

***A technical report on the inventory of moraine dammed
glacial lakes (GLOFs) in Chenab, Beas, Ravi and Satluj
Basins using high resolution Satellite data (2022)***



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Abstract	With the projected increase in the frequency and intensity of extreme events including floods, droughts, landslides etc. which are attributable to climate change, disaster management need greater attention. Susceptibility of the State of Himachal Pradesh to the vagaries of climate change has now been well documented. Scientific insight gained from the analysis of multi spectral Satellite images carried out by the authors suggests that spatial extent of majority of glaciers is changing very fast leading to the formation of moraine dammed lakes. Formation of such lakes is posing potential threat to the infrastructure and human life thriving in the downstream areas of many drainage systems originating from the snow clad mountains ranges of the State. Various studies have been carried out on this vital issue of climate change and reveals that there is an alarming increase in such potential lakes which can be disastrous in the event of any break due to one or the other reasons. The present study has been carried out using LISS III satellite data for the year 2022. The mapping has been carried out in Chenab, Beas, Ravi and Satluj basins for the delineation of all such lakes in the higher regions. The area mostly being inaccessible where about 70% catchment as in case of the Satluj basin is on the international territory, so the investigation is inaccessible as in the present case where the mapping by any other conventional method is just not possible because of rugged topography of the area besides the area under International boundary, so the remote sensing technology has been found to be very useful in acquiring the information. The interpretation has been carried out using ArcGIS software. Based on this, a complete inventory of moraine dammed glacial lakes (GLOFs) basin wise has been generated which forms the base line data for future monitoring as far as disaster preparedness in the state is concerned. Besides this, the monitoring of Parechhu lake has also been carried out separately using LISS IV data during the year 2013 from April to September and the up to date status was conveyed to the Govt. of Himachal Pradesh and other stakeholders in the State. The regular monitoring of all such moraine dammed glacial and river section lakes is thus important and needs regular monitoring in order to meet out any eventuality at the pre disaster level.
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A technical report on the inventory of moraine dammed glacial lakes (GLOFs) in Satluj, Beas, Chenab and Ravi Basins using high resolution satellite data (2022).

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1 Introduction

1.1 Background:

During its geological history, the earth has experienced alternate cycles of warm and cold climates. During cold climate, glaciers and ice sheets have formed on the surface of the earth. Geological evidence suggests that the earth has experienced glaciations during Permo-Carboniferous and in the Pleistocene period (Embleton and King, 1975). Precambrian tillites and boulder-beds are reported from many parts of the world, such as Scotland, U.S.A. Clear evidence of Carboniferous-Carboniferous ice age is also established in India and South Africa. The Carboniferous- Carboniferous glaciation was followed by Mesozoic era, during which the world temperature was higher than that of today and no evidence of glaciation was observed in the geological formations of that period. In Cenozoic era, large-scale glaciation was experienced, which includes glaciation during Pleistocene and Quaternary periods (Smith *et al.*, 2005). It has also influenced the present distribution of glaciers on the earth's surface. During Pleistocene the earth's surface had experienced repeated glaciation over a large land mass. During the peak of glaciation, the area covered by the glaciers was 46 Million sq. km. (Embleton and King, 1975). This was more than three times the present ice cover of the earth. Available data indicates that during the Pleistocene, the earth has experienced four or five glaciation periods separated by an interglacial periods. During an interglacial period, climate was warmer and deglaciation occurred on a large scale.

The most recent glaciation reached its maximum advance about 20,000 years ago when the Himalayan snow line was depressed from 600 to 1000 meters lower than the present elevation due to fall of temperatures by 5 to 8°C. At present total glaciated area on the earth is about 14.9 million sq. km. Out of this 2.5 million sq. Km. is located in Arctic and 1.7 million sq. km. in the Greenland ice sheet (Flint, 1971). The remaining 0.7 million sq. km. area is distributed in the other parts of the World. Himalaya has one of the largest concentrations of glaciers outside the Polar Regions and some estimates suggest that the number could be as high as five thousand (Kulkarni and Bahuguna, 2001).

In the Himalaya, glaciers cover approximately 33000 sq. km area, and this is one of the largest concentrations of glacier-stored water outside the Polar Regions. Melt water from

these glaciers forms an important source into run-off of North Indian Rivers during critical summer months. This makes these rivers perennial and has helped to sustain and flourish the Indian civilization along the banks of Ganga and Indus. This supply is available during dry periods and naturally regulates the flow of large rivers thus compensating extremes of precipitation. Glacial activity also generates sediments. However there have been several evidences in recent geological history about the glacier mass fluctuations resulting in the stream runoff originating from them. Stream runoff is an important component in planning of water resources and micro and mini hydroelectric projects. Glacier mass fluctuations are also indicators of global climatic changes. In the context of the Himalayan glaciers, which are source of many giant north Indian rivers, systematic monitoring of Himalayan glaciers is of paramount importance in view of their large number and area covered.

Global warming has already caused a significant glacier ice loss since the Little Ice Age (AD 1550-1850) (Denton and Hughes, 1981) resulting in both glacier retreat and thinning (loss of ice volume). Many glaciers in the Himalayan mountain chain are reported to be gradually retreating (Mayeswki and Jeschke, 1979; Li *et al.*, 1998; Kulkarni and Bahuguna, 2002; Raina, 2004; Kulkarni and Alex, 2003; Kulkarni *et al.*, 2005; Kulkarni *et al.*, 2006). Catastrophic natural processes triggered by these glacier changes were responsible for considerable death and destruction throughout the mountains. These processes included ice avalanches, landslides and debris flows, outbursts from moraine-dammed lakes and also outbursts from glacier dammed lakes. Glacier avalanches have occurred where glaciers have retreated up steep rock slopes. Sources of debris flows are frequently moraine complexes exposed during glacier retreat, which may be ice-cored. Outbursts from moraine dammed lakes result from the catastrophic breaching of the moraine dam - a process that is commonly initiated by glacier avalanches - generated waves that overtop the moraine. Himalayan and Trans-Himalayan glaciers are in general state of retreat since 1850 AD. Most of the Himalayan glaciers are covered by debris, which slows down their melting.

Glaciers in the Himalayas are fast retreating like other ice mountains the world over. A recent study showed that the last three decades of the 20th century have been the hottest period in 1,000 years. The melting of the Gangotri glacier is accelerating at an average retreat rate of 30 meters annually. The rate between 1935 and 1990 was 18 meters per year and 7

meters annually between 1842 and 1935. The overall deglaciation from 1962 to 2001 in the Baspa basin of Himachal Pradesh has been estimated as 19%. Chhota Shigri glacier of Chandra valley also retreated by about 12% in the last one and half decade. The deglaciation processes are also noticeable for large glaciers in Ganga headwater like Gangotri which shows about 10% decrease during the last 18 years. The maximum retreat of 34.5 metres per year has been observed at Meola glacier in Dhauliganga river basin. The retreat of the Parbati glacier is reported to be unusual and more alarming.

In short, the deglaciation in the Himalayas is influenced by various factors, climatic, regional etc. However, the main underlying factor is ever increasing warming on the mountains, chiefly because of excess emission of greenhouse gases and Asian brown cloud. The ongoing ice melting is only the tip of the iceberg that will hit us in the near future. As the Indian economy depends to a great extent on agriculture- a highly climate sensitive sector and the knowledge about potential climate change impacts on agriculture has special significance. Agriculture productivity is sensitive to two broad classes (a) direct effects from change in temperature and (b) indirect effects through changes in soils, distribution and frequency of infestation by pests, insects, diseases or weeds etc. Several studies predict that rice and wheat yield would decline considerably with climatic changes in India. As the mountain areas accounts only 21% of the total geographical area of India, where about 60-70% population largely depends on agriculture, horticulture and animal husbandry related activities for their livelihood. If the present trend of climate change continues, this will have an adverse effect on their lifestyles.

1.2 An overview of Snow and Glaciers in Himachal Himalaya

Himachal Pradesh is a small hilly state that forms a part of the Western Himalayan region. The five major rivers of the Northern India viz. Beas, Chenab, Ravi, Satluj and Yamuna of the Indus and the Ganges River System either originates or passes through this Himalayan State forming the life line of the people of the Himalayan region and that of the Punjab Plains. The discharge dependability of these rivers mainly depends upon the solid precipitation available in the form of snow and glaciers in the higher reaches of the Himalayan region and the also to some extent on the liquid precipitation available in the form of monsoonal rains and the winter rains in the upper catchments. Based on the earlier studies

carried out using LISS I and LISS II satellite data in Satluj basin suggests the presence of 334 glaciers in the Satluj basin. The aerial extent of the glaciers in the basin has been calculated as 1515 sq.km. The study also shows the presence of 1987 permanent snow fields having a total area of 1182 sq.km. Thus the total area under glaciers and permanent snow fields in the Satluj basin has been calculated as 2607 sq.km. Similarly, the interpretation in Chenab basin were carried out using IRS LISS III satellite data for the year 2000-01 and the results obtained from the investigation suggest the presence of 457 glaciers in the Chenab basin having total aerial extent as 1055.27 sq.km. The total number of permanent snow fields in this basin is 732 having total area as 245.0 sq.km. This makes total number of glaciers and snowfields in Chenab basin as 1189 having an aerial extent of 1300.27 sq.km.

Glacial hazards relate to hazards associated with glaciers and glacial lakes in high mountain areas and their impacts downstream. The climatic change/variability in recent decades has made considerable impacts on the glacier life cycle in the Himalayan region. As a result, many big glaciers melted, forming a large number of glacial lakes. Due to an increase in the rate at which ice and snow melted, the accumulation of water in these lakes started increasing. Sudden discharge of large volumes of water with debris from these lakes potentially causes glacial lake outburst floods (GLOFs) in valleys downstream. Outbursts from glacier lakes have repeatedly caused the loss of human lives as well as severe damage to local infrastructure.

Himalayan alpine glaciers have their snow line above 3800 meters from m.s.l. (Hewitt, 2011). Geological study of glaciers in this region therefore is very difficult considering the fact that geological field surveys are hazardous and life threatening. With the advent of space borne technologies like- Remote Sensing (RS) and Geographic Information System (GIS) it is now possible to monitor such inaccessible places throughout the year. With further increase of remote sensing platforms with improved spatial and temporal resolutions aid regular observation and supervision of various properties of alpine glaciers scilicet- ice extent, snow line, position of terminus, volume, glacier mass balance (Racoviteanu et al., 2008).

Remote sensing data and GIS are ideal tools for studying and monitoring glacial lakes and assessing their hazard potential. GIS is capable of integrating and aggregating the data

acquired from different sources i.e. topographic maps, satellite data, published reports etc. Glacial lakes are identified and mapped from the satellite data using image processing tools. The glacial lakes and surrounding characteristics such as slope, geology, geomorphology, etc. are used to identify the potentially dangerous glacial lakes. A comprehensive approach by coupling of remote sensing, geo-morphometric analyses aided with GIS modelling for the identification of potentially dangerous and hazard assessment is used for the present study of glacial lakes in Himachal Pradesh

1.3 Hazard vulnerability of the State

Mountain areas are especially vulnerable to natural disasters where development over the years has further accentuated the problem by upsetting the natural balance of various physical processes operating in the mountain eco-system. The increased pressure on the mountain environment has contributed in some measure to environmental problems such as landslides, land subsidence, removal of vegetation and soil erosion. According to one estimate, about 58.36% of the land is subjected to intense soil erosion, majority of which is located in the Himalaya. The State of Himachal Pradesh, which forms part of the Northwestern Himalaya, is environmentally fragile and ecologically vulnerable. Geologically the Himalaya is considered to be the youngest mountain chains in the world and is still in the building phase. Natural hazards are matter of immediate concern to the State of Himachal Pradesh, as every year the State experiences the fury of nature in various forms like earthquakes, landslides, cloud bursts, flash floods, snow avalanches and droughts etc. The fragile ecology of the mountain state coupled with large variations in physio-climatic conditions has rendered it vulnerable to the vagaries of nature. The incidence of cloudbursts in the last few years has baffled both the meteorologist and the common man equally. Notwithstanding, the continuous efforts made by the Government to cope with natural hazards through relief and rehabilitation measures, landslides and snow avalanches continue to inflict widespread harm and damage to human life as well as property. The roads that are the State's lifeline are repeatedly damaged, blocked or washed away by one or other acts of nature. In the circumstances, the Government has to divert the already scarce resources of the state for relief and rehabilitation measures as opposed to long term development.

In the Himalayas, during the retreating phase a large number of lakes are being formed either at the snout of the glacier as a result of damming of the morainic material known as moraine dammed lakes or supra glacial lakes formed in the glacier surface area. A glacial lake is defined as a water mass existing in a sufficient amount and extending with a free surface in, under, beside and/or in front of a glacier and originated by glacier activities and/or retreating processes of a glacier. Most of these lakes are formed by the accumulation of vast amounts of water from the melting of snow and by blockade of end moraines located in the down valleys close to the glaciers. In addition, the lakes can also be formed due to landslides causing artificial blocks in the waterways. The sudden break of a moraine/block may generate the discharge of large volumes of water and debris from these glacial lakes and water bodies causing flash floods namely GLOF. A Glacial Lake Outburst Flood (GLOF), also known as a jökulhlaup in Icelandic (A jökulhlaup is technically a sudden and often catastrophic flood that occurs during a volcanic eruption, but is also used to describe other sorts of glacial flooding), can occur when a lake contained by a glacier or a terminal moraine dam fails. This can happen due to erosion, a buildup of water pressure, an avalanche of rock or heavy snow, an earthquake, or if a large enough portion of a glacier breaks off and massively displaces the waters in a glacial lake at its base.

Many countries has a series of monitoring efforts to help prevent death and destruction that are likely to experience due to these events. The importance of this situation has magnified over the past century due to increased population, and the increasing number of glacial lakes that have developed due to glacier retreat. There are a number of GLOF events that have been reported worldwide. There are number of such events that have happened in Nepal Himalayas but no such event has been reported so far from Indian Himalayas. On the basis of earlier studies carried out in Himachal Himalayas in Satluj basin, there are about 38 such lakes in entire Satluj basin out of which 14 falls in Himachal part. Similarly 50 moraine dammed lakes in Chenab basin and 5 supra glacial lakes have been mapped using remote sensing. The state of Himachal Pradesh invariably experience flash floods, the cause of which is unknown. In the year 2000, the Satluj valley experiences the heaviest floods causing loss of more than 800 crores. It is still a matter of investigation whether the floods were caused by cloud bursting or due to Glacier Lake Outburst Floods (GLOF) phenomena. The formation of landslide dammed lakes in high altitude zones such as Parechhu in the upper catchment of

Spiti basin in Tibet caused tremendous threat to the life and property located in the downstream areas. It is therefore necessary that a constant and repeated monitoring of the upper catchment areas having international dimensions required to be carried out on a regular basis.

1.4. Objectives of the Study

The main objective of the study is to have an updated inventory for the monitoring of all the moraine dammed glacier lakes/ water bodies in the upper catchments of the Satluj, Beas, Ravi & Chenab basins in Himachal Pradesh using high resolution satellite data of LANDSAT 8 and IRS R2/2A, LISS III for the year 2022.

1.5. Study area and data used

The study area comprises all the basins/sub-basins located within the Beas, Ravi, and Chenab River basins in Himachal Pradesh. The Satluj Basin has been studied in detail, starting with its origin, Mansarovar Lake in the Tibetan Region. The Landsat 8 and LISS III satellite data have been used to monitor moraine-damaged lakes in the Chenab, Ravi, Beas, and Satluj basins. The river Satluj is one of the main tributaries of the Indus and originates near Manasarovar and Rakas lakes in the Tibetan plateau at an elevation of about 4,500 m (approx.). The entire Satluj basin has been divided into three sub-basins, viz., Spiti as sub-basin number 1, Upper Satluj basin (Tibet) as 3, and Lower Satluj sub-basin number 2. Likewise, the other basins comprise Ravi, Beas (Upper Beas, Jiwa and Parvati) and Chenab (Chandra, Bhaga, and Miyar), which have been studied in detail for mapping of the moraine-dammed lakes (GLOFs) and are as per Fig.1.1.

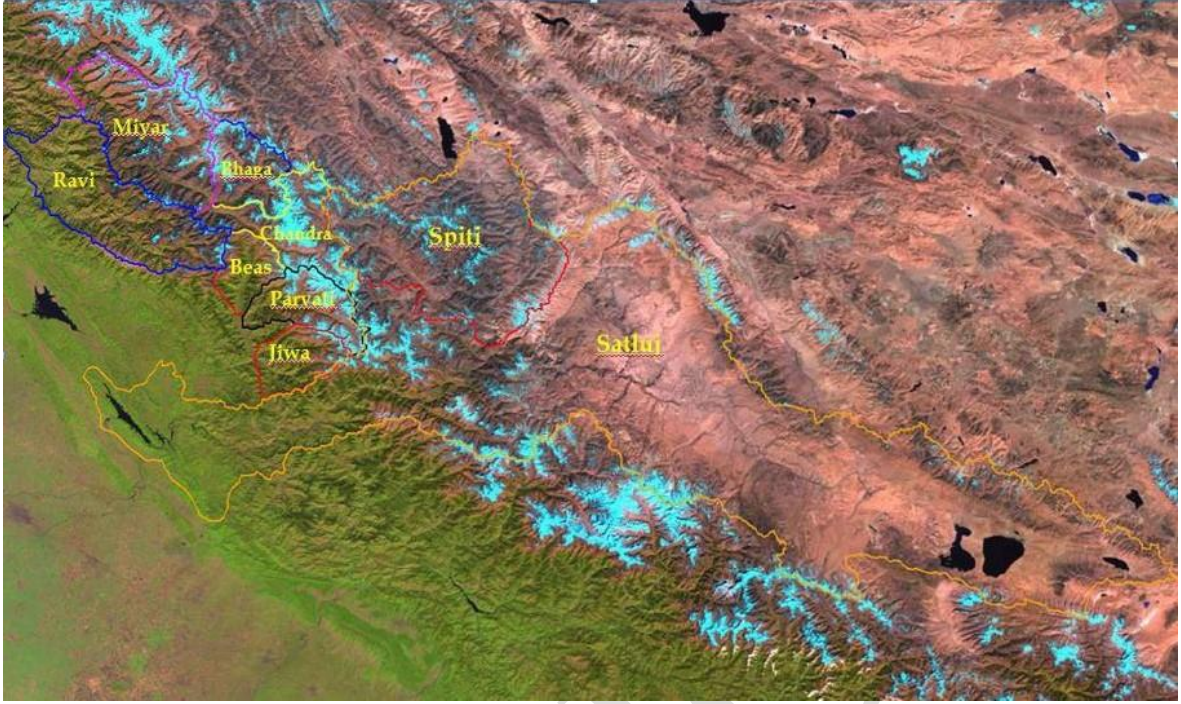


Figure 1. 1: Different sub basins in Himachal Pradesh

1.6. Methodology

The Landsat satellite data, having a spatial resolution of 30m, and LISS III satellite data, having a spatial resolution of 23.5 m have been used for the delineation of all moraine-dammed glacial lakes (GLOFs) in different basins, viz., Chenab, Beas, Ravi, and Satluj basins, for the year 2022. Satluj basin has been studied in detail right from its origin from Mansarovar Lake in the Tibetan Himalayas. The cloud-free data during the months of August-September/October 2022 has been used for mapping purposes (Table 1.1). The geometric rectification was done using polynomial transformation of third order with a resulting Root Mean Square (RMS) error of less than one pixel. The basin boundaries were superimposed on the satellite image, and the visible lakes were delineated using ArcGIS software. The digitized polygons have been cleaned for open ends and built into a polygon layer. All the polygons have been assigned polygon IDs. The water spread area is considered to represent the boundary of the lake. The flowchart explaining the methodology is given in Fig. 1.1.

Table 1. 1: Satellite data Used for GLOFs, 2022

LISS-III Satellite data used for monitoring in the study area			
Sr. No.	Date of Pass	Path –Row	Satellite Sensor
1	28 Aug 2022	96-48	Resourcesat2/LISS III
2	28 Aug 2022	96-49	Resourcesat2/LISS III
3	31 Aug 2022	99-48	Resourcesat2A/LISS III
4	31 Aug 2022	99-49	Resourcesat2A/LISS III
5	02 Sep 2022	97-48	Resourcesat2/LISS III
6	05 Sep 2022	100-49	Resourcesat2A/LISS III
7	12 Sep 2022	99-48	Resourcesat2/LISS III
8	12 Sep 2022	99-49	Resourcesat2/LISS III
9	16 Sep 2022	95-47	Resourcesat2/LISS III
10	29 Sep 2022	100-49	Resourcesat2A/LISS III
11	05 Oct 2022	94-48	Resourcesat2/LISS III
12	15 Oct 2022	96-48	Resourcesat2A/LISS III
13	17 Oct 2022	94-48	Resourcesat2A/LISS III
14	08 Nov 2022	96-48	Resourcesat2/LISS III
15	18 Sept 2022	147-38	LANDSAT 8
16	18 Sept 2022	147-37	LANDSAT 8
17	27 Oct 2022	148-37	LANDSAT 8
18	Oct 2022	145-38	LANDSAT 8

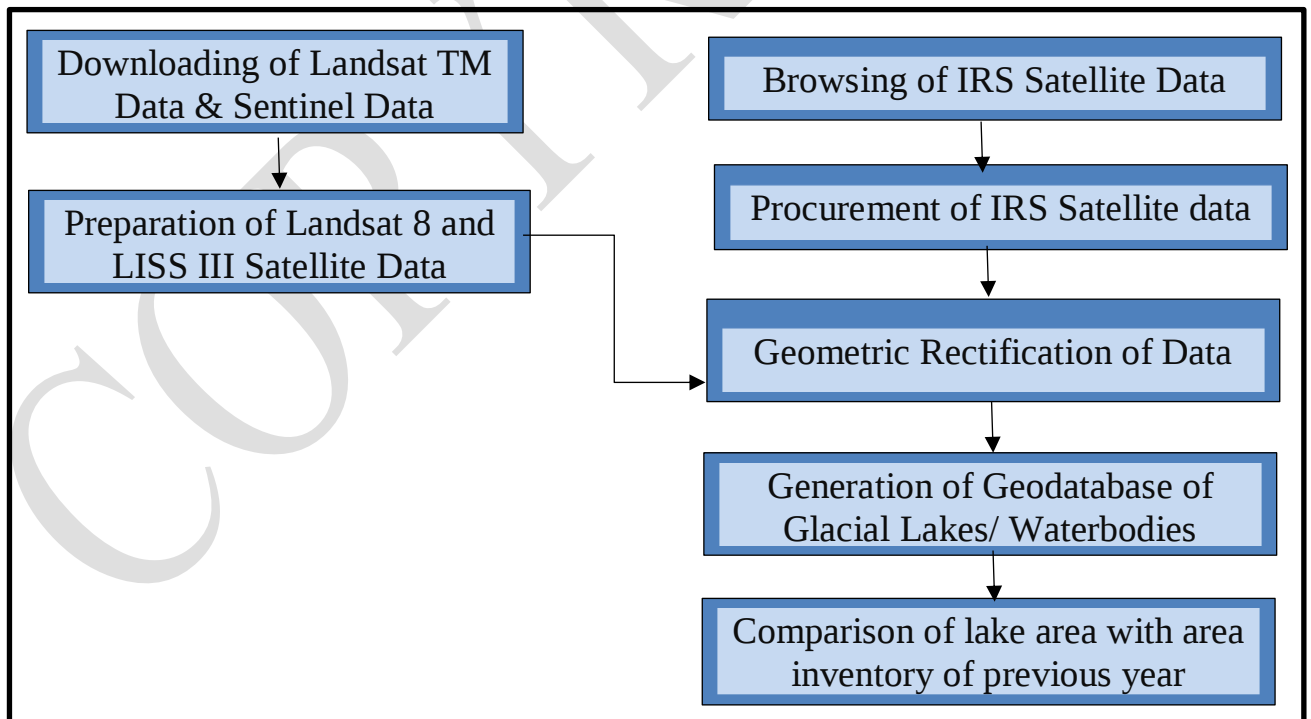


Figure 1. 2: Flow Chart of Methodology

2. LISS III Based inventory of moraine dammed lakes in Chenab (Chandra, Bhaga & Miyar Sub basins) Beas, Ravi & Satluj Basins in Himachal Pradesh.

2.1 Inventory of lakes in Chenab Sub-Basin

The Chenab basin is one of the major river basins that originate from the Himachal Himalaya near Baralacha Pass. Two rivers, viz., Chandra and Bhaga, originate from this place and flow in opposite directions before they confluence each other at a place known as Tandi near Keylong. Besides this, Miyar Sub-basin, has been studied in detail for having an updated inventory of moraine-dammed lakes in the catchment.

2.1.1 Inventory of lakes in Chandra Sub-Basin

From the analysis of satellite data of LANDSAT 8 for 18th September 2022 in the Chandra basin (Figs. 2.1.1 and 2.1.2), 73 lakes were mapped in comparison to 52 moraine-dammed glacial lakes mapped in 2019, 64 in 2018, 46 in 2017 and 23 in 2016, reflecting an increasing trend in the basin (Table: 2.1, Figs. 2.1.3 and 2.1.4). Further, it is observed that out of these 73 moraine-dammed glacial lakes, the maximum number of lakes, i.e., 69 lakes, were the small ones with an area less than 5 ha; 01 lake falls within the areal range of 5-10 ha, and 03 lakes with IDs 1 (111.54 ha), 3 (166.02 ha) and 1205 (48.28 ha) are such that they have an area of more than 10 ha. Further analysis reveals that the glacial lakes mapped under the category of less than 5 hectares have increased from 20 lakes in 2016, 43 in 2017, 59 lakes in 2018, reduced to 47 in 2019, and again increased to 69 lakes in 2022. The lake with ID 19 water spread receded from 5-10 hectares (6.61 ha) in 2019 to less than 5 hectares category (3.69 ha) in 2022. The number of lakes mapped under the 5-10 hectares category has been reduced from 3 in 2019 to 1 in 2022. The water spread of moraine-dammed glacial lakes ID 1 and 3 increased by 12.86 and 3.95 ha in 2022, respectively. The area of Lake ID 1 (at the snout of Geepang Gath Glacier) has risen from 98.68 ha (2019) to 111.54 ha (2022) and seems quite deep, having a large water column. In contrast, the lake with ID 3 (at the snout of Samudri Tapu Glacier) has risen from 162.07 ha (2019) to 166.02 ha (2022) and appears to be shallow based on its tone and texture (Annexure 1). The 32 moraine-dammed/glacial lakes, which could be seen temporally with 2019 data, indicated that 23 lakes were increased and 09 lakes have been reduced in their areal extent. The 41 moraine-dammed/glacial lakes that could not be compared with 2019 data are either new ones or could not be mapped during 2019

because of cloud cover in the satellite data, thus forming the baseline data for their monitoring during the next ablation season.

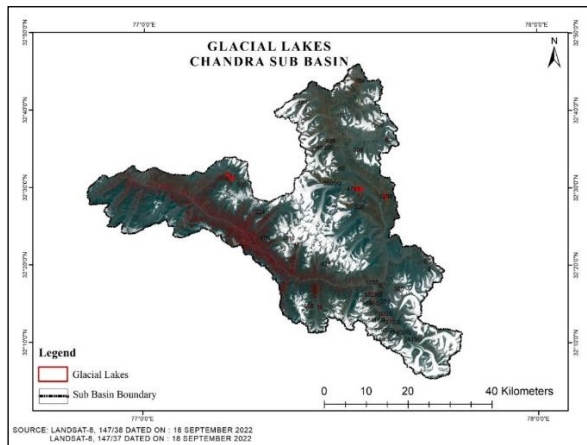


Figure 2.1. 1: Satellite view of lakes in Chandra Sub-basin based on Landsat-8, 2022

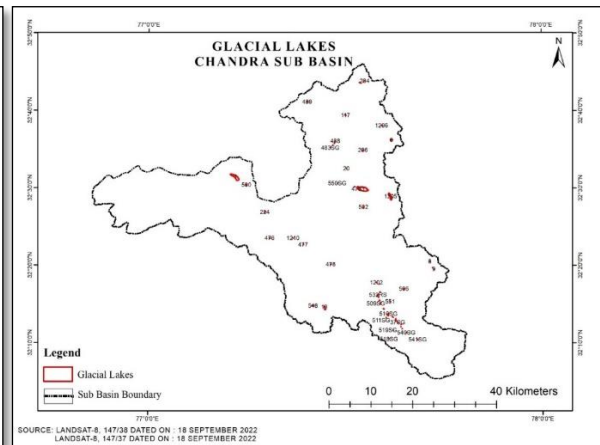


Figure 2.1. 2: Inventory of lakes in Chandra Sub-basin based on Landsat-8, 2022

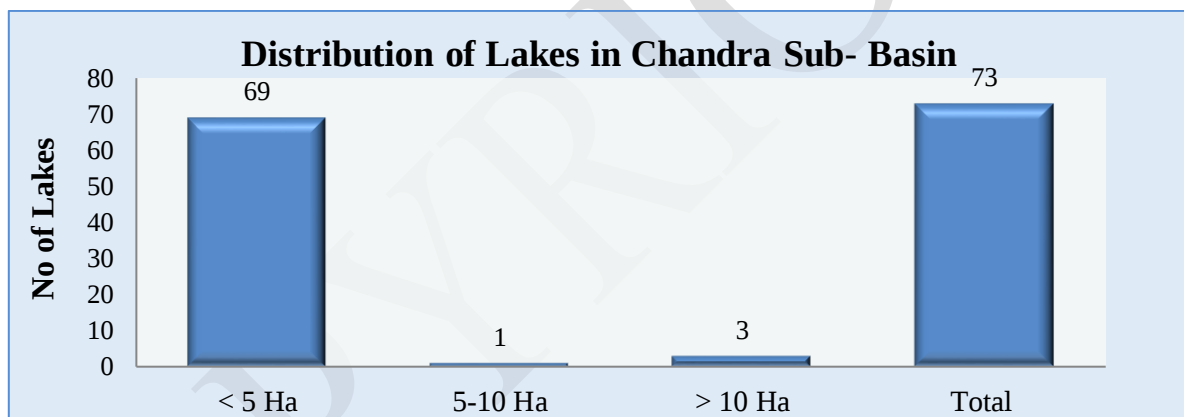


Figure 2.1. 3: Distribution of lakes in Chandra sub basin (2022)

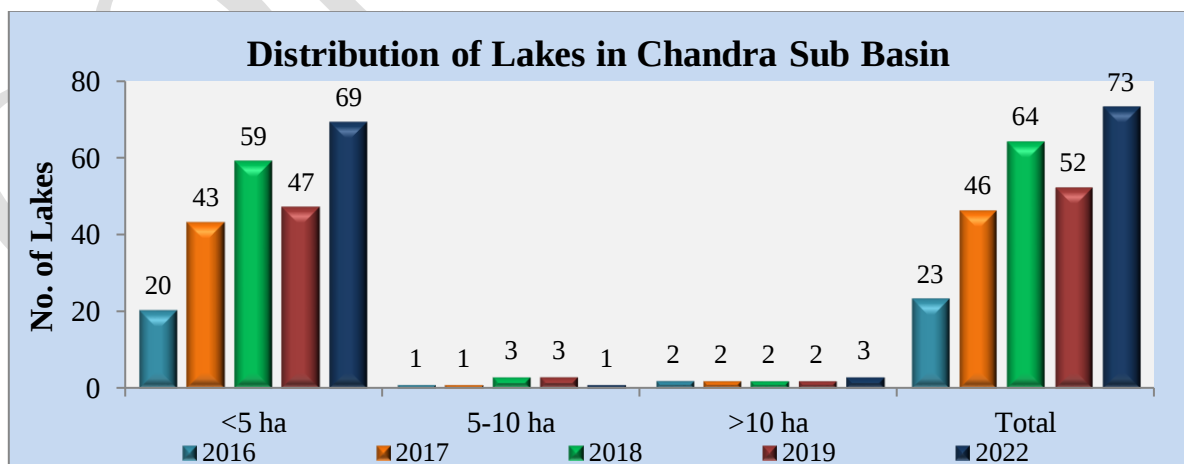


Figure 2.1. 4: Distribution of lakes in Chandra sub basin (2016-2022)

2.1.2 Inventory of lakes in Bhaga Sub Basin

The satellite data for Landsat 8 of 18th September 2022 has been analyzed in the Bhaga basin, which is a sub-basin of the Chenab, and shows a total of 124 moraine-dammed/glacial lakes delineated in 2022 (Table: 2.1 & Figs. 2.1.5 and 2.1.6) in comparison with, 21 in 2016, 56 in 2017, 84 in 2018 and 51 lakes mapped in 2019 (Table: 2.1 and Fig. 2.1.8), respectively. Further out of these 124 moraine-dammed/glacial lakes mapped in 2022, the majority of the lakes, i.e., 118 lakes, are small ones with an area less than 5 ha, 4 lakes are within the areal range of 5-10 ha, and 2 lakes are an area of more than 10 ha (Fig. 2.1.7). The lake ID 11, 10.30 ha in 2022, has been reduced by 0.10 ha w.r.t. 10.40 ha in 2019. The lake ID 6, 12.03 ha in 2022, has been increased by 1.09 ha; earlier it was 10.94 ha in 2019. Temporally, 41 moraine-dammed/glacial lakes could be seen out of 124 lakes show 26 lakes are showing an increase in their spatial extent and 15 lakes are showing a reduction in their spatial extent in 2022 when compared with that of 2019 data, and the 84 lakes that could not be compared from the baseline data for their monitoring during the next ablation season 2023. ID 11, 10.30 ha in 2022, has been reduced by 0.10 ha w.r.t. 10.40 ha in 2019. The lake ID 6, 12.03 ha in 2022, has been increased by 1.09 ha; earlier it was 10.94 ha in 2019. Temporally, 41 moraine-dammed/glacial lakes mapped out of 124 lakes show 26 lakes are showing an increase in their spatial extent and 15 lakes are showing a reduction in their spatial extent in 2022 when compared with that of 2019 data, and the 84 lakes that could not be compared from the baseline data for their monitoring during the next ablation season 2023 (Annexure 2).

