features such as grassy meadows, shallow carbon pools, rocky moraines, scree vegetation, and snow-clad mountains. Due to limited anthropogenic nutrient influx, the wetland has a near pristine water quality with only traces of geogenic elements. The high-altitude wetland complements the landscape biotic profile and hosts several resident and migratory animals, also serving as a stopover site for Ruddy Shelduck, Gadwall, Plover, and others. The wetland catchment and its periphery are dotted with burrows of Himalayan Marmots and other faunal species. Although sightings of large mammals such as Snow Leopard, Tibetan Wolf, Blue Sheep and others have become infrequent due to anthropogenic disturbances, the wetland is a well-knit part of their range distribution.

The picturesque landscape of Chandertal not only holds cultural relevance for local people, but also interests many travel enthusiasts. The wetland is revered by many and has been placed in several local legends and folklore as a sacred lake. Local people hailing from remote villages of Lahaul and Spiti celebrate festivals such as Bees Bahado at the wetland, marking their socio-cultural linkages with Chandertal.

Chandertal forms the core of the Chandratal Wildlife Sanctuary designated in the year 2007 and governed as per the provisions of The Wildlife Protection Act, 1972. In 2005, the wetland was also accorded the status of Wetland of International Importance under the Ramsar Convention. The sanctuary is currently placed within the administration of the Spiti Wildlife Division of Himachal Pradesh Forest Department. The eco-sensitive zone comprising the wetland catchment, downstream stretches and other habitats fall under the jurisdiction of Lahaul Division administration.

The ability of Chandertal to provide these ecosystem services and biodiversity values is dependent on the following:

a) Connectivity with surface drainages linked with Chandra-Bhaga glacier system which enables water storage and regulation of hydrological regimes

b) Oligotrophic status limiting ecosystem productivity and supporting peculiar diversity of high-altitude species

c) Thermal stratification which enables survival of aquatic life within the wetland at sub-zero temperatures

d) Lower albedo and high thermal heat capacity which enables Chandertal to moderate local weather patterns

e) Waterlogged condition and influx of organic matter along with lower decomposition rate in the Chandertal trench which creates conducive condition for peat accumulation

f) Landscape aesthetics of Chandra Bhaga sub-basin which underpin Chandertal's touristic attraction

g) Cultural and relational values reflected in customary practices such as Bees Bhado

In order to sustain these,

a) Ensuring connectivity with surface drainages, inflowing as well as outflowing, as well as a stable water level regime

b) Low sedimentation regime that ensures that water holding capacity and hydrological buffering functions are maintained

c) Low nutrient status

d) Grazing regime that is aligned with peat accumulation rates

e) Maintenance of peat in wet conditions which prevents release of GHGs

f) Tourism which is aligned with ecosystem fragility and that does not create adverse anthropogenic footprint such as solid waste and sewage into the wetland

g) Maintenance and enhancement of relational and cultural values that communities hold for these ecosystems

h) Governance regime that secures full range of ecosystem services and biodiversity values of Chandertal and mainstreaming in sectoral development plans for climate change, rural development, infrastructure development, tourism and others.

3.2 Status and trends

An analysis of status and trends in ecological character of Chandertal since the time of Ramsar designation is discussed in Table 3.1.

	Ecological character element	Current Status (2015-19)	Data Source	Trends since Ramsar Site Designation in 2005	Data Source	Whether change is anthropogenically induced and adverse? (Green – No or positive change Red – Adverse Change Yellow – Incomplete information)
1	**Wetland type and extent**					
1.1	Wetland type	Distal lake linked with Chandra Bhaga glacier system	Satellite imagery (Sentinel 2B Imagery September 2018)	No change	Satellite imagery (Landsat 7 September 2000)	No change
1.3	Wetland area	46 ha	Sentinel 2B Imagery September 2018	45 ha	Satellite imagery (Landsat 7 September 2000)	Area has remained stable
1.4	Wetland shape	Crescent shape	Sentinel 2B Imagery September 2018;	Crescent shape	Satellite imagery (Landsat 7 September 2000)	No change
1.5	Wetland soil	Sand texture at inlets and outlet Silt texture at shoreline Silt-Clay at peatland	Field assessment (2019)	Not assessed		
1.6	Bathymetric profile	Maximum depth = 29m in southern part; Shallow depth =15-17m in northern part	Bakke et. al. (2016)	Evidences of sediment deposits on northern and eastern margins		
2	**Water regimes**					
2.1	Water permanence	Permanently inundated. Frozen (Dec-March)	Field assessment (2019); Bakke et. al. (2016)	No change		

2.2	Hydrological connectivity within wetland complex	A complex of distal glacial lake, peat-bogs and ephemeral wetlands	Field assessment (2019) Satellite images (Sentinel 2B, 2018)	No change		
2.3	Water source	Snow melt and Precipitation (980 mm for the period 1970-2020)	NASA POWER	Relative dominance of rainfall has increased		Rainfall driven hydrology may bring adverse changes to wetland ecological character, especially vegetation and sedimentation
2.4	Water destination	Chandra River	Sentinel 2B Imagery September 2018;	Chandra River	Landsat 7 Imagery September 2000	
2.5	Water regime stability	Relatively stable with ~50cm inter annual water level difference.	Field assessment (2019)	Insufficient data		
2.6	Water balance	Wetland stores ~5.72 MCM of water during high flow season (summer-monsoon) and ~5.71 MCM during dry season (post monsoon winter)	Hydrological modeling for current management plan	Insufficient data		
2.7	Water pH	7-8.5 (Alkaline in nature)	Field assessment (2019)	Insufficient data		
2.8	Water salinity	EC 212 micro-siemens/cm	Bahadur et.al. (2016)	Insufficient data		
2.9	Dissolved or suspended nutrients in water	Turbidity (>10NTU), DO (~8mg/l)	Field assessment (2019)	Insufficient data		

3	**Wetland catchment**					
3.1	Climate	Temperate and cold arid climate. Mid-latitude westerlies influence wetland hydrology the most. Temperature = -22 to 11 °C Rainfall = ~980 mm	NASA POWER	Increase in temperature and precipitation in Western Himalayas	NASA POWER	Finer basin/landscape scale assessment are required. Available information suggests that the wetland might progress towards increased vegetated state
3.2	Geomorphic setting	Moraine deposits and Debris flow deposit have been recorded. Debris layer is highly heterogeneous from silt measuring few millimeters to big boulders	Field assessment (2019); CGWB (2013); Wadia (1931)	No change		
3.3	Geology	Highly rugged terrain (structural hills and valley fill); Dominant rocks are Quartzite, Shale, Conglomerates, Limestones	Field assessment (2019); Bakke et. al. (2016); Mandal et. al. (2014); CGWB (2013)	No change		
3.4	Soil type	Major types - Sandy & Silt loam. Alkaline (pH = 8); Organic Carbon (0.42-0.78%)	Field assessment (2019)	Limited information		
3.5	Land use Land cover	Catchment dominated by alpine vegetation and rocky moraines.	Sentinel 2B Imagery, September 2018	Reduction in area under snow.	Landsat 7, September 2000	The landscape changes are conducive for increased vegetation in and around wetland.

				Increase in area under wet meadows.		
3.6	Drainage pattern	Parallel drainage network mainly originates from eastern part of the catchment. Wetland outflows into the Chandra River	Aster DEM Sentinel 2B, September 2018	No change	Landsat 7, September 2000	
3.7	Topography	Slope varies from 0-61°	Aster DEM	No change		
4	**Biota**					
4.1	Vegetation	28 species Dominated by Poaceae and Cyperaceae family	2019 Field assessment	Limited information on trends		
4.2	Waterbirds	16 species	Field assessment (2019); Chandertal Management Plan (2018-2028)	14 species	Rana et. al. (2014)	Adverse. Though the number of species reported have not changed much, the species habitat is disturbed due to intensified tourism and grazing
4.3	Mammals	12 species	WISA Field assessment (2019)	11 species	ZSI (2018)	Adverse. Habitat degradation, Increased competition for dietary resources between wild animals and livestock
4.4	Micro-organisms	16 species of Rhizopods	ZSI. Himalayan Ecosystem Series: 4. (2018)	No information		
4.5	Invertebrate fauna	Amphipods are common in shallow areas	Field assessment 2019	No information		
4.6	**Species interaction**					

4.6.1	Migration					
	Plant/Animal	Wetland is a stopover and nesting ground for migratory waterbirds such as Ruddy Shelduck, Garganey and Gadwall	Field assessment (2019); ZSI. Himalayan Ecosystem Series: 4. (2018); Mehta & Thakur (2017); Thakur & Mehta (2016)	Limited information on migration trend		
5	**Ecosystem services**					
5.1	Provisioning services	Supports local medicine (Amchi system of medicine); Alpine pastureland around wetland serves as major source of fodder for livestock belonging to Gaddi community	Field assessment (2019); HPFD (2018); Sharma et. al. (2011); Fleischner (1994)	No information		
5.1.1	Use of water from wetland	Moderate to low dependence of graziers and camp owners	Field assessment (2019)	Extraction of water from the downstream stretches of the wetland has increased, but overall effect remains insignificant		
5.2	Regulating services	Climate regulation value Possible carbon stock in examined peat locations range from 17-120kg/m3)	2019 Field assessment	No information		

5.2.1	Water regime moderation					Hydrological studies are required
5.3	Cultural services					
5.3.1	Recreational and Tourism values	About 40,000 tourists visit the lake annually	Field assessment (2019);	About 2,000 visitors to the lake annually	Field assessment (2019); HPFD (2018)	Current tourist footfall is beyond carrying capacity reported by TERI (2020) under SECURE Himalayas Project
5.3.2	Spiritual and religious values	Community consider the wetland as a sacred lake and celebrate *Bees Bahado* at the wetland. Gaddi herders also have a local deity and made a stone temple in downstream of the wetland	Pers. Comm./2019 Field assessment	Traditional values are perceived to be of low importance by youngsters	Field assessments (2019)	Wetland is valued more for its economic services, rather than spiritual values

3.3 Priority Features and Risk of Adverse Change

From the perspective of wetlands management planning, it is important to distil key ecosystem components, processes and services, maintaining which can ensure that the goal of wetlands conservation and wise use is met efficiently and effectively. The prioritization is done on the basis of five indictors listed in the assessment approach and methods section, and are linked with governance, species, communities and human well-being dimensions. The prioritization matrix is presented in the table below:

Table 4: Prioritization of wetland features for wetlands management planning

Selection criteria	Priority ecosystem Component	Priority ecosystem Processes	Priority ecosystem Services
Maintaining wetland feature in a particular state required to fulfil regulatory commitments	Schedule I species as per WLPA 1972 (Snow Leopard, Tibetan Wolf, Himalayan Ibex, Blue Sheep) Wetland area as per Ramsar designation in 2005		
Species or ecological community has a high conservation value globally or nationally	Species of conservation significance as per IUCN red list, Central Asian Flyway Action Plan and Mammals initiative (Snow Leopard, Ruddy Shelduck) Peatland and alpine meadows which serve as breeding grounds for migratory waterbirds		
Species or ecological community is a characteristic feature and is required to maintain site's uniqueness	Floral community inhabiting peat bog (plants belonging to *Poaceae, Cyperaceae and Sphagnaceae*)		
Wetland features support or has a significant influence on a prioritized ecosystem component, process and services.	Bathymetry which encourages post glacial peatland development; Peat bogs which act as carbon stores	Water density stratification which controls circulation and sedimentation patterns; Sedimentation which influences water holding capacity	

Wetland features support well-being of communities in instrumental or relational terms	Water depth which influences water regime moderation capacity	Carbon accumulation	Water regime moderation which buffers downstream communities; Tourism and recreational values which are source of livelihoods; Spiritual and cultural linkages of communities; Wetland as a source of fodder for pastoralists

Image 12: Left over toilet assembly at camping site near Chandertal

The primary objective of wetlands management planning is to prevent the risk of human-induced adverse change in ecological character. To identify the priority ecosystem component, processes and ecosystem service at risk, a mapping of known status and trends in wetlands features (derived from ecological character description contained in previous section) with priority wetland features is done. The implication is presented in the form of positive or adverse change, or aspects which are currently unassessed and thereby need further assessment and research. The risk assessment matrix is presented in the following table:

Table 5: Ecological character risk assessment matrix

Wetland Features	Observed trends	Impact on priority ecosystem component						Impact on priority ecosystem processes			Impact on priority ecosystem services		
		WLPA 1972 Schedule I Species	Wetland area as per Ramsar designation	Species of conservation significance (IUCN and CMS)	Peat Bog habitat	Bathymetry	Water Depth	Sedimentation	Water density stratification	Carbon accumulation	Water regime moderation	Tourism and recreation	Source of fodder
Wetland extent	Stable area of distal lake (sec 1 of ECD)		+/-										
Wetland catchment	Increase in relative proportion of rainfall (sec. 3.1 of ECD)	'+/-		'+/-	-		-	+			+/-		
Glacier dynamics	Reduced glacier area and mass (sec 3.1 and 3.5 of ECD);	-	-	-	-		-	+	+/-	-	-	-	+/-
	Fragmentation of glaciers	-	-	-	-		-	+			+/-	-	+/-
Wetland carbon	Peat bog areas vulnerable to grazing	-		-	-					-	-		-
Biota	Declining wildlife sightings (mammals and waterbirds) due to anthropogenic drivers (sec 4 of ECD)	-		-								-	
Ecosystem services	Number of tourists beyond carrying capacity (sec 5.3 of ECD)	-		-	-			+				+/-	
	Decline in cultural values (sec 5 of ECD)			-								-	

