DISTRICT SURVEY REPORT
OF
KALIMPONG DISTRICT

(For mining of minor minerals)
As per Notification No.S.O.141 (E) New Delhi Dated 15th of January 2016, S.O.3611 (E) New Delhi Dated 25th of July 2018 and Enforcement & Monitoring Guidelines for Sand Mining (EMGSM) January 2020, Issued by Ministry of Environment, Forest and Climate Change (MoEF&CC)

SEIAA Approval Date:

2nd September 2022

(As published in the Minutes of 72nd Meeting of SEIAA under Miscellaneous Section, Point No.1)

August, 2022

PREPARED BY
Department of Industry, Commerce & Enterprises
Government of West Bengal

GOVERNMENT OF WEST BENGAL
DIRECTORATE OF MINES & MINERALS
4, ABANINDRANATH TAGORE ROAD
KOLKATA-700016

No. 1333 MD

Kolkata, 6th January, 2022.

TO WHOM IT MAY CONCERN

This is to certify that DSRs of concerned districts of West Bengal have been duly validated by respective district authorities and their suggestions/inputs, if any, have been duly incorporated in the DSRs. The DSRs have been finally scrutinised and accepted by the scrutiny committee of DMM, WB and the same have been forwarded to the Dept. of Industry, Commerce and Enterprises along with respective scrutiny reports for onward transmission to SEAC for necessary action.

Director of Mines and Minerals

Govt. of West Bengal

Table of Content

List of Plates

List of Annexure

List of Figure

List of Table

Abbreviations

% DEP – Departures

° C – Degree Centigrade

BGL – Below Ground Level

CD - Community Development

Cft- Cubic Feet

CGWB - Central Ground water Board

CRIS - Customized Rainfall Information System

Cum - Cubic meter

DGMS - Directorate General of Mines Safety

DGPS - Differential Global Positioning system.

DL&LRO - District Land & Land Reform officer

DSR - District Survey Report

EC – Environmental Clearance

EIA- Environment Impact Assessment

EMGSM - Enforcement and Monitoring Guideline for Sand Mining

ENVIS - Environmental Information System

ft – Feet

GIS - Geographical Information System

GMEC - Global Management and Engineering Consultant

GSI - Geological Survey of India

Ha – Hectare

HFT - Himalayan Frontal Thrust

hr - Hour

IMD – Indian Meteorological Department

ISRO - The Indian Space Research Organisation

KM - Kilometer

LISS - Linear Imaging Self-Scanning Sensor

LOI - Letter of Intent

LULC - Land Use Land Cover

m^2 - Square meter

MBT- Main Boundary Thrust

Mcum – Million Cubic Meter

MMDR - Mines & Minerals (Development and Regulation) Act

MMR - Metalliferous Mines Regulation

MOEF & CC - Ministry of Environment, forest & Climate Change

Mph- miles per hour

M-Sand - Mineral Sand

MSME - Micro, Small & Medium Enterprises

Mt - Metric Ton

MT – Million Tons

NGT - National Green Tribunal

NH – National Highway

NIC - National Informatics Centre

OC - Officer In Charge

OGL - Original Ground level

PSU - Public Sector Unit

R/F – Rain Fall

SSMG - Sustainable Sand Mining Guidelines

WBMDTCL- West Bengal Mineral Development and Trading Corporation Limited

The WBMMCR 2016 – The West Bengal Minor Mineral Concession Rules, 2016

Definitions

Riverbed: A riverbed is the area between two banks of river where sediment deposited. During the normal flow period, river water is contained in and flows along the riverbed. However, during a flood, the river overflows the riverbed and flows onto the floodplain.

Sandbars: The sandbar is the ridge of sand or coarse sediment that is built over a period of time.

Pre monsoon Sandbars: Sandbars which are identified from satellite imagery of pre monsoon period.

Post monsoon Sandbars: Sandbars which are identified from satellite imagery of post monsoon period.

Restricted Area: Sandbars or part of sandbars which are falling within restricted area. As per the Enforcement & Monitoring Guidelines for Sand Mining (EMGSM) 2020 the restricted zone for mining is a distance from the bank is ¼th of river width and not be less than 7.5 meters. Also, there is a no mining zone up to a distance of 1 kilometre (1 km) from major bridges and highways on both sides, or five times (5x) of the span (x) of a bridge/public civil structure (including water intake points) on up-stream side and ten times (10x) the span of such bridge on down-stream side, subjected to a minimum of 250 meters on the upstream side and 500 meters on the downstream side. No mining zone has been marked for an area up to a width of 100 meters from the active edge of embankments.

Potential Zone: Sandbars which are falling within the central $3/4^{th}$ part of the riverbed and which are not falling within the restricted area.

Potential Block: Each individual sand bars of potential zone is Potential Block.

River bed occurrence: River bed occurrence means sand, stone, boulder, pebbles, gravel accumulated in the river bed by natural phenomenon.

Replenishment: Quantum of sand deposited in a mined out void during monsoon period.

Aggradations: Aggradation (or alluviation) is the term used in geology for the increase in land elevation, typically in a river system, due to the deposition of sediment. Aggradation occurs in areas in which the supply of sediment is greater than the amount of material that the system is able to transport.

Act: It means the Mines and Minerals (Development and Regulation) Act, 1957(67 of 1957), as subsequently amended.

Mineral: It means minor minerals as defined in clause (e) of section 3 of the Act.

Sand: A natural resource, is a minor mineral as defined under S 3(e) of the Mines and Minerals (Development and Regulation) Act, 1957 (" MMDR Act").

Lease: It means a mining lease granted under West Bengal Minor Mineral Concession Rules, 2016.

Mining: Excavation of mineral by manual method or using machineries.

EXECUTIVE SUMMARY:

Kalimpong district is the youngest member of the State West Bengal having a total population of 251,642 numbers distributed over 65-gram panchayats. The district covers around 1,056.5 sq. km. area confined between the Teesta and the Jaldhaka watersheds. The District is having enriched biodiversity and its temperate climate favours agro-horticultural activities. The district has a rich diversification with respect to forest resources. Extensive tea plantation in the district along with the forest resources generates considerable amount of revenue every year.

Drainage system of Kalimpong district is mostly controlled by the Topography. Numerous rivers are coming down from the mighty Himalayas in the North and flowing to the Tarai region in the South and South-East. The major rivers in the district are Teesta and Jaldhaka. Because of the hilly topography for a large portion of the terrain, no rivers in the district are navigable throughout the year, except Teesta and Jaldhaka. Kalimpong witnessed several landslides and flood during monsoons.

The district Kalimpong geologically made up of rocks of ages ranging from pre-Cambrian to Quaternary. Three distinct geological formations found in the region are Lower Tertiary Siwalik sediments, Damuda series of Gondwana age and Daling - Darjeeling Gneisses of pre-Cambrian formation. The geological formation of the district indicates the presence of major minerals such as coal, lead, zinc, copper, limestone and minor minerals such as building and ornamental stones and silica sand. However, mineral resources of the district are still not well established. Around 15 million tonne of inferred resources of coal has been identified in Dalingkot coalfield which is extended from Pankhabari in the west of the Darjeeling district to Jaldhaka in the east of Kalimpong. The base metal prospect of the Daling-Chu- Mal Nadi is situated within the Gorubathan subgroup of the Dalings. MECL has carried out detailed exploration in the Mal Khola block and established probable reserves of 1.79 million tonne. of 3.86% Pb and 3.64% Zn (TMC- 7.50% Pb+Zn) in the Mal Khola block within a vertical depth of 125m and a strike length of 200m. Geological Survey of India (GSI) has also established copper deposits at Pedong in Kalimpong district.

The district is so far not exposed to extensive mining activities. The district is currently generating revenue from mining of minor minerals such as sand, stone and gravels from the riverbed. However, in-stream mining directly alters the channel geometry and bed elevation. Therefore, mining of riverbed should be carried out scientifically and based on statutory guidelines for conservation of land, river channels and sustainable development of the society.

The occurrence of riverbed sand and gravel in the district has been established by Directorate of Mines and Minerals, Government of West Bengal and others in previous instances. It requires further systematic and scientific approach to quantify the resource along with their grade assessment. The occurrences of riverbed are mostly observed in the river Relli, Geet, Palla, Rishi and Chel River. This report also recommends undertaking detail exploration (G2 level) program to assess the mineral occurrences in the major rivers of the district and should have a proper development and production plan for the specified minerals.

1 Preface

The needs for District Survey Report (DSR) have been necessitated by Ministry of Environment, Forest and Climate Change (MoEF & CC) vide their Notification No. 125 (Extraordinary, Part II Section 3, Sub-section ii), S.O. 141 (E), dated 15th January 2016. The notification was addressed to bring certain amendments with respect to the EIA notification 2006 and in order to have a better control over the legislation, district level committee's for introduced in the system. As a part of this notification, preparation of District Survey Reports has been introduced. Subsequently, MOEF& CC has published Notification No. 3611 (E), dt. 25th July, 2018 regarding inclusion of the "Minerals Other than Sand" and format for preparation of the DSR has been specified. Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) January 2020, Issued by MoEF & CC is prepared in consideration of various orders/directions issued by Hon'ble NGT in matters pertaining to illegal sand mining and also based on the reports submitted by expert committees and investigation teams. This DSR has been prepared in conformity with the S. O. 141 (E), S. O. 3611 (E) and other sand mining guidelines published by MOEF& CC time to time as well as the requirement specified in West Bengal Minor Mineral Concession Rules, 2016.

The purpose of DSR is to identify the mineral potential areas where mining can be allowed; and also, to distinguish areas where mining will not be allowed due to proximity to infrastructural structures and installations, areas of erosion. The DSR would also help to estimate the annual rate of replenishment wherever applicable.

Preparation of this DSR involved both primary and secondary data generation. The primary data generation involved the site inspection, survey, ground truthing etc. while secondary data has been acquired through various authenticated sources and satellite imagery studies. The secondary data related to district profile, local geology, mineralization and other activities are available in rather a piecemeal fashion.

The DSR of Kalimpong district describes the general geographical profile of the district, distribution of natural resources, livelihood, climatic condition, inventory of minor minerals and revenue generation.

2 Introduction

The District Survey Report of Kalimpong District has been prepared as per the guide line of Ministry of Environment, Forests & Climate Change (MoEF& CC), Government of India vide Notification S.O.-1533(E) dated 14th Sept, 2006 and subsequent MoEF& CC Notification S.O. 141(E) dated 15th Jan, 2016. This report shall guide systematic and scientific utilization of natural resources, so that present and future generation may be benefitted at large. Further, MoEF& CC published a notification S.O. 3611(E) Dated 25th July, 2018 and recommended the format for District Survey Report.

The main objective of DSR is Identification of areas of aggradations or deposition where mining can be allowed; and identification of areas of erosion and proximity to infrastructural structures and installations where mining should be prohibited and calculation of annual rate of replenishment and allowing time for replenishment after mining in that area. The DSR would also help to calculate the annual rate of replenishment wherever applicable and allow time for replenishment. Beside the sand mining, the DSR also include the potential development scope of in-situ minor minerals.

The objectives of the District Survey Report are as following:

1. To identify and quantify minor mineral resources for its optimal utilization.
2. To regulate sand and gravel mining, identification of site specific end-use consumers and reduction in demand and supply gaps.
3. To facilitate use information technology (IT) for surveillance of the sand mining at each step.
4. To enable environmental clearance for cluster of sand and gravel mines.
5. To restrict illegal mining.
6. To reduce occurrences of flood in the area.
7. To maintain the aquatic habitats.
8. To protect ground water in the area by limiting extraction of material in riverbeds to an elevation above the base flow.
9. To maintain data records viz. details of mineral resource, potential area, lease, approved mining plan, co-ordinates of lease hold areas, and revenue generation.
10. To design a scientific mining plan and estimate ultimate pit limit.
11. To frame a comprehensive guideline for mining of sand and other minor minerals.

The District Survey Report (DSR) comprises secondary data on geology, mineral resources, climate, topography, land form, forest, rivers, soil, agriculture, road, transportation, irrigation etc of the district collected from various published and un-published literatures and reports as well as various websites. Data on lease and mining activities in the district, revenue etc. have been collected from the DL&LRO office of the district and from West Bengal Mineral Development Corporation Limited.

Demand and Utilisation of Sand

Sand is a multi-purpose topographical material. It is known as one of the three fundamental ingredients in concrete. The composition of sand is diverse. Mostly sand is made of silica which is a common element. It can also come from another source of minerals like quartz, limestone, or gypsum.

From beds to flood plains to coastlines- we can find the sand at almost everywhere. The robustness of sand has played a significant role in everyday life. We use sand practically every other day.

Sand extraction from river beds and brick earth mining for making raw bricks are the main mining activities in the district. With a spurt in construction of real estate sectors and various govt. sponsored projects, the demand for both sand and bricks has increased manifold. The extraction of sand is carried out either manually or through semi- mechanized system. The depth of mining for both river bed sand and brick earth is restricted due to statutory provision in the regulations pertaining to conservation and development of minor minerals.

River sand mining is a common practice as habitation concentrates along the rivers and the mining locations are preferred near the markets or along the transportation route, for reducing the transportation cost.

In the real world, there are a lot of situations where we can find uses of sand. Followings are the common sand uses.

1. While bunging metal, we can mix sand with clay binder for frameworks used in the foundries.
2. Sand can be used for cleaning up oil leak or any spill by dredging sand on that spill. The material will form clumps by soaking up, and we can quickly clean the mess.
3. Sand can be used as a road base which is a protective layer underneath all roads
4. Industrial sand is used to make glass, as foundry sand and as abrasive sand.
5. One creative usage of sand is serving as a candle holder. We can try putting some sand before pouring tea light or any candle in a glass. It holds the candle still and refrain the candle from rolling by giving it an excellent decoration.
6. Adds texture and aesthetic appeal to space.
7. Sand is mostly pure to handle, promptly available and economically wise.
8. We use sand in aquariums, fabricating artificial fringing reefs, and in human-made beaches
9. Sandy soils are ideal for growing crops, fruits and vegetables like watermelon, peaches, peanuts, etc.
10. Sand can light a path by filling mason jars with sand and tea light which is another inexpensive way to make a walkway glow.
11. Sand helps to improve resistance (and thus traffic safety) in icy or snowy conditions.
12. We need sand in the beaches where tides, storms or any form of preconceived changes to the shoreline crumble the first sand.
13. Sand containing silica is used for making glass in the automobile and food industry- even household products for the kitchen.
14. Sand is a strong strand which is used for plaster, mortar, concrete, and asphalt.
15. The usual bricks formulated of clay only are way weaker and lesser in weight than blocks made of clay mixed with sand.

2.1 Statutory Framework

Table 2.1: Requirement of District Survey Report & its year wise modification of Guidelines

Year	Particulars
1994	The Ministry of Environment, Forest & Climate Change (MoEF&CC) published Environmental Impact Assessment Notification 1994 which is only applicable for the Major Minerals more than 5 ha.
2006	In order to cover the minor minerals also into the purview of EIA, the MoEF&CC issued EIA Notification SO 1533 (E), dated 14th September 2006, made mandatory to obtain environmental clearance for both Major & Minor Mineral more than 5 Ha.
2012	Further, Hon'ble Supreme Court wide order dated the 27th February, 2012 in I.A. No.12- 13 of 2011 in Special Leave Petition (C) No.19628-19629 of 2009, in the matter of Deepak Kumar etc. Vs. State of Haryana and Others etc., ordered that "leases of minor minerals including their renewal for an area of less than five hectares be granted by the States/Union Territories only after getting environmental clearance from MoEF& CC"; and Hon'ble National Green Tribunal, order dated the 13th January, 2015 in the matter regarding sand mining has directed for making a policy on environmental clearance for mining leases in cluster for minor Minerals.
2016	The MoEF&CC in compliance of above Hon'ble Supreme Court's and NGT'S order has prepared "Sustainable Sand Mining Guidelines (SSMG), 2016" in consultation with State governments, detailing the provisions on environmental clearance (EC) for cluster, creation of District Environment Impact Assessment Authority, preparation of District survey report and proper monitoring of minor mineral. There by issued Notification dated 15.01.2016 for making certain amendments in the EIA Notification, 2006, and made mandatory to obtain EC for all minor minerals. Provisions have been made for the preparation of District survey report (DSR) of River bed mining and other minor minerals.
2016	West Bengal Minor Minerals Concession Rules, 2016 amended the Mines and Minerals (Development and Regulation) Act, 1957 (Act 67 of 1957), to make the rules regulating the grant of mining licenses, prospecting license-cum-mining leases and mining leases in respect of minor minerals by auction process. The rule also incorporates EIA 2016 also includes SSMG 2016 for minor mineral mining.
2018	MoEF&CC published a notification S.O. 3611(E) Dated 25th

	July, 2018 and recommended the format for District Survey Report .The notification stated about the objective of DSR i.e. "Identification of areas of aggradations or deposition where mining can be allowed; and identification of areas of erosion and proximity to infrastructural structures and installations where mining should be prohibited and calculation of annual rate of replenishment and allowing time for replenishment after mining in that area".
2020	Enforcement & Monitoring Guidelines for Sand Mining (EMGSM) 2020 has been published modifying Sustainable sand Mining Guidelines, 2016 by MoEF&CC for effective enforcement of regulatory provisions and their monitoring. The EMGSM 2020 directed the states to carry out river audits, put detailed survey reports of all mining areas online and in the public domain, conduct replenishment studies of river beds, constantly monitor mining with drones, aerial surveys, ground surveys and set up dedicated task forces at district levels. The guidelines also push for online sales and purchase of sand and other riverbed materials to make the process transparent. They propose night surveillance of mining activity through night-vision drones.

Details statutory Guidelines for sand or gravel mining:

- **The West Bengal Minor Minerals Concession Rules, 2016**

1) (a) No person shall undertake mining operation in any area prohibited by the 'State Government in the public interest by notification in the *Official Gazette*.
Provided that nothing in the sub-rule shall affect any mining operation undertaken in any area in accordance with the terms and conditions of a mining lease or mineral concession already granted.
(b) No person shall transport or store or cause to be transported or stored any mineral otherwise than in accordance with the provisions of these rules and the West Bengal Minerals (Prevention of Illegal Mining, Transportation and Storage) Rules, 2002.

(2) No minor mineral coming out in course of digging of wells or excavation of tanks shall be disposed of by the person digging or excavating without informing the District Authority as well as the Executive Officer of the *Panchayat Samiti* or the Executive Officer of the Municipality concerned, as the case may be, about such occurrence.
Provided that disposal of such minor mineral may be allowed on pre-payment of prices of such minor mineral at the prevailing market rate as determined on the basis of the rates published by the Public Works Department / concerned department of the State Government for the concerned area from time to time.

(3) No mining of river bed occurrences shall be allowed within 300 meters, upstream and downstream, measured from the center line of any bridge, regulator or similar hydraulic structure and from the end point of bank protection works.

(4) No river bed mining shall be allowed beneath 3 meters of the river bed or ground water level, whichever is less.

(5) No mining operation in case of river bed occurrence shall be done within a distance of three (3) kilometers of a barrage axis or dam on a river unless otherwise permitted by the concerned Executive Engineer or Revenue Officer or authorized officer and such distance shall be reckoned across an imaginary line parallel to the 'barrage, or dam axis, as the case maybe.

(6) No extraction of river bed occurrence shall 'be allowed beyond the central one third of the river bed, or keeping a distance of 100 meter from the existing bank line whichever is less, unless otherwise permitted by the concerned Executive Engineer or Revenue Officer.

(7) No extraction of minerals other than river bed occurrence shall be allowed within fifty (50) meters from any road, public structure, embankment, railway line, bridge canal, road and other public works or buildings.

(8) No mining lease shall be granted without proof of existence of mineral contents in the area for which the application for a mining lease has been made in accordance with such parameters as may be prescribed by the Government from time to time.

N.B- The aforesaid application for mining lease shall succeed the competitive bidding for mining lease for a specified mineral(s).

- **Sustainable Sand Mining Management Guidelines, 2016 (MoEF& CC)**

  The sustainable sand Mining Management Guidelines 2016 has been prepared after extensive consultation with the States and Stakeholders over a period of one year. The main objective of the Guideline is to ensure sustainable sand mining and environment friendly management practices in order to restore and maintain the ecology of river and other sand sources.

a) Parts of the river reach that experience deposition or aggradation shall be identified first. The Lease holder/ Environmental Clearance holder may be allowed to extract the sand and gravel deposit in these locations to manage aggradation problem.

b) The distance between sites for sand and gravel mining shall depend on the replenishment rate of the river. Sediment rating curve for the potential sites shall be developed and checked against the extracted volumes of sand and gravel.

c) Sand and gravel may be extracted across the entire active channel during the dry season.

d) Abandoned stream channels on terrace and inactive flood plains be preferred rather than active channels and their deltas and flood plains. Stream should not be diverted to form inactive channel.

e) Layers of sand and gravel which could be removed from the river bed shall depend on the width of the river and replenishment rate of the river.

f) Sand and gravel shall not be allowed to be extracted where erosion may occur, such as at the concave bank.

g) Segments of braided river system should be used preferably falling within the lateral migration area of the river regime that enhances the feasibility of sediment replenishment.

h) Sand and gravel shall not be extracted within 200 to 500 meter from any crucial hydraulic structure such as pumping station, water intakes, and bridges. The exact distance should be ascertained by the local authorities based on local situation. The cross-section survey should cover a minimum distance of 1.0 km upstream and 1.0 km downstream of the potential reach for extraction. The sediment sampling should include the bed material and bed material load before, during and after extraction period. Develop a sediment rating curve at the upstream end of the potential reach using the surveyed cross- section. Using the historical or gauged flow rating curve, determine the suitable period of high flow that can replenish the extracted volume. Calculate the extraction volume based on the sediment rating curve and high flow period after determining the allowable mining depth.

g) Sand and gravel could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two thirds of the bar and riparian vegetation is accepted as a method to promote channel stability.

Flood discharge capacity of the river could be maintained in areas where there are significant flood hazard to existing structures or infrastructure. Sand and gravel mining may be allowed to maintain the natural flow capacity based on surveyed cross- section history.

h) Alternatively, off-channel or floodplain extraction is recommended to allow rivers to replenish the quantity taken out during mining.

i) The Piedmont Zone (Bhabhar area) particularly in the Himalayan foothills, where riverbed material is mined, this sandy-gravelly track constitutes excellent conduits and holds the greater potential for ground water recharge. Mining in such areas should be preferred in locations selected away from the channel bank stretches.

j) Mining depth should be restricted to 3 meter and distance from the bank should be 3 meter or 10 percent of the river width whichever less.

The borrow area should preferably be located on the river side of the proposed embankment, because they get silted up in course of time. For low embankment less than 6 m in height, borrow area should not be selected within 25 m from the toe/heel of the embankment. In case of higher embankment the distance should not be less than 50 m. In order to obviate development of flow parallel to embankment, cross bars of width eight times the depth of borrow pits spaced 50 to 60 meters centre-to-centre should be left in the borrow pits.

k) Demarcation of mining area with pillars and geo-referencing should be done prior to start of mining.

- **Enforcement and Monitoring Guidelines for Sand Mining, 2020 (MoEF& CC)**

The Ministry of Environment Forest & Climate Change formulated the Sustainable Sand Management Guidelines 2016 which focuses on the Management of Sand Mining in the Country. But in the recent past, it has been observed that apart from management and systematic mining practices there is an urgent need to have a guideline for effective enforcement of regulatory provision and their monitoring. Section 23 C of MMDR, Act 1957 empowered the State Government to make rules for preventing illegal mining, transportation and storage of minerals. But in the recent past, it has been observed that there was large number of illegal mining cases in the Country and in some cases, many of the officers lost their lives while executing their duties for curbing illegal mining incidence. The illegal and uncontrolled illegal mining leads to loss of revenue to the State and degradation of the environment.

a) Parts of the river reach that experience deposition or aggradations shall be identified. The Leaseholder/ Environmental Clearance holder may be allowed to extract the sand and gravel deposit in these locations to manage aggradations problem.
b) The distance between sites for sand and gravel mining shall depend on the replenishment rate of the river. Sediment rating curve for the potential sites shall be developed and checked against the extracted volumes of sand and gravel.
c) Sand and gravel may be extracted across the entire active channel during the dry season.
d) Abandoned stream channels on the terrace and inactive floodplains be preferred rather than active channels and their deltas and flood plains. The stream should not be diverted to form the inactive channel.
e) Layers of sand and gravel which could be removed from the river bed shall depend on the width of the river and replenishment rate of the river.
f) Sand and gravel shall not be allowed to be extracted where erosion may occur, such as at the concave bank.
g) Segments of the braided river system should be used preferably falling within the lateral migration area of the river regime that enhances the feasibility of sediment replenishment.
h) Sand and gravel shall not be extracted up to a distance of 1 kilometer (1 km) from major bridges and highways on both sides, or five times (5x) of the span (x) of a bridge/public civil structure (including water intake points) on up-stream side and ten times (10x) the span of such bridge on down-stream side, subjected to a minimum of 250 meters on the upstream side and 500 meters on the downstream side.
i) The sediment sampling should include the bed material and bed material load before, during and after the extraction period. Develop a sediment rating curve at the upstream end of the potential reach using the surveyed cross-section. Using the historical or gauged flow rating curve, determine the suitable period of high flow that can replenish the extracted volume. Calculate the extraction volume based on the sediment rating curve and high flow period after determining the allowable mining depth.
j) Sand and gravel could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two-thirds of the bar and riparian vegetation is accepted as a method to promote channel stability.
k) The flood discharge capacity of the river could be maintained in areas where there is a significant flood hazard to existing structures or infrastructure. Sand and gravel mining may be allowed to maintain the natural flow capacity based on surveyed cross-section history. Alternatively, off-channel or floodplain extraction is recommended to allow rivers to replenish the quantity taken out during mining.
l) The Piedmont Zone (Bhabhar area) particularly in the Himalayan foothills, where riverbed material is mined, this sandy-gravelly track constitutes excellent conduits and holds the greater potential for groundwater recharge. Mining in such areas should be preferred in locations selected away from the channel bank stretches.
m) Mining depth should be restricted to 3 meters and distance from the bank should be ¼th or river width and should not be less than 7.5 meters.
n) The borrow area should preferably be located on the riverside of the proposed embankment because they get silted in the course of time. For low embankment, less than 6 m in height,

borrow area should not be selected within 25 m from the toe/heel of the embankment. In the case of the higher embankment, the distance should not be less than 50 m. In order to obviate the development of flow parallels to the embankment, crossbars of width eight times the depth of borrow pits spaced 50 to 60 meter center-to-center should be left in the borrow pits.

o) Demarcation of mining area with pillars and geo-referencing should be done prior to the start of mining.

p) A buffer distance /un-mined block of 50 meters after every block of 1000 meters over which mining is undertaken or at such distance as may be the directed/prescribed by the regulatory authority shall be maintained.

q) A buffer distance /un-mined block of 50 meters after every block of 1000 meters over which mining is undertaken or at such distance as may be the directed/prescribed by the regulatory authority shall be maintained.

r) River bed sand mining shall be restricted within the central 3/4th width of the river/rivulet or 7.5 meters (inward) from river banks but up to 10% of the width of the river, as the case may be and decided by regulatory authority while granting environmental clearance in consultation with irrigation department. Regulating authority while regulating the zone of river bed mining shall ensure that the objective to minimize the effects of riverbank erosion and consequential channel migration are achieved to the extent possible. In general, the area for removal of minerals shall not exceed 60% of the mine lease area, and any deviation or relaxation in this regard shall be adequately supported by the scientific report.

s) Mining Plan for the mining leases (non-government) on agricultural fields/Patta land shall only be approved if there is a possibility of replenishment of the mineral or when there is no riverbed mining possibility within 5 KM of the Patta land/Khatedari land. For government projects mining could be allowed on Patta land/Khatedari land but the mining should only be done by the Government agency and material should not be used for sale in the open market.

The minerals reserve for riverbed area is calculated on the basis of maximum depth of 3 meters and margins, width and other dimensions as mentioned in para (s) above. The area multiplied by depth gives the volume and volume multiplied with bulk density gives the quantity in Metric Ton. In case of riverbed, mineable material per hectare area available for actual mining shall not exceed the maximum quantity of 60,000 MT per annum.

2.2 Methodology of DSR Preparation

The steps followed during the preparation of District Survey Report are given in Figure 2.1. The individual steps are discussed in following paragraphs.

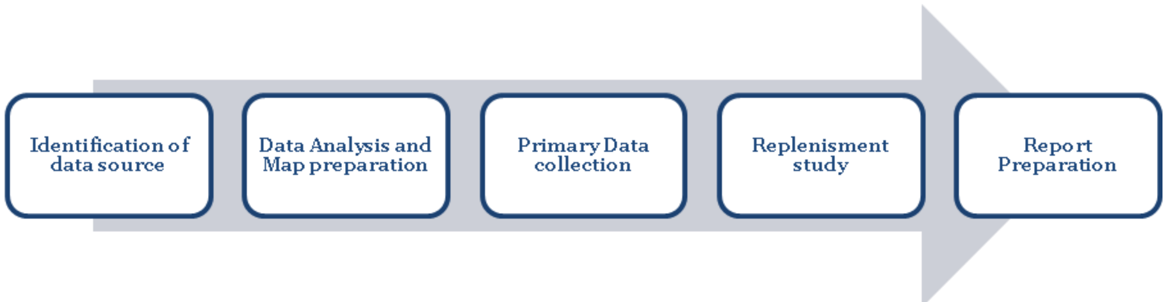


Figure 2.1: Steps followed in preparation of DSR

Data source Identification: District Survey Report has been prepared based on the Primary data base and secondary data base collated from different sources. This is very critical to identify authentic data sources before collating the data set. The secondary data sources which are used in DSR are mostly Government published data based or the published report in reputed journal. District profile has been prepared based on the District Statistical handbook published by West Bengal Government as well as District Census 2011. Potential mineral resources have been described based on GSI or any other govt. agencies work done. Mining lease details and the revenue generated from minor minerals has been prepared based on available data from DL&LRO offices of the district. Satellite image has been used for map preparation related to physiography and land utilization pattern of the district.

Data Analysis and Map preparation: Dataset which are captured during the report preparation, are gone through detail analysis work. District Survey Report involves the analytical implication of captured dataset to prepare relevant maps. Methodology adopted for preparation of relevant maps is explained below.

Land Use and Land Cover Map: Land Use and Land Cover classification is a complex process and requires consideration of many factors. The major steps of image classification may include determination of a suitable classification system via Visual Image Interpretation, selection of training samples, Satellite image (FCC-False Colour Composite) pre-processing, selection of suitable classification approaches, post-classification processing, and accuracy assessment.

Here LISS-III satellite Imagery has been taken for Supervised Classification as supervised classification can be much more accurate than unsupervised classification, but depends heavily on the training sites, the skill of the individual processing the image, and the spectral distinctness of the classes in broader scale.

According to the Visual Image Interpretation (Tone, Texture, Colour etc.) training set of the pixel has been taken. Pictorial descriptions of Land Use classification are explained in Figure 2.2.

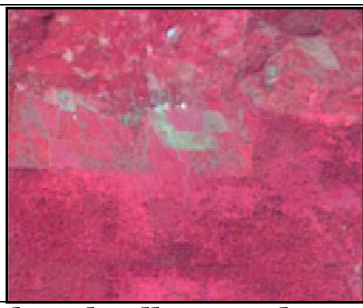
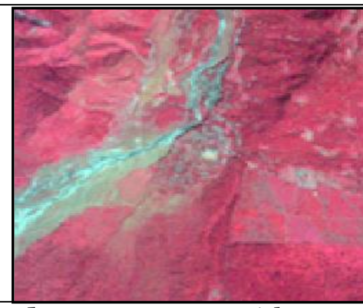
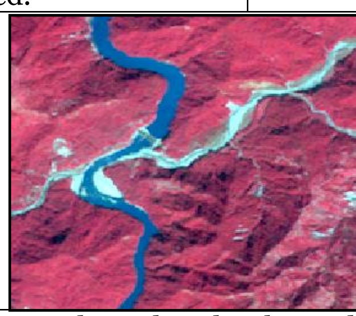
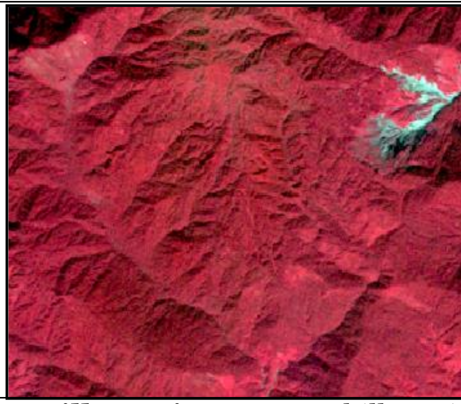
	
Agricultural Land - Based on their Geometrical shape, Red and Pink colour tone, Agricultural Land has been identified.	**Vegetation Covered Area** - Based on their continuous Red colour tone, Vegetation Covered Area has been identified.
	
Agricultural Fallow Land - Based on their Geometrical shape, Light and dark cyan with light pink colour tone, Agricultural Land has been identified.	**Settlement** – Area with Cyan Colour including geometrical shape has been recognized as Settlement Area.
	
Water Bodies – Blue colour has been classified as Water Bodies.	

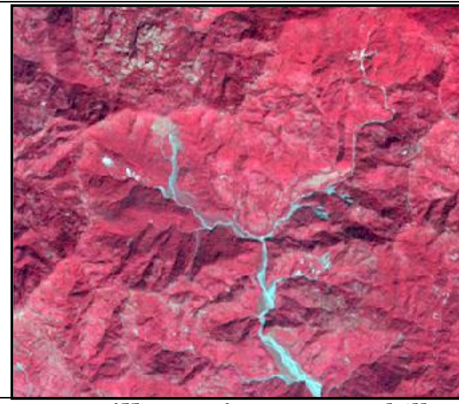
Figure 2.2: Pictorial description of Land Use Classification methods

Geomorphological Map: The major steps of preparing Geomorphological Map is identifying features like – Alluvial Fan, Alluvial Plain, Hilly Region etc. from Satellite Imagery (FCC-False Colour Composite) via Visual Image Interpretation and then digitization has been taken into the consideration to prepare map including all the Geomorphological features according to their location.

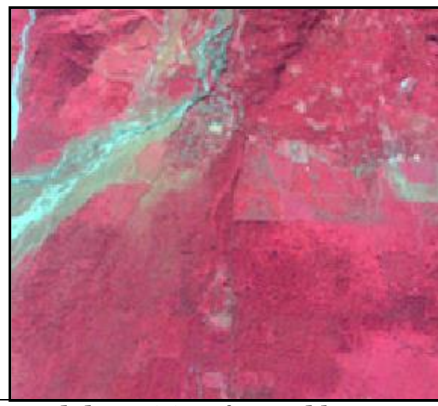
Pictorial descriptions of Geomorphological unit's classification are explained in Figure 2.3.



Upper Hilly Region – Upper hilly region has been identified based on their high elevation and sharp edges of the land.



Lower Hilly Region– Lower hilly region has been identified based on their elevation and sharp edges which is comparatively less in height than upper hilly region.



Alluvial Fan- A fan-based deposition formed by stream where the velocity is abruptly decreased. In Satellite Imagery the flat area has been identified as Alluvial Fan just below the Lower hilly region.

Figure 2.3: Pictorial description of Geomorphological Units Classification methods

<u>Physiographical Map:</u> The major step of preparing Physiographical Map is generating contour at a specific interval to show the elevation of the area using Cartosat DEM.

<u>Block Map:</u>

- Raw Data collected from **National Informatics Centre (NIC Website) during Sept 2020.**
- Data has been geo-referenced using GIS software.
- Digitization of block boundary, district boundary, state boundary, international boundary, and district headquarter, sub –district headquarter, places, road, railway, river, nala etc.
- Road name, River name, Railway name has been filled in attribute table of the Layers
- Final layout has been prepared by giving scale, legend, north arrow, etc.

Transportation Map:

- Raw Data collected from **National Informatics Centre (NIC Website) during Sept 2020.**
- Data has been geo-referenced using GIS software.
- Digitization of block boundary, district boundary, state boundary, international boundary, and district headquarter, sub –district headquarter, places, road, railway, river, nala etc.
- Road name, River name, Railway name has been filled in attribute table of the Layers
- Final layout has been prepared by giving scale, legend, north arrow, etc.

Drainage Map:

- Raw Data collected from **National Informatics Centre (NIC Website) during Sept 2020**.
- Data has been geo-referenced using GIS software.
- Digitization of block boundary, district boundary, state boundary, international boundary, and district headquarter, sub –district headquarter, places, road, railway, river, nala etc.
- Road name, River name, Railway name has been filled in attribute table of the Layers
- Final layout has been prepared by giving scale, legend, north arrow, etc.

Earthquake Map:

- Raw data collected from **Ministry of Earth Science.**
- Data has been geo-referenced using GIS software.
- Digitization of Earthquake zone and superimposed it over Block Boundary.
- Zone name has been filled in attribute table of the Layers
- Final layout has been prepared by giving scale, legend, north arrow, etc.

Soil Map:

- Raw data collected from **National Bureau of Soil Survey and Land Use Planning during Sept 2020.**
- Data has been geo-referenced using GIS software.
- Digitization of Soil classification zone and superimposed it over District Boundary.
- Soil classification has been filled in attribute table of the Layers.
- Final layout has been prepared by giving scale, legend, north arrow, etc.

Wildlife Sanctuary and National Park location Map:

- Raw data collected from **ENVIS Centre on Wildlife & Protected Areas during August 2020.**
- Data has been geo-referenced using GIS software.
- Digitization of Wildlife Sanctuary & National Park and superimposed it over Block Boundary.
- Wildlife Sanctuary &National Park name has been filled in attribute table of the Layers

Final layout has been prepared by giving scale, legend, north arrow, etc.

Primary Data Collection: To prepare DSR, capturing primary data or field data has also been carried out in the district. Field study involves assessment of the mineral resources of the district by means of pitting / trenching in specific interval. This provides clear picture of mineral matters characterization and their distribution over the area.

Replenishment study: One of the principal causes of environmental impacts from in-stream mining is the removal of more sediment than the system can replenish. Therefore, there is a need for replenishment study for river bed sand in order to nullify the adverse impacts arising due to excess sand extraction. The annual rate of replenishment carried out on every river of the district to have proper assessment of the sand reserve for mining purposes.

Four times Physical survey has been carried out by GPS/DGPS/ Total Station to define the topography, contours and offsets of the riverbed. The surveys clearly depict the important attributes of the stretch of the river and its nearby important civil and other feature of importance. This information will provide the eligible spatial area for mining.

Report Preparation: The district survey report portrays general profile, geomorphology, land use pattern and geology of the district. The report then describes the availability and distribution of riverbed sands and other minor minerals in the district. Apart from delineation the potential mining blocks, the report also includes inventorization of the minerals, recent trends of production of minor minerals and revenue generation there from. Annual replenishment of the riverbed sand has been estimated using field observation, satellite imagery and empirical formula. The road network connecting arterial road to potential mining blocks has been identified. Potential environmental impacts of mining of these minerals, their mitigation measures along with risk assessment and disaster management plan have also been discussed. Finally the reclamation strategy for already mined out areas is also chalked out.

3 General Profile of the district

3.1 General Information

Kalimpong is the 21st district of West Bengal. It was formed on 14th February 2017 after splitting from the Darjeeling district of West Bengal. The district of Kalimpong is the northern most district of the State of West Bengal. Lying on the foot hills of the Himalayas, the district is the gateway to the State of Sikkim and the bordering countries of Bhutan. (https://en.wikipedia.org/wiki/Kalimpong_district)

Kalimpong district is bounded on the north by the State of Sikkim, on the south by Jalpaiguri district; on the west by Darjeeling district of west Bengal and on the east by Bhutan. Geographically the district is situated between 26°51' and 27°12' N latitude and between 88°28' and 88°53'E longitude (Figure 3.1). The district covers an area of 1056.5 sq.km. (https://kalimpong.gov.in/).

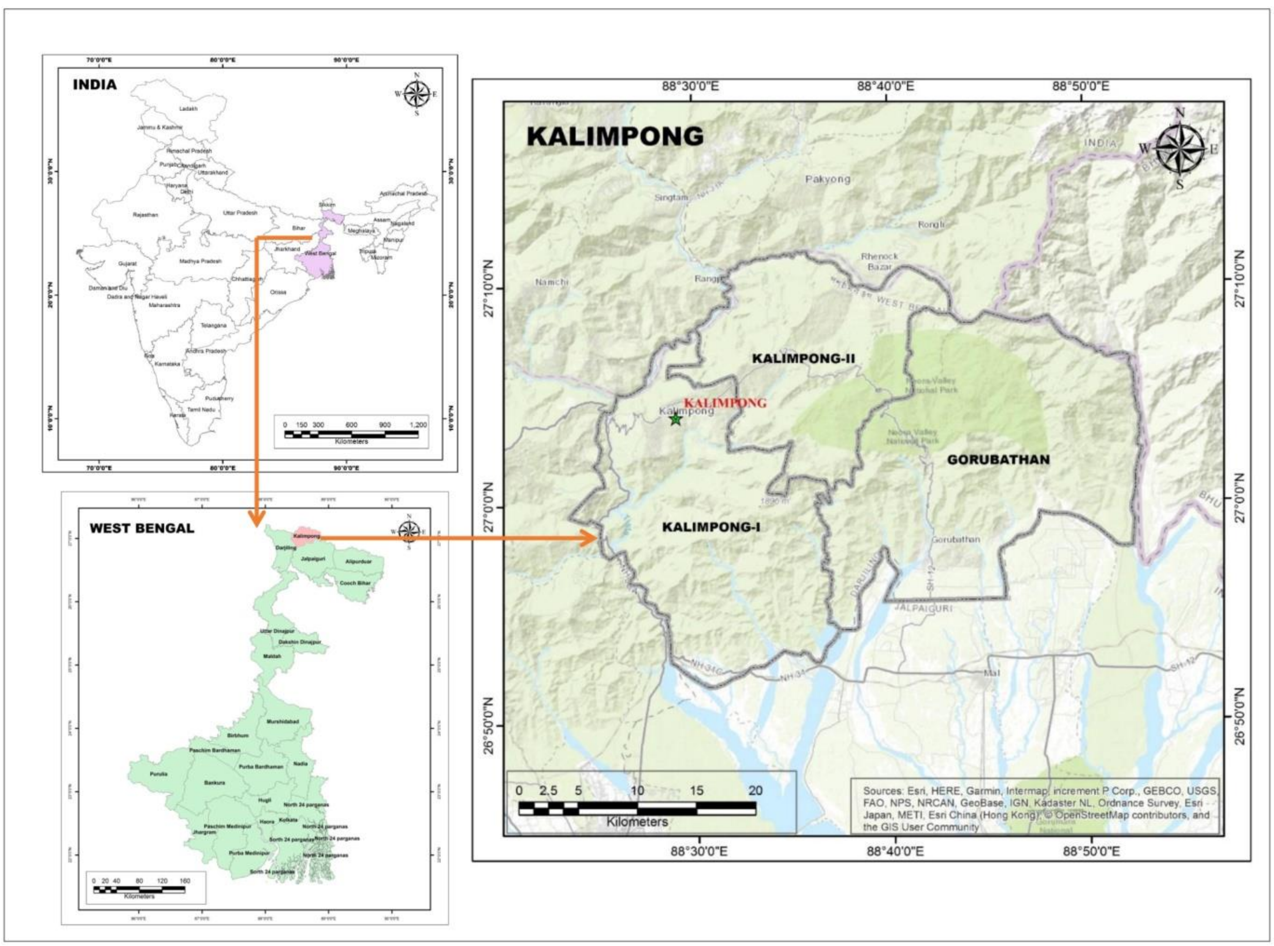


Figure 3.1: Location Map of Kalimpong
(Source: National Informatics Centre and ESRI Base Map)

Kalimpong district comprises of 3 Community Development Blocks, namely, Kalimpong -I, Kalimpong -II, and Gorubathan and the Kalimpong Municipality (Figure 3.2). Kalimpong is the district headquarters (Table 3.1). Kalimpong I block consists of rural areas with 18 gram panchayats. This block has one police station at Kalimpong. Kalimpong II block also consists of rural areas only with 13 gram panchayats. This block is served by Kalimpong police station. Gorubathan block consists of rural areas only with 11 gram panchayats. This block has two police stations: Gorubathan and Jaldhaka. The Kalimpong municipality consists of 23 wards.

Table 3.1: Block distribution of Kalimpong District

District	CD block	Headquarters	Distance from District HQ (km)	No of Gram Panchayat	Area (km²)
Kalimpong	Kalimpong Block - I	Kalimpong	0.0	18	360.46
	Kalimpong Block - II	Algarah	12.82	13	241.26
	Gorubathan	Fagu	25.75	11	442.72

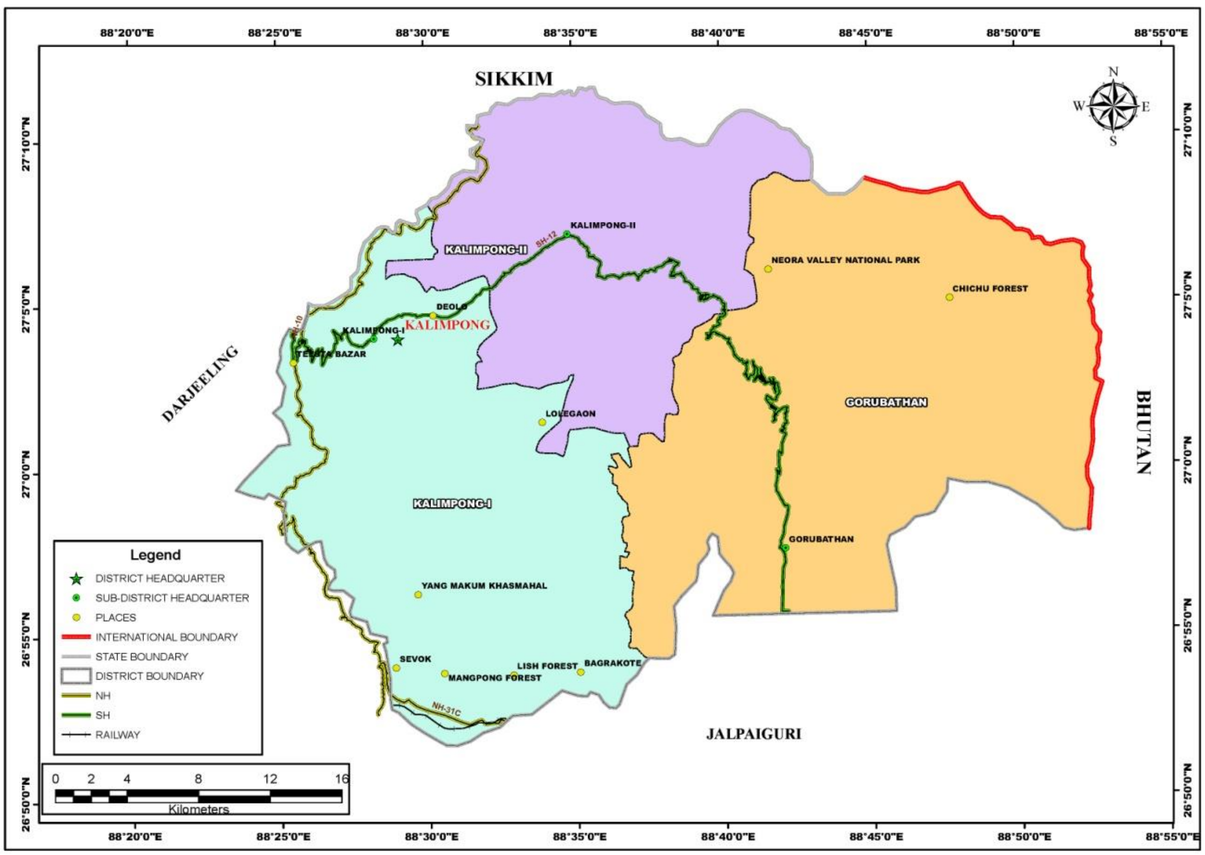


Figure 3.2: Block divisional map of Kalimpong
(Source: National Informatics Centre)

3.2 Climate Condition

The climate of Kalimpong district is interesting because of its position in relation to the Tibetan landmass, the wide differences in altitudes, the powerful effect of the monsoons against the Himalayan barrier and the peculiar configuration of the neighboring monsoons, which deflect winds and affect local temperature and rainfall.