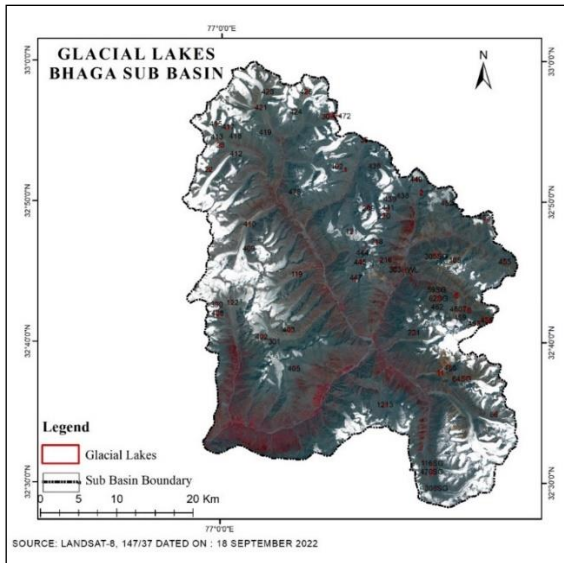


Figure 2.1. 5: Satellite view of lakes in Bhaga basin based on Landsat 8, 2022

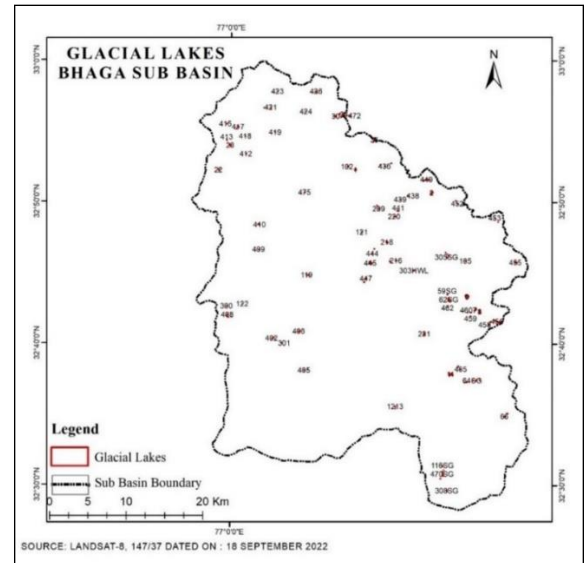


Figure 2.1. 6: Inventory of lakes in Bhaga sub basin based on Landsat 8, 2022

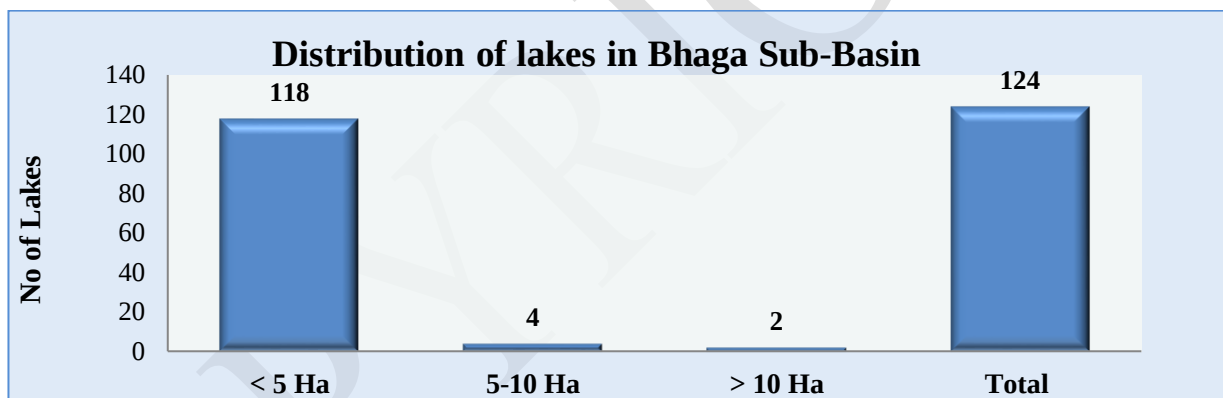


Figure 2.1. 7: Distribution of lakes in Bhaga sub basin

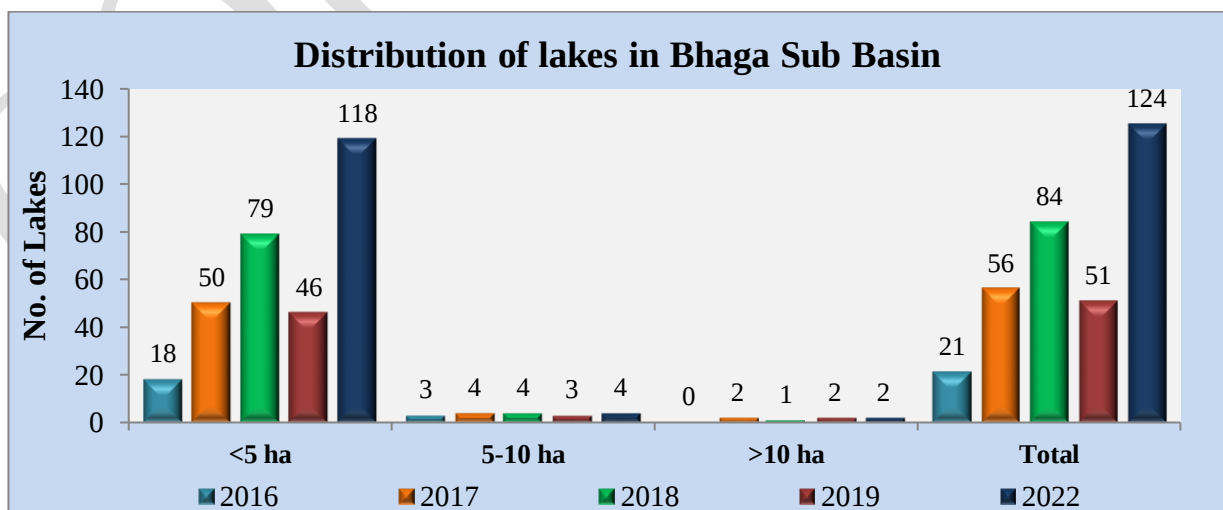


Figure 2.1. 8: Distribution of lakes in Bhaga sub basin (2016-2022)

2.1.3 Inventory of lakes in Miyar Sub Basin:

From the analysis of satellite data of IRS-RS2-L3 for 5th October 2022 and Landsat 8 for 18th September and 27th October 2022 in the Miyar sub-basin (Fig. 7.1.9), a total of 202 moraine-dammed/glacial lakes were delineated in comparison with, 89 in 2016 118 in 2017, 106 in 2018 and 139 lakes that were mapped in 2019 (Fig. 2.1.12). The majority of moraine-dammed/glacial lakes fall in the category of area less than 5 ha, i.e., 96% (194) lakes, followed by those within the area range of 5-10 ha, i.e., about 3% (6) lakes. The only 1%, i.e., 2 lakes, fall under the category of more than 10 ha (Table: 2.1 & Fig. 2.1.12). The areal extent of the lake with ID 1 has increased from 9.58 ha in 2019 (5-10 ha category) to 12.51 ha in 2022, placing it in the category of areas greater than 10 ha. The lake with ID 209, with an area of more than 10 ha, shows an increase of about 5.90 ha, i.e., the area has increased from 15.97 ha (2019) to 21.87 ha (2022), respectively (Annexure 3). Further, 102 moraine-dammed/glacial lakes could be seen temporally w.r.t. 2019; 57 lakes showed an increase in their water spread, whereas 45 lakes showed a reduction in their water spread w.r.t. 2019. The 100 lakes could not be compared and created the baseline data for next year's monitoring.

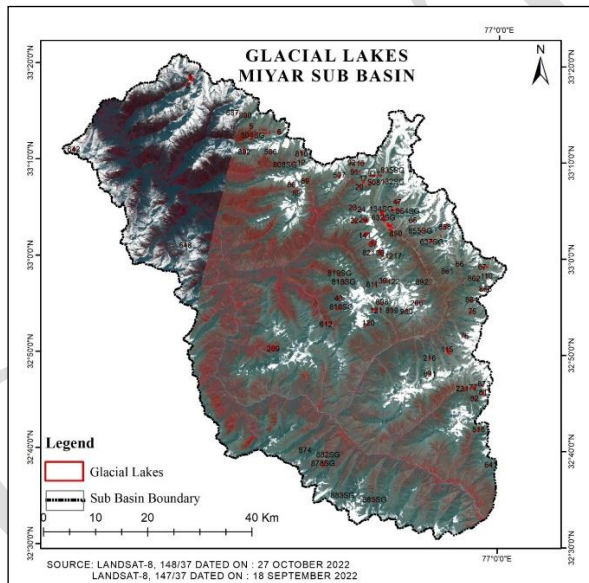


Figure 2.1. 9: Satellite view of Lake in Miyar Sub-basin based on Landsat-8, Sept.2022

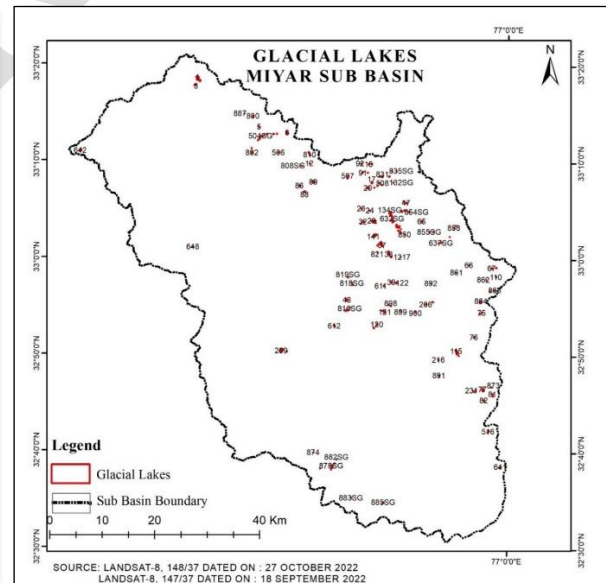


Figure 2.1. 10: Inventory of lake in Miyar sub basin based on Landsat-8, Sept.2022

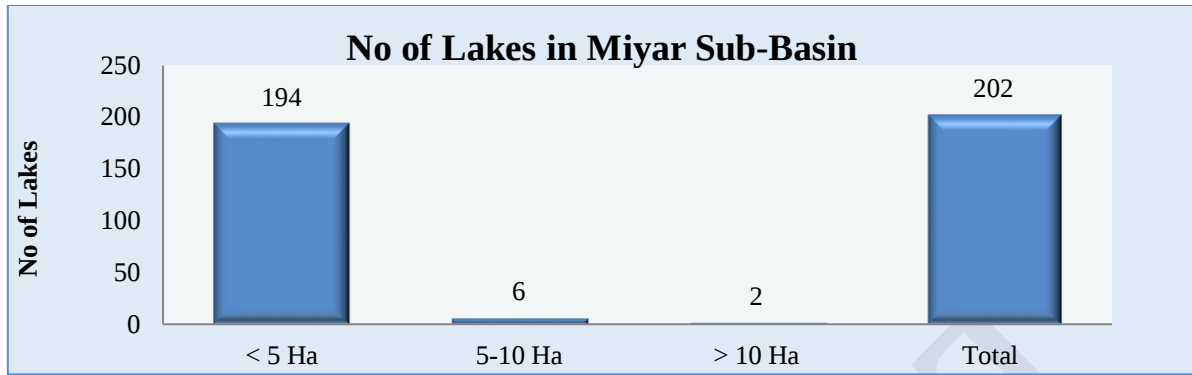


Figure 2.1. 11: Distribution of lakes in Miyar sub basin

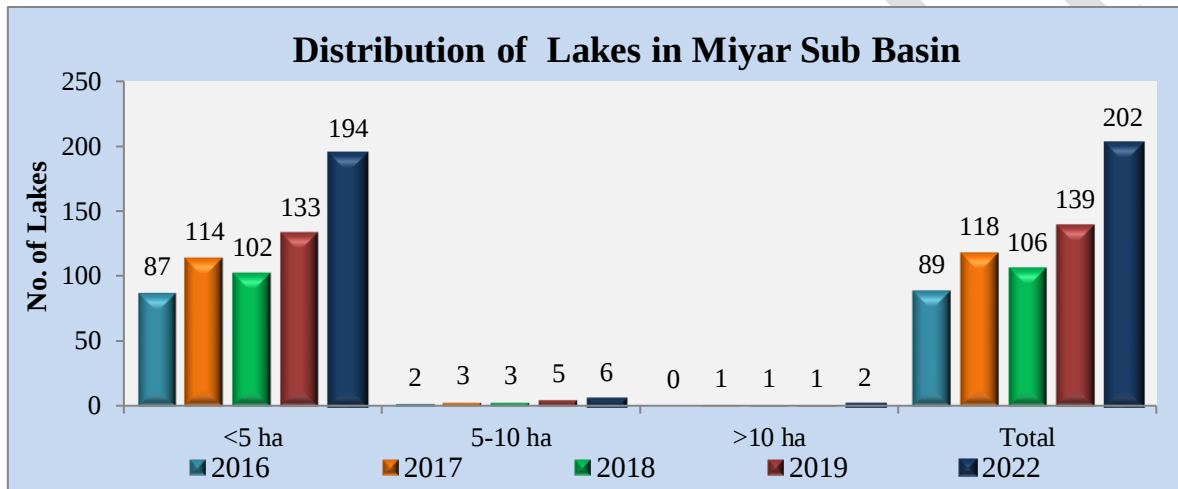


Figure 2.1. 12: Distribution of lakes in Miyar sub basin (2016-2022)

The Chenab basin, which mainly originates from the Himalayas, has 399 moraine-dammed/glacial lakes in total as mapped from high-resolution satellite data of 2022. The basin comprises the majority of the moraine-dammed/glacial lakes about 95% (381) are the small lakes with an area of <5 ha, followed by 11 lakes, i.e., about 3%, have an area in-between 5-10 ha. About 2%, i.e., 7 moraine-dammed/glacial lakes, are the big ones with an area of more than 10 ha (Table: 2.1 & Fig. 2.1.13). Further, when seen temporally w.r.t. the preceding years, it has been found that an enhancement of about 37% in the total number of lakes could be seen with that of 2019, 36% in 2018 (254), 45% in 2017 (220), and 66% with that of 2016 (133). The analysis further reveals an overall increase of about 87% with that of 51 lakes mapped in the Chenab basin during 2001 (Randhawa et al. 2005) (Table 2.1 & Fig. 2.1.14). The comparative analysis of the moraine-dammed/glacial lakes mapped in 2022 reflects that out of the total 399 lakes mapped, 7 (2022) lakes were the big ones with an area of more than 10

ha in comparison to 5 lakes (2019), 11 lakes have an area between 5-10 ha in comparison to 11 (2019), and 281 are the small ones in comparison to 226 (2019), respectively.

Table 2. 1: Distribution of lakes in Chenab Basin

Categories	Year	Chandra	Bhaga	Miyar	Chenab
No. of lakes with area >10ha	2016	2	0	0	2
	2017	2	2	1	5
	2018	2	1	1	4
	2019	2	2	1	5
	2022	3	2	2	7
No. of lakes with area between 5-10ha	2016	1	3	2	6
	2017	1	4	3	8
	2018	3	4	3	10
	2019	3	3	5	11
	2022	1	4	6	11
No. of lakes with area <5ha	2016	20	18	87	125
	2017	43	50	114	207
	2018	59	79	102	240
	2019	47	46	133	226
	2022	69	118	194	381
Total No. of lakes	2016	23	21	89	133
	2017	46	56	118	220
	2018	64	84	106	254
	2019	52	51	139	242
	2022	73	124	202	399

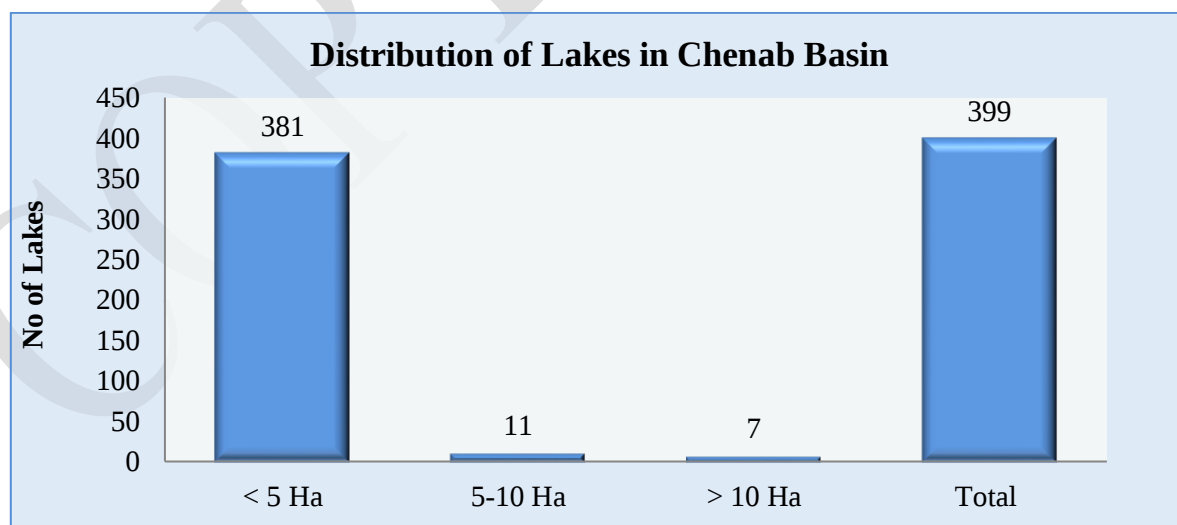


Figure 2.1. 13: Distribution of lakes in Chenab sub basin (2022)

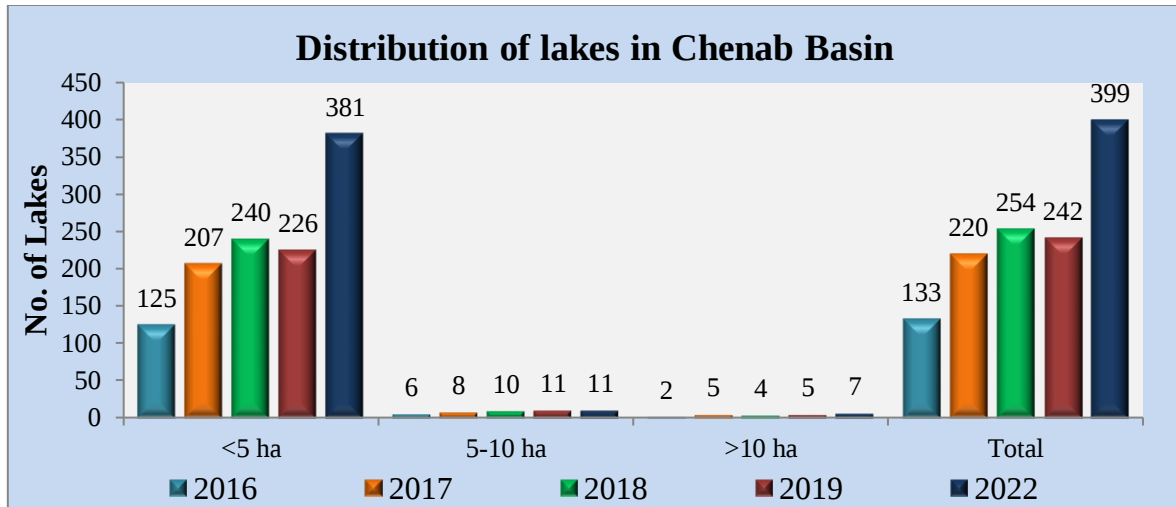


Figure 2.1. 14: Distribution of lakes in Chenab basin (2016-2022)

2.2 Inventory of lakes in Beas Basin:

Beas is another major river in Himachal Pradesh which originates from Rohtang area in Kullu district. Beas Basin has been divided into three sub basins i.e. Jiwa, Parbati and the Beas its own basin in Himachal Pradesh. Since the Beas basin falls in the transition zone, so the effect due to the climatic variations seems to be more pronounced which could be seen in the snow and glaciated regions of the state.

2.2.1 Inventory of lakes in Upper Beas Sub Basin:

The interpretation of Landsat 8 of 18th September 2022 reveals the presence of a total of 25 moraine-dammed/glacial lakes in comparison to the 23 lakes (2019) in the Upper Beas Basin upstream of Bhuntar (Fig. 2.2.1 & 2.2.2), and the variation is mainly due to the presence of cloud cover in the satellite data; as a result, maximum information could not be derived. While compared with the past data, it is found that the total number of moraine-dammed/glacial lakes has increased from 9 in 2015, 17 in 2016, to 25 in 2017, decreased to 23 in 2018 and 15 in 2019 (Table 2.2 & Fig. 2.2.4). Further analysis of the 25 moraine-dammed/glacial lakes mapped in 2022 reveals that 23 lakes are the small ones with an area less than 5 ha, 1 lake has an area in-between 5-10 ha and 1 lake has an area more than 10 ha. The lake with ID 6 has shown a reduction in its area (8.90 ha) by 1.56 ha, as a result of which this lake has been counted in the category of the lakes with an area greater 10 ha in 2019 (10.47 ha) but is now in between 5-10 ha, whereas the lake with ID 50 jumps from less than 5 ha to greater than 10 ha (Annexure 4 & Fig. 2.2.4). Temporal analysis of the common lakes

reveals that 8 lakes show an increase in their water spread in 2022 compared to 2019 and 7 lakes show a reduction in their water spread in 2022, whereas 10 lakes that could not be seen temporally in 2022 forms the baseline data for their monitoring during the next ablation season (Annexure 4).

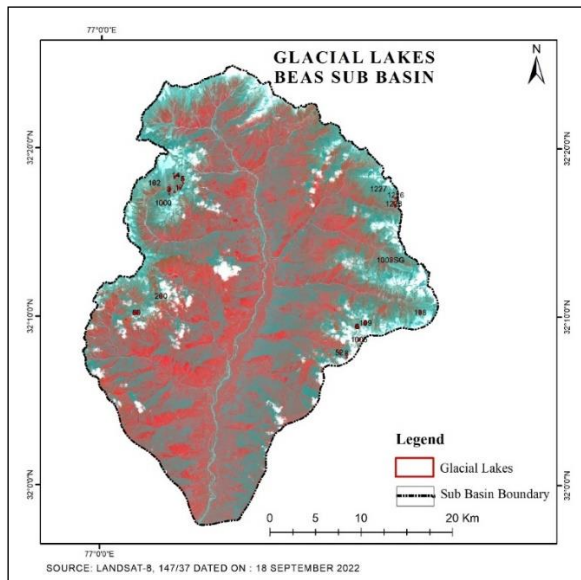


Figure 2.2. 1: Satellite view of Upper Beas Sub Basin based on Landsat-8, 2022

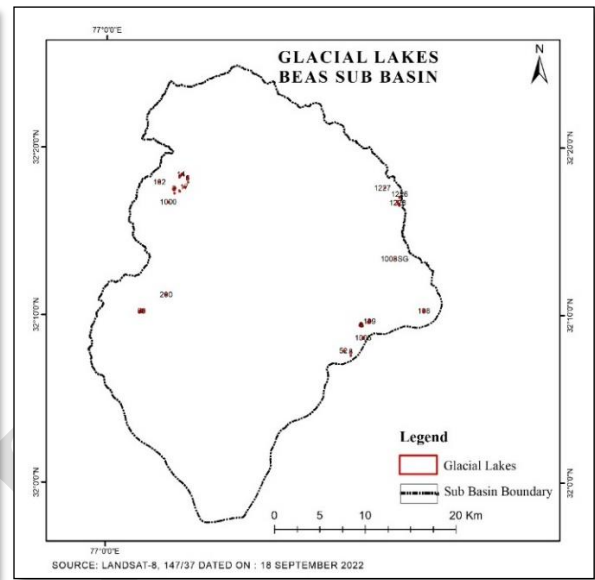


Figure 2.2. 2: Lake Inventory in Upper Beas Sub-Basin based on Landsat-8, 2022

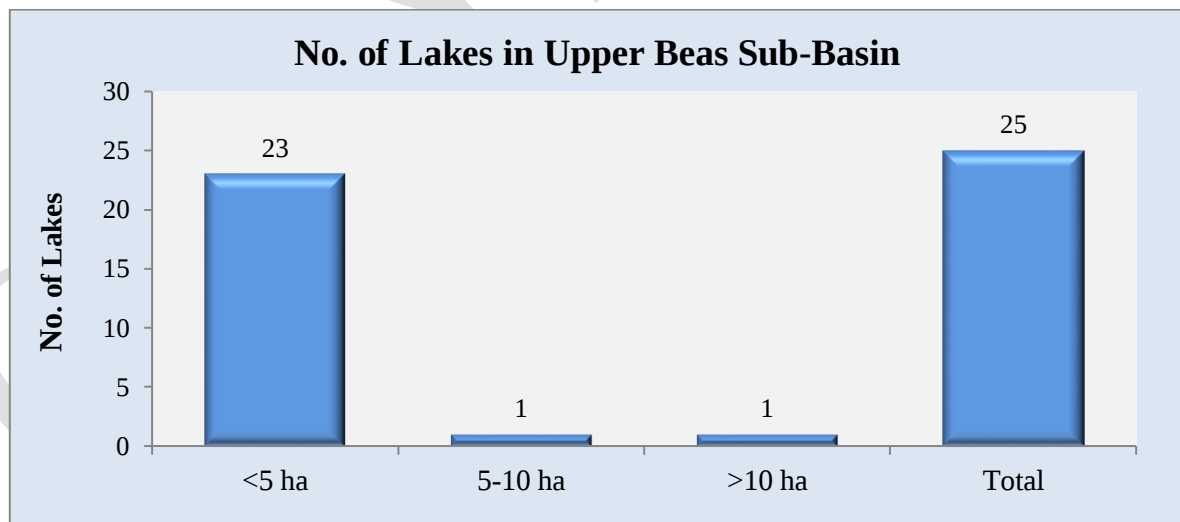


Figure 2.2. 3: Distribution of lakes in Upper Beas sub-basin (2022)

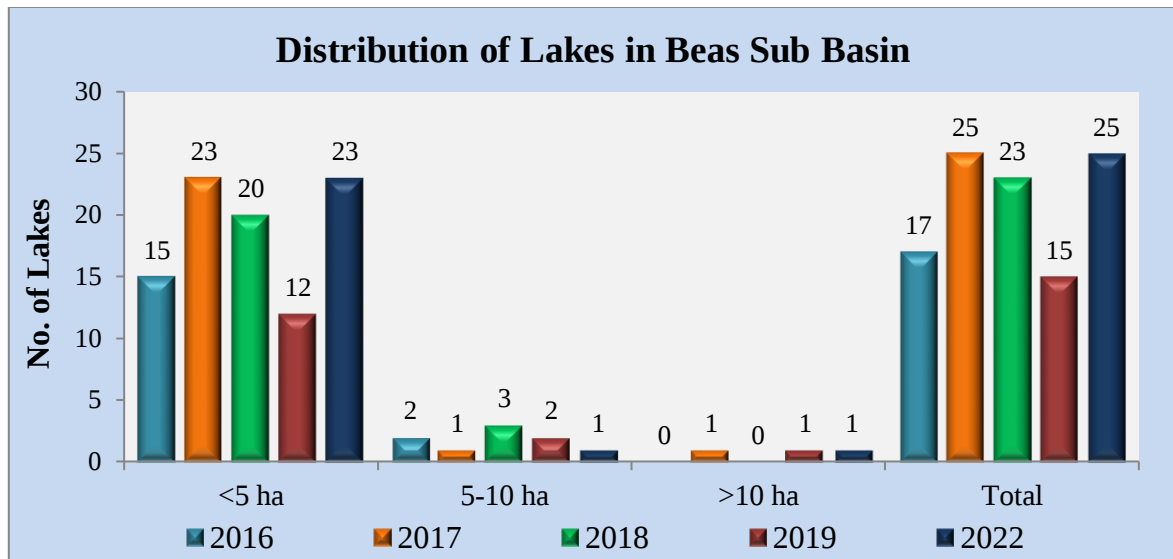


Figure 2.2. 4: Distribution of lakes in upper Beas sub basin (2016- 2019)

2.2.2 Inventory of lakes in Jiwa sub basin:

The Jiwa and Sainj are two of the Beas basin's principal tributaries, and the Jiwa sub-basin is located on the southeast bank of the Beas River. From the analysis of the LANDSAT 8 satellite data of 18th September 2022 (Figs. 2.2.5 & 2.2.6), a total of 49 moraine-dammed/glacial lakes were mapped in comparison to the 20 (2016), 32 lakes (2017), 15 lakes in 2018, and 41 mapped in 2019 (Table 2.2 & Fig. 2.2.8), and the variation in numbers is mainly due to the data quality, as a result of which the catchment is prevented from being visualized. The 49 moraine-dammed/glacial lakes mapped in 2022 reveal that 46 glacial lakes fall in the category of lakes with an area less than 5 ha and 3 lakes mapped in-between 5-10 hectares, which shows an increase in the water spread of those lakes; earlier they were in the less than 5-hectare category. Besides this, no lake could be mapped in 2016, 2017, 2018, 2019, and 2022 that has an area of more than 10 ha (Table 2.2 & Fig. 2.2.12). Further analysis of the data obtained, it is found that only 32 moraine-dammed/glacial lakes could be seen temporally w.r.t. 2019, emphasizing that 27 lakes are showing an increase in their water spread, whereas 5 lakes have shown a decrease. The remaining 17 lakes form the baseline data for their monitoring during the next ablation season (Annexure 5).