+ means positive impact; - means negative impact

3.4 Key Knowledge Gaps

HAWs are, in general, under-researched and poorly documented owing to harsh physical conditions and access challenges. While the current knowledge base on Chandertal allows to describe the wetland character based on broad assumptions, more fine-grained data and information is required to be able to assess and monitor trends and suitably adapt management. Following research gaps need to be addressed on priority:

- Comprehensive inventory of plant and animal species and habitat conditions
- Impact of long-term changes in glaciers and precipitation patterns on wetlands hydrological regimes
- Extent of wetland sedimentation and its impact of hydrological functioning
- Mapping of springs and spring sheds and their relationship with wetland hydrology
- Extent of peatlands and carbon storage, and strategies for ensuring that peatlands are maintained in wet conditions
- Carrying capacity of tourism within Chandertal catchment
- Carrying capacity of grazing within Chandertal catchment
- Community attitudes and perceptions on multiple values of wetlands

4. Institutional Arrangements

Governance improvement, at all levels of planning and decision-making is important to achieve wetlands wise use. Wetland functioning, their biodiversity and ecosystem services values are linked with institutional settings and governance systems, which in turn provide the crucial steering function towards wetlands wise use. Institutions encompass all formal and informal interactions among stakeholders and social structures that determine decision making, power relationships and sharing of responsibilities. Various institutions come together collectively to form governance systems that include interactions between different centers of power in the society at different scales. Most importantly, institutions and governance influence the direct and indirect drivers of change in a wetland ecosystem. The degree of fit of institutions and governance systems with the functioning of Chandertal at basin scale is one of the key determinants of integrated management.

Institutional arrangement can create an enabling environment for conservation and wise use of Chandertal by establishing mechanisms for:

- Defining clear management framework in terms of goals, objectives and outcomes
- Clarifying roles and responsibilities of different agencies, government and non-government, participating in different aspects of wetlands management including planning and visioning, allocating resources (human and financial), implementing actions, monitoring and review.
- Ensuring integration of site management within broad scale sectoral plans and programmes
- Enabling stakeholder participation so that wetlands management reflects needs and capacities of diverse stakeholder groups.
- Enabling knowledge-based development on direct and indirect drivers of adverse change in wetland character, including emerging risks and risk management options.
- Enabling adaptive management by putting in place monitoring and review mechanisms, assessing management effectiveness and incorporating learnings into management plan implementation.

4.1 Existing Institutional and Governance Arrangements

4.1.1 Site Management

Chandertal forms the core of the Chandratal Wildlife Sanctuary, notified in the year 2007 under The Wildlife (Protection) Act, 1976. While the protected area falls within the Lahaul sub-division, administration of the protected area is vested with the Spiti Wildlife Division of the Himachal Pradesh Forest Department, owing to proximity to Kaza, the district headquarters. The Divisional Forest Officer of the Spiti Wildlife Division functions under the Additional District Magistrate of Spiti sub-division. Within the Forest Department hierarchy, the work of Divisional Forest Officer (Spiti Wildlife Division) is overseen by the Chief Conservator of Forest (Wildlife), South. The administrative set up for the protected area comprises a Range Forest Officer supported by a Deputy Ranger and a Forest Guard. The unit reports to the Divisional Forest Officer (Spiti Wildlife Division).

A management plan has been approved for Chandratal Wildlife Sanctuary (2018-2028) by the Himachal Pradesh Forest Department, which lists activities for enforcement of extant regulation; ecotourism and conservation education; and research monitoring and training.

In June 2016, a draft notification for 6,150 ha of eco-sensitive zone was issued, by the virtue of which land use change is prohibited, and regulations placed on tourism, discharge of effluents and solid wastes, and a range of developmental activities. Activities prohibited in the eco-sensitive zone include:

a) Commercial mining, stone quarrying and crushing units
b) Setting up of saw mills and new wood-based industries, and commercial use of firewood
c) Use or production of any hazardous substances
d) Setting up of industries causing water, air, soil or noise pollution
e) Establishment of new major thermal and hydro-electric projects
f) Discharge of untreated effluents and solid wastes in natural waterbodies or land area including use of polythene bags

Activities regulated under the notification include:

a) Tourism and establishment of hotels and resorts (and fencing of existing premises of hotels and lodges)
b) Construction including trenching grounds
c) Discharge of treated effluents and solid wastes in natural waterbodies or land area
d) Air, vehicular and noise pollution
e) Groundwater extraction, including commercial use of natural water resources
f) Erection of electrical lines
g) Felling of trees
h) Widening and strengthening of existing roads
i) Collection of non-timber forest products
j) Migratory graziers
k) Small-scale non-polluting industries
l) Introduction of exotic species
m) Protection of hill slopes and river banks
n) Sign board and hoardings

Monitoring of the implementation of various provisions of the Eco-Sensitive Zone Notification is placed within the charge of the Monitoring Committee headed by the District Magistrate, Lahaul and Spiti and with Divisional Forest Officer, Kaza as the Member Secretary. The notification, as on the date of compiling the management plan, was still pending with the MoEFCC, and the committee therefore is yet to be constituted.

At state level, Himachal Pradesh State Wetland Authority (HPSWA) has been notified in 2017 as the nodal policy-making, programming and regulatory body for wetlands. The HPSWA has been constituted as per the provisions of Wetlands (Conservation and Management) Rules, 2017 and is placed under the aegis of Himachal Pradesh Council for Science, Technology & Environment (HIMCOSTE). HIMCOSTE was established at Shimla by the Government of Himachal Pradesh in 1986 under the country-wide programme of Department of Science and Technology, Government of India to promote science and technology in the state. The HIMCOSTE in the past has prepared annual management plans for Chandertal as per the guidelines of the MoEFCC, with activities including construction of structures to prevent rolling of stones and boulders into the wetland, and awareness activities. The budgets allocated by the Ministry to HIMCOSTE are transferred to the Forest Department for implementation of approved actions, in their capacity as the site managers of the wetland.

4.1.2 State Government Departments and Agencies

A number of State Government Department and agencies implement programmes in and around Chandertal, or have the potential to support management of Ramsar Site. An overview of these is given in Table 6.

Table 6: Overview of programmes implemented by various State Government Departments in Chandertal

Name of the department/ organization	Ongoing programmes relevant to Chandertal	Major achievements in past 3 years	Budgetary allocations
Himachal Pradesh Forest Department – Wildlife wing	Chandratal Wildlife Sanctuary Management Plan 2018-28	Annual Biodiversity Census	INR 90.5 Lakhs (2018-20)
		Development of tourism infrastructure such as parking space and guard room 1km before the wetland.	
HIMCOSTE			
State Biodiversity Board	UNDP SECURE Himalayas Project (2019)	Identification of medicinal plants in Lahaul and Pangi areas to support rural livelihood programme. It includes identification of key species, harvesting pattern, and promotion of livelihood opportunities based on indigenous products	
	Implementation of Biological Diversity Act 2002	Inventory of Rare, Endangered and Threatened species, including medicinal plants.	
		Constituted Biodiversity Management Committees (BMCs) in Lossar and Khoksar Panchayats	
		Training workshop on Mainstreaming Biodiversity: Sustaining People and their Livelihoods at Keylong June, 2018	
Himachal Pradesh State Wetlands Authority	Wetlands Conservation Programme	Awareness campaigns with local schools on values of wetlands and their role in wetland management	INR 13 lakhs (2016-17)
		Revision of Annual action plan 2020-21 under NPCA	

		Wetland Health Card and brief documents have been prepared and submitted to MoEFCC under 100 days programme	
State Centre on Climate Change	Inventory of glacial lake in Himachal Pradesh	Mapping of glacial lakes (within Chandrabhaga sub-Basin)	
Environment, Science and Technology Department	Himachal Pradesh Knowledge Cell on Climate Change (HPKCCC)	State Action Plan for Climate Change, 2012 lists down measures to mitigate and adapt to climate risks in the state. One of its sections lays focus on conservation of wetlands of international importance including Chandertal.	
Himachal Pradesh Tourism Department	Infrastructure Development Investment Project for Tourism (IDIPT-HP)	Chandertal is one of the selected sites within 100 destinations prioritized under the programme. It is proposed to develop tourist, health care and communication facilities around Chandertal	NA
Himachal Pradesh Animal Husbandry Department	Livestock Health and Disease Control (LH&DC) - Foot & Mouth Disease (FMD) Control Programme	FMD - immunization of entire cattle and buffalo population against FMD	FMD – INR 248.00 lakh
	Peste-des-petis rumnants (PPR)-Control Program	PPR - mass vaccination of sheep and goats (covering at least 30% of population of Sheep & Goat) against PPR disease	PPR – INR 30.00 lakh
Himachal Pradesh Disaster Management Authority	Samarth (mass awareness campaign on DRR)	Organization of community DRR campaign 'Samarth' in all districts	

4.1.2 Key Organisations/Agencies

HAWs in general have received limited research focus, which also reflects in the paucity of temporal data on the wetland. The National Centre for Antarctic and Ocean Research, Ministry of Earth Sciences and select IITs have conducted assessment of GLOF potential of wetlands of Chandra Bhaga Sub-basin. The Wildlife Institute of India, under the framework of Secure Himalayas project has coordinated development of a knowledge database on Lahaul-Pangi landscape. Aspects of climate change included in the project may be relevant during

management plan implementation. The Nature Conservation foundation (NCF) and Snow Leopard Trust have supported formulation of the management plan for the Chandratal Wildlife Sanctuary. In 2010-2015, WWF India worked on management planning of Chandertal and formed Gaddi groups as part of community-based wetland management

4.1.3 Private Sector

There are a number of private hoteliers and tent operators who run tourism businesses in Chandertal. Geographically, Chandertal lies in remote areas of Lahaul Spiti district which greets tourists with majestic natural landscapes and provide unique cultural experience. Chandertal lies in the circuit between Spiti and Lahaul which has numerous tourist attractions such as Tabo, Kaza, Kibber, confluence of river Chandra and Bhaga at Tandi, Udaipur, Miyar valley, Keylong, Jispa, Zanskar Sumdo and further towards Leh-Ladakh or Chamba. Due to a recent spurt in both summer and winter tourism in Spiti and State Governments priority in promotion of tourism, the Lahaul Spiti district has seen a rapid increase in tourism and allied businesses such as transport and hospitality. As per Himachal Pradesh Tourism Department (HPTD) data (himachaltourism.gov.in), the number of tourists visiting the Lahaul Spiti district have increased significantly from 90,393 in 2014 to 1,32,983 in 2019. It also informs that there are 84 registered hotels and 14 registered homestays in the district.

The Chandertal wetland is recognized as a major economic asset for the remote region that supports tourism-based livelihoods. Tourism at Chandertal is a major revenue generator for local residents with many working as camp workers, tour operators and allied services. The rate of increase in tourism at the wetland is alarming as during 2010-2018, key informant interviews suggested the number of tourists visiting Chandertal has increased manifold, from nearly 2,000 to 40,000 per year. During the field visit in 2019, the camp site at Chandertal accommodated nearly 150 tents for tourists, exclusive of ancillary tents. Due to such conspicuous rise, major settlements such as Kaza, Keylong, Tabo and even on-the-way villages such as Hansa, Lossar, Chhatru, Kibber, Chichong etc. have undergone rapid changes to accommodate more tourists and generate income.

During the field visit it was also noted that the tourism sector is dominated by private non-resident hoteliers and camp owners. Although some resourceful local residents have stepped into the tourism sector, the non-residents hoteliers and camp owners are increasing their footprint by procuring land lease to build hotels, cafes and restaurants. Moreover, due to the top-down approach of tourism development in the landscape, representation of local community aspirations in terms of decision making, generating livelihoods and interacting with tourists is appallingly compromised. Most of the local residents are engaged as helping staff, construction labour, drivers and so on. Whereas, the outsiders encash a major proportion of economic benefits generated out of the landscape tourism.

4.1.4 Policy and Regulation

With India as a contracting party to the Ramsar Convention and Chandertal a designated Ramsar Site, there are specific commitments for conservation and wise use of the wetland. Article 3 of the Convention enjoins the Contracting Parties to formulate and implement their planning so as to promote the conservation of wetlands included in the Ramsar List, and arrange to be informed at the earliest possible time if the ecological character of the site is changing or is likely to change as a result of technological developments, pollution or other human interference.