The temperature in the Kalimpong district varies from 25ºC to 8ºC. The maximum summer temperature is 25°C and the minimum 15°C. The maximum temperature in winter is 17°C and the minimum temperature 8ºC recorded between December and March. The average temperatures vary during the year by 10.1 °C. (https://www.imdpune.gov.in/library/public/Climate%20of%20WestBengal.pdf

The average maximum and minimum temperature recorded around Kalimpong Town during preceding five years is given in Table 3.2.

Table 3.2: Monthly average temperature distribution of Kalimpong District

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Avg. Temperature (°C)	12	13.3	16.9	19.6	21.1	22.1	22	22.1	21.9	20.2	16.3	13.4
Min. Temperature (°C)	8	9.4	12.6	15.4	17.5	19.2	19.4	19.5	19.1	16.4	11.9	9
Max. Temperature (°C)	16.1	17.3	21.3	23.8	24.7	25	24.7	24.8	24.7	24	20.7	17.9

(Source: Climate-Data.Org)

3.3 Rainfall and humidity

Climate of the Kalimpong district is tropical monsoonal in nature. Kalimpong gets about 3141 mm rainfall annually. The precipitation during the southwest monsoon constitutes about 80 percent of the rainfall, July being the wettest month. On an average, there are about 105 rainy days in a year (Figure 3.3). The maximum rainfall in the area as per IMD data was recorded in the month of July followed by August and September. The following table shows the annual total rainfall recorded for Kalimpong district along with the month(s) while maximum precipitation is recorded over 5 years from 2016-2020 (Table 3.3) https://hydro.imd.gov.in/hydrometweb/(S(zfnwfwzmlzosbvnaeglg1h45))/DistrictRaifall.aspx).

Table 3.3: Annual rainfall (in milimeter) recorded in Kalimpong District

Month	2016	2017	2018	2019	2020	Average
Jan	6.5	0.9	0.7	0.4	31.9	8.08
Feb	3	4.6	6	26.7	40.9	16.24
Mar	46.3	79.1	40.4	46.6	62.2	54.92
Apr	34	61.3	79.9	129.1	124	85.66

Month	2016	2017	2018	2019	2020	Average
May	191.4	276.1	241.9	141	214.2	212.92
Jun	727.9	531	408.2	260.3	693.5	524.18
Jul	1168.3	760.2	592.9	1069.2	1065.6	931.24
Aug	310.9	767.9	558.7	487.4	644	553.78
Sept	535	531	579.7	669.4	827	628.42
Oct	306.2	63.8	59.4	74.4	91.2	119
Nov	0	7.6	1.7	7.7	1.8	3.76
Dec	0	0	11.3	2.4	2.8	3.3
Yearly Total	3329.5	3083.5	2580.8	2914.6	3799.1	3141.5

Source: Website of Indian Meteorological Department, Govt. of India

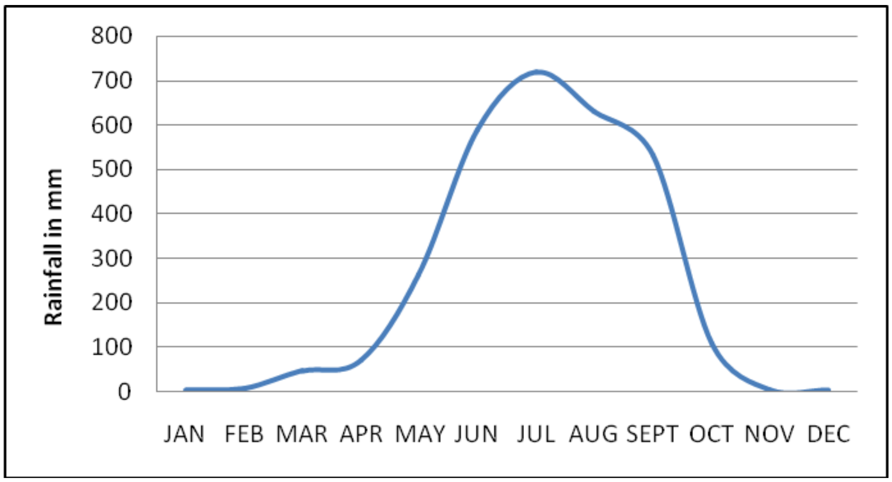


Figure 3.3: Graphical representation of Kalimpong District rainfall

3.3.1 Relative Humidity, Wind speed & Wind direction

Kalimpong has some very humid months, with other moderately humid months on the other side of the year. The least humid month is January (48.6% relative humidity), and the most humid month is August (80.8%).Sky remains heavily overcast during the monsoon. Fog or mist is very common from June to September but rare in December.

Wind in Kalimpong is usually extremely calm. The windiest month is January, followed by April and December. January's average wind speed of around 1.3 knots (2.4 Km/H) is considered "light air." Maximum sustained winds (the highest speed for the day lasting more than a few moments) are at their highest in early December where average top sustained speeds reach 9.8 knots, which is considered a gentle breeze.

Surface winds of Kalimpong District are generally from the east. But during winter months the prevailing wind direction is E-NE. During the monsoon (June to September), the prevailing direction is from E-SE.

3.4 Topography& Terrain

Physiographically Kalimpong district can be broadly divided into Hills and Plain land (Figure 3.4). The natural slope of the land is from North to South. Numerous rivers and springs flow South-wards emerging from the hills at the North, the most important river flowing in the western boundary is Teesta and in the east Jaldhaka.

Topographically, the Kalimpong district is highly complex with innumerable variety of micro and macro relief forms. Topography map of Kalimpong District indicates that north-eastern portion is rugged where elevation is greater than 2000 meters. Highest elevation recorded as 3177 m. The elevation of southern and western portion is less than 400 m and the elevation of the remaining part ranges between 400 to 2000 m. lowest elevations of 137 m located in the southern part of the district.

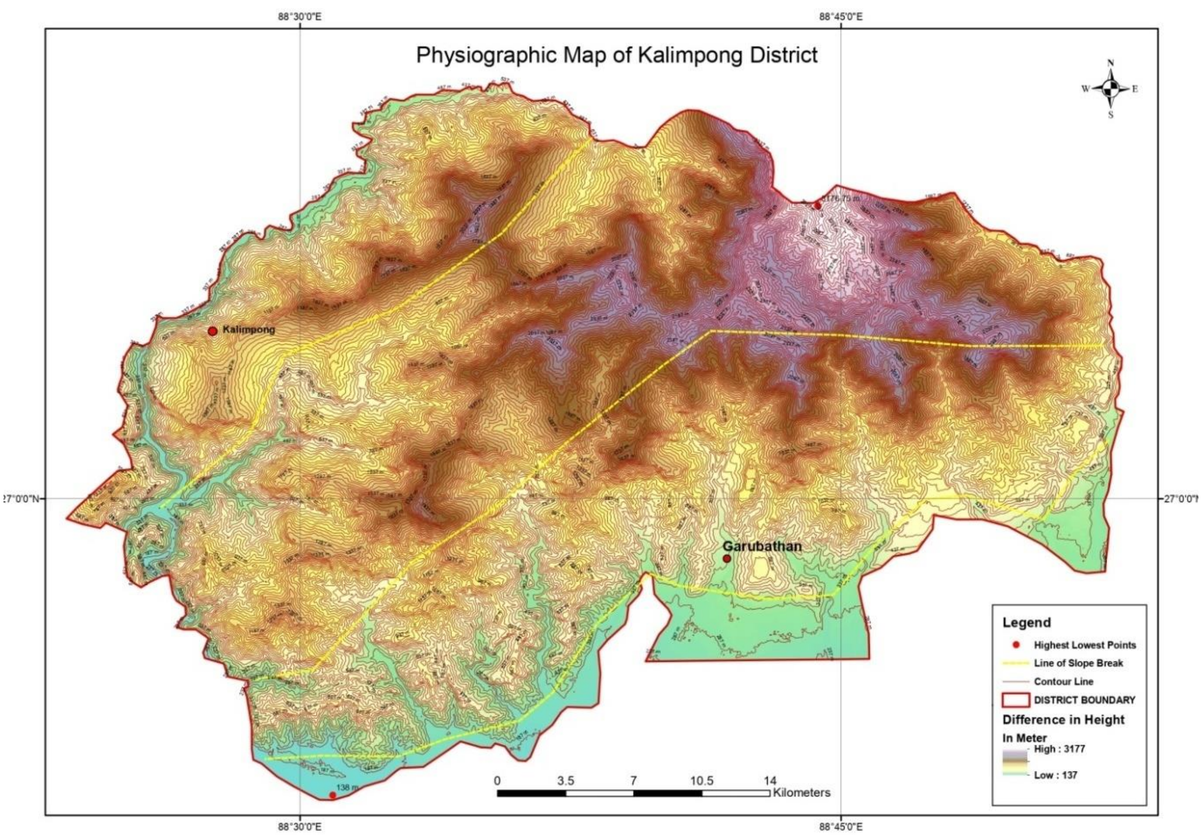


Figure 3.4: Physiographic map of Kalimpong District

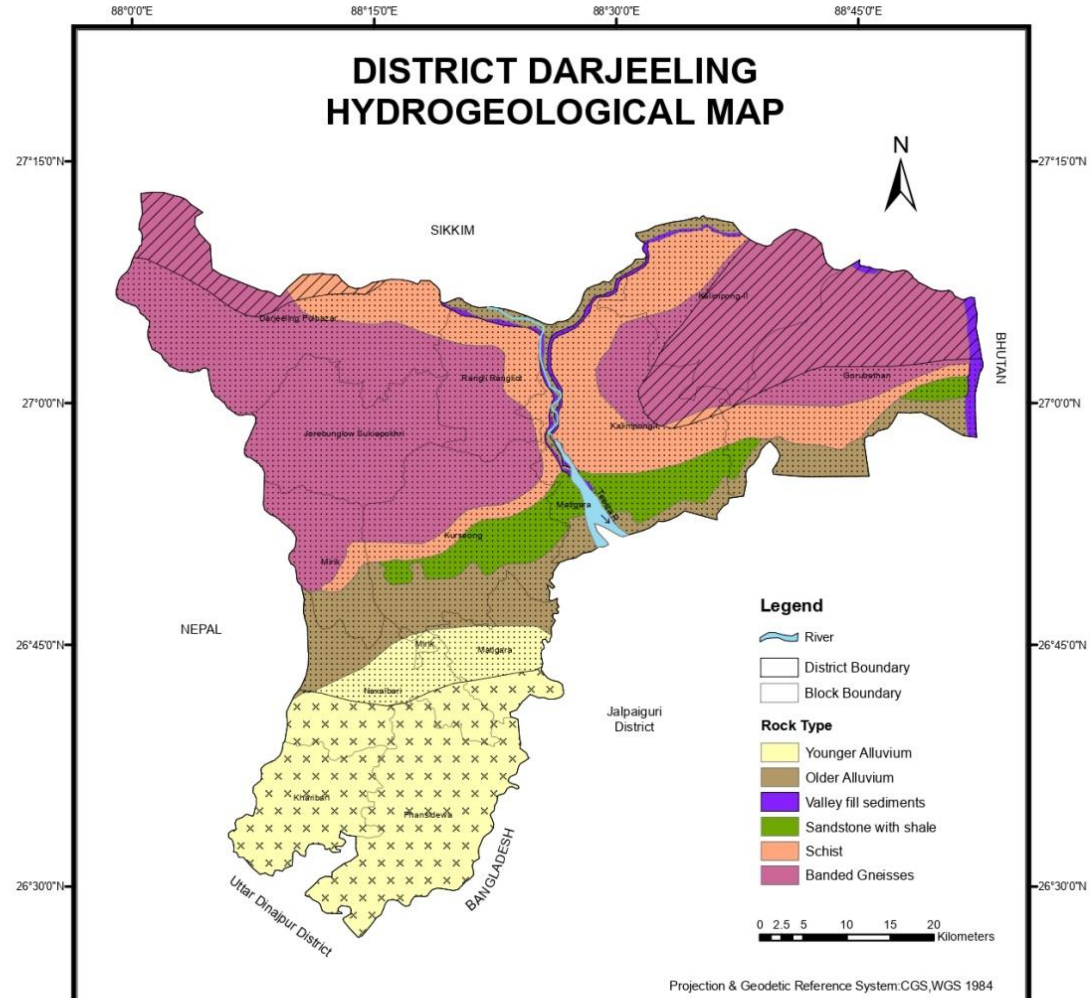
(Source: Cartosat-1, Bhuvan India)

3.5 Water courses and Hydrology

The district is covered by three major geological formations viz, the Precambrian crystallines, the Vindhyans and the Gondwanas. Besides, the tertiary laterite and alluvium also covers part of the district. Ground water occurs mostly under phreatic condition in all the lithological units and locally under semi-confined and confined condition (Census, 2011).

Figure 3.5 represents hydrogeological map of the district which includes Darjeeling district also. Rock type of the district consists of Banded Gneisses, Schist, Sandstone with shale, valley fill sediments and younger Alluvium of Azoic to Quaternary age. This rock group chiefly comprises the district profile. Thickness of the aquifer varies between 5 to 50m in consolidated rocks which poses yield of 2-2000 cum/day and the thickness of alluvium in this part varies between 50-700m. Groundwater yield of the alluvium is 200-1500 cum/day (http://wbwridd.gov.in/swid/mapimages/DARJEELING.pdf).

Eastern and central part of the district comprises mainly of Banded gneiss and schist of Azoic to Proterozoic age. Thickness of the rock type varies between 5 to 50m and having yield value of 2-1000 cum/day.



Symbol	Rock Type	Age	Lithology	Aquifer Description	Hydrogeology
(dotted)	Banded Gneisses, Schist,Sandstone with shale, Valley fill sediments and Younger Alluvium	Azoic to Quarternary	Granular/fracture zones variably encountered between 20-400m b.g.l.	Thickness of aquifer varies between 5-50m in consolidated rocks and 50-700m in alluvium	Groundwater yield prospects between 2-2000 cum/day in consolidated rock and 200-1500 cum/day in alluvium
(hatched)	Banded Gneisses and Schist	Azoic to Proterozoic	Granular/fracture zones encountered between 20-150m b.g.l.	Thickness of aquifer varies between 5-50m	Groundwater yield prospects between 2-1000 cum/day
× × ×	Younger Alluvium (Clay/Silt/Sand/Calcareous concretion)	Quarternary	Granular/fracture zones encountered between 50-400m b.g.l.	Thickness of aquifer varies between 50-700m	Groundwater yield prospects between 200-1500 cum/day

Reference:CGWB & GSI

Figure 3.5: Hydrogeological map of Un-divided Darjeeling district

(Source: wbwridd.gov.in)

3.6 Ground water Development

Central Groundwater Board (CGWB) has carried out hydrogeological investigation study over different part India. The present report incorporates data published by CGWB. It has been noted that the monitor station are located in the lower elevation or flat land, there are no monitoring station fall in Kalimpong district. Kalimpong district is the newly formed district from Darjeeling in 2014. Therefore, the report provides the information related to undivided Darjeeling district.

Depth of water in wells measured by CGWB at 32 locations which varied from 1.46 to 14.24 m bgl during pre-monsoon period with an average of 4.6m and 1.01 to 9.6 m bgl during post-monsoon period with an average of 3.2 m in the year 1996 to 2018. Figure 3.6 represents water level fluctuation graph measured at Sevok monitoring station by CGWB. Figure shows the depletion of groundwater level over the period (https://indiawris.gov.in/wris/#/groundWater%20(CGWB%20website%20for%20Ground%20water%20data).

Over all stage of ground water development is 6% indicating sufficient scope of development (CGWB, 2017).

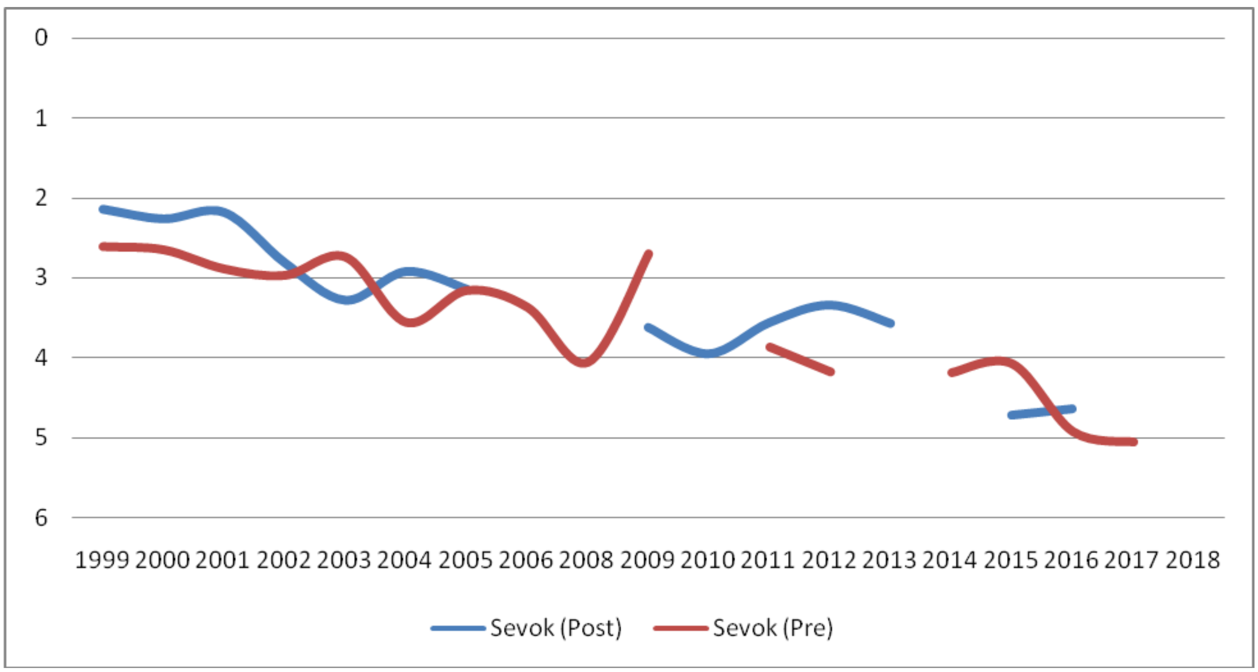


Figure 3.6: Graphical representation of pre-monsoon and post-monsoon data of CGWB monitor well at Sevok

Hydrographs showing variation in water level observed in between 2011 to 2021 in the district is given in Figure 3.7.

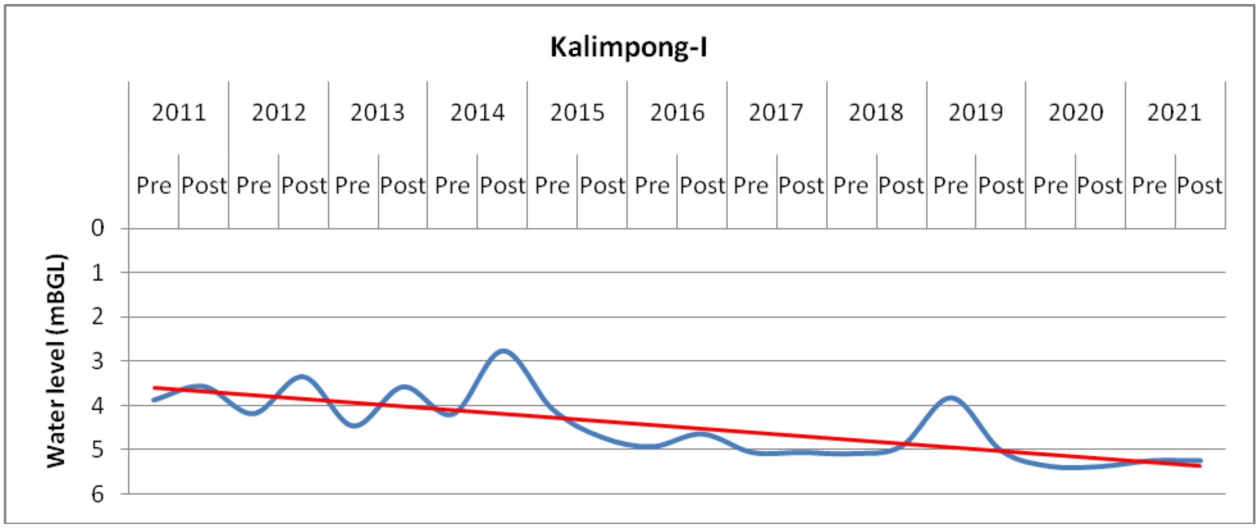


Figure 3.7: Block wise Hydrograph showing variation of water level during 2011 to 2021

3.7 Drainage System

The Kalimpong district is drained mainly by the Teesta and its tributaries, except the extreme eastern portion where the chief effluent is the Jaldhaka. Teesta and its tributary Relli are the main channels here. Besides these Lish, Geet, Chel, Rishi, Neora and Murti are also important rivers in southern portion of the Kalimpong subdivision. The region fosters many perennial rivers which flow through deep gorges and belong to Himalayan or extra peninsular rivers. The rivers of this group are glacier, spring and rain-fed, originating from the Himalayans to traverse great alluvial Indo-Gangetic plains.

A Drainage map of Kalimpong District is furnished as Figure 3.8 as well as in Plate-1.

The drainage system of the district is mainly governed by Brahmaputra drainage basin. The Brahmaputra system is represented in the area by its Teesta sub-system and Jaldhaka sub-system. Drainage system of Kalimpong is explained in detail in Chapter 7.2.

Table 3.4: Rivers and tributaries in Kalimpong District

Watershed	Sub-Watershed	Flow Regime	Rivers & Tributaries	Length in Kalimpong(km)
Brahmaputra	Teesta	Middle	Teesta	37
			Lish	12.10
			Geet	30.20
			Chel	10.46
			Neora	27.46
			Relli	30.64

Watershed	Sub-Watershed	Flow Regime	Rivers & Tributaries	Length in Kalimpong(km)
			Riyang	18.70
			Rangpoo Chu	9.66
			Rishi Chu	17.36
	Jaldhaka	Upper	Jaldhaka	19.47
			Ni Chu	14.90
			Murti	13.82

Source: Cajee L, 2018

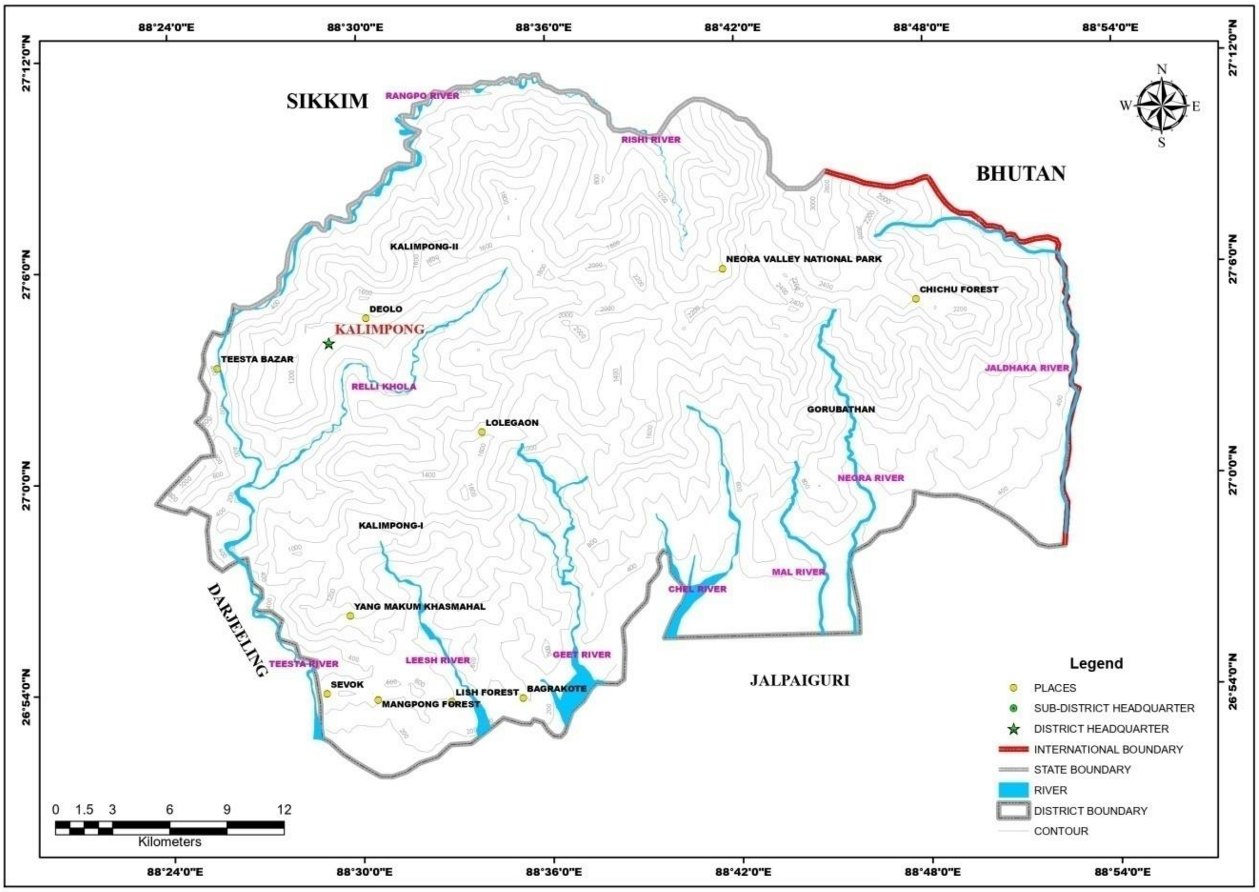


Figure 3.8: Drainage map of Kalimpong District

(Source: National Informatics Centre)

3.8 Demography

According to the Census (2011), Kalimpong district (enumerated as Kalimpong subdivision then) encompasses a geographical area of 1053.12 sq km and has a population of 251642 (persons) including 129040 males and 122602 females. The district has a sex ratio of 950 females for every 1000 males. The majority of the populations in Kalimpong district are the Gorkhas, Lepchas and Bhutias etc. The major religions in the district are Hindu (65.69%) and Buddhist (16.41%) followed by Christian (12.60%) of the total population. The literacy rate in the district is 81.65% (persons), 87.18% (males) and 75.89% (females).

In 2014, Kalimpong sub-division of Darjeeling district has been declared as Kalimpong district. Table 3.5 representing Kalimpong district demographic profile modified based on 2011 census. Literacy rate of Kalimpong city is 90.19 % higher than state average of 76.26 %. In Kalimpong, Male literacy is around 93.79 % while female literacy rate is 86.49 %. Among the community blocks, Kalimpong-I is having highest literacy rate. Figure 3.9 and 3.10 representing block wise population distribution and literacy rate respectively for Kalimpong district (***Census, 2011***).

Table 3.5: Demographic distribution of Kalimpong District

C.D.Block/MC	Area (Sq.Km.)	Number of households	Male	Female	Population	Literacy (%)	Percent of population to district population
Kalimpong Municipality	8.68	10113	25,690	23,713	49,403	90.19	19.63
Kalimpong-I	360.46	15358	37,750	36,996	74,746	81.43	29.7
Kalimpong-II	241.26	13172	34,546	32,284	66,830	79.68	26.56
Gorubathan	442.72	12662	31,054	29,609	60,663	76.88	24.11
TOTAL	**1053.12**	**51305**	**129040**	**122602**	**2,51,642**	**81.65**	**100**

(Source: Census, 2011)

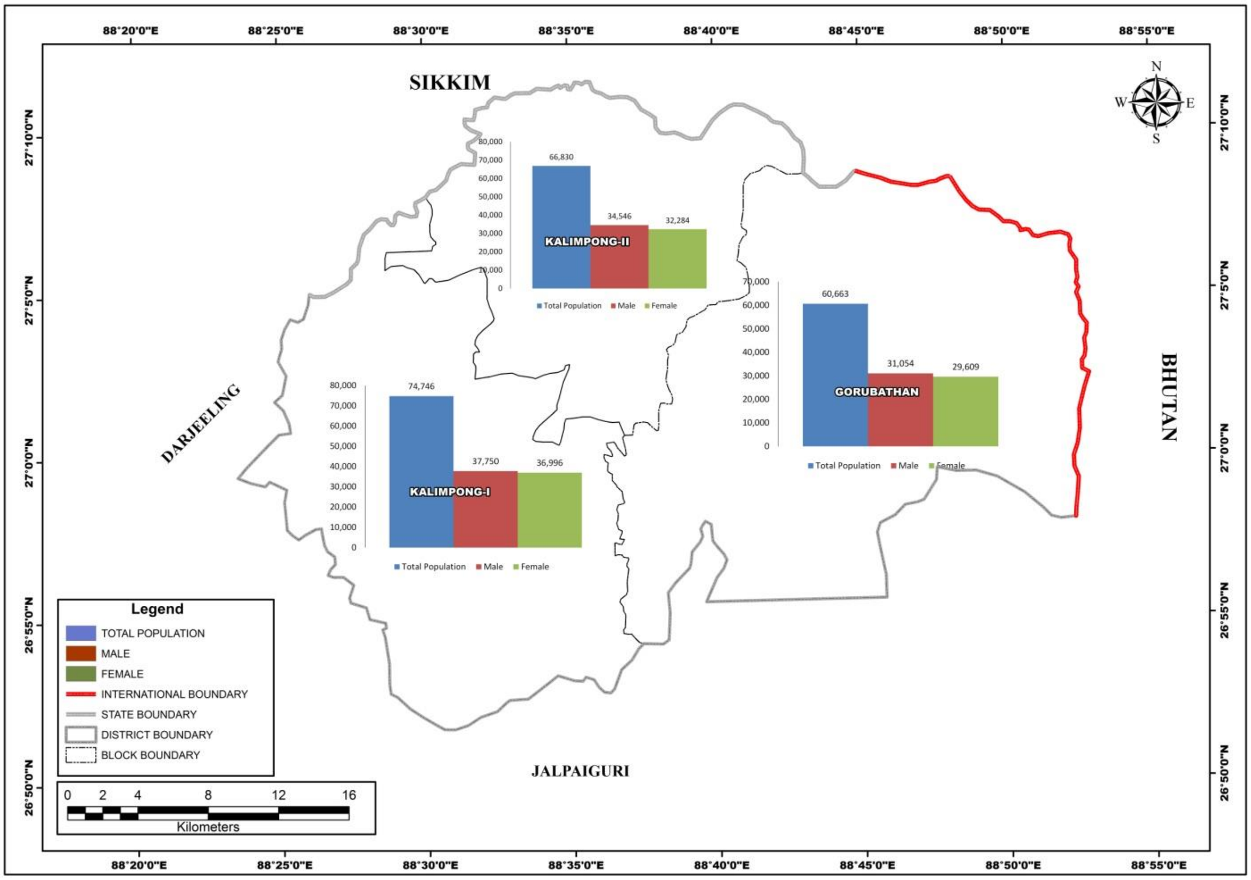


Figure 3.9: Block-wise population distribution in Kalimpong District

(Source: Census, 2011)

From the above Figure 3.9, it is observed that the population of male is greater than population of female in each block of Kalimpong district. It is observed from Figure 3.10 that the Literacy rate in Kalimpong Municipality & Kalimpong I block is higher than the other blocks of Kalimpong district.

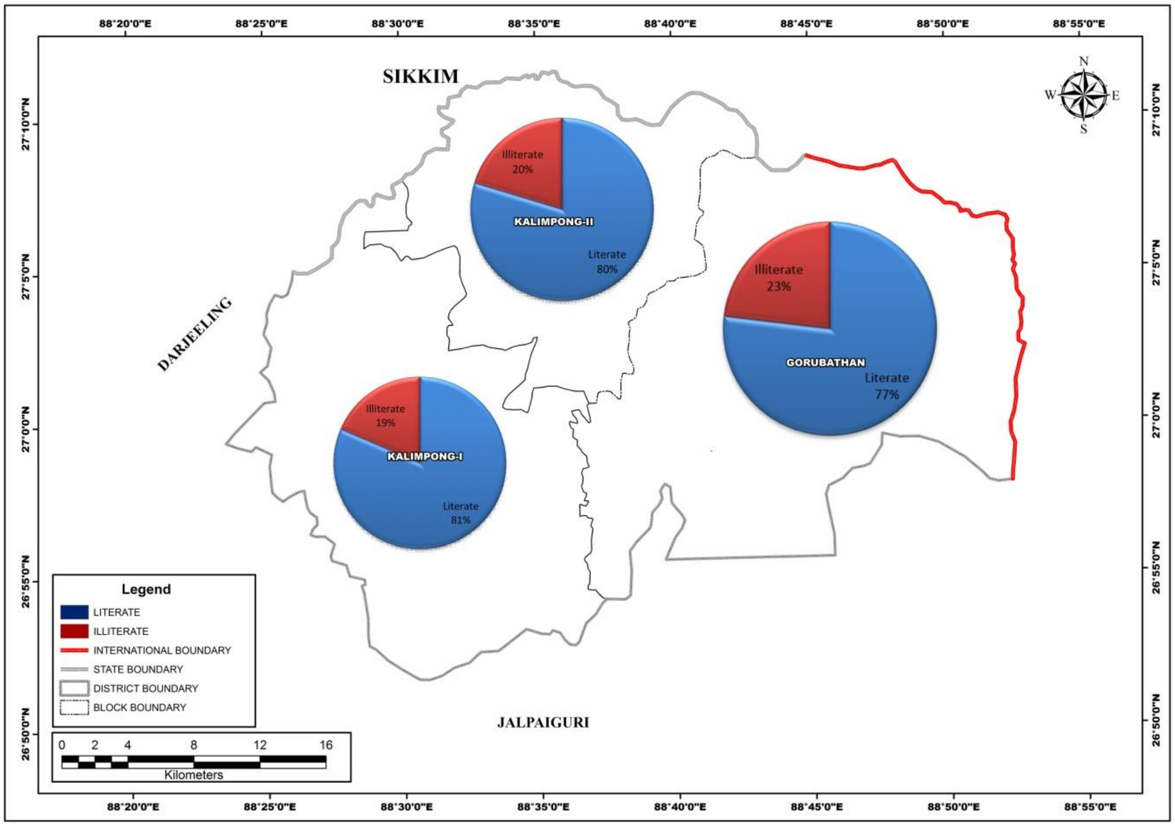


Figure 3.10: Demographic map showing Block-wise Literacy rate of Kalimpong District

(Source: Census, 2011)

3.9 Cropping pattern

Placed between the Teesta and the Jaldhaka rivers and stretched from the lesser Himalayas to its foothills, the Kalimpong district is rich with an abundance of flora and fauna, with temperate climate that favours agro-horticulture. More than 80% of people in Kalimpong depend on farming for their livelihood. Major agro-products include paddy, maize, millet, pulse, oilseed, and potato; however, Kalimpong is more widely known as a hub of cash crops like ginger, cardamom, betel-nut and oranges.

Kalimpong is also the home to the Dalle Khursani (Capsicum Annuum), a variety of small but extremely hot chillies, which add delectable pungency to the exotic cuisine of the hills.

3.10 Land Form and Seismicity

The hilly region of the district is very prone to landslide due to poor water retention capacity of the soil clubbed with steep land slope (from North to South, and South-East). The considerable portion of the district falls under the Seismic Zone IV (in a scale of I to V in ascending order of propensity f Seismic Activity), making it very prone to the earthquakes (Census, 2011). Figure 3.11 shows the district position on the earthquake map of West Bengal. However, no major earth quake event has been recorded with its epicenter in Darjeeling district. Many earthquake shocks experienced in the district have been recorded.

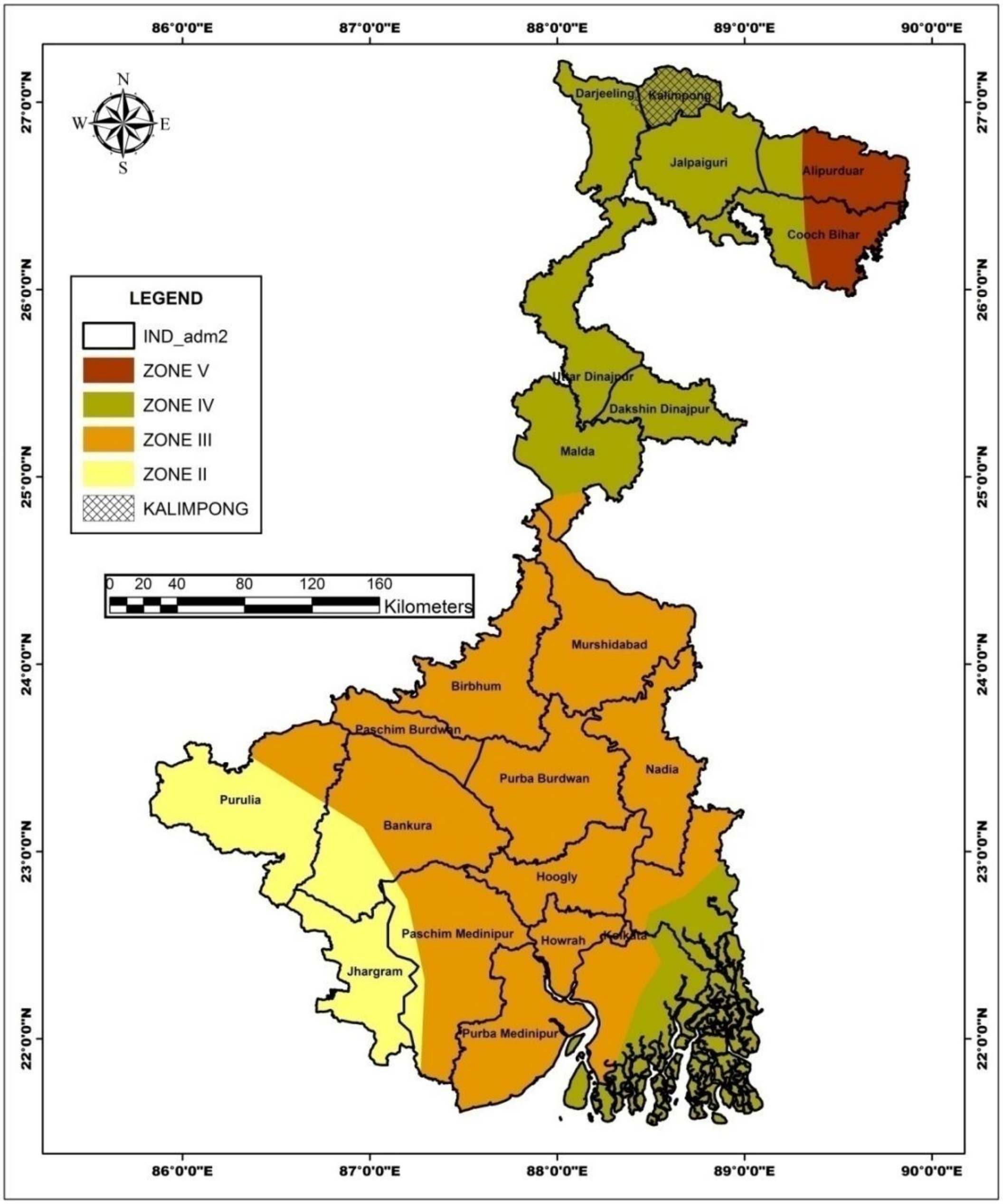


Figure 3.11: Earthquake zonation map of West Bengal highlighting the Kalimpong district position

(Source: https://pib.gov.in/PressReleasePage.aspx?PRID=1740656)

3.10.1 Earthquake:

District has many earthquake shocks experienced since, eighteenth century. During Dhubri earthquake of 3rd July 1930, the district fell within the higher isoseismic zone of the earthquake with its focus near Cherrapunji; the quake reached within minutes and caused massive devastation. Cracks appeared in several buildings of Kalimpong and Darjeeling town due to the earthquake. The Bihar-Nepal earthquake of 15th January 1934 was severely felt in the district, the worst affected parts being Darjeeling town and its neighboring spurs and the railway station at Tindharia. Kurseong and Kalimpong escaped with minor cracks in buildings but landslides occurred at several places in the Teesta valley in Kalimpong district. The September 18, 2011 earthquake left a trail of devastation in Sikkim and Darjeeling hilly area damaging roads, building and other structures, uprooting mobile phone towers and snapping communication and power lines. The impact of the quake in Darjeeling hills was felt mainly in Kalimpong district and Kurseong subdivisions of Darjeeling district (Mili, 2012).

On 25th April and 12th May 2015, Nepal and its surrounding area were hit by earthquakes which are considered to be the most devastating in the living memory of the inhabitants of these affected areas. The 7.9 magnitude quake was the strongest to hit Nepal for 81 years. It was the most horrible natural disaster to hit Nepal since the 1934 Nepal–Bihar border earthquake. Earthquakes are often followed by landslides and rock avalanches and glacier avalanches in Himalayan hilly areas. Landslides also blocked the river channels, sewage and other communication system in Darjeeling district. Mud wall, buildings and boundary walls in different locations of Siliguri and Jalpaiguri had collapsed because of the tremors (Dey, 2015).

3.10.2 Landslide:

In Kalimpong district along with other district of Darjeeling Himalaya, occurrences of landslides are prominent from a long time of history. The Teesta basin is one of the most vulnerable among the Himalayan river basins considering the occurrence of landslides and floods. The landslides occurred in 1899, 1950, 1968, 1976, 1991, 1993, 2003, 2004, 2005, 2006, 2009, 2011 and 2015. All of the slides occurred in the Kalimpong, Darjeeling Town, Kurseong, Pulbazar, Rongtong, Tindharia, etc.

As per the landslides records available, in September 1899 landslide 72 lives were lost in Darjeeling Himalaya. Darjeeling, Kalimpong, Kurseong, Ghum, Tindharia were affected by this disaster. A massive landslide occurred in June 1950, in which 127 lives were lost along with the loss of several properties including roads and Siliguri-Kalimpong railways line.667 lives were lost along with the destruction of a tea garden due to October 1968 landslides. The affected areas of the landslide were Kalimpong, Darjeeling town, Manpuri, Lebong, Tista Bazar, etc. Again, Rimbik, Lodhama, Darjeeling Town, Bijanbari, Lebong, Ghum, Happy Valley were affected by the landslides that occurred on September 1980. The landslide of June 2011 was the subsequent effects of high rainfall of about 60 mm rainfall in about 3 hours at Kalimpong, 152 mm at Darjeeling and Kurseong. In this landslide, no such significant casualties had occurred. In the same year, in September, the landslides occur due the subsequent effect of Sikkim earthquake but the Darjeeling Himalayas has been less affected than the Sikkim Himalayas (Biswas and Pal 2015).

Heavy rain has triggered landslides at Kalimpong, Mirik, Darjeeling and Kurseong during June-July, 2015, causes the loss of several lives and properties. Thus, the landslide disaster of 2015 triggers severely the natural environment of the Darjeeling Himalayas. Geological survey conducted for the Darjeeling Landslide by the Survey of India and the report says that the Nepal earthquake has a significant role in the occurrence of the landslide. However, historical record suggests that intense rainfall is the key factor for the June-July, 2015 landslide. As the developmental activity is increased in the mountainous region, thereby, the land use management is significant to reduce the vulnerability of the landslides (Biswas and Pal 2015).

The mitigation measures to tackle the landslide hazard in the district are (Nad, 2015)-

- ✓ Structural measures: The stability of a vulnerable slope may be increased either by reducing the volume at the head or by expanding the volume at the toe.
- ✓ Drainage Corrections: The streams and temporary water resources particularly at the head of the slides are diverted from the slide area.
- ✓ Proper land use measures: proper scientific land use planning and Ban on non-biodegradable materials in hazard areas.
- ✓ Afforestation: Afforestation programmed lunched for minimize the breakdown situation of environmental equilibrium. The grass cover must not be disturbed unnecessarily in the hilly area.
- ✓ Public Awareness: Village wise Training Programmed, Landslide Management Education from School Level.
- ✓ Settlement policy: Restricting Development in Landslide Prone Areas, Protection of Existing Development, Monitoring and Warning System.

3.10.3 Critical landslide prone area:

The primary risk inclined territories of landslides prone areas tabulated as per research work by Deepak and Pradeep (2019) are given in Table 3.6. A landslide zonation map of the district is given in Figure 3.12.

Table 3.6: Critical landslide prone areas of Kalimpong district

Level of Landslide Prone Area	Hazard Areas
Very high (severe) landslide prone area	The north-central part of the Darjeeling hills falling in Kalimpong district
High landslide prone area	River bank of Teesta in Kalimpong district
Moderately high zone of landslide hazard	North-west and south-east below high zone in Kalimpong district
Moderate zone of landslide hazard	Eastern part where there remain a chance of at

Level of Landslide Prone Area	Hazard Areas
	least one landslide/ km²
Low landslide hazard prone area	Small patches in southern part of Kalimpong district

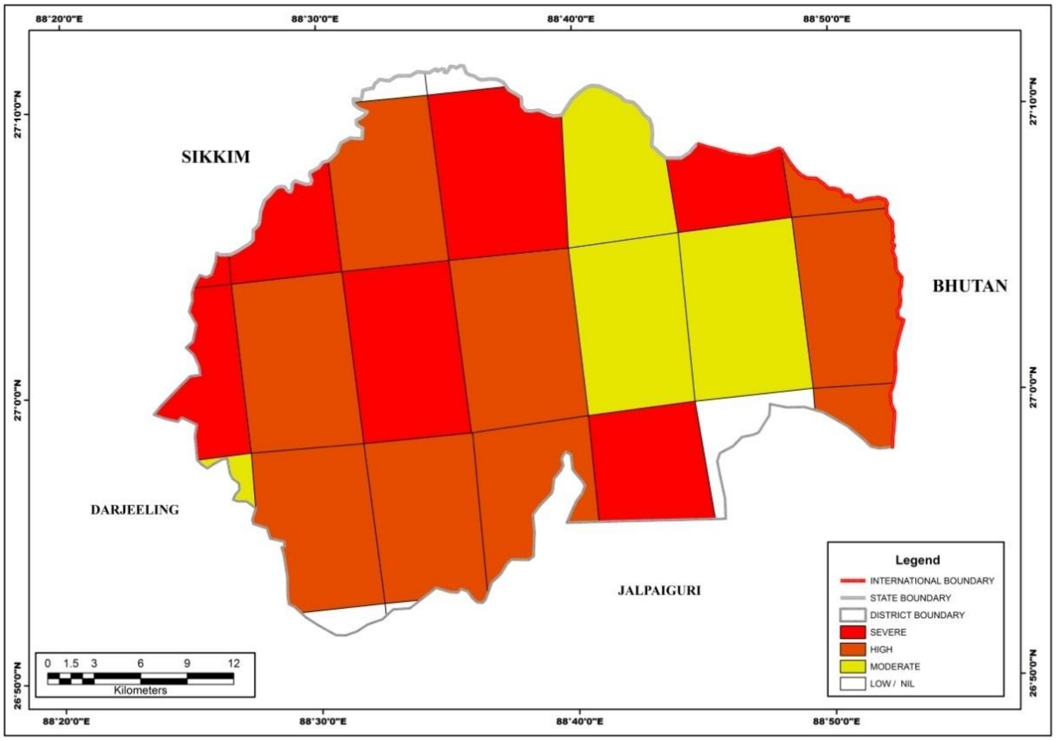


Figure 3.12: Landslide Hazard Zonation Map of Kalimpong District

(Source: ***Nad, 2015****)*

3.11 Flora

Kalimpong is a precious part of the Eastern Himalayas and boasts a rich bio-diversity. The Neora Valley National Park (88 sq. km), on the north-eastern face of the district with its dense subtropical and impenetrable temperate forest, is a national asset. A wide range of vegetation structures with extremely rich plant and animal diversity developed in the district due to the extreme climatic, edaphic and physiographic variations. Plants of diverse forms, such as trees, shrubs, climbers, lianas, annual and perennial herbs, geophytes, epiphytes, parasites, and saprophytes, are evenly distributed. The estimated vascular flora for the district is 2,912 (Table 3.7).