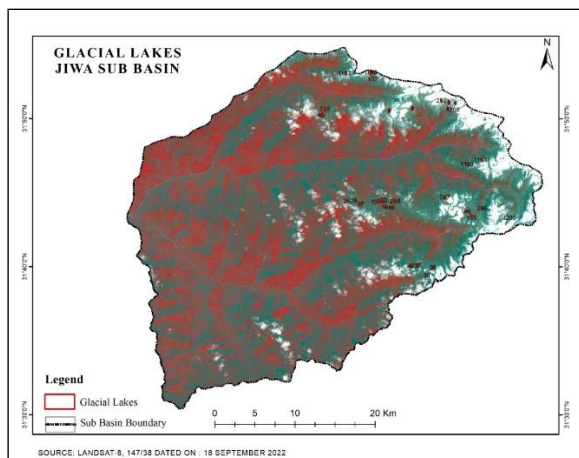


Figure 2.2. 5: Satellite view of Jiwa Sub Basin based on Landsat 8, 2022

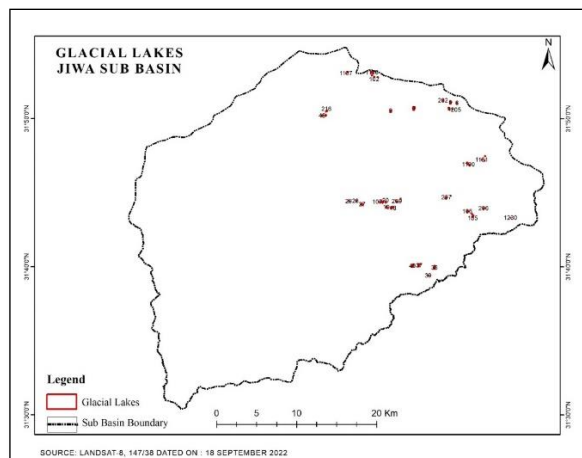


Figure 2.2. 6: Lake Inventory in Jiwa Sub-Basin based on based on Landsat 8, 2022

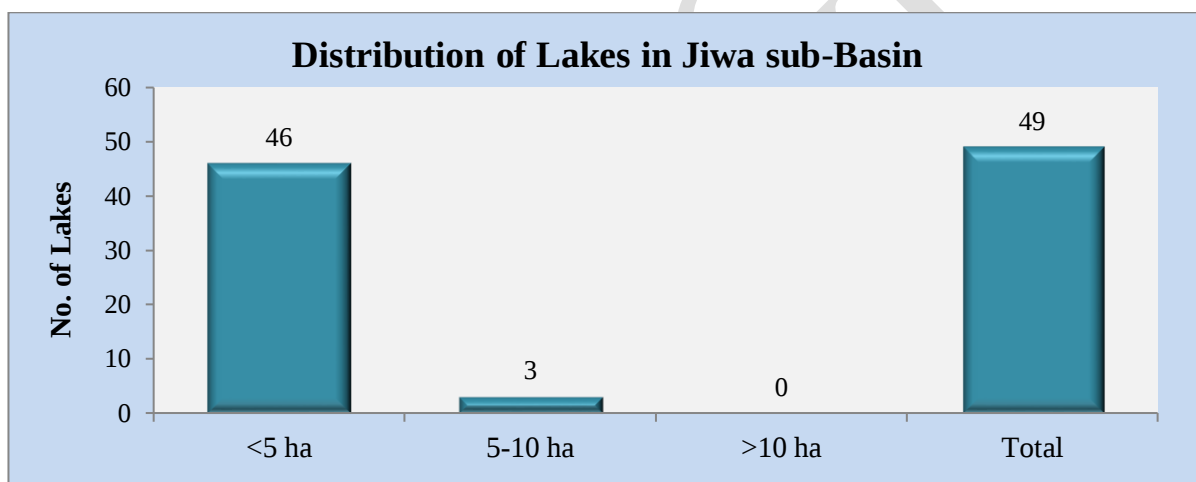


Figure 2.2. 7: Distribution of lakes in Jiwa sub basin (2022)

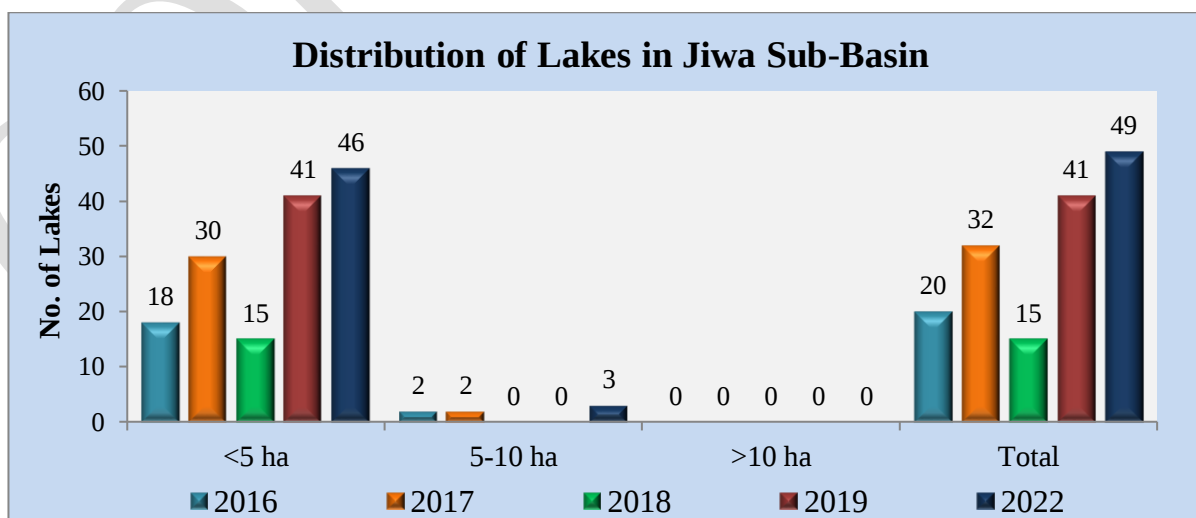


Figure 2.2. 8: Distribution of lakes in Jiwa sub basin (2016-2022)

2.2.3 Inventory of lakes in Parvati sub basin:

Parvati is a major tributary of the Beas Basin that joins the Beas River on its left bank near Bhuntar in Kullu district. Based on the Landsat 8 satellite data analysis for 18 September 2022, 65 moraine-dammed/glacial lakes were mapped in 2022 (Figs. 2.2.9 & 2.2.10) in comparison to the 26 (2016), 44 (2017), 27 lakes in 2018 and 37 lakes that were mapped in 2019, respectively (Table 2.2 & Fig. 2.2.12), and the variation in the number of lakes is mainly due to the data quality, as a result of which complete information of the catchment was not available, resulting in a variation in the number of lakes mapped. Further out of these 65 lakes mapped, 3 lakes with IDs 21, 26 & 50 were the lakes, which falls under the category of greater than 10 ha. The lake with IDs 21, 26 & 50 indicates an increase in its area by about 1.49 ha, 1.39 ha and 0.54 ha, respectively, w.r.t. 2019. The number of lakes with an area of more than 10 ha does not show any change in between 2019 & 2022, i.e., the number remains the same (3 lakes). Besides this, the lakes with IDs 3, 17, and 28 having an area in between 5-10 ha also show an increase in their area w.r.t. 2019. Similarly, there were 59 moraine –dammed glacial lakes in 2022, falling under the category of less than 5 ha, in comparison to 23 lakes mapped in 2016, 39 lakes as mapped in 2017, 27 lakes in 2018, 30 lakes mapped in 2019 and thus it can be inferred that there is variation in the small category lakes during 2019 & 2022. Further analysis reveals that out of these 65 moraine-dammed/glacial lakes mapped, 41 lakes could be seen temporally to 2019, which indicates that 24 lakes are showing an increase in their area w.r.t. 2019, whereas 10 lakes are showing a reduction in their area w.r.t. 2019. The remaining Lakes which could not be compared, forming the baseline data for next year (Annexure 6).

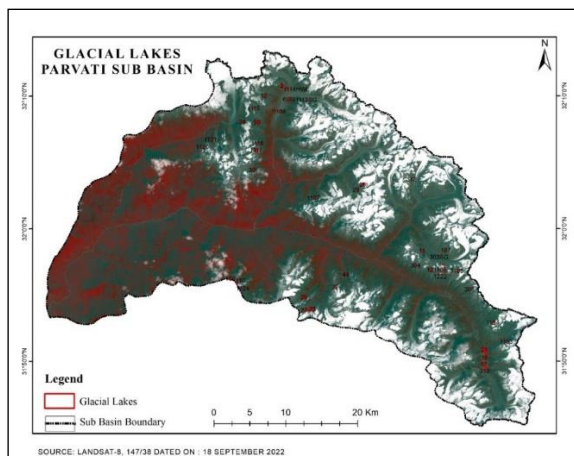


Figure 2.2. 9: Satellite View of Parvati Sub-Basin based on LANDSAT 8, 2022

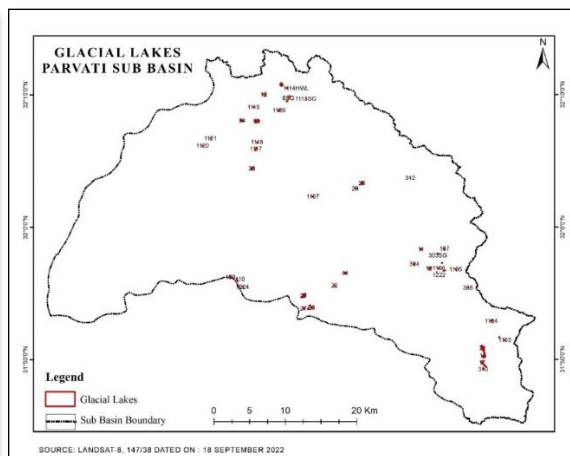


Figure 2.2. 10: Inventory of lakes in Parvati Sub Basin based on LANDSAT 8, 2022

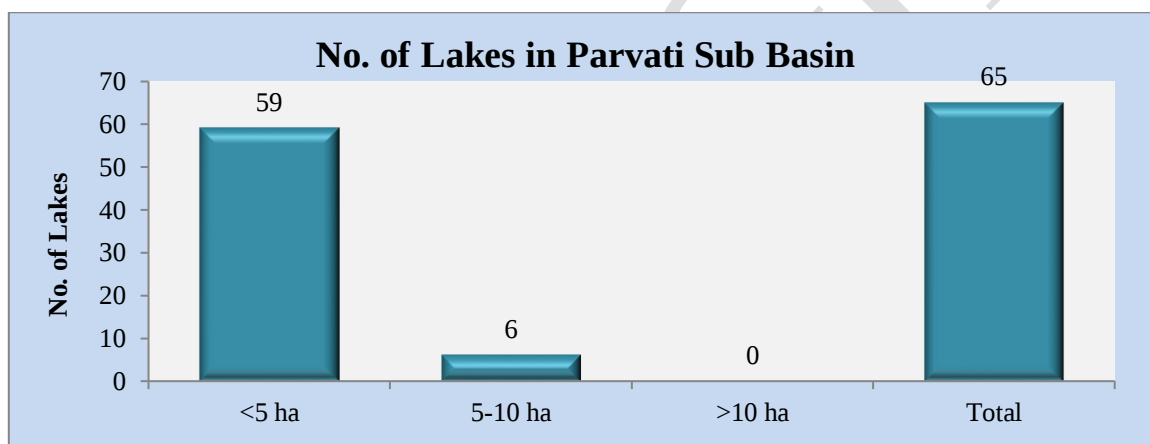


Figure 2.2. 11: Distribution of lakes in Parvati sub basin

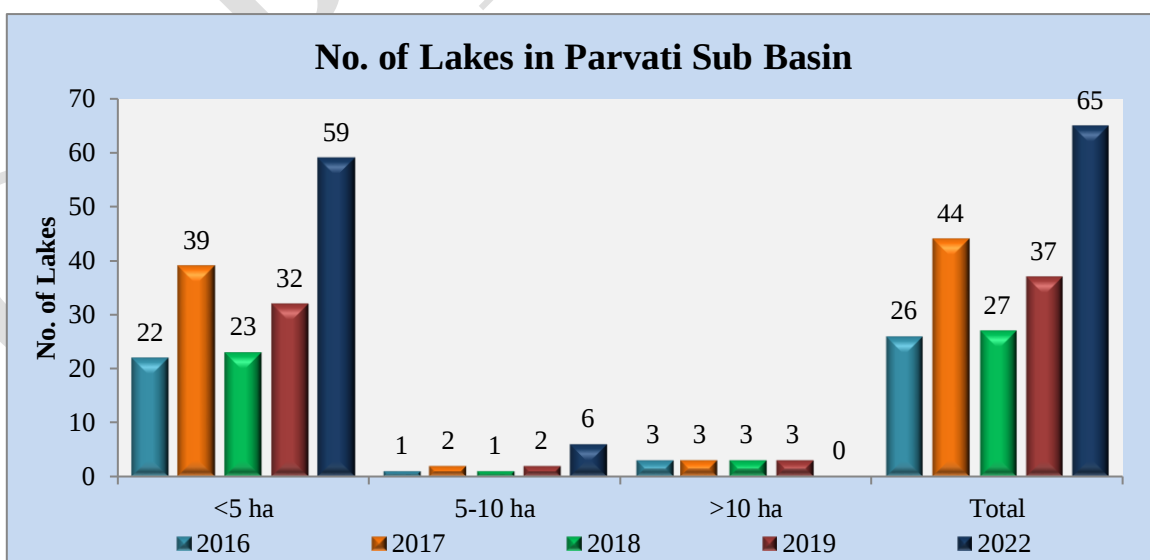


Figure 2.2. 12: Distribution of lakes in Parvati sub basin (2016-2022)

In 2022 in the Beas basin, a total of 139 moraine-dammed glacial lakes delineated in comparison to 63 lakes in 2016, 101 lakes in 2017, 65 lakes mapped in 2018 and 93 in 2019 respectively. Thus, its indicating an overall increase of about 54% increase with respect to 2016, 27% in the with respect to 2017, 53% w.r.t. 2018 and 33% w.r.t. 2019. It's represented a fluctuating trend because of the difference between temporal satellite datasets of glacial lakes stems from factors like sensor capabilities, data processing methods, frequency of observation, and Climate change. These differences can lead to variations in how glacial lakes are monitored and analyzed over time. Further analysis of these 139 lakes reveals that 128 lakes (91%) are small one with area less than 5ha in comparison to 85 lakes (2019), 07 lakes are with aerial range between 5-10 hectare in comparison to 4 lakes (2019) and 04 lakes are such which have the area more than 10 hectare in comparison to the 4 lakes of 2019 (Table 2.2 & Fig. 2.2.14).

Table 2. 2: Distribution of lakes in Beas Basin

Categories	Year	Upper Beas	Jiwa	Parvati	Beas
No. of lakes with area >10 ha	2016	0	0	3	3
	2017	1	0	3	4
	2018	0	0	3	3
	2019	1	0	3	4
	2022	1	0	3	4
No. of lakes with area between 5-10 ha	2016	2	2	1	5
	2017	1	2	2	5
	2018	3	0	1	4
	2019	2	0	2	4
	2022	1	3	3	7
No. of lakes with area <5 ha	2016	15	18	22	55
	2017	23	30	39	92
	2018	20	15	23	58
	2019	12	41	32	85
	2022	23	46	59	128
Total No. of lakes	2016	17	20	26	63
	2017	25	32	44	101
	2018	23	15	27	65
	2019	15	41	37	93
	2022	25	49	65	139

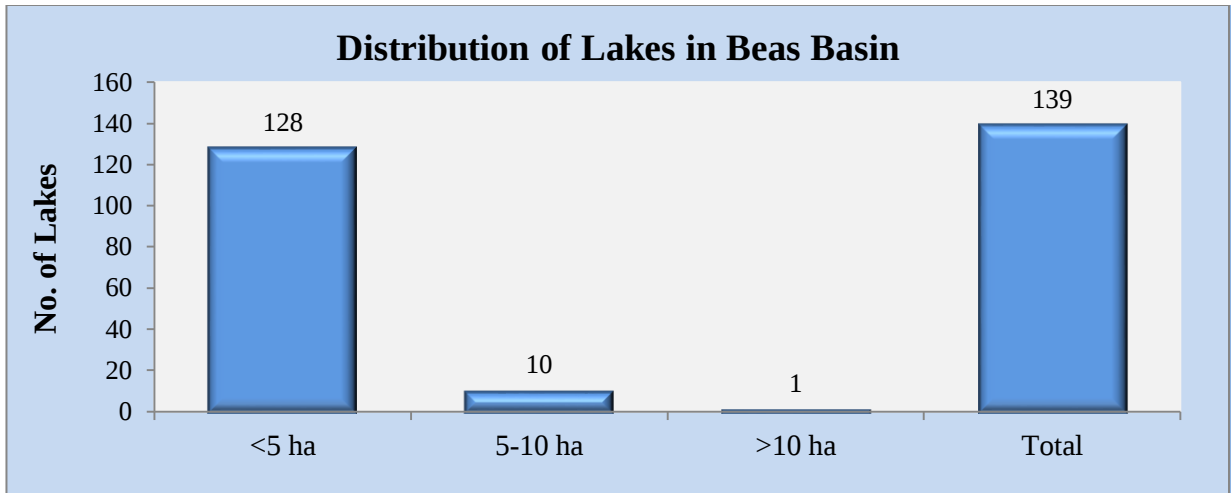


Figure 2.2. 13: Distribution of lakes in Beas basin (2022)

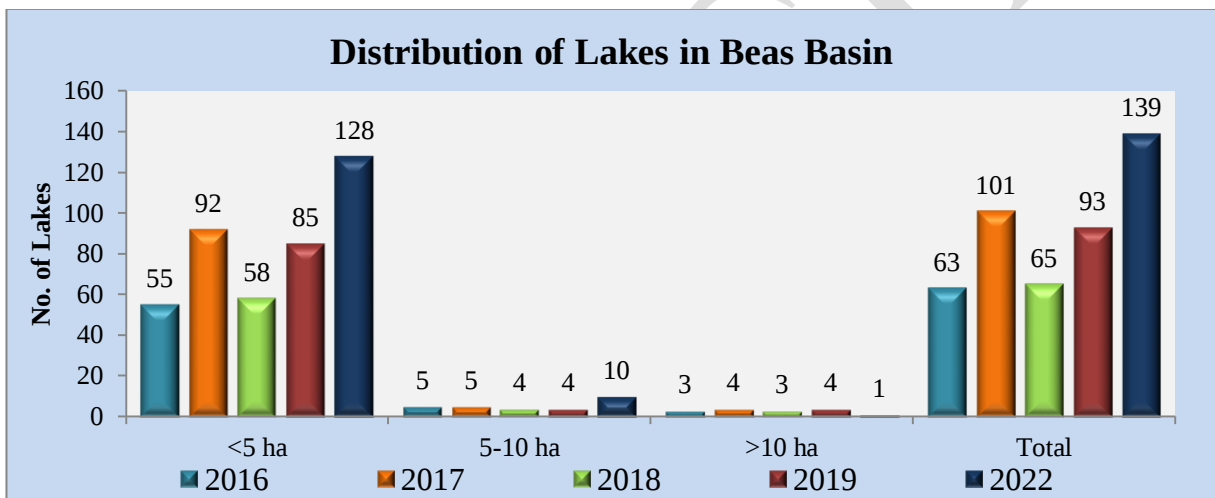


Figure 2.2. 14: Distribution of lakes in Beas basin (2016-2022)

2.3 Inventory of lakes in Ravi Basin:

Ravi is another major river that originates from the Himachal Himalaya in the Bara Bhangal area of the Kangra district, flows towards the west, enters the Chamba district, and then culminates into the Ranjeet Sagar Dam, beyond which it enters Punjab and then to Pakistan. The LISS III of 5th October 2022 and Landsat 8 satellite data for 18th September and 27th October 2022 were interpreted. 86 moraines dammed/glacial lakes were mapped in 2022 (Fig. 2.3.3) against 28 lakes in 2016, 54 lakes in 2017, 66 lakes in the Ravi basin in 2018, and 38 lakes delineated in 2019, respectively (Table: 2.3 & Fig. 2.3.4). The variation in the number of lakes for the preceding years is mainly due to the non-availability of good-quality cloud-free satellite data, as a result of which complete information of the basins could not be derived.

Further analysis reveals that out of 86 lakes mapped in 2022, 82 lakes are the small ones with an area of less than 5 ha, 1 lake comprises an area within 5-10 ha, and 3 lakes are such that they have an area of more than 10 ha in comparison to 1 lake of 2019 (Table: 2.3 & Fig. 2.3.4); in other words, we can say that about 95% of the lakes delineated in the Ravi basin in 2022 are the smaller lakes. Further analysis of lakes with an area >10 ha reveals that the areal extent of the lake with ID 31 has expanded from 5.76 ha in 2019, which falls under the 5-10 ha category, to 13.80 ha in 2022, placing it in the category of areas greater than 10 ha. The lake with ID 16HWL is mainly a high-altitude wetland showing an increase of about 0.16 ha. Besides this, one lake with ID 1159 has been identified in 2022, which was not shown earlier. 36 lakes could be seen temporally, out of which 28 lakes showed an increase in their spatial extent w.r.t. 2019, and 8 lakes showed a decrease in their aerial extent w.r.t. 2019. In contrast, the remaining 50 could not be seen temporally, thus forming the baseline date for their monitoring during the next ablation season (Annexure 7).

Table 2. 3: Distribution of lakes in Ravi Basin

Ravi	No. of lakes with area <5 ha	No. of lakes with area 5-10 ha	No. of lakes with area >10 ha	Total No. of lakes
2016	25	0	3	28
2017	50	1	3	54
2018	61	2	3	66
2019	35	2	1	38
2022	82	1	3	86

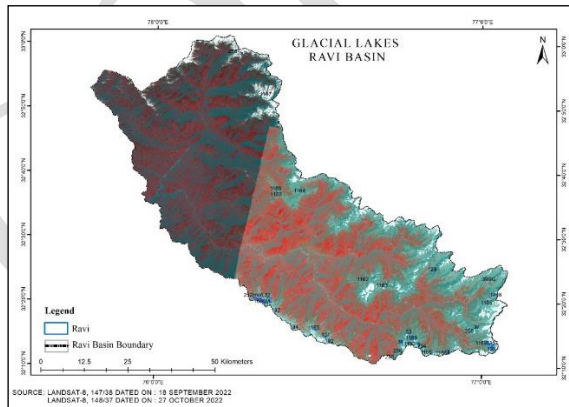


Figure 2.3. 1: Satellite view of lakes in Ravi Basin based on LISS III and Landsat 8, 2022

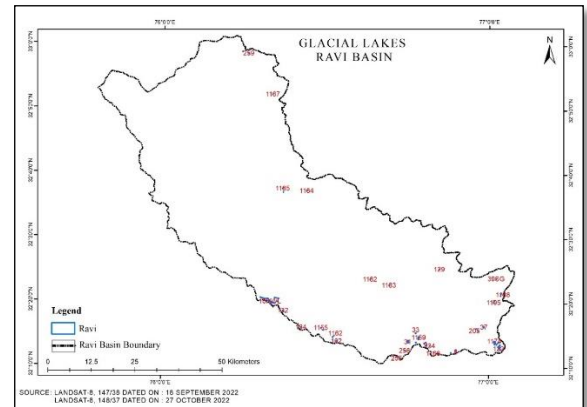


Figure 2.3. 2: Inventory of lakes in Ravi Basin based on LISS III and Landsat 8, 2022

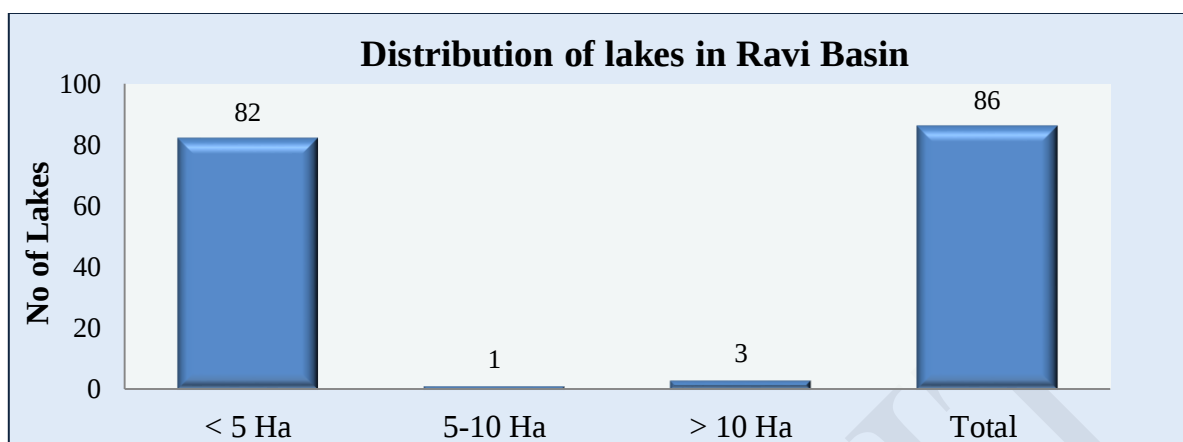


Figure 2.3. 3: Distribution of lakes in Ravi Basin (2022)

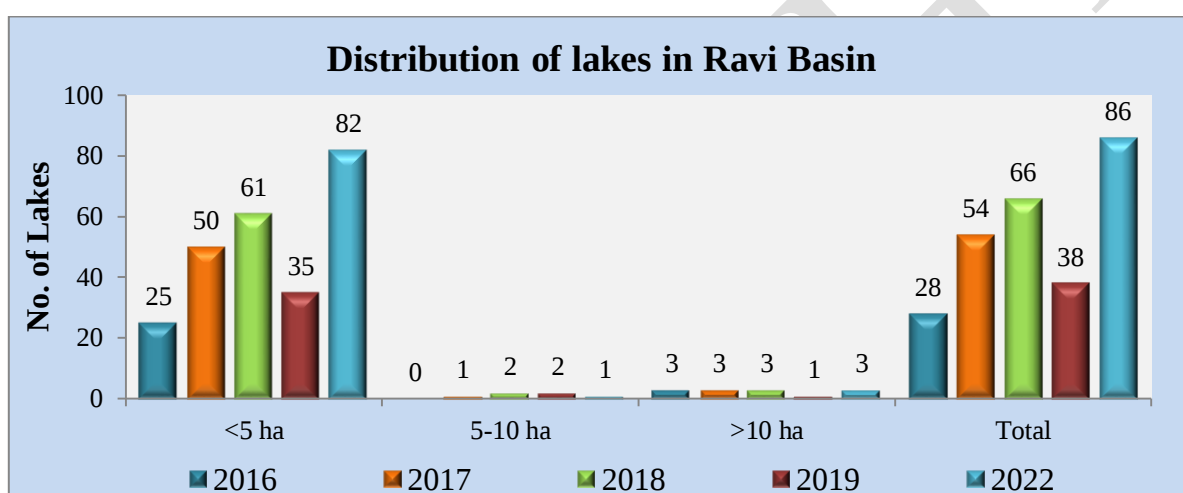


Figure 2.3. 4: Distribution of lakes in Ravi basin (2016-2022)

2.4 Inventory of lakes in Satluj River Basin:

IRS LISS-III Resourcesat 2 satellite data with a spatial resolution of 23.5 m were used to generate a more detailed inventory of moraine-dammed glacial lakes/high altitude wetlands in the Satluj catchment, and the information was compared to that generated for the year 2022 due to technical reasons using LISS-III satellite data. During the year 2022, good quality data could not be obtained by virtue of the area under the impact of snow cover for a longer period and thereafter the cloud cover during the monsoon season. The study area is covered by LISS-III and Landsat 8 coverage mainly by seven numbers of scenes within 96/48, 96/49, 97/48, 98/48, 99/49, 100/49 and 145/38 path and rows and these data products were analyzed using visual interpretation techniques. As far as data availability is concerned, an attempt has been made to get the best quality data products during August/September, but still in parts the impacts of cloud cover or snow could be seen. Thus, based on the above LISS III and Landsat

8 satellite data products for the above-mentioned paths -rows, a total of 995 lakes and wetlands were delineated in 2022 in the study area, comprising 183 from Spiti basins, 173 from Lower Satluj basin, and 639 from Upper Satluj basin respectively in comparison to the total number of lakes delineated in 2019 (562), 2018 (769), 2017(642) and (Fig: 2.4.3). The difference in the total number of lakes varies mainly due to the non-availability of good-quality snow-free and cloud-free data coverage during that particular year.

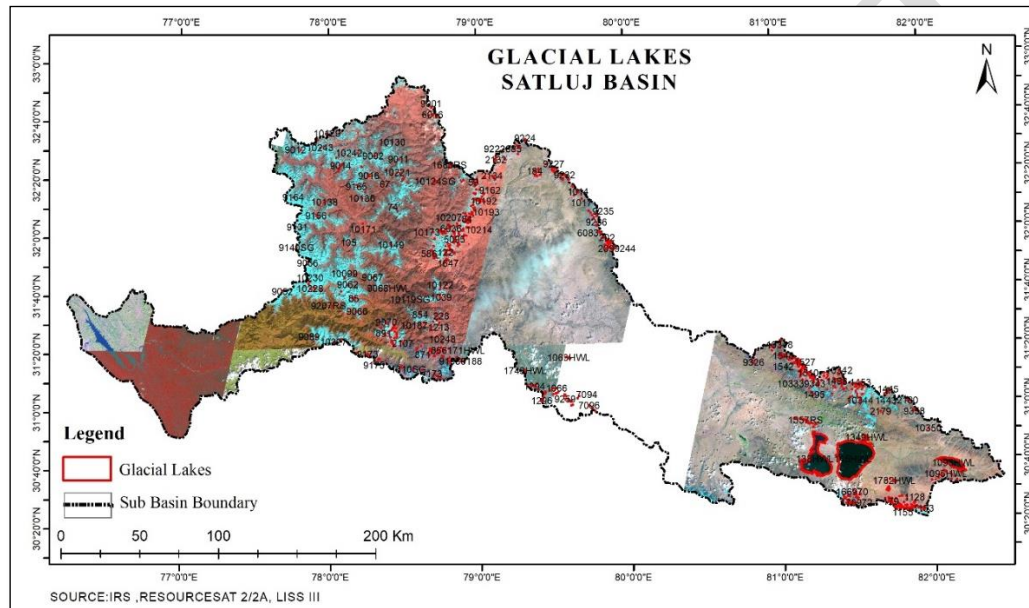


Figure 2.4. 1: Satellite view of lakes in Satluj basin based on LISS III and Landsat 8, 2022

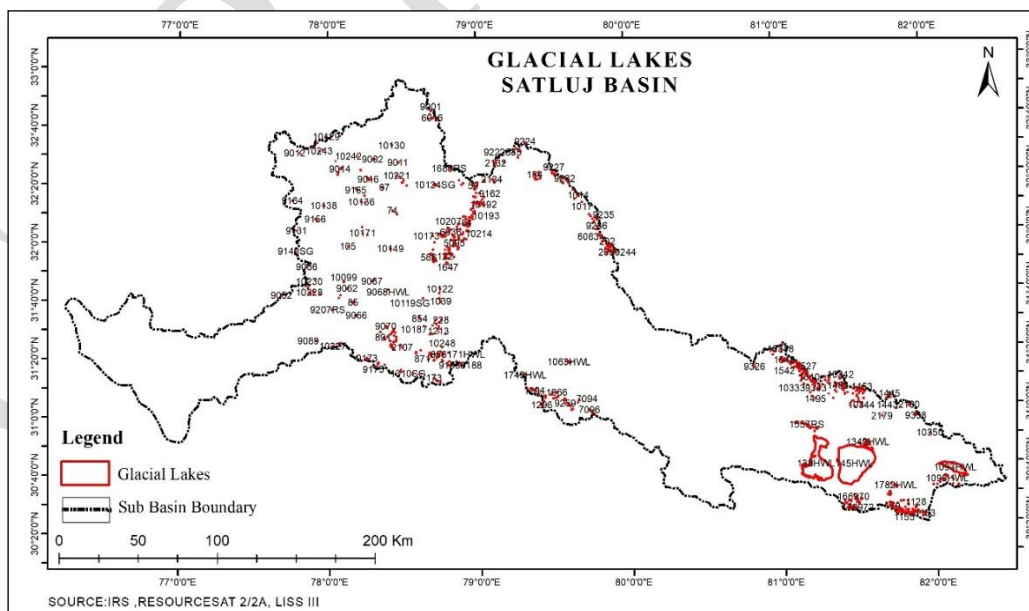


Figure 2.4. 2: Inventory of lakes in Satluj basin based on LISS III and LANDSAT 8, 2022

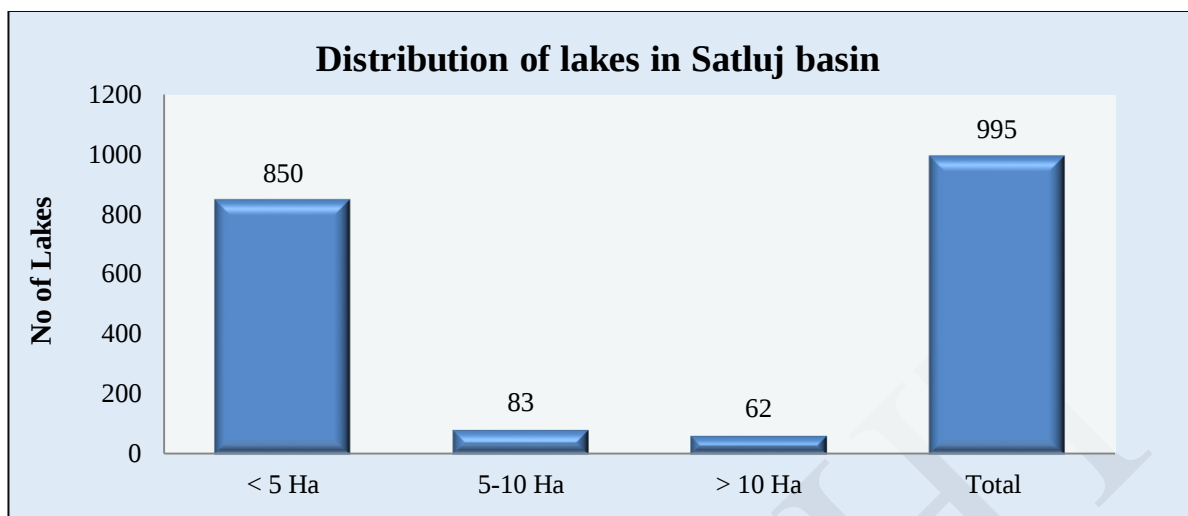


Figure 2.4. 3: Distribution of lakes in Satluj basin (2022)

2.4.1 Inventory of lakes in Upper Satluj Sub-Basin:

Based on the further analysis of LISS III satellite data, it has been evident that 639 moraine-dammed/glacial lakes were mapped in the Upper Satluj basin. Further analysis reflects an increasing trend from 443 in 2016 to 450 (2017), 495 (2018), decreased to 437 in 2019 and increased to 639 in 2022. In other words, the number of lakes increased by 196 (30%) w.r.t. 2016, 189 (29%) w.r.t. 2017, 144 (23%) w.r.t. 2018 and 202 (31%) w.r.t. 2019, respectively (Fig. 2.4.4), and this variation could be due to the non-availability of good-quality, snow-free, and cloud-free data coverage based on LISS III satellite data. Further out of these 639 lakes mapped in 2022, the majority of the lakes, i.e., 516 lakes, fall under the category of small lakes with an area of less than 5 ha; another 70 were medium-sized lakes falling within the areal range of 5-10 ha, and the remaining 53 lakes had an areal range of more than 10 ha. In the Upper Satluj basin, the lakes with IDs 1557RS (71.15 ha), 1771RS (13.73 ha), 1772RS (4.89 ha), 1775RS (5.57 ha), 2170RS (2.32 ha), and 10326RS (13.47) are some of the water bodies that have been developed along the nala sections that need regular monitoring, although these water bodies are small (Annexure 8).