The legal and regulatory basis for management of Chandertal are set by several national and state level acts and rules. The Environment (Protection) Act (1986), The Indian Wildlife

Protection Act (1972 and amended upto1993), Biological Diversity Act (2002); and The Water (Prevention and Control of Pollution) Act, 1974 are some of the key national legislations that protect biodiversity and environment of Chandertal and its surrounding eco-sensitive zone representing alpine settings.

The Wetland (Conservation and Management) Rules, 2017 sets out the regulatory framework for Ramsar Sites. The rules prohibit a range of activities in the notified wetlands, key activities being hydrological fragmentation, conversion to non-wetland uses and discharge of untreated water. Similarly, Chandertal being a notified Wildlife Sanctuary also enjoys protection as per Wildlife Protection Act, 1972 which lays down guidelines on provisions for wildlife protection, habitat management and necessary developmental work.

The regulatory framework for conservation of wetlands is closely tied with the environment, water and other sectoral policies of the central and state government. The National Environment Policy (2006) identified wetlands as critical 'freshwater resources' and recommends prudent use and mainstreaming in sectoral development policies. The National Water Policy (2020 draft) calls for a more holistic approach to water, considering the role of ecosystems such as wetlands in maintaining the water cycle, including the linkages between green and blue water flows.

The Government of Himachal Pradesh has adopted a number of policies and programmes which directly or indirectly support wetlands conservation. State Action Plan on Climate Change, 2012 includes wetlands conservation, especially climate vulnerability assessment of wetlands as a priority area within mitigation and adaptation actions, although wetlands and carbon linkages are missed out. State Disaster Management Plan, 2017 (updated in 2020) covers mountain hazards and role of wetlands in regulating the hazard risks. Within non-structural measures of DRR, wetlands conservation and catchment area treatment are identified as key measures. Moreover, regular monitoring of lake water levels is also recommended as a part of early warning mechanisms. The Himachal Pradesh Tourism Policy, 2019 focuses on sustainable tourism and provisions for carrying out capacity-based tourism development. The State also has a policy on Payment for Ecosystem Services (PES) (2013), however the mechanism for quantifying the downstream ecosystem services of HAW are not defined, and the focus currently is largely on forests.

There are informal institutional arrangements pertaining to management of Chandratal as well. Several Gaddi herders inherited rights to graze in the high-altitude meadows in the landscape around Chandertal, which is regulated by the state forest department. The customary right derives from inheritance, and cannot be transferred under any circumstances.

Bees Bahado is a local festival celebrated in the landscape where local communities visit the sacred wetland and pay tribute to their local deities. The scaredness of the wetland is maintained by communities through cleaning and tourist sensitisation. Every year, the herders bring their livestock to the high-altitude landscape to graze upon the alpine pastures. The Gaddi herders consider the place as home of the Gods and Goddess, as well as various benevolent and malevolent lesser spirits. Thus, they adhere to traditional wisdom and learnings to graze sustainably and avoid any displeasure to the local deities.

Khoksar and Lossar Gram Panchayats support management of Chandertal area by regulating developmental activities at Chandertal. They also support collection and management of plastic and solid waste, and ecotourism activities at Chandertal. Recently in 2019, Khoksar Panchayat released an order to shift tourist camps from Chandratal ESZ to Batal.

4.2 Gaps

An analysis of current institutional arrangements indicates that the current set-up is configured towards meeting the regulatory requirements under The Wildlife (Protection) Act, 1976 and the Eco-sensitive Zone notification, but does not cater to the needs of managing Chandertal as a high-altitude wetland of significant ecological and socio-economic values, and its designation as a Ramsar Site. In the table below, the current arrangements are contrasted against the desired wetland governance features. Some of the critical gaps remain in terms of intersectoral and stakeholder engagement in wetlands management and availability of management-oriented knowledge base to guide review and adaptation of management actions, and incorporation of best practices.

Table 7: Evaluation of existing institutional arrangements and governance regimes

Desired features of governance	**What exists at present**	**What is the gap**
Clear wetlands management framework in terms of goals, objectives and outcomes.	Management Plan for Chandratal Wildlife Sanctuary (2018-2028) defines management framework for the Chandratal Protected Area and its Eco-sensitive Zone.	Management framework for Chandertal Ramsar site remains undefined. The current PA plan is focused on enforcement of Wildlife (Protection) Act, 1976 and ESZ notification.
Clarity of role and responsibilities with respect to wetland management	Being part of Protected Area, the Divisional Forest Officer is responsible for ensuring wetlands conservation. The PA plan enlists activities that are to be undertaken by Forest Department to secure biological diversity of the Chandertal Protected Area	No mechanism to assess wetland ecosystem health, status and trends in various wetland features, and implications for management Human resources allocated for management of Chandertal and the Eco-sensitive zone lack in number and capacity. During the field visit in 2019, the DFO (WL) Spiti is responsible for managing the large Spiti Wildlife Division. Range Officer, Kibber supports the DFO in management of Chandertal Wildlife Sanctuary with support from only two contractual guard/helpers at-site. Due to jurisdictional arrangements shared between Lahaul District Administration and Spiti Wildlife Division, roles & responsibilities are inadequately shared between two jurisdictional areas.

Mechanisms for participation of stakeholders	At site, only the Forest Department implements the management plan with support from State Police and local camp workers.	Active intervention of other stakeholders such as State Wetlands Authority, State Biodiversity Board and State Climate Change Centre are absent. Coordination with other major actors such as District Administration (Tourism Development Office) of Keylong and Kaza, State Wetlands Authority and Climate Change Centre, State Animal Husbandry Dept., Disaster Management, Gram Panchayat of Khoksar and Lossar is inefficient and reactive. Stakeholder coordination and engagement mechanisms are absent
Integration of site management within broad scale environmental and developmental programming.	At state level, mainstreaming is the key function of HPSWA	Mechanisms for consideration of Chandertal ecosystem services and biodiversity values in district level planning are not well-defined.
Ability of management to address direct drivers of wetland degradation	The management plan focuses on capacity building of staff in wildlife & habitat conservation, management of tourism, and awareness of community members for participatory management of the WLS	Current management led by Forest Department covers active, reactive and proactive measures for biodiversity conservation. Several wetland functions such as nutrient cycling, carbon accumulation, and others are not factored in the current WLS management plan. Besides monitoring of key biota, wetland quality and carbon concentration in peat-bog ecosystem as climate mitigation measures are missing.

Ability to secure and enhance biodiversity and ecosystem services	Current management is focused on preserving biodiversity values of the landscape.	Wetland ecosystem services such as carbon accumulation, nutrient cycling, water regulation for disaster risk reduction are not covered in the current management regime. Also, the anthropogenic drivers such as tourism and grazing pose threats to delivery of these critical ecosystem services, which are not addressed in the management plan.
Ability to access science and knowledge base to adapt management	Research topics have been enlisted in the PA plan to cater to biodiversity aspects. NCPOR, Goa has established a long-term programme 'Himansh' to study glacial dynamics of Himalayan Cryosphere, and Chandra Sub-basin is one of the focus areas. Adhoc research is done on different aspects of wetlands	There is no mechanism to define research needs catering to wetland management needs, not a system to integrate research in management actions.

4.3 Proposed Institutional Arrangement

Institutional arrangement for managing Chandertal should be capable of bringing multiple stakeholders together for wetlands conservation, and ensure incorporation of wetlands ecosystem services and biodiversity values in various development plans.

At site level, it is proposed to entrust management of Chandertal to the Lahaul and Spiti District Wetlands Management Committee. The Committee will be headed by the Deputy Commissioner, who is also the chief administrative authority, and for all intents and purposes, head of all district level offices. The Committee may have following members:

- Senior Town Planner
- Executive Engineer, Himachal Pradesh State Pollution Control Board
- Divisional Forest Officer, Spiti
- Representative, Tour Operators
- Representative, Hoteliers and Restaurants
- Representative, HIMCOSTE
- Village Pradhan, Khoksar
- Expert member, High Altitude Wetlands (nominated by HPSWA)

The committee will have the following role and functions:

- Maintain an overview of implementation of various actions enlisted in management plan
- Review developmental projects in and around Lahaul and Spiti District which have implications for Chandertal, and suggest necessary modifications to prevent adverse change
- Ensure convergence of schemes and action plans of various line departments with Chandertal management plan
- Consider changes to wetlands management plan indicated as an outcome of monitoring data or research studies
- Consider views of various stakeholders on wetlands management and ensure necessary incorporation without compromising the ecological character of the wetland
- Recommend thresholds for number of tourists and location of tourist camps around Chandertal
- Maintain an overview of implementation of extant regulation, and bring violations in the notice of respective authorities
- Management will be guided by information on wetland ecological character and drivers of change, the design of which is discussed in Chapter 5 of this management plan. The overall responsibility to implement the Wetlands Inventory, Assessment and Monitoring System is proposed to be assigned to HIMCOSTE. Specific responsibilities include:
- Ensure systematic collection, collation and synthesis of monitoring data, preferably in a GIS environment
- Collate progress of implementation of various management actions and report progress to District Wetlands Management Committee and State Wetlands Authority
- Commission specific studies, listed out in Chapter 7, and recommend amendments and refinements to management plan implementation based on study outcomes
- Prepare and make available to District Wetlands Management Committee and State Wetlands Authority summary wetlands monitoring report, specifically highlighting status and trends that require management intervention
- Update Ramsar Information Sheet every six years and submit to the Ramsar National Focal Point at the MoEFCC
- Conduct periodic capacity development programmes for line departments and agencies of the state governments, NGOs and CSOs involved in implementation of management action plan
- Conduct management effectiveness assessment as outlined in Chapter 5, and use the findings to revise management plan
- Address any knowledge and research need raised by District Wetlands Management Committee related to implementation of wetlands management plan

5. Management Framework

Management of Chandertal needs to be based on recognition of the full range of ecosystem services and biodiversity values of the high-altitude wetland and their mainstreaming into developmental planning at all levels. The effectiveness of management will be reflected in the ability to maintain the current near-pristine condition of the wetland, and ensuring the anthropogenically induced drivers of adverse change are reduced to the extent possible.

The evaluation of wetland features, as summarized in Chapter 2 and 3 of the management plan and the institutional arrangements in Chapter 4 indicate that the current management arrangements are focused on regulation of the wetland on protected area-based approaches. The sustainability of such a management approach is limited, as it is centered on a few wetland features (primarily maintaining habitats for key species), and cannot ensure alignment of sub-basin scale land and water use with wetlands functioning. As the impacts of climate change unfold over the Western Himalayas in the form of shrinking glacial cover, increase in temperatures, increasing dominance of liquid precipitation and range shifts in vegetation in the landscape, the wetland is likely to transform towards higher inundation regime variability and colonization of shorelines by wet-meadows. With melting of Samudra Tapu glacier, its proglacial lake has been increasing in size and volume, thus exposing the Bhaga sub-basin to the risks of GLOF. With increasing variability in climate system and precipitation, the value of Chandertal and other HAW (including the peat bogs) as regulators of water regimes and as carbon stocks will become highly critical in the times to come. At the same time, climate change and the ongoing developmental pressures may lead to intensification of existing risks as well as creating new risks, thereby calling for systematic monitoring, and periodic adaptation in management approaches on the basis of new information that is generated in the process.

The current chapter sets out the management planning framework, including setting the management goal and purpose, management strategy, objectives, targets and indicators, and likely risks and risk mitigation options pertaining to implementation of management plan.

5.1 Management Goal and Purpose

The goal of managing Chandertal is *'maintaining Chandertal ecosystem in a healthy state and ensure sustenance of ecosystem services and biodiversity values.*

The purpose is to:

- Sustain wetland and associated alpine habitats of migratory birds and notable wild species to complement conservation efforts in the Upper Spiti landscape and high altitude stretches of Lahaul
- Ensure water security in the Chandra sub-basin by sustaining base flows of the wetland
- Provide income generation opportunities to local communities through wetland-based sustainable tourism
- Maintain peatland carbon stocks as a contribution to climate change mitigation
- Reduce disaster risks for settlements in downstream, especially Batal, Chhatru and other settlements of Lahaul Division

5.2 Management Strategy

Chandertal still retains a near pristine condition, and thereby an overall passive management strategy, which relies on close monitoring of the wetland ecosystem will guide management implementation. Following are the five core management strategy elements:

1. *Maintenance of natural regimes of Chandertal by limiting anthropogenic drivers of adverse change*

   Management plan will entail limiting anthropogenically induced adverse change in the wetland regime by regulating two major activities, namely tourism and grazing. No physical intervention around the wetland is proposed, which is also in line with the provisions of the Wildlife (Protection) Act, 1972 and Eco-sensitive Zone notification which provides the regulatory framework for management of Chandertal.

2. *Integration of HAW management with sectoral planning at various levels*

   It is important that any sectoral plan directly or indirectly linked with the Chandra-Bhaga sub-basins takes into cognizance the ecological sensitivity of the wetland system, and the entire cryosphere to with which it is linked. The management plan thus envisages putting in place institutional mechanisms, in the form of District Wetlands Committee which will be working in close collaboration with HPSWA, concerned line departments and agencies and stakeholders so that these sectoral interactions are duly considered prior to initiating any such programmes.