Table 3.7: Vascular flora in Kalimpong

Taxa	Estimated number of Species
Angiosperms (dicots)	1900
Angiosperms (monocots)	750
Gymnosperms	12
Pteridophytes	250

(Source: Das, 2008)

There are six natural subtropical forests beginning at different zones: Mongpong (from Tiger Bridge), continuing to Lish, Guling and Nazoke Chunabhatti, stretching to Nimbong. Pubung-Mangzing stretching to Gitdabling, Dalimkot-Gourbathan, extending to Samsing and above Kumai, taking its route to Rongo and above and Jholung Paren to Todey via Godak.

The Tarkhola and the forests along the eastern flank of river Teesta are connected to Neora Valley through Munsong, Damsang-Algarah and Paktham-Lahba. The second connectivity of forests begins at Chunabhatti (Bagrakote)-Pubung and continues through Nimbong, Pemling, Lolaygaon and Lahba to join Neora Valley. The forests of Ambiok-Dalimkot (Gorubathan), Samsing, Kumai, Rongo, Paaren- Godak and Todey Tangta skirt the national park on the south-eastern flank.

At the foot of Kalimpong, along the river banks of Relli and Teesta, the rain forests can be observed containing the species Acacia (Khair), MeliosmaPinnata (Dabdabe), Albizia (Siris) and Dalbergia (sissoo). The lofty sal trees and the intermixed species of Terminalia, Lagerstroemia parviflora, and Dillenia from the sal forest lie in the lower hills. The tropical mixed forests in this zone show the presence of Tetrameles (Maina), Beilschmiedia (Tarsing), Macarange (Malata), along with the undergrowths. The subtropical forests, mostly deciduous, extending to an altitude of 1800m, are home to species like Gynocardiaodrata (Gante), Callicarpa (Guenlo), Duabanga (Lampate), Terminalia (Saj), Phyllanthus (Amala), Cinamomum (Tejpat), Engelhardia (Mauwa) and Ficus (Khaniun). The beauty of these forests has been enhanced by the magnificent and lofty climbers like Entada (Pangra), Tinospora (Gurjo, Combretum (Thakauli), Mucuna (Kaoso & Baldengra), Cissus (Charchare).

The popular bio-diversity and typical Himalayan flora is exhibited by the evergreen temperate forests. The temperate ranges cover the forests of Algarah, Charkhola- Lolaygaon, Damsang, Thosum, TodeyTangta and continue above to the Rachela peak, the tri-junction of Sikkim, Bhutan and Kalimpong. Floristically, this climatic border is marked by the presence of certain species like Leucoceptrumcanum (Ghurpis), Edgeworthiagardneri (Argeli), Rapidophora (Kanchirno), Thunbergia, Agapetes, etc. There are about seven species of Rhododendrons in the Neora Valley, some of them forming a pure (monoculture) forest at the peak of Rachela. Species like Rhododendron arboreum, Magnolia campbellii, Alcimandracathcartii, Abutilon indicum, Mussaendatreutlerii and others can be seen along the ridges of Labha, Gumbadara, Jhandi, Damsang, TodeyTangta and above and they are popular with explorers.

The evergreen patches of Pinus, Thuja and Cryptomeria can be seen along the roadsides of Labha and Kafer. The common trees of this temperate forests are Quercus lamellose (Oak), Betula alnoides (Birch), Acer spp. (Maple), Alnusnapalensis (Alder), Lyonia, Castanopsis, Lithocarpus, Sorbus, Llex, etc. The upper ridges of this zone are often dominated by the thickets of Arundinaria maling and allied spp. Neora Valley is host to a number of plants of tremendous botanical value. The highly endangered saprophytic herbs of the humus soil of the deep forest, Balanophora and Monotropa are available in this forest. The notable names of vegetational wealth include Rhododendron spp, Tsuga dumosa, Taxus buccata, Helwingiahimalaica, Paris Polyphylla, Polygonatumspp, Arasaemaspp, Smilax spp, etc., and they form the integral part of this upper forest.

About 300 species of orchids have been reported in this part of the Himalayas. Some of the popular orchids available here are Paphiopedilium, Pleone, Orchis, Herminium, Oberonia, Liparis, Coelogyne, Dendrobium, Cymbidium, etc. along with the common ground orchids like Habenaria, Satyrium, etc. The only medicinal plant garden of the nation that cultivates the precious Cinchona (and has its headquarters at Mungpoo) has a major stretch of cultivation in Kalimpong – at Munsong and Rongo – Gairibas. The commercial cultivation of Cinchona spp, Dioscoreaspp, Cephaelisipecacuanha, and other herbal plants such as Digitalis, Solanum, Rauwolfia, Mentha etc. have ben carried here since its inception in the 60s.

Kalimpong district has one protected area – Neora Valley National Park. It has rich floristic diversity. The lower altitudinal zone or foothills (500 to 1,700m) displays characteristic subtropical vegetation. The dominant tall tree species (10-30m) include Duabanga grandiflora, Micheliachampaca, Terminalia alata, Gmelina arborea, Schimawallichii, Castonopsis indica, Phoebehainesiana, Ficus subincisa, Quercus glauca, Erythrina stricta, Syzygiumformosum, Phyllanthusemblica, and others. The undergrowth includes Pandanus nepalensis, Maesa indica, Garugapinnata, and Holmskioldiasanguinea. The common herbs are Ageratum conyzoides, Oxaliscorniculata, Urnealobata, Pouzolziasanguinea, Mimosa pudica, Eranthemumpulchellum, andothers. Above this zone, lies a small sub-temperate zone (1,700-1,900m), characterized byOstodespaniculata, Ficus oligodon, Syzygiumclaviflorum, Catunregamlongispina, Ehretiaserrata, Morinda angustifolia, and Solanum erianthumc. The ecological zone between 1,900and 3,150m receives comparatively more rainfall and has higher humidity than the tropicalarea and therefore harbours rich vegetation with wide ranging biodiversity. The 15-25m hightrees form a dense, closed canopy, and include Michelia dolorosa, Magnolia campbellii, Alnusnepalensis, Rhododendron arboreum, Acer thomsonii, Juglans regia, Betula alnoides, Cotoneastergriffithii, Elaeocarpus lanceifolicus, Larix griffithiana, Juniperuspseudosabina, Abiesdensa, Tsuga dumosa, Taxus baccata, Pinus roxburghii, and Cryptomeria japonica. Therich biodiversity of this zone is displayed in the occurrence of natural virgin forests, densebamboo grooves, and a colourful canopy of rhododendron trees and green valleys. In addition the forests hold a number of epiphytes, mainly orchids. The common climbers are Thunbergialutea, Clematis nepalensis, Lonicera macrantha, Jasminum dispermum, Schiandragrandi flora, and

Parthenocissussemicor data, and the rich undergrowth is comprised of Rubuspaniculata,Arundinariamaling, Viburnum erubescens, Agapeteshookeri, Astilberivularis, Strobilanthusthomsonii, and Hedychium coccinium. Herbaceous floras are represented by Primula listeri,Swertiadulata, Galinsoga parviflora, Anaphaliscontorta, Aconitum spicatum, Meconopsisnepalensis, Gentianacapitata, Rumexnepalensis, and Polygonum orientale. Except in the veryhigh altitude areas (above 3000m) the trees and shrubs are festooned with thick growths ofepiphytic flora such as bryophytes, pteridophytes, and angiosperms. Heterophyticangiospermicflora such as Viscum, Loranthus, Balanophora, Ropalocnemahimalaica, Aeginetia indica, andmany others are also abundant. (Das, 2008).

Endangered Floral Species:

List of threatened Plants of Undivided Darjeeling District is furnished in Table 3.8.

Table 3.8: Threatened Plants of Un-divided Darjeeling District

Scientific Name	Family	Status	Distribution sites and Avg. altitude
Acer hookeri	ACERACEAE	Endangered	Darjeeling, 600-1500 m
Acer osmastonii	ACERACEAE	Endangered	Darjeeling (endemic), Salombong, Birch hill
Pimpinella tongloensis	APIACEAE	Endangered	Endemic to Singaleela range in the Darjeeling-Sikkim Himalaya
Phoenix rupicola	ARECACEAE	Rare	450 m
Begonia scutata	BEGONIACEAE	Rare	Darjeeling, Peninsular India. 1000-1500 m
Codonopsisaffinis	CAMPANULACEAE	Rare	Darjeeling and Sikkim Hiamalaya. 1830-3335 m
Bulleyiayunnanen sis	ORCHIDACEAE	Rare	Darjeeling hills
Diplomerishirsuta	ORCHIDACEAE	Vulnerable	Darjeeling. 1500-2000 m
Christiopteristricu spis	POLYPODIACEAE	Indeterminate	Darjeeling
Ophiorrhizalurida	RUBIACEAE	Rare	Darjeeling. 300-1500 m
Christellaclarkei	THELYPTERIDACE AE	Vulnerable	Darjeeling. 4000 m

(Source: India Biodiversity Portal)

3.12 Fauna

The wildlife of Kalimpong is enriched by the presence of endangered species like the red panda and munal pheasant, Himalayan black bear, clouded leopard tiger, Himalayan tahr, goral, gaur and pangolin at widely different altitudes. The forest belts host the Siberian weasel, today cat, Asiatic black bear, India leopard, barking bear, Indian bison, moupan hare and Himalayan squirrels.

The district possesses a rich variety of fauna. There are about 90 species of mammals in the un-divided Darjeeling District. Among the large carnivores, Wild Leopard, Clouded Leopard, Leopard-Cats are seen both in the hills and jungles of the Tarai region. The Jackal, Indian Fox are also normal residents of the forests. The Himalayan Black Bear, Common Indian Sloth Bear and Malayan Sun-Bear are the species belonging to Ursidae family which can still be found, although in very limited number, in forests. Among the herbivore, Elephant is very common. Several wild Elephants, sometimes in herds, sometimes singly can often be seen, mainly near the forest areas in the vicinity of river streams and in the Tarai. Among the less challenging smaller herbivore, the Gaur, Sambar, Spotted-Deer, Barking-Deer and Hog-Deer can also be occasionally observed. Among the goats, Serow and Ghoral can still be seen in the forests. The Red-Tailed Rabbit, Hispid Hare, Squirrels, Porcupines, Moles, Rats, Mice, wide variety of poisonous and non-poisonous Snakes, Martens and numerous other small animals are the common residents here. (Census, 2011).

The District is very rich in Bird life containing about 550 species. Nearly one quarter of the species of birds found in India, is found here. More than half of the species are passerine birds, the largest families being the Timaliinae (Laughing-Thrushes, Babblers) with 61 species; the Sylviinae (Warblers) with 60 species; the Turdinae (Chats, Robins, Thrushes) with 56 species; the Muscioa-pmas (Fly-catchers) with 27 species; the Fringillinae (Finches) with 22 species. There are plenty of Minivets, Orioles, Sunbirds, Malay Tree Sparrow. The best represented families in the Coraciformes are the Picidae (Woodpeckers) with 15 species; the Cuculidae (cuckoos) with 16 species and Asionidae (owls) with 14- species. There are five species of King-fisher of which the tiny Indian three-toed Kingfisher (Ceyx e. enthaca) a forest species, is the most beautiful one. Accipitrine birds number about 40 and include the fine Himalayan Lammergeyer (Gypaetus barbatus hemachalanus), Hodgson's Feather-toed Hawk Eagle (Spizaetus n. nipalensis), the Himalayan Rufous bellied Hawk-Eagle (Lophotnorohis k. kienerl) and the handsome bold miniature Falcon, the Himalayan Red-legged Falconet (Microphierax c. coerulscens). There are about a dozen species of pigeon and doves, some being only found at high elevations. Only Bengal Green-Pigeon (Crocopus p. phoenicopterus) is found m the plains. The Green-Pigeon (Sphenocercus s. spenurus) and the Himalayan Pintailed Green-Pigeon (Sphenocercus a. apicandus) are common in the hills.

Endangered Fauna: There has been a depletion of natural fauna of this region to a certain degree due to human interference on animal kingdom. Because of unnecessary shooting and poaching, extension of tea cultivation and spread of human settlements on the fringe of forests and even setting up of settlements on the seasonal migration routes of some animals like elephants, there has been considerable depletion of fauna in this district. All of these have made conservation of wild life an urgent need of the district for the maintenance of ecological balance. In 1955, Mahanadi Wild Life Sanctuary has been setup for the protection of gaur (Indian bison).

Neora Velley National Park: The Neora Valley is bird watching heaven. The dominant genera in the amphibian species are Rana, Loepa and butterflies like Pieris, Poutia, Apollo, Papilio etc. can be spotted. The park is also home to the endangered red panda (Ailurus fulgens). The discovery of around 19 royal Bengal tigers (Panthera tigris) by the Tiger Census of

2002has listed the park among the most sensitive wildlife zones in the country. (https://kalimpong.gov.in/flora-and-fauna/).

Figure 3.13 is Wild Life Sanctuary and National Park location map of West Bengal and District Kalimpong highlighted in the map to show its proximity to the Sanctuary and National Park.

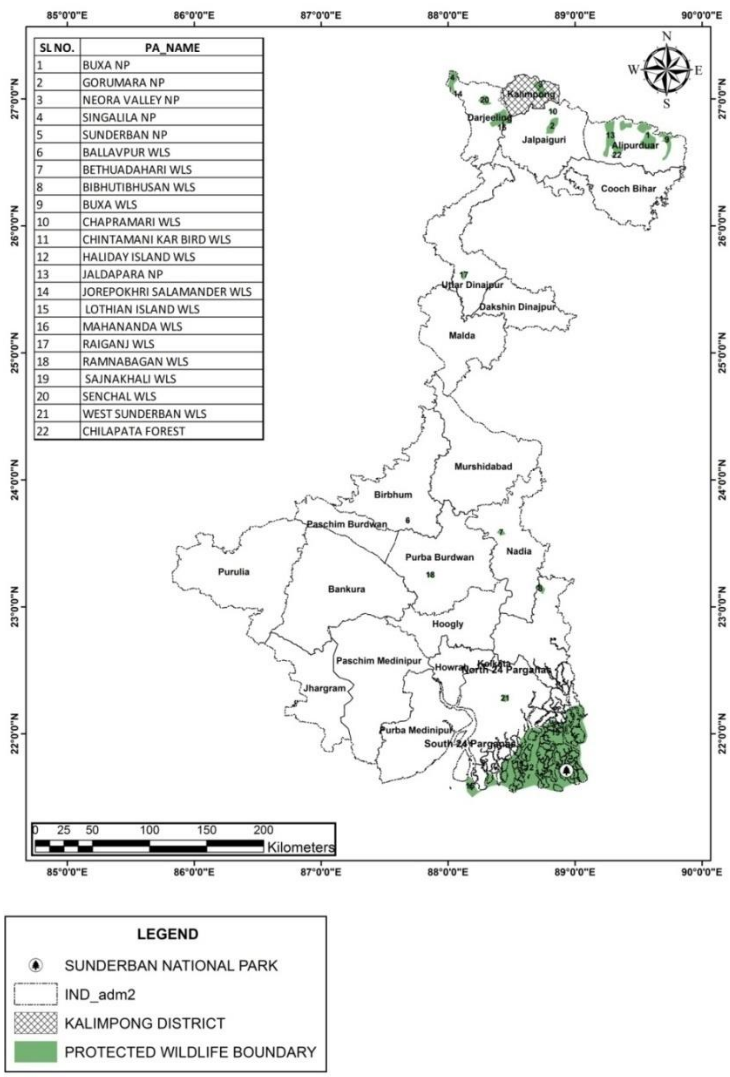


Figure 3.13: District location with respect to Wild Life Sanctuary of West Bengal

(Source: http://wiienvis.nic.in/)

4 Geomorphology of the district

4.1 General Landforms

Darjeeling Himalaya rises abruptly from the North Bengal plain, the elevation changing rapidly from 100-130 m above sea level (a.s.l) to 2000-3000 m a.s.l within a distance of few kilometers. The hilly areas are a part of the Siwalik Range or Outer Himalayas. The general slopes of the hills are from north to south. Narrow ridges separated by closely-spaced V-shaped valleys, where the slope varies between 15°and 40°. The region is highly prone to landslides, often causing disruptions to socio-economic activities as well as destruction of life and properties (Geomorphological Field Guide Book, IGI).

The complex landform of the district has been form due to different geomorphic processes, each of which has developed its own characteristic assemblage. The geomorphic configuration of the hilly tract is the joint product of geologic foundation and fluvial processes; although slope-wash, in particular mass-movements and related phenomena play a significant role in the final shaping of the landform. The region is characterized by a myriad of ridges and valleys because of the spurs ramifying into lateral spurs which give off lesser ones and these in turn cut the terrain into ridges and valleys, creating a mosaic of micro-topographical units (Cajee 2018).

Lower hills: This region is bounded by contour heights of approximately 400 - 1000 m and covers most of the central section of the district which is found in the western and south-eastern portion of the district in an around Teesta and Chal river valley region. The rivers in this region are mostly south-flowing and cut deep gorges and V-shaped valleys. The landscape is characterized by narrow ridges, deep incisions and numerous mass-movement scars. The average slope in this zone varies between 10° - 30°, with slope length sometimes exceeding 800 m. These lower hills are the most dissected and eroded tract in the Darjeeling Himalaya.

Middle hills: Whole northern part of the district is a part of middle-hill zone and is bounded by 1000 m and 2000 m contours. Kalimpong town and the Algara region fall under this category. These hill slopes are mostly used by tea plantations.

Upper hills: The upper hills lie above the 2000 m contour line and have been identified in Labha area that is north-eastern portion of the district.

Beyond the hill region in the North, starts the flat plain at South and South-west part of the district. This foothills zone is called the "Terai". It covers the tilted plains at the base of the foothills. This is formed due to the coalescing of several alluvial fans within the catchment area of the major rivers like Teesta, Jaldhaka. These streams form smaller fans, the apex part of which could be noticed at the entrance of the mountains. Fragments of higher fan levels with well-develop soil profile are preserved between the alluvial fans. The shape of the terraces and the fan systems on the Terai piedmont zone is irregular, and are partly controlled by tectonics (Geomorphological Field Guide Book, IGI).

4.2 Soil and rock pattern

Soils of the study area are heterogeneous in nature. The texture varies from gravely loam to loam and it is classified as lithic and Typic Haplustepts. Alfisols are dominant and covers 52.96% of the area followed by Ultisols (36.27%). Darjeeling Himalayan soil generally classified into six types such as Mountain glacial soil, Forest soil, Brown forest soil, Cinchona soil, Terai soil and Tea soil.

The soil developed on steep hill slopes is shallow, excessively drained to vary severe erosional hazards. These are mostly the residual of the eroded soil and lack profile development. The soil, developed on foothill slopes and valley are moderately deep-to-deep, well drained, loamy in texture with moderate erosion hazards, they show some degree of profile development and are classified as Umbric and/ or Fluvaquentic Dystrochrepts, Lithic and/ or Typic Haplustepts. These soils are strongly to moderately acidic in reaction and are rich in humus content with moderate to low base saturation.

The basic soil types are yellow and red-brown soils and brown forest soils, all of siliceous and aluminous type. Red and yellow soils have developed on gneisses and schists along the upper part of slopes. Over the Siwaliks are developed coarse pale yellow to red brown soils, on the Daling shale clayey dark grey soils and on the Gondwanas mainly sandy soils. Over the Darjeeling gneisses prevail red to brown silty and sandy soils. On the floors of main river valleys shallow sandy alluvial soils exits, which at the mountain fore land are more silty in nature.

The character of bedrock is reflected mainly in the grain size composition of soils. A very high percentage of sandy and coarse particles reaching up to 50-80% are a characteristic feature of grain composition of soils over the Darjeeling gneisses as well as Damuda and Daling series. On the steeper slope segments a high content of coarse debris is present. Soil textural map of the Kalimpong Subdivision area indicates that the entire area covered by coarse loamy and gravelly loamy soil. In the slope deposits disturbed by mass movements there exist with the horizons of various content of silty-clay fraction, influencing changes in the infiltration rate. On the contrary in the tea gardens and on the terraced slopes the spatial differentiation in physical properties of soil is connected mainly with agricultural practices (Das and Mondal, 2018).

Figure 4.1 is showing soil pattern of the Kalimpong district. Soil type of the district mainly divided based on Brown Forest Soil of Hill slopes and Terai soil and their sub-type as explained below table (Table 4.1).

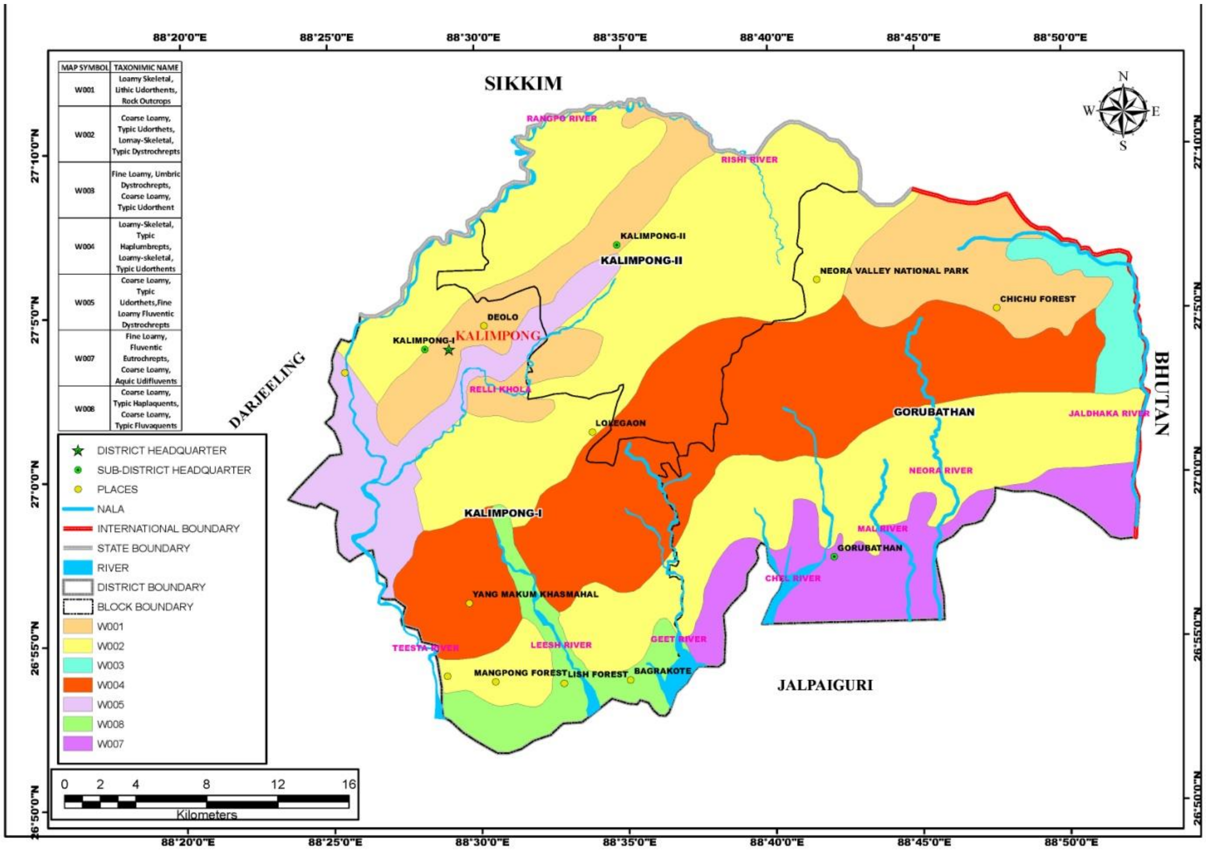


Figure 4.1: Soil Map of Kalimpong District
(Source: https://esdac.jrc.ec.europa.eu/content/west-bengal-soils-sheet-2)

Table 4.1: Description of District soil type

MAP SYMBOL	DESCRIPTION
HILLS AND SIDE SLOPES (BROWN FOREST SOILS)	
W001	Shalow, excessively drained, gravelly loamy soil occurring on very steep side slopes with gravelly loamy surface and severely eroded, associated with rock outcrops.
W002	Moderately shallow, excessively drained, coarse loamy soil occurring on steep side slopes with gravelly loamy surface, severe erosion and strong rockiness associated with moderately shallow, well drained, gravelly loamy soils with loamy surface and moderate erosion.
W003	Deep well drained, fine loamy soils occurring on steep side slopes with gravelly loamy surface, moderate erosion and moderate rockiness, associated with moderately shallow, excessively drained, coarse loamy soils with loamy surface, severe erosion and moderate rockiness.

W004	Moderately shallow, well drained, gravelly loamy soils occurring on steep side slopes with gravelly loamy surface, moderate erosion and moderate rockiness associated with moderately shallow, somewhat excessively drained, gravelly loamy soil with loamy surface, moderate erosion and moderate rockiness.
W005	Moderately Shallow, somewhat excessively drained, coarse loamy soils on gently sloping side slopes with gravelly loamy surface, moderate erosion and slight rockiness associated with deep, well drained, fine loamy soils with loamy surface and slight erosion.
PIEDMONT PLAIN (TERAI SOILS)	
W007	Very deep, imperfectly drained, fine loamy soils occurring on very gently sloping lower piedmont plain with loamy surface and moderate erosion associated with very deep, imperfectly drained, coarse loamy soils.
W008	Very deep, poorly drained, coarse loamy soils occurring on level to nearly level lower piedmont plain with loamy surface associated with very deep, poorly drained, coarse lomay soils

The rock formations from north to south consist of the moderately resistant Darjeeling Gneisses, the Daling Metamorphics of varying resistant (i.e., phyllite to quartzite), and the Damuda Shales with coal beds. Tertiary sandy molass deposits of Siwalik unconformably overlie the Damuda formation. The overall rock type of the district is mainly consisting of Granite, Gneiss, Shales, and most importantly Sandstone and solidified but poorly consolidated clutter of Conglomerate formations.

Rock type of the district may be divided into three tracts, which are, from north to south, the hard rock area, the Bhabar belt, the Terai belt. The Bhabar belt comprises rock fragments, big boulders and fine grained clastics derived from the hard- rock area is characterized by gentle slope, boulder surface and forest of tall trees. These are the coarse alluvial zone below the Siwalik Hills (outermost foothills of the Himalayas) where streams disappear into permeable sediments. The Terai belt is the zone of rejected recharge and, as such has developed swampy condition and is composed mostly of coarse granular materials alternating with finer clastics (Mili J, 2012).

4.3 Different geomorphologic units

Geomorphologically the Kalimpong district can be broadly divided into two regions. These are the valley regions (below 400 m.) and the mountain region (above 1000 m).The hilly areas are a part of the Shivalik Range. Darjeeling Himalayas has an elevation range of 2000-3000 m, and occurs as the foreland of the Kanchenjunga massif. Geological foundations of the Darjeeling hills consist of Precambrian slates, schist, phyllite, quartzite, gneisses, lower Gondwana and Siwalik sandstones and recent to sub-recent alluvium.

The foothills of Darjeeling Himalayas, is known as the Terai. This is primarily a plain land having elevation of 100 to 150 m. Geological formations of these plains are Alluvium, Older Alluvium and Laterite of Siwalik System.

Figure 4.2 below represent the Geomorphological variation of Kalimpong district. Map shows the position of upper hills in the north-eastern part of the district where Neora Valleyis situated. Central region of the northern hilly area is also part of upper hills. Lower and middle ranges are demarcated by Lower hill region. Southern part of the district fall under Alluvial Fan, characteristic of hilly terrain where river off load sediments from narrow canyon to plan land.

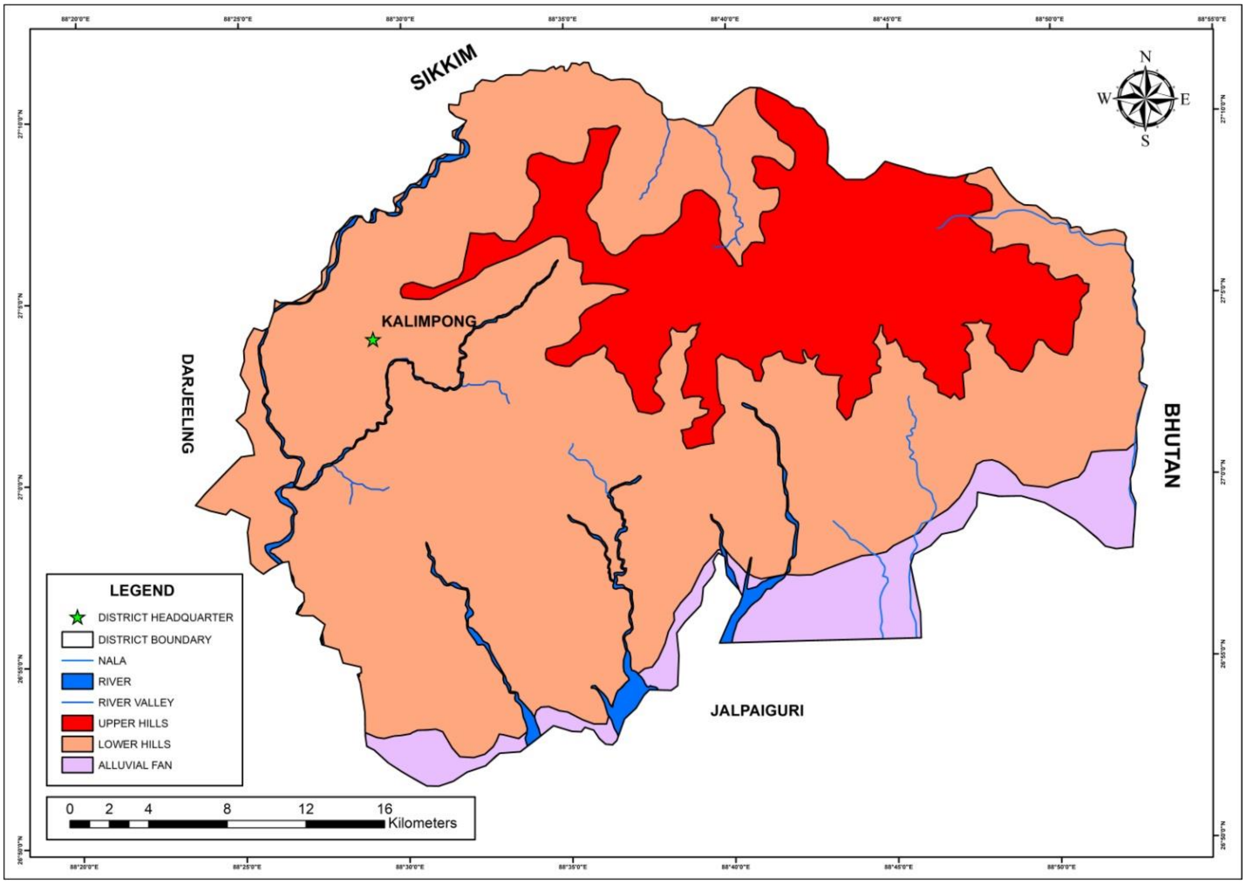


Figure 4.2: Geomorphological map of Kalimpong District

(Source: Resourcesat-1&2 – Liss-3,Bhuvan India)

5 Land use pattern of the district

The land share of un-divided Darjeeling district, which includes Kalimpong, is modest in comparison to other districts in the state. Due to its mountainous terrain, fortunately, for a large proportion of land there is still a forest cover. Data from Census (2011), shows that the total forest land is 124.58 ha. Total land for agricultural use is 160 ha. Table 5.1 gives land utilization static of Darjeeling district including Kalimpong as sub-division. Figure 5.1 is pie diagram representing broad land use pattern of the district and Figure 5.2 is Land Use Land Cover map of the district.

Table 5.1: Classification of Land Utilisation Statistics in the district

Year	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
Reporting Area (In Thousand Hectares)	325.47	325.47	325.47	325.47	325.47
Forest Area	124.57	124.57	124.57	124.57	124.58
Area under Non-agricultural use	39.88	40.16	40.53	38.62	39.21
Barren &uncultivable land	2.48	2.14	2.46	2.57	2.33
Permanent pastures & other grazing land	0.87	1.13	0.83	0.57	0.5
Land under Misc. tree groves not included in Net area sown	2.21	2.33	2.35	2.64	2.78
Cultivable waste land	1.67	1.55	1.49	1.31	1.12
Fallow land other than Current fallow	3.75	3.65	3.22	3.18	2.93
Current fallow	17.53	17.67	16.44	17.36	16.55
Net area sown	132.51	132.27	133.58	134.65	135.47

Source: http://wbpspm.gov.in/publications/District%20Statistical%20Handbook.

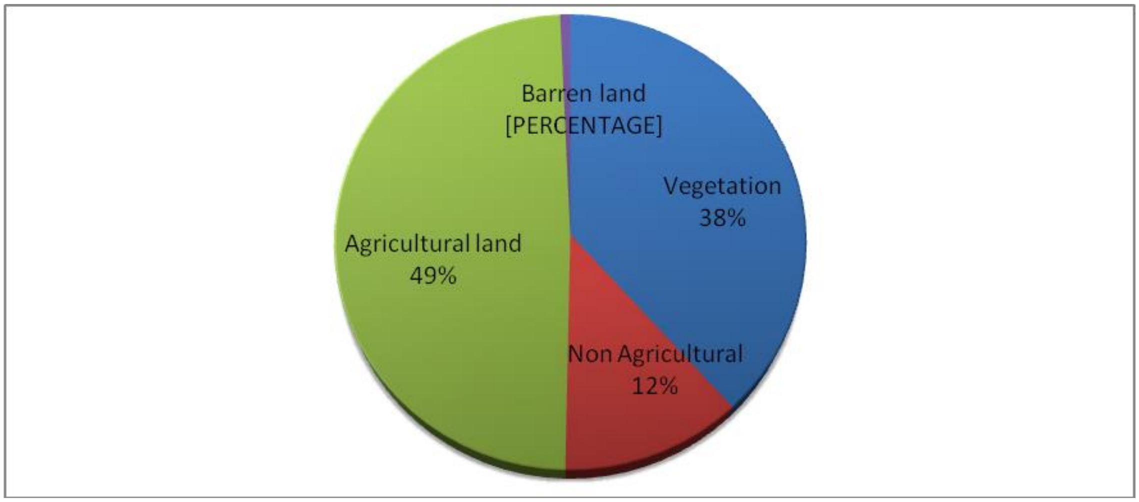


Figure 5.1: Land use pattern of Kalimpong District

Table 5.2 : Distribution of Villages according to Agricultural Land Use, 2011

Name of C.D. Block	Total area (in Hectares)	Percentage of cultivable area to total area	Percentage of irrigated area to cultivable area
Darjeeling Pulbazar	38370.91	44.37	44.05
Rangli Rangliot	27298.65	35.16	20.4
Jorebunglow Sukiapokhr	20293.16	55	23.91
Kalimpong-I	30486.93	37.19	27.49
Kalimpong-II	19810.14	34.5	21.81
Gorubathan	30389.16	44.17	14.01
Mirik	11917.62	63.02	25.74
Kurseong	31596.2	51.41	24.47
Matigara	11275.43	62.37	31.68
Naxalbari	16029.8	60.67	51.18
Phansidewa	30638.94	73.1	12.55
Kharibari	14078.23	66.5	2.7
Total	**282185.2**	**50.2**	**24.56**

Table 5.2 shows the distribution of agricultural land, both irrigated and un-irrigated land, among the villages of un-divided Darjeeling district. In Darjeeling district around 50 percent land area of the total land of the district is available for cultivation. Irrigation is considered as an important factor for cultivation. As per the Table 5.2, 24.56 % of the cultivable land is under irrigation. The proportions of cultivable area in the block Kalimpong-I, Kalimpong-II and Gorubathan, which are in the current Kalimpong district, are lowest to its total area. Gorubathan is the lowest among all the blocks constituting un-divided Darjeeling. Kalimpong-II and Gorubathan are also recorded having less proportion of irrigated area than the district average.

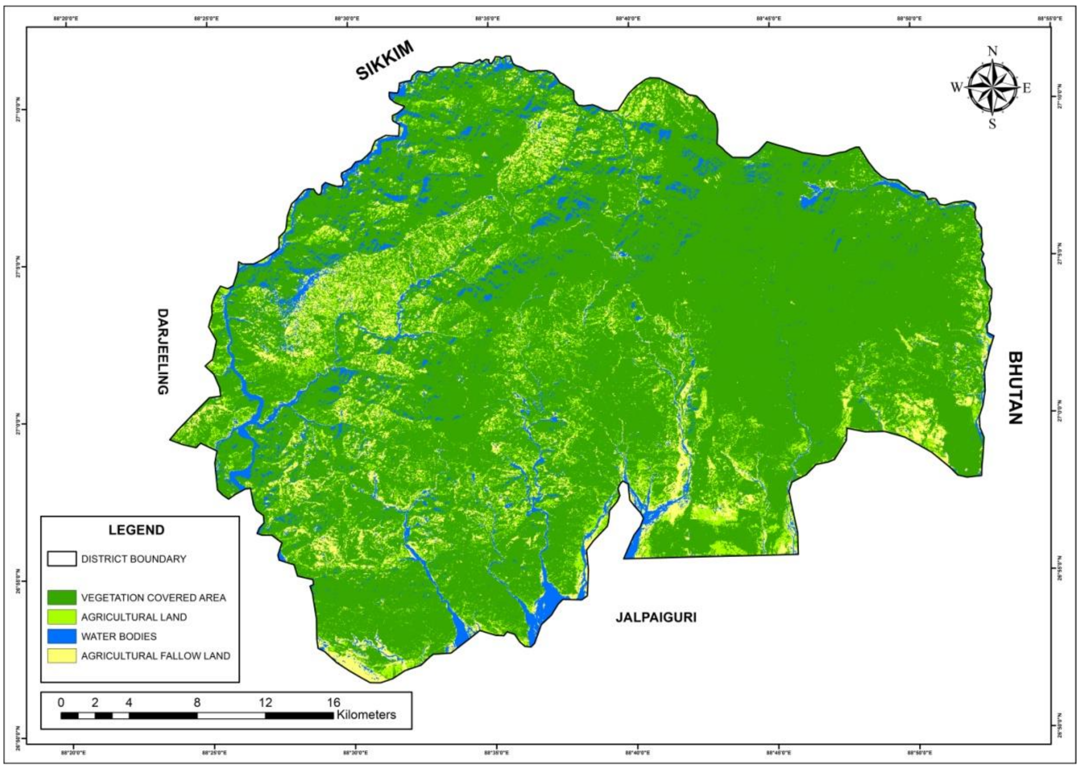


Figure 5.2: Land Use Land Cover map of Kalimpong District

(Source: Resourcesat-1&2 – Liss-3,Bhuvan India)

5.1 Forest -detail of area

The forests under Kalimpong district mostly fall under the Kalimpong Forest Division excluding the area under Neora Valley National Park which had been handed over to Wild Life Wing of Forest Directorate. High temperature and high rainfall lead the growth of dense tropical evergreen forest with thick under growth. The most remarkable features of the forests of the district is the wonderful variety of species they contain; there are, in fact probably few places in the world in which so many different types of forest, exist within so small an area. All the forests in the study area are reserved forest controlled by the Forest Department.

The forest area is 52 % of the total subdivision. The Kalimpong division comprises the reserved forests situated on the mountain slopes to the east of Teesta River, where they form a continuous belt extending round that portion of the area. East of Chel river, they extend northwards up to the frontiers of Sikkim and Bhutan. West of that river, they extend in a narrow strip along the southern boundary of the district westward as far as the Teesta and then northwards up the left bank of that river to where the Rangpo constitutes the frontier of Sikkim. They are also connected with the broad tract of the forest east of the Chel River by a narrow belt of forest running from Paiengaon to Labha, where they enlarged up to the Sikkim frontier, thus forming a complete circle. Besides this, a narrow stretch extends from Labha some 20km in a southwesterly direction into the interior of the circle thus formed.

The district has different kinds of vegetation cover due to various climate, edaphic, topographical and altitudinal variations. The five major forest types according to altitudinal variation found in study areas are:

- Tropical moist deciduous forest (300 – 1000m)
- Tropical evergreen lower mountain forest (1000 – 2000m)
- Tropical evergreen upper mountain forest (2000 – 3000m)
- Temperate forest (3000 – 3500m)
- Sub temperate forest (above 3500m)

About 30% of the forest covers found in the lower hills are deciduous. Evergreen forest constitutes only about 6% of the total forest coverage. Shorarobusta remains the most prominent species of Tropical moist deciduous forest along with heavy under growth. Tropical lower Montana evergreen forests are found on steep higher slopes, where drainage condition is good. Tropical upper Montana evergreen forests are found in the areas where high humidity along with dense fogs and less sunlight is available. Undergrowth is dense and contains Nettles, Raspberries, Farms and bamboos. On the steep ridges, Rhododendrons and bamboos are abundant. These forests, form belts along the left bank of the Teesta River and the northern boundary of the Jalpaiguri district, where they descends to 150m elevation; and they occupy the greater portion of the higher ground of the subdivision(1500 m to 3200 m in elevation). In the greater part of the tract the rainfall is very heavy, amounting to over 5080 mm a year on the southern foothills, and the soil and sub-soil, consisting for the most part of soft micaceous schist, are easily eroded.

Table 5.3 shows the forest classification and the statistic of revenue generation from these forests as per census (2011).

Table 5.3: Classification of Forest Area, Out-turn of Forest Produce, Revenue and Expenditure of Forest Department

Item	Unit	2006-07	2007-08	2008-09	2009-10	2010-11
1. Area by class of forest:	-	-	-	-	-	
Reserved forest	hectare	104373.00	104373.00	104373.00	104373.00	104373.00

Item	Unit	2006-07	2007-08	2008-09	2009-10	2010-11
Protected forest	"	1752.30	1752.30	1752.30	1752.30	1752.30
Unclassed state forest	"	5759.87	5759.87	5759.87	5759.87	5759.87
Khas forest	"	-	-	-	-	-
Vested waste land	"	-	-	-	-	-
Forest owned by Corporate Bodies	"	-	-	-	-	-
Forest owned by Private Individuals	"	-	-	-	-	-
Total		**111885.17**	**111885.17**	**111885.17**	**111885.17**	**111885.17**
2. Forest Produce:	-	-				
Timber	thousand cu. metre	96.75	98.29	91.35	93.10	93.45
Fuel	"	22.56	18.27	15.30	17.20	17.10
Pole	Number	-	-	17	14	18
3. Revenue & Expenditure:	-					
Revenue	Rs. in thousand	184292.00	222943.00	87698.00	82921.00	88767.00
Expenditure	"	188930.00	113070.00	74521.00	78701.28	80874.00

(Source: http://wbpspm.gov.in/publications/District%20Statistical%20Handbook)

5.2 Agriculture & Irrigation

Agriculture not only dominates the economy but it is also varied in nature due to variations in altitude, climate and soils. It is imperative to cut terraces for farming due to steep slopes. The steep slope again encourages soil erosion, thereby affecting the cropping pattern. The influence of temperature and heavy rain is also well-marked on the cropping pattern of the district.

More than 80% of people in Kalimpong depend on farming for their livelihood. Major agro-products include paddy, maize, millet, pulse, oilseed, and potato; however Kalimpong is more widely known as a hub of cash crops like ginger, cardamom, betel-nut and oranges. Kalimpong is also the home to the Dalle Khursani (Capsicum Annuum), a variety of small but extremely hot chilies, which add delectable pungency to the exotic cuisine of the hills.

The two distinct divisions of the district are mountainous region to the north forming the greater part and the plains to the south. Most of the area in the district is under forest. Cultivation is suitable between 300 m and 600 m in the hill areas. The lower hills are mainly used for plantation crops like Tea, Cinchona and Rubber. The net cultivated area is 48% of the total area of the district.

The plain-lands under the Tarai region are favourable for cultivation of rice, jute and potato. Maize (Corn) and ginger are cultivated primarily in the sloping lands at the foot of the hills. Organised sugarcane cultivation in the district has been accelerated after 2006-07. Among the vegetables, production of Cucurbits like Squash, Pumpkin, Zucchini, Gourds etc. are maximum in the district, followed by Cabbage, Cauliflower, Tomato, Bringaletc (Census, 2011).

The crops of the district broadly fall into two groups - (a) plantation crops like tea, orange, cinchona and (b) non-plantation crops like rice, wheat, maize, jute, potato, vegetables etc.

These two may again be conveniently grouped under the following broad categories;-

(1) Subsistence Farming — Paddy, maize, millet, soyabean, wheat, barley etc.
(2) Cash Crop Raising — Potato and vegetables, ginger, cardamom etc.
(3) Plantation Agriculture — Tea, medicinal plants and pineapples.
(4) Miscellaneous categories — Horticulture, floriculture, orchid culture, sericulture and production of mushrooms.

Tea production form the most important part of the district economic scenario. Fruits like Orange, Pomegranate, Pineapple, Mandarin Orange, Banana, Lichee, different Citrus fruits; different vegetables and medicinal herbs like Cucumber, Brinjal, Cabbage, Cauliflower, Cardamom, Chillies, Turmeric, Ginger, Dar-haldi (Daru-Haridra in Sanskrit), Khayer, Cumin, Mint, Potato are cultivated in the district. Food Crops like Rice, Maize, and Wheat etc. are cropped mainly in the Tarai region (Census, 2011).