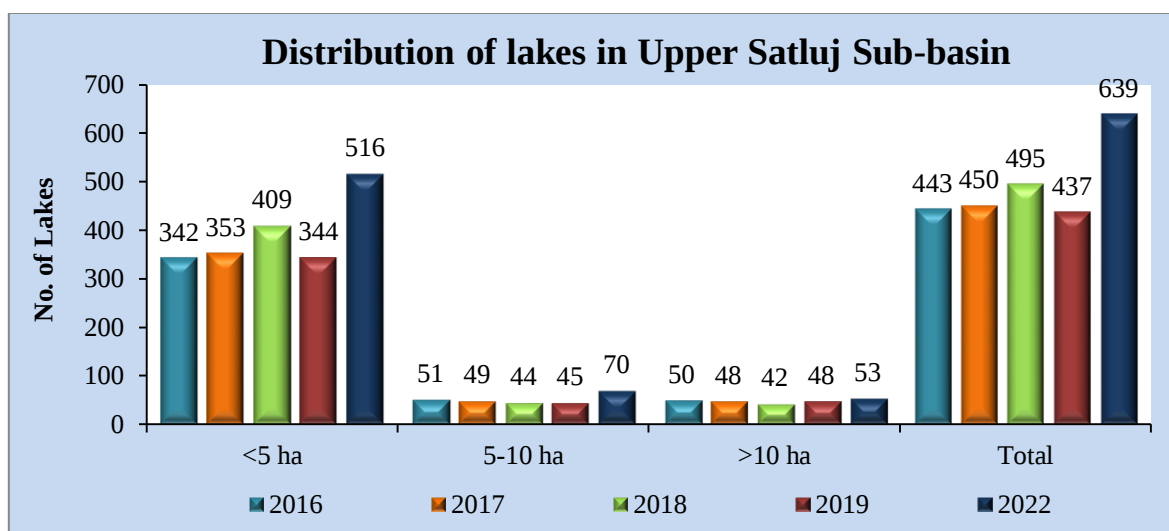


Figure 2.4. 4: Distribution of lakes in Upper Satluj Sub-basin (2016-2022)

2.4.2 Inventory of lakes in Lower Satluj Sub-Basin:

Similarly, in the Lower Satluj basin, 173 lakes were mapped using high-resolution satellite data. The total number of lakes mapped varied from 72 in 2016 to 102 (2017), 98 (2018), 52 (2019), and 173 (2022). The increase in the number of lakes identified between 2016 and 2022, i.e., 101 (2016), 71 (2017), 75 (43%) w.r.t. 2018, and reduction of 121 (69%) w.r.t. 2019, respectively (Fig. 2.4.5). In addition, out of 173 lakes mapped in 2022, the majority of the lakes, i.e., 166 lakes, are small ones with an area less than 5 hectares, 5 lakes are within the areal range of 5-10 hectares, and 2 lakes fall under the more than 10-hectare category. Among these, lakes with IDs 9207RS (4.55 ha) and 9058RS (0.41 ha), developed along the nala sections, are relatively small but require regular monitoring.

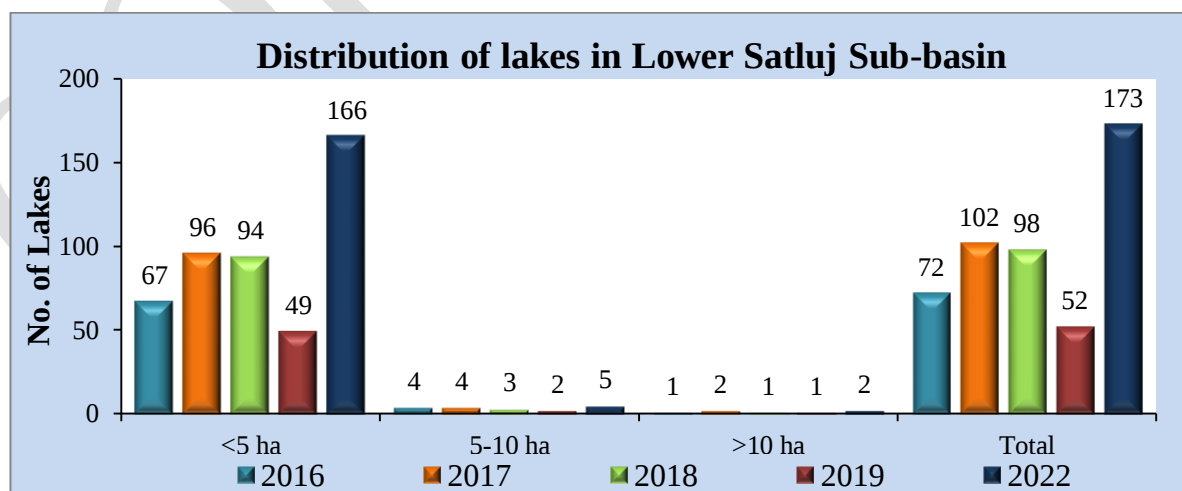


Figure 2.4. 5: Distribution of lakes in Lower Satluj Sub basin (2016-2022)

2.4.3 Inventory of lakes in Spiti Sub-Basin:

In the Spiti sub-basin, the variation in the total number of lakes is from 66 (2016), 90 (2017), 176 (2018), 73 (2019), 197 (2020), 129 (2021), and 183 (2022), thus indicating an increase of about 63% (117 lakes) w.r.t. 2016, 50% (93 lakes) w.r.t. 2017, 4% (7 lakes) w.r.t. 2018, and a reduction of about 60% (110 lakes) w.r.t. 2019, respectively (Fig. 2.4.6). The difference is mainly due to the data quality, which is either due to shadow regions, snow cover, or cloud cover impacts and receding glaciers. In addition, out of 183 lakes mapped in 2022, the majority of the lakes, i.e., 168 lakes, are small ones with an area less than 5 ha, 8 lakes are within the areal range of 5-10 ha, and 7 lakes have an area of more than 10 ha (Fig. 2.4.6). Among these, the lakes with IDs 1682RS (2.05 ha), 1683RS (11.82 ha), 1684RS (3.81 ha), 1685RS (2.37 ha), 1686RS (0.43 ha), 1687RS (1.19 ha), 9003RS (1.59 ha), and 9004RS (0.55 ha) were the water bodies developed along the nala sections. Although these water bodies are small, they need regular monitoring (Annexure 8).

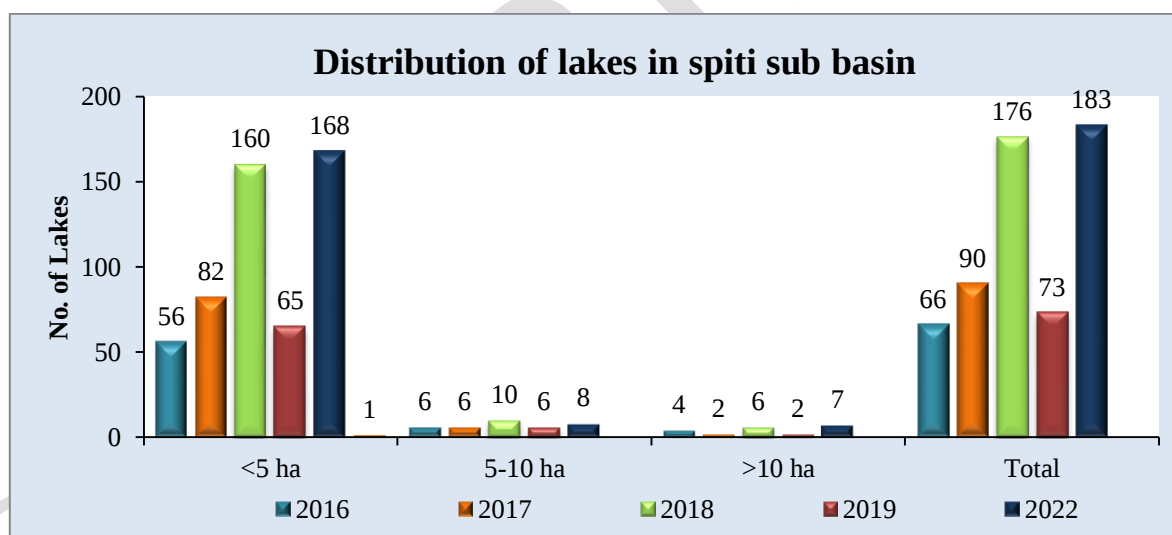


Figure 2.4. 6: Distribution of lakes in Spiti Sub basin (2016-2022)

Based on the LISS-III satellite data analysis (96-48, 97-48, 97-49, 98-48, 98-49, 99-49 and 100-49) and Landsat 8 (145-38) a total of 995 lakes mapped in 2022 comprises of 850 lakes as the small one with area less 5ha, 83 lakes with area 5-10 ha and 62 lakes with area more than 10ha (Table 2.4 & Fig. 2.4.7). The number of Lakes forms part of the sub basin 3 i.e. Upper Satluj basin (639) followed by 173 from the Lower Satluj and 183 from the Spiti basins i.e. sub basin 1 (Table 2.4).

Further analysis of these 995 lakes mapped in the entire Satluj basin using LISS-III and Landsat 8 satellite data in 2022 reveals that total number of lakes with area more than 10 ha varies from 55 (2016), 52 (2017), 49 (2018), 51 (2019) and 62 (2022). Likewise, the analysis for 2022 based on LISS-III products, the total number of 995 lakes with area less than 5ha varies from 464 (2016) to 531 (2017) to 663 (2018) to 458 (2019) to 850 (2022) and indicating an enhancement of 386 lakes w.r.t 2016, 319 lakes w.r.t 2017, 187 lakes w.r.t 2018 and 392 lakes w.r.t. 2019 respectively. Likewise the lakes within the aerial range of 5-10 ha shows an increase of 21 lakes w.r.t. 2016 (62), 24 lakes w.r.t 2017 (59), 26 lakes w.r.t 2018 (57) and 30 lakes in comparison to 2019 (53) respectively in comparison to 83 lakes in 2022. Also, the analysis for 2022 based on LISS-III products, the total number of lakes with area more than 10ha shows an increase of 6 lakes w.r.t. 2016 (56), and increase of 11 lake w.r.t 2017 (51) 13 lakes 2018(49) 6 lakes w.r.t. 2019 (56) and in comparison to 62 lakes in 2022 respectively. The large variation in the number of lakes with reference to the preceding years is mainly due to the non-availability of cloud free satellite data covering the entire catchment. Hence these small dimensional lakes/water bodies can be future vulnerable sites and thus needs proper monitoring using higher resolution satellite data for better management. The lakes with ids RS are the lakes formed along the small river section due to debris coverer along the river course on the left bank of Spiti River are the vulnerable locations formed due to temporary damming along the stream course and thus needs monitoring.

Table 2. 4: Distribution of lakes in Satluj Basin

Categories	Year	Spiti	Lower Satluj	Upper Satluj	Satluj
No. of lakes with area >10ha	2016	4	1	50	55
	2017	2	2	48	52
	2018	6	1	42	49
	2019	2	1	48	51
	2022	7	2	53	62
No. of lakes with area between 5-10 ha	2016	6	4	51	62
	2017	6	4	49	59
	2018	10	3	44	57
	2019	6	2	45	53
	2022	8	5	70	83
No. of lakes with area <5 ha	2016	56	67	342	464
	2017	82	96	353	531

	2018	160	94	409	663
	2019	65	49	344	458
	2022	168	166	516	850
Total No. of lakes	2016	66	72	443	581
	2017	90	102	450	642
	2018	176	98	495	769
	2019	73	52	437	562
	2022	183	173	639	995

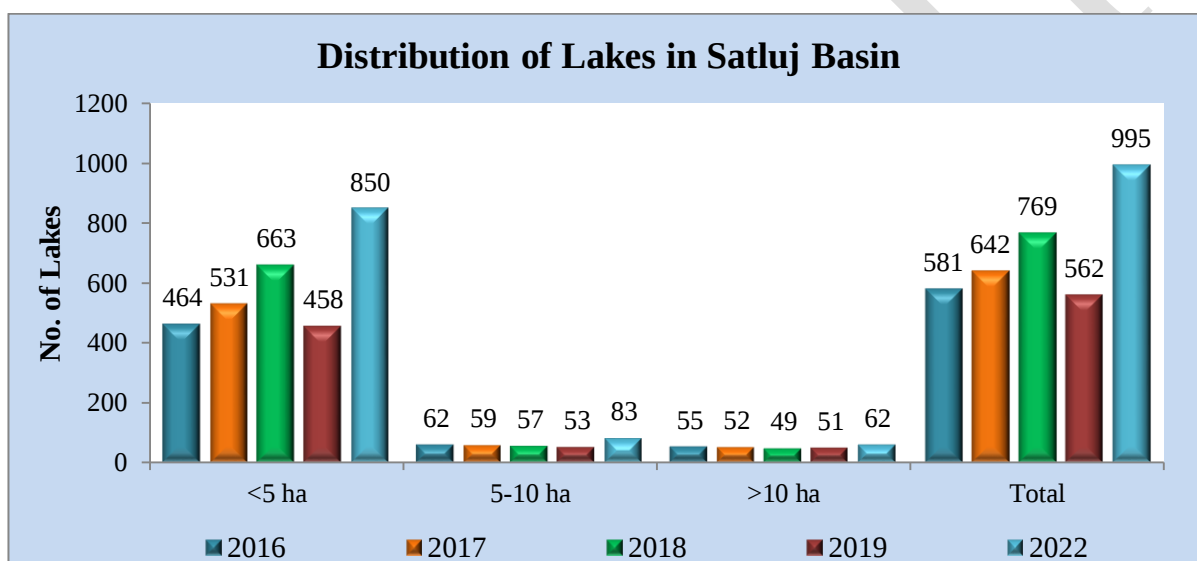


Figure 2.4. 7: Distribution of lakes in Satluj basin (2016-2022)

3. Distribution of Moraine-dammed glacial lakes and water bodies in upper Catchment:

In the year 2022, the total 1619 moraine dammed/ glacial lakes have been analyzed from satellite data of 4 basins (Chenab, Beas, Ravi and Satluj) and its sub-basins. These total 1619 glacial lakes have been reflecting an increasing trend i.e., 935 lakes in 2019, 1154 in 2018, 1017 in 2017 and 805 in 2016. There were enhancement in number of lakes in between, 212 lakes in 2016-17, 137 lakes in 2017-18 and reduction of 219 lakes in 2018-19 and again increased by 684 in 2019-2022, reflecting a fluctuating trend. For further analysis of glacial lakes have been divided into three categories viz. less than 5ha, 5-10ha and more than 10ha based on its areal extent. Further analysis reveals that majority of lakes mapped under the category of less than 5 hectares i.e., 1441 lakes followed by in between 5-10 hectares, 102

moraine-dammed glacial lakes were mapped. There were 76 moraine dammed glacial lakes were mapped in the category of greater than 10 hectares. As far as the temporal variation of all such lakes with an area of more than 10 ha is concerned, there has been a considerable increase in their total number in all four basins, i.e., the total number of such lakes varies from 63 (2016), 64 (2017), 59 (2018), 61 (2019) and 76 (2022), respectively.

Table 3. 1: Distribution of Lakes in Himachal Pradesh

Year	No. of lakes with area >10ha	No. of lakes with area between 5-10 ha	No. of lakes with area <5ha	Total No. of lakes
2016	63	73	669	805
2017	64	73	880	1017
2018	59	73	1022	1154
2019	61	70	783	935
2022	76	102	1441	1619

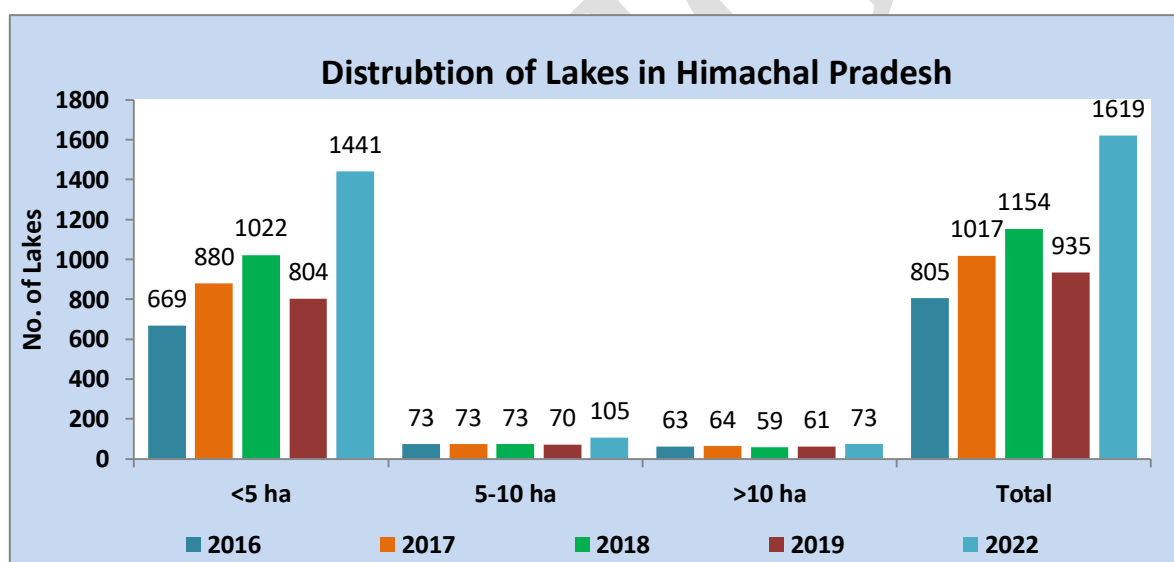


Figure 3. 1: Distribution of lakes in Himachal Pradesh (2016-2022)

The Chenab basin (Chandra, Bhaga and Miyar sub-basins) has 399 moraine-dammed/glacial lakes and water bodies in the upper catchment (2022); there were 242 lakes in 2019. Figs. 3.3 to 3.7 indicate some of the pictures of the lake formation in different sub-basins of the Chenab basin as per the satellite image, which needs regular monitoring to assess any change in their behaviour. Similarly, in the Beas basin, comprised of Upper Beas, Jiwa, and Parvati sub-basins, 139 lakes were mapped against 93 in 2019. Likewise, 86 lakes were mapped compared to 38 lakes in the Ravi basin. In the Satluj Basin (Upper Satluj, Lower

Satluj, and Spiti sub-basins), 995 lakes were interpreted in 2022 from the satellite data, against 562 lakes in 2019. The enhancement of 684 lakes in all basins was visualized in all the basins, mainly due to the non-availability of good-quality (snow- or cloud-free and shadow region, etc.), high-resolution satellite data coverage during 2019. Fig. 3.8 reflects Moraine Dammed Lake at the Glacier Snout and water bodies along the River Section in Spiti sub-basin of Satluj basin. The lakes/ water bodies where accumulated water could be seen in river, needs to monitor regularly in order to assess any temporal change in their areal extent in coming years.

Table 3. 2: Distribution of lakes in Chenab, Beas, Ravi and Satluj basin

Categories	Year	Chenab	Beas	Ravi	Satluj
No. of lakes with area >10ha	2016	2	3	3	55
	2017	5	4	3	52
	2018	4	3	3	49
	2019	5	4	1	51
	2022	7	4	3	62
No. of lakes with area between 5-10ha	2016	6	5	0	62
	2017	8	5	1	59
	2018	10	4	2	57
	2019	11	4	2	53
	2022	11	7	1	83
No. of lakes with area <5ha	2016	125	55	25	464
	2017	207	92	50	531
	2018	240	58	61	663
	2019	226	85	35	437
	2022	381	128	82	850
Total No. of lakes	2016	133	63	28	581
	2017	220	101	54	642
	2018	254	65	66	769
	2019	242	93	38	562
	2022	399	139	86	995

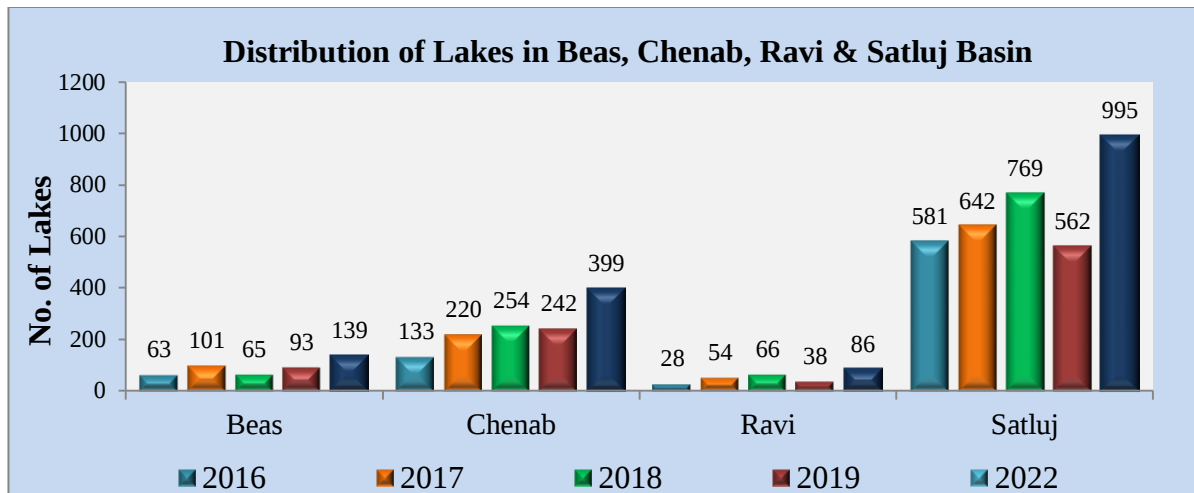


Figure 3. 2: Distribution of lakes in Chenab, Beas, Ravi and Satluj basin (2016-2022)

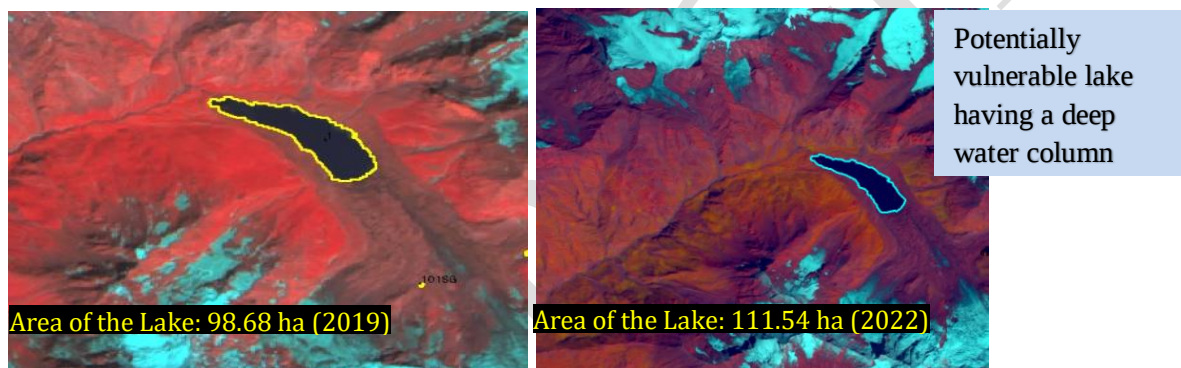


Figure 3. 3: Moraine dammed lake at Geepang Gath Glacier Snout in Chandra Basin

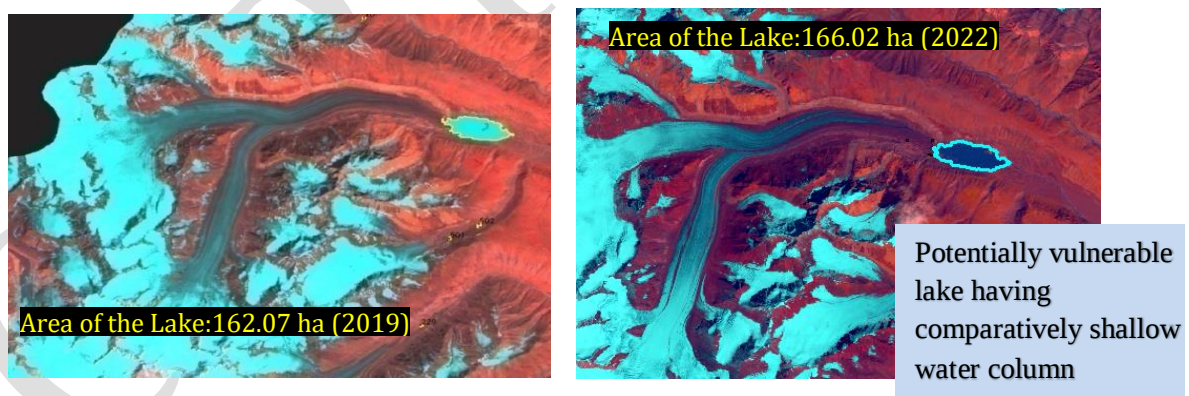
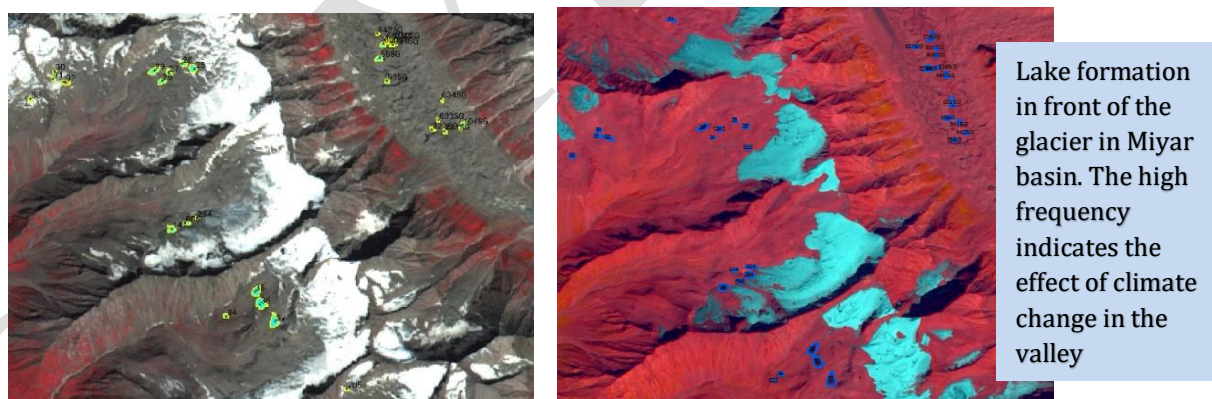
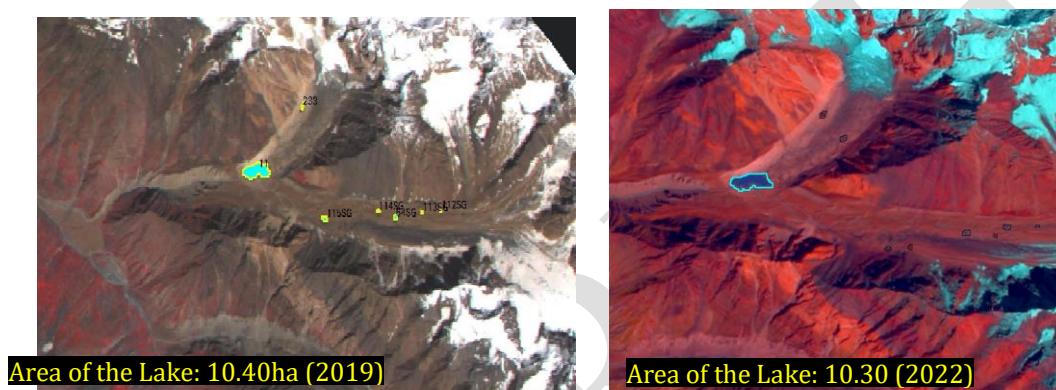
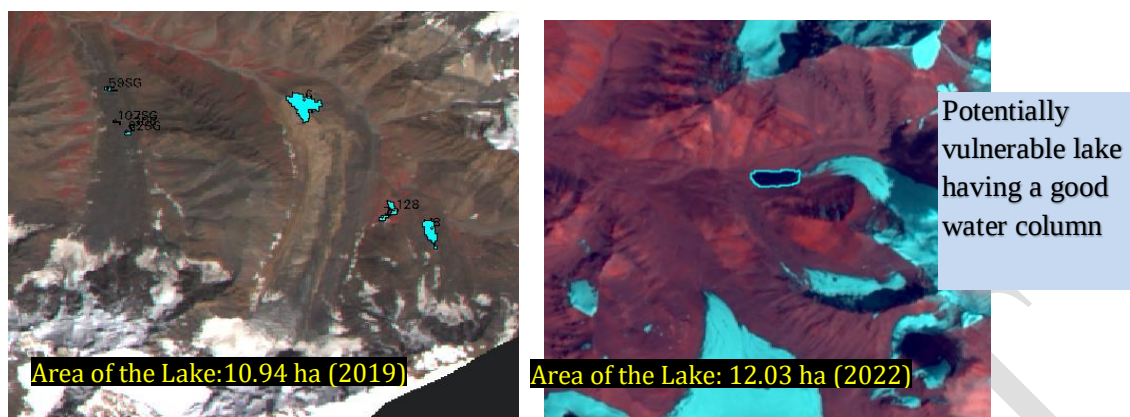


Figure 3. 4: Moraine Dammed Lake at the Snout of Samudri Tapu Glacier in Chandra Basin



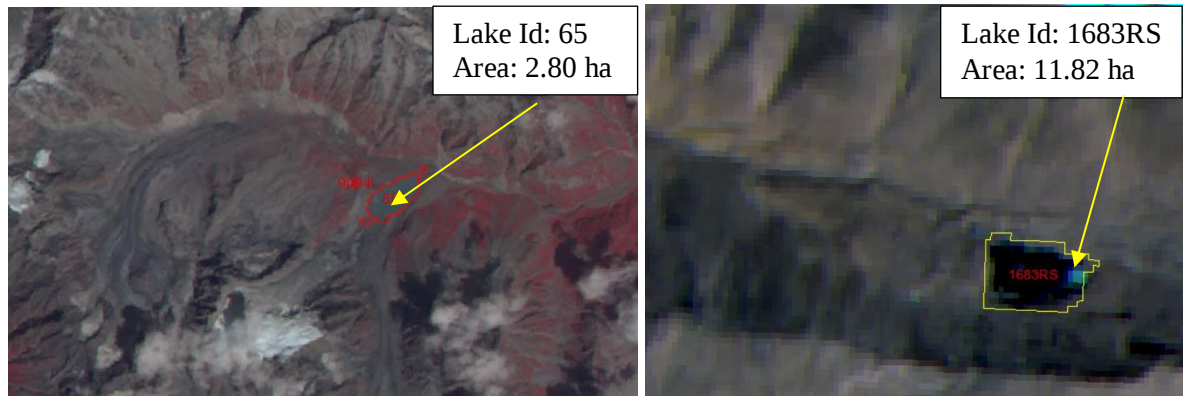


Figure 3. 8: (a) Moraine Dammed Lake at the Glacier Snout (b) water bodies along the River Section in Spiti basin

4. Concluding Remarks

The analysis carried out using Landsat 8 and LISS III for 2022 reveals that there has been a considerable increase in the number of moraine dammed lakes (GLOFs) in each basin. The number of lakes has increased from 581 lakes in 2016 to 995 lakes in 2022 in the Satluj basin. Likewise in the Chenab basin, a total of 133 lakes were identified in 2016, which has now increased to 399 lakes in 2022. Similarly, in the Beas basin, 63 lakes (2019) were marked against 139 lakes in 2022, whereas in the Ravi basin, 28 lakes were marked in 2019 against 86 lakes in 2022. Thus, from the above observations, it is inferred that the formation of such lakes in the Higher Himalayan region is on the increasing side. The analysis further reveals that the higher number of smaller lakes, i.e., the lakes with an area less than 5 hectares, indicates that the effect of the climatic variations is more pronounced on the glaciers of the Himalayan region, resulting in the formation of small lakes in front of the glacier snouts due to the damming of the morainic material. Since these lakes are the small one but needs to be monitored regularly in terms of their spatial behavior, so that any eventuality arising out of these lakes could assessed well in advance in order to a minimize the post disaster effects in the catchments. Besides this, the other category of lakes in each basin with area between 5-10ha are also potential sites which can cause considerable damage in if any one of these bursts.

The Parechhu Lake in the Tibetan Himalayan Region was also monitored separately during the ablation period of 2022 and does not show any major change in its water spread and seems to be stable based on the observations made which have been reported to SJVNL as well as to the Government during 2022. Besides this, the landslide on the upstream side of

the lake depression was also monitored in order to assess any change in the water level by virtue of the landside which may block the river course causing major threat like that of the Parechhu formation during the year 2004. The lakes/water bodies coded with abbreviation *RS with their ids* are some of the locations where accumulated water could be seen and these are the permanent features which needs regular monitoring in order to assess any temporal change in their behavior in the time to come.

Based on the above analysis carried out for 2022, it is found that there is a considerable increase in the total number of lakes in each basins with respect to the preceding years which reflects that formation of such lakes i.e. moraine dammed glacial lakes or the lakes due to the melting of Himalayan glaciers in the Higher Himalayan region is on the increasing side. The analysis further reveals that the higher number of smaller lakes i.e. the lakes with area less than 5 hectare indicates that the effect of the climatic variations is more pronounced on the glaciers of the Himalayan region resulting in the formation of small lakes in front of the glacier snouts due to the damming of the morainic material resultant of the melting of the glaciers. The recent tragedy of 2013 in the Uttarakhand Himalaya has also been correlated with the bursting of a lake having a total area of about 08 hectare in front of the snout of the Chorabari glaciers that caused widespread damage in the downstream areas besides the heavy rainfall (Dobhal et.al.2013). Thus the magnitude of such lakes as far as the destruction is concerned cannot be overruled. Besides this, the lakes with area >10 hectare and the area between 5-10 hectare can be seen as the potential vulnerable sites for causing damage in case of bursting of any one of them. Thus a proper monitoring of all such lakes is very much essential in the Himalayan region in order to avoid any eventuality like in Uttarakhand in future, which will not only save the precious human lives but also the public and the Govt. property.