3. *Dovetailing with existing management framework for Chandratal Wildlife Sanctuary*

   Chandertal forms the core and integral part of the Chandratal Wildlife Sanctuary and is governed by the broader management framework set by the HPFD. The current management plan will form an integral part of the Sanctuary Management Plan (approved for 2018-2028), and will complement wetland related actions of the plan.

4. *Adaptive management based on systematic monitoring and evaluation and integration in decision-making*

   HAW such as Chandertal are highly dynamic and complex. The scientific knowledgebase on these ecosystems is still evolving, and there are high uncertainties as well as unpredictability associated with outcomes of various management interventions, attributed to various reasons including:

   - Climatic variation that is uncontrollable (such as melting rates of glaciers)
   - Partial observability (as not all wetland features and factors can be monitored on the basis of a comprehensive design)
   - Partial controllability of actions (as management interventions are implemented through a number of agencies)
   - Structural uncertainty arising out of lack of complete understanding of ecosystem functions

The management plan envisages to be adaptive – a monitoring system will support iterative learning which will then be used to improve management using a goal-oriented and structured process. This is core of adaptive management – a formal iterative process of resource management that acknowledges uncertainty yet strives to achieve management objectives by increased system knowledge using a structured feedback process.

5. *Ensuring sustainable and responsible tourism at Chandertal*

Tourism has been identified as a major economic development opportunity for Himachal Pradesh, and HAW form a core asset for this sector. The management plan seeks to blend principles of eco-tourism with recreational and adventure tourism for better appreciation of Chandertal values, which will ultimately contribute to affirmative behavior in favor of wetlands conservation and wise use.

5.3 Management Objectives and Performance Indicators

The management strategies have been translated into three major and thirteen specific objectives which reflect the desired state of key features of Chandertal (Table 8). For each wetland feature, the performance indicators are the attributes which can indicate change.

Overall objectives for management of Chandertal are:

1. To maintain healthy habitats and viable population of dependent species in Chandertal
2. To ensure and promote wise-use of ecosystem services provided by Chandertal towards human society
3. To develop a participatory and integrated institutional arrangement for conservation and wise use of Chandertal

Table 8: Management objectives, performance indicator and measurable attributes

Management specific objectives	**Performance indicator**	**Measurable attribute**
Objective 1: Maintain naturalness of the wetland catchment	Proportion of natural land cover around the wetland (marshes, grasses etc.)	% of wetland catchment under natural land cover / devoid of construction or human-made infrastructure
Objective 2: Maintain water quality to support ecosystem processes and services	Water quality (physical and chemical parameters)	Dissolved Oxygen Electrical conductivity Nutrient concentrations
Objective 3: Maintain peat carbon stocks in Chandertal catchment and eco-sensitive zone	Wetted soil and high carbon concentration	Soil Organic Carbon
Objective 4: Reduce risks of GLOFs in Chandertal ESZ	Water level of the Samudra Tapu wetland	Rate of increase in water level
Objective 5: Maintain and improve alpine habitats to support diverse wetland-dependent species	Species diversity and distribution	Species count
Objective 6: Align grazing within the regenerative capacity of the alpine ecosystems within Chandertal ESZ	Regeneration of alpine vegetation	Change in vegetation cover within direct catchment
		Number of herders practicing rotational grazing
Objective 7: Systematic wetlands inventory, assessment and monitoring system (WIAMS) to inform management decisions and assess effectiveness	Decision making takes cognizance of WIAMS generated data	Number of parameters enlisted in WIAMS
Objective 8: Preserve cultural values and	Prevalence of values and wise use practices	Appreciation of wetland values by locals

traditional practices aligned with wise use of Chandertal		
Objective 9: Preserve recreational and touristic value of Chandertal	Prevalence of Touristic and Recreation Value	Visitation rate Tourist satisfaction score Visitor's environmental sensitive behaviour
Objective 10: Maintain compliance with relevant rules and regulations at spatial scale of Chandertal ESZ	Compliance with conditions/guidelines laid under the Rules and Regulation	Number of violations
Objective 11: Ensure consideration of HAW values and functions in sectoral plans	Integration of Chandertal management actions in sectoral plans, such as Zonal master plan	Number of plans that take into account Chandertal values and functions
Objective 12: Enhance awareness on wetland values to promote stakeholder participation in wetlands management	Reflections of stakeholder aspirations in management plan	Diversity of stakeholder groups engaging in management
		Consideration of stakeholder issues and feedback in management implementation
Objective 13: Maintain and enhance capacities of responsible staff members for integrated wetland management	Management effectiveness	Management effectiveness assessment
		Use of integrated wetland inventory, assessment and monitoring system to inform management

5.4 Risks and Risk Mitigation Options

The management plan is based on certain risks and assumptions, which have a bearing on the capability to meet the goals and objectives discussed in the sections above. The identified risks and their mitigation strategies are summarized in table below.

Table 9: Risk and Mitigation Options

Risk	Level of risk	Risk mitigation
Extreme events Due to rapid loss of glacial mass in Samudra Tapu glacier, there is a pertinent risk of GLOF in terminal wetland and Chandra River, which could fundamentally alter the entire wetland regime.	Medium	The monitoring plan includes monitoring and addressing GLOF Risks
Focus on commercial tourism Commercial tourism is promoted as an economic development and livelihood generation opportunity	High	Carrying capacity assessment has been proposed to act as a basis of regulation of tourists. Institutional arrangements also emphasize consideration of ecological sensitivities in all sectoral-development projects.

Emergence of animal diseases Grazing practices lead to emergence of wildlife diseases such as FMD	Medium	Management plan provides for regular coordination with Animal Husbandry Department and strengthening permit system
Limited stakeholder engagement in wetlands management The desired level of stakeholder engagement in wetlands management in not achieved. Wetlands management is pursued as a forest department activity	Medium	Constitution of District Wetlands Committee is proposed.
Piece-meal implementation of management plan Management plan is not implemented as per the envisaged timeline and sequence, leading to sub-optimal results.	Medium	Management plan will be endorsed by the Himachal Pradesh State Wetlands Authority and the MoEFCC prior to implementation.
Monitoring systems are not put in place Desired wetlands inventory, assessment and monitoring systems are not put in place, thus limiting tracking of management effectiveness and implementation review.	Medium	Establishing monitoring systems has been built into the terms of reference of HIMCOSTE, which has the necessary ware withal for the purpose.

6. Monitoring Plan

Management of Chandertal is aimed at maintaining its ecological character, and in doing so, retaining those essential ecological and hydrological functions which ultimately enable the wetland to provide its provisioning, regulating and cultural services. Having a system to describe, monitor and detect changes in ecological character is therefore critical to support decision making for wise use of this Ramsar Site. Equally important is to be able to assess effectiveness of management in terms of ability to develop and implement an integrated planning, management and evaluation system to secure wise use of the wetland.

The present system for monitoring Chandertal is highly fragmented and disjointed. A few government agencies and departments (for example the HPFD and HPSWA) collect information on specific parameters of interest, chiefly biodiversity and habitat related. There is no system at present for systematic collection of data on various wetland features and collating the same to inform management. This severely limits the possibility of objectively defining the status and trends of various wetland features, and identification of related drivers and pressures.

The current section of the management plan describes a monitoring framework for Chandertal to support integrated management for wise use of this HAW. The section details monitoring purpose and strategy and associated resource requirements. The monitoring plan is proposed to be applied both at the scale of wetland ecosystem, as well as institutional arrangements supporting management. Thus, a section outlining strategy and framework for assessing management effectiveness is also included. The cost implications of the monitoring plan have been factored in the Chapter 7 (action plan) and Chapter 8 (budget and financing).

6.1 Monitoring Objective

Monitoring plan for Chandertal addresses the inter-related requirements of wetland inventory and wetland assessment. It is imperative to put in place an integrated Wetland Inventory, Assessment and Monitoring System (WIAMS) to address the overall information needs for wetland management, and to provide a robust decision support system for the same. The ambit of monitoring is also envisaged to include assessment of management effectiveness. The following are the specific objectives for establishing WIAMS:

- Developing up-to-date and scientifically valid information on status and trends of wetland features and influencing factors
- Establishing a baseline for measuring change in ecosystem components, processes and services
- Informing decision makers and stakeholders on the status and trends in biodiversity, ecological functioning and ecosystem services of the wetland
- Supporting compliance to national and state legal requirements and regulatory regimes
- Determining impacts of developmental projects on ecosystem components, processes and services
- Identifying risks to ecological character and support development of response strategies
- Assessing effectiveness of wetland management

6.2 Monitoring Strategy

Monitoring strategy responds to the following information needs of Chandertal management:

- Inventory - to establish the ecological character baseline
- Assessment – to establish status, trends and threats to wetland using inventory information
- Monitoring – to assess changes in status and trends, including reduction in existing threats or appearance of new threats, or even changes in management effectiveness

As this information pertains to various spatial scales, the overall information requirements can be classified into three hierarchical levels:

- Chandertal
- Catchment
- Chandra Bhaga cryosphere

A hierarchical classification of inventory, assessment and monitoring needs for Chandertal is presented in Table 10. The information needs for inventory are derived from the core datasets needed to establish a baseline on ecological character[5] for Chandertal, and contain all the essential ecosystem components, processes and services, as well as management related parameters that characterize the site. Within the wetland catchment, information needs to pertain to climate trends, geology and geo-morphic features, proximity to glaciers, extent of other HAW and habitats, hydrological connectivity within, biodiversity profile, and governance regime. At all levels, information on institutional arrangements and management practices is included so as to enable creation of a baseline on sectoral programmes, and the linked stakeholders, which are likely / have an impact on the wetland state. While not explicitly mentioned, strategic environmental assessments can be commissioned for any developmental project that has /is likely to have negative impact on the wetlands or surrounding cryosphere.

Information needs for monitoring the wetland have been derived from assessment of ecological character carried out for development of the management plan. Six cluster of needs have been identified: a) wetland extent & physical regime; b) catchment; c) hydrology; d) species and habitats; e) resources and linkages; f) institutions and governance.

This monitoring information adequately addresses the needs of Wetland (Conservation and Management) Rules, 2017; Ramsar site guidelines and existing regulations of The Wildlife Protection Act, 1972 and Environment Protection Act, 1986 (related to ESZ) of the Ministry of Environment, Forests and Climate Change. A list of wetland features, indicators and corresponding methodology and data collection frequency is provided as Table 11.

The monitoring and assessment needs are envisaged to be addressed by a dedicated monitoring programme and specific research and assessment projects. Inventory, being based on collated information on identified wetland features and management practices, will be developed based on the monitoring and assessment information, as well as secondary sources.

[5] Derived from the core inventory fields required for ecological character description as per Ramsar Convention Resolution X.15: Describing the ecological character of wetlands, and data needs and formats for core inventory: harmonized scientific and technical guidance. These fields have been further integrated into guidance related to information requirement for describing Ramsar site at the time of designation and subsequent updates (Ramsar Convention Resolution XI.8 and XI.8 annex 1)

Inventory, assessment and monitoring form an integral part of wetland management, and thereby core activity of Chandertal management authorities. The management plan proposes to establish a formal coordination with line government departments and key CSOs to monitor wetland ecological character and drivers of adverse change to effectively deliver effectively deliver wetland function.

Linkages also need to be developed so that data from the existing monitoring networks of different agencies (for example, biodiversity monitoring by State Forest Department and tourist footfall by State Police) can be upscaled for other wetland features and shared with other agencies. Similarly, provision for participation of NGOs and civil society in monitoring programme has also been built, especially for socioeconomics and livelihoods aspects and biodiversity monitoring (for example, waterbird census being implemented by NGOs under the aegis of Asian Waterbird Census). Thematic management needs-based research can be taken up by specialized agencies such as ZSI, BSI, HIMCOSTE, Wadia Institute of Himalayan Geology or National Centre for Polar and Arctic Research to complement the monitoring programme.