Agro-forestry is an integral part of the farming system of the district, where trees are integrated extensively with crop and livestock production. Two type of agro-forestry is practiced in the district. The large cardamom based agro-forestry system which accelerates the nutrient cycling, increases the soil fertility and productivity, reduces soil erosion and also provides aesthetic values for the mountain societies. Another is alder-based jhum system, a unique and highly productive form of jhuming (shifting cultivation or slash and burn agriculture). This system is usually practice at high altitude of Rimbhik and Lava region only by lepchas. Normally a jhum farmer cultivates the jhum fields for two years within a nine-year cycle (1:4 ratio of cropping to fallow). But the alder system allows two harvests in two out of every four to five years (1: 1 ratio of cropping to fallow) (Mukherjee, 2012).

Agriculture is a way of life to the people of Kalimpong as it is the source of livelihood, employment and raw materials to leading industries. In the Kalimpong-I block in 2011, among the class of total workers, cultivators formed 23.99%, agricultural labourers formed 33.47%. In the Kalimpong II, 42.57% of total workers is cultivators and agricultural labourers is 19.37%. In Gorubathan cultivators formed 30.99%, agricultural labourers formed 19.47% of total workers.

In 2013–14, Kalimpong I CD block produced 5,467 tonnes of Aman paddy, the main winter crop, from 2,531 hectares, 42 tonnes of wheat from 37 hectares, 12,133 tonnes of maize from 5,695 hectares and 2,775 tonnes of potatoes from 293 hectares. Kalimpong II CD block produced 3,799 tonnes of Aman paddy, the main winter crop, from 1,754 hectares, 67 tonnes of wheat from 59 ha, 8,462 tonnes of maize from 4,071 hectares and 4,848 tonnes of potatoes from 473 ha. Gorubathan CD block produced 1,163 tonnes of Aman paddy, the main winter crop, from 643 hectares, 75 tonnes of wheat from 66 hectares, 4,822 tonnes of maize from 1,578 hectares and 5,820 tonnes of potatoes from 364 hectares. (District Statistical Handbook)

Table 5.4 and 5.5 are on the crop production capacity of the un-divided Darjeeling district.

Table 5.4: Production of Principal Crops in the un-divided Darjeeling District(thousand tonnes)

Crops		2006-07	2007-08	2008-09	2009-10	2010-11
(1)		(2)	(3)	(4)	(5)	(6)
Foodgrains :						
1.	**Rice**	**58.7**	**59.5**	**68.7**	**75.4**	**77.8**
	Aus	8.9	6.2	5.9	7.6	8.2
	Aman	46.6	49.6	59.6	64.4	65.6
	Boro	3.2	3.7	3.2	3.4	4.0
2.	Wheat	3.2	3.8	2.8	3.4	3.5
3.	Barley	-	-	-	-	-
4.	Maize	30.8	38.2	42.9	39.6	40.8
5.	Other Cereals	14.4	14.3	14.3	14.3	14.2
	Total Cereals	**107.1**	**115.8**	**128.7**	**132.7**	**136.3**
6.	Gram	-	-	-	-	-
7.	Tur	(b)	(b)	(b)	(b)	(b)
8.	Other Pulses	1.2	0.7	0.7	0.6	0.7
	Total Pulses	**1.2**	**0.7**	**0.7**	**0.6**	**0.7**
	Total Foodgrains	**108.3**	**116.5**	**129.4**	**133.3**	**137.0**
Oil Seeds :						
1.	Rapeseed & Mustard	0.1	0.1	0.1	0.1	0.2
2.	Linseed	(b)	(b)	(b)	(b)	(b)

Crops		2006-07	2007-08	2008-09	2009-10	2010-11
3.	Other Oil seeds	8.0	0.2	0.2	0.1	0.2
	Total Oil seeds	**8.1**	**0.3**	**0.3**	**0.2**	**0.4**
Fibres :						
1.	Jute	31.4	28.3	33.9	36.8	30.2
2.	Mesta	-	-	-	-	-
3.	Other Fibres	-	-	-	-	-
	Total Fibres	**31.4**	**28.3**	**33.9**	**36.8**	**30.2**
Miscellaneous crops :						
1.	Sugarcane	-	2.3	0.9	0.3	0.3
2.	Potato	110.4	109.2	124.0	149.4	126.7
3.	Tobacco	-	-	-	-	-
4.	Tea(P)	88.9	75.2	77.1	72.2	73.9
5.	Chillies (dry)	0.3	1.1	0.6	0.6	0.6
6.	Ginger	6.3	6.7	6.8	6.9	6.9
	Total Miscellaneous crops	**205.9**	**194.5**	**209.4**	**229.4**	**208.4**

(Source: http://wbpspm.gov.in/publications/District%20Statistical%20Handbook)

Table 5.5: Production of Fruits and Vegetables in the district

Name of Fruits / Vegetables	Production (Thousand tonnes)				
	2006-07	2007-08	2008-09	2009-10	2010-11
A. Fruits					
Mango	0.17	0.17	0.17	0.17	0.19
Banana	3.30	3.53	3.94	3.94	3.94
Pineapple	124.93	126.40	126.90	126.90	131.90
Papaya	2.80	2.99	2.99	2.99	3.01
Guava	1.44	1.45	1.45	1.45	1.45
Jackfruit	2.10	2.56	2.57	2.57	2.57
Litchi	2.92	0.55	0.55	0.55	0.55
Mandarin Orange	0.46	35.98	35.98	36.23	36.53
Other Citrus	5.69	1.24	1.24	1.24	1.24
Sapota	-	-	-	-	-
Others	32.55	32.75	32.75	32.73	32.76

Name of Fruits / Vegetables	Production (Thousand tonnes)				
	2006-07	2007-08	2008-09	2009-10	2010-11
Total	**176.35**	**207.62**	**208.54**	**208.77**	**214.14**
B. Vegetables					
Tomato	13.26	13.47	13.47	14.47	14.66
Cabbage	29.17	30.08	30.08	30.08	30.50
Cauliflower	26.19	26.62	26.62	26.62	26.97
Peas	12.19	12.22	12.22	12.22	12.59
Brinjal	46.39	24.57	24.57	24.57	20.64
Onion	0.49	0.46	0.46	0.46	0.48
Cucurbits	64.98	80.59	80.59	78.59	81.37
Ladies Finger	7.93	6.05	6.05	6.05	6.23
Radish	13.59	13.92	13.92	13.92	9.73
Others	23.70	26.68	26.68	26.68	36.80
Total	**237.90**	**234.66**	**234.66**	**233.66**	**239.97**

(Source: http://wbpspm.gov.in/publications/District%20Statistical%20Handbook)

5.3 Horticulture

A large variety of fruits such as Pine apples, Oranges, Plums, Peaches, Apples etc. are grown in the valleys and on the slopes under moderate rainfall. The Oranges are of excellent quality. The better orangeries usually occur at elevations of 650 m to 1300 m. The traditional orange orchards cover about 3.82 sq.km. of area. The production of Darjeeling Mandarin Oranges and other variety of Citrus fruits are around 37,770 tonnes as on 2010-11. Pineapples are the highest growing fruit variety in the district with an annual production of 1,31,900 tonnes in 2010-11 (Census, 2011).

Table 5.6: Production of Flowers in the district

Name of Flowers	Production				
	2006-07	2007-08	2008-09	2009-10	2010-11
Rose	1.099	1.525	1.525	1.525	1.525
Chrysanthemum	1.870	1.770	1.770	1.770	1.770
Gladiolus	19.015*	20.910	20.910	20.910	20.930
Tuberose	-	-	-	-	-

Name of Flowers	Production				
	2006-07	2007-08	2008-09	2009-10	2010-11
Marigold	..	0.110	0.110	0.110	0.110
Jasmine	0.048	0.018	0.018	0.018	0.018
Seasonal Flower	0.102	0.102	0.102	0.102	0.103
Misc.Flower	0.066	0.078	0.078	0.078	0.078

* crore Spike

(Source: Directorate of Food Processing Industries and Horticulture, Govt. of W.B.)

5.4 Mining

The district is not very rich in mineral resources and there are no large mines in the district. However, collection of sand, stone and gravels from the river-bed of the hilly torrents are the minor mineral sources. These materials are primarily utilized for construction purpose.

6 Geology

The Sikkim-Darjeeling Himalaya contains the stretch of tectonically active Eastern Himalaya. It is composed of three main tectonic units: the Higher Himalaya, the Lower Himalaya and the Siwaliks separated by thrusts, but joined by great fluvial system of the Teesta River. The Higher Himalaya with relief up to 2,000–4,000 m was uplifted by about 2,000 m in the Quaternary rising above the snowline. Its mountain massifs previously had fluvial relief which later had been totally transformed by glacial processes. The Lower Himalaya dissected 1,000–2,000 m locally with remains of mature relief fragments are continuously in the forest belt. The Siwaliks in this part of the Himalayan Range are reduced to a narrow belt, which blend with the Lower Himalaya. Along the Frontal Fault it rises above 1,000 m directly over the alluvial plains of the Sub-Himalayan foredeep, which is still active and split into blocks of various tectonic tendencies (Singh and Keyho, 2014).

The geological formations of the district show the predominance of metamorphic rocks over a major portion of the area. Unaltered sedimentary rocks occur on the south. Darjeeling hills of Kalimpong district consist of Precambrian slates, schist, phyllite, quartzite, gneisses, lower Gondwana and Siwalik sandstones and recent to sub-recent alluvium. The several tectonic units of the Darjeeling Himalaya over-thrusted towards south are built mostly of metamorphic rocks (Darjeeling gneisses, Daling schist and quartzite). The Main Boundary Thrust (MBT) separates them from the Siwalik built of sandstones, conglomerates and mudstones, which are over-thrusted over the Quaternary fore-deep along the Himalayan Frontal Thrust (HFT). The foreland of the Himalaya is built of Quaternary sediments which show a distinct fractional differentiation starting from boulders and gravels in the root part of piedmont fans and terraces, at distance of 5-10 km from the margin turning to sand and farther downstream to sandy loam and silt. A brief description of various formation of the Darjeeling Himalaya is given below:

Table 6.1: Geological succession of Kalimpong

Age	Series	Lithological Characteristics
Recent to Sub-recent	Alluvium	Younger flood plain deposits of rivers consisting of sands, pebbles, gravels, boulders etc.
Pleistocene to Lower Pleistocene (Lower Tertiary)	Siwalik	Micaceous sandstone with siltstone, clay, lignite lenticles, etc.
Thrust (Main Boundary Fault)		
Permian	Damuda (Lower Gondwana)	Quartzitic sandstone with slaty bands, seams of graphitic coal, lampophyre silt and minor bands of limestone.
Thrust(Fault Of Nappe Qutlier)		

Age	Series	Lithological Characteristics
Pre-Cambrian	Daling series	Slate, chlorite-sericite schist, chlorite-quartz schist.
	Darjeeling Gneiss	Golden silvery mica-schist, carboniferous mica-schist, coarse grained gneiss.

Source: Cajee L, 2018

6.1 Daling-Darjeeling Group:

The Daling series and the Darjeeling gneiss of the surrounding area are the parts of the Daling and the Darjeeling series of Sikkim Dharwar. Formerly the Darjeeling series was regarded as an older series over – trusted on the Daling. However, it has now been accepted that the apparently higher grade of the metamorphism of the Darjeeling group (which seems older) is due to interlaminated granite of a later date. Thus, the term Dalings and Darjeeling can be applied respectively lower and upper portion of a sedimentary succession, the upper part of which has been injected and metamorphosed by granite magma under stress.

The Daling-Darjeeling group is remarkable in Himalayan Geology for their constant development and the monotonous lithology over a great thickness. They are represented by the late Precambrian to early Precambrian argillaceous sequence exposed in far western Lower Himalaya and an important litho-stratigraphic unit in Darjeeling Himalaya. The Dalings are well exposed all along the lower and middle course of Teesta River.

6.1.1 The Darjeeling Gneiss:

The gneissic formation consists of garnetiferous mica schist, quartzite and biotite – kyanite and sillimanite gneiss. The gneissic beds are foliated, much folded and crumpled. It is highly micaceous and is composed of colorless and gray quartz, white opaque feldspar, muscovite and biotite. It varies in texture from a fine grained to moderately coarse rock. The Darjeeling gneiss dips in between angles of 35° to 45° towards North West.

6.1.2 The Daling Series:

The Daling group of rock comprises mica-schist, greenish fissile slate and Phyllite with bands of quartzite. The most impressive feature is the progressively higher grade of metamorphism of the Daling upwards. The surface exposure is bounded by the Darjeeling Gneiss to the north and by the rocks of the Damuda series to the south. The dip of the rock beds ranges from 30° to 80° towards mainly north and northeast. The rocks of the Daling series and Darjeeling gneiss are overlain by the rocks of Permian age along a thrust.

6.2 Gondwana Group:

During upper and middle Permian, the rocks of Lower Gondowana formation of Damuda series were deposited which constitute a narrow belt being sandwiched in between the Daling series on the north and Siwalicks of Tertiary on the south.

Along Teesta River section, Gondwana Group of rocks are exposed in a narrow strip of about a kilometer, north of Main Boundary Fault extending either side along the general strike varying between NE-SWand E-W. All along the foothills of Darjeeling district, south of Sikkim, the Siwaliks are steeply over thrust by formations belonging to Damudas of Lower Gondwana. The thrust planes are dipping at 60-70 degrees towards the north. This thrust zone coincides with the well-known Main Boundary fault, which extends for the whole distance along the Himalayan Range. The Damudas are characteristic coal bearing rocks, their fossil flora indicating a lower Gondwana (Permo- Carboniferous) age. A few outcrops of Gondwanas are also found as infolded imbricate slices within the Daling in some of the stream sections in Kalimpong district.

6.3 Siwalik Group:

The Darjeeling Sub Himalayas and the foothill belt are mainly constituted of Siwalik and younger group of rocks of middle Miocene to Lower Pleistocene age. The Siwalik are exposed in a narrow strip of hill range. Siwalik beds are exposed along the Teesta River. The deepest outcrops forming the southern margin of the Siwalik Hills consist of bluish grey nodular marls and clays with micaceous fine-grained sandstones ofage from Pliocene to Pleistocene and dip ranges from 40° to 70° north – northeasterly.

7 Mineral wealth

7.1 Overview of mineral resources

The district contains several important mineral deposits. Geological formation of the district indicates the presence of major minerals deposits such as coal, lead, zinc, copper, limestone, graphite, nickel, mica, iron ore and minor minerals such as building and ornamental stones and silica sand. Of these major minerals, resource of coal is well established along with lead-zinc, copper-gold and limestone deposits. Deposits of Sand and Building stones are explored economically.

7.2 Details of Resources

The mineral resources of the district whose categorization and estimation have been done are furnished in this section.

7.2.1 Sand and other riverbed minerals:

I. Drainage System

Drainage system of the district comprises 6 river courses namely, Teesta, Jaldhaka, Relli, Geet, Neora and Rishi (Table 7.1 and Table 7.2). A brief description of each river courses is given below (Census, 2011).

River Teesta (also spelt as Tista) is the most important river of Kalimpong district. The main stream of the river is originated from Cholamoo (Tso Lhamo) Lake in Tibet. Passing through the mighty Himalayas during its early path, the river reaches the plain land at Sevok near Siliguri and expands in the plains after entering Jalpaiguri district. The river ultimately meets Brahmaputra as a tributary in Bangladesh. River Teesta is fed by numerous smaller tributaries from East and large but fewer tributaries from West bank throughout its journey from Sikkim to Bangladesh through Darjeeling and Jalpaiguri. The principal tributary of river Teesta are river Rangpo to the left bank which creates a natural boundary between Darjeeling and Sikkim for some distance and rivers Great Rangeet (Bari Rangeet / Rangeet Chhu) and Rammam joins Teesta from the right bank forming the district boundary with Sikkim. The River Teesta is primarily a snow-fed river in its upper course and fed by heavy rainfall during the month of June to September in its lower course. Like all other hilly rivers in the region the river bed almost remains dry in other seasons.

River Jaldhaka flows at the Eastern most portion of district Kalimpong and forms the natural boundary (international boundary) with Bhutan flowing from North to South. The river is originated from the sacred Kupup Lake (also known as Bitan Cho) in Eastern Sikkim and flows through Bhutan before entering Kalimpong. Beyond Kalimpong, the river flows East and South-East ward direction and ultimately meets river Dharla (tributary of Brahmaputra) in Bangladesh after flowing through Jalpaiguri and Cooch Behar districts of West Bengal. The river enters Kalimpong district at Bindu in the North-East corner of the district and meets with two smaller streams named Bindu Khola and Dudh Pokhri and the combined flow is known as river Jaldhaka. The major right bank tributary lying in Kalimpong district is Nakshal Khola. At the lower course, beyond the boundaries of Kalimpong district, Jaldhaka is met with its other tributaries like rivers Murti, Sutunga, Jarda in right bank and rivers Dayna (Diana), Kuchi Dayna, Rehti-Duduya, Mujnai on its left bank.

River Geet is originated from the Siwalik Himalayan region in the Gorubathan C.D. Block of Kalimpong district and flows from North to South. It is also a tributary of river Teesta. The Geet is formed by the joining of two small rivulets, one originating below Lava and the other below the Chumang reserve forest. Ramthi and Lethi form the major tributaries of the river.

The Neora originates from the Rechila Chawk just below the Rechila-danda and joins the Thosum chu at the boundary of Thosum and Rechila. It then flows southwards and eventually joins the Teesta.

The Relli originates in Khempong Reserve Forest below Labha-Algarah and runs along the southern boundary of Saihur reserve forest after which it is joined by the Pala and Lolleykhola and moving southwards it joins the Rani khola.

Leesh River originates at the ridge of Pabringtar village and flows downwards receiving the Amlkhola on the western side and Turung khola on the east further southwards it is joined by the Phang khola and Chunkhola near the Bagrakote colliery and eventually joins the Teesta at the Kalagaiti Tea estate.

Murti originates in the Mo block south of Thosum hills flowing through the reserve forest and emerging in the Samsing area and eventually joining the Jaldhaka River.

Rishi River is located at the north eastern corner of the Kalimpong district. The river drains into the river Rongli, a left bank tributary of the river Rongpo.

(Cajee, 2018)

Table 7.1: Drainage system with description of main rivers

S.No.	Name of the River	Area drained (Sq.km)	% Area drained in the district
1	River Teesta	7.10	0.67%
2	Relli River	2.94	0.28%
3	Geet River	3.22	0.30%
4	Neora River	2.52	0.24%
5	Jaldhaka River	1.42	0.13%
6	Rishi River	0.85	0.1%

Table 7.2: Salient Features of important rivers and streams

S.No.	Name of the River or Stream	Total Length in the District (in Km)	Place of origin	Altitude at Origin
1	River Teesta	37.00	Tso Lhamo Lake, Sikkim	5100m
2	Relli River	30.64	Alagara – Labhaforest range, Kalimpong	2400m
3	Geet River	30.20	Lava in Kalimpong District	2195m
4	Neora River	27.46	RechilaChawk, Kalimpong	3000m
5	Jaldhaka River	19.47	Kupup Lake, Sikkim	950m
6	Rishi Khola	17.36	Lava-Pankhasari ridge	2000m

II. Annual deposition of riverbed minerals

Annual deposition of riverbed minerals is dependent on various factors which are explained below.

A. Geomorphological studies

Geomorphological characteristic of a river is foremost factor for annual deposition of sedimentary load. The study includes following parameter:

i) Place of Origin

The place of origin of each of the rivers is given in Table 7.3.

Table 7.3: Place of origin of rivers of Kalimpong district

Name of the River or Stream	Place of origin
River Teesta	Tso Lhamo Lake, Sikkim
Relli River	Alagara - Labha Forest range, Kalimpong
Geet River	Lava in Kalimpong District
Neora River	RechilaChawk, Kalimpong
Jaldhaka River	Kupup Lake, Sikkim
Rishi Khola	Lava-Pankhasari ridge

ii) Catchment Area

The Kalimpong district is mainly drained by the Teesta and its tributaries, except the extreme eastern portion where the chief effluent is the Jaldhaka. Teesta and its tributary Relli are forming the main catchment area. Besides these Leesh, Gish, Chel and Murti are also important rivers in southern portion of the Kalimpong subdivision.

iii) General profile of river stream

Relative disposition of rivers in Kalimpong district along with the distribution of the section lines are shown in Figure 7.1. River profile has been studied along the cross section lines (Figure 7.2 and Figure 7.3) which was chosen based on the drastic variation of the river widths, proximity of the operating sand Ghats and the position of the sand bars.

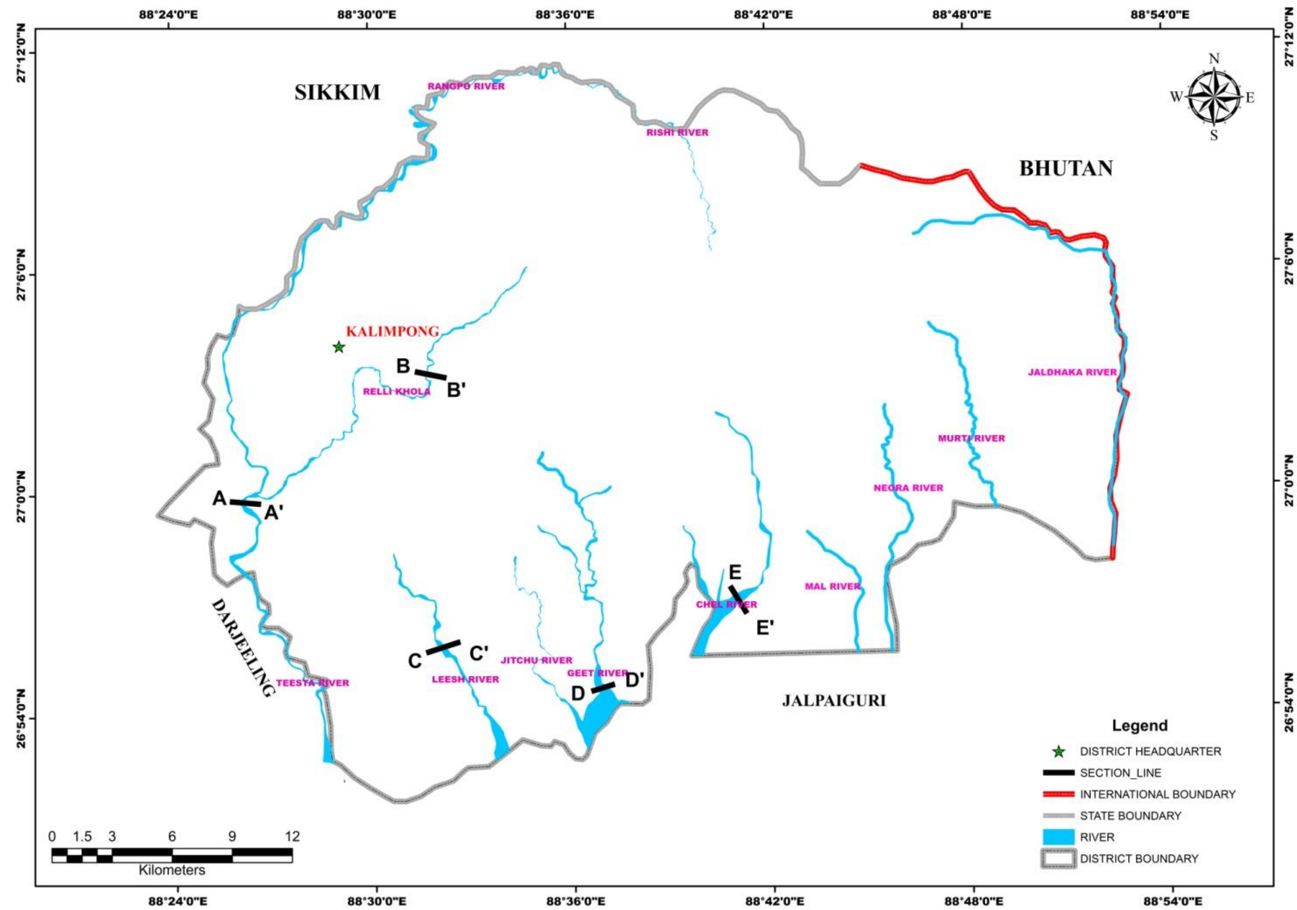


Figure 7.1: Plan showing the major rivers along with the distribution of section lines

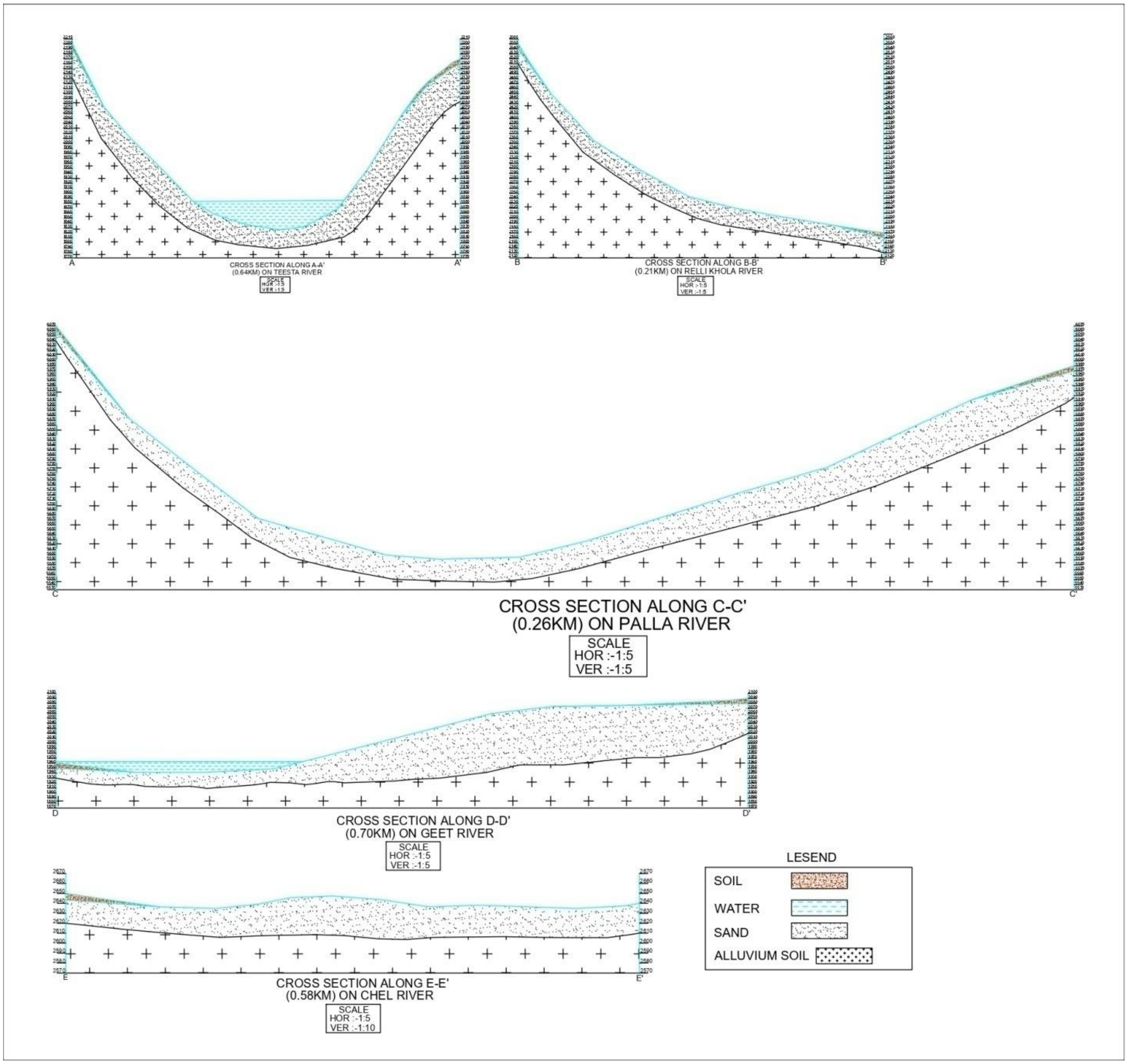


Figure 7.2: Cross section of rivers during pre monsoon period

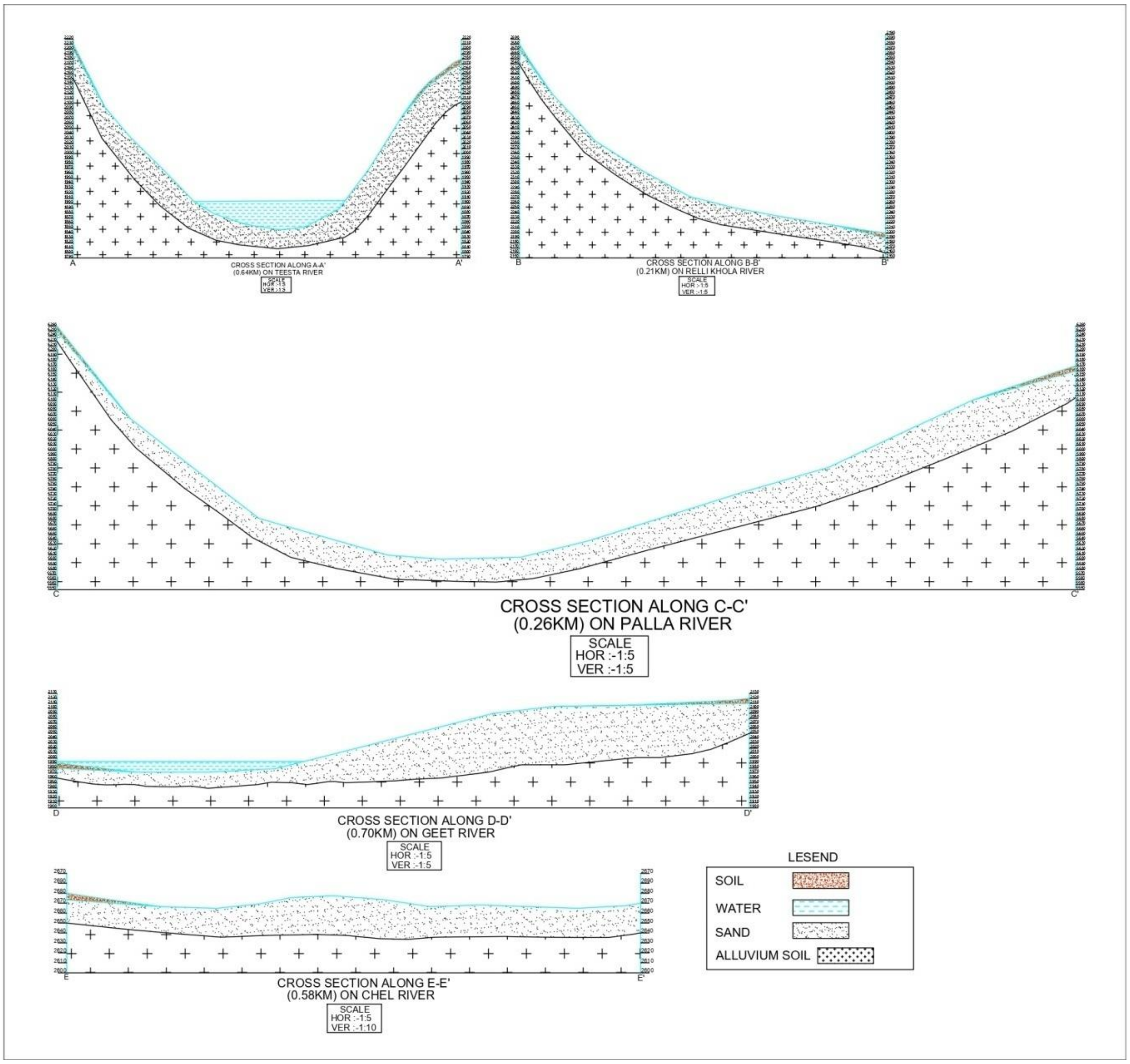


Figure 7.3: Cross section of rivers during post monsoon period

iv) Annual deposition factor

Annual deposition of riverbed materials depends on various factors, such as process of deposition, mode of sediment transport, sediment transport rate, and sediment yield of the river.

1. Process of deposition

Deposition is the processes where material being transported by a river is deposited. Deposition occurs when the forces responsible for sediment transportation are no longer sufficient to overcome the forces of gravity and friction, creating a resistance to motion; this is known as the null-point hypothesis. This can be when a river enters a shallow area or towards its mouth where it meets another body of water.

The principle underlying the null point theory is due to the gravitational force; finer sediments remain in the water column for longer durations allowing transportation outside the surf zone to deposit under calmer conditions. The gravitational effect or settling velocity determines the location of deposition for finer sediments, whereas a grain's internal angle of friction determines the deposition of larger grains on a shore profile.

Deposition of non-cohesive sediments: Large-grain sediments transported by either bedload or suspended load. In case of bedload, when there is insufficient bed shear stress and fluid turbulence are insufficient to keep the sediment moving, the grain cease horizontal movement and rapidly come to rest. In case of suspended load the grain settle longer distance vertically through the fluid before coming to rest.

Deposition of cohesive sediments: The cohesion of sediment occurs with the small grain sizes associated with silts and clays, or particles smaller than 4Φ or 62.5 μm. If these fine particles remain dispersed in the water column, Stokes law applies to the settling velocity of the individual grains. The face of a clay platelet has a slight negative charge where the edge has a slight positive charge when two platelets come into close proximity with each other the face of one particle and the edge of the other are electrostatically attracted, and then have a higher combined mass which leads to quicker deposition through a higher fall velocity.

2. Mode of sediment transport in rivers

Sediment transport in rivers provides a dynamic linkage between flow and channel form. Mainly there are three processes by which sediment load is transported and these are (i) rolling or traction, in which the particle moves along a sedimentary bed but is too heavy to be lifted from it; (ii) saltation; and (iii) suspension, in which particles remain permanently above the bed, sustained there by the turbulent flow of the water.

Another name for sediment transport is sediment load. The total load includes all particles moving as bedload, suspended load, and wash load.

Bed load: Bedload is the portion of sediment transport that rolls, slides or bounces along the bottom of a waterway. This sediment is not truly suspended, as it sustains intermittent contact with the streambed, and the movement is neither uniform nor continuous. Bedload occurs when the force of the water flow is strong enough to overcome the weight and cohesion of the sediment. While the particles are pushed along, they typically do not move as fast as the water around them, as the flow rate is not great enough to fully suspend them. Bedload transport can occur during low flows (smaller particles) or at high flows (for larger particles). Approximately 5-20% of total sediment transport is bedload. In situations where the flow rate is strong enough, some of the smaller bedload particles can be pushed up into the water column and become suspended.

Suspended load: While there is often overlap, the suspended load and suspended sediment are not the same thing. Suspended sediment are any particles found in the water column, whether the water is flowing or not. The suspended load, on the other hand, is the amount of sediment carried downstream within the water column by the water flow. Suspended loads require moving water, as the water flow creates small upward currents (turbulence) that keep the particles above the bed. The size of the particles that can be carried as suspended load is dependent on the flow rate. Larger particles are more likely to fall through the upward currents to the bottom, unless the flow rate increases, increasing the turbulence at the streambed. In addition, suspended sediment will not necessarily remain suspended if the flow rate slows.

Wash load: The wash load is a subset of the suspended load. This load is comprised of the finest suspended sediment (typically less than 0.00195 mm in diameter). The wash load is differentiated from the suspended load because it will not settle to the bottom of a waterway during a low or no flow period. Instead, these particles remain in permanent suspension as they are small enough to bounce off water molecules and stay afloat. However, during flow periods, the wash load and suspended load are indistinguishable.

3. Sediment Transport Rate

The rate at which sediment is moved past a cross section of the flow is called either the sediment transport rate or the sediment discharge. It‘s related to the sediment load, but it‘s different, just because different fractions of the sediment load are transported at different rates. It can be measured in mass per unit time, or in weight per unit time, or in volume per unit time. The sediment transport rate is commonly denoted by qs.

4. Estimation of Sedimentation

There are two approaches to obtaining values describing sediment loads in streams. One is based on direct measurement of the quantities of interest, and the other on relations developed between hydraulic parameters and sediment transport potential.

The total bed material load is equal to the sum of the bedload and the bed material part of the suspended load; in terms of volume transport per unit width, qt = qb + qs. Here wash load, i.e. that part of the suspended load that is too fine to be contained in measurable quantities in the river bed, is excluded from qs.

There are number of equations to compute the total sediment load. Most of these equations have some theoretical and empirical bases.

In 1973, Ackers and White developed a general theory for sediment transport which was calibrated against the flume-transport data then available. Their functions have been widely accepted as one of the best available procedures for estimating the total bed over the full width of the flow section.

Dendy Bolton formula is often used to calculate the sedimentation yield. But use of these equations to predict sediment yield for a specific location would be unwise because of the wide variability caused by local factors not considered in the equations development. However, they may provide a quick, rough approximation of mean sediment yields on a regional basis. Computed sediment yields normally would be low for highly erosive areas and high for well stabilized drainage basins with high plant density because the equations are derived from average values. The equations express the general relationships between sediment yield, runoff, and drainage area.

5. Sediment Yield

The water that reaches a stream and its tributaries carries sediment eroded from the entire area drained by it. The total amount of erosional debris exported from such a drainage basin is its sediment load or sediment discharge and the sediment yield is the sediment discharge divided by the total drainage area of the river upstream of the cross section at which the sediment discharge is measured or estimated. Sediment yield is generally expressed as a volume or weight per unit area of drainage basin—e.g., as tons per square kilometer. Further, sediment yield is usually measured during a period of years, and the results are thus expressed as an annual average.

v) Replenishment Study as per EMGSM guidelines 2020:

Replenishment study for a river solely depends on estimation of sediment load for any river system and the estimation is a time consuming and should be done over a period. The process in general is very slow and hardly measurable on season to season basis except otherwise the effect of flood is induced which is again a cyclic phenomenon. Usually replenishment or sediment deposition quantities can be estimated in the following ways as given below:

A. Replenishment study based on satellite imagery involves demarcation of sand bars potential for riverbed mining. Both pre and post monsoon images need to be analysed to established potential sand bars. Volume estimation of sand is done by multiplying Depth and Area of the sand bar. The sand bars are interpreted with the help of satellite imagery. Ground truthing has been done for 100% of the total identified sand bars. During ground truthing, width and length of each segment were physically measured. It has also been observed that in few cases, sand bars have attained more than 3 meters height from the average top level of the river beds. Considerations of sand resources have been restricted within 3 meters from the average top surface of the river bed.
B. Direct field measurement of the existing leases involving estimation of the volume difference of sand during pre and post-monsoon period. With systematic data acquisition, a model has developed for calculation of sediment yield and annual replenishment with variable components.

C. The replenishment estimation based on a theoretical empirical formula with the estimation of bed-load transport comprising of analytical models to calculate the replenishment estimation.

V (A). Replenishment Study based on field investigation:

Sedimentation in any river is dependent on sediment yield which depends on soil erosion in river's catchment area. Catchment yield is computed using Strange's Monsoon runoff tables for runoff coefficient against rainfall return period. Peak flood discharge is calculated by using Dickens, Jarvis and Rational formula at 25, 50 and 100 years return period. The estimation of bed load transport using Ackers and White Equation.

Methodology Adopted: To delineate replenishment percentage in the river bed of the district, below mentioned steps have been followed.

1. **Field data collation**

Field data collations were started during April 20202 at the mining start period, June for pre monsoon period, during December for post monsoon period and finally March 2021 at the end of mining for the river ghats. However, the nonoperational areas were covered through traverses. In both the cases, relative elevation levels were captured through GPS/DGPS/ Electronic Total Station. Thickness of the sand bars was measured through sectional profiles. In few instances, sieve analysis of the sands was carried out to assess their particle size distribution. Figure 7.4, 7.5 and &.6 are showing the site view of River Teesta, Relli and Rishi.

Figure 7.4: Site View of River Teesta

Figure 7.5: Site View of River Relli

Figure 7.6: Site View of Rishi River

2. **Selection of Study profiles:**

Study profiles are selected based on the occurrence of the sand bars in the channel profiles. Aerial extents of each of the profiles are mapped from satellite imagery.

3. **Data Compilation:**

Following data were compiled for generation of this annual replenishment report:

- Elevation levels of the different sand ghats and sand bars as measured at site.
- Extents of the sand bars are measured from the pre monsoon satellite imagery.
- Sand production data of the district.

All these data were compiled while estimation of the replenished sand in the Kalimpong district.

4. **Assessment of sediment load**:

Assessment of sediment load in a river is subjective to study of the whole catchment area, weathering index of the various rock types which acts as a source of sediments in the specific river bed, rainfall data over a period not less than 20 years, and finally the detail monitoring of the river bed upliftment with time axis. Again the sediment load estimation is not a dependent variable of the district boundary, but it largely depends upon the aerial extents of the catchment areas, which crosses the district and state boundaries.

The major sand producing rivers of the Kalimpong district are Relli, Geet, Rishi, Leesh and Rangpo Rivers. Teesta River is main river of the district but from sand mining prospective the river is not sand producing. Planning has been done for systematic sand mining in these rivers.

From the satellite imagery as well as ground survey during post monsoon period, altogether 52 sand bars are identified in Kalimpong district. Out of 53 sand bars, 10 are falling in Relli River, 11 are falling in Geet River, 10 are falling in Leesh River, 8 are falling in Chel River, 7 bars in Rishi River, 5 are in Rangpo River and remaining 2 sandbars are falling in small river channels of Palla. Whereas during pre-monsoon period total 45 no of sand bars identified. Among these, 9 are falling in Relli River, 11 are falling in Geet River, 7 are falling in Leesh River, 7 are falling in Chel River, 5 bars in Rishi River, 5 are in Rangpo River and remaining 1 sandbar is falling in small river channel of Palla.

While calculation of the areas of sand bar, a classification system has been adopted with three categories of land identified within the channel areas which is as follows:

a. The untapped Sand Bars.
b. The Sand bars worked in the pre-monsoon period.

c. Main channel course within the channel.

A summary of sediment load comparison between pre- and post-monsoon period for different rivers of Kalimpong district is given in Table 7.4 and details of each sand bars along with their sand resources in pre monsoon and post monsoon periods are provided in Annexure 2. Maps showing distribution of sand bars on rivers of the Kalimpong district during pre- and post-monsoon period are depicted in Plate 2A and Plate 2B respectively.

Table 7.4: Sediment load comparison between Pre and Post Monsoon period for different rivers of Kalimpong district

River Name	Pre- Monsoon no of sand bar	Post-Monsoon no of sand bar	Pre-Monsoon Sediment Load (Mcum)	Post-Monsoon Sediment Load (Mcum)	Volume Difference (Mcum)	Variation %
Relli River	9	10	1.03	1.23	0.203	20%
Geet River	11	11	0.99	1.27	0.284	29%
Leesh River	7	10	0.93	1.33	0.402	43%
Chel River	7	8	0.96	1.01	0.047	5%
Palla River	1	2	0.08	0.09	0.006	8%
Rangpo River	5	5	0.08	0.10	0.026	33%
Rishi River	5	7	0.00	0.00	0.000	3%
Total	**45**	**53**	**4.073**	**5.042**	**0.969**	**24%**

Thus, in Kalimpong district about 0.969 million cum of sand has been found as an incremental volume when compared between pre and post monsoon sand reserve data. Percentage difference is about 124% which is replenishment and aggradation rate for the year.

Long-term satellite imagery study has also been carried out for sand producing rivers of Kalimpong district to analyse the changes in river course. A representative map, showing long-term (from 1985-2010-to 2022) erosion-accretion areas on both the banks of Geet River has been prepared and furnished as Plate No. 5A and 5B. 5B Map shows changes in river channel through erosion and accretion of river bank and it shows accretion of about 50 m in the northern part of the river bank.

V (B). Replenishment estimation based on field investigation

The study was carried out on existing mining leases. In order to assess the annual replenishment rate, an approach of direct measurement methodology has been adopted. The depth and area of the mining leases are measured through DGPS/Total station just before the closure of the mines in pre-monsoon period and the same areas are resurveyed in the post-monsoon period. The difference between the depth of the surveyed areas are accounted for the volumetric measurement of the replenished sand.

Table 7.5 represents field measurement of replenishment rate estimated for major rivers.

Table 7.5: Replenishment rate of the district

Location	River Name	Area	Surface RL	Thickness	Volume	After mining floor RL	Surface RL	Thickness	Volume	Difference in RL	Replenishment Rate
		m2	m	m	cum	m	m	m	cum	m	%
Pagrangbong (17)	Geet	10100.00	282.00	1.50	15150.00	280.50	281.90	1.40	14165.25	0.10	93.50%
IchaKM (45)	Relli	7300.00	625.00	1.50	10950.00	623.50	624.89	1.39	10128.75	0.11	92.50%
Yokprintam (58)	Relli	4900.00	480.00	1.50	7350.00	478.50	479.90	1.40	6835.50	0.11	93.00%

The replenishment study conducted at the mining block shows the average replenishment rate of the year 2020 is about 93%.

V (C). Replenishment estimation based on an empirical formula:

The river reaches with sand provide the resource and thus it is necessary to ascertain the rate of replenishment of the mineral. Regular replenishment study needs to be carried out to keep a balance between deposition and extraction.

Sediment load deposition in a river is dependent on catchment area, weathering index of the various rock types of the catchment area, land-use pattern of the area, rainfall data and grain size distribution of the sediments. Again, the sediment load estimation is not a dependent variable of the district boundary, but it largely depends upon the aerial extents of the catchment areas, which crosses the district and state boundaries.

i. Methodology of the study:

The replenishment estimation is based on a theoretical empirical formula with the estimation of bedload transport comprising of analytical models to calculate the replenishment estimation. Sedimentation in riverbed depends on catchment yield, peak flood discharge due to rainfall, bed load transport rates and sediment yield characteristic of the river. Some of the common methods used for replenishment study are explained below.

a. Catchment Yield Calculation:

The total quantity of surface water that can be expected in a given period from a stream at the outlet of its catchment is known as yield of the catchment in that period. The annual yield from a catchment is the end product of various processes such as precipitation, infiltration and evapo-transpiration operating on the catchment.

Catchment Yield can be estimated using following formula:

Catchment Yield (m^3) =Catchment area (m^2) × Runoff coefficient (%) × Rainfall (m)

The runoff generated from the watershed is analyzed using Strange's Tables to get the reliable yield results. Runoff from a catchment is dependent upon annual rainfall as well as catchment characteristics such as soil types and the type of groundcover / land usage. Remote sensing was used for demarcation of catchment area relevant to the drainage system. Runoff coefficient of the catchment has been established based on Strange's Table.

Strange (1892) studied the available rainfall and runoff and obtained yield ratios as functions of indicators representing catchment characteristics. Catchments are classified as good, average and bad according to the relative magnitudes of yield of sediment. For example, catchment with good forest cover and having soils of high permeability would be classified as bad, while catchment having soils of low permeability and having little or no vegetal cover is termed good. Based on the study Strange established runoff coefficient table as given in Table 7.6.