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Annexure 1-8

Annexure 1: Aerial extent of lakes in Chandra Sub Basin

Sr. No.	Basin	Sub-Basin	Lake id Number	Longitude	Latitude	Area (hectare) in 2022	Area(hectare) in 2019	Change in Area w.r.t. 2019
1	Chenab	Chandra	1	32.52	77.22	111.54	98.68	12.86
2	Chenab	Chandra	3	32.50	77.55	166.02	162.07	3.95
3	Chenab	Chandra	6	32.60	77.62	7.60	6.96	0.64
4	Chenab	Chandra	8	32.34	77.71	2.17	2.29	-0.12
5	Chenab	Chandra	9	32.33	77.73	0.59	0.44	0.15
6	Chenab	Chandra	18	32.24	77.45	3.36	3.02	0.34
7	Chenab	Chandra	19	32.25	77.45	3.69	6.61	-2.92
8	Chenab	Chandra	20	32.54	77.50	0.81	0.81	0.00
9	Chenab	Chandra	112	32.73	77.54	0.65	0.43	0.22
10	Chenab	Chandra	113	32.73	77.54	0.22	0.21	0.01
11	Chenab	Chandra	117	32.66	77.50	0.80	1.04	-0.24
12	Chenab	Chandra	204	32.73	77.55	0.70	0.7	0.00
13	Chenab	Chandra	206	32.58	77.55	0.81	0.74	0.07
14	Chenab	Chandra	224	32.45	77.30	1.74	0.78	0.96
15	Chenab	Chandra	476	32.39	77.31	2.15	-----	-----
16	Chenab	Chandra	477	32.38	77.39	1.18	-----	-----
17	Chenab	Chandra	478	32.34	77.46	1.42	-----	-----
18	Chenab	Chandra	479	32.50	77.53	0.60	-----	-----
19	Chenab	Chandra	480	32.50	77.53	0.96	-----	-----
20	Chenab	Chandra	481	32.50	77.52	0.37	-----	-----
21	Chenab	Chandra	488	32.60	77.48	0.35	-----	-----
22	Chenab	Chandra	489	32.69	77.40	0.62	-----	-----
23	Chenab	Chandra	490	32.69	77.40	0.53	-----	-----
24	Chenab	Chandra	500	32.51	77.25	3.96	2.88	1.08
25	Chenab	Chandra	502	32.46	77.55	1.55	1.55	0.00
26	Chenab	Chandra	505	32.66	77.50	0.30	0.3	0.00
27	Chenab	Chandra	506	32.28	77.65	2.14	0.63	1.51
28	Chenab	Chandra	530	32.58	77.54	0.75	-----	-----
29	Chenab	Chandra	531	32.33	77.72	0.11	-----	-----
30	Chenab	Chandra	548	32.25	77.42	2.80	-----	-----
31	Chenab	Chandra	549	32.25	77.42	1.05	-----	-----
32	Chenab	Chandra	551	32.26	77.61	1.81	-----	-----
33	Chenab	Chandra	1202	32.30	77.58	0.61	-----	-----
34	Chenab	Chandra	1203	32.29	77.59	0.33	-----	-----
35	Chenab	Chandra	1204	32.28	77.59	0.24	-----	-----
36	Chenab	Chandra	1205	32.48	77.61	48.28	-----	-----
37	Chenab	Chandra	1206	32.64	77.59	1.11	-----	-----

38	Chenab	Chandra	1207	32.64	77.59	0.09	-----	-----
39	Chenab	Chandra	1208	32.73	77.54	0.18	-----	-----
40	Chenab	Chandra	1209	32.73	77.55	0.07	-----	-----
41	Chenab	Chandra	1210	32.39	77.37	0.36	-----	-----
42	Chenab	Chandra	126SG	32.23	77.61	0.45	0.44	0.01
43	Chenab	Chandra	129SG	32.22	77.63	0.44	0.43	0.01
44	Chenab	Chandra	208SG	32.26	77.59	0.74	0.59	0.15
45	Chenab	Chandra	209SG	32.24	77.60	0.23	0.75	-0.52
46	Chenab	Chandra	216SG	32.20	77.64	0.44	1.31	-0.87
47	Chenab	Chandra	218SG	32.20	77.64	0.16	0.24	-0.08
48	Chenab	Chandra	37SG	32.21	77.63	1.13	0.49	0.64
49	Chenab	Chandra	483SG	32.59	77.46	0.05	-----	-----
50	Chenab	Chandra	484SG	32.59	77.47	0.03	-----	-----
51	Chenab	Chandra	485SG	32.60	77.47	0.02	-----	-----
52	Chenab	Chandra	486SG	32.60	77.47	0.06	-----	-----
53	Chenab	Chandra	487SG	32.60	77.47	0.12	-----	-----
54	Chenab	Chandra	507SG	32.27	77.58	0.24	0.45	-0.21
55	Chenab	Chandra	508SG	32.26	77.59	0.58	0.26	0.32
56	Chenab	Chandra	509SG	32.25	77.59	0.87	0.44	0.43
57	Chenab	Chandra	510SG	32.23	77.61	0.99	0.29	0.70
58	Chenab	Chandra	511SG	32.22	77.60	0.56	0.43	0.13
59	Chenab	Chandra	518SG	32.18	77.61	0.18	0.25	-0.07
60	Chenab	Chandra	519SG	32.20	77.62	0.49	0.82	-0.33
61	Chenab	Chandra	532RS	32.27	77.58	1.85	-----	-----
62	Chenab	Chandra	533RS	32.27	77.58	0.25	-----	-----
63	Chenab	Chandra	534SG	32.25	77.59	0.23	-----	-----
64	Chenab	Chandra	535SG	32.24	77.60	0.51	-----	-----
65	Chenab	Chandra	536SG	32.23	77.61	0.24	-----	-----
66	Chenab	Chandra	537SG	32.22	77.62	0.57	-----	-----
67	Chenab	Chandra	538SG	32.22	77.62	0.18	-----	-----
68	Chenab	Chandra	539SG	32.22	77.63	0.60	-----	-----
69	Chenab	Chandra	540SG	32.19	77.66	1.05	-----	-----
70	Chenab	Chandra	541SG	32.18	77.68	0.59	-----	-----
71	Chenab	Chandra	550SG	32.51	77.48	0.21	-----	-----
72	Chenab	Chandra	552SG	32.21	77.63	0.66	-----	-----
73	Chenab	Chandra	553SG	32.21	77.64	0.39	-----	-----

SG-Supra Glacier

HWL- High Altitude Wetland Lake

RS- River Section

Annexure 2: Aerial extent of lakes in Bhaga Sub Basin

Sr. No.	Basin	Sub-Basin	Lake id Number	Latitude	Longitude	Area (hectare) in 2022	Area(hectare) in 2019	Change in Area w.r.t. 2019
1	Chenab	Bhaga	1	32.872	77.174	2.58	3.04	-0.46
2	Chenab	Bhaga	2	32.845	77.280	5.93	6.47	-0.54
3	Chenab	Bhaga	6	32.723	77.330	12.03	10.94	1.09
4	Chenab	Bhaga	7	32.707	77.341	1.11	0.8	0.31
5	Chenab	Bhaga	8	32.705	77.348	5.09	5.3	-0.21
6	Chenab	Bhaga	11	32.631	77.307	10.30	10.4	-0.10
7	Chenab	Bhaga	22	32.871	76.983	0.67	0.54	0.13
8	Chenab	Bhaga	23	32.900	76.999	2.77	2.08	0.69
9	Chenab	Bhaga	30	32.935	77.146	1.86	2	-0.14
10	Chenab	Bhaga	34	32.937	77.156	1.85	1.73	0.12
11	Chenab	Bhaga	36	32.907	77.200	1.91	2.1	-0.19
12	Chenab	Bhaga	63	32.872	76.983	0.56	0.4	0.16
13	Chenab	Bhaga	66	32.582	77.383	2.06	2.09	-0.03
14	Chenab	Bhaga	102	32.876	77.164	1.58	0.79	0.79
15	Chenab	Bhaga	105	32.765	77.327	0.31	1.08	-0.77
16	Chenab	Bhaga	119	32.748	77.106	0.63	0.95	-0.32
17	Chenab	Bhaga	120	32.748	77.109	0.58	0.24	0.34
18	Chenab	Bhaga	121	32.798	77.183	0.87	0.61	0.26
19	Chenab	Bhaga	122	32.714	77.017	0.24	1.74	-1.50
20	Chenab	Bhaga	123	32.698	77.001	0.40	0.38	0.02
21	Chenab	Bhaga	128	32.708	77.342	1.48	1.55	-0.07
22	Chenab	Bhaga	208	32.830	77.204	0.33	0.64	-0.31
23	Chenab	Bhaga	209	32.826	77.207	0.92	0.85	0.07
24	Chenab	Bhaga	214	32.740	77.186	0.69	0.5	0.19
25	Chenab	Bhaga	216	32.765	77.231	1.57	1.08	0.49
26	Chenab	Bhaga	218	32.787	77.218	3.58	3.02	0.56
27	Chenab	Bhaga	220	32.817	77.228	1.04	0.77	0.27
28	Chenab	Bhaga	231	32.679	77.270	2.97	2.08	0.89
29	Chenab	Bhaga	233	32.641	77.317	0.74	0.44	0.30
30	Chenab	Bhaga	300	32.711	76.995	0.71	0.31	0.40
31	Chenab	Bhaga	301	32.668	77.072	0.22	0.18	0.04
32	Chenab	Bhaga	400	32.511	77.297	0.23	-----	-----
33	Chenab	Bhaga	401	32.674	77.061	0.31	-----	-----
34	Chenab	Bhaga	402	32.673	77.058	0.45	-----	-----
35	Chenab	Bhaga	403	32.681	77.096	1.28	-----	-----
36	Chenab	Bhaga	404	32.682	77.099	0.27	-----	-----
37	Chenab	Bhaga	405	32.636	77.103	0.45	-----	-----
38	Chenab	Bhaga	406	32.698	76.997	0.31	-----	-----
39	Chenab	Bhaga	407	32.700	76.995	0.09	-----	-----

40	Chenab	Bhaga	408	32.701	76.996	0.51	-----	-----
41	Chenab	Bhaga	409	32.778	77.039	0.26	-----	-----
42	Chenab	Bhaga	410	32.807	77.040	0.40	-----	-----
43	Chenab	Bhaga	411	32.807	77.038	0.37	-----	-----
44	Chenab	Bhaga	412	32.890	77.021	0.72	-----	-----
45	Chenab	Bhaga	413	32.906	76.994	0.15	-----	-----
46	Chenab	Bhaga	414	32.907	76.994	0.08	-----	-----
47	Chenab	Bhaga	415	32.925	76.994	0.43	-----	-----
48	Chenab	Bhaga	416	32.920	77.007	0.23	-----	-----
49	Chenab	Bhaga	417	32.922	77.010	1.83	-----	-----
50	Chenab	Bhaga	418	32.911	77.020	0.36	-----	-----
51	Chenab	Bhaga	419	32.916	77.062	0.29	-----	-----
52	Chenab	Bhaga	420	32.944	77.056	0.14	-----	-----
53	Chenab	Bhaga	421	32.945	77.055	0.29	-----	-----
54	Chenab	Bhaga	422	32.944	77.046	0.07	-----	-----
55	Chenab	Bhaga	423	32.964	77.065	0.37	-----	-----
56	Chenab	Bhaga	424	32.940	77.104	0.32	-----	-----
57	Chenab	Bhaga	425	32.963	77.118	0.19	-----	-----
58	Chenab	Bhaga	426	32.964	77.119	0.97	-----	-----
59	Chenab	Bhaga	427	32.963	77.120	0.25	-----	-----
60	Chenab	Bhaga	428	32.935	77.143	0.29	-----	-----
61	Chenab	Bhaga	429	32.937	77.152	0.82	-----	-----
62	Chenab	Bhaga	430	32.933	77.153	0.15	-----	-----
63	Chenab	Bhaga	431	32.935	77.155	0.19	-----	-----
64	Chenab	Bhaga	432	32.934	77.155	0.18	-----	-----
65	Chenab	Bhaga	434	32.905	77.198	0.20	-----	-----
66	Chenab	Bhaga	435	32.877	77.209	0.33	-----	-----
67	Chenab	Bhaga	436	32.876	77.215	0.45	-----	-----
68	Chenab	Bhaga	437	32.880	77.224	0.44	-----	-----
69	Chenab	Bhaga	438	32.841	77.247	0.47	-----	-----
70	Chenab	Bhaga	439	32.837	77.237	0.90	-----	-----
71	Chenab	Bhaga	440	32.824	77.233	0.40	-----	-----
72	Chenab	Bhaga	441	32.823	77.234	0.44	-----	-----
73	Chenab	Bhaga	442	32.817	77.231	0.21	-----	-----
74	Chenab	Bhaga	443	32.779	77.200	0.17	-----	-----
75	Chenab	Bhaga	444	32.773	77.198	0.36	-----	-----
76	Chenab	Bhaga	445	32.762	77.195	6.80	-----	-----
77	Chenab	Bhaga	446	32.764	77.222	0.49	-----	-----
78	Chenab	Bhaga	447	32.744	77.189	1.36	-----	-----
79	Chenab	Bhaga	448	32.859	77.269	1.06	-----	-----
80	Chenab	Bhaga	449	32.860	77.273	1.21	-----	-----

81	Chenab	Bhaga	450	32.860	77.276	0.72	-----	-----
82	Chenab	Bhaga	451	32.836	77.314	0.14	-----	-----
83	Chenab	Bhaga	452	32.832	77.316	0.46	-----	-----
84	Chenab	Bhaga	453	32.815	77.369	0.77	-----	-----
85	Chenab	Bhaga	454	32.811	77.373	0.20	-----	-----
86	Chenab	Bhaga	455	32.763	77.398	3.10	-----	-----
87	Chenab	Bhaga	456	32.693	77.372	7.03	-----	-----
88	Chenab	Bhaga	457	32.693	77.363	0.85	-----	-----
89	Chenab	Bhaga	458	32.690	77.360	1.45	-----	-----
90	Chenab	Bhaga	459	32.700	77.335	0.42	-----	-----
91	Chenab	Bhaga	460	32.704	77.335	0.28	-----	-----
92	Chenab	Bhaga	461	32.704	77.331	0.22	-----	-----
93	Chenab	Bhaga	462	32.711	77.303	0.33	-----	-----
94	Chenab	Bhaga	463	32.718	77.303	0.43	-----	-----
95	Chenab	Bhaga	464	32.718	77.306	0.25	-----	-----
96	Chenab	Bhaga	465	32.637	77.320	0.76	-----	-----
97	Chenab	Bhaga	469	32.585	77.386	1.14	-----	-----
98	Chenab	Bhaga	472	32.935	77.165	1.64	-----	-----
99	Chenab	Bhaga	475	32.845	77.103	0.82	-----	-----
100	Chenab	Bhaga	1212	32.637	77.108	0.17	-----	-----
101	Chenab	Bhaga	1213	32.593	77.230	0.45	-----	-----
102	Chenab	Bhaga	1214	32.591	77.230	0.14	-----	-----
103	Chenab	Bhaga	107SG	32.721	77.303	0.25	0.3	-0.05
104	Chenab	Bhaga	112SG	32.625	77.348	0.18	0.19	-0.01
105	Chenab	Bhaga	113SG	32.625	77.343	0.72	0.19	0.53
106	Chenab	Bhaga	116SG	32.523	77.296	0.47	0.46	0.01
107	Chenab	Bhaga	117SG	32.519	77.297	0.15	0.21	-0.06
108	Chenab	Bhaga	118SG	32.516	77.296	0.35	0.15	0.20
109	Chenab	Bhaga	303HWL	32.753	77.256	1.31	1.3	0.01
110	Chenab	Bhaga	304SG	32.771	77.304	0.42	0.29	0.13
111	Chenab	Bhaga	305SG	32.769	77.301	1.06	0.5	0.56
112	Chenab	Bhaga	308SG	32.494	77.302	0.87	0.38	0.49
113	Chenab	Bhaga	466SG	32.622	77.327	0.37	-----	-----
114	Chenab	Bhaga	467SG	32.622	77.330	0.36	-----	-----
115	Chenab	Bhaga	468SG	32.624	77.342	0.18	-----	-----
116	Chenab	Bhaga	470SG	32.514	77.296	0.54	-----	-----
117	Chenab	Bhaga	471SG	32.513	77.297	0.22	-----	-----
118	Chenab	Bhaga	473SG	32.775	77.300	0.16	-----	-----
119	Chenab	Bhaga	474SG	32.721	77.304	0.40	-----	-----
120	Chenab	Bhaga	59SG	32.725	77.302	0.57	-----	-----
121	Chenab	Bhaga	5SG	32.773	77.302	0.16	-----	-----

122	Chenab	Bhaga	62SG	32.719	77.305	1.01	-----	-----
123	Chenab	Bhaga	64SG	32.624	77.338	0.85	-----	-----
124	Chenab	Bhaga	67SG	32.509	77.293	0.29	-----	-----

Annexure 3: Aerial extent of lakes in Miyar Sub Basin

Sr. No.	Name of the Basin	Name of Sub-Basin	Lake id Number	Latitude	Longitude	Area (hectare) in 2022	Area (hectare) in 2019	Change in Area w.r.t. 2019
1	Chenab	Miyar	1	33.312	76.362	12.51	9.58	2.93
2	Chenab	Miyar	2	33.308	76.361	1.27	0.83	0.44
3	Chenab	Miyar	3	33.299	76.359	1.64	1.23	0.41
4	Chenab	Miyar	5	33.227	76.489	1.19	1.59	-0.40
5	Chenab	Miyar	6	33.218	76.547	6.94	8.07	-1.13
6	Chenab	Miyar	12	33.165	76.593	0.39	0.5	-0.11
7	Chenab	Miyar	15	33.164	76.715	1.69	1.4	0.29
8	Chenab	Miyar	16	33.165	76.721	0.67	0.59	0.08
9	Chenab	Miyar	17	33.133	76.721	3.33	3.4	-0.07
10	Chenab	Miyar	20	33.124	76.713	5.68	3.42	2.26
11	Chenab	Miyar	23	33.088	76.700	2.16	2.06	0.10
12	Chenab	Miyar	24	33.085	76.716	0.71	0.75	-0.04
13	Chenab	Miyar	25	33.067	76.729	0.75	1.42	-0.67
14	Chenab	Miyar	26	33.068	76.727	0.48	0.69	-0.21
15	Chenab	Miyar	28	33.065	76.723	0.23	1.05	-0.82
16	Chenab	Miyar	29	33.067	76.722	1.19	1.68	-0.49
17	Chenab	Miyar	30	33.066	76.704	0.48	0.39	0.09
18	Chenab	Miyar	31	33.065	76.704	0.41	0.4	0.01
19	Chenab	Miyar	32	33.065	76.706	1.12	-----	-----
20	Chenab	Miyar	33	33.062	76.700	0.68	0.49	0.19
21	Chenab	Miyar	34	33.025	76.735	0.58	0.55	0.03
22	Chenab	Miyar	35	33.030	76.740	2.51	2.03	0.48
23	Chenab	Miyar	36	33.027	76.741	2.56	2.36	0.20
24	Chenab	Miyar	37	33.024	76.743	2.73	2.61	0.12
25	Chenab	Miyar	38	33.009	76.757	2.19	1.93	0.26
26	Chenab	Miyar	39	32.961	76.763	1.71	1.45	0.26
27	Chenab	Miyar	43	32.930	76.672	6.26	5.55	0.71
28	Chenab	Miyar	47	33.098	76.792	2.17	2.35	-0.18
29	Chenab	Miyar	48	33.100	76.786	1.07	1.67	-0.60
30	Chenab	Miyar	65	33.066	76.824	3.10	1.86	1.24
31	Chenab	Miyar	66	32.991	76.921	0.52	0.59	-0.07
32	Chenab	Miyar	67	32.986	76.968	1.85	1.93	-0.08
33	Chenab	Miyar	69	32.987	76.976	0.78	0.8	-0.02

34	Chenab	Miyar	75	32.909	76.947	0.94	1.78	-0.84
35	Chenab	Miyar	76	32.867	76.932	2.82	2.87	-0.05
36	Chenab	Miyar	77	32.777	76.950	4.26	4.2	0.06
37	Chenab	Miyar	81	32.769	76.970	1.19	1.5	-0.31
38	Chenab	Miyar	82	32.758	76.952	1.86	3.21	-1.35
39	Chenab	Miyar	86	33.126	76.574	2.04	1.58	0.46
40	Chenab	Miyar	87	33.116	76.582	0.38	0.39	-0.01
41	Chenab	Miyar	88	33.117	76.584	1.05	1.04	0.01
42	Chenab	Miyar	89	33.133	76.602	8.37	5.19	3.18
43	Chenab	Miyar	90	33.150	76.701	0.11	0.69	-0.58
44	Chenab	Miyar	91	33.151	76.703	0.45	0.44	0.01
45	Chenab	Miyar	92	33.165	76.700	1.42	0.7	0.72
46	Chenab	Miyar	110	32.971	76.976	0.51	0.49	0.02
47	Chenab	Miyar	113	32.946	76.963	0.30	1.04	-0.74
48	Chenab	Miyar	115	32.842	76.896	9.23	1.12	8.11
49	Chenab	Miyar	117	32.839	76.898	0.73	0.8	-0.07
50	Chenab	Miyar	120	32.888	76.734	2.14	1.77	0.37
51	Chenab	Miyar	121	32.910	76.750	2.14	1.04	1.10
52	Chenab	Miyar	122	32.960	76.773	2.37	1.38	0.99
53	Chenab	Miyar	124	33.006	76.761	0.99	0.99	0.00
54	Chenab	Miyar	130	33.307	76.364	1.04	0.59	0.45
55	Chenab	Miyar	131	33.306	76.368	1.30	1.62	-0.32
56	Chenab	Miyar	141	33.040	76.725	1.50	1.31	0.19
57	Chenab	Miyar	205	33.013	76.756	0.31	0.28	0.03
58	Chenab	Miyar	206	32.923	76.833	1.55	2.2	-0.65
59	Chenab	Miyar	209	32.842	76.539	21.87	15.97	5.90
60	Chenab	Miyar	216	32.828	76.860	0.36	0.29	0.07
61	Chenab	Miyar	229	32.775	76.951	3.01	1.62	1.39
62	Chenab	Miyar	231	32.775	76.935	0.52	0.34	0.18
63	Chenab	Miyar	234	33.042	76.729	1.32	0.34	0.98
64	Chenab	Miyar	502	33.299	76.358	0.62	0.69	-0.07
65	Chenab	Miyar	502	33.298	76.357	0.99	1.37	-0.38
66	Chenab	Miyar	506	33.183	76.530	1.65	2.08	-0.43
67	Chenab	Miyar	507	33.144	76.672	2.14	0.96	1.18
68	Chenab	Miyar	508	33.132	76.735	1.46	0.69	0.77
69	Chenab	Miyar	516	32.704	76.961	3.96	4.83	-0.87
70	Chenab	Miyar	517	32.642	76.985	0.73	0.39	0.34
71	Chenab	Miyar	518	32.882	76.727	0.72	0.54	0.18
72	Chenab	Miyar	605	33.150	76.702	0.40	0.29	0.11
73	Chenab	Miyar	607	33.150	76.713	0.22	0.25	-0.03
74	Chenab	Miyar	608	33.127	76.732	0.29	0.3	-0.01

75	Chenab	Miyar	609	33.041	76.728	0.66	0.54	0.12
76	Chenab	Miyar	610	33.005	76.762	0.28	0.25	0.03
77	Chenab	Miyar	611	32.954	76.747	0.31	0.39	-0.08
78	Chenab	Miyar	612	32.885	76.647	4.07	5.19	-1.12
79	Chenab	Miyar	639	32.773	76.933	0.15	0.29	-0.14
80	Chenab	Miyar	640	32.775	76.930	0.16	0.29	-0.13
81	Chenab	Miyar	641	32.643	76.986	0.85	0.29	0.56
82	Chenab	Miyar	642	33.184	76.124	8.77	0.8	7.97
83	Chenab	Miyar	648	33.020	76.356	2.32	4.66	-2.34
84	Chenab	Miyar	800	33.246	76.477	1.88	-----	-----
85	Chenab	Miyar	801	33.191	76.474	0.22	-----	-----
86	Chenab	Miyar	802	33.183	76.476	3.51	-----	-----
87	Chenab	Miyar	809	33.179	76.595	0.21	-----	-----
88	Chenab	Miyar	810	33.180	76.594	1.68	-----	-----
89	Chenab	Miyar	820	33.014	76.756	0.35	-----	-----
90	Chenab	Miyar	821	33.012	76.734	0.09	-----	-----
91	Chenab	Miyar	822	33.024	76.733	0.22	-----	-----
92	Chenab	Miyar	824	33.043	76.727	0.35	-----	-----
93	Chenab	Miyar	825	33.043	76.730	0.95	-----	-----
94	Chenab	Miyar	826	33.063	76.729	0.48	-----	-----
95	Chenab	Miyar	828	33.124	76.726	0.20	-----	-----
96	Chenab	Miyar	829	33.129	76.741	0.84	-----	-----
97	Chenab	Miyar	830	33.142	76.743	0.26	-----	-----
98	Chenab	Miyar	831	33.144	76.743	0.41	-----	-----
99	Chenab	Miyar	832	33.143	76.739	0.32	-----	-----
100	Chenab	Miyar	833	33.143	76.736	0.09	-----	-----
101	Chenab	Miyar	834	33.140	76.671	0.31	-----	-----
102	Chenab	Miyar	850	33.043	76.789	0.84	-----	-----
103	Chenab	Miyar	858	33.055	76.890	0.78	-----	-----
104	Chenab	Miyar	859	33.059	76.893	0.31	-----	-----
105	Chenab	Miyar	860	33.040	76.881	0.07	-----	-----
106	Chenab	Miyar	861	32.978	76.895	0.20	-----	-----
107	Chenab	Miyar	862	32.966	76.956	0.19	-----	-----
108	Chenab	Miyar	863	32.948	76.974	1.38	-----	-----
109	Chenab	Miyar	864	32.929	76.946	1.17	-----	-----
110	Chenab	Miyar	865	32.928	76.943	0.25	-----	-----
111	Chenab	Miyar	866	32.926	76.944	0.55	-----	-----
112	Chenab	Miyar	867	32.906	76.944	0.23	-----	-----
113	Chenab	Miyar	871	32.827	76.859	0.07	-----	-----
114	Chenab	Miyar	872	32.765	76.971	0.17	-----	-----
115	Chenab	Miyar	873	32.781	76.968	0.17	-----	-----

116	Chenab	Miyar	874	32.667	76.606	0.29	-----	-----
117	Chenab	Miyar	887	33.250	76.459	0.11	-----	-----
118	Chenab	Miyar	890	32.927	76.847	0.85	-----	-----
119	Chenab	Miyar	891	32.801	76.861	1.20	-----	-----
120	Chenab	Miyar	892	32.959	76.843	0.15	-----	-----
121	Chenab	Miyar	894	32.911	76.747	1.73	-----	-----
122	Chenab	Miyar	895	32.911	76.748	0.09	-----	-----
123	Chenab	Miyar	896	32.912	76.744	0.06	-----	-----
124	Chenab	Miyar	897	32.922	76.757	0.32	-----	-----
125	Chenab	Miyar	898	32.920	76.762	0.50	-----	-----
126	Chenab	Miyar	899	32.912	76.782	0.33	-----	-----
127	Chenab	Miyar	900	32.910	76.812	0.49	-----	-----
128	Chenab	Miyar	901	32.909	76.812	0.25	-----	-----
129	Chenab	Miyar	905	33.216	76.547	0.49	-----	-----
130	Chenab	Miyar	1216	33.066	76.724	0.62	-----	-----
131	Chenab	Miyar	1217	33.004	76.781	0.34	-----	-----
132	Chenab	Miyar	1218	33.004	76.762	0.25	-----	-----
133	Chenab	Miyar	1219	32.964	77.119	0.92	-----	-----
134	Chenab	Miyar	104SG	33.057	76.778	1.05	-----	-----
135	Chenab	Miyar	105SG	33.085	76.782	0.41	0.9	-0.49
136	Chenab	Miyar	132SG	33.133	76.765	0.11	0.24	-0.13
137	Chenab	Miyar	134SG	33.082	76.760	1.24	0.44	0.80
138	Chenab	Miyar	136SG	33.048	76.848	0.42	0.48	-0.06
139	Chenab	Miyar	207SG	32.912	76.666	0.14	0.55	-0.41
140	Chenab	Miyar	208SG	32.911	76.670	0.18	0.24	-0.06
141	Chenab	Miyar	221SG	33.057	76.774	1.38	0.44	0.94
142	Chenab	Miyar	223SG	33.056	76.772	0.40	0.48	-0.08
143	Chenab	Miyar	503SG	33.207	76.491	1.02	0.2	0.82
144	Chenab	Miyar	504SG	33.212	76.493	1.25	0.79	0.46
145	Chenab	Miyar	55SG	33.068	76.763	0.98	0.98	0.00
146	Chenab	Miyar	59SG	33.065	76.764	0.50	0.54	-0.04
147	Chenab	Miyar	602SG	33.205	76.487	0.58	0.29	0.29
148	Chenab	Miyar	615SG	33.152	76.772	0.18	0.3	-0.12
149	Chenab	Miyar	627SG	33.080	76.757	0.67	0.24	0.43
150	Chenab	Miyar	629SG	33.076	76.759	1.40	0.4	1.00
151	Chenab	Miyar	632SG	33.071	76.763	1.47	0.44	1.03
152	Chenab	Miyar	633SG	33.058	76.773	0.13	0.24	-0.11
153	Chenab	Miyar	635SG	33.083	76.783	0.26	0.3	-0.04
154	Chenab	Miyar	637SG	33.030	76.864	0.66	0.49	0.17
155	Chenab	Miyar	803SG	33.215	76.501	0.37	-----	-----
156	Chenab	Miyar	804SG	33.215	76.506	0.67	-----	-----

157	Chenab	Miyar	805SG	33.215	76.518	0.16	-----	-----
158	Chenab	Miyar	806SG	33.215	76.520	0.15	-----	-----
159	Chenab	Miyar	807SG	33.216	76.526	0.19	-----	-----
160	Chenab	Miyar	808SG	33.161	76.577	0.51	-----	-----
161	Chenab	Miyar	811SG	33.185	76.591	0.32	-----	-----
162	Chenab	Miyar	812SG	32.841	76.550	0.07	-----	-----
163	Chenab	Miyar	814SG	32.913	76.671	0.20	-----	-----
164	Chenab	Miyar	815SG	32.913	76.675	0.19	-----	-----
165	Chenab	Miyar	816SG	32.917	76.678	0.31	-----	-----
166	Chenab	Miyar	817SG	32.956	76.684	0.14	-----	-----
167	Chenab	Miyar	818SG	32.959	76.682	0.34	-----	-----
168	Chenab	Miyar	819SG	32.969	76.674	0.26	-----	-----
169	Chenab	Miyar	835SG	33.153	76.762	0.39	-----	-----
170	Chenab	Miyar	836SG	33.143	76.757	0.62	-----	-----
171	Chenab	Miyar	837SG	33.080	76.761	0.28	-----	-----
172	Chenab	Miyar	838SG	33.079	76.761	0.27	-----	-----
173	Chenab	Miyar	839SG	33.077	76.761	0.16	-----	-----
174	Chenab	Miyar	840SG	33.075	76.762	0.54	-----	-----
175	Chenab	Miyar	841SG	33.068	76.765	0.65	-----	-----
176	Chenab	Miyar	842SG	33.066	76.766	0.50	-----	-----
177	Chenab	Miyar	843SG	33.060	76.772	0.86	-----	-----
178	Chenab	Miyar	844SG	33.057	76.775	0.09	-----	-----
179	Chenab	Miyar	845SG	33.055	76.777	0.24	-----	-----
180	Chenab	Miyar	846SG	33.050	76.776	0.79	-----	-----
181	Chenab	Miyar	847SG	33.053	76.781	0.14	-----	-----
182	Chenab	Miyar	848SG	33.048	76.779	0.18	-----	-----
183	Chenab	Miyar	849SG	33.046	76.781	0.84	-----	-----
184	Chenab	Miyar	852SG	33.085	76.788	1.01	-----	-----
185	Chenab	Miyar	853SG	33.085	76.790	0.57	-----	-----
186	Chenab	Miyar	854SG	33.082	76.798	0.76	-----	-----
187	Chenab	Miyar	855SG	33.048	76.839	0.59	-----	-----
188	Chenab	Miyar	857SG	33.029	76.859	0.36	-----	-----
189	Chenab	Miyar	868SG	32.837	76.898	0.12	-----	-----
190	Chenab	Miyar	870SG	32.835	76.901	0.10	-----	-----
191	Chenab	Miyar	875SG	32.640	76.620	0.19	-----	-----
192	Chenab	Miyar	876SG	32.638	76.642	0.07	-----	-----
193	Chenab	Miyar	877SG	32.640	76.644	0.13	-----	-----
194	Chenab	Miyar	878SG	32.644	76.643	0.92	-----	-----
195	Chenab	Miyar	879SG	32.644	76.645	0.35	-----	-----
196	Chenab	Miyar	880SG	32.645	76.645	0.19	-----	-----
197	Chenab	Miyar	881SG	32.648	76.649	0.24	-----	-----

198	Chenab	Miyar	882SG	32.655	76.653	0.53	-----	-----
199	Chenab	Miyar	883SG	32.589	76.683	0.16	-----	-----
200	Chenab	Miyar	884SG	32.579	76.747	0.07	-----	-----
201	Chenab	Miyar	885SG	32.582	76.749	0.48	-----	-----
202	Chenab	Miyar	888SG	33.211	76.497	0.16	-----	-----