Table 10: Inventory, assessment and monitoring needs for managing Chandertal

	Information Purpose		
Information scale	**Inventory**	**Assessment**	**Monitoring**
Chandertal	Wetland extent and type	Trends in wetland extent (past 20 years) and drivers of change	Land use land cover change (with respect to year 2000 as baseline)
	Notified boundary (Wildlife Sanctuary & Ramsar)		Shoreline change
	Surface connectivity (with northern & eastern drainages; physical status of inlets and outlet (number and cross section)	Trends in surface connectivity	Degree of fragmentation
	Water regime (water balance, freezing and thawing duration, inundation regime, water quality)	Water quality trends (pH, DO, nutrients)	Water quality
		Inundation regime trends	Seasonal water balance
	Bathymetry (Depth profile and water holding capacity)	Water levels and wetland volume	Water levels and storage capacity
	Sediment flows (source identification, rate of sedimentation)		
	Type and extent of wetland habitats		Habitat type and area
	Floral diversity	Trends in key species	
	Faunal diversity	Trends in key species	Species count (waterbirds, mammals)
	Ecosystem services (carbon stock, tourism, waterflows downstream, availability of pastures, medicinal plants, cultural values)	Carrying capacity of Tourism and Grazing Changes in wetland use and dependence (livelihood or cultural)	Revenue generated through wetland services (e.g., Tourism)

	Socio-economics (dependency, income)		Number of direct and indirect beneficiaries
	Sectoral programmes and institutional arrangements for wetland management	Degree of convergence amongst sectors and schemes	Representation in decision making and collaboration among stakeholders
		Mechanism for conflict resolution	Institutional capacity
		Capacity to implement wetland management (securing values and addressing adverse drivers of change)	
Catchment	Extent and type of HAWs (peat, streams, meadows, glacial lakes)	Trends in wetland extent (past 20 years) and drivers of change	Land use land cover change (with respect to year 2000 as baseline)
	Surface connectivity (with source glacier; Condition of inlets and outlets)	Trends in surface connectivity	Degree of fragmentation*
	Water regime (Inflow-outflow balance, surface & groundwater interaction, inundation regime, water quality)	Water quality trends (pH, DO, nutrients)	Water quality
	GLOF risk (moraine stability, discharge, depth of the wetlands)	GLOF Risk (water level or area increase in Chandertal, Samudra Tapu and Gepang Gath)	Precipitation pattern Moraine stability
	Plants and animal species	Trends in key species	Species count (waterbirds, mammals)
	Ecosystem services (Frequency and Seasonality, dependency)		
	Sectoral programmes and institutional arrangements in wetland catchment	Degree of convergence amongst sectors and schemes (number of action plan activities implemented through convergence, number of development projects reviewed or modified due to consideration of wetlands values and functions)	Representation in decision making and collaboration among stakeholders
		Mechanism for conflict resolution	Institutional capacity

		Capacity to implement wetland management (securing values and addressing adverse drivers of change)	
Cryosphere (including Samudra Tapu, CB-14 glaciers)	Land use land cover	Change in glacier mass balance (in comparison to 2000 baseline)	Land use land cover and landscape fragmentation
	Climate settings (minimum and maximum temperature; precipitation)	Trends in temperature and precipitation (proportion of rainfall to snowfall)	Climatic changes (Precipitation, proportion of rainfall and snowfall, maximum and minimum temperature)
	Glacial cover (no. of glaciers, glacial mass)	Trends in glacial cover (glacial retreat)	Glacial retreat
	Distribution of HAWs	Change in extent and distribution of HAWs	Extent and distribution of HAWs
	Geology and geomorphology (Rock type, topography, landforms)		
	Drainage pattern and hydrological connectivity (hydrological structures if any)		Proposed hydropower projects
	Sectoral development programmes		Priority areas and actions of different sectors

Table 11: Monitoring and Assessment Parameters and Indicators

Wetland Features	Core data	Additional data	Monitoring Method	Monitoring Frequency
▪ Physical regime	▪ Wetland area ▪ Percentage cover of emergent macrophytes	▪ Percentage wetland area under different habitat types ▪ Soil Organic Carbon (for peatlands)	▪ Remote sensing; ▪ Field survey; ▪ Laboratory test for Carbon	▪ Lean & peak hydrological seasons, ▪ every year
▪ Hydrological regimes	▪ Water level ▪ Freezing – thawing cycle ▪ Location of sediment accumulation ▪ Number of inflows and duration of water flows ▪ Number of outflows and duration of water flows ▪ Surface flows connectivity with other wetlands of the network ▪ Dissolved Oxygen ▪ pH ▪ Alkalinity	▪ Bathymetry ▪ Water inflow proportion received in form of snowmelt, precipitation and rainfall ▪ Water-balance ▪ Sediment flux ▪ Nutrient concentrations	▪ Remote sensing & GIS; ▪ Field survey; ▪ Sonar machines for bathymetry; ▪ Field sampling or laboratory testing	▪ Lean & peak hydrological seasons, ▪ every year
▪ Catchments	▪ Proximity to glacier ▪ % catchment area under glacial cover ▪ Land-use and landcover of direct catchment ▪ Temperature ▪ Precipitation	▪ Glacier mass-balance ▪ Solar radiation ▪ Land-use and landcover of indirect catchment	▪ Remote sensing & GIS; ▪ Field survey; ▪ Secondary data from Global Land Ice Measurements from Space (GLIMS) or Space Application Centre (SAC);	▪ Lean & peak hydrological seasons, ▪ every year

	▪ Status of vegetation in the meadows (if any) ▪ Solid waste dumping in the direct catchment		▪ Indian Meteorological Department	
▪ Species and habitats	▪ Occurrence of high conservation value species ▪ Population of waterbirds and other dependent fauna ▪ Diverse habitat extent and quality	▪ Species richness for all wetland-dependent biota	Field survey Camera traps	Every year
▪ Livelihoods and Resource Linkages	▪ Number of graziers visiting wetland catchment ▪ Number of tourists (local, national and international) visiting the wetland ▪ Local norms and belief systems	▪ Tourist behavior indicators ▪ Demographic profile of wetland-dependent communities ▪ Perceptions of wetland values and benefits ▪ Cultural inventory ▪ Resource use conflicts ▪ Traditional knowledge of communities on wetlands	▪ Surveys ▪ Secondary data collection	Every year
▪ Institutions and governance	▪ Compliance with the provisions of various rules and regulation (WPA, ESZ notification) ▪ Availability of finances, staff and other infrastructure for	▪ Diversity of stakeholder groups engaging in HAW management ▪ Consideration of stakeholder issues and feedback in management implementation	▪ Management Effectiveness Evaluation ▪ Ground surveillance ▪ Stakeholder meetings	▪ MEE – 4 years ▪ Ground surveillance – Every -month ▪ Meetings – Every year

	implementing management actions ▪ Participation of wetland communities and other stakeholders in meetings and workshops ▪ Participation of wetlands managers in planning meetings for various sectors ▪ Reflection of wetland values and benefits in sectoral plans ▪ Management effectiveness	▪ Risk screening of developmental projects in wetlands catchments		

6.3 Assessing management effectiveness

Chandertal is a dynamic high-altitude ecosystem and so are its management needs. Management plans, which are developed based on assumptions known to managers, need to be periodically assessed to make sure that the set goals and objectives are being achieved.

The effectiveness of management towards achieving the overarching objective of maintenance of ecological character can be greatly enhanced if following questions are periodically reflected upon:

- What is the current status of the Chandertal?
- Is the management achieving the goal of maintenance of ecological character?
- What are the current and future threats?
- Are adequate resources available for implementing management, and if not, how can they be improved?
- Are management processes adequate, effective and efficient?
- What other steps can be taken to improve management?

The Contracting Parties to the Ramsar Convention adopted the R-METT (Ramsar Site Management Effectiveness Tracking Tool) to assist Ramsar site managers in assessing effectiveness of management in achieving wetland wise use outcomes. The assessment looks into the following aspects:

- **Context** of management (wetland ecological character, threats and risks of adverse change)
- **Management planning** that defines how the management goals and objectives have been defined
- **Inputs** including human, technical and financial resources applied to implement management actions
- **Process** of management plan implementation
- **Outputs** (tangible and intangible) that result from implementation of management actions.
- **Outcomes** with respect to the objectives defined by the management plan

It is proposed that management effectiveness assessments for Chandertal is to be done mid-term (3 years) and end-term (5 years), so that management action plans are revised and updated to reflect the condition of wetlands as well as ability of management to prevent adverse change in ecological character. A baseline assessment is proposed to be done at inception of the management plan.

6.4 Infrastructure and Human Resources Requirements

Implementing the monitoring strategy as outlined in the previous sections requires the following physical and human infrastructure support:

- Remote Sensing and GIS unit with advanced capabilities of satellite image processing, preparation of maps and development and maintenance of spatial datasets
- Ecological monitoring laboratory with capabilities for analysis of chemical, physical and biological properties of water and soil
- Electronic reporting system for recording and reporting prohibited activities as per relevant regulations
- Database system for storing and retrieving monitoring and assessment data. The monitoring data would be stored along with metadata, as per the quality control procedures suggested in the following sections.

- Network of hydro-meteorological and water quality stations for hydro-biological monitoring (Map 12)

Deployment of the aforementioned resources can be done in a cost-effective manner by applying the lessons and expertise of the existing infrastructure created by the state government for management of Chandertal to collaborate with state and national level agencies and centres such as HIMCOSTE, HP - DEST and others. Need based training programmes will also be conducted to upgrade skills of the concerned state government departments and agencies.

6.5 Reporting

Reporting constitutes an important element of a wetland monitoring programme. The intended user group, format, style and peer review requirement need to be set in the initial phases of set up of the monitoring programme.

Periodic reports, for example as a part of the annual report of the District Wetlands Committee and State Wetlands Authority should aim to provide a summary overview of the outcomes of monitoring.

Special publications, for example wetland atlases constituting thematic maps on various parameters or wetland health card can be produced to inform stakeholders on wetland status and trends.

Outcomes of specific assessments, for example ecological character status and trends, economic valuation, peat carbon assessment could be made available in the form of technical report series, with an extended summary for general readership.

Map 12: Monitoring stations

6.6 Quality Control

Quality control in monitoring systems is required to ensure the scientific validity of sampling, laboratory analysis, data analysis and reporting. They also play a critical role in preventing introduction of random and systematic errors in data collection, analysis and reporting.

It is recommended that a Quality Management and Assurance Plan is developed for the monitoring programme. The plan should determine, *inter alia*:

Specification of objectives for sampling programme

Data quality objectives: maximum amount of uncertainty that can be tolerated to ensure that the data is fit for intended use

Sampling programme design: Statistical robustness of sampling frame; means to ensure that samples are representative of environment; sample recording; procedures for minimizing environmental impact

Documentation: Procedures for field sample record keeping and methods documentation

Sample processing validity (especially for water quality and biological components)

Data quality control methods: processes for quality control samples, duplicates and replicates,

Performance audit procedures, including data and systems audit

6.7 Review and Adaptation

In line with the guidance of NPCA, the management plan should be reviewed at mid-term (3 years) and end-term (5 years) to determine the extent to which the objectives, particularly support to management is achieved, and monitoring system remains relevant for the wetland state (particularly in the light of new and emerging threats). The review process should also aim at increasing the sophistication of the monitoring system to be able to assess complex landscape scale processes affecting the ecological character of wetland and related management.

Review process should include documentation on the way wetland inventory, assessment and monitoring information is being used to support management planning and policy goals. Review should also include identification of appropriate mechanisms to ensure that wetland monitoring is continued in the event of a funding shortfall.

7. Action Plan

The activities to meet the three main objectives and thirteen sub-objectives have been clustered under six components namely; Institutions and Governance; Wetlands Inventory Assessment and Monitoring; Communication, Education, Participation and Public Awareness; Sediment; Water Regime and Habitat Management; Preservation and Integration of Cultural Values in wetlands management and Tourism Promotion and Livelihood Sustenance.