Table 7.6: Runoff coefficient of the catchment based on Strange's table

Total monsoon rainfall (mm)	Runoff coefficient (%)			Total monsoon rainfall (mm)	Runoff coefficient (%)		
	Good catchment	Average catchment	Bad catchment		Good catchment	Average catchment	Bad catchment
25.4	0.1	0.1	0.1	787.4	27.4	20.5	13.7
50.8	0.2	0.2	0.1	812.8	28.5	21.3	14.2
76.2	0.4	0.3	0.2	838.2	29.6	22.2	14.8
101.6	0.7	0.5	0.3	863.6	30.8	23.1	15.4
127	1	0.7	0.5	889	31.9	23.9	15.9
152.4	1.5	1.1	0.7	914.4	33	24.7	16.5
177.8	2.1	1.5	1	939.8	34.1	25.5	17
203.2	2.8	2.1	1.4	965.2	35.3	26.4	17.6
228.6	3.5	2.6	1.7	990.6	36.4	27.3	18.2
254	4.3	3.2	2.1	1016	37.5	28.1	18.7
279.4	5.2	3.9	2.6	1041.4	38.6	28.9	19.3
304.8	6.2	4.6	3.1	1066.8	39.8	29.8	19.9
330.2	7.2	5.4	3.6	1092.2	40.9	30.6	20.4
355.6	8.3	6.2	4.1	1117.6	42	31.5	21
381	9.4	7	4.7	1143	43.1	32.3	21.5
406.4	10.5	7.8	5.2	1168.4	44.3	33.2	22.1
431.8	11.6	8.7	5.8	1193.8	45.4	34	22.7
457.2	12.8	9.6	6.4	1219.2	46.5	34.8	23.2

Total monsoon rainfall (mm)	Runoff coefficient (%)			Total monsoon rainfall (mm)	Runoff coefficient (%)		
	Good catchment	Average catchment	Bad catchment		Good catchment	Average catchment	Bad catchment
482.6	13.9	10.4	6.9	1244.6	47.6	35.7	23.8
508	15	11.3	7.5	1270	48.8	36.6	24.4
533.4	16.1	12	8	1295.4	49.9	37.4	24.9
558.8	17.3	12.9	8.6	1320.8	51	38.2	25.5
584.2	18.4	13.8	9.2	1346.2	52.1	39	26
609.6	19.5	14.6	9.7	1371.6	53.3	39.9	26.6
635	20.6	15.4	10.3	1397	54.4	40.8	27.2
660.4	21.8	16.3	10.9	1422.4	55.5	41.6	27.7
685.8	22.9	17.1	11.4	1447.8	56.6	42.4	28.3
711.2	24	18	12	1473.2	57.8	43.3	28.9
736.6	25.1	18.8	12.5	1498.6	58.9	44.4	29.4
762	26.3	19.7	13.1	1524	60	45	30

Rainfall return period for 25, 50 and 100 years calculated as below:

As per Weibull's Formula (Subramanya, 2008),

Return period/Recurrence interval = (n+1)/m

Where: n number of years on record;
m is the rank of observed occurrences when arranged in descending order.

b. Peak Flood Discharge Calculation:

The term "peak discharge" stands for the highest concentration of runoff from the basin area. The accurate estimation of flood discharge remains one of the major challenges as it depends upon physical characteristic of the catchment area and the flood intensity, duration and distribution pattern. There have been many different approaches for determining the peak runoff from an area. As a result, many different models (equations) for peak discharge estimation have been developed. Formulas used for Peak Discharge calculation areas below:

As per Dicken's formula (Subramanya, 2008),

$$Q = CA^{3/4}$$

Where: Q is Maximum flood discharge (m^3/sec) in a river
A is Area of catchment in Sq. Km
C is Constant whose value varies widely between 2.8 to 5.6 for catchments in plains and 14 to 28 for catchments in hills

As per Jarvis formula (Subramanya, 2008),

$$Q = CA^{1/2}$$

Where: Q is Maximum flood discharge (m^3/sec) in a river
A is Area of catchment in Sq. Km

C is Constant whose value varies between 1.77 as minimum and 177 as maximum. Limiting or 100 percent chance floods are given by the value of C of 177

As per Rational formula (Subramanya, 2008),

Q = CIA

Where: Q is Maximum flood discharge (m^3/sec) in a river
A is Area of catchment in Sq. Km
C is Runoff coefficient which depends on the characteristics of the catchment area. It is a ratio of runoff: rainfall
I is Intensity of rainfall (in m/sec)

c. Bed Load Transport Calculation:

The most important problems in river engineering are to predict bed load transport rates in torrential floods flowing from mountainous streams. Three modes of transport namely; rolling, sliding and saltation may occur simultaneously in bed load transport. The different modes of transportation are closely related and it is difficult, if not impossible, to separate them completely. There are number of equations to compute the total sediment load. Most of these equations have some theoretical and empirical bases.

Ackers and White:

Ackers and White (1973) used dimensional analysis based on flow power concept and their proposed formula is as follows.

$$C_t = C_s G_s (d_{50}/h) (V/U_*)^{n'} [(F_{gr}/A_1) - 1]^m$$

The dimensionless particle d_{gr} is calculated by:

$$d_{gr} = d_{50} (g(G_s-1)/v^2)^{1/3}$$

The particle mobility factor $F_{gr}$is calculated by:

$$F_{gr} = (U^{*n'}/(Gs-1)g\, d_{50})^{1/2} * (V/(5.66\log(10h/d_{50}))^{1-n'}$$

Where,

A_1 = Critical particle mobility factor
C_s = Concentration coefficient in the sediment transport function
C_t = Total sediment concentration
d_{50} = Median grain size
d_{gr} = Dimensionless particle diameter
F_{gr} = Particle mobility parameter
g = Acceleration of gravity
D_s, S_g = Specific gravity
h = Water depth
m = Exponent in the sediment transport function
n' = Manning roughness coefficient
U_* = Shear velocity
V = Mean flow velocity
ν = Kinematic viscosity

Meyer – Peter's equation (Ponce, 1989**):**

Meyer-Peter's equation (Ponce, 1989) is based on experimental work carried out at the Federal Institute of Technology, Zurich. Mayer-Peter gave a dimensionless equation based on rational laws. Mayer- Peter equation gave an empirical formula of bed load transport rates in flumes and natural rivers. The simplified Meyer-Peter's equation is given below:

$$g_b = 0.417[\tau 0 (\eta'/ \eta)^{1.5} - \tau c]^{1.5}$$

Where,
gb = Rate of bed load transport (by weight) in N per m width of channel per second.

η' = Manning's coefficient pertaining to grain size on an un-rippled bed and Strickler formula i.e. η' = (1/24) x d1/6 where d is the median size (d_{50}) of the bed sediment in m.

η = The actual observed value of the rugosity coefficient on rippled channels. Its value is generally taken as 0.020 for discharges of more than 11cumecs, and 0.0225 for lower discharges.

τc = Critical shear stress required to move the grain in N/m2 and given by equation τc = 0.687da, where da is mean or average size of the sediment in mm. This arithmetic average size is usually found to vary between d_{50} and d_{60}.

τ0= Unit tractive force produced by flowing water i.e.γwRS. Truly speaking, its value should be taken as the unit tractive force produced by the flowing water on bed = 0.97γwRS. R is the hydraulic mean depth of the channel (depth of flow for wider channel) and S is the bed slope.

d. **Sediment Yield Estimation:**

Sedimentation occurs as the velocity decreases along with its ability to carry sediment. Coarse sediments deposit first, then interfere with the channel conveyance, and may cause additional river meanders and distributaries. The area of the flowing water expands, the depth decreases, the velocity is reduced, and eventually even fine sediments begin to deposit. As a result, deltas may be formed in the upper portion of reservoirs. The deposited material may later be moved to deeper portions of the reservoir by hyraulic processes within the water body.

There are many sediment transport equations which are suitable for use in the prediction of the rate of replenishment of river. Some of the famous sediment transport equations are:

1. Dendy – Bolton Equation
2. Yang Equations
3. Engelund-Hansen Equation
4. Modified Universal Soil Loss Equation (MUSLE) developed by Williams and Berndt (1977)

Dendy – Bolton Equation:

Dendy – Bolton formula (Dendy and Bolton 1976) is often used to calculate the sedimentation yield because:-

- The formula uses catchment area and mean annual runoff as key determinants.

- It does not differentiate in basin wide smaller streams and their characteristics.
- Dendy and Bolton equation calculates all types of sediment yield i.e. sheet and rill erosion sediments, gully erosion sediments, channel bed and bank erosion sediments and mass movement etc.

Dendy-Bolton determined the combined influence of runoff and drainage area on sediment yield to compute the sediment yield. They developed two equations i.e. for run off less than 2 inch and for run off more than 2 inch, which are given below:

For run off less than 2 inch:

$$(Q<2in)\ S=1289\times (Q)^{0.46}\times [1.43-0.26\ \mathrm{Log}\ (A)]$$

For run off more than 2 inches:

$$(Q > 2\ in):\ S= 1958\times (e^{-0.055\times Q}) \times [1.43-0.26\ \mathrm{Log}\ (A)]$$

Where: S = Sediment yield (tons/sq miles/yr)
Q = Mean Annual runoff (inch)
A = Net drainage are in sq mile

Dendy-Bolton formula is often used to calculate the sediment yield. But use of these equations to predict sediment yield for a specific location would be unwise because of the wide variability caused by local factors not considered in the equations development. However, they may provide a quick, rough approximation of mean sediment yields on a regional basis for preliminary watershed planning. Computed sediment yields normally would be low for highly erosive areas and high for well stabilized drainage basins with high vegetation density because the equations are derived from average values. The equations express the general relationships between sediment yield, runoff, and drainage area. Many variables influence sediment yield from a drainage basin. They include climate, drainage area, soils, geology, topography, vegetation and land use. The effect of any of these variables may vary greatly from one geographic location to another, and the relative importance of controlling factors often varies within a given land resource area. Studies revealed that sediment yield per unit area generally decreases as drainage area increases. As drainage area increases, average land slopes usually decrease; and there is less probability of an intense rainstorm over the entire basin. Both phenomena tend to decrease sediment yield per unit area.

Modified Universal Soil Loss Equation (MUSLE):

Modified universal soil loss equation (MUSLE) for estimation of sediment yield is also widely used. MUSLE is a modification of the Universal Soil Loss Equation (USLE). USLE is an estimate of sheet and rill soil movement down a uniform slope using rain- fall energy as the erosive force acting on the soil (Wischmeier and Smith 1978). Depending on soil characteristics (texture, structure, organic matter, and permeability), some soils erode easily while others are inherently more resistant to the erosive action of rain- fall.

MUSLE is similar to USLE except for the energy component. USLE depends strictly upon rainfall as the source of erosive energy. MUSLE uses storm-based runoff volumes and runoff peak flows to simulate erosion and sediment yield (Williams 1995). The use of runoff variables rather than rainfall erosivity as the driving force enables MUSLE to estimate sediment yields for individual storm events. The generalized formula of MUSLE is as below:

Y=11.8 × (Q × qP).56 × K × Ls × C × P

Where,
Y = sediment yield of stream (t/yr/km2),
Q = average annual runoff (m3),
K = soil erodibility factor,
qP = Highest discharge recorded (m3/s),
Ls = gradient/slope length,
C = cover management factor,
P = erosion control practice

ii. Estimation of Replenishment:

Geomorphologically the Kalimpong district can be broadly divided into two regions. These are the valley regions (below 400 m.) and the mountain region (above 1000 m).The hilly areas are a part of the Shivalik Range. Darjeeling Himalayas has an elevation range of 2000-3000 m, and occurs as the foreland of the Kanchenjunga massif. The drainage is controlled by the general slope of the terrain, as a number of southerly flowing nala with steep gradients drain the area. The major sand producing rivers of the Kalimpong district are Relli, Geet, Rishi, Leesh and Rangpo rivers. These rivers and its tributary rivers are forming the main catchment area.

For replenishment study, following assumption/calculation are taken in to consideration:

- Catchment area (Watershed area) against each river has been calculated based on remote sensing data.
- Rainfall runoff coefficient as per Strange's table for the catchment area is consider 45%, as the rainfall in the district is more than 1524 mm and the characteristic of the catchment of the district is average in nature.
- Peak flood discharge of the river of the district calculated based on Dicken's formula which is more applicable to north Indian and central Indian catchment. Here Dicken constant C is taken as 12 in present study as per published literature by Saha (2002).
- Bed load transport has not been computed in the regional aspect of the district, as the values are highly dependent on local factors such as particle mobility factor, roughness coefficient, Shear velocity, Mean flow velocity, Kinematic viscosity etc.
- Sedimentation yield calculated as per Dendy -Bolton formula as the equations express the general relationships between sediment yield, runoff, and drainage area.
- Computed sediment yields by Dendy Bolton formula normally would be low for highly erosive areas and high for well stabilized drainage basins with high plant density because the equations are derived from average values.
- Dendy -Boltan formula also says that actual sediments yield from individual drainage basins may vary 10-fold or even 100 fold from computed yields. Since the district river basin comprises of sedimentary rocks with good average rainfall therefore the estimated replenishment considered as 50 fold of computed results sediment yield.

The data estimated for each river in the district are given in Table 7.7.

Table 7.7: Replenishment parameter estimated for each river in the district

Estimation parameter	Teesta	Geet	Rishi
Catchment Area (m^2)	719430000	328520000	132830000
Annual Rainfall (m) (in 2020)	3.799	3.799	3.799
Strange Runoff coefficient (%)	45%	45%	45%
Annual Run-off (m) (in 2020)	0.83578	0.83578	0.83578
Catchment Yield (m^3)	1229901557	561621366	227079526.5
Peak Flood Discharge (m^3/sec)	52713597.23	29282126.11	14847501.42
Flow depth d (m)	0.5	0.3	0.3
Channel width b (m)	275	112.95	14.05
Mean velocity v (m/s)	0.1	0.06	0.07
Channel slope S_o (m/m)	0.05	0.04	0.06
Sediment Yield (Tons/year)	1361.62	691.03	311.75
Estimated Annual Replenishment (in million m3)	0.02550	0.01294	0.00584

Sedimentation rate of a river is dependent on the annual rainfall of the district. Sedimentation rate for the period 2016-2020 of each river is presented in Table 7.8 and Figure 7.7.

Table 7.8: Year-wise sedimentation rate for last 5 years of each river

Year	Teesta	Geet	Rishi
2016	0.4	0.45	0.5
2017	0.69	0.77	0.85
2018	2.05	2.27	2.54
2019	0.99	1.1	1.23
2020	0.15	0.16	0.18

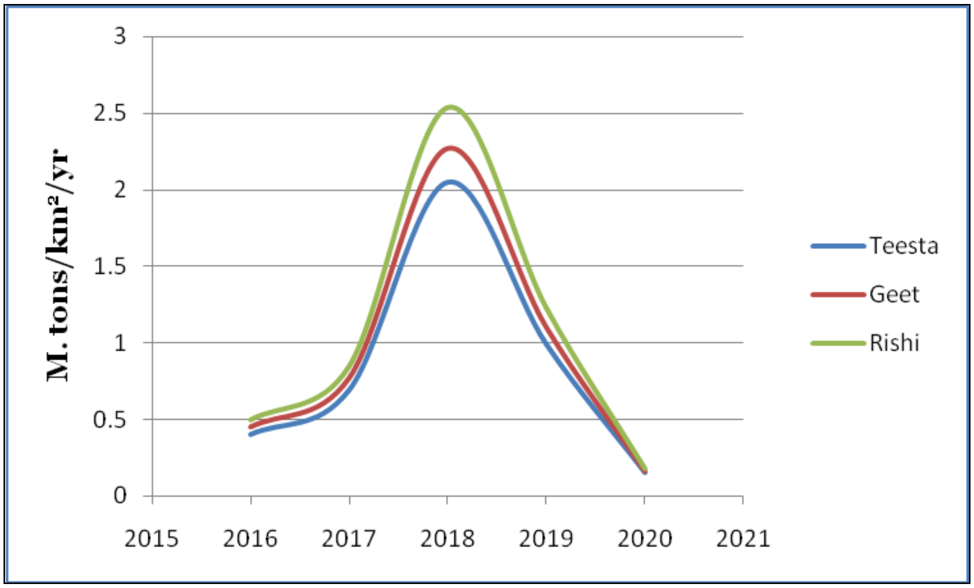


Figure 7.7: Graphical representation of year-wise sedimentation rate

The estimation of sedimentation rate based on empirical formula need critical analysis of different factors related to the LULC property of the catchment area, slope geometry, sediment erosion factor of catchment litho-type. This will help to assess replenishment rate more precisely.

Replenishment studies based on empirical formula for existing mining leases have also been conducted and are given in Table 7.9.

Table 7.9: River wise replenishment rate estimation based on empirical formula

Location	River Name	Lease Area	Surface RL Before mining	Mine out Thickness	Mine out Volume	Annual Rainfall-2020	Estimated Replenished Volume as per Dendy-Bolton	Replenishment Rate
		m2	m	m	cum	m	cum	%
Pagrangbong (17)	Geet	10100.00	282.00	1.50	15150.00	3.80	10605.00	70.00%
IchaKM (45)	Relli	7300.00	625.00	1.50	10950.00		7336.50	67.00%
Yokprintam (58)	Relli	4900.00	480.00	1.50	7350.00		5145.00	70.00%

Theoretical Replenishment study based on mining lease shows variations from 67% to 70% with an average of 69% of replenishment rate in the district.

Illustration of Replenishment Estimation is given in Table 7.10.

Table 7.10: Illustration of replenishment rate calculation based on 3 methods

Based on Satellite imageries		Based on field investigation		Based on empirical formula	
Particulars	Estimation	Particulars	Estimation	Particulars	Estimation
		River Name	Relli	River Name	Relli
River	Relli	Location	Yokprintam	Location	Yokprintam
Total Pre-monsoon Sand Bar Area	803065 (sq.m)	Mining Area	4900 (Sq.m)	Lease Area	4900 (Sq.m)
Average Pre monsoon Thickness	0.8 (m)	Pre monsoon RL	480.00 (m)	Surface RL Before mining	480 (m)
Total Sand Volume	0.64 (Mcum)	Sand Thickness	1.5 (m)	Mine out Thickness	1.5 (m)
Total Post-monsoon Sand Bar Area	808028 (sq.m)	Volume excavated (Cum)	7350	Mine out Volume (Cum)	7350
Average Post-monsoon Thickness	1 (m)	Post monsoon RL	479.90 (m)	Drainage area for lease block	0.31 (Sq.km)
Total Sand Volume	0.76 (M.cum)	Thickness	1.4 (m)	Monsoon Rainfall-2020	3.80 (m)
Pre and Post monsoon Volume Difference	0.12 (M.cum)	Volume deposited (Cum)	6835.5	Estimated Volume as per Dendy- Bolton (S = 1280 Q0.46[1.43 - 0.26 log(A)]) Where, Q is runoff, A is drainage area)	5145.0 (Cum)
Replenishment and Agrredation %	119%	Replenishment Rate	93.00%	Replenishment Rate	70%

Replenishment studies have been carried out in the district based on three different methodologies as illustrated in Table 7.10. Table 7.11 explained comparison of the outcome of these three methodologies adopted for the district.

Table 7.11: Comparison of replenishment study

Replenishment Study Method	Geet	Relli
Estimated Annual Replenishment based on Sattelite imageries **(*)**	129%	119%
Estimated Annual Replenishment based on field investigation	93.5%	92.75%
Estimated Annual Replenishment based on empirical formula	70%	68.50%

(*)Replenishment study based on satellite imagery involves estimation of replenish volume along with aggredation volume.

vi) Total potential of minor mineral in the river bed

The major sand producing rivers of the Kalimpong district are Relli, Geet, Rishi, Leesh and Rangpo rivers. The total potential of minor mineral in the riverbed are 3.053 mcum.

B. Geological studies

i) Lithology of the catchment area

The overall rock type of the catchment area is mainly consisting of Granite, Gneiss, Shales, and most importantly Sandstone and solidified but poorly consolidated clutter of Conglomerate formations.

The district may be divided into three tracts, which are, from north to south, the hard rock area, the Bhabar belt and the Terai belt. The Bhabar belt comprises rock fragments, big boulders and fine grained clastics derived from the hard- rock area. The Terai belt is composed mostly of coarse granular materials alternating with finer clastics. Leesh, Geet, Chel are the most sand producing river flowing in this belt. Whereas Relli, Rangpo river catchment is part of Bhabar belt.

ii) Tectonics and structural behavior of rocks

The hilly region of the district is very prone to landslide due to poor water retention capacity of the soil clubbed with steep land slope (from North to South, and South-East). The considerable portion of the district falls under the Seismic Zone IV (in a scale of I to V in ascending order of propensity f Seismic Activity), making it very prone to the earthquakes (Census, 2011).

The geological formations of the district show the predominance of several tectonic units of the Darjeeling Himalaya over-thrusted towards south are built mostly of metamorphic rocks (Darjeeling gneisses, Daling schist and quartzite). Along Teesta river section, Main Boundary Fault extending either side along the general strike varying between NE-SW and E-W. All along the foothills of Darjeeling district, south of Sikkim, the Siwaliks are steeply over thrust by formations belonging to Damuda of Lower Gondwana. The thrust planes are dipping at 60-70 degrees towards the north. This thrust zone coincides with the well-known Main Boundary fault, which extends for the whole distance along the Himalayan Range.

C. Climate Factors

i) Intensity of rainfall

Kalimpong gets about 2,254 mm rainfall annually. The precipitation during the southwest monsoon constitutes about 80 percent of the rainfall, July being the wettest month. On an average, there are about 105 rainy days in a year. The intensity of rainfall due to depressions sometimes becomes very great and may cause enhanced soil erosion in the district.

ii) Climate zone

Climate of the Kalimpong district is tropical monsoonal in nature. The climate of Kalimpong Sub-division is interesting because of its position in relation to the Tibetan landmass, the wide differences in altitudes, the powerful effect of the monsoons against the Himalayan barrier and the peculiar configuration of the neighboring monsoons, which deflect winds and affect local temperature and rainfall.

iii) Temperature variation

The temperature in the Kalimpong district varies from 25°C to 8°C. The maximum summer temperature is 25°C and the minimum 15°C. The maximum temperature in winter is 17°C and the minimum temperature 8°C recorded between December and March. The average temperatures vary during the year by 10.1 °C.

Annual Deposition:

Annual deposition of riverbed minerals has been calculated on post-monsoon sand volume. The pre-monsoon sand volume of the river is the depleted resources and is replenished by the monsoon rainfall.

Sand bar area recommended for mineral concession in the table is calculated as per the Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) 2020. As per guidelines, mining depth restricted to 3 meters depth and distance from the bank is ¼th of river width and not less than 7.5 meters. Also mining is prohibitated up to a distance of 1 kilometre (1 km) from major bridges and highways on both sides, or five times (5x) of the span (x) of a bridge/public civil structure (including water intake points) on up-stream side and ten times (10x) the span of such bridge on down-stream side, subjected to a minimum of 250 meters on the upstream side and 500 meters on the downstream side.

For the purpose of estimating mineable mineral potential, the thickness of the sand bar considered extractable based on base flow level. The annual minable mineral potential is given in Table 7.12.

Table 7.12: Annual deposition of Riverbed minerals

Sl.No.	River or Stream	Portion of the river stream recommended for mineral concession	Length of area recommended for mineral concession (in meter)	Average width of area recommended for mineral concession (in meters)	Area recommended for mineral concession (in sq. m)	Mineable mineral potential (in mcm) (60% of total mineral potential	Considered Thickness (m)
1	Relli River	43.39%	15,700.00	81.38	12,77,635.44	0.767	1.0
2	Palla River	23.38%	1,200.00	56.69	68,030.00	0.041	1.0

3	Leesh River	51.01%	11,300.00	118.11	13,34,698.00	0.801	1.0
4	Geet River	36.12%	10,300.00	112.95	11,68,329.70	0.841	1.2
5	Chel River	29.76%	11,000.00	83.60	9,19,596.00	0.607	1.1
6	Rangpo River	12.24%	4,650.00	24.86	1,15,592.00	0.062	0.9
7	Rishi River	6.57%	3,300.00	14.05	46,354.00	0.031	1.1
Total for the District			**57450**	**491.64**	**4930235.14**	**3.15**	

III. Riverbed Mineral Potential

Sand is the important riverbed mineral found to be potential for mining. Considerable quantity of quality sands are found to occur in part of Relli, Geet and Chel, rivers. Smaller patches are also available locally in the other smaller rivers as well. Table 7.14 summarizes the potential riverbed mineral deposits of the district. Sand mining can be developed on cluster approach with restricted usage of Machinery's for lifting of sands. The rivers in the north Bengal are filled by Gravels & boulders. Development of river bed material with huge boulders also requires usage of machinery's to increase more production in turn revenue.

Table 7.9: Resources of Potential Riverbed Mineral

Boulder (million Cubic meter)	Pebbles/Gravel (million Cubic meter)	Sand/White sand (million Cubic meter)	Total Mineable, Mineral Potential (million Cubic meter)
0.611	**0.405**	**2.137**	**3.15**

Based on satellite imagery study and field investigation, potential zones for riverbed deposits for each river of the district have been identified and the details of the zones are provided in Table 7.14.

Table 7.14: Potential Zone of Riverbed Mineral

Sl. No	RIVER NAME	Location of potential zones						Area within prohibited zone as per rule 3 of WBMMC Rules, 2016 (sq.m)
		ZONE	BLOCK NAME	MOUZA NAME	JL NO	COORDINATE		
						LATITUDE	LONGITUDE	
1	RELLIK HOLA	ZONE 1	KALIMPONG II	IchaKhaasmahal, PudungKhasmahal, YokprintamKhasmahal	45, 46,58	27°4'49.39"N	88°33'29.283"E	18540.24
						27°2'50.965"N	88°31'49.805"E	
		ZONE 2	KALIMPONG I	LolayKhasMahal	44	27°2'50.965"N	88°31'49.805"E	11389.51

Sl. No	RIVER NAME	Location of potential zones						Area within prohibited zone as per rule 3 of WBMMC Rules, 2016 (sq.m)
		ZONE	BLOCK NAME	MOUZA NAME	JL NO	COORDINATE		
						LATITUDE	LONGITUDE	
						27°3'11.51"N	88°30'12.941"E	
		ZONE 3	KALIMPONG II	SlokbhirKhasmahal, SamalbongKhasmahal	59, 60	27°2'20.252"N	88°29'42.727"E	54355.56
						26°59'58.5"N	88°27'3.507"E	
2	PALLA RIVER	ZONE 4	KALIMPONG II	PallaKhasmahal	43	27°2'49.495"N	88°32'31.491"E	1868.276
						27°2'28.858"N	88°31'47.578"E	
3	LEESH RIVER	ZONE 5	KALIMPONG II	PemlingKhasmahal, NobgaonKhasmahal	64, 66	26°57'50.126"N	88°30'43.824"E	93506.11
						26°52'45.648"N	88°34'2.985"E	
4	GEET RIVER	ZONE 6	KALIMPONG I &GORUBATHAN	NimbongKhasmahal, Pagrangbong, ManbariKhasmahal	65, 17, 20	26°58'43.207"N	88°36'49.294"E	84914.55
						26°53'54.306"N	88°37'24.306"E	
5	CHEL RIVER	ZONE 7	GORUBATHAN	DalingmaKhasmahal, GorubathanKhasmahal, Mal Khasmahal	27, 28, 29	27°0'29.317"N	88°42'16.959"E	6631.036
						26°55'29.627"N	88°39'35.107"E	
6	RANGPO RIVER	ZONE 8	KALIMPONG II	KashoneKhasmahal	4	27°11'29.993"N	88°33'47.534"E	2875.966
						27°11'1.775"N	88°35'51.16"E	
7	RISHI RIVER	ZONE 9	KALIMPONG II	LingsaykhaKhasmahal	10	27°9'41.049"N	88°39'18.347"E	1344.708
						27°8'29.318"N	88°39'53.472"E	
		ZONE 10	KALIMPONG II	LingsaykhaKhasmahal	10	27°7'7.823"N	88°40'18.014"E	193.1032
						27°6'53.673"N	88°40'27.998"E	

NO MINING ZONE:

As per the Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) 2020 the restricted zone for mining is a distance from the bank is ¼th of river width and not be less than 7.5 meters. Also, there is a no mining zone up to a distance of 1 kilometre (1 km) from major bridges and highways on both sides, or five times (5x) of the span (x) of a bridge/public civil structure (including water intake points) on up-stream side and ten times (10x) the span of such bridge on down-stream side, subjected to a minimum of 250 meters on the upstream side and 500 meters on the downstream side.

Also, no mining zone has been marked for an area up to a width of 100 meters from the active edge of embankments. Also, the concave side of the river is marked as no mining zone, as mining is this area will affect the course of river in future and will erode the river bank. A representative map of no mining zone shown on River Relli of Kalimpong district is given in Figure 7.8. Table 7.16 summarized the area of no mining zones demarcated for each river of the district.

Table 7.15: No mining zone in the district

Sl. No.	River Name	Zone	Block Name	No mining Area Sq.m
1	Relli River	Zone 1	Kalimpong II	7963.374
			Kalimpong I	10576.87

Sl. No.	River Name	Zone	Block Name	No mining Area Sq.m
		Zone 2	Kalimpong I	11389.51
		Zone 3	Kalimpong I	54355.56
2	Palla River	Zone 4	Kalimpong II	1868.276
3	Leesh River	Zone 5	Kalimpong I	93506.11
4	Geet River	Zone 6	Kalimpong I	79838.68
			Gorubathan	5075.873
5	Chel River	Zone 7	Gorubathan	6631.036
6	Rangpo River	Zone 8	Kalimpong II	2875.966
7	Rishi River	Zone 9	Kalimpong II	1344.708
		Zone 10	Kalimpong II	193.1032

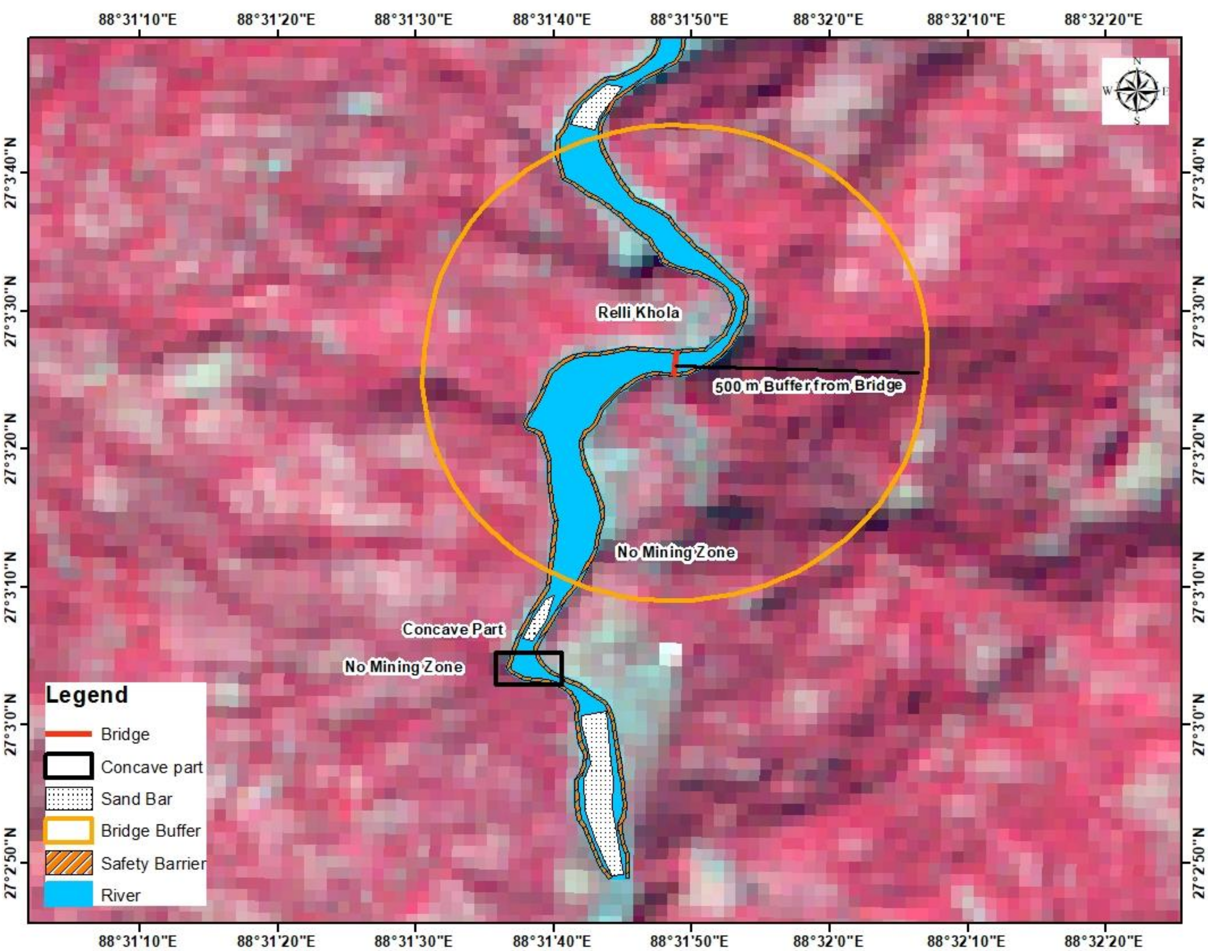


Figure 7.8: A representative map showing no-mining zone demarcated on Relli River

7.2.2 In-situ Minerals:

I. Mineral Reserve

Mineral resources of the district are still not well established. Reserve of Coal is only mentioned in the Mineral Year Book of West Bengal 2014. Occurrences of coal have been established over a stretch of 77 km between Pankhabari to the west of the Darjeeling district and Jaldhaka to the east of Kalimpong district. Coal reserves are found in Dalingkot coalfield, several seam occur near Tindharia. A total of 15 million tonne of inferred resources of coal down to a depth of 300m has been estimated (Source: Glimpse of Geology of West Bengal, GSI Publication).

Coal bearing Damuda series consisting of quartzitic and carbonaceous sandstone, shale and coal occur as a thin bed being sandwiched in between two thrusts viz. Daling thrust in the north against Daling rocks and Main Boundary Fault in the south against Siwalik rocks. As a result of thrusting, Daling rocks of Precambrian age are lying above the Damuda of Lower Gondwana (Permian) with a reverse succession. Generally, the rocks striking in West-Southwest to East-Northeast direction have a steep (upto 80°) northerly dip. These Gondwana rocks are well exposed at Pankhabari, Tindharia, Kalijhora, Bagrakotx, Dalingkot and in the valley of Mahanadi and Teesta. The coal exposures are not continuous everywhere due to nature of thrusting. This coal bearing Damuda Series has been lithologically sub-divided into three units i.e., upper and a lesser coal bearing unit separated by a barren unit. The upper, middle and lower units are formally named as the Dalingkot, Chunabhati and Rongtong formation.

II. Mineral Potential

The Sikkim-Darjeeling area highly potential with respect to the basemetal occurrences confined essentially to the Daling/Darjeeling Group of rocks with biotitic granites occurring as tongue-like bodies. The most important base metal deposits for lead and zinc in the Himalayan terrain near Gorubathan, Darjeeling district are reported from Khar Khola, Mal Khola, Daling Chu and Sukha Khola blocks. Minor Occurrences of copper-ore are reported from Pedong area of Kalimpong district.

Preliminary exploration of Gorubathan Lead-Zinc deposits, Kalimpong District, West Bengal was continued in the field season 1979-80. The Gorubathan groups of base metal deposits consist mainly of KharKhola, Mal Khola, Daling Chu and Sukha Khola Blocks distributed intermittently over a strike length of about 7km, in respective order, from east to west following the regional strike. Lenticular bodies of magnetite-quartz-galena-sphalerite-pyrite-pyrrhotite ore, widely varying in grade and width, occur in the Mal Khola and Daling Chu Blocks. Chalcopyrite occurs in minor amounts. Available drill hole data indicates that there are only three mineralised horizons of quartz-magnetite rock in the Daling Chu - Mal Khola Blocks. The two important zones are: - 1) Daling Kote Lode No. 1 and 2) Daling Kote Lode No. 2 with a parting zone of about 30m between the lodes. The drilling data indicates that Daling Kote Lode No. 1 consists of more than one ore shoot but there is a possibility that folding has caused repetition of the mineralised zone. The other mineralised zone is the Mal Quartz-Magnetite

Rock, occurring 60m to 90m above the Daling Kote Lode No. 2. The existence of a fourth horizon, below the Daling Kote Lode No. 1, indicated by a series of isolated mineralised bodies of quartz-magnetite rock on the surface, has been disproved by drilling.

Figure 7.9: Location of Gorubathan base metal deposits

Figure 7.10: Quartz Magnetite chlorite schist boulder at Daling Chu River section

Drilling in the Mal Khola and Daling Chu Blocks has yielded significant results. With the availability of additional analytical data the ore reserves have been updated and amounts to 3.25 million tonnes with 3.80% Pb and 3.83% Zn. The average thickness of the mineralised zone is 4.14m. This reserve has been categorised as "Probable Ore Reserve". Reserve of magnetite as a by-product is 42 million tonnes (Bhattacharya and Neogi, 1984).

MECL has carried out detailed exploration in the Mal Khola block. The rock types of the Mal Khola Block are quartz-chlorite-biotite-sericite schist, quartzite, epidiorite and quartz magnetite rock. These litho-units belong to the Gorubathan sub-Group of the Daling Group and are of Precambrian age. The overall strike of the formations is E-W northerly dips varying form 20° to 45°. The lead-zinc mineralisation in the form of galena and sphalerite occurs mainly in association with the quartz magnetite rock. Reserves of 1.79 mt. of 3.86% Pb and 3.64% Zn (TMC- 7.50% Pb+Zn) have been estimated in the Mal Khola block within a vertical depth of 125m and a strike length of 200m. These reserves have been put under "Probable" category.

The important copper-lead-zinc prospects are located at Bhotang (Copper-Lead-Zinc) (27°10'30'':88°32'00'') and Pedong (Copper) (27°09':88°37'). In Pedong, the richer mineralize zones have a grade of about 2.5% Cu (VE). However, drilling program does not established potential mineralization in Bhotang area (Mineral Resources of India, GSI).

Table 7.16 summarized the in-situ mineral deposits of the district.

Table 7.16: In-situ Minerals Occurrences

Name of mineral	Name of associated minerals, if any	Host rock of mineralization	Area of mineralization	Depth of mineralization	Whether virgin or partially excavated	Name of land (whether free for mining/forest/agricultural	Mineral reserve (approximate) mentioning grade	Location of potential mineralized zones				Infrastructure available near the mineralized zone
								Administrative Block	Mouza	Plot No.s	Co-ordinates	
1	2	3	4	5	6	7	8	9				11
Coal	No associated minerals	Carbonaceous sandstone, shale	Tindhari, Kalijhora, Bagrakot, Dalingkot	300m	Partially excavated	Forest/ agricultural land	15 million tonne	Kalimpong –I to Gorubathan	NA	NA	26°49'; 88°15' to 26°54'; 88°43'	Metalled road
Lead-Zinc	Magnetite, Tungsten, Chalcopyrite	Quartz-chlorite-biotite-sericite schist	Mal Khola	125m	Virgin	Forest land	1.79 mt. of 3.86% Pb and 3.64% Zn (TMC- 7.50% Pb+Zn)	Gorubathan block	Forest Mouza	NA	latitudes 26°58'10" and 27°00' and longitudes 88°36'15" and 88°45'00"	Metalled road
Lead-Zinc	Magnetite, Tungsten, Chalcopyrite	sedimento-volcanogenic association of the Gorubathan subgroup	DalingChu	150-200m	Virgin	Forest land	3.25 million tonnes with 3.80% Pb and 3.83% Zn	Gorubathan block	Forest Mouza	NA	latitudes 26°58'10" and 27°00' and longitudes 88°36'15" and 88°45'00"	Metalled road

7.3 Exploration Requirement of the district

Geologically, the district holds good prospect with respect to base metals, coal and limestone deposits. However, due to lack to details investigation mineral prospect of the district has not been established. GSI has carried out exploration during 1970's to 2000's in search of base metals deposits of the district.

Base-metal (Pb-Zn) prospect in-between Daling-Chu and Mal Nadi for nearly 1.7 km. strike length has been established at the foot hills of Kalimpong based on rigorous geological investigation by GSI. The base metal prospect of the Daling-Chu- Mal Nadi is situated within the sedimento-volcanogenic association of the Gorubathan subgroup of the Dalings. The lithotypes are an association of close alternation of sericite-chlorite phyllite and quartzite with epidiorites. The mineralisation has been seen to-date to be restricted within a width of about 150 metres. It occurs as distinct bands, consisting of several beds alternating with phyllitic or quartzitic strata. Most of the beds show fine laminations to thick stratifications. The foliation surfaces are parallel or sub-parallel to these interfaces. Within the mineralised horizons, the sulphides, magnetite and silica and silicate gangues occur either as distinctly alternate lamina or as composite mosaic (Ray et. al, 1971 GSI Progress report).

Tinkatare village of Gorubathan Block, Kalimpong Subdivision, Darjeeling District is located on the east bank of Murti River. The area is a part of sub Himalayan terrain, where thrusted sequences of Proterozoic Daling rocks along with Gondwana rocks and Siwalik sediments are exposed in E-W trend. P-II stage investigation had been envisaged by GSI and DMM of WB to assess the potentiality of base metal mineralization in the area. Under this investigation an area of 1.5 sq. km. has been covered by detailed mapping along with pitting and trenching and geochemical sampling petrological analysis. Dissemination, veins and stringers of sulphide minerals are noticed within the Daling schist of the study area. The main ore forming minerals are chalcopyrite, pyrite and rarely sphalerite and galena. In Khanigaon area at Arikholaa 2m thick zone of copper mineralization is encountered within the quartz-chlorite-sericite schist with average 0.80% Cu (Huin et. al, GSI report, FS 2003-04).

GSI has carried out investigation in search of wolframite-scheelite in Munsong area principally by large scale mapping (1:2000), pitting and trenching, sampling and geological traverses. The presence of small, concordant and highly ferruginised veins of quartz carrying tungsten mineralization have been identified with associated sulphides, in sericite phyllite belonging to Dalings. The tungsten minerals are wolframite and scheelite and the sulphides are mainly pyrite with minor chalcopyrite and pyrrhotite. Quartz veins are arranged en echelon over a length of about 20m and width varying between 2m and 7m ((Bhattacharya and Basu, 1986, GSI report).

Search for gold was carried out by GSI in and around Samthar area of Kalimpong district. Stratigraphically, the area exhibits the rocks belonging to Gorubathan Formation of Dalling Group. The broad lithotypes of the area are dominantly arenaceous unit with some phyllitic/argillaceous partings. They comprise quartzite/quartz-sericite schist/quartzite with concordant quartz veins; gritty, highly sheared and brecciated biotite-chlorite-quartz schist/biotite quartzite and magnetite quartzite; and a dominantly phyllitic unit with some intercalation of arenaceous bands/chlorite phyllite (at places carbonaceous)/slaty phyllite, etc. The sulphides are generally associated with this litho assemblage. The general strike of the lithounits is WNW-ESE to NW-SE with a moderate dip towards NNE to NE. The reported arsenic in this area is in the form of arseno-pyrite which occurs as dissemination, stringers, veinlets and patches along with pyrite and pyrrhotite in epigenetic quartz veins intruding the phyllites. Besides, there are also thin bands of magnetite quartzite with fine laminations of sulphides representing syngenetic stratabound mineralisation. Analytical results of Deorali Pit, where a zone of 2.8 m of 0.25 ppm (or a zone of 1.0 m of 0.84 ppm) wt. average of Au has been established (Chattopadhyay and Ray, 2001).

8 Overview of mining activity in the district

8.1 General overview

Kalimpong district is not having any large mines. Collection of sand, stone and gravels from the river-bed of the hilly terrain are the minor mineral sources. These materials are primarily utilized for construction purpose.

As per the data received from Department of Mines and Minerals, Siliguri, the details of sand blocks for mining is given in Table 8.1.

Census (2011) of Un-divided Darjeeling district recorded production of minor mineral. Total production of Sand in the district during 2010-11 is 1913111.75 tonne, Stone of 1041403.42 tonne and Gravel of 2452.25 tonne.