SG-Supra Glacier

HWL- High Altitude Wetland Lake

RS- River Section

Annexure 4: Aerial extent of lakes in Upper Beas Sub Basin

Sr. No.	Name of the Basin	Name of Sub- Basin	Lake id Number	Latitude	Longitude	Area (hectare)in 2022	Area (hectare) in 2019	Change in Area w.r.t. 2019
1	Beas	Upper Beas	3	32.293	77.079	4.201	6.33	-2.13
2	Beas	Upper Beas	5	32.303	77.095	2.021	2.14	-0.12
3	Beas	Upper Beas	6	32.157	77.298	8.908	10.47	-1.56
4	Beas	Upper Beas	8	32.131	77.286	0.787	0.72	0.07
5	Beas	Upper Beas	14	32.307	77.089	2.784	1.62	1.16
6	Beas	Upper Beas	15	32.305	77.086	2.197	0.79	1.41
7	Beas	Upper Beas	16	32.299	77.095	0.330	2.39	-2.06
8	Beas	Upper Beas	17	32.294	77.091	2.209	0.55	1.66
9	Beas	Upper Beas	50	32.171	77.041	10.354	3.32	7.03
10	Beas	Upper Beas	52	32.132	77.278	1.103	6.98	-5.88
11	Beas	Upper Beas	102	32.299	77.062	0.495	0.99	-0.50
12	Beas	Upper Beas	108	32.171	77.372	2.049	0.44	1.61
13	Beas	Upper Beas	109	32.161	77.308	3.734	1.69	2.04
14	Beas	Upper Beas	200	32.187	77.070	0.886	2.82	-1.93
15	Beas	Upper Beas	1000	32.279	77.072	1.194	0.62	0.57
16	Beas	Upper Beas	1001	32.288	77.079	0.511	-----	-----
17	Beas	Upper Beas	1002	32.290	77.085	0.973	-----	-----
18	Beas	Upper Beas	1005	32.144	77.301	1.949	-----	-----
19	Beas	Upper Beas	1006	32.127	77.286	0.301	-----	-----
20	Beas	Upper Beas	1226	32.285	77.343	0.695	-----	-----
21	Beas	Upper Beas	1227	32.294	77.325	0.151	-----	-----
22	Beas	Upper Beas	1228	32.279	77.341	2.404	-----	-----
23	Beas	Upper Beas	1229	32.160	77.307	0.333	-----	-----
24	Beas	Upper Beas	1229	32.277	77.342	0.985	-----	-----
25	Beas	Upper Beas	1003SG	32.223	77.337	0.384	-----	-----

SG-Supra Glacier

HWL- High Altitude Wetland Lake

RS- River Section

Annexure 5: Aerial extent of lakes in Jiwa Sub Basin

Sr. No.	Name of the Basin	Name of Sub-Basin	Lake id Number	Latitude	Longitude	AREA(hectare) in 2022	Area(hectare) in 2019	Change in Area w.r.t. 2019
1	Beas	Jiwa	2	31.8428	77.5609	3.14	3.21	-0.07
2	Beas	Jiwa	3	31.8455	77.5913	7.61	3.8	3.81
3	Beas	Jiwa	4	31.8453	77.6383	0.76	0.49	0.27
4	Beas	Jiwa	5	31.8522	77.6399	4.32	4.19	0.13
5	Beas	Jiwa	6	31.8515	77.6484	0.87	0.73	0.14
6	Beas	Jiwa	17	31.7342	77.5633	2.12	1.89	0.23
7	Beas	Jiwa	18	31.7334	77.5611	2.32	1.77	0.55
8	Beas	Jiwa	19	31.7343	77.5553	2.43	2.28	0.15
9	Beas	Jiwa	20	31.74	77.5542	1.75	1.1	0.65
10	Beas	Jiwa	27	31.7374	77.5228	3.26	2.64	0.62
11	Beas	Jiwa	28	31.7413	77.5153	0.81	0.51	0.30
12	Beas	Jiwa	29	31.7412	77.5055	0.82	0.71	0.11
13	Beas	Jiwa	36	31.6664	77.6184	5.75	4.75	1.00
14	Beas	Jiwa	37	31.6685	77.5973	3.66	1.29	2.37
15	Beas	Jiwa	39	31.6573	77.6102	0.68	0.63	0.05
16	Beas	Jiwa	40	31.6682	77.5895	5.89	2.45	3.44
17	Beas	Jiwa	45	31.8375	77.4706	2.12	2.15	-0.03
18	Beas	Jiwa	46	31.8378	77.4749	1.47	1.29	0.18
19	Beas	Jiwa	102	31.8809	77.5391	0.70	0.64	0.06
20	Beas	Jiwa	105	31.7238	77.6691	2.66	3.98	-1.32
21	Beas	Jiwa	106	31.7295	77.662	3.16	2.07	1.09
22	Beas	Jiwa	107	31.7403	77.5484	1.32	0.9	0.42
23	Beas	Jiwa	202	31.8543	77.6301	0.85	0.7	0.15
24	Beas	Jiwa	205	31.8445	77.642	0.31	-----	-----
25	Beas	Jiwa	206	31.7329	77.6835	1.43	0.75	0.68
26	Beas	Jiwa	207	31.7453	77.6345	0.58	0.64	-0.06
27	Beas	Jiwa	208	31.7437	77.5736	0.60	0.34	0.26
28	Beas	Jiwa	209	31.7406	77.5691	1.45	1.72	-0.27
29	Beas	Jiwa	210	31.7412	77.551	0.46	0.41	0.05
30	Beas	Jiwa	211	31.7396	77.5501	1.17	0.49	0.68
31	Beas	Jiwa	212	31.7402	77.5457	0.41	0.35	0.06
32	Beas	Jiwa	215	31.7263	77.6681	0.51	0.43	0.08
33	Beas	Jiwa	216	31.8426	77.4761	2.06	2.05	0.01
34	Beas	Jiwa	1126	31.6699	77.5988	0.43	-----	-----
35	Beas	Jiwa	1127	31.7445	77.6327	0.22	-----	-----
36	Beas	Jiwa	1128	31.7436	77.6336	0.22	-----	-----
37	Beas	Jiwa	1129	31.7468	77.6402	0.12	-----	-----
38	Beas	Jiwa	1130	31.7824	77.6635	3.28	-----	-----
39	Beas	Jiwa	1131	31.7876	77.6811	0.83	-----	-----

40	Beas	Jiwa	1132	31.7864	77.6848	0.41	-----	-----
41	Beas	Jiwa	1133	31.7917	77.6854	0.51	-----	-----
42	Beas	Jiwa	1134	31.8462	77.6373	0.42	-----	-----
43	Beas	Jiwa	1135	31.8829	77.536	0.57	-----	-----
44	Beas	Jiwa	1136	31.8861	77.5363	2.85	-----	-----
45	Beas	Jiwa	1137	31.8852	77.5019	0.71	-----	-----
46	Beas	Jiwa	1138	31.8864	77.5043	0.55	-----	-----
47	Beas	Jiwa	1228	31.8807	77.5438	0.51	-----	-----
48	Beas	Jiwa	1229	31.7844	77.6616	0.48	-----	-----
49	Beas	Jiwa	1230	31.7222	77.7189	0.09	-----	-----

SG-Supra Glacier

HWL- High Altitude Wetland Lake

RS- River Section

Annexure 6: Aerial extent of lakes in Parvati Sub Basin

Sr.	Name of the Basin	Name of Sub-Basin	Lake id Number	Longitude	Latitude	Area (hectare) in 2022	Area (hectare) in 2019	Change in Area w.r.t. 2019
1	Beas	Parvati	1	32.168	32.168	0.94	1.04	-0.10
2	Beas	Parvati	2	32.168	32.168	1.02	0.95	0.07
3	Beas	Parvati	3	32.180	32.180	7.17	6.29	0.88
4	Beas	Parvati	6SG	32.163	32.163	0.80	0.25	0.55
5	Beas	Parvati	11	31.973	31.973	1.84	1.31	0.53
6	Beas	Parvati	12	31.949	31.949	1.70	0.91	0.79
7	Beas	Parvati	17	31.830	31.830	6.17	3.79	2.38
8	Beas	Parvati	18	31.837	31.837	2.19	2.42	-0.23
9	Beas	Parvati	21	31.849	31.849	11.21	14.56	-3.35
10	Beas	Parvati	22	31.927	31.927	0.50	1	-0.50
11	Beas	Parvati	23	31.899	31.899	3.36	4.44	-1.08
12	Beas	Parvati	24	31.898	31.898	1.88	1.95	-0.07
13	Beas	Parvati	25	31.902	31.902	1.53	-----	-----
14	Beas	Parvati	26	31.915	31.915	14.67	15.21	-0.54
15	Beas	Parvati	27	31.898	31.898	3.33	2.13	1.20
16	Beas	Parvati	28	32.056	32.056	5.38	3.84	1.54
17	Beas	Parvati	29	32.049	32.049	0.93	1.33	-0.40
18	Beas	Parvati	30	32.075	32.075	4.56	5.07	-0.51
19	Beas	Parvati	33	32.135	32.135	1.78	1.86	-0.08
20	Beas	Parvati	34	32.135	32.135	2.39	1.02	1.37
21	Beas	Parvati	44	31.943	31.943	2.71	1.66	1.05
22	Beas	Parvati	50	32.134	32.134	13.32	11.83	1.49
23	Beas	Parvati	51	31.838	31.838	1.88	1.73	0.15
24	Beas	Parvati	107	31.973	31.973	1.03	0.84	0.19
25	Beas	Parvati	108	31.845	31.845	2.39	1.71	0.68

26	Beas	Parvati	109	31.938	31.938	3.76	3.04	0.72
27	Beas	Parvati	110	31.935	31.935	0.61	0.54	0.07
28	Beas	Parvati	304	31.954	31.954	1.23	0.46	0.77
29	Beas	Parvati	305	31.949	31.949	0.83	0.29	0.54
30	Beas	Parvati	306	31.924	31.924	0.41	0.4	0.01
31	Beas	Parvati	307	31.883	31.883	0.37	0.24	0.13
32	Beas	Parvati	308	31.862	31.862	0.63	0.5	0.13
33	Beas	Parvati	309	31.842	31.842	0.51	-----	-----
34	Beas	Parvati	310	31.822	31.822	1.75	0.75	1.00
35	Beas	Parvati	312	32.062	32.062	0.27	0.2	0.07
36	Beas	Parvati	1100	31.825	31.825	0.82	-----	-----
37	Beas	Parvati	1101	31.827	31.827	0.87	-----	-----
38	Beas	Parvati	1102	31.843	31.843	0.65	-----	-----
39	Beas	Parvati	1103	31.858	31.858	1.22	-----	-----
40	Beas	Parvati	1104	31.882	31.882	0.80	-----	-----
41	Beas	Parvati	1105	31.947	31.947	1.44	-----	-----
42	Beas	Parvati	1106	31.949	31.949	0.96	-----	-----
43	Beas	Parvati	1107	32.039	32.039	1.52	-----	-----
44	Beas	Parvati	1108	32.147	32.147	0.42	-----	-----
45	Beas	Parvati	1109	32.148	32.148	0.76	-----	-----
46	Beas	Parvati	1110	32.148	32.148	0.16	-----	-----
47	Beas	Parvati	1115	32.152	32.152	1.04	-----	-----
48	Beas	Parvati	1116	32.107	32.107	1.09	-----	-----
49	Beas	Parvati	1117	32.100	32.100	1.63	-----	-----
50	Beas	Parvati	1118	32.101	32.101	0.74	-----	-----
51	Beas	Parvati	1119	32.098	32.098	0.82	-----	-----
52	Beas	Parvati	1120	32.103	32.103	0.34	-----	-----
53	Beas	Parvati	1121	32.113	32.113	0.44	-----	-----
54	Beas	Parvati	1220	31.945	31.945	0.62	-----	-----
55	Beas	Parvati	1221	31.946	31.946	0.04	-----	-----
56	Beas	Parvati	1222	31.944	31.944	0.14	-----	-----
57	Beas	Parvati	1223	31.956	31.956	0.47	-----	-----
58	Beas	Parvati	1224	31.926	31.926	0.75	-----	-----
59	Beas	Parvati	1225	31.933	31.933	0.77	-----	-----
60	Beas	Parvati	1111SG	32.159	32.159	0.51	-----	-----
61	Beas	Parvati	1112SG	32.166	32.166	0.31	-----	-----
62	Beas	Parvati	1113SG	32.162	32.162	0.47	-----	-----
63	Beas	Parvati	1114HWL	32.176	32.176	1.56	-----	-----
64	Beas	Parvati	301SG	32.159	32.159	0.23	0.18	0.05
65	Beas	Parvati	303SG	31.967	31.967	0.86	-----	-----

Annexure 7: Aerial extent of lakes in Ravi Basin

Sr. No.	Name of the Basin	Lake id Number	Latitude	Longitude	Area (hectare) in 2022	Area (hectare) in 2019	Change in Area w.r.t. 2019
1	Ravi	8	32.2073	76.899	0.78	1.09	-0.31
2	Ravi	9	32.2257	76.809	3.99	2	1.99
3	Ravi	31	32.2334	76.7538	13.80	5.76	8.04
4	Ravi	32	32.3451	76.3465	2.59	2.54	0.05
5	Ravi	32	32.2375	76.7546	0.24	1.28	-1.04
6	Ravi	33	32.2563	76.7775	3.19	2.74	0.45
7	Ravi	34	32.2233	76.8199	0.96	0.8	0.16
8	Ravi	37	32.2737	76.9843	1.73	1.35	0.38
9	Ravi	37	32.2724	76.9857	2.52	1.87	0.65
10	Ravi	101	32.2446	76.5243	2.16	1.05	1.11
11	Ravi	102	32.2347	76.5357	3.55	3.58	-0.03
12	Ravi	108	32.2129	76.8998	2.27	1.42	0.85
13	Ravi	118	32.2247	77.0323	1.29	1.14	0.15
14	Ravi	120	32.2206	77.0327	1.01	0.84	0.17
15	Ravi	122	32.2165	77.0308	2.96	3.29	-0.33
16	Ravi	123	32.2171	77.0334	0.84	0.54	0.30
17	Ravi	124	32.216	77.0351	1.62	0.83	0.79
18	Ravi	129	32.4217	76.8487	2.31	2.39	-0.08
19	Ravi	132	32.3124	76.3718	4.68	4.05	0.63
20	Ravi	134	32.2697	76.4275	5.16	3.4	1.76
21	Ravi	205	32.2628	76.9673	1.46	1.11	0.35
22	Ravi	254	32.3437	76.3581	1.23	1.06	0.17
23	Ravi	255	32.1945	76.7202	0.42	0.52	-0.10
24	Ravi	256	32.2107	76.7443	0.51	0.5	0.01
25	Ravi	258	32.9822	76.2408	1.05	7.32	-6.27
26	Ravi	259	32.9776	76.2591	2.50	1.09	1.41
27	Ravi	1150	32.221	77.0301	1.37	2.38	-1.01
28	Ravi	1151	32.226	77.0345	2.17	-----	-----
29	Ravi	1152	32.345	76.352	0.58	-----	-----
30	Ravi	1153	32.3359	76.3552	1.99	-----	-----
31	Ravi	1154	32.3097	76.3713	1.34	-----	-----
32	Ravi	1155	32.2687	76.4882	2.51	-----	-----
33	Ravi	1156	32.2633	76.496	0.70	-----	-----
34	Ravi	1157	32.2626	76.4947	0.23	-----	-----
35	Ravi	1158	32.2625	76.4935	0.12	-----	-----
36	Ravi	1159	32.2439	76.7867	15.19	-----	-----
37	Ravi	1160	32.232	76.7781	3.40	-----	-----

38	Ravi	1161	32.307	76.3789	0.18	-----	-----
39	Ravi	1162	32.2487	76.5285	0.83	-----	-----
40	Ravi	1163	32.2305	76.8029	0.93	-----	-----
41	Ravi	1164	32.2319	76.8083	1.32	-----	-----
42	Ravi	1165	32.2059	76.8849	0.19	-----	-----
43	Ravi	1166	32.2076	76.8314	0.39	-----	-----
44	Ravi	1167	32.227	77.0241	1.17	-----	-----
45	Ravi	1168	32.2273	77.0183	0.34	-----	-----
46	Ravi	1169	32.232	77.0135	0.86	-----	-----
47	Ravi	1170	32.2301	77.0263	0.10	-----	-----
48	Ravi	1171	32.2312	77.0292	0.07	-----	-----
49	Ravi	1172	32.2318	77.0304	0.12	-----	-----
50	Ravi	1173	32.2299	77.0184	0.78	-----	-----
51	Ravi	1174	32.235	77.018	1.63	-----	-----
52	Ravi	1175	32.2356	77.0161	0.91	-----	-----
53	Ravi	1176	32.2307	77.0213	0.36	-----	-----
54	Ravi	1177	32.2328	77.0187	0.53	-----	-----
55	Ravi	1178	32.2201	77.0356	0.36	-----	-----
56	Ravi	1179	32.2195	77.0332	0.81	-----	-----
57	Ravi	1180	32.2141	77.0343	0.09	-----	-----
58	Ravi	1181	32.2682	76.9618	0.54	-----	-----
59	Ravi	1182	32.3949	76.6373	0.74	-----	-----
60	Ravi	1183	32.3797	76.6953	1.29	-----	-----
61	Ravi	1184	32.6231	76.4412	1.18	-----	-----
62	Ravi	1185	32.6288	76.3673	0.83	-----	-----
63	Ravi	1186	32.6196	76.3693	0.52	-----	-----
64	Ravi	1187	32.8723	76.3341	1.07	-----	-----
65	Ravi	1188	32.3567	77.0433	1.13	-----	-----
66	Ravi	1189	32.3601	77.0393	0.27	-----	-----
67	Ravi	1190	32.3571	77.0371	0.53	-----	-----
68	Ravi	1192	32.3537	77.0362	0.36	-----	-----
69	Ravi	1193	32.3416	77.0191	0.07	-----	-----
70	Ravi	1194	32.3407	77.0181	0.09	-----	-----
71	Ravi	1195	32.3363	77.0153	0.48	-----	-----
72	Ravi	1196	32.3368	77.0146	0.04	-----	-----
73	Ravi	1197	32.3355	77.015	0.10	-----	-----
74	Ravi	1198	32.3414	77.0165	0.06	-----	-----
75	Ravi	1199	32.3413	77.016	0.04	-----	-----
76	Ravi	1200	32.3416	77.0178	0.01	-----	-----
77	Ravi	1201	32.3415	77.0168	0.02	-----	-----
78	Ravi	15HWL	32.332	76.3444	3.34	3	0.34

79	Ravi	16HWL	32.3357	76.332	29.35	29.19	0.16
80	Ravi	17HWL	32.3427	76.3258	2.43	2.3	0.13
81	Ravi	250HWL	32.3427	76.3158	4.78	3.98	0.80
82	Ravi	251HWL	32.344	76.3112	1.57	1.05	0.52
83	Ravi	252HWL	32.3453	76.3048	3.33	2.77	0.56
84	Ravi	253HWL	32.3465	76.3018	0.63	0.34	0.29
85	Ravi	2HWL	32.343	76.3225	1.77	1.14	0.63
86	Ravi	39SG	32.3974	77.0222	0.94	0.94	0.00

SG-Supra Glacier

HWL- High Altitude Wetland Lake

RS- River Section

Annexure 8: Aerial extent of lakes in Satluj Basin

Sr. No.	Name of the Basin	Lake Id.	Basin No.	Latitude	Longitude	Area (hectare) in 2022	Area (hectare) in 2019	Change in Area w.r.t. 2019
1	Satluj	38	1	32.7072	78.7018	0.28	2.56	-2.28
2	Satluj	59	3	32.3195	78.9789	8.44	1.68	6.76
3	Satluj	61	3	32.3167	78.9944	0.5	7.18	-6.68
4	Satluj	67	3	32.3145	78.3673	1.26	7.68	-6.42
5	Satluj	68	3	32.2207	78.9832	0.79	6.3	-5.51
6	Satluj	70	3	32.2086	79.0197	3.58	1.8	1.78
7	Satluj	71	3	32.2205	78.9867	0.45	2.6	-2.15
8	Satluj	72	1	32.2243	78.9977	1.83	2.28	-0.45
9	Satluj	74	1	32.1811	78.4331	1.34	4.76	-3.42
10	Satluj	75	1	32.1755	78.9832	0.47	3.3	-2.83
11	Satluj	76	3	32.1498	78.963	2.73	1.59	1.14
12	Satluj	80	1	32.1374	78.9597	0.52	2.58	-2.06
13	Satluj	81	1	32.1227	78.943	6.41	1.04	5.37
14	Satluj	84	3	32.1076	78.9329	13.33	1.37	11.96
15	Satluj	85 (1)	3	32.1046	78.9384	0.51	1.08	-0.57
16	Satluj	85 (2)	2	31.6599	78.1661	42.8	34.89	7.91
17	Satluj	94	3	32.0199	78.8762	3.1	6.39	-3.29
18	Satluj	95	3	32.0073	78.8517	0.68	2.21	-1.53
19	Satluj	96	3	32.0308	78.7874	0.19	1.7	-1.51
20	Satluj	97	3	32.01775	78.91074	6.55	5.73	0.82
21	Satluj	99	1	32.03289	78.77954	0.95	14.72	-13.77
22	Satluj	101	3	31.99455	78.84817	1.72	21.1	-19.38
23	Satluj	103	3	31.96034	78.81074	0.29	3.85	-3.56
24	Satluj	105	3	31.97979	78.13248	2.37	1.37	1.00
25	Satluj	106	3	31.98203	78.84996	0.66	5.63	-4.97
26	Satluj	122	3	31.91893	78.78318	21.67	16.86	4.81

27	Satluj	131	1	31.9177	78.70239	0.91	0.71	0.20
28	Satluj	152	1	32.12918	78.92664	1.26	2.47	-1.21
29	Satluj	167	2	31.36005	78.70338	0.91	-----	-----
30	Satluj	168	2	31.36257	78.72359	1.38	1.07	0.31
31	Satluj	173	2	31.22415	78.6987	3.93	13.2	-9.27
32	Satluj	228	2	31.55334	78.75101	5.41	6.42	-1.01
33	Satluj	405	2	31.40324	78.42052	2.45	3.14	-0.69
34	Satluj	582(1)	2	31.31498	78.32961	0.7	0.41	0.29
35	Satluj	582(4)	2	31.31236	78.32923	2.85	2.31	0.54
36	Satluj	582(5)	2	31.31054	78.32953	1.24	0.46	0.78
37	Satluj	586	1	31.91219	78.70119	5.47	5.56	-0.09
38	Satluj	589	1	31.90074	78.71849	1.25	1.39	-0.14
39	Satluj	811	1	32.05417	78.90381	0.71	9.86	-9.15
40	Satluj	814	1	32.04716	78.7445	1.01	0.9	0.11
41	Satluj	816	1	32.04574	78.74518	0.36	0.32	0.04
42	Satluj	819	1	32.04437	78.75468	1.05	0.81	0.24
43	Satluj	820	1	32.04449	78.75639	0.74	0.66	0.08
44	Satluj	821	1	32.04166	78.758	2.47	1.76	0.71
45	Satluj	822	1	32.04067	78.76144	0.83	0.65	0.18
46	Satluj	825	1	32.04027	78.76915	0.46	0.55	-0.09
47	Satluj	848	2	31.70891	78.74094	2.49	2.23	0.26
48	Satluj	854	2	31.56423	78.60985	3.83	2.92	0.91
49	Satluj	865	2	31.36118	78.77069	0.52	0.67	-0.15
50	Satluj	866	2	31.35863	78.73333	2.5	2.04	0.46
51	Satluj	869	2	31.32632	78.70189	1.94	1.36	0.58
52	Satluj	870	2	31.32565	78.69614	1.79	1.39	0.40
53	Satluj	871	2	31.33307	78.6636	1.22	1.1	0.12
54	Satluj	891	2	31.45823	78.36856	1.69	1.21	0.48
55	Satluj	998	1	32.70642	78.68172	1.01	1.11	-0.10
56	Satluj	999	1	32.61064	78.08083	0.45	1.1	-0.65
57	Satluj	1013	3	32.25444	78.9913	2.02	3.06	-1.04
58	Satluj	1022	1	32.03588	78.77733	0.27	0.95	-0.68
59	Satluj	1033	3	31.90577	78.78523	0.21	0.52	-0.31
60	Satluj	1035	1	31.88719	78.70477	1.87	0.8	1.07
61	Satluj	1039	2	31.66128	78.75004	0.97	0.75	0.22
62	Satluj	1048	2	31.3665	78.72231	0.4	0.46	-0.06
63	Satluj	1049	3	31.51831	78.73463	3.12	4.14	-1.02
64	Satluj	1209	2	31.54213	78.73625	1.28	1.58	-0.30
65	Satluj	1213	3	31.5075	78.73187	1.05	1.45	-0.40
66	Satluj	1218	2	31.49374	78.42893	0.33	0.21	0.12
67	Satluj	1220	2	31.50708	78.43375	0.46	0.61	-0.15
68	Satluj	1230	3	32.03393	78.77804	0.6	5.06	-4.46
69	Satluj	1231	1	32.03916	78.75865	0.38	0.45	-0.07

70	Satluj	1232	1	32.03151	78.8724	4.96	0.97	3.99
71	Satluj	1234	3	31.93018	78.69469	0.6	1.45	-0.85
72	Satluj	1237	3	31.92987	78.82671	0.58	0.73	-0.15
73	Satluj	1238	3	31.93361	78.79569	0.32	1.26	-0.94
74	Satluj	1259	3	31.96945	78.86867	8.94	1.97	6.97
75	Satluj	1269	2	31.33963	78.71671	0.73	2.1	-1.37
76	Satluj	1270	2	31.3642	78.75776	0.85	0.69	0.16
77	Satluj	1272	2	31.32203	78.7597	1.38	1.33	0.05
78	Satluj	1273	2	31.32216	78.75809	0.95	0.46	0.49
79	Satluj	1274	2	31.32168	78.75673	0.96	1.17	-0.21
80	Satluj	1275	2	31.32396	78.75546	0.95	0.74	0.21
81	Satluj	1619	2	31.4485	78.37473	0.6	0.81	-0.21
82	Satluj	1623	2	31.41136	78.41012	1.73	0.64	1.09
83	Satluj	1625	2	31.40337	78.42519	0.72	0.63	0.09
84	Satluj	1626	2	31.39865	78.4221	1.75	0.71	1.04
85	Satluj	1628	2	31.43132	78.43117	1.7	1.25	0.45
86	Satluj	1640	2	31.49101	78.4287	2.85	1.62	1.23
87	Satluj	1647	3	31.88007	78.79356	0.61	0.64	-0.03
88	Satluj	1648	3	31.88197	78.79362	1.1	0.96	0.14
89	Satluj	1652	3	31.93055	78.81992	0.31	0.45	-0.14
90	Satluj	1653	3	31.93265	78.81652	2.52	1.31	1.21
91	Satluj	1654	3	31.91401	78.84011	8.45	22.28	-13.83
92	Satluj	1656	1	32.04258	78.75193	0.83	0.76	0.07
93	Satluj	1658	1	32.03495	78.77954	0.19	0.45	-0.26
94	Satluj	1660	1	32.03028	78.76249	1.21	0.2	1.01
95	Satluj	1668	1	32.08076	78.80309	1.37	1.64	-0.27
96	Satluj	1692	1	32.69971	78.73672	0.65	0.4	0.25
97	Satluj	1693	1	32.69495	78.73045	0.4	0.4	0.00
98	Satluj	1714	2	31.31065	78.32587	0.41	0.52	-0.11
99	Satluj	2100	2	31.53103	78.71732	0.76	2.38	-1.62
100	Satluj	2101	2	31.37547	78.74461	0.35	0.2	0.15
101	Satluj	2102	2	31.37447	78.74401	0.91	0.88	0.03
102	Satluj	2103	2	31.35124	78.7305	0.31	0.41	-0.10
103	Satluj	2104	2	31.35953	78.66777	0.3	0.45	-0.15
104	Satluj	2106	2	31.37284	78.58121	1.48	0.4	1.08
105	Satluj	2107	2	31.40055	78.4893	4.32	0.42	3.90
106	Satluj	2113	3	31.93284	78.822	1.49	2.77	-1.28
107	Satluj	2114	3	31.94124	78.81161	0.3	1.8	-1.50
108	Satluj	2115	3	31.93237	78.81991	2.16	0.45	1.71
109	Satluj	2117 (1)	1	32.20334	79.01702	0.87	6.27	-5.40
110	Satluj	2117 (2)	3	31.93098	78.7838	0.37	0.26	0.11
111	Satluj	2118 (1)	1	32.30218	78.20145	0.55	3.18	-2.63
112	Satluj	2118 (2)	3	31.92924	78.78104	7.4	0.34	7.06

113	Satluj	2119	1	32.04547	78.26151	0.99	1.66	-0.67
114	Satluj	2120	1	32.08567	78.86384	1.89	1.74	0.15
115	Satluj	5045	1	32.32515	78.97307	8.45	2.44	6.01
116	Satluj	5048	3	32.31334	78.18443	0.85	0.94	-0.09
117	Satluj	5056	1	32.21486	79.00932	1.8	0.42	1.38
118	Satluj	5058	3	32.21637	79.00104	0.76	1.25	-0.49
119	Satluj	5068	3	32.12025	78.94705	5.02	1.41	3.61
120	Satluj	5073	1	32.14156	78.91853	3.01	1.27	1.74
121	Satluj	5074	1	32.09392	78.91444	2.34	1.17	1.17
122	Satluj	5077	1	32.08061	78.8004	0.47	0.31	0.16
123	Satluj	5079	1	32.07195	78.8848	4.07	0.35	3.72
124	Satluj	5081	1	32.06355	78.92751	1.78	1.2	0.58
125	Satluj	5095	3	31.99235	78.8447	23.26	0.33	22.93
126	Satluj	6004	1	31.89455	78.71259	0.71	0.4	0.31
127	Satluj	6013	3	31.97847	78.83646	2.15	1.19	0.96
128	Satluj	6014	3	31.98038	78.83739	6.28	0.3	5.98
129	Satluj	6016	1	32.71013	78.70841	6.56	0.69	5.87
130	Satluj	6017	1	32.70721	78.70277	0.66	0.49	0.17
131	Satluj	6019	1	32.70684	78.70639	1.46	0.94	0.52
132	Satluj	6035	1	32.0424	78.75506	0.3	-----	-----
133	Satluj	6036	1	32.02906	78.84438	18.72	0.56	18.16
134	Satluj	9000	1	32.47496	78.30544	0.77	4.19	-3.42
135	Satluj	9001 (1)	1	32.75559	78.69568	0.46	0.37	0.09
136	Satluj	9001 (2)	1	32.75488	78.69617	1.06	-----	-----
137	Satluj	9001(3)	1	32.74947	78.69798	1.25	-----	-----
138	Satluj	9001 (4)	1	32.74957	78.69656	0.55	-----	-----
139	Satluj	9002	1	32.47646	78.30254	3.03	3.74	-0.71
140	Satluj	9004	1	32.27647	79.01701	3.34	0.73	2.61
141	Satluj	9005	1	32.25812	78.97743	2.66	0.68	1.98
142	Satluj	9006	1	32.22409	79.02596	6.47	0.94	5.53
143	Satluj	9007	1	32.22425	79.00576	3.14	0.94	2.20
144	Satluj	9008	1	32.2529	78.98657	0.74	0.37	0.37
145	Satluj	9009	1	32.34629	78.50005	0.2	17.12	-16.92
146	Satluj	9011	1	32.45694	78.47309	6.45	0.18	6.27
147	Satluj	9012	1	32.51419	77.81002	2.23	2.15	0.08
148	Satluj	9014	1	32.42252	78.08231	3.98	7.58	-3.60
149	Satluj	9016	1	32.36293	78.2725	18.38	1.13	17.25
150	Satluj	9017	1	32.35525	78.50882	0.76	1.42	-0.66
151	Satluj	9021	1	32.31522	78.98994	0.6	1.99	-1.39
152	Satluj	9027	1	32.17039	78.97257	2.01	1.25	0.76
153	Satluj	9028	1	32.172	78.9763	0.26	0.36	-0.10
154	Satluj	9030	1	32.14424	78.90671	1.69	1.62	0.07
155	Satluj	9033	1	31.96549	78.8742	0.4	8.19	-7.79