Table 12: Components of Action Plan

Component	Objectives
Component 1 - Institutions and Governance	Objective 1: Maintaining naturalness of the wetland catchment Objective 10: Maintain compliance with relevant rules and regulations at spatial scale of Chandertal ESZ Objective 12: Ensure consideration of HAW values and functions in sectoral plans
Component 2 - Wetlands Inventory Assessment and Monitoring	Objective 7: Systematic wetlands inventory, assessment and monitoring system (WIAMS) to inform management decisions and assess effectiveness
Component 3 - Communication, Education, Participation and Public Awareness	Objective 11: Enhance awareness on wetland values to promote stakeholder participation in wetlands management Objective 13: Maintain and enhance capacities of responsible staff members for integrated wetland management
Component 4 - Water Regime and Habitat Management	Objective 2: Maintain water quality to sustain ecosystem processes and services Objective 3: Maintain peat carbon stocks in Chandertal catchment and Eco-Sensitive Zone Objective 4: Reduce risks of GLOFs in Chandertal ESZ Objective 5: Maintain and improve alpine habitats to support diverse wetland-dependant species
Component 5 - Promotion of responsible wetland tourism supporting local economy	Objective 8: Preserve cultural values and traditional practices aligned with wise use of Chandertal Objective 9: Preserve recreational and touristic value of Chandertal

Component 1: Institutions and Governance

1.1 Establishment of District Wetland committee

As detailed in section 4.3 of the management plan, it is envisaged that management of Chandertal will be entrusted to the Lahaul and Spiti District Wetlands Management Committee. The committee will have the following role and functions:

- Maintain an overview of implementation of various actions enlisted in the management plan
- Review development projects in and around Lahaul and Spiti District which have implications for Chandertal, and suggest necessary modifications to prevent adverse change
- Ensure convergence of schemes and action plans of various line departments with the Chandertal Management Plan
- Consider changes to wetlands management plan indicated as an outcome of monitoring data or research studies
- Consider views of various stakeholders on wetlands management and ensure necessary incorporation without compromising the ecological character of the wetland
- Recommend thresholds for number of tourists and location of tourist camps around Chandertal
- Maintain an overview of implementation of extant regulation, and bring violations in the notice of respective authorities
- Management will be guided by information on wetland ecological character and drivers of change, the design of which is discussed in Chapter 5 of this management plan. The overall responsibility to implement the Wetlands Inventory, Assessment and Monitoring System is proposed to be assigned to HIMCOSTE. Specific responsibilities include:
- Ensure systematic collection, collation and synthesis of monitoring data, preferably in a GIS environment
- Collate progress of implementation of various management actions and report progress to District Wetlands Management Committee and State Wetlands Authority
- Commission specific studies, listed out in Chapter 7, and recommend amendments and refinements to management plan implementation based on study outcomes
- Prepare and make available summary wetlands monitoring reports to District Wetlands Management Committee and State Wetlands Authority, specifically highlighting status and trends that require management intervention
- Update Ramsar Information Sheet every six years and submit to the Ramsar National Focal Point at the MoEFCC
- Conduct periodic capacity development programmes for line departments and agencies of the state governments, NGOs and CSOs involved in implementation of management action plan
- Conduct management effectiveness assessment as outlined in Chapter 5, and use the findings to revise management plan
- Address any knowledge and research need raised by the District Wetlands Management Committee related to implementation of wetlands management plan

Following activities are to be undertaken:

- Issue notification of constitution of DWC by HPSWA
- Conduct regular meeting of the DWC as per the Terms of Reference defined above
- Prepare annual updates of management plan implementation
- Prepare annual wetlands monitoring report

1.2 Enforcement of Extant Regulations

Regular watch and ward of the wetland and the entire sanctuary is essential to ensure that provisions of Wildlife (Protection) Act, 1972 and Eco-sensitive Zone Notification are not violated.

Following activities are proposed:

- Recruitment of field staff/guard
- Purchase of field vehicle for patrolling purposes
- Provision for purchase of field equipment for watch and ward including:
    - Digital camera
    - Binoculars
    - Global Positioning System Devices
    - Walking shoes and jackets for field staff
    - Sleeping bags (capable of withstanding sub-zero temperatures) for field staff
    - Solar lights
    - Medical kits for basic medical emergencies
- Regular patrolling and report violations

1.3 Constitution of 'Wetland Mitra' network

'Wetland Mitra' is conceived as an informal, voluntary and non-statutory network of concerned citizens to foster and promote community engagement in wetlands conservation and management efforts. An effective 'Wetland Mitra' network enables wetlands managers to gain access to local views, rights and capacities for supporting wetlands management. The network is also designed as a communication and outreach vehicle for promoting awareness on the value of wetlands, and management and conservation efforts. By involving themselves within the Wetland Mitra network, citizens gain an opportunity of shaping wetlands management by bringing onboard indigenous and local knowledge, and views of diverse stakeholder groups. As Wetland Mitra network member, the communities also built their capacity on various dimensions of wetlands management.

Key role and responsibilities are as follows:

- Promote awareness on values and functions of wetlands with local communities, students, resident welfare groups and other stakeholders.
- Participate in wetlands management planning and implementation processes and bring on board stakeholder views.
- Promote consideration of wetlands in local development plans of Gram Panchayats and Municipal Areas as may be the case.
- Alert authorities on any detrimental activities on wetlands such as encroachment, conversion, dumping of solid waste, discharge of untreated waste, release of non-native species and others.

In order to deliver the aforementioned roles and responsibilities, all members of the Wetlands Mitra network:

- Make themselves aware of the values and functions of wetlands by participating in training workshops, outreach events, connecting with experts, self-reading and other mechanisms as feasible.
- Make themselves aware of the government official responsible for wetlands management.
- Understand the wetlands management approach and key activities being undertaken or planned.

- Dedicate a part of their time towards promoting awareness on wetlands values and functions, keeping watch and ward, and participating in wetlands management planning, implementation and monitoring activities.
- Understand that their role as a Wetlands Mitra network member is completely on a voluntary basis, and does not confer any special rights or privileges.

The DWC for each wetland may constitute a Wetland Mitra network by following steps:

- In liaison with Panchayat functionaries, draw up a list of local community members who can be a part of the Wetland Mitra network. These members should be local residents and have engaged with wetlands issues in the past.
- Call an open meeting at the district headquarters, district forest office, municipality office or a suitable venue, especially ensuring that the people identified above participate. At the meeting, present the purpose and objectives of Wetland Mitra network to the communities and seek nomination.
- While constituting the network ensure a fair representation of all stakeholders, and that half of the members are women.
- Issue an office order through the office of concerned wetland manager on constitution of the Wetland Mitra network, initially for a three-year period.
- Make the nominated members aware of their role and responsibilities as a part of Wetland Mitra network.

In order to sustain the network, the DWC shall:

- Conduct a workshop to make the Wetland Mitra aware of the current efforts for conservation and management of the wetland, as well as record their views on the current status of wetland, major threats and management needs.
- Involve Wetland Mitra network in communication and outreach activities.
- Proactively engage with the network during implementation of wetlands management plan, and share the results of major studies being taken up by various agencies.
- Proactively engage with the network during field visits.

1.4 Capacity development

To support management plan implementation, it is proposed to conduct training workshops at various levels, involving specialized agencies. Specific topics are as follows:

Workshop theme	**Relevant group**
Managing High Altitude Wetlands	HPSWA DWC Line Departments
Monitoring High Altitude Wetlands	HPSWA DWC Universities and research organization who are likely to be involved in wetlands monitoring Frontline staff
Wildlife monitoring techniques	Field staff

Nature-based tourism	Tour operators Residents of Lossar and Khoksar Panchayat
Conserving and managing peatlands	HPSWA DWC Frontline staff
Mainstreaming ecosystem services and biodiversity values of HAW into sectoral development planning	HPSWA DWC
Maintaining Ramsar Site Designation Commitments	HPSWA DWC

1.5 Management Effectiveness Evaluation

A mid-term and end-term review of management plan implementation is proposed to assess the extent to which stipulated objectives have been achieved with a high degree of resource efficiency and in participation with stakeholders. Wetlands International South Asia shall carry out the evaluation, specifically looking at the following elements:

- Degree to which wetland ecological character is being maintained as a result of management being applied
- Implementation quality, timeliness and resourcing of activities
- Quality and comprehensiveness of wetlands monitoring
- Effectiveness of management being applied, in terms of design, activities, outcomes and impacts
- Quality of stakeholder engagement in implementation of various activities and discharging wetland management functions
- Changes in external environment, requiring adaptation in management plan

Component 2: Wetland Inventory, Assessment and Monitoring

2.1 Establishment of Wetland Monitoring System

Wetland inventory, assessment and monitoring protocols for various wetland features as proposed in Section 6.2 will be established. Specific activities to be undertaken are:

- Development of MoUs with specialized agencies for monitoring
- Identification of field monitoring stations
- Water-level recorders
- Finalization of water quality sampling framework and field assessment protocol
- Finalization of plant and animal diversity assessment sampling framework and field assessment protocol
- Finalization of peat carbon sampling framework and field assessment protocol

2.2 Wetlands Monitoring

Protocols as finalized above will be implemented. Specific activities include:

- Regular monitoring as per monitoring schedule
- Publication of monitoring report annually

2.3 Animal Diseases Surveillance

One of the perceived threats to the high-altitude biodiversity is risk of catching infection from migratory livestock in the zoonotic or viral diseases such as Foot and Mouth Disease (FMD) and others. Following activities are proposed:

- Livestock tagging for regulating grazing in Chandertal ESZ
- Livestock health check-up at Hamta Pass and other migratory passages (bottlenecks) in the landscape.

2.4 Ecosystem Health Card

It is proposed to develop an Ecosystem Health Report Card, and publish biannually to assess and communicate wetland monitoring information to decision-makers and stakeholders. The health report card summarizes indicators along major indices (water quality, catchment status, biodiversity status) which represent various ecosystem features of the lake, and are reported against respective thresholds set in line with management goals.

Following activities are to be taken:

- Convening a workshop with wetland stakeholders to firm up methodology for assessment of wetland health.
- Field assessment and desk work for development of Wetland Health Report Card
- Publication and dissemination
- Feedback

2.5 Research Studies

With reference to knowledge gaps (section 3.4), following specific research studies are proposed to be commissioned to address the knowledge gaps in assessing status and trends in wetland character, and using the outcomes to refine management:

- Climate Change risk assessment
  - Impact of long-term changes in precipitation patterns on hydrological regimes of Chandertal and Samudra Tapu
  - Spatio-temporal changes in glacial mass and extent in Chandra sub-basin
  - Predictive climate modelling to detect range shift in alpine vegetation and species habitat use patterns
  - Risk of GLOF in Chandra-Bhaga sub-basins
  - Short term, medium term and long-term scenarios for Chandertal wetland ecosystem and possible mitigation and adaptation strategies
- Characterization of hydrological regimes of Chandertal in terms of:
  - Water inflows and outflows
  - Sedimentation and its impact on hydrological functioning
  - Springs and spring sheds and their relationship with wetland hydrology
  - Water level variations
  - Thermocline development and implication for wetland functioning
  - Water chemistry
- Comprehensive inventory of plant and animal species, including migratory species
- Extent of peatlands and carbon storage, and strategies for ensuring that peatlands are maintained in wet conditions
- Carrying capacity assessment with respect to:
  - Seasonal tourism within Chandertal
  - Grazing within Chandertal
- Community attitudes and perceptions on wetland values, threats and management regime

Component 3: Communication and Outreach

3.1 Interpretation Centre

A wetland interpretation center is proposed to be constructed at Keylong with due approval from district administration. The following facilities are proposed to be developed in the interpretation complex:

- Exhibits including posters, models, flying patterns hanging from ceiling, wetland birds interactive panel and ecosystem food chain
- Viewing Gallery comprising panels highlighting the ecological, socioeconomic and cultural aspects of Chandertal.
- Mini hall for audio-visual facilities for screening documentaries and arranging talks/workshops/meetings
- Souvenir shop for visitors having wetland products, wetland biodiversity replicas, reading materials, photographs, maps to take away on payment basis as memorabilia
- Medical facilities for handling emergencies

3.2 Signage

Signage indicating Chandertal as a Ramsar Site, is proposed to be placed at all major entry points of the wetland, namely along Kaza-Manali road. Signages are also proposed in the Panchayat offices and school premise in the district.

At the 19th meeting of the Ramsar Standing Committee, 29 October-1 November 1996, the members adopted a decision that defines recommended wording for signs at all Ramsar Sites, when translated into the local languages of the sites. The decision reads as follows:

The Contracting Parties should endeavour to place descriptive signs at all Ramsar Sites, and these signs should include the Ramsar logo, as well as the following suggested text (amended for Chandertal):

> THIS SITE, COVERING 49 HECTARES, HAS BEEN DESIGNATED BY THE GOVERNMENT OF INDIA FOR INCLUSION IN THE LIST OF WETLANDS OF INTERNATIONAL IMPORTANCE ESTABLISHED UNDER THE CONVENTION ON WETLANDS, THE INTERNATIONAL TREATY SIGNED IN RAMSAR (IRAN) IN 1971 TO PROMOTE THE CONSERVATION AND SUSTAINABLE USE OF WETLAND AREAS WORLDWIDE.
>
> The protection and management of this site is under the responsibility of: LAHAUL AND SPITI DISTRICT WETLANDS COMMITTEE UNDER HIMACHAL PRADESH STATE WETLANDS AUTHORITY, DEPARTMENT OF ENVIRONEMNT, GOVERNMENT OF HIMACHAL PRADESH.