8.2 List of existing mining leases of the districts

Table 8.1: Details of sand mining leases of the districts

ID	Block	Mouza	JL No	River	Road	Plot No	Area in Hectares	Latitude	Longitude	Bidder Name	Date of Issuance of Environmental Clearance (E.C.)	Date of Execution of Lease Deed	Lease Agreement Start Date (date of effect)	Lease Agreement Expiry Date	Quantum of Sand Extraction permissible as per Mining Plan (tonnes)	Reasons for non-execution of lease deed
150/SB2021	KALIMPONG-I	PUDUNG KM, LOLEY KM UNDER KPG BLOCK II,	46,44	Relli	Kachha Road	1053, 1	0.73	27° 3' 14.00"N	88° 31' 41.00"E						0	EC Awaiting
153/SB2021	KALIMPONG-I	ICCHEY KM, LOLEY KM UNDER KPG BLOCK II,	45,44	Relli	Kachha Road	3034,1303	0.4	27° 3' 54.66"N	88° 31' 49.46"E	SHRI SAMIM AHMED	30-11-2018	10-12-2018	10-12-2018	09-Dec-23	22033.32	
402/SB2021	KALIMPONG-II	DALAPCHAND KM, LOLAY KM	31,44	Relli	Kachha Road	1009, 1501	0.69	27° 4' 36.19"N	88° 33' 8.53"E						0	EC Awaiting
307/SB2021	KALIMPONG-I	NAVGAON KM	66	Leesh	Kachha Road	501	1.42	26° 55' 50.77"N	88° 32' 6.68"E						0	EC Awaiting
309/SB2021	KALIMPONG-I	NAVGAON KM	66	Leesh	Kachha Road	501	1.42	26° 55' 43.82"N	88° 32' 6.72"E						0	EC Awaiting
310/SB2021	KALIMPONG-I	NAVGAON KM	66	Leesh	Kachha Road	501	1.42	26° 55' 41.30"N	88° 32' 13.70"E						0	EC Awaiting
372/SB2021	GARUBATHAN	POKHREYBONG KM	17	Geet	Kachha Road	1901	1.01	26° 57' 10.33"N	88° 36' 23.11"E	SHRI SAMIM AHMED	30-11-2018	10-12-2018	10-12-2018	08-Jun-25	55001.62	
408/SB2021	KALIMPONG-I	YOKPRINGTAM KM	58	Relli	Kachha Road	56	0.49	27° 3' 6.38"N	88° 30' 15.97"E	SHASHI LEPCHA	30-11-2018	10-12-2018	19-12-2018	18-Dec-23	26683.96	
406/SB2021	KALIMPONG-I	YOKPRINGTAM KM	58	Relli	Kachha Road	56	0.49	27° 2' 55.09"N	88° 30' 31.35"E						0	EC Awaiting
366/SB2021	KALIMPONG-II	KASHYONE	4	Rangpo	Kachha	1	0.77	27° 11' 15.18"N	88° 34' 28.42"E						0	EC Awaiting

ID	Block	Mouza	JL No	River	Road	Plot No	Area in Hectares	Latitude	Longitude	Bidder Name	Date of Issuance of Environmental Clearance (E.C.)	Date of Execution of Lease Deed	Lease Agreement Start Date (date of effect)	Lease Agreement Expiry Date	Quantum of Sand Extraction permissible as per Mining Plan (tonnes)	Reasons for non-execution of lease deed
					Road											
405/SB2021	KALIMPONG-I	YOKPRINGTAM KM	58	Relli	Kachha Road	56	0.57	27° 2' 57.46"N	88° 30' 23.31"E						0	EC Awaiting
233/SB2021	KALIMPONG-II	PALA KM, KANKEBONG KM	43,42	Pala	Kachha Road	18,593	0.57	27° 2' 40.24"N	88° 31' 46.81"E						0	EC Awaiting
237/SB2021	KALIMPONG-II	PALA KM, KANKEBONG KM	43,42	Pala	Kachha Road	115,593	0.81	27° 2' 40.96"N	88° 32' 23.78"E						0	EC Awaiting
173/SB2021	KALIMPONG-I	PUDUNG KM, KANKEBONG KM	46,42	Relli	Kachha Road	1926,592	0.4	27° 2' 40.52"N	88° 31' 40.66"E						0	EC Awaiting
234/SB2021	KALIMPONG-II	PALA KM, KANKEBONG KM	43,42	Pala	Kachha Road	18,593	0.65	27° 2' 40.02"N	88° 31' 53.00"E						0	EC Awaiting
313/SB2021	KALIMPONG-I	NAVGAON KM	66	Leesh	Kachha Road	501	1.42	26° 55' 40.66"N	88° 32' 13.99"E						0	EC Awaiting
236/SB2021	KALIMPONG-II	PALA KM, KANKEBONG KM	43,42	Pala	Kachha Road	115,593	0.65	27° 2' 39.48"N	88° 32' 5.75"E						0	EC Awaiting
268/SB2021	GARUBATHAN	MAL KM	29	Chel	Kachha Road	15	0.49	26° 57' 30.38"N	88° 41' 46.54"E						0	EC Awaiting
274/SB2021	GARUBATHAN	MAL KM	29	Chel	Kachha Road	15	1.01	26° 57' 21.42"N	88° 41' 37.07"E						0	EC Awaiting
276/SB2021	GARUBATHAN	MAL KM	29	Chel	Kachha Road	15	1.21	26° 57' 17.32"N	88° 41' 29.51"E						0	EC Awaiting
277/SB2021	GARUBATHAN	MAL KM	29	Chel	Kachha Road	15	1.21	26° 57' 11.41"N	88° 41' 13.42"E						0	EC Awaiting
403/SB2021	KALIMPONG-I	PUDUNG KM, LOLEY KM UNDER KPG BLOCK II,	46,44	Relli	Kachha Road	1053, 1	0.81	27° 3' 42.77"N	88° 31' 42.96"E						0	EC Awaiting

ID	Block	Mouza	JL No	River	Road	Plot No	Area in Hectares	Latitude	Longitude	Bidder Name	Date of Issuance of Environmental Clearance (E.C.)	Date of Execution of Lease Deed	Lease Agreement Start Date (date of effect)	Lease Agreement Expiry Date	Quantum of Sand Extraction permissible as per Mining Plan (tonnes)	Reasons for non-execution of lease deed
340/SB2021	GARUBATHAN	POKHREYBONG	17	Geet	Kachha Road	1901	1.01	26° 57' 34.88"N	88° 36' 43.63"E						0	EC Awaiting
343/SB2021	GARUBATHAN	POKHREYBONG	17	Geet	Kachha Road	1901	1.01	26° 57' 26.50"N	88° 36' 36.36"E						0	EC Awaiting
363/SB2021	GARUBATHAN	POKHREYBONG KM	17	Geet	Kachha Road	1901	1.01	26° 57' 29.16"N	88° 36' 25.99"E						0	EC Awaiting
365/SB2021	GARUBATHAN	POKHREYBONG KM	17	Geet	Kachha Road	1901	1.01	26° 57' 17.53"N	88° 36' 26.10"E						0	EC Awaiting
152/SB2021	KALIMPONG-I	ICCHEY KM, LOLEY KM UNDER KPG BLOCK II,	45,44	Relli	Kachha Road	3034,1303	0.73	27° 3' 47.49"N	88° 31' 45.69"E						0	EC Awaiting
172/SB2021	KALIMPONG-I	PUDUNG KM, KANKEBONG KM	46,42	Relli	Kachha Road	1926,592	0.69	27° 2' 37.95"N	88° 31' 34.99"E						0	EC Awaiting
235/SB2021	KALIMPONG-II	PALA KM, KANKEBONG KM	43,42	Pala	Kachha Road	115,593	0.4	27° 2' 43.04"N	88° 31' 59.19"E						0	EC Awaiting
238/SB2021	KALIMPONG-II	PALA KM, KANKEBONG KM	43,42	Pala	Kachha Road	115,701	0.32	27° 2' 41.14"N	88° 32' 27.85"E						0	EC Awaiting
281/SB2021	GARUBATHAN	MAL KM	29	Chel	Kachha Road	15	1.21	26° 57' 12.89"N	88° 41' 9.64"E						0	EC Awaiting
304/SB2021	KALIMPONG-I	NAVGAON KM	66	Leesh	Kachha Road	501	1.42	26° 55' 57.50"N	88° 31' 59.41"E						0	EC Awaiting
387/SB2021	KALIMPONG-I	PUDUNG KM, LOLEY KM UNDER KPG BLOCK II,	46,44	Relli	Kachha Road	1053,1	0.67	27° 3' 37.71"N	88° 31' 46.14"E	SHASHI LEPCHA	30-11-2018	19-12-2018	19-12-2018	18-Dec-23	26231.77	
404/SB2021	KALIMPONG-I	YOKPRINGTAM KM	58	Relli	Kachha Road	56	0.61	27° 2' 59.42"N	88° 30' 17.17"E						0	EC Awaiting

8.3 Detail of production of sand and other minerals during last five years

Last 5 years production of minor mineral of Kalimpong District is furnished in Table 8.2.

Table 8.2: Details of production of Minor Mineral as per mine plan in Kalimpong district

Sl. No.	Year	Total Production in cft	Total Production in cum
1	2017-2018	0	0
2	2018-2019	1060000	37433900
3	2019-2020	1477000	52160255
4	2020-2021	2785500	98369933
5	2021-2022	795000	28075425

Conversion factor: 1cum=35.315 cft

9 Details of revenue generated from mineral sector during last three years

Revenue generated for last 3 years in Kalimpong District is furnished in Table 9.1.

Table 9.1: District revenue generation from mineral sector (in Rs.)

Year	Total Revenue
2017-2018	Nil
2018-2019	482625
2019-2020	3102000

10 Transport (Railway, road)

Local transport infrastructure is critical in mineral transport point of view of Kalimpong district. The district physiography is dominated by hilly terrain.

Kalimpong, the district headquarter is well connected by National and State Highways with neighboring district. Highways are passing through the district and connected block headquarters with Kalimpong. Kalimpong city is located off the NH10, which links Sevok to Gangtok. The NH31A is an offshoot of the NH 31, which connects Sevok to Siliguri. These two National Highways together, via Sevok, links Kalimpong to the plains. State highway no 12 connects Gorubathan and Kalimpong through Kalimpong-II. SH 12 joined NH 10 at Teesta bazaar area (Figure 10.1).

The closest major railway station is at New Jalpaiguri, on the outskirts of Siliguri. The Northeast Frontier Railway (NFR) zone along with IRCON international Limited, has proposed to construct the 44.98 km long Sevok-Rangpo railway line, which will enable travelling between Sevok in West Bengal to Rangpo in Sikkim.

Kalimpong does not have an airstrip. The nearest airport is Bagdogra airport (IXB), near Siliguri which is located 80 km from district head quarter.

A transportation map demarcating approach road to the potential sand blocks from the nearest National Highway/ Sate Highway has been prepared and presented in Figure 10.2.

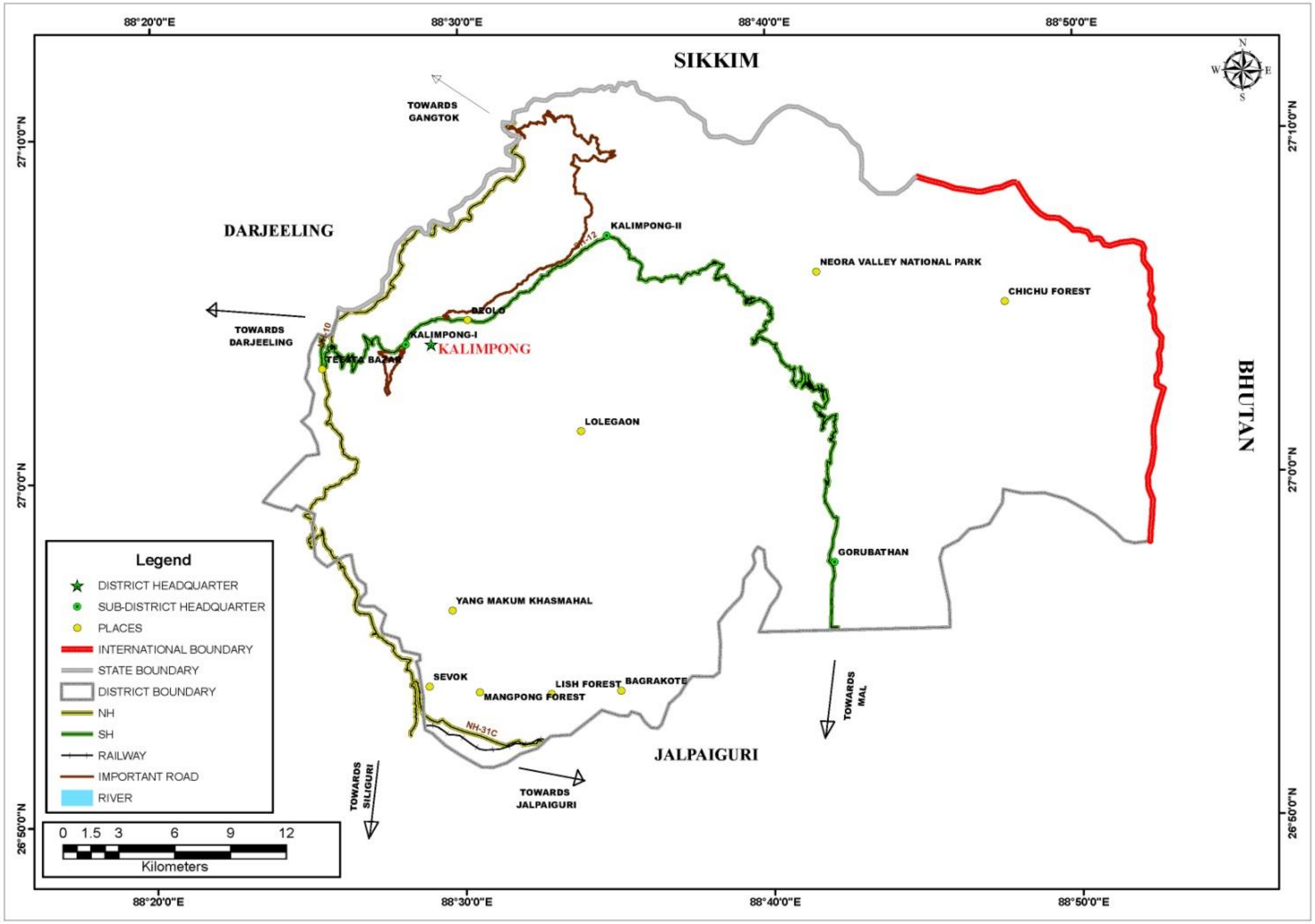


Figure 10.1: Transportation map of Kalimpong District

(Source: National Informatics Centre)

Figure 10.2: Map showing approach road to potential sand bars

11 Remedial measure to mitigate the impact of Mining

11.1 Environmental Sensitivity

The Kalimpong Hill area represents a unique geo- environmental setup. As the mountains serve as the source of resources for the population residing in the hills as well as in the plains, the form of environmental degradation is quite extensive particularly the extraction of timber and other forest produces, mining and agriculture are also taken into account. As human population increases in the hills, forests are being depleted for the extension of agricultural lands, introduction of new settlements, roadways etc.

Due to unprecedented growth of population during the last few decades, nature has started reacting sharply to the accumulated human guilt. Soil erosion and its conservation play an important role.

The land use practices play the most important role in determining the stability factors in respect of landslide hazards. Stone quarrying from the slope is another way of human intervention that causes occasional slope failure.

In the rural and inaccessible high hills, demand for fuel is another important factor, which may be treated as an important cause for slope failure. In West Bengal part of Eastern Himalaya, because of the presence of coal and dolomite, mining started from eighteenth century. Unscientific mining of low energetic coal seams and illegal felling of trees to meet the demand of firewood is practically unavoidable in the hills. The adverse effect of this unscientific mining is realized in the form of landslide, removal of soil cover, formation of gullies and badlands; siltation of river beds leading to frequent floods, endangering the lives and properties of local inhabitants.

11.2 Sand mining Impact

Another serious environmental problem around the globe in recent years is of sand and gravel mining. Sand mining is a process of extraction of sand from an open pit, river bed, sea beaches, ocean floor, river banks, deltas and island dunes. The extracted sand could be utilised for various types of manufacturing, such as concrete used in the construction of building and other structures. The sand can also be used as an abrasive. The demand for sand will increase with population growth and urbanization. The high demand of sand has led to unsustainable sand mining process resulting in illegal mining.

Although most jurisdictions have legal limit on the location and volume of sand that can be mined, illegal sand extraction is taking place in many parts of the country due to rapid urbanisation and industrialisation.

Removal or extraction of too much sand from rivers leads to erosion of river banks. Deltas can recede due to sand mining. These destructive effects of sand mining ultimately result in loss of fertile land and property. It also destabilizes the ground and causes failure of engineering structures.

In-stream mining directly alters the channel geometry and bed elevation. Removing sediment from the channel disrupts the pre-existing balance between sediment supply and transporting capacity, typically inducing incision upstream and downstream of the extraction site. The resultant incision alters the frequency of floodplain inundation along the river courses, lowers valley floor water table and frequently leads to destruction of bridges and channelization structures.

Sand Mining in beaches disturbs the ecosystem of different fauna of the beaches. The sand mining from natural barriers, made up of sand, causes flooding of the natural habitat. The sand mining activity destroys the aesthetic beauty of beaches and river bank and makes the ecosystem unstable. If there are popular tourist destination, tourism potential of such areas will decline.

It can be concluded that there has been little in-depth research on the environmental, social and political effects of land use practices and calls for urgent attention by the competent authority.

11.3 Remedial measure

11.3.1 Sustainable Mining Practices:

- The depth of mining in riverbed shall not exceed 3 meter or base flow level whichever is less, provided that where the Joint Inspection Committee certifies about excessive deposit or over accumulation of mineral in certain reaches requiring channelization, it can go above 3 meters.
- Mining shall be done in layers of 1 meter depth to avoid ponding effect and after first layer is excavated, the process will be repeated for the next layers.
- No stream should be diverted for the purpose of sand mining. No natural water course and/ or water resources are obstructed due to mining operations.
- No blasting shall be resorted to in river mining and without permission at any other place.

11.3.2 Monitoring the Mining of Mineral and its Transportation:

- For each mining lease site, the access should be controlled in a way that vehicles carrying mineral from that area are tracked and accounted for.
- There should be regular monitoring of the mining activities in the State to ensure effective compliance of stipulated EC conditions and of the provisions under the Minor Mineral Concessions Rules framed by the State Government.

11.3.3 Noise Management:

- Noise arising out of mining and processing shall be abated and controlled at source to keep within permissible limit.
- Restricted sand mining operation has to be carried out between 6 am to 7 pm.

11.3.4 Air Pollution and Dust Management:

- The pollution due to transportation load on the environment will be effectively controlled and water sprinkling will also be done regularly.
- Air pollution due to dust, exhaust emission or fumes during mining and processing phase should be controlled and kept in permissible limits specified under environmental laws.
- The mineral transportation shall be carried out through covered trucks only and the vehicles carrying the mineral shall not be overloaded. Wheel washing facility should be installed and used.

11.3.5 Bio-Diversity Protection:

- Restoration of flora affected by mining should be done immediately. Five times the number of trees destroyed by mining to be planted preferably of indigenous species. Each EC holder shall have to undertake plantation of trees over at least 20% of the total area of lease in the same plot or plots utilised for such working.
- No mining lease shall be granted in the forest area without forest clearance in accordance with the provisions of the Forest Conservation Act, 1980 and the rules made there under.
- Protection of natural home of any wild animal shall have to be ensured.
- No felling of tree near quarry is allowed. For mining lease within 10km of the National Park / Sanctuary or in Eco-Sensitive Zone of the Protected Area, recommendation of Standing Committee of National Board of Wild Life (NBWL) has to be obtained as per the Hon'ble Supreme Court order in I.A. No. 460 of 2004.
- Spring sources should not be affected due to mining activities. Necessary protection measures are to be incorporated.

11.3.6 Management of Instability and Erosion:

- Removal, stacking and utilization of top soil should be ensured during mining. Where top soil cannot be used concurrently, it shall be stored separately for future use keeping in view that the bacterial organism should not die and should be spread nearby area.
- The EC should stipulate conditions for adequate steps to check soil erosion and control debris flow etc. by constructing engineering structures
- Use of oversize material to control erosion and movement of sediments

- No overhangs shall be allowed to be formed due to mining and mining shall not be allowed in area where subsidence of rocks is likely to occur due to steep angle of slope.
- No extraction of stone / boulder / sand in landslide prone areas.
- Controlled clearance of riparian vegetation to be undertaken.

11.3.7 Waste Management:

- Site clearance and tidiness is very much needed to have less visual impact of mining.
- Dumping of waste shall be done in earmarked places as approved in Mining Plan.
- Rubbish burial shall not be done in the rivers.

11.3.8 Pollution Prevention:

- Take all possible precautions for the protection of environment and control of pollution.
- Effluent discharge should be kept to the minimum and it should meet the standards prescribed.

11.3.9 Protection of Infrastructure:

- Mining activities shall not be done for mine lease where mining can cause danger to site of flood protection works, places of cultural, religious, historical, and archeological importance.
- For carrying out mining in proximity to any bridge or embankment, appropriate safety zone should be worked out on case to case basis, taking into account the structural parameters, location aspects and flow rate, and no mining should be carried out in the safety zone so worked out.
- Mining shall not be undertaken in a mining lease located in 200-500 meter of bridge, 200 meter upstream and downstream of water supply / irrigation scheme, 100 meters from the edge of National Highway and railway line, 50 meters from a reservoir, canal or building, 25 meter from the edge of State Highway and 10 meters from the edge of other roads except on special exemption by the Sub-Divisional level Joint Inspection Committee.

12 Suggested reclamation plan for already mined out areas

As per statute all mines/quarries are to be properly reclaimed before final closure of the mine. Reclamation plans should include:

a) A baseline survey of river cross section. The study of cross section is basis for delineating channel form. Cross-sections must be surveyed between two monumented endpoints set on the river banks, and elevations should be referenced based on benchmark set in the area;

b) The proposed mining cross-section data should be plotted over the baseline data to illustrate the vertical extent of the proposed excavation;

c) The cross-section of the replenished bar should be the same as the baseline data. This illustrates that the bar elevation after the bar is replenished will be the same as the bar before extraction;

d) A planimetric map showing the aerial extent of the excavation and extent of the riparian buffers;

e) A planting plan developed by a plant ecologist familiar with the flora of the river for any areas such as roads that need to be restored;

f) Each EC holder shall have to undertake plantation of trees over at least 20% of the total area of the plot or plots of land as subject to such working in accordance with a plan approved by the concerned Divisional Forest Officer holding jurisdiction, provided further the competent authority l.e, The Divisional Forest Officer may fix up norms for plantation of trees in a particular area regarding choice of species, spacing, nos of trees and maintenance etc.;

g) A monitoring plan has to establish.

13 Risk assessment & disaster management plan

Risk analysis is the systematic study of risks encountered during various stages of mining operation. Risk analysis seek to identify the risks involved in mining operations, to understand how and when they arise, and estimate the impact (financial or otherwise) of adverse outcomes. The sand mining operation in the district is mainly done manually.

13.1 Identification of risk due to river sand mining

There is no land degradation due to mining activities as mining is done only on river bed dry surface. There will be no OB or waste generation as the sand is exposed in the river bed and is completely saleable. There will be neither any stacking of soil nor creation of OB dumps. The mining activity will be carried out up to a maximum depth of 3m below the surface level. So, there is no chance of slope failure, bench failure in the mines. However, there are some identified risk in the mining activity which are as follows:

1. Accident during sand loading and transportation
2. Inundation/ Flooding
3. Quick Sand Condition

13.2 Mitigation measures

13.2.1 Measures to prevent accidents during loading and transportation:

- During the loading truck should be brought to a lower level so that the loading operation suits to the ergonomic condition of the workers.
- The workers will be provided with gloves and safety shoes during loading.
- Opening of the side covers of the truck should be done carefully and with warning to prevent injury to the loaders.
- Mining operations will be done during daylight only.
- The truck will be covered with tarpaulin and maintained to prevent any spillage.
- To avoid danger while reversing the trackless vehicles especially at the embankment and tipping points, all areas for reversing of lorries should be made man free as far as possible.
- All transportation within the main working will be carried out directly under the supervision and control of the management.
- Overloading should not be permitted and the maximum permissible speed limits hold be ensured.
- There will be regular maintenance of the trucks and the drivers will have valid driving license.

13.2.2 Measures to prevent incidents during Inundation/ Flooding:

To minimize the risk of flooding/ inundation following measures should be under taken:

- Mining will be completely closed during the monsoon months.

- Proper weather information particularly on rain should be kept during the operational period of mines so that precautionary measures will be undertaken.

13.2.3 Measures for mitigation to quick sand condition:

- Quick sand zone and deep water zone will be clearly demarcated and all the mines workers will be made aware of the location.
- Mining will be done strictly as per the approved mining plan.

13.3 Disaster management plan

As the depth of mining will be maximum of 3m below the surface level considering local condition, the risk related to mining activity is much less. The mining operation will be carried out under the supervision of experienced and qualified Mines Manager having Certificate of Competency to manage the mines granted by DGMS. All the provisions of Mines Act 1952, MMR 1961 and Mines Rules 1955 and other laws applicable to mine will strictly be complied. During heavy rainfall and during the monsoon season the mining activities will be closed. Proper coordination with Irrigation Department should be maintained so that at the time of releasing water, if any, from the dam suitable warning/information is given in advance. Special attention and requisite precautions shall be taken while working in areas of geological weakness like existence of slip, fault etc. The mining site will be supplied with first aid facilities and the entire mines worker will have access to that.

14 Conclusions and Recommendations

The District Survey Report for Kalimpong district has been prepared as per Ministry of Environment, Forests and Climate Change (MoEF&CC) guidelines. The Guideline of WBMMCR, 2016 is also taken into consideration while preparation of this report.

Potential areas of economic mineralization and mineral deposition have been identified and list is furnished in the report. Estimation of annual sand deposition by replenishment study has been incorporated.

The district survey report has been prepared by utilizing both primary and secondary data. The primary data generation involved the satellite imagery study, site inspection, survey, ground truthing etc. while secondary data has been acquired through various authenticated sources and satellite imagery studies.

As per the study conducted during the preparation of the DSR of Kalimpong, drainage system of the district is mostly controlled by the topography. Numerous rivers are coming down from the mighty Himalayas in the North and flowing to the Tarai region in the South and South-East. The major rivers in the district are Teesta and Jaldhaka. Because of the hilly topography for a large portion of the terrain, no rivers in the district are navigable throughout the year, except Teesta and Jaldhaka.

The whole district falls under Zone IV as per the earthquake zonation map of India. Most of the downhill areas of the district are susceptible to landslides as because of weathered and unconsolidated formations. Kalimpong witnessed several landslides and flood during monsoons. Therefore, mining in the hilly areas should be taken with utter most care for sustainable development.

Presence of thick vegetation cover throughout the district, Neora Valley National Park and high hill slopes has constricted the district from extensive mining activity although occurrences of both major and minor minerals are reported.

Around 15 million tonne of inferred resources of coal has been reported in Dalingkot coalfield which is extended from Pankhabari in the west of the Darjeeling district to Jaldhaka in the east of Kalimpong. The base metal prospect of the Daling-Chu- MaiNadi is situated within the Gorubathan subgroup of the Dalings. MECL has carried out detailed exploration in the Mal Khola block and established probable reserves of 1.79 million tonne. of 3.86% Pb and 3.64% Zn (TMC- 7.50% Pb+Zn) in the Mal Khola block within a vertical depth of 125m and a strike length of 200m.Geological Survey of India (GSI) has also established copper deposits at Pedong in Kalimpong district.

The district is so far not exposed to extensive mining activities. The district is currently generating revenue from mining of minor minerals such as sand, stone and gravels from the riverbed. However, in-stream mining directly alters the channel geometry and bed elevation.

Therefore, mining of riverbed should be carried out scientifically and based on statutory guidelines for conservation of land, river channels and sustainable development of the society.

The occurrence of riverbed sand and gravel in the district has been established by Directorate of Mines and Minerals, Government of West Bengal and others in previous instances. However, it requires further systematic and scientific approach to quantify the resource along with their grade assessment. The occurrences of riverbed are mostly observed in the river Relli, Geet, Palla, Rishi and Chel River. This report also recommends to undertake detail exploration (G2 level) program to assess the mineral occurrences in the major rivers of the district and should have a proper development and production plan for the specified minerals.

As per the data received from DL&LRO office, Kalimpong, total5 blocks have been allotted for mining of river sand in the district. Out of which 3 blocks are allotted in Relli River, 1 block in Geet River and another in Palla River. Total allotted block area for 5 blocks is only 3.55 Ha and estimated reserve is around 1002285 CuM. Beside this, about 22 blocks (area 16.61 Ha.) are in the process of allotment by the competent authority. Revenue generated in the district of Kalimpong from Minor minerals during the period of April 2017 to March 2020 is Rs. 0.36 Crores. Potential areas where sand blocks are not allotted yet are also identified and discussed in the current DSR.

Incremental volume of sand is estimated in this DSR and found as around 0.97 million cubic meters when compared between pre and post monsoon sand reserve data. So, the district is potential for scientific and systematic sand mining.

14.1 Conclusion:

1. The rivers are enriched with gravels and boulders along with sand where the percentage of larger grains (gravels and boulders) are much more in the uphill region while percentage of sand is found to be more towards the plains after the hill slope break areas.
2. The replenishment study has been carried out during the preparation of this DSR. Both field-based surveys coupled with satellite imagery study and empirical studies were carried out to determine the rate of replenishment in each river of the district.
3. The determined values of various methods as adopted for replenishment study gives a comparable value and in all cases the values are found to be much more as compared to the capping limit (60%) as suggested in the Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) January 2020, Issued by Ministry of Environment, Forest and Climate Change (MoEF&CC) 2020.
4. Field base study shows variation of replenishment from 92.5 to 93.5% in the district and for theoretical replenishment study shows variations from 67% to 70% with an average of 69% of replenishment rate in the district.
5. The total potential river bed deposit for the district comes to about 3.053 million cubic meters.

14.2 Recommendation:

1. The mining lease distribution for the district must be carried out by involving a district level committee constituted with inter-disciplinary members of various departments including irrigation and waterways, DL&LRO, forest, biodiversity, wetland management, SWID or any other relevant department which the district authority may find suitable to include.
2. While recommending for Mining Leases, the District Level Committee should ensure the protection of Biodiversity Zones as recorded by relevant Government Agenesis from time to time.
3. During finalization of mining leases for the district, strict adherence of Supreme Court orders No 1501 dated 03/06/2022 should be followed.
4. Efforts should be given to restrict distribution of mining leases along the confluence zone of the rivers where rich aquatic habitats are reported.
5. Since the state of West Bengal has royalty system in volumetric measurement, specific gravity for sand and gravel has not been determined during this study. However, during the finalization of mining lease if it is found necessary to conduct such test may be initiated by the state government on case-to-case basis.
6. It is recommended to have a periodical review along with primary data collection during pre- and post-monsoon periods to record the seasonal variance of the sedimentation rate on annual basis and update replenishment rate of the district.

References

Ackers, P., and White, W.R. (1973), Sediment transport: New approach and analysis, ASCE Journal of the Hydraulics Division, Vol. 99, HY11.

Bhattacharya A.C. and Neogi S. (1984), Preliminary Exploration Of Gorubathan Lead-Zinc Deposits, Darjeeling District, West Bengal, GSI Progress Report of FS 1979-80.

Bhattacharya A.C. and Basu D.L. (1986); Report on the Investigation For Tungsten In Munsong And Adjoining Areas Of Darjeeling District West Bengal, GSI Report.

Biswas S.S. and Pal R, (2016), Causes of Landslides in Darjeeling Himalayas during June-July, 6 (2).

Chattopadhyay S and Ray S (2001); Report on Search for Auriferous Veins At Samthar (P - II), Darjeeling District, West Bengal, GSI Report on FS 1998-99.

Cajee Laitpharlang (2018), Physical Aspects of the Darjeeling Himalaya: Understanding from a Geographical Perspective, IOSR Journal Of Humanities And Social Science (IOSR-JHSS), 23 (3), 66-79.

Census (2011), District Census handbook Darjeeling, West Bengal, Census of India 2011, Series 20, Part XII-A.

Das Mondal P (2018); Physical Aspects of the Kalimpong District, Darjeeling Himalaya: Understanding From A Geographical Perspective, International Journal of Humanities and Social Science Invention, 7 (09), PP 01-09.

Deepak and Pardeep (2019), Occurrence of Landslide and Management in Darjeeling Himalayas, Journal of Advances and Scholarly Researches in Allied Education, 16 (1), 453-458.

Dendy, F.E., and Bolton, G.C., (1976), Sediment yield-runoff drainage area relationships in the United States. Journal of Soil and Water Conservation 31, 264-266.

Dey S (2015), A Devastating Disaster: A Case Study of Nepal Earthquake and Its Impact on Human Beings, Journal of Humanities and Social Science (IOSR-JHSS) Volume 20, Issue 7.

Dynamic Ground Water Resources of India (As on March 2013), Ministry of Water Resources, Central Ground Water Board (2017), Govt. of India.

Geomorphological Field Guide Book on Darjeeling Himalayas (2017), Indian Institute of Geomorphologist.

Geology and Mineral Resources of India, GSI Publication.

GSI (2018), Glimpse of Geology of West Bengal, GSI Publication.

Huin Ak, Roy N, Chakraborti S And Das S; Final Report on Base metal Investigation In Kumai Area, Darjeeling District, West Bengal (P-II), GSI Report FS 2003-04.

https://en.wikipedia.org/wiki/Kalimpong_district

https://hydro.imd.gov.in/hydrometweb/(S(zfnwfwzmlzosbvnaeglg1h45))/DistrictRaifall.aspx https://indiawris.gov.in/wris/#/groundWater%20(CGWB%20website%20for%20Ground%20water%20data

https://kalimpong.gov.in/flora-and-fauna/

https://kalimpong.gov.in/

https://www.imdpune.gov.in/library/public/Climate%20of%20WestBengal.pdf

http://wbwridd.gov.in/swid/mapimages/DARJEELING.pdf

http://wbpspm.gov.in/publications/District%20Statistical%20Handbook

Indian Minerals Year Book (2014), 53rd Edition, State Reviews (West Bengal), Indian Bureau of Mines, GoI.

Indian Minerals Year Book (2012), 51st Edition, State Reviews (West Bengal), Indian Bureau of Mines, GoI.

Mineral Exploration Corporation Limited (1985), Geological Report On Exploration For Lead-Zinc Ore Gorubathan (Mal Khola) Block District- Kalimpong, West Bengal.

Mili J (2012), An Integrated approach towards Landslide Hazard Zonation and Mitigation in the Kurseong Sub-division of Darjeeling Himalayas, Open access shodhganga.inflibnet.ac.in /handle/10603/195005.

Nad C. (2015), Landslide Hazard Management of Darjeeling Hill: A Critical Need For Inhabited, International Journal of Humanities and Social Science Invention, 4 (3) 48-60.

Ponce, V. M., (1989), Engineering Hydrology, Principles and Practices, Prentice Hall, 558p.

Ray K.K., Mukhopadhyay S.K., Chatterjee S.K. and Ghosh P.C. (1972), Investigation of Daling Chu-Mal Nadi Prospect, Kalimpong Subdivision, Darjeeling District, West Bengal, GSI Progress Report for F.S. 1971-72.

Shankar B and Tarafdar P (FS 2000-2001), Report on the Base metal Investigation of Mangwa Jhora - Peshok Area, Darjeeling District, West Bengal, GSI Progress Report.

Subramanya K (2008), Engineering Hydrology. 3rd Edision, Tata McGraw-Hill, New Delhi.

WiejaczkaŁukasz T. L., Piróg Danuta and Paweł P. (2018), Socio-environmental issues of river bed material extraction in the Himalayan piedmont (India), Environmental Earth Sciences 77:718.

Williams, J.R. (1995), The EPIC model, In: V.P. Singh (ed.), Computer models of watershed hydrology. Water Resources Publications, Littleton, Colorado, pp 909-1100.

Wischmeier, W.H. and Smith, D.D. (1978) Predicting Rainfall Erosion Losses. A Guide to Conservation Planning. The USDA Agricultural Handbook No. 537, Maryland.

PLATE 1

DRAINAGE MAP OF THE DISTRICT

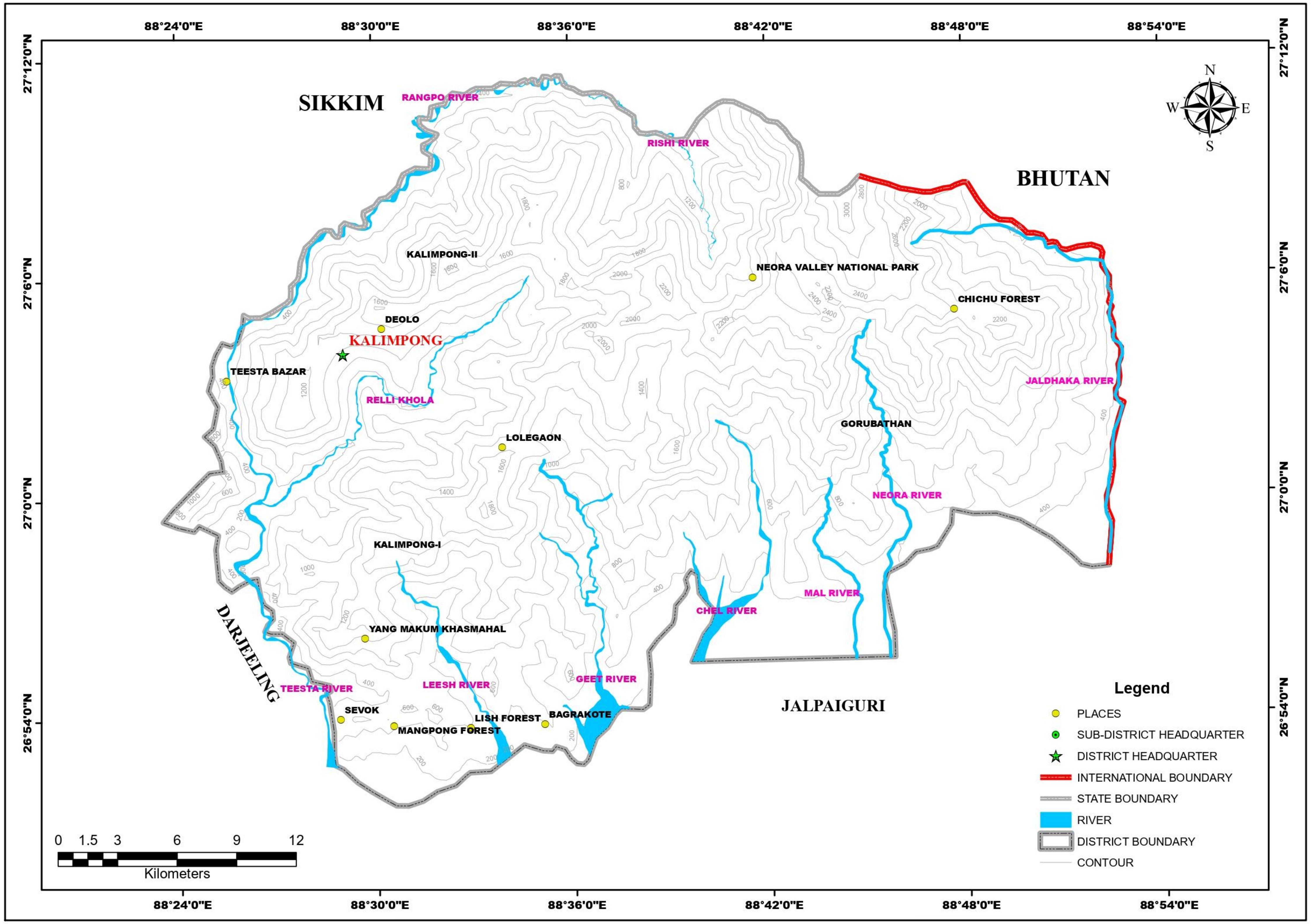
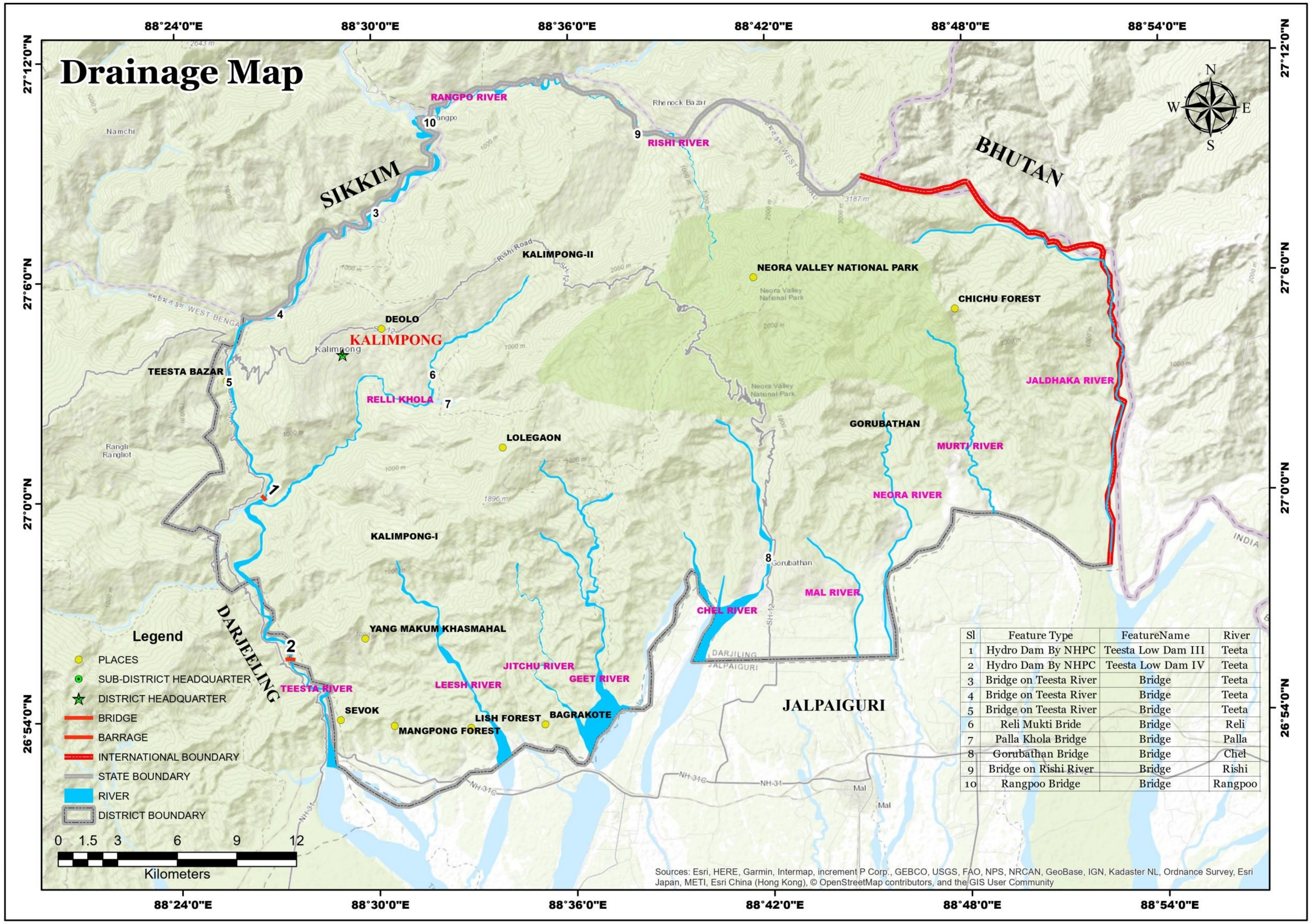


Plate 1A: Drainage Map of the District*(Source: National Informatics Centre -NIC Website, September 2020)*

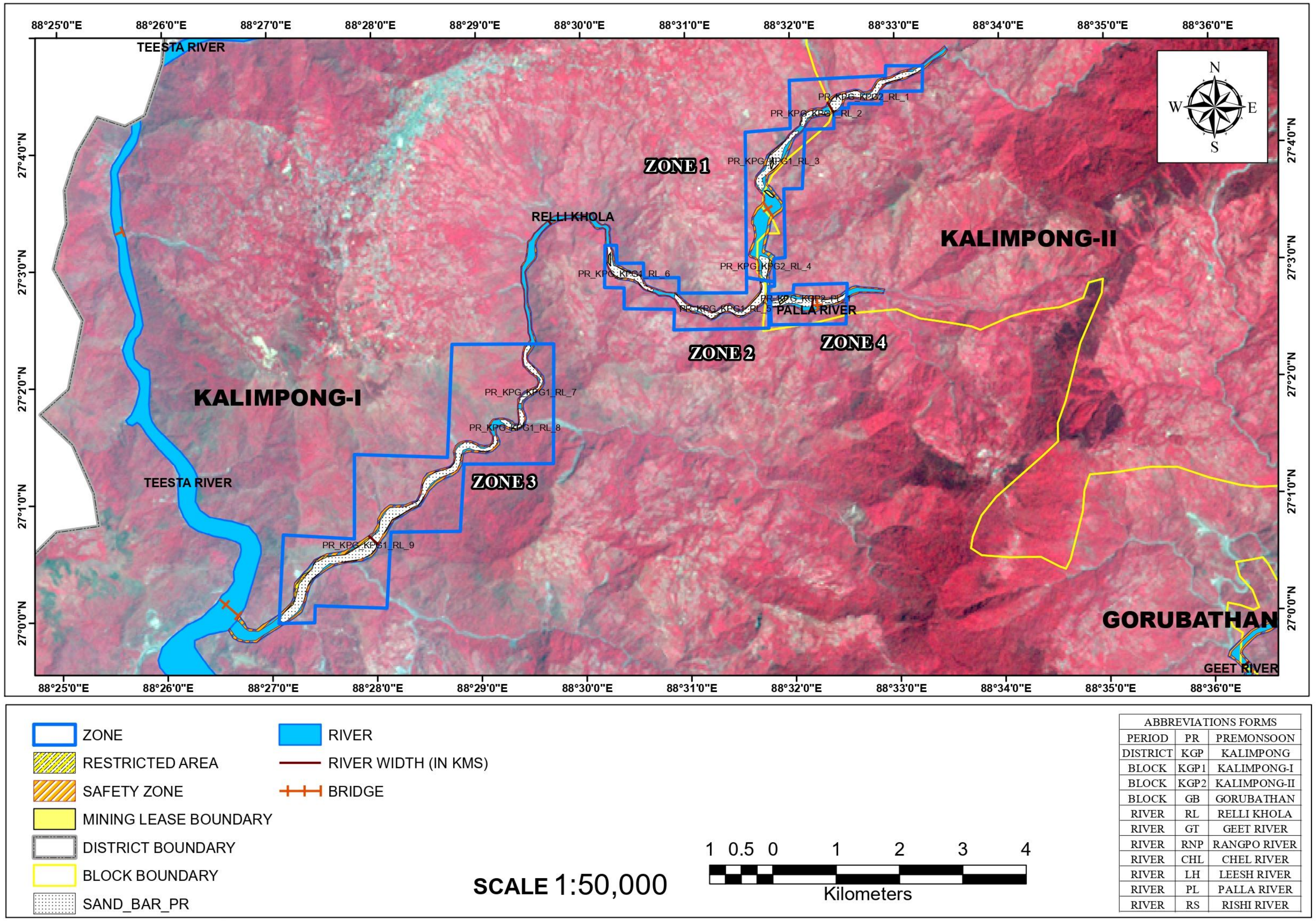


Sl	Feature Type	FeatureName	River
1	Hydro Dam By NHPC	Teesta Low Dam III	Teeta
2	Hydro Dam By NHPC	Teesta Low Dam IV	Teeta
3	Bridge on Teesta River	Bridge	Teeta
4	Bridge on Teesta River	Bridge	Teeta
5	Bridge on Teesta River	Bridge	Teeta
6	Reli Mukti Bride	Bridge	Reli
7	Palla Khola Bridge	Bridge	Palla
8	Gorubathan Bridge	Bridge	Chel
9	Bridge on Rishi River	Bridge	Rishi
10	Rangpoo Bridge	Bridge	Rangpoo

Plate No 1B: Location Map of dams, barrages, bridge showing on drainage system of the district*(Source: National Informatics Centre -NIC Website, September 2020)*

PLATE 2A

DISTRIBUTION MAP OF SAND BARS ON RIVERS DURING PRE-MONSOON PERIOD OF KALIMPONG DISTRICT



ABBREVIATIONS FORMS		
PERIOD	PR	PREMONSOON
DISTRICT	KGP	KALIMPONG
BLOCK	KGP1	KALIMPONG-I
BLOCK	KGP2	KALIMPONG-II
BLOCK	GB	GORUBATHAN
RIVER	RL	RELLI KHOLA
RIVER	GT	GEET RIVER
RIVER	RNP	RANGPO RIVER
RIVER	CHL	CHEL RIVER
RIVER	LH	LEESH RIVER
RIVER	PL	PALLA RIVER
RIVER	RS	RISHI RIVER

Plate 2A1: Distribution Map of Sand Bars on Rivers During Pre-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March 2020)*