156	Satluj	9036	1	31.86357	77.85632	0.77	0.89	-0.12
157	Satluj	9037	1	31.95465	78.80455	0.66	1.34	-0.68
158	Satluj	9038	1	32.1221	78.946	0.61	2.23	-1.62
159	Satluj	9040	1	32.22556	78.98314	2.59	2.26	0.33
160	Satluj	9052	2	31.70132	77.68592	2.08	1.72	0.36
161	Satluj	9055	2	31.71156	77.88113	0.63	0.72	-0.09
162	Satluj	9056	2	31.72032	77.90037	2.46	1.79	0.67
163	Satluj	9057	2	31.72121	77.9029	2.31	1.76	0.55
164	Satluj	9059	2	31.70727	77.94516	2.56	3.04	-0.48
165	Satluj	9060	2	31.68581	78.06764	0.83	0.31	0.52
166	Satluj	9061	2	31.7019	78.07899	1.56	1.8	-0.24
167	Satluj	9062	2	31.7394	78.12443	3.18	3.92	-0.74
168	Satluj	9063	2	31.73703	78.12613	0.4	0.5	-0.10
169	Satluj	9064	2	31.66198	78.15959	0.58	0.5	0.08
170	Satluj	9065	2	31.58418	78.17793	1.08	1.07	0.01
171	Satluj	9066	2	31.58491	78.18556	7.41	8.62	-1.21
172	Satluj	9067	2	31.77945	78.2926	2.99	1.85	1.14
173	Satluj	9068	2	31.78939	78.30542	2.5	2.58	-0.08
174	Satluj	9070	2	31.52207	78.3828	7.2	7.7	-0.50
175	Satluj	9071	2	31.5154	78.38567	3.91	3.55	0.36
176	Satluj	9074	2	31.48698	78.44443	0.42	0.37	0.05
177	Satluj	9077	2	31.41365	78.48047	1.86	1.62	0.24
178	Satluj	9080	2	31.41786	78.41255	0.85	0.39	0.46
179	Satluj	9081	2	31.43736	78.40965	2.01	2.55	-0.54
180	Satluj	9082	2	31.43663	78.40646	0.5	0.24	0.26
181	Satluj	9084	2	31.42762	78.07706	0.61	0.75	-0.14
182	Satluj	9085	2	31.42228	78.06896	1.33	1.08	0.25
183	Satluj	9086	2	31.41893	78.06866	2.6	1.74	0.86
184	Satluj	9089	2	31.44032	77.91615	1.59	0.68	0.91
185	Satluj	9091	2	31.57358	78.60018	0.57	0.56	0.01
186	Satluj	9092	2	31.57507	78.6005	0.66	0.63	0.03
187	Satluj	9093	2	31.57492	78.60251	0.46	0.51	-0.05
188	Satluj	9095	2	31.47455	78.67152	0.69	0.58	0.11
189	Satluj	9096	2	31.47618	78.6732	0.33	0.19	0.14
190	Satluj	9097	2	31.47348	78.67531	0.51	0.5	0.01
191	Satluj	9098	2	31.48624	78.73201	0.37	0.46	-0.09
192	Satluj	9099	2	31.47627	78.77626	0.37	0.46	-0.09
193	Satluj	9100	2	31.52477	78.69287	0.37	0.46	-0.09
194	Satluj	9101	2	31.52576	78.69398	0.29	0.36	-0.07
195	Satluj	9102	2	31.55673	78.75201	0.3	0.38	-0.08
196	Satluj	9103 (1)	2	31.5603	78.75204	0.41	0.51	-0.10
197	Satluj	9103 (2)	2	31.55861	78.75291	0.47	0.59	-0.12
198	Satluj	9104	2	31.56148	78.75497	0.35	0.44	-0.09

199	Satluj	9105	2	31.67551	78.7373	0.49	0.53	-0.04
200	Satluj	9106	1	31.88931	78.6998	0.42	0.37	0.05
201	Satluj	9113	1	31.9347	78.68584	0.47	1.28	-0.81
202	Satluj	9115	1	32.04891	78.73668	0.33	0.37	-0.04
203	Satluj	9116	1	32.04481	78.74464	0.61	0.62	-0.01
204	Satluj	9117	1	32.04367	78.75553	0.21	0.24	-0.03
205	Satluj	9118	1	32.04035	78.75918	0.35	0.36	-0.01
206	Satluj	9119	1	32.03965	78.75783	0.65	0.59	0.06
207	Satluj	9120	1	32.03969	78.75971	0.26	0.3	-0.04
208	Satluj	9122	1	32.03606	78.83428	0.73	0.24	0.49
209	Satluj	9123	1	32.0319	78.78085	0.42	0.58	-0.16
210	Satluj	9124	1	32.05282	78.78236	1.48	1.05	0.43
211	Satluj	9125	1	32.04305	78.83117	0.78	0.96	-0.18
212	Satluj	9126	3	32.01361	78.82309	1.71	2.11	-0.40
213	Satluj	9127	3	32.01143	78.84512	2.39	0.26	2.13
214	Satluj	9128	3	32.01105	78.84726	0.4	1.12	-0.72
215	Satluj	9129	3	32.00788	78.85089	0.2	0.63	-0.43
216	Satluj	9130	3	31.99925	78.71068	0.42	2.21	-1.79
217	Satluj	9131	3	32.07072	77.7877	0.4	1.6	-1.20
218	Satluj	9132	1	32.07095	78.82034	0.41	3.11	-2.70
219	Satluj	9135	3	32.01704	78.87492	7.28	1.9	5.38
220	Satluj	9136	3	31.97117	78.79746	0.77	7.87	-7.10
221	Satluj	9137	3	31.97625	78.84032	0.32	0.25	0.07
222	Satluj	9138	3	31.97537	78.83646	0.55	1.41	-0.86
223	Satluj	9142	3	31.95068	78.80986	0.33	0.48	-0.15
224	Satluj	9143	3	31.93225	78.82604	0.25	0.3	-0.05
225	Satluj	9144	3	31.93066	78.82275	0.21	0.26	-0.05
226	Satluj	9145	3	31.93135	78.82565	0.19	0.19	0.00
227	Satluj	9146	3	31.93165	78.81682	0.45	0.24	0.21
228	Satluj	9147	3	31.93283	78.81249	0.19	0.21	-0.02
229	Satluj	9148	3	31.90836	78.80191	1.33	-----	-----
230	Satluj	9149	3	31.90698	78.785	0.34	0.55	-0.21
231	Satluj	9150	3	31.90619	78.78596	0.59	0.27	0.32
232	Satluj	9151	3	31.90502	78.7862	0.35	0.68	-0.33
233	Satluj	9152	3	31.88298	78.79013	1.11	0.34	0.77
234	Satluj	9156	1	32.1365	77.91428	2.1	0.32	1.78
235	Satluj	9157	1	32.18244	78.43503	0.2	-----	-----
236	Satluj	9158	1	32.21463	79.01073	0.62	0.62	0.00
237	Satluj	9162	1	32.2516	79.0444	1.41	2.44	-1.03
238	Satluj	9163	3	32.23039	78.24751	0.76	1.75	-0.99
239	Satluj	9164	3	32.24218	77.76094	3.48	0.3	3.18
240	Satluj	9165	3	32.30951	78.18712	1.11	0.56	0.55
241	Satluj	9166	1	32.31594	78.99318	1.29	1.58	-0.29

242	Satluj	9167	1	32.57075	77.92985	0.99	2.91	-1.92
243	Satluj	9170	1	32.69765	78.73343	2.21	0.8	1.41
244	Satluj	9171	1	32.73024	78.68921	1.07	0.27	0.80
245	Satluj	9172	2	31.3502	78.18481	0.62	0.77	-0.15
246	Satluj	9173	2	31.33934	78.25372	16.35	20.23	-3.88
247	Satluj	9174	2	31.33182	78.26031	0.31	0.38	-0.07
248	Satluj	9175	2	31.2937	78.29839	0.51	0.63	-0.12
249	Satluj	9176	2	31.3062	78.32622	0.46	0.57	-0.11
250	Satluj	9181	2	31.22241	78.70141	0.57	0.71	-0.14
251	Satluj	9188	2	31.29544	78.89032	0.5	0.62	-0.12
252	Satluj	9189	2	31.30432	78.88137	0.2	0.25	-0.05
253	Satluj	9190	2	31.30569	78.87752	1.86	2.31	-0.45
254	Satluj	9191	2	31.30779	78.8755	0.43	0.53	-0.10
255	Satluj	9192	2	31.31741	78.8456	0.21	0.26	-0.05
256	Satluj	9193	2	31.29462	78.80385	2.41	0.75	1.66
257	Satluj	9194	2	31.31977	78.80235	0.15	0.19	-0.04
258	Satluj	9195	2	31.3124	78.7929	0.29	0.37	-0.08
259	Satluj	9196	2	31.3281	78.75198	0.2	0.25	-0.05
260	Satluj	9203	2	31.36923	78.67017	0.32	0.39	-0.07
261	Satluj	9204	2	31.33085	78.66254	1.41	1.75	-0.34
262	Satluj	9209	2	31.98013	78.8354	0.97	1.5	-0.53
263	Satluj	9210	2	31.5027	78.43257	2.28	1.79	0.49
264	Satluj	9212	1	32.13848	78.9481	1.17	0.32	0.85
265	Satluj	9213	3	32.20664	78.97564	0.36	0.25	0.11
266	Satluj	9215	1	32.70771	78.70667	0.9	1.25	-0.35
267	Satluj	9217	1	32.32493	78.89621	1.62	-----	-----
268	Satluj	9218	1	32.36209	78.29117	1.43	-----	-----
269	Satluj	10098	1	32.06781	78.82088	0.61	-----	-----
270	Satluj	10099	1	31.77738	78.10137	3.06	-----	-----
271	Satluj	10100	1	31.77806	78.10354	2.93	-----	-----
272	Satluj	10101	2	31.44223	77.91579	1	-----	-----
273	Satluj	10102	2	31.45621	78.36566	0.28	-----	-----
274	Satluj	10103	2	31.44622	78.37116	0.34	-----	-----
275	Satluj	10104	2	31.41313	78.40951	0.2	-----	-----
276	Satluj	10105	2	31.40863	78.41136	0.31	-----	-----
277	Satluj	10106	2	31.40085	78.42314	1.46	-----	-----
278	Satluj	10110	2	31.43427	78.43401	0.27	-----	-----
279	Satluj	10111	2	31.47001	78.43466	1.01	-----	-----
280	Satluj	10112	2	31.49463	78.43052	0.57	-----	-----
281	Satluj	10113	2	31.49481	78.42964	0.91	-----	-----
282	Satluj	10114	2	31.49741	78.43234	0.46	-----	-----
283	Satluj	10115	2	31.49234	78.42655	0.43	-----	-----
284	Satluj	10116	2	31.48981	78.42524	1.93	-----	-----

285	Satluj	10117	2	31.57632	78.60119	0.63	-----	-----
286	Satluj	10118	2	31.68014	78.62958	0.81	-----	-----
287	Satluj	10120	2	31.65677	78.74691	0.58	-----	-----
288	Satluj	10121	2	31.67845	78.74158	0.21	-----	-----
289	Satluj	10122	2	31.73284	78.74429	5.6	-----	-----
290	Satluj	10127	1	32.29991	78.98517	14.17	-----	-----
291	Satluj	10128	1	32.27797	78.99503	0.57	-----	-----
292	Satluj	10129	1	32.60685	77.98924	6.06	-----	-----
293	Satluj	10130	1	32.55494	78.43072	2.78	-----	-----
294	Satluj	10131	1	32.34216	78.50099	0.6	-----	-----
295	Satluj	10132	1	32.26997	78.24467	0.36	-----	-----
296	Satluj	10133	3	32.31435	78.36858	1.02	-----	-----
297	Satluj	10134	3	32.32859	79.00166	2.18	-----	-----
298	Satluj	10135	3	32.25554	79.04856	0.24	-----	-----
299	Satluj	10136	1	32.23292	78.22237	1.21	-----	-----
300	Satluj	10137	1	32.2384	79.03433	1.45	-----	-----
301	Satluj	10138	1	32.21202	77.97045	7.67	-----	-----
302	Satluj	10139	3	32.22182	78.98511	0.66	-----	-----
303	Satluj	10140	1	32.13398	78.96761	0.4	-----	-----
304	Satluj	10141	3	32.10103	78.87206	0.51	-----	-----
305	Satluj	10142	1	32.07064	78.86317	2.27	-----	-----
306	Satluj	10143	1	32.03668	78.75877	0.79	-----	-----
307	Satluj	10144	3	32.00853	78.84887	1.23	-----	-----
308	Satluj	10145	3	31.97711	78.83768	2.06	-----	-----
309	Satluj	10146	3	31.9768	78.8393	0.58	-----	-----
310	Satluj	10147	3	31.98761	78.84354	0.35	-----	-----
311	Satluj	10148	3	31.96391	78.81183	5.86	-----	-----
312	Satluj	10149	3	31.96463	78.41563	8.32	-----	-----
313	Satluj	10150	3	31.9565	78.78233	1.04	-----	-----
314	Satluj	10151	3	31.93175	78.82133	0.29	-----	-----
315	Satluj	10152	3	31.92935	78.82427	0.2	-----	-----
316	Satluj	10153	3	31.93131	78.6927	0.2	-----	-----
317	Satluj	10154	3	31.91691	78.84249	0.3	-----	-----
318	Satluj	10155	3	31.88028	78.79475	0.25	-----	-----
319	Satluj	10156	3	31.87937	78.79548	0.2	-----	-----
320	Satluj	10157	3	31.90708	78.78346	0.31	-----	-----
321	Satluj	10158	3	31.91115	78.78354	0.48	-----	-----
322	Satluj	10159	3	31.9305	78.69315	0.5	-----	-----
323	Satluj	10160	3	31.93131	78.82449	0.2	-----	-----
324	Satluj	10161	3	31.92676	78.78338	1.24	-----	-----
325	Satluj	10162	3	31.93329	78.79672	0.61	-----	-----
326	Satluj	10163	3	31.93386	78.68476	1.1	-----	-----
327	Satluj	10164	3	31.95758	78.70339	0.51	-----	-----

328	Satluj	10165	1	32.07369	78.88647	0.31	-----	-----
329	Satluj	10166	1	32.08007	78.8063	0.72	-----	-----
330	Satluj	10167	1	32.08057	78.80499	0.57	-----	-----
331	Satluj	10168	1	32.07024	78.81805	1.02	-----	-----
332	Satluj	10169	1	32.06223	78.9323	1.28	-----	-----
333	Satluj	10170	1	32.01466	78.92571	1.35	-----	-----
334	Satluj	10171	1	32.05453	78.22904	2.44	-----	-----
335	Satluj	10172	1	32.03559	78.77845	0.23	-----	-----
336	Satluj	10173	1	32.03553	78.7021	2.03	-----	-----
337	Satluj	10174	1	32.03843	78.77585	0.19	-----	-----
338	Satluj	10175	1	32.03852	78.758	0.36	-----	-----
339	Satluj	10176	1	32.03076	78.78294	0.62	-----	-----
340	Satluj	10177	1	32.04277	78.75293	0.22	-----	-----
341	Satluj	10178	1	32.04455	78.75205	0.43	-----	-----
342	Satluj	10179	1	31.93383	78.81334	3.9	-----	-----
343	Satluj	10180	1	31.93079	78.82829	0.42	-----	-----
344	Satluj	10181	1	31.92913	78.69566	0.53	-----	-----
345	Satluj	10182	1	31.89983	78.71754	0.78	-----	-----
346	Satluj	10183	1	31.89798	78.71415	1.17	-----	-----
347	Satluj	10184	1	31.89212	78.72208	0.38	-----	-----
348	Satluj	10185	1	32.4775	78.31557	0.31	-----	-----
349	Satluj	10186	2	31.70189	77.68304	0.46	-----	-----
350	Satluj	10187	2	31.51998	78.63425	0.35	-----	-----
351	Satluj	10188	2	31.47612	78.68996	0.53	-----	-----
352	Satluj	10189	3	32.2263	79.00754	0.39	-----	-----
353	Satluj	10190	3	32.19066	78.97267	5.27	-----	-----
354	Satluj	10191	3	32.18491	78.96033	3.15	-----	-----
355	Satluj	10192	1	32.20994	79.04333	29.26	-----	-----
356	Satluj	10193	1	32.16112	78.97788	10.22	-----	-----
357	Satluj	10194	1	32.16088	78.46181	1.34	-----	-----
358	Satluj	10195	1	32.1451	78.96815	0.28	-----	-----
359	Satluj	10196	1	32.14364	78.9641	1.29	-----	-----
360	Satluj	10197	1	32.14017	78.94563	0.59	-----	-----
361	Satluj	10198	1	32.14344	78.92036	0.25	-----	-----
362	Satluj	10199	3	32.12975	78.97047	4.56	-----	-----
363	Satluj	10200	3	32.12285	78.94786	2.11	-----	-----
364	Satluj	10201	3	32.12849	77.92518	2.05	-----	-----
365	Satluj	10202	3	32.11935	78.95083	1.29	-----	-----
366	Satluj	10203	3	32.11896	78.94137	0.76	-----	-----
367	Satluj	10204	3	32.10775	78.94182	12.49	-----	-----
368	Satluj	10205	3	32.10659	78.94718	1.14	-----	-----
369	Satluj	10206	3	32.10467	78.92489	1	-----	-----
370	Satluj	10207 (1)	3	32.10443	78.94732	0.3	-----	-----

371	Satluj	10207 (2)	3	32.10337	78.88095	1.01	-----	-----
372	Satluj	10208	3	32.08773	78.93683	0.7	-----	-----
373	Satluj	10209	3	32.09296	78.94709	6.53	-----	-----
374	Satluj	10210	3	32.0926	78.92982	1.44	-----	-----
375	Satluj	10211	3	32.0816	78.79959	0.17	-----	-----
376	Satluj	10212	3	32.09068	78.22797	1.38	-----	-----
377	Satluj	10213	3	32.05583	78.7982	0.52	-----	-----
378	Satluj	10214 (1)	3	32.06041	78.94301	7.77	-----	-----
379	Satluj	10214(2)	3	32.05826	78.80669	10.47	-----	-----
380	Satluj	10215	3	32.04374	78.90327	2.95	-----	-----
381	Satluj	10216	3	32.04337	78.89172	2.79	-----	-----
382	Satluj	10217	1	31.95715	78.86666	4.06	-----	-----
383	Satluj	10218	1	31.95797	78.70191	0.61	-----	-----
384	Satluj	10219	1	32.40197	78.06709	1.73	-----	-----
385	Satluj	10220	1	32.40453	78.06941	1.75	-----	-----
386	Satluj	10221	1	32.38101	78.46169	1.21	-----	-----
387	Satluj	10222	2	31.55593	78.711	1.27	-----	-----
388	Satluj	10223	2	31.35331	78.75758	3.86	-----	-----
389	Satluj	10224	2	31.36148	78.73314	0.37	-----	-----
390	Satluj	10225	2	31.29759	78.79479	2.17	-----	-----
391	Satluj	10226	2	31.28996	78.80605	0.72	-----	-----
392	Satluj	10227	2	31.40924	78.02737	8.77	-----	-----
393	Satluj	10228	2	31.71791	77.87135	4.74	-----	-----
394	Satluj	10229	2	31.74462	77.85952	3.08	-----	-----
395	Satluj	10230	2	31.75707	77.87083	1	-----	-----
396	Satluj	10231	2	31.75916	77.86633	0.45	-----	-----
397	Satluj	10232	2	31.79375	77.91262	1	-----	-----
398	Satluj	10233	1	32.426	78.08823	2.41	-----	-----
399	Satluj	10234	1	32.4683	78.05021	1.01	-----	-----
400	Satluj	10235	1	32.39028	78.06496	1.31	-----	-----
401	Satluj	10236	1	32.35204	78.88052	1.3	-----	-----
402	Satluj	10237	1	32.34527	78.50232	0.56	-----	-----
403	Satluj	10238	1	32.43058	78.0922	0.61	-----	-----
404	Satluj	10239	1	32.42757	78.08982	1.19	-----	-----
405	Satluj	10240	1	32.5452	77.91015	1.2	-----	-----
406	Satluj	10241	1	32.53319	77.96593	1.26	-----	-----
407	Satluj	10242	1	32.49438	78.19399	1.82	-----	-----
408	Satluj	10243	1	32.52445	77.94238	4.7	-----	-----
409	Satluj	10244	1	32.09822	78.90795	1.34	-----	-----
410	Satluj	10245	1	32.0943	78.92635	0.66	-----	-----
411	Satluj	10246	2	31.49118	78.34324	0.74	-----	-----
412	Satluj	10247	2	31.4906	78.34511	0.47	-----	-----
413	Satluj	10248	2	31.39996	78.75415	1.34	-----	-----

414	Satluj	10107SG	2	31.45148	78.4483	0.53	-----	-----
415	Satluj	10108SG	2	31.46182	78.44933	0.46	-----	-----
416	Satluj	10109SG	2	31.46138	78.44765	0.43	-----	-----
417	Satluj	10119SG	2	31.67633	78.62903	0.26	-----	-----
418	Satluj	10123SG	1	32.34149	78.49557	0.51	-----	-----
419	Satluj	10124SG	1	32.32713	78.71956	118.91	-----	-----
420	Satluj	10125SG	1	32.33398	78.90862	2.94	-----	-----
421	Satluj	10126SG	1	32.33207	78.90665	2.12	-----	-----
422	Satluj	1216SG	2	31.36543	78.58084	0.71	0.43	0.28
423	Satluj	1264SG	2	31.24933	78.61367	0.2	0.3	-0.10
424	Satluj	1265SG	2	31.24864	78.61549	0.54	0.35	0.19
425	Satluj	1310SG	2	31.24988	78.55659	0.71	0.43	0.28
426	Satluj	1649SG	1	31.89685	78.70055	0.26	0.51	-0.25
427	Satluj	1682RS	1	32.42176	78.82794	2.05	0.4	1.65
428	Satluj	1683RS	1	32.41939	78.81656	11.82	1.09	10.73
429	Satluj	1684RS	1	32.41537	78.22027	3.81	1.96	1.85
430	Satluj	1685RS	1	32.41429	78.82759	2.37	1.44	0.93
431	Satluj	1686RS	1	32.38095	78.4606	0.43	1.6	-1.17
432	Satluj	1687RS	1	32.37593	78.48079	1.19	1.57	-0.38
433	Satluj	171HWL	2	31.36956	78.79531	1.41	2.72	-1.31
434	Satluj	49HWL	1	32.32449	78.52984	1.61	7.43	-5.82
435	Satluj	9003RS	1	32.37548	78.26149	1.59	0.9	0.69
436	Satluj	9018SG	1	32.3381	79.00212	3.13	-----	-----
437	Satluj	9019SG	1	32.34084	78.49918	0.21	-----	-----
438	Satluj	9020SG	1	32.3435	78.50192	2.87	-----	-----
439	Satluj	9058RS	2	31.72476	77.89693	0.41	0.51	-0.10
440	Satluj	9068HWL	2	31.73163	78.39914	2.91	3	-0.09
441	Satluj	9069HWL	2	31.72969	78.40061	1.02	0.74	0.28
442	Satluj	9072SG	2	31.47619	78.41324	0.62	-----	-----
443	Satluj	9073SG	2	31.48378	78.41904	0.41	-----	-----
444	Satluj	9075SG(1)	2	31.4401	78.45054	0.58	-----	-----
445	Satluj	9075SG (2)	2	31.43503	78.44624	0.4	-----	-----
446	Satluj	9078SG	2	31.3907	78.43346	0.75	-----	-----
447	Satluj	9083SG	2	31.46041	78.38893	0.53	-----	-----
448	Satluj	9107SG	1	31.90639	78.7086	0.73	0.93	-0.20
449	Satluj	9108SG	1	31.92733	78.69798	0.61	0.5	0.11
450	Satluj	9109SG	1	31.92999	78.82314	0.35	0.26	0.09
451	Satluj	9110SG (1)	1	31.92946	78.81859	1.79	-----	-----
452	Satluj	9110SG (2)	1	31.92999	78.69358	0.21	0.47	-0.26

453	Satluj	9111SG	1	31.93024	78.82163	0.89	0.31	0.58
454	Satluj	9112SG	1	31.92905	78.6912	0.76	0.36	0.40
455	Satluj	9114SG	1	32.00396	78.90195	2.15	0.75	1.40
456	Satluj	9139SG	3	31.95602	78.80402	0.28	0.45	-0.17
457	Satluj	9140SG	3	31.95306	77.7819	1.32	0.63	0.69
458	Satluj	9141SG	3	31.95198	78.80828	1.08	0.44	0.64
459	Satluj	9153SG	3	31.87529	78.80048	0.72	0.46	0.26
460	Satluj	9154SG	3	31.87323	78.80251	0.56	0.42	0.14
461	Satluj	9177SG	2	31.30271	78.37206	0.4	0.5	-0.10
462	Satluj	9178SG	2	31.27313	78.47883	0.41	0.51	-0.10
463	Satluj	9179SG	2	31.26244	78.47621	0.4	0.49	-0.09
464	Satluj	9180SG	2	31.2609	78.47784	0.5	0.62	-0.12
465	Satluj	9182SG	2	31.21284	78.71145	0.5	0.62	-0.12
466	Satluj	9183SG	2	31.21313	78.71446	0.19	0.24	-0.05
467	Satluj	9184SG	2	31.21137	78.71229	0.2	0.25	-0.05
468	Satluj	9185SG	2	31.21052	78.71603	0.36	0.45	-0.09
469	Satluj	9186SG	2	31.20461	78.72279	0.83	1.04	-0.21
470	Satluj	9187SG	2	31.19998	78.74159	0.35	0.44	-0.09
471	Satluj	9198SG	2	31.34764	78.6801	0.56	0.69	-0.13
472	Satluj	9199SG	2	31.35141	78.68111	0.14	0.18	-0.04
473	Satluj	9200SG	2	31.35461	78.67698	0.36	0.44	-0.08
474	Satluj	9201SG	2	31.36018	78.67889	0.2	0.25	-0.05
475	Satluj	9202SG	2	31.36443	78.67824	0.3	0.37	-0.07
476	Satluj	9205SG	2	31.38389	78.61117	0.4	0.49	-0.09
477	Satluj	9206SG	2	31.37481	78.58029	0.98	1.21	-0.23
478	Satluj	9207RS	2	31.61887	78.02092	4.55	5.51	-0.96
479	Satluj	11	3	32.4775	79.27944	3.87	-----	-----
480	Satluj	17	3	32.4185	79.47736	1.47	-----	-----
481	Satluj	27	3	32.3705	79.53357	1.94	-----	-----
482	Satluj	40	3	32.3329	79.61978	1.73	-----	-----
483	Satluj	184	3	32.3777	79.39309	29.7	23.32	6.38
484	Satluj	198	3	32.0211	79.8177	0.69	1.16	-0.47
485	Satluj	199	3	32.0178	79.82626	3.66	3.26	0.40
486	Satluj	200	3	31.9887	79.83644	2.84	3.74	-0.90
487	Satluj	202	3	31.9775	79.87186	10.6	8.32	2.28
488	Satluj	203	3	31.9701	79.8819	5.11	3.44	1.67
489	Satluj	204	3	31.9683	79.87579	5.16	3.65	1.51
490	Satluj	207	3	31.9562	79.87737	6.02	3.52	2.50
491	Satluj	208	3	31.9502	79.85625	2.94	1.51	1.43
492	Satluj	209	3	31.9251	79.86486	34.77	33.76	1.01
493	Satluj	210	3	31.9325	79.8821	3.3	2.41	0.89
494	Satluj	211	3	31.9273	79.90156	2.34	0.94	1.40
495	Satluj	665	3	31.9678	79.88951	4.71	4.12	0.59

496	Satluj	806	3	32.4217	79.4777	1.44	1.15	0.29
497	Satluj	885	3	32.5067	79.25378	6.58	2.71	3.87
498	Satluj	887	3	32.52	79.28806	1.35	0.54	0.81
499	Satluj	890	3	32.513	79.29184	3.17	1.44	1.73
500	Satluj	891	3	32.5121	79.29784	1.59	1.06	0.53
501	Satluj	895	3	32.3502	79.40604	5.12	3.62	1.50
502	Satluj	1008	3	32.4181	79.47205	0.76	0.45	0.31
503	Satluj	1014	3	32.2543	79.6836	8.25	5.25	3.00
504	Satluj	1017	3	32.2159	79.70578	3.79	1.92	1.87
505	Satluj	1023	3	32.0296	79.81243	2.2	1.25	0.95
506	Satluj	1029	3	31.9342	79.91935	1.73	1.36	0.37
507	Satluj	1066	3	31.1317	79.51336	7.48	5.31	2.17
508	Satluj	1290	3	31.1542	79.31876	2.15	0.81	1.34
509	Satluj	1291	3	31.1531	79.3414	6.56	3.98	2.58
510	Satluj	1292	3	31.1506	79.35758	2.73	1.52	1.21
511	Satluj	1293	3	31.1498	79.36184	0.89	0.41	0.48
512	Satluj	1294	3	31.1435	79.36581	7.97	4.44	3.53
513	Satluj	1295	3	31.0604	79.41057	4.73	3.99	0.74
514	Satluj	1296(1)	3	31.0619	79.41584	0.74	0.98	-0.24
515	Satluj	1296	3	31.06	79.41402	5.49	3.77	1.72
516	Satluj	1728	3	32.3827	79.50902	4.37	2.24	2.13
517	Satluj	1729	3	32.39	79.52998	1.18	-----	-----
518	Satluj	1732	3	32.1254	79.80099	2.69	1.86	0.83
519	Satluj	1733	3	32.1165	79.80376	2.35	2.35	0.00
520	Satluj	1734	3	32.1126	79.80213	1.01	0.6	0.41
521	Satluj	1738	3	31.9634	79.87916	2.94	2.4	0.54
522	Satluj	1739	3	31.9587	79.87445	1.1	0.79	0.31
523	Satluj	2121	3	31.9169	79.90662	1.33	1.33	0.00
524	Satluj	2122	3	31.9677	79.8665	0.65	0.31	0.34
525	Satluj	2123	3	32.0275	79.8149	0.57	0.94	-0.37
526	Satluj	2124	3	32.0591	79.8	1.19	0.85	0.34
527	Satluj	2126	3	32.095	79.7733	2.63	0.74	1.89
528	Satluj	2127	3	32.12	79.774	0.34	0.31	0.03
529	Satluj	2128	3	32.2877	79.646	3.32	0.89	2.43
530	Satluj	2132	3	32.4466	79.1312	6.43	4.33	2.10
531	Satluj	2134	3	32.3542	79.1037	4.18	2.2	1.98
532	Satluj	2136	3	31.4499	78.7939	9.91	7.41	2.50
533	Satluj	2140	3	31.0137	79.7483	1.29	0.71	0.58
534	Satluj	6075	3	32.5284	79.2718	2.8	1.86	0.94
535	Satluj	6076	3	32.3767	79.5207	0.97	-----	-----
536	Satluj	6080	3	32.1065	79.7849	0.35	0.2	0.15
537	Satluj	6083	3	32.0282	79.8104	0.57	0.99	-0.42
538	Satluj	6086	3	31.9596	79.8739	0.68	0.3	0.38

539	Satluj	6089	3	31.9257	79.9152	0.94	0.89	0.05
540	Satluj	6090	3	31.9403	79.8758	0.84	0.4	0.44
541	Satluj	6092	3	31.1313	79.4912	2.09	1.26	0.83
542	Satluj	7091	3	31.031	79.608	2.19	1.4	0.79
543	Satluj	7092	3	31.0352	79.6187	0.47	0.41	0.06
544	Satluj	7094	3	31.0722	79.6518	1.95	0.91	1.04
545	Satluj	7096	3	31.0285	79.7295	11.74	7.82	3.92
546	Satluj	9220	3	32.4628	79.1304	2.97	-----	-----
547	Satluj	9221	3	32.4516	79.1874	3.16	-----	-----
548	Satluj	9222	3	32.4915	79.1719	4.85	-----	-----
549	Satluj	9223	3	32.5541	79.3321	2.75	-----	-----
550	Satluj	9224	3	32.5601	79.3316	4.14	-----	-----
551	Satluj	9225	3	32.39	79.4174	10.96	-----	-----
552	Satluj	9226	3	32.3737	79.4183	3.11	-----	-----
553	Satluj	9227	3	32.3924	79.5087	3.59	-----	-----
554	Satluj	9229	3	32.3536	79.5631	1.17	-----	-----
555	Satluj	9230	3	32.3262	79.5818	1.46	-----	-----
556	Satluj	9231	3	32.3534	79.5899	4.58	-----	-----
557	Satluj	9232	3	32.3527	79.5945	7.26	-----	-----
558	Satluj	9233	3	32.1448	79.7515	2.71	-----	-----
559	Satluj	9234	3	32.134	79.763	0.4	-----	-----
560	Satluj	9235	3	32.1276	79.7967	3.26	-----	-----
561	Satluj	9236	3	32.0782	79.8024	4.09	-----	-----
562	Satluj	9237	3	32.0613	79.8024	0.46	-----	-----
563	Satluj	9238	3	32.0169	79.8306	0.29	-----	-----
564	Satluj	9239	3	32.0115	79.8273	0.58	-----	-----
565	Satluj	9240	3	31.9662	79.882	0.92	-----	-----
566	Satluj	9241	3	31.9521	79.8808	1.23	-----	-----
567	Satluj	9242	3	31.9336	79.889	0.51	-----	-----
568	Satluj	9243	3	31.9313	79.9076	0.51	-----	-----
569	Satluj	9244	3	31.9405	79.9268	1.15	-----	-----
570	Satluj	9245	3	31.1461	79.3695	0.44	-----	-----
571	Satluj	9246	3	31.1589	79.3804	2.78	-----	-----
572	Satluj	9247	3	31.1251	79.392	1.37	-----	-----
573	Satluj	9248	3	31.1253	79.3951	0.79	-----	-----
574	Satluj	9249	3	31.1147	79.4377	1.04	-----	-----
575	Satluj	9250	3	31.1119	79.4366	2.13	-----	-----
576	Satluj	9251	3	31.1107	79.4358	0.47	-----	-----
577	Satluj	9252	3	31.1082	79.4389	0.7	-----	-----
578	Satluj	9253	3	31.1039	79.4378	0.3	-----	-----
579	Satluj	9255	3	31.0975	79.4906	5.86	-----	-----
580	Satluj	9256	3	31.1017	79.507	2.89	-----	-----
581	Satluj	9258	3	31.1047	79.5161	0.72	-----	-----