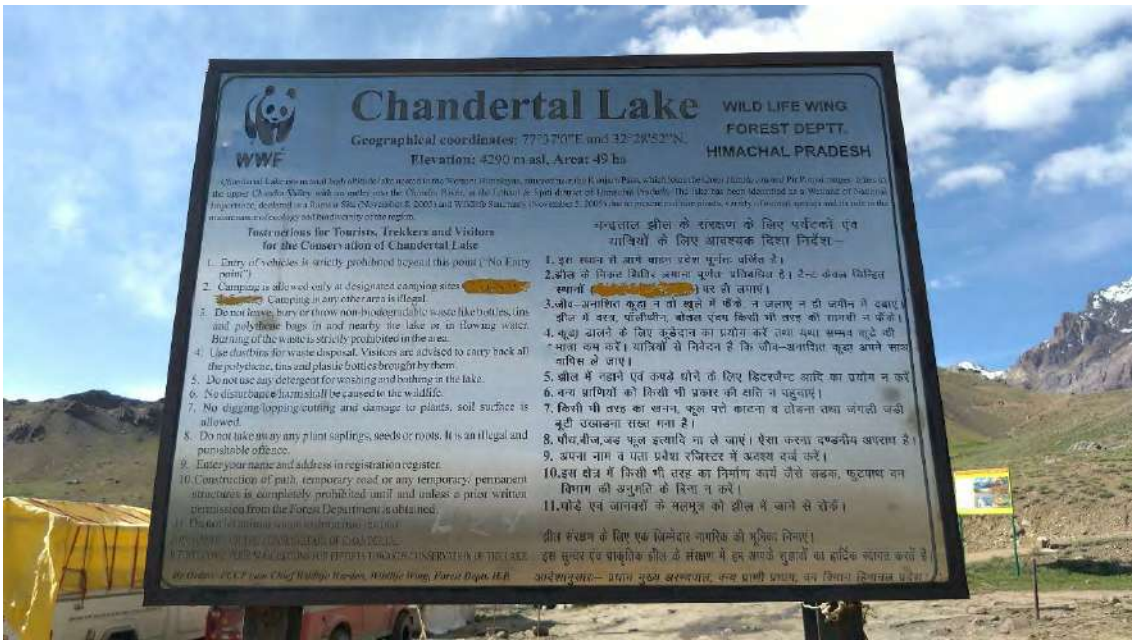


Image 13: Existing signage at Chandertal

3.3 Awareness Programmes

Public events are proposed to be organized on the eve of World Wetlands Day (Feb 2), World Environment Day (June 5), International Day for Biological Diversity (May 22) and *Bees Bahado* as a means of reaching out to public on the issues of wetland conservation and wise use. Public events on specific issues, as eco-tourism, biodiversity, climate change and glacial dynamics are also proposed to be organized as means of engaging with stakeholders.

3.4 Publications and brochures

Following publications are proposed:

- Coffee table book covering various ecological, hydrological, and cultural dimensions of Chandertal
- Dos and Don'ts for visitors
- Management plan summary
- Wildlife of Chandertal
- Plant diversity of Chandertal
- Cultural inventory

Component 4: Water Regime and Habitat management

4.1 Water retention structure for Peat-bogs

The peatland in the Chandra peat trench has gentle slope and thus snow melt drains out of the peatland, exposing the wetland carbon. It is proposed to constructed a permeable water retention structure at the outlet of peat trench to prevent drying out of peat area. The structure can be of coir or any other natural material.

4.2 Rotational Grazing

In order to reduce grazing pressure in the wetland catchment, it is proposed to shift grazing to downstream stretches of the wetland or away from wet meadows and peatland in catchment of Chandertal. The interventions shall be guided by the carrying capacity assessment for grazing and implemented in close consultation with Gaddi community. Following activities are proposed:

- Consultation meeting to disseminate findings of the carrying capacity study
- Development of a rotational grazing strategy for the region – earmarking areas and number of animals to be permitted
- Development of a grazing regulation mechanism
- Implementation of rotational grazing programme

Component 5: Responsible Wetland Tourism

5.1 Training of Camp Owners and Staffers

Training programmes are proposed for camp owners and staffers to educate them on the values and ecological sensitivities of HAW. All camp owners and their key operating staff should mandatorily go through the programme at least once every year.

5.2 Tourist Dos and Don'ts

In consultation with Wetland Mitra and Tourist Camp owners, the DWC would enable drafting of tourist dos and don'ts. The responsibility of implementing this guidance would be on camp owners and Wetland Mitra.

5.3 Access Regulation

A system of regulation of number of vehicles and tourists permitted to drive up to Chandertal shall be put in place on the basis of carrying capacity assessment.

5.4 Alternate Camping Site

A place downstream of Chandertal will be identified as an alternate camping site, with restrictions on number of camps and ensuring adequate waste management infrastructure. Recommending alternate locations shall be included as one of the terms of reference of tourism carrying capacity study.

5.5 Homestays

Feasibility study for a homestay programme will be taken up in close consultation with Wetland Mitra. Based on the recommendations of the feasibility assessment, pilot programmes will be taken up and performance assessed periodically.

8. Budget and Financing

8.1 Budget

Management plan implementation will entail a budget of Rs. 32.63 crores. Of this, the component on Communication and Outreach is allocated 66%. This is followed by allocation of 19% of implementing actions under component for Wetland Inventory, Assessment and Monitoring. The components on Institutions and Governance and Responsible Wetland Tourism have been allocated 7% and 6% of the budget respectively. The component on Water Regime and Habitat Management is allocated 1% of the budget as the cost of monitoring and research are already factored under component 2 of the budget. Component wise summary and detailed budget is presented in table 13 and 14 respectively.

Table 13: Component wise summary budget

Management Plan Components	Amount (Rs Lakh)	Year 1	Year 2	Year 3	Year 4	Year 5
Component 1: Institutions and Governance	233.1	34.7	35.2	34.2	20.2	36.7
Component 2: Wetland Inventory, Assessment and Monitoring	625.0	6.0	116.0	114.0	52.5	26.5
Component 3: Communication and Outreach	2,154.0	15.5	523.0	523.0	13.7	3.5
Component 4: Water Regime and Habitat management	40.0	-	10.0	10.0	-	-
Component 5: Responsible wetland tourism	211.5	-	6.0	55.0	26.0	25.0
Grand Total	**3,263.6**	**56.2**	**690.2**	**736.2**	**112.4**	**91.7**

Table 14: Detailed activity wise budget

	Activities	Physical Target	Unit	Rate (lakhs)	Year 1		Year 2		Year 3		Year 4		Year 5	
					HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2
1	**Component I: Institutions and Governance**				**7.95**	**26.75**	**30.45**	**4.75**	**10.45**	**23.75**	**14.95**	**5.25**	**12.95**	**23.75**
1.1	Establishment of Lahaul and Spiti District Wetland Management Committee													
1.1.1	Official notification													
1.1.2	Meetings	10	Meeting	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
1.1.3	Annual reports	5	Report	1		1.00		1.00		1.00		1.00		1.00
1.2	Enforcement of extant regulations													
1.2.1	Recruitment of field staff/guards	2	Person	3.6	7.20		7.20		7.20		7.20		7.20	
1.2.2	Purchase of field vehicle for patrolling purposes	1	4 wheeler	15			15.00							
		4	2 wheeler	1		4.00								
1.2.3	Provision for purchase of field equipment for watch and ward :													
	Digital camera	2	Unit	1		1.00		1.00						
	Binoculars	2	Unit	1		2.00								
	Global Positioning System Devices	4	Unit	0.5		2.00								
	Walking shoes and jackets	6	Unit	0.5		3.00								
	Sleeping bags	3	Unit	0.5		1.50								
	Solar lights	5	Unit	0.5		1.00	1.50							
	Medical kits	5	Unit	0.5		0.50		0.50		0.50		0.50		0.50
1.2.4	Patrolling	5	Field Visits	1.5		1.50		1.50		1.50		1.50		1.50
1.3	Constitution of 'Wetland Mitra' network													
1.3.1	Inception workshop	2	Meeting	1		1.00					1.00			

	Activities	Physical Target	Unit	Rate (lakhs)	Year 1		Year 2		Year 3		Year 4		Year 5	
					HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2
1.3.2	Office order													
1.3.3	Annual workshops	5	workshop	1			1.00		1.00		1.00		1.00	
1.4	Capacity development													
1.4.1	Training workshops on													
1.4.1.1	Managing High Altitude Wetlands	1	Training	2.5		2.50								
1.4.1.2	Monitoring High Altitude Wetlands	1	Training	2.5			2.50							
1.4.1.3	Widlife monitoring techniques	1	Training	2.5			2.50						2.50	
1.4.1.4	Nature-based tourism	1	Training	1.5					1.50			1.50		
1.4.1.5	Conserving and managing peatlands	1	Training	5							5.00			
1.4.1.6	Mainstreaming ecosystem services and biodiversity values of HAW into sectoral development planning	1	Training	5						5.00			1.50	
1.4.1.7	Maintaining Ramsar Site Designation Commitments	1	Training	5		5.00								
1.5	Management Effectiveness Evaluation													
1.5.1	Mid-term evaluation	1	Evaluation	15						15.00				
1.5.2	End term evaluation	1	Evaluation	20										20.00
2	**Component 2: Wetland Inventory, Assessment and Monitoring**				**-**	6.00	**38.50**	**77.50**	**42.50**	**71.50**	**6.00**	**46.50**	**21.50**	**5.00**
2.1	Development of monitoring system													
2.1.1	Development of MoUs with specialized agencies for monitoring	2	Meeting	2		2.00	2.00							
2.1.2	Identification of field monitoring stations	1	Assessment	1.5			1.50							
2.1.3	Installation of water level recorders at wetland site	4	Unit	1			4.00							

	Activities	Physical Target	Unit	Rate (lakhs)	Year 1		Year 2		Year 3		Year 4		Year 5	
					HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2
2.1.4	Finalization of water quality sampling framework and field assessment protocol	1	Protocol	5			5.00							
2.1.5	Finalization of plant and animal diversity assessment sampling framework and field assessment protocol	1	Protocol	5			5.00							
2.1.6	Finalization of peat carbon sampling framework and field assessment protocol	1	Protocol	5			5.00							
2.2	Wetlands monitoring													
2.2.1	Wetland monitoring	9	Field visit	4		4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
2.2.2	Annual monitoring report	5	Reports	1			1.00		1.00		1.00		1.00	
2.3	Animal diseases surveillance													
2.3.1	Livestock tagging	2	Tagging camp	2.5				2.50				2.50		
2.3.2	Livestock health check-up camps	2	Camps	2.5					2.50				2.50	
2.4	Ecosystem Health Card													
2.4.1	Stakeholder workshop	1	Workshop	2.5			2.50							
2.4.2	Health assessment	3	Costed within monitoring											
2.4.3	Publication and dissemination	3	Health card	1				1.00			1.00			1.00
2.5	Research studies													
2.5.1	Climate Change risk assessment													
	Inception workshop	1	workshop	1.5			1.50							
	Study	1	Study	35				10.00		15.00		10.00		

	Activities	Physical Target	Unit	Rate (lakhs)	Year 1		Year 2		Year 3		Year 4		Year 5	
					HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2
	Results sharing workshop	1	Workshop	2.5									2.50	
	Publication and dissemination	1	Publications	1									1.00	
2.5.2	Characterization of hydrological regimes													
	Inception workshop	1	workshop	1.5			1.50							
	Study	1	Study	35				10.00		15.00		10.00		
	Results sharing workshop	1	Workshop	2.5									2.50	
	Publication and dissemination	1	Publications	1									1.00	
2.5.3	Comprehensive inventory of plant and animal species, including migratory species													
	Inception workshop	1	workshop	1.5			1.50							
	Study	1	Study	35				10.00		15.00		10.00		
	Results sharing workshop	1	Workshop	2.5									2.50	
	Publication and dissemination	1	Publications	1									1.00	
2.5.4	Extent of peatlands and carbon storage, and strategies for ensuring that peatlands are maintained in wet conditions								5.00					
	Inception workshop	1	workshop	1.5			1.50							
	Study	1	Study	35				10.00		15.00		10.00		
	Results sharing workshop	1	Workshop	2.5									2.50	
	Publication and dissemination	1	Publications	1									1.00	
2.5.5	Carrying capacity assessment - Tourism and Grazing													

	Activities	Physical Target	Unit	Rate (lakhs)	Year 1		Year 2		Year 3		Year 4		Year 5	
					HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2
	Tourism													
	Inception workshop	1	Workshop	1.5			1.50							
	Study	1	Study	40				20.00	20.00					
	Results sharing workshop	1	Workshop	2						2.00				
	Publication and dissemination	1	Publications	1						2.00				
2.5.6	Community attitudes and perceptions on values of wetlands													
	Inception workshop	1	workshop	1.5			1.00							
	Study	1	Study	20				10.00	10.00					
	Results sharing workshop	1	Workshop	2						2.00				
	Publication and dissemination	1	Publications	1.5						1.50				
3	**Component 3: Communication and Outreach**				**1.50**	**14.00**	**266.50**	**256.50**	**271.50**	**251.50**	**11.50**	**2.25**	**1.50**	**2.00**
3.1	Interpretation centre													
3.1.1	Construction & operations	2000	m2	0.5			250.00	250.00	250.00	250.00				
3.2	Signage													
3.2.1	Signage	5	Signage	2.5		2.50	5.00	5.00						
3.2.2	Maintenance	5	Signage	0.25								0.75		0.50
3.3	Awareness programmes													
3.3.1	Meetings and workshops	10	Meetings and workshops	1.5	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
3,4	Publications													
3.4.1	Coffee table book	500	Book	0.02					10.00					
3.4.2	Dos and Don't's for visitors	10000	Publication	0.002		10.00					10.00			