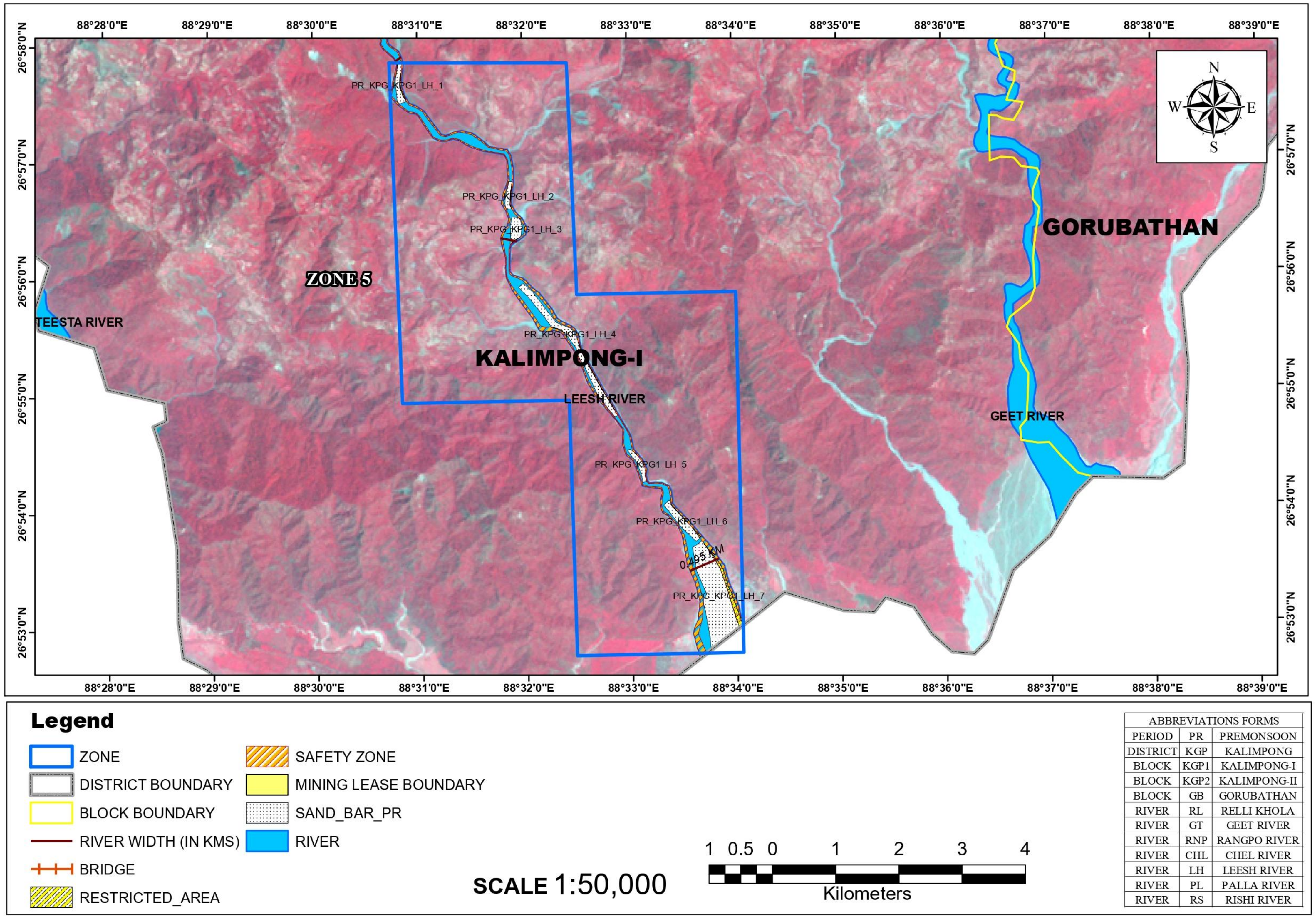
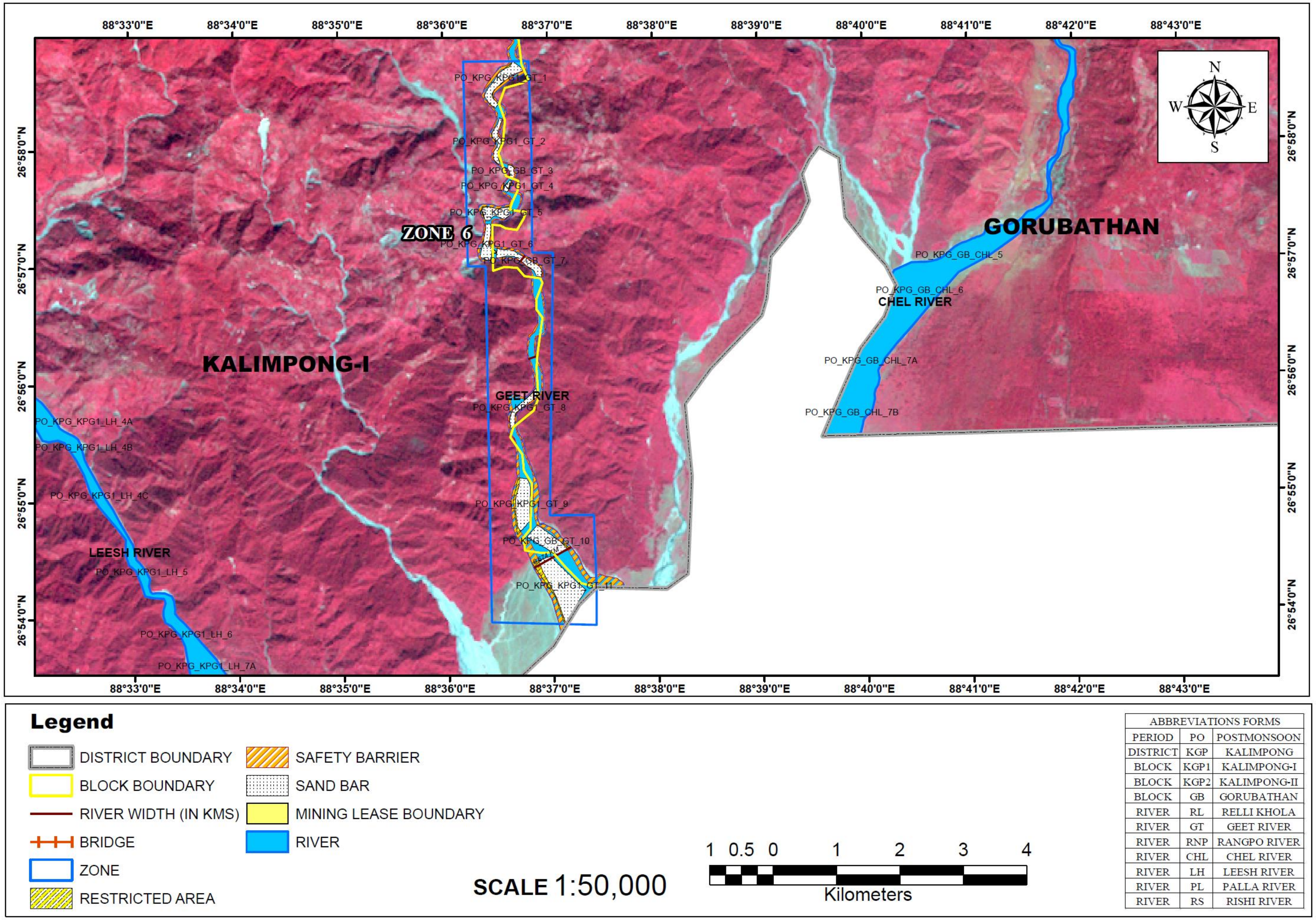
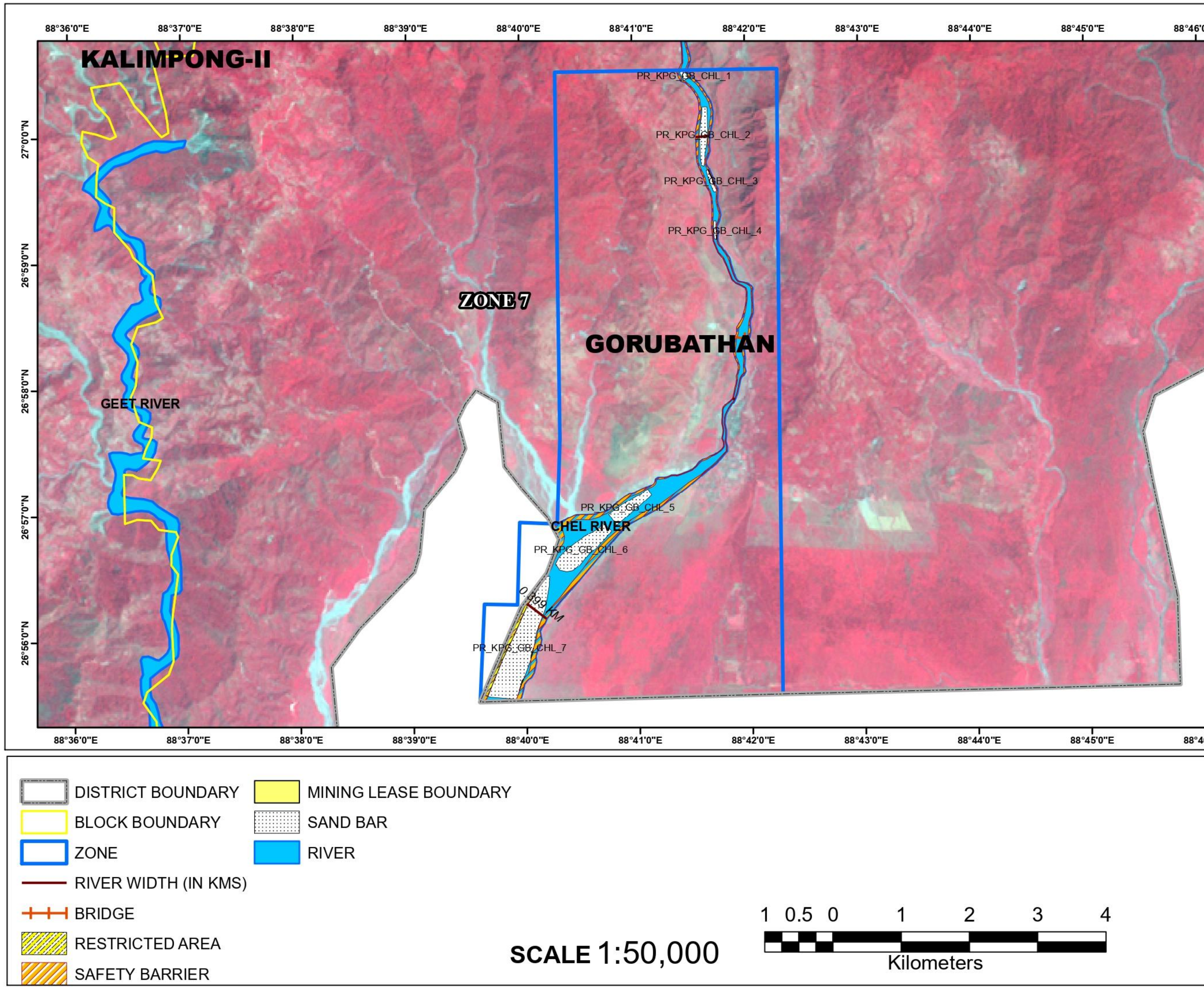


Plate 2A2: Distribution Map of Sand Bars on Rivers During Pre-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor,March 2020)*



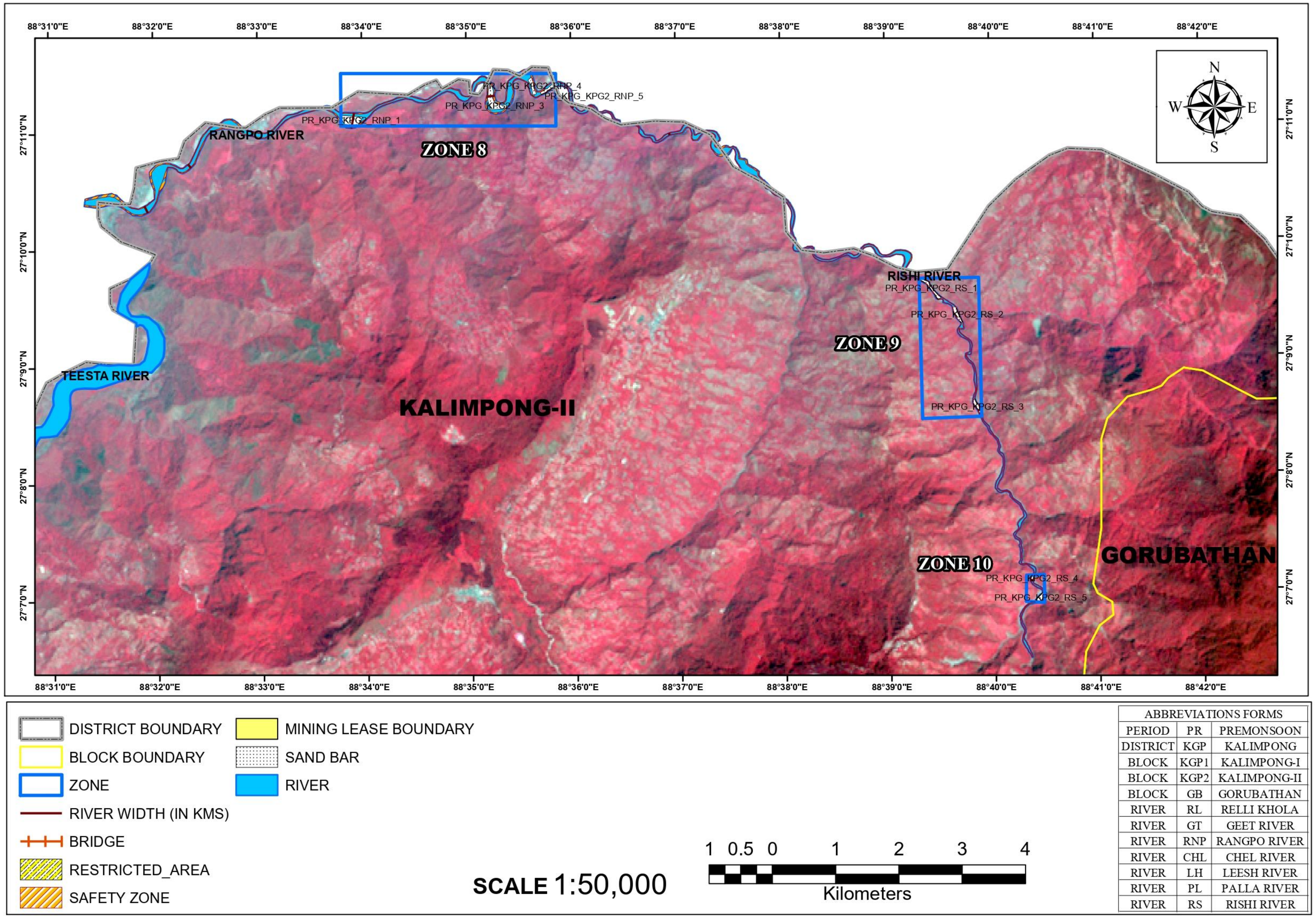
ABBREVIATIONS FORMS		
PERIOD	PO	POSTMONSOON
DISTRICT	KGP	KALIMPONG
BLOCK	KGP1	KALIMPONG-I
BLOCK	KGP2	KALIMPONG-II
BLOCK	GB	GORUBATHAN
RIVER	RL	RELLI KHOLA
RIVER	GT	GEET RIVER
RIVER	RNP	RANGPO RIVER
RIVER	CHL	CHEL RIVER
RIVER	LH	LEESH RIVER
RIVER	PL	PALLA RIVER
RIVER	RS	RISHI RIVER

Plate 2A3: Distribution Map of Sand Bars on Rivers During Pre-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor,March 2020)*



ABBREVIATIONS FORMS		
PERIOD	PR	PREMONSOON
DISTRICT	KGP	KALIMPONG
BLOCK	KGP1	KALIMPONG-I
BLOCK	KGP2	KALIMPONG-II
BLOCK	GB	GORUBATHAN
RIVER	RL	RELLI KHOLA
RIVER	GT	GEET RIVER
RIVER	RNP	RANGPO RIVER
RIVER	CHL	CHEL RIVER
RIVER	LH	LEESH RIVER
RIVER	PL	PALLA RIVER
RIVER	RS	RISHI RIVER

Plate 2A4: Distribution Map of Sand Bars on Rivers During Pre-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March 2020)*



ABBREVIATIONS FORMS		
PERIOD	PR	PREMONSOON
DISTRICT	KGP	KALIMPONG
BLOCK	KGP1	KALIMPONG-I
BLOCK	KGP2	KALIMPONG-II
BLOCK	GB	GORUBATHAN
RIVER	RL	RELLI KHOLA
RIVER	GT	GEET RIVER
RIVER	RNP	RANGPO RIVER
RIVER	CHL	CHEL RIVER
RIVER	LH	LEESH RIVER
RIVER	PL	PALLA RIVER
RIVER	RS	RISHI RIVER

Plate 2A5: Distribution Map of Sand Bars on Rivers During Pre-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March 2020)*

ANNEXURE 2B

DISTRIBUTION MAP OF SAND BARS ON RIVERS DURING POST-MONSOON PERIOD OF KALIMPONG DISTRICT

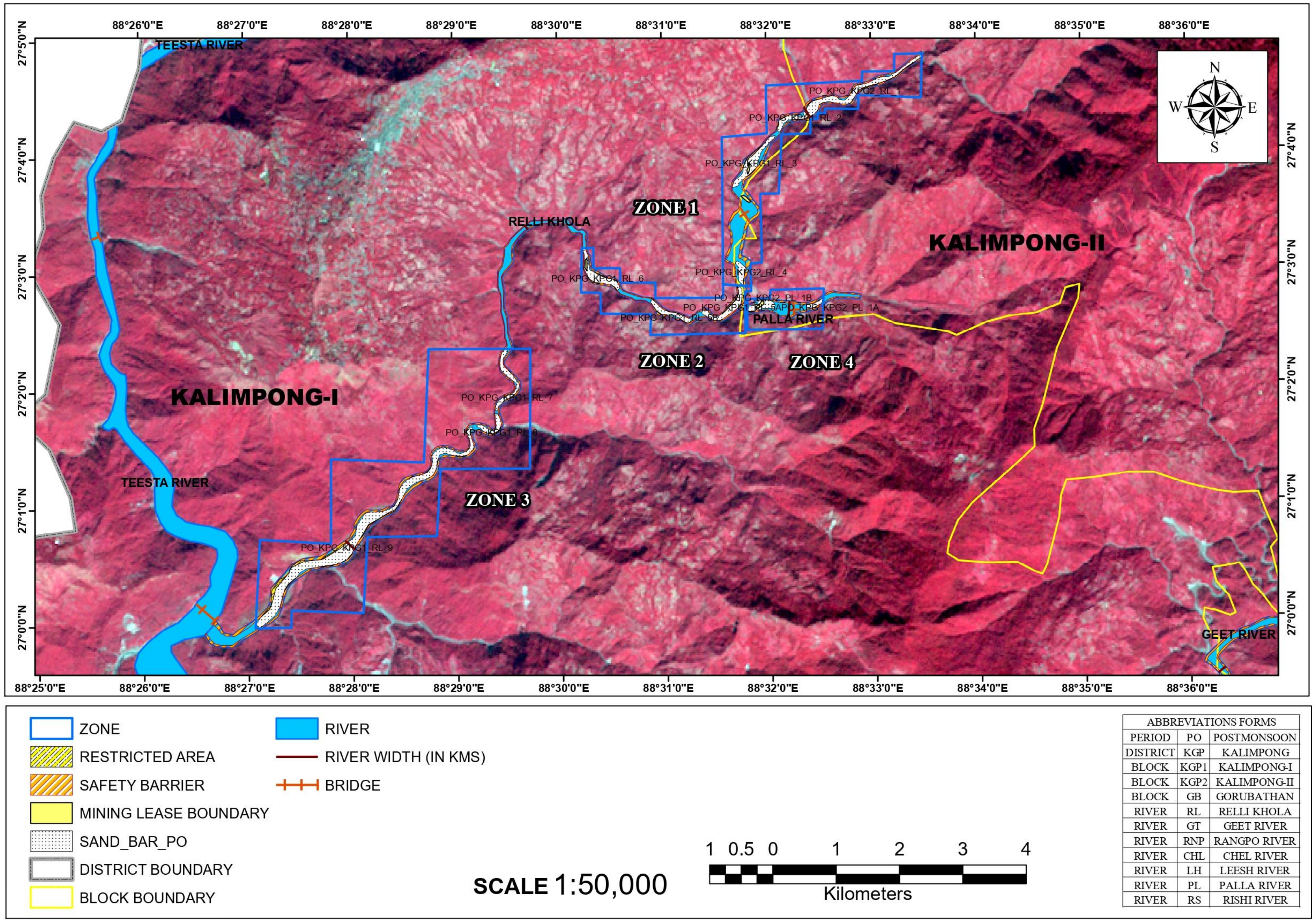
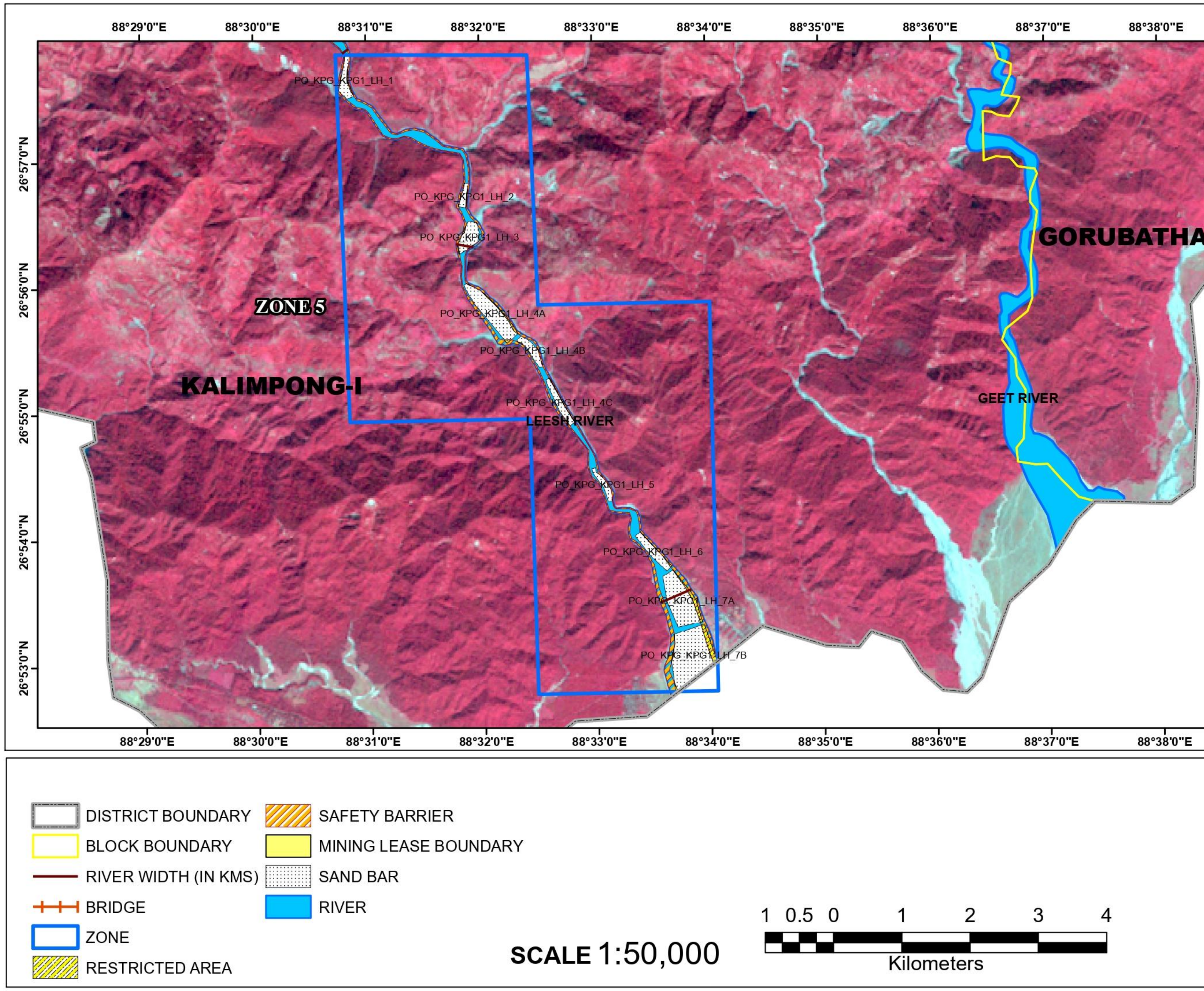
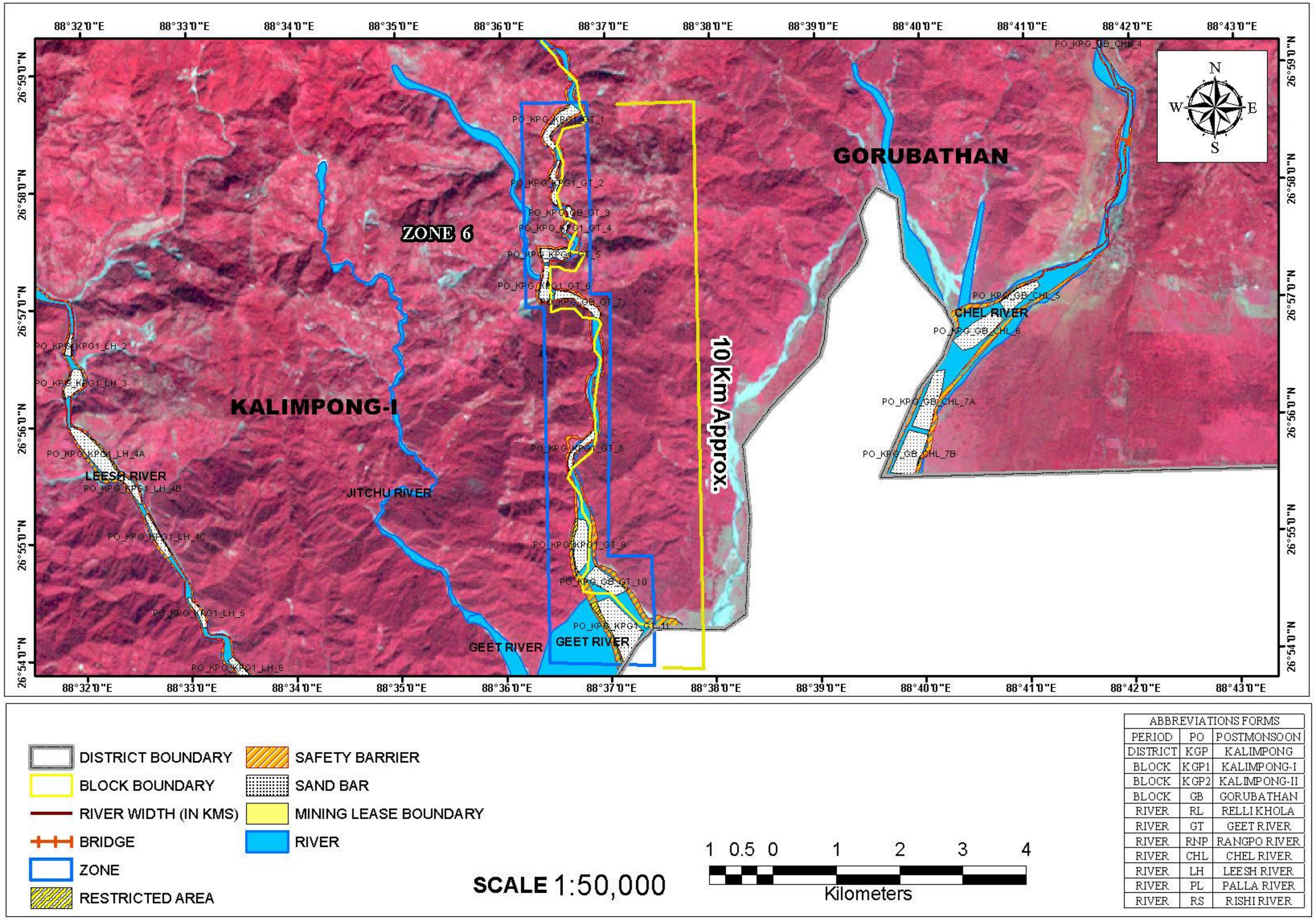


Plate 2B1: Distribution Map of Sand Bars on Rivers During Post-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November 2020)*



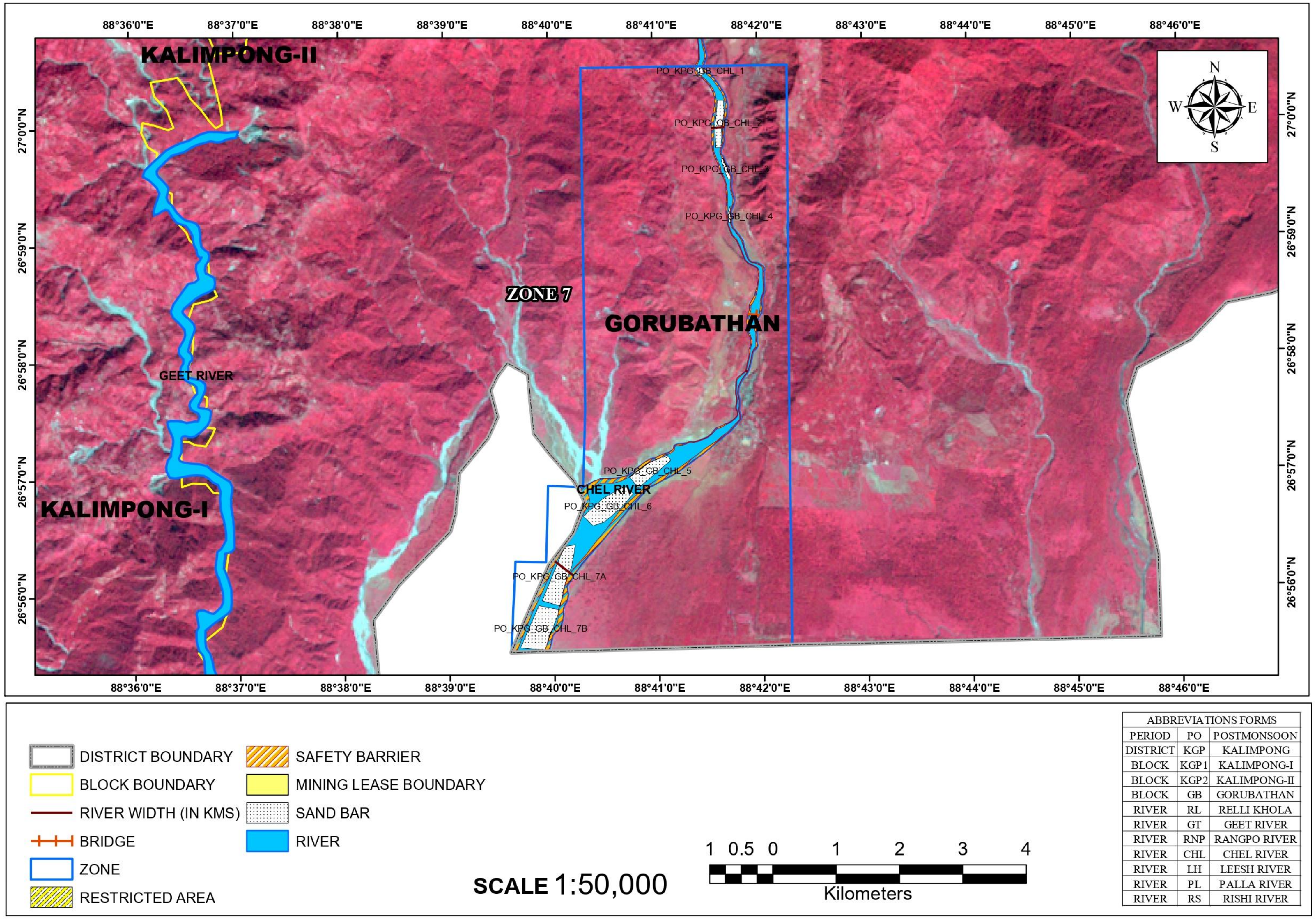
ABBREVIATIONS FORMS		
PERIOD	PO	POSTMONSOON
DISTRICT	KGP	KALIMPONG
BLOCK	KGP1	KALIMPONG-I
BLOCK	KGP2	KALIMPONG-II
BLOCK	GB	GORUBATHAN
RIVER	RL	RELLI KHOLA
RIVER	GT	GEET RIVER
RIVER	RNP	RANGPO RIVER
RIVER	CHL	CHEL RIVER
RIVER	LH	LEESH RIVER
RIVER	PL	PALLA RIVER
RIVER	RS	RISHI RIVER

Plate 2B2: Distribution Map of Sand Bars on Rivers During Post-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor,November 2020)*



ABBREVIATIONS FORMS		
PERIOD	PO	POSTMONSOON
DISTRICT	KGP	KALIMPONG
BLOCK	KGP1	KALIMPONG-I
BLOCK	KGP2	KALIMPONG-II
BLOCK	GB	GORUBATHAN
RIVER	RL	RELLI KHOLA
RIVER	GT	GEET RIVER
RIVER	RNP	RANGPO RIVER
RIVER	CHL	CHEL RIVER
RIVER	LH	LEESH RIVER
RIVER	PL	PALLA RIVER
RIVER	RS	RISHI RIVER

Plate 2B3: Distribution Map of Sand Bars on Rivers During Post-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor,November 2020)*



ABBREVIATIONS FORMS		
PERIOD	PO	POSTMONSOON
DISTRICT	KGP	KALIMPONG
BLOCK	KGP1	KALIMPONG-I
BLOCK	KGP2	KALIMPONG-II
BLOCK	GB	GORUBATHAN
RIVER	RL	RELLI KHOLA
RIVER	GT	GEET RIVER
RIVER	RNP	RANGPO RIVER
RIVER	CHL	CHEL RIVER
RIVER	LH	LEESH RIVER
RIVER	PL	PALLA RIVER
RIVER	RS	RISHI RIVER

Plate 2B4: Distribution Map of Sand Bars on Rivers During Post-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor,November 2020)*

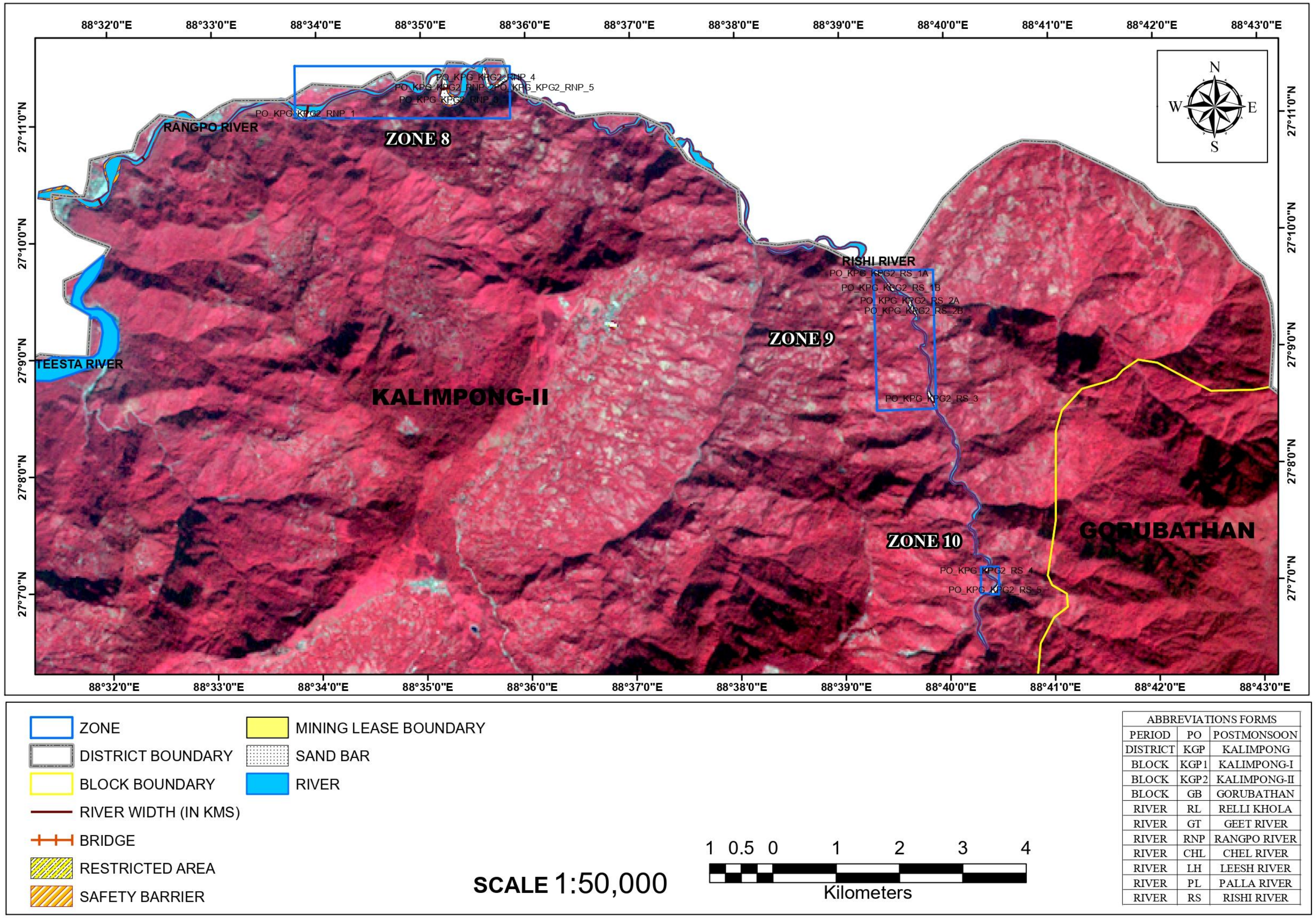
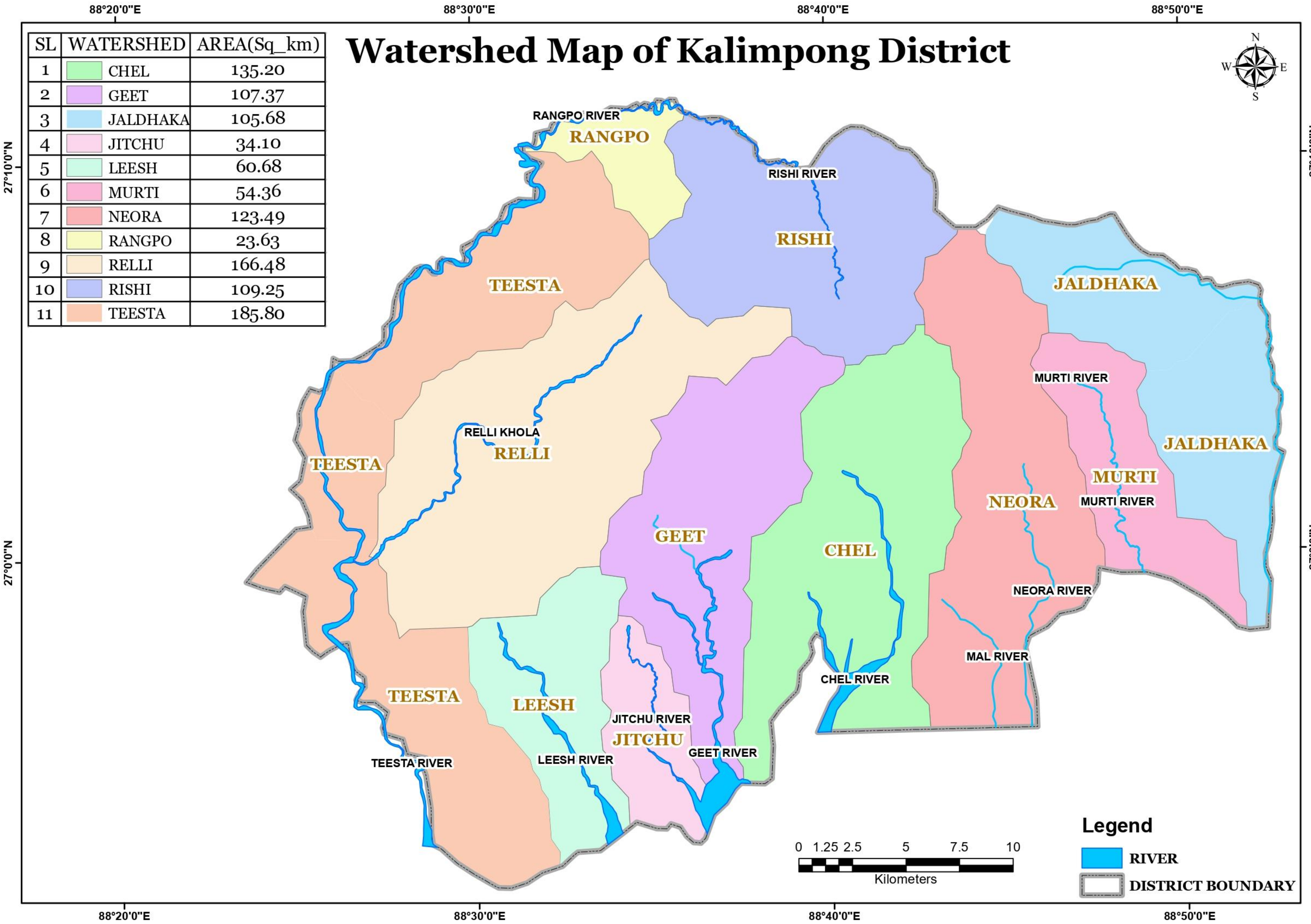


Plate 2B5: Distribution Map of Sand Bars on Rivers During Post-Monsoon Period of Kalimpong District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor,November 2020)*

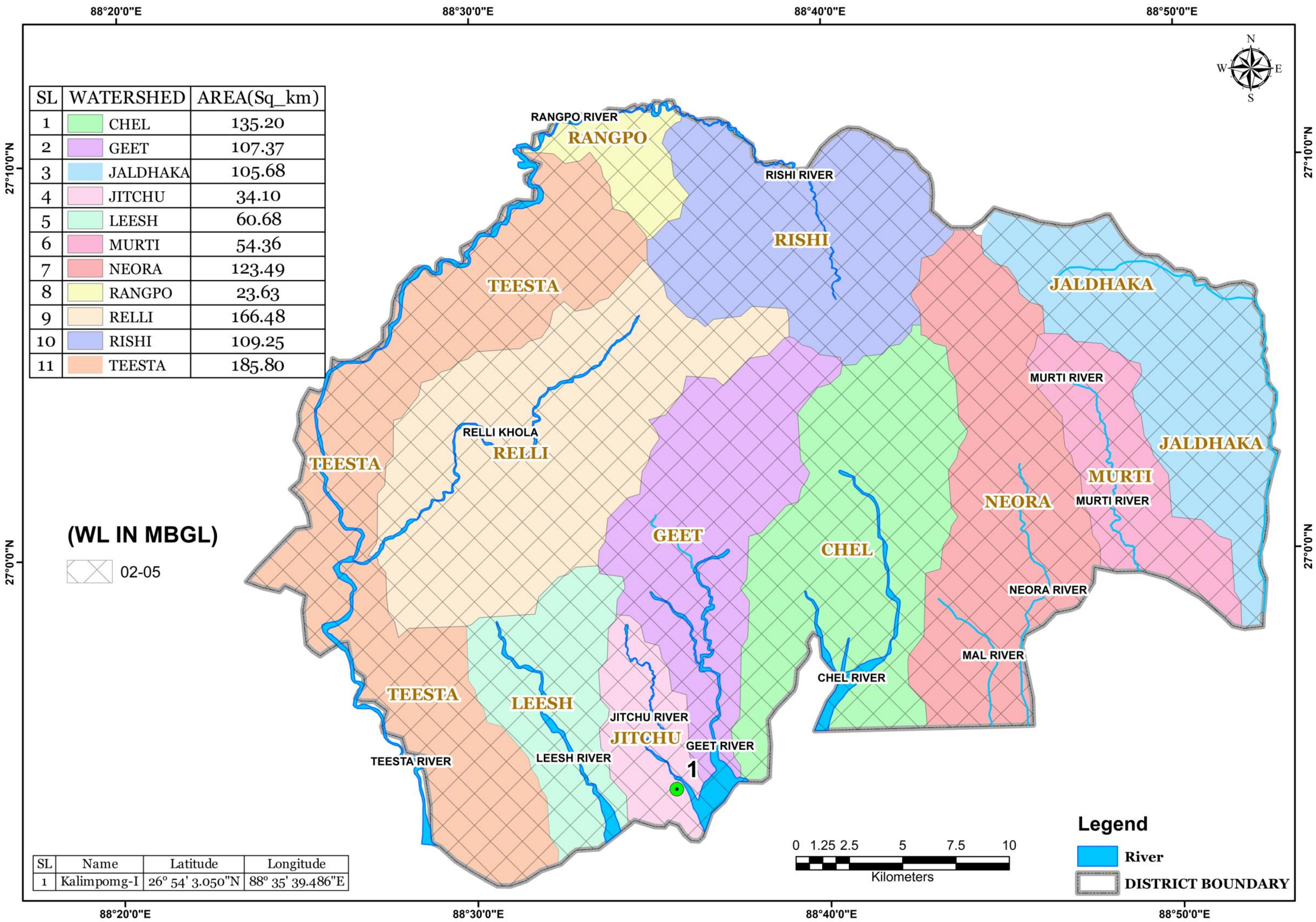
PLATE3

WATERSHED MAP OF KALIMPONG DISTRICT



SL	WATERSHED	AREA(Sq_km)
1	CHEL	135.20
2	GEET	107.37
3	JALDHAKA	105.68
4	JITCHU	34.10
5	LEESH	60.68
6	MURTI	54.36
7	NEORA	123.49
8	RANGPO	23.63
9	RELLI	166.48
10	RISHI	109.25
11	TEESTA	185.80

Plate 3A: Watershed map of the district*(Source: World Wild Fund for Nature, September 2020)*



SL	WATERSHED	AREA(Sq_km)
1	CHEL	135.20
2	GEET	107.37
3	JALDHAKA	105.68
4	JITCHU	34.10
5	LEESH	60.68
6	MURTI	54.36
7	NEORA	123.49
8	RANGPO	23.63
9	RELLI	166.48
10	RISHI	109.25
11	TEESTA	185.80

SL	Name	Latitude	Longitude
1	Kalimpomg-I	26° 54' 3.050"N	88° 35' 39.486"E

Plate 3B: District Watershed map showing ground water level during Pre-monsoon period *(Source: World Wild Fund for Nature, September 2020)*