582	Satluj	9259	3	31.0927	79.5691	3.71	-----	-----
583	Satluj	9260	3	31.0884	79.5679	0.56	-----	-----
584	Satluj	9261	3	31.0951	79.5625	0.53	-----	-----
585	Satluj	9262	3	31.067	79.568	0.36	-----	-----
586	Satluj	9265	3	31.0851	79.6631	0.81	-----	-----
587	Satluj	9266	3	30.9979	79.767	1.44	-----	-----
588	Satluj	10249	3	32.3483	79.0473	0.42	-----	-----
589	Satluj	10250	3	32.4398	79.1211	0.41	-----	-----
590	Satluj	10251	3	32.5165	79.2865	1.35	-----	-----
591	Satluj	10253	3	32.372	79.5265	2.84	-----	-----
592	Satluj	10254	3	32.332	79.5732	2.87	-----	-----
593	Satluj	10255	3	32.327	79.6207	3.26	-----	-----
594	Satluj	10256	3	32.2604	79.6727	0.58	-----	-----
595	Satluj	10257	3	32.235	79.6535	3.39	-----	-----
596	Satluj	10258	3	31.9926	79.8456	5.12	-----	-----
597	Satluj	10259	3	31.9647	79.8985	6.42	-----	-----
598	Satluj	10260	3	31.9604	79.8926	1.16	-----	-----
599	Satluj	10261	3	31.9589	79.8947	4.17	-----	-----
600	Satluj	10262	3	31.9558	79.8907	1.09	-----	-----
601	Satluj	10263	3	31.9311	79.9021	0.21	-----	-----
602	Satluj	10264	3	31.9362	79.9216	0.61	-----	-----
603	Satluj	10265	3	31.9237	79.9141	0.78	-----	-----
604	Satluj	10266	3	31.9179	79.9058	0.62	-----	-----
605	Satluj	10267	3	31.9178	79.9048	0.6	-----	-----
606	Satluj	10269	3	32.3536	79.3952	0.84	-----	-----
607	Satluj	10270	3	32.3562	79.4266	1.9	-----	-----
608	Satluj	10272	3	32.3343	79.1197	1.13	-----	-----
609	Satluj	10273	3	32.3468	79.1175	0.49	-----	-----
610	Satluj	10275	3	31.0631	79.4158	0.52	-----	-----
611	Satluj	10276	3	31.0709	79.4199	0.74	-----	-----
612	Satluj	10277	3	31.0765	79.4216	0.39	-----	-----
613	Satluj	10278	3	31.0817	79.4241	2.8	-----	-----
614	Satluj	10279	3	31.085	79.4247	1.02	-----	-----
615	Satluj	10280	3	31.114	79.4352	0.65	-----	-----
616	Satluj	10281	3	31.1028	79.4362	0.57	-----	-----
617	Satluj	10282	3	31.1016	79.4356	0.77	-----	-----
618	Satluj	10283	3	31.1205	79.4745	2.43	-----	-----
619	Satluj	10284	3	31.1072	79.5205	0.77	-----	-----
620	Satluj	10285	3	31.0695	79.5879	0.55	-----	-----
621	Satluj	10286	3	31.061	79.5885	0.55	-----	-----
622	Satluj	10289	3	31.015	79.7469	4.33	-----	-----
623	Satluj	10267SG	3	32.352	79.3941	0.84	-----	-----
624	Satluj	10274HWL	3	31.3077	79.5756	0.64	-----	-----

625	Satluj	10287SG	3	31.0528	79.6053	0.45	-----	-----
626	Satluj	10288SG	3	31.0614	79.6102	0.39	-----	-----
627	Satluj	10290HWL	3	31.3011	79.6063	2.28	-----	-----
628	Satluj	10291SG	3	31.0871	79.5676	0.48	-----	-----
629	Satluj	1063HWL	3	31.3045	79.5991	56.17	-----	-----
630	Satluj	1743HWL	3	31.2331	79.3062	5.94	-----	-----
631	Satluj	2135RS	3	32.3469	79.052	6.44	5.17	1.27
632	Satluj	6091HWL	3	31.24	79.3017	0.76	0.66	0.10
633	Satluj	9254SG	3	31.079	79.4234	0.56	-----	-----
634	Satluj	26	3	31.26026	81.1319	15.65	-----	-----
635	Satluj	98	3	30.46591	81.40452	0.54	0.97	-0.43
636	Satluj	155	3	31.02587	81.53421	4.30	-----	-----
637	Satluj	166	3	30.47138	81.42906	6.96	6.05	0.91
638	Satluj	171	3	30.91932	81.14234	1.66	-----	-----
639	Satluj	172	3	30.44819	81.71969	7.87	6.34	1.53
640	Satluj	173	3	30.4477	81.67489	9.51	7.5	2.01
641	Satluj	174	3	30.44856	81.43233	9.64	8.92	0.72
642	Satluj	178	3	30.43045	81.43237	204.39	201.14	3.25
643	Satluj	179	3	30.42936	81.7127	25.88	24.26	1.62
644	Satluj	181	3	30.88767	81.23118	0.73	12.39	-11.66
645	Satluj	181	3	30.42963	81.46166	18.31	-----	-----
646	Satluj	182	3	30.88562	81.22864	3.51	-----	-----
647	Satluj	184	3	30.42101	81.72069	23.51	19.96	3.55
648	Satluj	185	3	30.40909	81.74516	10.71	8.69	2.02
649	Satluj	193	3	30.79416	81.5114	0.14	-----	-----
650	Satluj	216	3	30.76188	81.21247	0.38	-----	-----
651	Satluj	222	3	30.5932	82.21545	7.12	-----	-----
652	Satluj	236	3	30.55354	81.73448	2.30	-----	-----
653	Satluj	273	3	30.45768	81.81583	1.20	-----	-----
654	Satluj	282	3	30.42781	81.72115	3.66	3.07	0.59
655	Satluj	284	3	30.44709	81.74807	2.32	-----	-----
656	Satluj	964	3	30.40789	81.76533	1.88	-----	-----
657	Satluj	966	3	30.40193	81.73995	5.78	3.55	2.23
658	Satluj	968	3	30.45435	81.69765	3.26	2.64	0.62
659	Satluj	969	3	30.43064	81.69671	5.68	3.88	1.80
660	Satluj	970	3	30.48088	81.51276	9.15	7.72	1.43
661	Satluj	971	3	30.47662	81.51323	3.92	3.18	0.74
662	Satluj	972	3	30.45457	81.49204	2.50	1.36	1.14
663	Satluj	973	3	30.45383	81.49639	0.20	0.43	-0.23
664	Satluj	975	3	30.49633	81.48262	0.35	0.98	-0.63
665	Satluj	976	3	30.48709	81.47504	0.58	0.46	0.12
666	Satluj	977	3	30.482	81.47449	1.58	2.4	-0.82
667	Satluj	978	3	30.43771	81.45634	4.29	2.76	1.53

668	Satluj	983	3	30.4537	81.39249	2.41	2.89	-0.48
669	Satluj	989	3	30.4264	81.47542	1.91	1.45	0.46
670	Satluj	990	3	30.42746	81.47902	3.98	1.84	2.14
671	Satluj	996	3	30.45899	81.49815	2.50	3.2	-0.70
672	Satluj	1102	3	30.47913	81.48592	0.43	0.32	0.11
673	Satluj	1128	3	30.42671	81.87012	24.18	25	-0.82
674	Satluj	1133	3	30.41876	81.86685	16.59	16.18	0.41
675	Satluj	1137	3	30.40817	81.81912	7.71	8.57	-0.86
676	Satluj	1141	3	30.40254	81.88384	5.83	2.3	3.53
677	Satluj	1142	3	30.40322	81.77325	0.94	0.51	0.43
678	Satluj	1143	3	30.40248	81.85263	0.51	5.23	-4.72
679	Satluj	1144	3	30.40045	81.78324	7.29	5.23	2.06
680	Satluj	1145	3	30.40082	81.77381	1.35	1.17	0.18
681	Satluj	1146	3	30.39881	81.86523	10.85	10.6	0.25
682	Satluj	1147	3	30.39865	81.77402	4.44	1.17	3.27
683	Satluj	1148	3	30.39823	81.77663	1.33	0.6	0.73
684	Satluj	1149	3	30.39645	81.76805	6.99	5.42	1.57
685	Satluj	1150	3	30.39633	81.79159	4.87	4.02	0.85
686	Satluj	1151	3	30.3947	81.78406	0.51	2.18	-1.67
687	Satluj	1152	3	30.3945	81.77354	0.74	1.27	-0.53
688	Satluj	1153	3	30.38376	81.92924	76.46	74.1	2.36
689	Satluj	1154	3	30.39213	81.79468	0.71	0.82	-0.11
690	Satluj	1155	3	30.39007	81.81772	17.13	14.27	2.86
691	Satluj	1156	3	30.3902	81.89373	11.44	11.74	-0.30
692	Satluj	1157	3	30.39128	81.83736	2.85	2.34	0.51
693	Satluj	1158	3	30.391	81.80248	2.45	4.12	-1.67
694	Satluj	1159	3	30.39112	81.81369	0.64	0.71	-0.07
695	Satluj	1161	3	30.38843	81.91422	1.08	-----	-----
696	Satluj	1162	3	30.38805	81.84757	0.60	0.3	0.30
697	Satluj	1163	3	30.38771	81.84341	0.60	0.46	0.14
698	Satluj	1164	3	30.3847	81.83988	15.32	16.08	-0.76
699	Satluj	1165	3	30.38643	81.84689	4.60	4.52	0.08
700	Satluj	1166	3	30.38448	81.83	0.72	1.08	-0.36
701	Satluj	1167	3	30.38266	81.8242	0.90	0.96	-0.06
702	Satluj	1168	3	30.38051	81.82947	4.19	4.71	-0.52
703	Satluj	1395	3	30.46014	81.41261	2.06	2.71	-0.65
704	Satluj	1443	3	30.98868	81.76134	2.73	1.4	1.33
705	Satluj	1445	3	31.07024	81.72201	9.13	7.61	1.52
706	Satluj	1446	3	31.05631	81.724	0.79	0.5	0.29
707	Satluj	1447	3	31.05178	81.72714	1.00	0.87	0.13
708	Satluj	1453	3	31.11688	81.54167	10.42	9.74	0.68
709	Satluj	1454	3	31.10289	81.54495	5.35	6.09	-0.74
710	Satluj	1455	3	31.09402	81.55018	1.57	1.03	0.54

711	Satluj	1456	3	31.09089	81.55396	1.27	1.78	-0.51
712	Satluj	1457	3	31.09424	81.56036	1.89	2.32	-0.43
713	Satluj	1458	3	31.07912	81.54674	2.19	1.91	0.28
714	Satluj	1460	3	31.09203	81.53015	1.13	2.26	-1.13
715	Satluj	1462	3	31.08267	81.51845	2.60	2.04	0.56
716	Satluj	1463	3	31.03878	81.51374	1.45	1.9	-0.45
717	Satluj	1465	3	31.03075	81.51827	0.78	0.46	0.32
718	Satluj	1467	3	31.00624	81.48879	1.05	1.26	-0.21
719	Satluj	1468	3	31.06374	81.50349	1.27	0.92	0.35
720	Satluj	1469	3	31.07184	81.50482	1.16	7.82	-6.66
721	Satluj	1470	3	31.11216	81.50223	8.44	7.82	0.62
722	Satluj	1471	3	31.09924	81.51266	4.49	4.23	0.26
723	Satluj	1472	3	31.09405	81.50337	7.15	5.6	1.55
724	Satluj	1473	3	31.0804	81.48047	2.27	3.24	-0.97
725	Satluj	1475	3	31.08428	81.42503	2.88	3.38	-0.50
726	Satluj	1476	3	31.08003	81.42423	1.56	1.26	0.30
727	Satluj	1479	3	31.1025	81.41614	2.60	2.8	-0.20
728	Satluj	1480	3	31.10421	81.41203	1.47	1.37	0.10
729	Satluj	1481	3	31.11395	81.42221	2.53	1.16	1.37
730	Satluj	1482	3	31.1145	81.43424	5.21	5.41	-0.20
731	Satluj	1483	3	31.13691	81.42382	5.79	5.48	0.31
732	Satluj	1484	3	31.14451	81.40691	2.18	1.91	0.27
733	Satluj	1485	3	31.13413	81.41283	1.55	4.686	-3.14
734	Satluj	1486	3	31.12499	81.40651	1.27	5.226	-3.96
735	Satluj	1487	3	31.1275	81.40087	5.50	5.766	-0.26
736	Satluj	1488	3	31.13824	81.38268	9.62	8.32	1.30
737	Satluj	1493	3	31.12446	81.26311	0.57	0.31	0.26
738	Satluj	1495	3	31.06004	81.23033	3.90	3.6	0.30
739	Satluj	1495	3	30.7807	81.5545	8.03	6.96	1.07
740	Satluj	1496	3	31.07363	81.2065	1.28	0.94	0.34
741	Satluj	1497	3	31.09536	81.19584	0.71	0.46	0.25
742	Satluj	1499	3	31.12885	81.22713	6.49	6.13	0.36
743	Satluj	1501	3	31.14285	81.23125	0.67	0.31	0.36
744	Satluj	1502	3	31.14544	81.23232	0.63	0.46	0.17
745	Satluj	1503	3	31.14813	81.23475	0.44	0.45	-0.01
746	Satluj	1505	3	31.14936	81.22459	2.74	1.79	0.95
747	Satluj	1508	3	31.1638	81.21519	2.76	2.55	0.21
748	Satluj	1509	3	31.16523	81.1996	1.01	1.03	-0.02
749	Satluj	1510	3	31.18161	81.19369	54.97	52.93	2.04
750	Satluj	1511	3	31.18932	81.17787	2.29	1.67	0.62
751	Satluj	1512	3	31.17849	81.15086	23.17	21.47	1.70
752	Satluj	1513	3	31.16923	81.1399	1.09	1.06	0.03
753	Satluj	1516	3	31.1931	81.12973	1.09	0.91	0.18

754	Satluj	1518	3	31.19864	81.1471	14.98	12.19	2.79
755	Satluj	1519	3	31.20348	81.1472	1.60	0.77	0.83
756	Satluj	1520	3	31.20817	81.15318	1.19	1.73	-0.54
757	Satluj	1524	3	31.22068	81.13383	0.72	0.54	0.18
758	Satluj	1525	3	31.21933	81.12841	1.82	3.96	-2.14
759	Satluj	1526	3	31.23075	81.14471	2.15	2.1	0.05
760	Satluj	1527	3	31.23397	81.1368	12.34	11.37	0.97
761	Satluj	1528	3	31.24602	81.14075	10.62	8.82	1.80
762	Satluj	1529	3	31.244	81.12974	3.21	3.38	-0.17
763	Satluj	1530	3	31.23739	81.12396	4.22	3.6	0.62
764	Satluj	1531	3	31.25767	81.12548	0.73	0.31	0.42
765	Satluj	1532	3	31.26004	81.11632	4.87	4.75	0.12
766	Satluj	1533	3	31.26363	81.11575	2.36	1.63	0.73
767	Satluj	1534	3	31.26915	81.1087	3.88	3.93	-0.05
768	Satluj	1535	3	31.27206	81.08437	2.11	1.77	0.34
769	Satluj	1537	3	31.26584	81.08867	7.99	5.38	2.61
770	Satluj	1538	3	31.24976	81.11282	2.15	1.48	0.67
771	Satluj	1539	3	31.24325	81.10194	4.14	4.58	-0.44
772	Satluj	1542	3	31.23992	81.08241	6.23	4.25	1.98
773	Satluj	1545	3	31.29039	81.04859	0.71	0.46	0.25
774	Satluj	1546	3	31.28663	81.04727	0.53	1.46	-0.93
775	Satluj	1547	3	31.29246	81.03236	6.65	5.79	0.86
776	Satluj	1548	3	31.28467	81.03148	17.21	17.41	-0.20
777	Satluj	1549	3	31.27692	81.02812	3.31	2.31	1.00
778	Satluj	1550	3	31.29452	81.01234	3.05	3.06	-0.01
779	Satluj	1551	3	31.33155	81.01152	1.00	0.7	0.30
780	Satluj	1552	3	31.24495	81.1325	5.39	4.38	1.01
781	Satluj	1553	3	31.24685	81.13517	1.21	0.71	0.50
782	Satluj	1554	3	31.12271	81.26227	1.64	0.92	0.72
783	Satluj	1562	3	30.38955	81.82158	1.59	-----	-----
784	Satluj	1564	3	30.37897	81.84174	4.29	-----	-----
785	Satluj	1565	3	30.39886	81.85157	18.33	-----	-----
786	Satluj	1744	3	31.28671	81.00098	0.86	0.75	0.11
787	Satluj	1745	3	31.37405	81.02004	1.32	2.16	-0.84
788	Satluj	1753	3	31.17243	81.32125	1.09	1	0.09
789	Satluj	1754	3	31.15999	81.32181	0.34	0.39	-0.05
790	Satluj	1754	3	31.03931	81.48212	0.48	0.81	-0.33
791	Satluj	1755	3	31.1385	81.32595	2.29	2.75	-0.46
792	Satluj	1756	3	31.01419	81.45735	0.91	0.21	0.70
793	Satluj	1777	3	30.42718	81.46493	3.46	1.89	1.57
794	Satluj	1778	3	30.42676	81.46672	1.02	0.3	0.72
795	Satluj	1779	3	30.42784	81.46886	1.09	0.27	0.82
796	Satluj	1781	3	30.46148	81.48199	2.99	2.46	0.53

797	Satluj	1809	3	30.39089	81.91629	0.67	-----	-----
798	Satluj	2172	3	31.222	81.16361	0.67	0.5	0.17
799	Satluj	2173	3	31.19374	81.13777	7.52	6.04	1.48
800	Satluj	2174	3	31.20903	81.17246	1.44	3.87	-2.43
801	Satluj	2175	3	31.16788	81.3949	8.90	5.04	3.86
802	Satluj	2176	3	31.03638	81.46932	0.45	1.59	-1.14
803	Satluj	2177	3	31.11099	81.51807	1.28	1.51	-0.23
804	Satluj	2179	3	30.94928	81.66732	4.29	2.93	1.36
805	Satluj	2180	3	31.00493	81.85001	24.28	23.56	0.72
806	Satluj	2182	3	30.36917	81.91283	1.63	-----	-----
807	Satluj	2184	3	30.40113	81.81455	0.36	-----	-----
808	Satluj	2185	3	30.39119	81.77831	0.34	0.8	-0.46
809	Satluj	2187	3	30.45878	81.77011	4.10		
810	Satluj	2190	3	31.34164	80.95211	0.64	0.75	-0.11
811	Satluj	2191	3	31.31842	80.95485	1.07	1.97	-0.90
812	Satluj	2193	3	31.2693	81.08504	0.73	-----	-----
813	Satluj	2194	3	31.10901	81.4804	0.52	-----	-----
814	Satluj	2195	3	30.45651	81.41009	2.33	2.12	0.21
815	Satluj	7029	3	30.47651	81.4005	0.31	1.02	-0.71
816	Satluj	7035	3	30.46466	81.4831	0.64	0.31	0.33
817	Satluj	7037	3	30.46266	81.48133	0.61	0.31	0.30
818	Satluj	7040	3	30.43891	81.69802	0.88	0.84	0.04
819	Satluj	7042	3	30.4049	81.74821	0.25	0.3	-0.05
820	Satluj	7043	3	30.40091	81.7569	0.30	0.86	-0.56
821	Satluj	7055	3	31.00644	81.48647	0.45	0.4	0.05
822	Satluj	7060	3	31.12554	81.36663	0.54	0.46	0.08
823	Satluj	7064	3	31.14932	81.31244	0.55	0.8	-0.25
824	Satluj	7066	3	31.18074	81.2973	1.80	1.94	-0.14
825	Satluj	7067	3	31.10683	81.24795	0.46	0.79	-0.33
826	Satluj	7071	3	31.15532	81.20575	0.69	0.21	0.48
827	Satluj	7074	3	31.24012	81.11378	1.25	1.47	-0.22
828	Satluj	7075	3	31.24157	81.09039	0.47	0.5	-0.03
829	Satluj	7076	3	31.24074	81.09037	0.37	0.45	-0.08
830	Satluj	7079	3	31.25933	81.07308	0.64	0.46	0.18
831	Satluj	7080	3	31.27302	81.07183	0.50	0.2	0.30
832	Satluj	7081	3	31.27598	81.06866	0.69	0.3	0.39
833	Satluj	7089	3	30.40764	81.80349	0.19	-----	-----
834	Satluj	7090	3	30.40993	81.8455	0.80	-----	-----
835	Satluj	9324	3	31.26439	80.82253	1.23	-----	-----
836	Satluj	9326	3	31.25181	80.83242	3.88	-----	-----
837	Satluj	9327	3	31.33744	80.97053	0.71	-----	-----
838	Satluj	9329	3	31.21762	81.12875	1.41	-----	-----
839	Satluj	9330	3	31.21814	81.15894	5.65	-----	-----

840	Satluj	9331	3	31.21778	81.15623	0.28	-----	-----
841	Satluj	9333	3	31.16163	81.1361	0.34	-----	-----
842	Satluj	9334	3	31.17767	81.19022	0.50	-----	-----
843	Satluj	9335	3	31.17794	81.19273	0.95	-----	-----
844	Satluj	9336	3	31.13747	81.18179	2.00	-----	-----
845	Satluj	9337	3	31.16038	81.22472	1.57	-----	-----
846	Satluj	9338	3	31.14801	81.22088	10.92	-----	-----
847	Satluj	9339	3	31.14842	81.23193	0.66	-----	-----
848	Satluj	9340	3	31.14712	81.23486	0.21	-----	-----
849	Satluj	9341	3	31.11006	81.22212	2.20	-----	-----
850	Satluj	9342	3	31.13905	81.25812	1.37	-----	-----
851	Satluj	9343	3	31.13766	81.27974	9.30	-----	-----
852	Satluj	9344	3	31.11681	81.25788	4.94	-----	-----
853	Satluj	9346	3	31.08404	81.31673	0.48	-----	-----
854	Satluj	9348	3	31.05885	81.34746	0.46	-----	-----
855	Satluj	9349	3	31.09284	81.37096	1.17	-----	-----
856	Satluj	9351	3	31.08842	81.44404	0.53	-----	-----
857	Satluj	9354	3	31.03509	81.51255	3.63	-----	-----
858	Satluj	9355	3	31.03173	81.51843	0.72	-----	-----
859	Satluj	9356	3	31.05148	81.51444	1.22	-----	-----
860	Satluj	9357	3	30.95315	81.89262	4.70	-----	-----
861	Satluj	9358	3	30.94623	81.89228	5.59	-----	-----
862	Satluj	9359	3	30.94647	81.90028	0.48	-----	-----
863	Satluj	9361	3	30.47079	81.4328	1.95	-----	-----
864	Satluj	9362	3	30.42279	81.46682	0.70	-----	-----
865	Satluj	9363	3	30.43378	81.46205	0.33	-----	-----
866	Satluj	9364	3	30.42776	81.46994	0.61	-----	-----
867	Satluj	9365	3	30.46546	81.48402	0.51	-----	-----
868	Satluj	9366	3	30.5033	81.46468	1.15	-----	-----
869	Satluj	9368	3	30.39164	81.7509	0.30	-----	-----
870	Satluj	9369	3	30.38174	81.82281	0.56	-----	-----
871	Satluj	9370	3	30.54585	81.99016	3.84	-----	-----
872	Satluj	9371	3	31.20832	81.16647	0.47	-----	-----
873	Satluj	9372	3	31.2101	81.17453	1.07	-----	-----
874	Satluj	9374	3	31.09375	81.53115	0.25	-----	-----
875	Satluj	9375	3	30.45361	81.49552	0.61	-----	-----
876	Satluj	10294	3	30.54232	82.15575	5.74	-----	-----
877	Satluj	10295	3	30.54486	82.11871	1.41	-----	-----
878	Satluj	10296	3	30.57001	82.05766	1.47	-----	-----
879	Satluj	10297	3	30.56925	82.06242	0.46	-----	-----
880	Satluj	10298	3	30.57472	82.05151	0.26	-----	-----
881	Satluj	10299	3	30.57258	82.03881	0.27	-----	-----
882	Satluj	10300	3	30.57315	82.03506	0.86	-----	-----

883	Satluj	10301	3	30.55692	82.03417	0.78	-----	-----
884	Satluj	10302	3	30.55608	82.03466	0.25	-----	-----
885	Satluj	10303	3	30.54677	82.01449	1.39	-----	-----
886	Satluj	10304	3	30.38793	81.92773	0.42	-----	-----
887	Satluj	10305	3	30.38583	81.92731	0.88	-----	-----
888	Satluj	10307	3	30.39094	81.86562	1.07	-----	-----
889	Satluj	10308	3	30.39371	81.86228	0.31	-----	-----
890	Satluj	10310	3	30.38793	81.83053	0.33	-----	-----
891	Satluj	10311	3	30.3881	81.81364	0.36	-----	-----
892	Satluj	10312	3	30.38597	81.81276	0.21	-----	-----
893	Satluj	10313	3	30.39072	81.77508	1.06	-----	-----
894	Satluj	10314	3	30.46146	81.78478	0.57	-----	-----
895	Satluj	10315	3	30.46108	81.78942	0.38	-----	-----
896	Satluj	10316	3	30.42824	81.73998	1.19	-----	-----
897	Satluj	10317	3	30.44104	81.71215	0.69	-----	-----
898	Satluj	10318	3	30.44019	81.71196	0.30	-----	-----
899	Satluj	10319	3	30.45382	81.70246	0.44	-----	-----
900	Satluj	10320	3	30.50652	81.69488	0.73	-----	-----
901	Satluj	10321	3	30.46749	81.44286	0.42	-----	-----
902	Satluj	10322	3	30.4706	81.48804	0.25	-----	-----
903	Satluj	10323	3	30.46485	81.48569	0.33	-----	-----
904	Satluj	10328	3	31.27725	81.07339	0.89	-----	-----
905	Satluj	10329	3	31.15846	81.20474	0.57	-----	-----
906	Satluj	10330	3	31.16074	81.32246	0.41	-----	-----
907	Satluj	10331	3	31.26248	81.06676	0.64	-----	-----
908	Satluj	10332	3	31.23219	81.13995	1.11	-----	-----
909	Satluj	10333	3	31.14392	81.15325	3.92	-----	-----
910	Satluj	10334	3	31.10559	81.24966	0.63	-----	-----
911	Satluj	10335	3	31.10855	81.24984	1.26	-----	-----
912	Satluj	10336	3	31.11597	81.25163	1.65	-----	-----
913	Satluj	10337	3	31.13896	81.36726	4.68	-----	-----
914	Satluj	10338	3	31.1408	81.36477	1.44	-----	-----
915	Satluj	10339	3	31.14648	81.36247	0.67	-----	-----
916	Satluj	10340	3	31.14722	81.36113	0.76	-----	-----
917	Satluj	10341	3	31.10219	81.35881	1.72	-----	-----
918	Satluj	10342	3	31.19007	81.40061	14.00	-----	-----
919	Satluj	10343	3	31.11103	81.52406	3.36	-----	-----
920	Satluj	10344	3	31.01283	81.53162	8.48	-----	-----
921	Satluj	10345	3	31.05075	81.54839	4.29	-----	-----
922	Satluj	10346	3	31.05009	81.69685	2.53	-----	-----
923	Satluj	10347	3	31.28167	81.01632	16.52	-----	-----
924	Satluj	10348	3	31.34808	81.00864	4.60	-----	-----
925	Satluj	10349	3	31.16218	81.29687	3.99	-----	-----

926	Satluj	10350	3	30.8412	81.97919	4.26	-----	-----
927	Satluj	10292HWL	3	30.66192	82.02798	0.93	-----	-----
928	Satluj	10293HWL	3	30.58455	82.17931	2.34	-----	-----
929	Satluj	1031HWL	3	30.77612	81.5239	1.97	1.71	0.26
930	Satluj	10325HWL	3	30.7798	81.53969	0.29	-----	-----
931	Satluj	10326RS	3	30.90012	81.18236	13.47	-----	-----
932	Satluj	10327HWL	3	30.87369	81.21533	2.38	-----	-----
933	Satluj	1039HWL	3	30.51434	81.70049	10.34	12.16	-1.82
934	Satluj	1074HWL	3	30.89145	81.22931	1.63	1.44	0.19
935	Satluj	1075HWL	3	30.89067	81.23184	2.68	2.63	0.05
936	Satluj	1088HWL	3	30.81828	81.54198	2.73	1.38	1.35
937	Satluj	1090HWL	3	30.77793	81.54045	1.57	1.87	-0.30
938	Satluj	1092HWL	3	30.76671	81.56477	12.85	14.13	-1.28
939	Satluj	1093HWL	3	30.63692	82.13435	5966.50	5992.49	-25.99
940	Satluj	1094HWL	3	30.59608	82.07085	14.37	14.85	-0.48
941	Satluj	1095HWL	3	30.59134	82.08261	15.69	17.22	-1.53
942	Satluj	1122HWL	3	30.43871	81.81599	0.53	0.48	0.05
943	Satluj	1123HWL	3	30.4389	81.8178	0.56	0.55	0.01
944	Satluj	1124HWL	3	30.43758	81.82002	5.17	4.48	0.69
945	Satluj	1136HWL	3	30.41051	81.77658	8.87	7.57	1.30
946	Satluj	1139HWL	3	30.42322	81.79689	3.22	2.9	0.32
947	Satluj	1349HWL	3	30.80109	81.56623	323.66	335.79	-12.13
948	Satluj	1355HWL	3	30.78101	81.54852	1.44	1.28	0.16
949	Satluj	1358HWL	3	30.77822	81.55292	1.47	2.04	-0.57
950	Satluj	1359HWL	3	30.78803	81.54221	4.50	3.19	1.31
951	Satluj	1363HWL	3	30.77269	81.54067	25.57	22.24	3.33
952	Satluj	1375HWL	3	30.70215	81.36109	27.39	28.96	-1.57
953	Satluj	1376HWL	3	30.89074	81.23726	1.33	2.28	-0.95
954	Satluj	1377HWL	3	30.89219	81.23772	0.31	-----	-----
955	Satluj	1383HWL	3	30.8934	81.21052	1.72	2.63	-0.91
956	Satluj	138HWL	3	30.68808	81.2336	25710.72	25705.79	4.93
957	Satluj	145HWL	3	30.68424	81.47093	41517.06	41640.43	-123.37
958	Satluj	1557RS	3	30.91101	81.16701	71.15	92.85	-21.70
959	Satluj	1566HWL	3	30.66191	82.03266	5.26	-----	-----
960	Satluj	1771RS	3	30.92534	81.09216	13.73	14.99	-1.26
961	Satluj	1772RS	3	30.92564	81.09995	4.89	3.52	1.37
962	Satluj	1773RS	3	30.92372	81.10912	2.45	2.52	-0.07
963	Satluj	1775RS	3	30.92171	81.13316	5.57	-----	-----
964	Satluj	1782HWL	3	30.54773	81.73757	30.34	30.65	-0.31
965	Satluj	1784HWL	3	30.55952	81.71042	3.28	2.68	0.60
966	Satluj	1786HWL	3	30.54162	81.74951	0.53	1.03	-0.50

967	Satluj	1787HWL	3	30.58455	82.11499	1.75	-----	-----
968	Satluj	1788HWL	3	30.57121	82.12248	2.00	-----	-----
969	Satluj	205HWL	3	30.78771	81.56521	6.20	6.38	-0.18
970	Satluj	207HWL	3	30.7843	81.54845	5.86	6.34	-0.48
971	Satluj	208HWL	3	30.78331	81.55289	2.40	2.55	-0.15
972	Satluj	210HWL	3	30.77125	81.55345	57.41	63.72	-6.31
973	Satluj	211HWL	3	30.50165	81.70621	1.73	1.99	-0.26
974	Satluj	2157HWL	3	30.79229	81.52063	0.25	0.41	-0.16
975	Satluj	2158HWL	3	30.79573	81.51234	0.60	0.77	-0.17
976	Satluj	2159HWL	3	30.7931	81.51177	0.30	0.25	0.05
977	Satluj	2160HWL	3	30.79541	81.51056	0.46	0.3	0.16
978	Satluj	2161HWL	3	30.79829	81.50414	0.92	1.32	-0.40
979	Satluj	2162HWL	3	30.79775	81.50329	0.41	0.51	-0.10
980	Satluj	2163HWL	3	30.7979	81.5024	0.32	0.2	0.12
981	Satluj	2165HWL	3	30.78138	81.55067	0.50	0.3	0.20
982	Satluj	2166HWL	3	30.77999	81.54926	0.24	0.35	-0.11
983	Satluj	2167HWL	3	30.76173	81.58324	99.15	214.31	-115.16
984	Satluj	2169HWL	3	30.89219	81.18789	11.29	2.15	9.14
985	Satluj	2170RS	3	30.92392	81.10509	2.32	2.05	0.27
986	Satluj	2196HWL	3	30.77584	81.52097	0.31	0.65	-0.34
987	Satluj	257HWL	3	30.78902	81.5687	1.96	1.74	0.22
988	Satluj	385HWL	3	30.77807	81.53761	3.88	5.32	-1.44
989	Satluj	7047HWL	3	30.554	81.69013	0.70	1.4	-0.70
990	Satluj	7088HWL	3	30.4202	81.76218	4.39	3.7	0.69
991	Satluj	9360 HWL	3	30.88945	81.23703	0.57	-----	-----
992	Satluj	9367 HWL	3	30.49917	81.6868	0.32	-----	-----
993	Satluj	960HWL	3	30.49631	81.69132	3.44	2.65	0.79
994	Satluj	961HWL	3	30.49721	81.69387	2.30	2.01	0.29
995	Satluj	962HWL	3	30.49421	81.70006	0.82	1.34	-0.52

SG-Supra Glacier
HWL- High Altitude Wetland Lake
RS- River Section