	Activities	Physical Target	Unit	Rate (lakhs)	Year 1		Year 2		Year 3		Year 4		Year 5	
					HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2
3.4.3	Management plan summary	500	Publication	0.02			10.00							
3.4.4	Wildlife of Chandertal	1000	Publication	0.005					5.00					
3.4.5	Plant diversity of Chandertal	1000	Publication	0.005					5.00					
3.4.6	Chandertal - cultural inventory		Costed within research studies											
4	**Component 4: Water regime and habitat management**				**-**	**-**	**10.00**	**-**	**10.00**	**-**	**-**	**-**	**-**	**-**
4.1	Water retention structure for Peat-bogs													
4.1.1	Installation of water retention measures	2	Units	10			10.00		10.00					
4.2	Rotational grazing													
4.2.1	Consultation meeting		Costed within research studies											
4.2.2	Implementation of rotational grazing programme													
	Identification of alternate grazing grounds		Report											

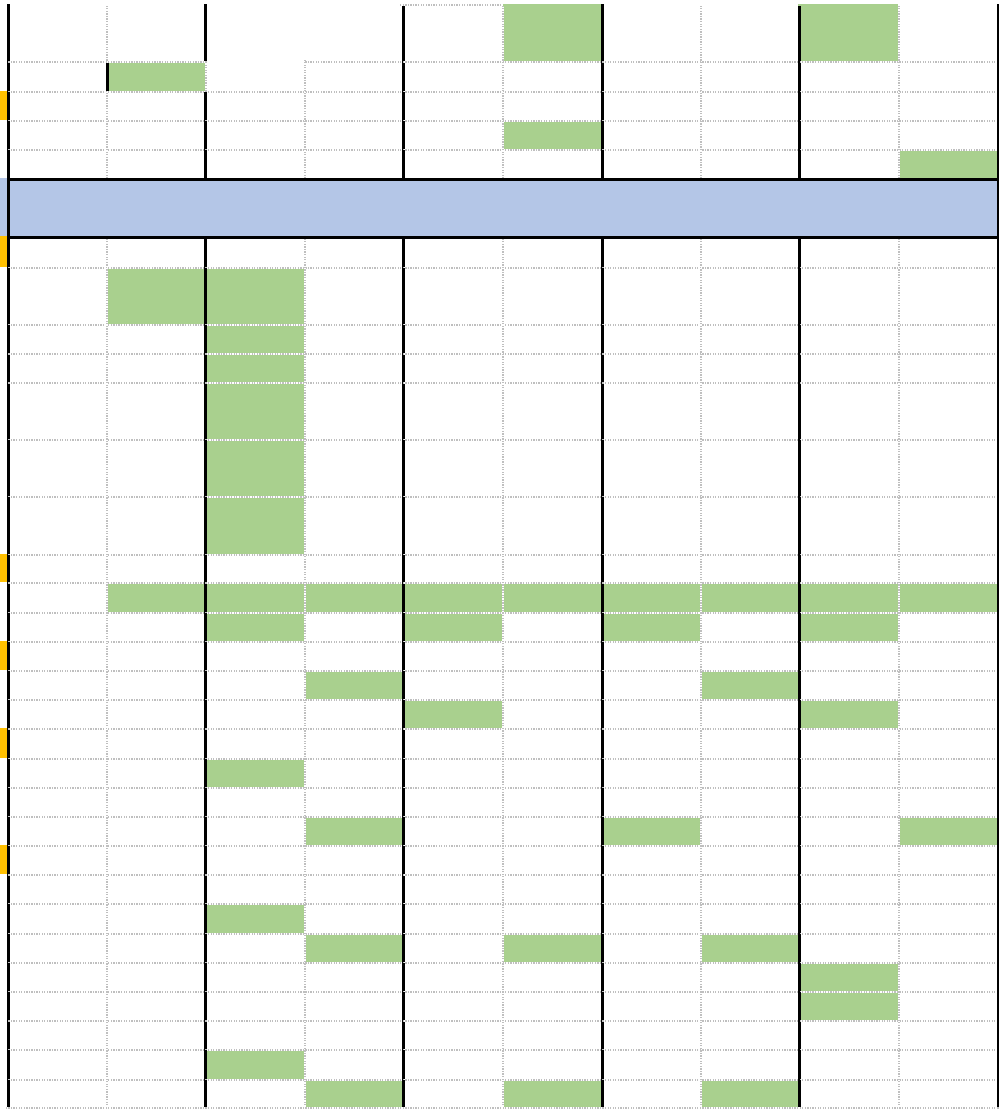
	Activities	Physical Target	Unit	Rate (lakhs)	Year 1		Year 2		Year 3		Year 4		Year 5	
					HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2
	Ensuring rotational grazing through patrolling		patrolling visits (costed within wetland monitorin)											
5	**Component 5: Responsible wetland tourism**				-	-	1.00	5.00	30.00	25.00	13.50	12.50	12.50	12.50
5.1	Training of camp owners and staffers													
5.1.1	Training	2	Trainings	1			1.00				1.00			
5.2	Tourist dos and don'ts													
5.3	Access regulation													
5.3.1	Prototype development	1	Prototype	5				5.00						
5.3.2	Implementation													
5.4	Alternate camping site													
5.4.1	Establishment of alternate camp site with adequate sustainability measures	1	camp site	50					25.00	25.00				
5.5	Homestays													
5.5.1	Feasibility assessment	1	Assessment	5					5.00					
5.5.2	Provide financial support for setting up homestays	10	Homestays	5							12.50	12.50	12.50	12.50

8.2 Phasing of activities

Table 15: Year wise activities

	Activities	Physical Target	Year 1		Year 2		Year 3		Year 4		Year 5	
			HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2	HY 1	HY 2
1	**Component I: Institutions and Governance**											
1.1	1.1 Establishment of Lahaul and Spiti District Wetland Management Committee											
1.1.1	Official notification											
1.1.2	Meetings	10										
1.1.3	Annual reports	5										
1.2	1.2 Enforcement of extant regulations											
1.2.1	Recruitment of field staff/guards	2										
1.2.2	Purchase of field vehicle for patrolling purposes	1										
		4										
1.2.3	Provision for purchase of field equipment for watch and ward :											
	Digital camera	2										
	Binoculars	2										
	Global Positioning System Devices	4										
	Walking shoes and jackets	6										
	Sleeping bags	3										
	Solar lights	5										
	Medical kits	5										
1.2.4	Patroling	5										
1.3	1.3 Constitution of 'Wetland Mitra' network											
1.3.1	Inception workshop	2										
1.3.2	Office order											
1.3.3	Annual workshops	5										
1.4	1.4 Capacity development											
1.4.1	Training workshops on											
1.4.1.1	Managing High Altitude Wetlands	1										
1.4.1.2	Monitoring High Altitude Wetlands	1										
1.4.1.3	Widlife monitoring techniques	1										
1.4.1.4	Nature-based tourism	1										
1.4.1.5	Conserving and managing peatlands	1										

1.4.1.6	Mainstreaming ecosystem services and biodiversity values of HAW into sectoral development planning	1	
1.4.1.7	Maintaining Ramsar Site Designation Commitments	1	
1.5	1.5 Management Effectiveness Evaluation		
1.5.1	Mid-term evaluation	1	
1.5.2	End term evaluation	1	
2	**Component 2: Wetland Inventory, Assessment and Monitoring**		
2.1	2.1 Development of monitoring system		
2.1.1	Development of MoUs with specialized agencies for monitoring	2	
2.1.2	Identification of field monitoring stations	1	
2.1.3	Installation of water level recorders at wetland site	4	
2.1.4	Finalization of water quality sampling framework and field assessment protocol	1	
2.1.5	Finalization of plant and animal diversity assessment sampling framework and field assessment protocol	1	
2.1.6	Finalization of peat carbon sampling framework and field assessment protocol	1	
2.2	2.2 Wetlands monitoring		
2.2.1	Wetland monitoring	9	
2.2.2	Annual monitoring report	5	
2.3	2.3 Animal diseases surveillance		
2.3.1	Livestock tagging	2	
2.3.2	Livestock health check-up camps	2	
2.4	2.4 Ecosystem Health Card		
2.4.1	Stakeholder workshop	1	
2.4.2	Health assessment	3	
2.4.3	Publication and dissemination	3	
2.5	2.5 Research studies		
2.5.1	Climate Change risk assessment		
	Inception workshop	1	
	Study	1	
	Results sharing workshop	1	
	Publication and dissemination	1	
2.5.2	Characterization of hydrological regimes		
	Inception workshop	1	
	Study	1	



	Results sharing workshop	1	
	Publication and dissemination	1	
2.5.3	Comprehensive inventory of plant and animal species, including migratory species		
	Inception workshop	1	
	Study	1	
	Results sharing workshop	1	
	Publication and dissemination	1	
2.5.4	Extent of peatlands and carbon storage, and strategies for ensuring that peatlands are maintained in wet conditions		
	Inception workshop	1	
	Study	1	
	Results sharing workshop	1	
	Publication and dissemination	1	
2,5,5	Carrying capacity assessment - Tourism and Grazing Tourism		
	Inception workshop	1	
	Study	1	
	Results sharing workshop	1	
	Publication and dissemination	1	
2.5.6	Community attitudes and perceptions on values of wetlands		
	Inception workshop	1	
	Study	1	
	Results sharing workshop	1	
	Publication and dissemination	1	
3	**Component 3: Communication and Outreach**		
3.1	3.1 Interpretation centre		
3.1.1	Construction & operations	2000	
3.2	3.2 Signage		
3.2.1	Sigange	5	
3.2.2	Maintenance	5	
3.3	3.3 Awareness programmes		
3.3.1	Meetings and workshops	10	
3,4	3.4 Publications		
3.4.1	Coffee table book	500	

3.4.2	Dos and Don't's for visitors	10000	
3.4.3	Management plan summary	500	
3.4.4	Wildlife of Chandertal	1000	
3.4.5	Plant diversity of Chandertal	1000	
3.4.6	Chandertal - cultural inventory		
4	**Component 4: Water regime and habitat management**		
4.1	4.1 Water retention structure for Peat-bogs		
4.1.1	Installation of water retention measures	2	
4.2	4.2 Rotational grazing		
4.2.1	Consultation meeting		
4.2.2	Implementation of rotational grazing programme		
	Identification of alternate grazing grounds		
	Ensuring rotational grazing through patrolling		
5	**Component 5: Responsible wetland tourism**		
5.1	5.1 Training of camp owners and staffers		
5.1.1	Training	2	
5.2	5.2 Tourist dos and don'ts		
5.3	5.3 Access regulation		
5.3.1	Prottype development	1	
5.3.2	Implementation		
5.4	5.4 Alternate camping site		
5.4.1	Establishment of alternate camp site with adequate sustainability measures	1	
5.5	5.5 Homestays		
5.5.1	Feasibility assessment	1	
5.5.2	Provide financial support for setting up homestays	10	

8.3 Financing arrangements

An analysis of possible sources of financing of Management Plan budget for Chandertal is presented in table 16 below. As per the analysis, approximately Rs. 240 lakhs can be leveraged from various ongoing programmes of Himachal Pradesh Government. The rest of the funds may be proposed for support under National Programme of Conservation of Aquatic Ecosystems of MOEFCC, GoI.

Table 16: Sources of financing

Components and activities	**Primary finance source**	**Convergence funding source**
1.1 Establishment of Lahaul and Spiti District Wetland Management Committee	NPCA	
1.2 Enforcement of extant regulations		HPFD under Chandratal Wildlife Sanctuary Management Plan 2018-2028
1.3 Constitution of 'Wetland Mitra' network	NPCA	
1.4 Capacity development	NPCA	
1.5 Management Effectiveness Evaluation	NPCA	
Component 2: Wetland Inventory, Assessment and Monitoring		
2.1 Development of monitoring system	NPCA	
2.2 Wetlands monitoring	NPCA	Wildlife monitoring elements can be covered under Chandratal Wildlife Sanctuary Management Plan 2018-2028
2.3 Animal diseases surveillance		Foot & Mouth Disease (FMD) Control Programme of Department of Animal Husbandry, Himachal Pradesh
2.4 Ecosystem Health Card	NPCA	
2.5 Research studies	NPCA	NCPOR Himansh Programme can include climate vulnerability assessment
Component 3: Communication and Outreach		
3.1 Interpretation centre	NPCA	
3.2 Signage	NPCA	
3.3 Awareness programmes	NPCA	
3.4 Publications	NPCA	

Component 4: Water regime and habitat management		
4.1 Water retention structure for Peat-bogs	NPCA	
4.2 Rotational grazing		HPFD under Chandratal Wildlife Sanctuary Management Plan 2018-2028
Component 5: Responsible wetland tourism		
5.1 Training of camp owners and staffers	NPCA	
5.2 Tourist dos and don'ts	NPCA	
5.3 Access regulation	NPCA	
5.4 Alternate camping site	NPCA	
5.5 Homestays		Sustainable tourism programme under Himachal Pradesh Tourism Department

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Stay in touch

Wetlands International South Asia
A-25, Floors 1 & 2, Defence Colony
New Delhi-110024, India
Tel: +91 11 24338906, 46038906
Email: wi.southasia@wi-sa.org
URL: https://south-asia.wetlands.org

Wetlands International
@WetlandsInt
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