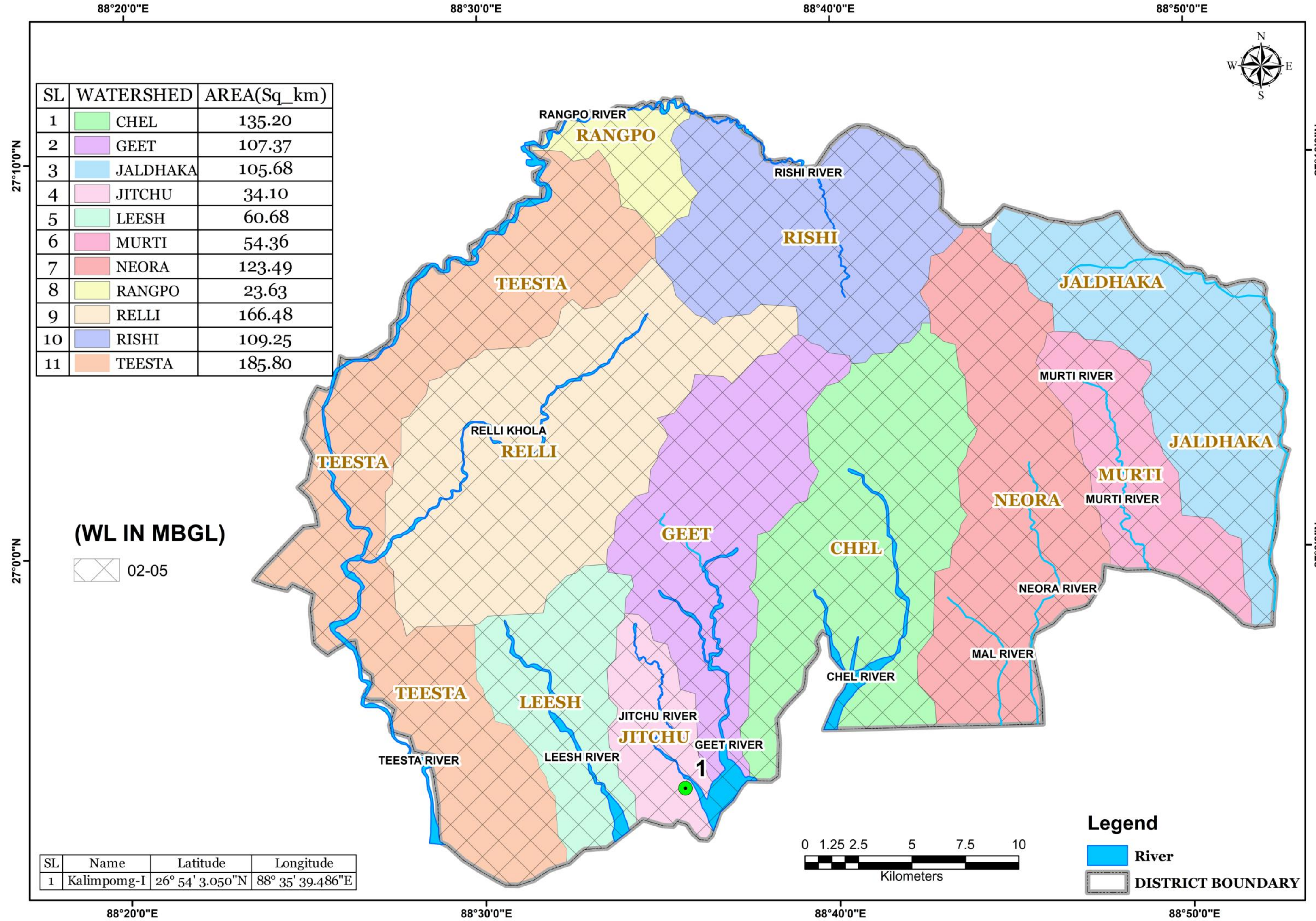


Plate 3C: District Watershed map showing ground water level during Post-monsoon period *(Source: World Wild Fund for Nature, September 2020)*

PLATE 4

FIELD SURVEY PHOTOGRAPHS

4A: Picture of Riverbed deposit of Relli River (Date: 25/12/2020, Lat: 27°4'18.375"N Long: 88°32'26.358" E)

4B: Picture of Riverbed deposit of Geet River (Date: 25/12/2020,Lat: 26°58' 32.946"N Long: 88°36'34.381" E)

4C: Picture of Riverbed deposit of Rishi River (Date: 25/12/2020, Lat: 27°9'40.010"N Long 88°39'21.134" E)

4D: Picture of Riverbed deposit of Chel River (Date: 25/12/2020, Lat:26°59'47.012"N Long: 88°41'35.528"E)

PLATE 5

LONG TERM EROSION-ACCRETION MAP

Plate 5A: Long term river course map showing very less erosion/ accretion along its banks*(Source: ISRO RESOURCE Sat 2 LISS III Sensor)*

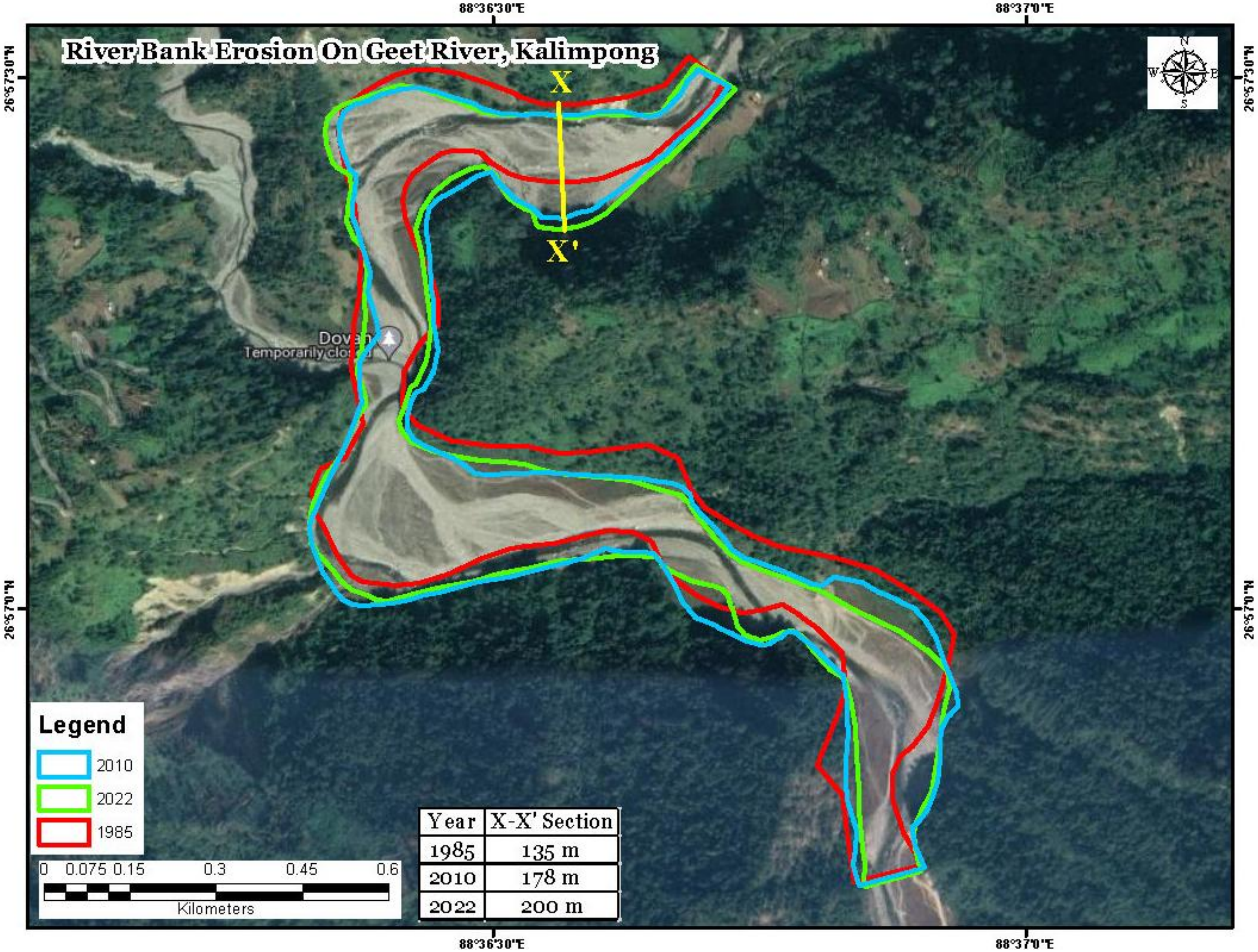


Plate 5B: Map showing long-term (10-year or more) erosion-accretion areas on both the banks of Geet River, Kalimpong *(Source: ISRO RESOURCE Sat 2 LISS III Sensor)*

Annexure 1
Compliance as per Enforcement & Monitoring Guidelines for sand Mining, 2020 (MoEF& CC) for preparation of District Survey Report

Sl. No.	Particulars	Status
1	District Survey Report for sand mining shall be prepared before the auction/e-auction/grant of the mining lease/Letter of Intent (LoI) by Mining department or department dealing the mining activity in respective states.	Noted.
2	In order to make the inventory of River Bed Material, a detailed survey of the district needs to be carried out, to identify the source of River Bed Material and alternative source of sand (M-Sand). The source will include rivers, de-siltation of reservoir/dams, Patta lands/Khatedari Land, M-sand etc.	Complied with and explained in Chapter 7 pg no 56 to 90.
3	District Survey Report is to be prepared in such a way that it not only identifies the mineral-bearing area but also define the mining and no mining zones considering various environmental and social factors.	Complied with and furnished in pg no 83-84.
4	Identification of the source of Sand & M-Sand. The sources may be from Rivers, Lakes, Ponds, Dams, De-silting locations, Patta land/Khtedari lands. The details in case of Rivers such as [name, length of river, type (Perennial or Non-Perennial), Villages, Tehsil, District], in case of Lakes, Ponds, Dams, De-silting locations [Name, owned/maintained by (State Govt./PSU), area, Villages, Tehsil, District] in case of Patta land/Khtedari lands [Owner Name, Sy No, Area, Agricultural/Non-Agricultural, Villages, Tehsil, District], in case of M-Sand Plant [Owner Name, Sy No, Area, Quantity/Annum, Villages, Tehsil, District], needs to be recorded .	Complied with and given in table 7.3 pg 68 to 70.
5	Defining the sources of Sand/M-Sand in the district is the next step for identification of the potential area of deposition/aggradation wherein mining lease could be granted. Detailed survey needs to be carried out for quantification of minerals. The purpose of mining in the river bed is for channelization of rivers so as to avoid the possibility of flooding and to maintain the flow of the rivers. For this, the entire river stretch needs to be surveyed and original ground level (OGL) to be recorded and area of	Complied with and given in table 7.11 pg 82.

Sl. No.	Particulars	Status
	aggradation/deposition needs to be ascertained by comparing the level difference between the outside riverbed OGL and water level. Once the area of aggradation/deposition is identified, then the quantity of River Bed Material available needs to be calculated. The next step is channelization of the river bed and for this central ¾th part of the river, width needs to be identified on a map. Out of the ¾th part area, where there is a deposition/aggradation of the material needs to be identified. The remaining ¼th area needs to be kept as no mining zone for the protection of banks. The specific gravity of the material also needs to be ascertained by analyzing the sample from a NABL accredited lab. Thus, the quantity of material available in metric ton needs to be calculated for mining and no mining zone.	
6	The permanent boundary pillars need to be erected after identification of an area of aggradation and deposition outside the bank of the river at a safe location for future surveying. The distance between boundary pillars on each side of the bank shall not be more than 100 meters.	Benchmark Pillars are established in strategic locations while boundary pillars will be fixed while fixation of the mining lease boundary subsequent to district level verification.
7	Identifying the mining and no mining zone shall follow with defining the area of sensitivity by ascertaining the distance of the mining area from the protected area, forest, bridges, important structures, habitation etc. and based on the sensitivity the area needs to be defined in sensitive and non-sensitive area.	Complied with and furnished in pg no 83-84.
8	Demand and supply of the Riverbed Material through market survey needs to be carried out. In addition to this future demand for the next 5 years also needs to be considered.	Complied with and given in pg no 4.
9	It is suggested that as far as possible the sensitive areas should be avoided for mining, unless local safety condition arises. Such deviation shall be temporary & shall not be a permanent feature.	Complied with and furnished in pg no 83-84.

Sl. No.	Particulars	Status
10	Sand and gravel could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two-thirds of the bar and riparian vegetation is accepted as a method to promote channel stability.	Noted. The DSR is composing of all the potential sand zones for defining the resources. In a subsequent phase blocking of potential zones shall be done in due consultation with the district level committee. The areas mentioned in the observation points shall be excluded while blocking of sand mining leases which are part of these potential zones marked in this DSR.
11	The final area selected for the mining should be then divided into mining lease as per the requirement of State Government. It is suggested the mining lease area should be so selected as to cover the entire deposition area. Dividing a large area of deposition/aggradation into smaller mining leases should be avoided as it leads to loss of mineral and indirectly promote illegal mining.	Shall be Complied with.
12	Cluster situation shall be examined. A cluster is formed when one mining lease of homogenous mineral is within 500 meters of the other mining lease. In order to reduce the cluster formation mining lease size should be defined in such a way that distance between any two clusters preferably should not be less than 2.5 Km. Mining lease should be defined in such a way that the total area of the mining leases in a cluster should not be more than 10 Ha.	Noted. Due care will be taken while distribution of mining leases either to prevent cluster situation or keeping the prescribed distance inbetween two mining clusters.
13	The number of a contiguous cluster needs to be ascertained. Contiguous cluster is formed when one cluster is at a distance of 2.5 Km from the other cluster.	Noted and shall be complied with.
14	The mining outside the riverbed on Patta land/Khatedari land be granted when there is possibility of replenishment of material. In case, there is no replenishment then mining lease shall only be granted when there is no riverbed mining possibility within 5 KM of the Patta land/Khatedari land. For government projects, mining could be allowed on Patta land/Khatedari land but the mining should only	Noted.

Sl. No.	Particulars	Status
	be done by the Government agency and material should not be used for sale in the open market. Cluster situation as mentioned in para k above is also applicable for the mining in Patta land/Khatedari land.	
15	The State Government should define the transportation route from the mining lease considering the maximum production from the mines as at this stage the size of mining leases, their location, the quantity of mineral that can be mined safely etc. is available with the State Government. It is suggested that the transportation route should be selected in such a way that the movement of trucks/tippers/tractors from the villages having habitation should be avoided. The transportation route so selected should be verified by the State Government for its carrying capacity.	Noted and final transport route will be submitted during preparation of mine plan.
16	Potential site for mining having its impact on the forest, protected area, habitation, bridges etc, shall be avoided. For this, a sub-divisional committee may be formed which after the site visit shall decide its suitability for mining.	Shall be Complied with.
17	Public consultation-The Comments of the various stakeholders may be sought on the list of mining lease to be auctioned. The State Government shall give an advertisement in the local and national newspaper for seeking comments of the general public on the list of mining lease included in the DSR. The DSR should be placed in the public domain for at least one month from the date of publication of the advertisement for obtaining comments of the general public. The comments so received shall be placed before the sub-divisional committee for active consideration. The final list of sand mining areas [leases to be granted on	After publication of the West Bengal Sand Mining Policy, 2021, it is now eminent that State owned The West Bengal Mineral Development and Trading Corporation Limited (WBMDTCL) shall be responsible for mining of sand/ gravel/ river bed materials in whole state of West Bengal. However, the existing mining leases which were in effect before hand of this Gazzate notification July 2021 will be in operation till the year 2027-28. In order to have the rational distribution of mining leases as per the prevailing norms and guidelines grant of mining leases in the state of West

Sl. No.	**Particulars**	**Status**
	riverbed &Patta land/Khatedari land, de-siltation location (ponds/lakes/dams), M-Sand Plants (alternate source of sand)] after the public hearing needs to be defined in the final DSR.	Bengal shall be carried out in phases till all the blocks are under the ambit of WBMDTCL. This DSR thus consist of the identified potential sand deposite areas within which the existing and future mining leases shall occur. The details of the mining leases as and when granted shall follow the procedure described in EMGSM 2020 and prevailing norms.
18	The LOI should not be granted for mining area falling on both riverbed and outside riverbed. Therefore, in the same lease, both types of area should not be included.	Shall be Complied with.

Annexure 2
Estimation of Sand Resources based on sediment load comparison between Pre and Post Monsoon period of Kalimpong District

Particulars	Code	Details	Particulars	Code	Details
PERIOD	PO	POST MONSOON	RIVER	RL	RELLI KHOLA
PERIOD	PR	PRE MONSOON	RIVER	PL	PALLARIVER
DISTRICT	KPG	KALIMPONG	RIVER	GT	GEET RIVER
BLOCK	KPG1	KALIMPONG I	RIVER	CHL	CHEL RIVER
BLOCK	KPG2	KALIMPONG II	RIVER	TS	TEESTA RIVER
BLOCK	GB	GORUBATHAN	RIVER	RNP	RANGPO RIVER

Pre monsoon period						**Post monsoon period**					
S L No	**Sand Bar_Code**	**RL (m)**	**Area in Sq.m**	**Sand Thickness in m.**	**Sand Volume in M. Cum**	**S L No**	**Sand Bar_Code**	**RL (m)**	**Area in Sq.m**	**Sand Thickness in m.**	**Sand Volume in M. Cum**
Estimation of Sand Resources in Relli River											
1	PR_KPG_KPG2_RL_1	739.8	143459	0.8	0.11	1	PO_KPG_KPG2_RL_1	740	163637.7	1	0.16
2	PR_KPG_KPG1_RL_2	677.8	35979.7	0.8	0.03	2	PO_KPG_KPG1_RL_2	678	41729.55	1	0.04
3	PR_KPG_KPG1_RL_3	635.8	117574.1	0.8	0.09	3	PO_KPG_KPG1_RL_3	636	105623.2	1	0.11
4	PR_KPG_KPG2_RL_4	569.8	43142.69	0.8	0.03	4	PO_KPG_KPG2_RL_4	570	33629.06	1	0.03
5	PR_KPG_KPG1_RL_5	559.8	142848	0.8	0.11	5	PO_KPG_KPG1_RL_5A	560	72851.02	1	0.07
						6	PO_KPG_KPG1_RL_5B	515	52136.75	1	0.05
6	PR_KPG_KPG1_RL_6	479.7	97928.55	0.8	0.08	7	PO_KPG_KPG1_RL_6	480	89361.15	1.1	0.1
7	PR_KPG_KPG1_RL_7	349.7	66295.86	0.8	0.05	8	PO_KPG_KPG1_RL_7	350	67334.4	1.1	0.07
8	PR_KPG_KPG1_RL_8	319.8	39929.18	0.8	0.03	9	PO_KPG_KPG1_RL_8	320	39929.18	1	0.04
9	PR_KPG_KPG1_RL_9	259.9	598911.6	0.8	0.48	10	PO_KPG_KPG1_RL_9	260	611403.8	0.9	0.55
Estimation of Sand Resources in Geet River											
1	PR_KPG_KPG1_GT_1	369.7	113239.2	1	0.11	1	PO_KPG_KPG1_GT_1	370	118631.6	1.3	0.15
2	PR_KPG_KPG1_GT_2	339.7	58958.22	1	0.06	2	PO_KPG_KPG1_GT_2	340	53609.01	1.3	0.07
3	PR_KPG_GB_GT_3	324.8	16485.27	1	0.02	3	PO_KPG_GB_GT_3	325	16485.27	1.2	0.02
4	PR_KPG_KPG1_GT_4	314.7	13077.65	1	0.01	4	PO_KPG_KPG1_GT_4	315	13077.65	1.3	0.02
5	PR_KPG_KPG1_GT_5	297.8	64155.59	1	0.06	5	PO_KPG_KPG1_GT_5	298	73905.22	1.2	0.09
6	PR_KPG_KPG1_GT_6	282.8	64341.66	1	0.06	6	PO_KPG_KPG1_GT_6	283	69213.49	1.2	0.08
7	PR_KPG_GB_GT_7	269.9	84759.9	1	0.08	7	PO_KPG_GB_GT_7	270	86146.02	1.1	0.09
8	PR_KPG_KPG1_GT_8	229.8	57404.73	1	0.06	8	PO_KPG_KPG1_GT_8	230	57404.73	1.2	0.07
9	PR_KPG_KPG1_GT_9	215	131061	1	0.13	9	PO_KPG_KPG1_GT_9	215	178069.8	1	0.18
10	PR_KPG_GB_GT_10	205	101902.8	1	0.1	10	PO_KPG_GB_GT_10	205	132169.2	1	0.13
11	PR_KPG_KPG1_GT_11	185	281739.6	1	0.28	11	PO_KPG_KPG1_GT_11	185	369618.10	1	0.36
Estimation of Sand Resources in Leesh River											

Pre monsoon period						**Post monsoon period**					
S L No	**Sand Bar_Code**	**RL (m)**	**Area in Sq.m**	**Sand Thickness in m.**	**Sand Volume in M. Cum**	**S L No**	**Sand Bar_Code**	**RL (m)**	**Area in Sq.m**	**Sand Thickness in m.**	**Sand Volume in M. Cum**
1	PR_KPG_KPG1_LH_1	689.8	56343.6	0.8	0.05	1	PO_KPG_KPG1_LH_1	690	67748.07	1	0.07
2	PR_KPG_KPG1_LH_2	399.8	33762.23	0.8	0.03	2	PO_KPG_KPG1_LH_2	400	29973.85	1	0.03
3	PR_KPG_KPG1_LH_3	374.8	60023.24	0.8	0.05	3	PO_KPG_KPG1_LH_3	375	91555.61	1	0.09
4	PR_KPG_KPG1_LH_4	324.8	245525.2	0.8	0.2	4	PO_KPG_KPG1_LH_4A	325	215914.4	1	0.22
						5	PO_KPG_KPG1_LH_4B	300	54602.73	1	0.05
						6	PO_KPG_KPG1_LH_4C	275	70305.72	1	0.07
5	PR_KPG_KPG1_LH_5	249.8	43610.41	0.8	0.03	7	PO_KPG_KPG1_LH_5	250	41243.99	1	0.04
6	PR_KPG_KPG1_LH_6	226.8	88482.48	0.8	0.07	8	PO_KPG_KPG1_LH_6	227	79497.38	1	0.08
7	PR_KPG_KPG1_LH_7	209.8	638047.4	0.8	0.51	9	PO_KPG_KPG1_LH_7A	210	275690.1	1	0.28
						10	PO_KPG_KPG1_LH_7B	200	408166.4	1	0.41
Estimation of Sand Resources in Chel River											
1	PR_KPG_GB_CHL_1	524.8	10793.19	0.9	0.01	1	PO_KPG_GB_CHL_1	525	10793.19	1.1	0.01
2	PR_KPG_GB_CHL_2	474.8	76517.07	0.9	0.07	2	PO_KPG_GB_CHL_2	475	79347.22	1.1	0.09
3	PR_KPG_GB_CHL_3	444.8	17551.58	0.9	0.02	3	PO_KPG_GB_CHL_3	445	17551.58	1.1	0.02
4	PR_KPG_GB_CHL_4	417.8	10825.23	0.9	0.01	4	PO_KPG_GB_CHL_4	418	9000.108	1.1	0.01
5	PR_KPG_GB_CHL_5	279.8	106002.6	0.9	0.1	5	PO_KPG_GB_CHL_5	280	124210.3	1.1	0.14
6	PR_KPG_GB_CHL_6	259.8	222319.5	0.9	0.2	6	PO_KPG_GB_CHL_6	260	212018.6	1.1	0.23
7	PR_KPG_GB_CHL_7	244.8	627283.7	0.9	0.56	7	PO_KPG_GB_CHL_7A	245	221682.1	1.1	0.24
						8	PO_KPG_GB_CHL_7B	237	244993	1.1	0.27
Estimation of Sand Resources in Palla River											
1	PR_KPG_KGP2_PL_1	629.7	116515.1	0.7	0.08	1	PO_KPG_KPG2_PL_1A	630	28279.4	1	0.03
						2	PO_KPG_KPG2_PL_1B	574	59751.49	1	0.06
Estimation of Sand Resources in Rangpo River											
1	PR_KPG_KPG2_RNP_1	355.8	40374.96	0.7	0.03	1	PO_KPG_KPG2_RNP_1	356	27751.98	0.9	0.02
2	PR_KPG_KPG2_RNP_2	389.8	14337.64	0.7	0.01	2	PO_KPG_KPG2_RNP_2	390	13330.69	0.9	0.01
3	PR_KPG_KPG2_RNP_3	399.8	29615.08	0.7	0.02	3	PO_KPG_KPG2_RNP_3	400	44676.3	0.9	0.04
4	PR_KPG_KPG2_RNP_4	414.8	15143.05	0.7	0.01	4	PO_KPG_KPG2_RNP_4	415	17376.96	0.9	0.02
5	PR_KPG_KPG2_RNP_5	419.8	12456.55	0.7	0.01	5	PO_KPG_KPG2_RNP_5	420	12456.55	0.9	0.01
Estimation of Sand Resources in Rishi River											

Pre monsoon period						**Post monsoon period**					
SL No	**Sand Bar_Code**	**RL (m)**	**Area in Sq.m**	**Sand Thickness in m.**	**Sand Volume in M. Cum**	**SL No**	**Sand Bar_Code**	**RL (m)**	**Area in Sq.m**	**Sand Thickness in m.**	**Sand Volume in M. Cum**
1	PR_KPG_KPG2_RS_1	684.8	1.680783	0.9	0.00	1	PO_KPG_KPG2_RS_1A	685	0.493217	1.1	0.00
				0.9	0.00	2	PO_KPG_KPG2_RS_1B	720	0.550596	1.1	0.00
2	PR_KPG_KPG2_RS_2	724.9	1.252582	0.9	0.00	3	PO_KPG_KPG2_RS_2A	725	0.609764	1	0.00
				0.9	0.00	4	PO_KPG_KPG2_RS_2B	745	0.644496	1	0.00
3	PR_KPG_KPG2_RS_3	829.9	1.013784	0.9	0.00	5	PO_KPG_KPG2_RS_3	830	1.013784	1	0.00
4	PR_KPG_KPG2_RS_4	1084.8	0.26895	0.9	0.00	6	PO_KPG_KPG2_RS_4	1085	0.26895	1.1	0.00
5	PR_KPG_KPG2_RS_5	1119.8	1.054695	0.9	0.00	7	PO_KPG_KPG2_RS_5	1120	1.054695	1.1	0.00

Annexure 3
Boundary Coordinates of Potential Blocks of Kalimpong District

Abbreviation used in the table as below

Particulars	Code	Details	Particulars	Code	Details
DISTRICT	KPG	KALIMPONG	RIVER	RL	RELLI KHOLA
BLOCK	KPG1	KALIMPONG I	RIVER	PL	PALLARIVER
BLOCK	KPG2	KALIMPONG II	RIVER	GT	GEET RIVER
BLOCK	GB	GORUBATHAN	RIVER	CHL	CHEL RIVER
RIVER	RNP	RANGPO RIVER	RIVER	TS	TEESTA RIVER

POTENTIAL BLOCKS ON RANGPO RIVER

KPG_KPG2_RNP_1		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 11' 8.245" N	88° 33' 47.693" E
2	27° 11' 6.318" N	88° 33' 52.586" E
3	27° 11' 5.659" N	88° 33' 59.036" E
4	27° 11' 3.467" N	88° 33' 57.340" E
5	27° 11' 2.789" N	88° 33' 51.325" E
6	27° 11' 4.053" N	88° 33' 49.274" E
7	27° 11' 6.238" N	88° 33' 47.589" E

KPG_KPG2_RNP_2		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 11' 17.102" N	88° 35' 14.990" E
2	27° 11' 16.796" N	88° 35' 12.110" E
3	27° 11' 17.047" N	88° 35' 12.116" E
4	27° 11' 17.790" N	88° 35' 12.276" E
5	27° 11' 21.340" N	88° 35' 12.393" E
6	27° 11' 22.313" N	88° 35' 12.253" E
7	27° 11' 23.202" N	88° 35' 12.276" E
8	27° 11' 23.551" N	88° 35' 13.366" E
9	27° 11' 19.536" N	88° 35' 15.227" E

KPG_KPG2_RNP_3		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 11' 13.175" N	88° 35' 17.482" E
2	27° 11' 12.195" N	88° 35' 19.917" E
3	27° 11' 12.710" N	88° 35' 22.220" E
4	27° 11' 11.020" N	88° 35' 22.497" E
5	27° 11' 10.918" N	88° 35' 22.408" E
6	27° 11' 9.871" N	88° 35' 21.432" E

7	27° 11' 9.070" N	88° 35' 20.093" E
8	27° 11' 8.788" N	88° 35' 18.489" E
9	27° 11' 8.594" N	88° 35' 17.065" E
10	27° 11' 9.219" N	88° 35' 13.693" E
11	27° 11' 11.692" N	88° 35' 11.362" E
12	27° 11' 12.193" N	88° 35' 11.286" E
13	27° 11' 14.002" N	88° 35' 11.202" E
14	27° 11' 16.255" N	88° 35' 11.946" E
15	27° 11' 16.291" N	88° 35' 11.954" E
16	27° 11' 16.636" N	88° 35' 14.277" E
17	27° 11' 13.750" N	88° 35' 16.053" E
18	27° 11' 13.596" N	88° 35' 16.437" E
19	27° 11' 13.267" N	88° 35' 16.722" E

KPG_KPG2_RNP_4		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 11' 18.084" N	88° 35' 39.756" E
2	27° 11' 17.042" N	88° 35' 38.127" E
3	27° 11' 17.851" N	88° 35' 37.711" E
4	27° 11' 19.780" N	88° 35' 37.409" E
5	27° 11' 22.000" N	88° 35' 36.658" E
6	27° 11' 24.337" N	88° 35' 35.505" E
7	27° 11' 25.289" N	88° 35' 35.191" E
8	27° 11' 28.548" N	88° 35' 36.221" E
9	27° 11' 28.131" N	88° 35' 36.506" E
10	27° 11' 27.062" N	88° 35' 36.976" E
11	27° 11' 26.562" N	88° 35' 37.211" E
12	27° 11' 23.494" N	88° 35' 38.193" E
13	27° 11' 22.909" N	88° 35' 38.362" E
14	27° 11' 22.262" N	88° 35' 38.470" E
15	27° 11' 20.764" N	88° 35' 38.821" E
16	27° 11' 20.069" N	88° 35' 39.183" E

KPG_KPG2_RNP_5		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 11' 18.207" N	88° 35' 44.354" E
2	27° 11' 17.518" N	88° 35' 42.751" E
3	27° 11' 18.733" N	88° 35' 42.213" E
4	27° 11' 20.698" N	88° 35' 46.025" E
5	27° 11' 23.346" N	88° 35' 49.832" E

6	27° 11' 21.541" N	88° 35' 50.618" E
7	27° 11' 21.531" N	88° 35' 50.568" E
8	27° 11' 21.114" N	88° 35' 49.553" E
9	27° 11' 20.720" N	88° 35' 48.820" E
10	27° 11' 19.670" N	88° 35' 46.827" E
11	27° 11' 18.688" N	88° 35' 45.596" E

POTENTIAL BLOCKS ON RISHI RIVER

KPG_KPG2_RS_1A		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 9' 39.159" N	88° 39' 23.398" E
2	27° 9' 37.802" N	88° 39' 23.005" E
3	27° 9' 38.358" N	88° 39' 21.877" E
4	27° 9' 39.018" N	88° 39' 20.730" E
5	27° 9' 39.867" N	88° 39' 18.886" E
6	27° 9' 40.024" N	88° 39' 18.544" E
7	27° 9' 40.102" N	88° 39' 18.360" E
8	27° 9' 40.798" N	88° 39' 18.690" E
9	27° 9' 40.010" N	88° 39' 21.134" E
10	27° 9' 39.642" N	88° 39' 22.119" E
11	27° 9' 39.271" N	88° 39' 23.267" E

KPG_KPG2_RS_1B		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 9' 30.104" N	88° 39' 29.584" E
2	27° 9' 30.095" N	88° 39' 29.403" E
3	27° 9' 30.282" N	88° 39' 28.867" E
4	27° 9' 30.622" N	88° 39' 28.440" E
5	27° 9' 31.354" N	88° 39' 28.022" E
6	27° 9' 31.903" N	88° 39' 27.709" E
7	27° 9' 32.233" N	88° 39' 27.483" E
8	27° 9' 32.700" N	88° 39' 27.088" E
9	27° 9' 32.830" N	88° 39' 27.016" E
10	27° 9' 34.201" N	88° 39' 25.890" E
11	27° 9' 34.552" N	88° 39' 26.767" E
12	27° 9' 33.210" N	88° 39' 27.877" E
13	27° 9' 31.734" N	88° 39' 29.357" E
14	27° 9' 30.623" N	88° 39' 30.486" E

KPG_KPG2_RS_2A		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 9' 21.765" N	88° 39' 39.255" E

2	27° 9' 21.459" N	88° 39' 39.116" E
3	27° 9' 22.029" N	88° 39' 38.749" E
4	27° 9' 22.695" N	88° 39' 38.393" E
5	27° 9' 24.150" N	88° 39' 37.929" E
6	27° 9' 26.208" N	88° 39' 37.534" E
7	27° 9' 26.465" N	88° 39' 37.485" E
8	27° 9' 26.278" N	88° 39' 38.001" E
9	27° 9' 25.930" N	88° 39' 38.852" E
10	27° 9' 25.653" N	88° 39' 39.299" E
11	27° 9' 25.126" N	88° 39' 39.537" E
12	27° 9' 23.992" N	88° 39' 39.865" E
13	27° 9' 23.320" N	88° 39' 40.182" E
14	27° 9' 22.446" N	88° 39' 39.744" E

KPG_KPG2_RS_2B		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 9' 17.996" N	88° 39' 42.985" E
2	27° 9' 17.029" N	88° 39' 43.165" E
3	27° 9' 17.093" N	88° 39' 42.513" E
4	27° 9' 17.558" N	88° 39' 42.236" E
5	27° 9' 17.696" N	88° 39' 42.125" E
6	27° 9' 17.994" N	88° 39' 42.005" E
7	27° 9' 18.482" N	88° 39' 41.497" E
8	27° 9' 18.671" N	88° 39' 41.346" E
9	27° 9' 19.891" N	88° 39' 40.153" E
10	27° 9' 20.735" N	88° 39' 39.618" E
11	27° 9' 21.871" N	88° 39' 39.982" E
12	27° 9' 22.893" N	88° 39' 40.383" E
13	27° 9' 22.318" N	88° 39' 40.655" E
14	27° 9' 20.420" N	88° 39' 41.742" E
15	27° 9' 18.241" N	88° 39' 42.840" E

KPG_KPG2_RS_3		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 8' 30.543" N	88° 39' 53.237" E
2	27° 8' 29.581" N	88° 39' 53.210" E
3	27° 8' 29.712" N	88° 39' 52.821" E
4	27° 8' 30.514" N	88° 39' 52.361" E
5	27° 8' 31.471" N	88° 39' 51.978" E
6	27° 8' 32.939" N	88° 39' 51.327" E
7	27° 8' 34.573" N	88° 39' 49.953" E
8	27° 8' 34.680" N	88° 39' 49.873" E

9	27° 8' 34.745" N	88° 39' 49.814" E
10	27° 8' 36.312" N	88° 39' 48.711" E
11	27° 8' 37.045" N	88° 39' 48.554" E
12	27° 8' 37.401" N	88° 39' 48.539" E
13	27° 8' 38.471" N	88° 39' 49.073" E
14	27° 8' 38.454" N	88° 39' 49.528" E
15	27° 8' 38.448" N	88° 39' 49.528" E
16	27° 8' 37.704" N	88° 39' 49.820" E
17	27° 8' 37.445" N	88° 39' 49.898" E
18	27° 8' 37.389" N	88° 39' 49.943" E
19	27° 8' 36.956" N	88° 39' 50.113" E
20	27° 8' 35.874" N	88° 39' 51.150" E
21	27° 8' 34.521" N	88° 39' 51.923" E
22	27° 8' 33.885" N	88° 39' 52.120" E
23	27° 8' 33.650" N	88° 39' 52.216" E
24	27° 8' 32.144" N	88° 39' 52.675" E
25	27° 8' 30.752" N	88° 39' 53.200" E

KPG_KPG2_RS_4		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 7' 4.659" N	88° 40' 21.070" E
2	27° 7' 4.553" N	88° 40' 20.479" E
3	27° 7' 5.838" N	88° 40' 20.203" E
4	27° 7' 6.954" N	88° 40' 20.830" E
5	27° 7' 7.208" N	88° 40' 20.999" E
6	27° 7' 7.295" N	88° 40' 21.060" E
7	27° 7' 7.773" N	88° 40' 21.495" E
8	27° 7' 7.384" N	88° 40' 21.710" E
9	27° 7' 6.121" N	88° 40' 21.802" E
10	27° 7' 6.012" N	88° 40' 21.779" E
11	27° 7' 5.961" N	88° 40' 21.768" E
12	27° 7' 5.398" N	88° 40' 21.555" E

KPG_KPG2_RS_5		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 6' 54.049" N	88° 40' 24.514" E
2	27° 6' 53.957" N	88° 40' 23.416" E
3	27° 6' 54.193" N	88° 40' 22.567" E
4	27° 6' 54.676" N	88° 40' 22.748" E
5	27° 6' 55.473" N	88° 40' 23.477" E
6	27° 6' 56.461" N	88° 40' 24.587" E

7	27° 6' 57.096" N	88° 40' 25.225" E
8	27° 6' 57.170" N	88° 40' 25.299" E
9	27° 6' 57.320" N	88° 40' 25.450" E
10	27° 6' 57.508" N	88° 40' 25.659" E
11	27° 6' 58.472" N	88° 40' 26.855" E
12	27° 6' 58.823" N	88° 40' 26.995" E
13	27° 6' 58.853" N	88° 40' 26.992" E
14	27° 6' 59.261" N	88° 40' 27.130" E
15	27° 6' 59.742" N	88° 40' 27.293" E
16	27° 6' 58.916" N	88° 40' 27.881" E
17	27° 6' 57.490" N	88° 40' 28.133" E
18	27° 6' 55.976" N	88° 40' 27.079" E
19	27° 6' 54.833" N	88° 40' 25.819" E
20	27° 6' 54.416" N	88° 40' 25.254" E
21	27° 6' 54.083" N	88° 40' 24.656" E

POTENTIAL BLOCKS ON RELLI RIVER

KPG_KPG2_RL_1		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 4' 27.443" N	88° 32' 50.527" E
2	27° 4' 25.090" N	88° 32' 48.679" E
3	27° 4' 24.235" N	88° 32' 47.809" E
4	27° 4' 24.082" N	88° 32' 47.437" E
5	27° 4' 23.837" N	88° 32' 45.752" E
6	27° 4' 23.834" N	88° 32' 45.694" E
7	27° 4' 24.236" N	88° 32' 41.896" E
8	27° 4' 24.820" N	88° 32' 38.130" E
9	27° 4' 25.474" N	88° 32' 34.912" E
10	27° 4' 24.789" N	88° 32' 33.208" E
11	27° 4' 24.802" N	88° 32' 32.800" E
12	27° 4' 23.771" N	88° 32' 30.256" E
13	27° 4' 23.671" N	88° 32' 29.960" E
14	27° 4' 21.846" N	88° 32' 29.416" E
15	27° 4' 20.129" N	88° 32' 28.384" E
16	27° 4' 18.375" N	88° 32' 26.358" E
17	27° 4' 17.766" N	88° 32' 24.593" E
18	27° 4' 17.754" N	88° 32' 24.559" E
19	27° 4' 21.494" N	88° 32' 22.459" E
20	27° 4' 22.193" N	88° 32' 22.850" E
21	27° 4' 22.415" N	88° 32' 22.999" E
22	27° 4' 23.031" N	88° 32' 23.397" E
23	27° 4' 24.162" N	88° 32' 24.352" E

KPG_KPG2_RL_1		
POINT NO	**LATITUDE**	**LONGITUDE**
24	27° 4' 25.598" N	88° 32' 26.273" E
25	27° 4' 26.358" N	88° 32' 29.066" E
26	27° 4' 26.469" N	88° 32' 29.585" E
27	27° 4' 27.167" N	88° 32' 32.620" E
28	27° 4' 27.535" N	88° 32' 34.064" E
29	27° 4' 28.240" N	88° 32' 37.071" E
30	27° 4' 28.067" N	88° 32' 38.916" E
31	27° 4' 27.298" N	88° 32' 40.258" E
32	27° 4' 26.250" N	88° 32' 41.732" E
33	27° 4' 25.874" N	88° 32' 44.704" E
34	27° 4' 27.735" N	88° 32' 47.419" E
35	27° 4' 29.445" N	88° 32' 48.269" E
36	27° 4' 31.758" N	88° 32' 49.837" E
37	27° 4' 32.259" N	88° 32' 50.411" E
38	27° 4' 33.461" N	88° 32' 51.706" E
39	27° 4' 33.708" N	88° 32' 52.538" E
40	27° 4' 33.721" N	88° 32' 54.273" E
41	27° 4' 34.456" N	88° 32' 57.836" E
42	27° 4' 35.332" N	88° 33' 0.250" E
43	27° 4' 36.106" N	88° 33' 1.359" E
44	27° 4' 36.794" N	88° 33' 2.854" E
45	27° 4' 37.231" N	88° 33' 4.284" E
46	27° 4' 37.466" N	88° 33' 5.291" E
47	27° 4' 37.648" N	88° 33' 6.073" E
48	27° 4' 37.755" N	88° 33' 10.512" E
49	27° 4' 39.318" N	88° 33' 13.031" E
50	27° 4' 40.790" N	88° 33' 15.981" E
51	27° 4' 42.663" N	88° 33' 18.642" E
52	27° 4' 44.526" N	88° 33' 21.213" E
53	27° 4' 45.837" N	88° 33' 23.128" E
54	27° 4' 46.603" N	88° 33' 24.850" E
55	27° 4' 48.025" N	88° 33' 26.886" E
56	27° 4' 49.296" N	88° 33' 28.518" E
57	27° 4' 47.795" N	88° 33' 29.016" E
58	27° 4' 46.524" N	88° 33' 27.269" E
59	27° 4' 45.268" N	88° 33' 25.532" E
60	27° 4' 43.832" N	88° 33' 22.766" E
61	27° 4' 42.461" N	88° 33' 20.442" E
62	27° 4' 40.145" N	88° 33' 17.351" E
63	27° 4' 37.589" N	88° 33' 13.940" E

KPG_KPG2_RL_1		
POINT NO	**LATITUDE**	**LONGITUDE**
64	27° 4' 34.984" N	88° 33' 7.070" E
65	27° 4' 34.263" N	88° 33' 4.675" E
66	27° 4' 33.499" N	88° 33' 0.893" E
67	27° 4' 31.996" N	88° 32' 54.845" E
68	27° 4' 31.664" N	88° 32' 54.484" E
69	27° 4' 31.484" N	88° 32' 53.637" E
70	27° 4' 29.337" N	88° 32' 51.878" E

KPG_KPG1_RL_2		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 4' 20.460" N	88° 32' 21.784" E
2	27° 4' 17.331" N	88° 32' 23.335" E
3	27° 4' 16.506" N	88° 32' 20.945" E
4	27° 4' 16.264" N	88° 32' 17.460" E
5	27° 4' 16.148" N	88° 32' 16.738" E
6	27° 4' 16.143" N	88° 32' 14.701" E
7	27° 4' 15.954" N	88° 32' 12.297" E
8	27° 4' 14.479" N	88° 32' 9.588" E
9	27° 4' 12.640" N	88° 32' 8.747" E
10	27° 4' 10.076" N	88° 32' 7.319" E
11	27° 4' 10.260" N	88° 32' 6.217" E
12	27° 4' 11.278" N	88° 32' 5.769" E
13	27° 4' 13.741" N	88° 32' 6.748" E
14	27° 4' 15.258" N	88° 32' 6.613" E
15	27° 4' 15.884" N	88° 32' 6.918" E
16	27° 4' 16.107" N	88° 32' 7.297" E
17	27° 4' 18.199" N	88° 32' 11.577" E
18	27° 4' 18.486" N	88° 32' 12.764" E
19	27° 4' 18.584" N	88° 32' 15.599" E
20	27° 4' 18.125" N	88° 32' 18.186" E
21	27° 4' 17.627" N	88° 32' 20.532" E
22	27° 4' 19.854" N	88° 32' 21.283" E
23	27° 4' 20.405" N	88° 32' 21.652" E
24	27° 4' 20.460" N	88° 32' 21.784" E
25	27° 4' 12.168" N	88° 32' 5.565" E
26	27° 4' 11.934" N	88° 32' 5.480" E
27	27° 4' 12.017" N	88° 32' 5.444" E
28	27° 4' 12.168" N	88° 32' 5.565" E

KPG_KPG1_RL_3

POINT NO	LATITUDE	LONGITUDE
1	27° 3' 42.129" N	88° 31' 41.243" E
2	27° 3' 41.494" N	88° 31' 39.839" E
3	27° 3' 41.636" N	88° 31' 39.757" E
4	27° 3' 42.754" N	88° 31' 39.724" E
5	27° 3' 44.851" N	88° 31' 40.617" E
6	27° 3' 46.529" N	88° 31' 42.489" E
7	27° 3' 48.328" N	88° 31' 45.010" E
8	27° 3' 49.996" N	88° 31' 45.825" E
9	27° 3' 51.606" N	88° 31' 45.991" E
10	27° 3' 52.356" N	88° 31' 46.251" E
11	27° 3' 55.453" N	88° 31' 47.829" E
12	27° 3' 58.551" N	88° 31' 52.280" E
13	27° 4' 2.796" N	88° 31' 56.818" E
14	27° 4' 3.504" N	88° 31' 57.399" E
15	27° 4' 4.049" N	88° 31' 58.045" E
16	27° 4' 5.838" N	88° 31' 59.582" E
17	27° 4' 7.305" N	88° 32' 1.125" E
18	27° 4' 7.733" N	88° 32' 1.740" E
19	27° 4' 7.896" N	88° 32' 2.491" E
20	27° 4' 8.002" N	88° 32' 4.538" E
21	27° 4' 6.695" N	88° 32' 3.829" E
22	27° 4' 5.092" N	88° 32' 1.732" E
23	27° 4' 2.159" N	88° 31' 58.696" E
24	27° 3' 59.658" N	88° 31' 56.242" E
25	27° 3' 57.526" N	88° 31' 55.493" E
26	27° 3' 53.567" N	88° 31' 54.200" E
27	27° 3' 51.303" N	88° 31' 53.202" E
28	27° 3' 50.511" N	88° 31' 52.299" E
29	27° 3' 49.095" N	88° 31' 50.687" E
30	27° 3' 47.117" N	88° 31' 47.933" E
31	27° 3' 47.110" N	88° 31' 47.918" E
32	27° 3' 45.104" N	88° 31' 45.038" E
33	27° 3' 44.038" N	88° 31' 43.382" E
34	27° 3' 42.898" N	88° 31' 43.298" E
35	27° 3' 42.880" N	88° 31' 43.200" E

KPG_KPG2_RL_4		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 2' 52.270" N	88° 31' 45.474" E
2	27° 2' 51.311" N	88° 31' 45.399" E
3	27° 2' 53.802" N	88° 31' 42.469" E

4	27° 3' 1.104" N	88° 31' 42.356" E
5	27° 3' 2.825" N	88° 31' 40.814" E
6	27° 3' 4.011" N	88° 31' 41.422" E
7	27° 3' 4.096" N	88° 31' 42.177" E
8	27° 3' 0.534" N	88° 31' 47.044" E
9	27° 3' 0.242" N	88° 31' 47.051" E
10	27° 2' 57.222" N	88° 31' 45.863" E
11	27° 2' 54.870" N	88° 31' 45.678" E
12	27° 2' 53.637" N	88° 31' 45.315" E

KPG_KPG1_RL_5A		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 2' 41.303" N	88° 31' 43.526" E
2	27° 2' 40.016" N	88° 31' 42.301" E
3	27° 2' 40.050" N	88° 31' 42.096" E
4	27° 2' 38.525" N	88° 31' 39.944" E
5	27° 2' 36.802" N	88° 31' 37.127" E
6	27° 2' 35.078" N	88° 31' 34.395" E
7	27° 2' 34.344" N	88° 31' 33.345" E
8	27° 2' 33.716" N	88° 31' 31.775" E
9	27° 2' 33.497" N	88° 31' 29.832" E
10	27° 2' 33.624" N	88° 31' 28.460" E
11	27° 2' 33.929" N	88° 31' 27.512" E
12	27° 2' 35.091" N	88° 31' 25.552" E
13	27° 2' 35.285" N	88° 31' 24.887" E
14	27° 2' 35.782" N	88° 31' 24.179" E
15	27° 2' 36.527" N	88° 31' 22.057" E
16	27° 2' 37.802" N	88° 31' 21.066" E
17	27° 2' 38.898" N	88° 31' 21.827" E
18	27° 2' 38.902" N	88° 31' 21.843" E
19	27° 2' 38.822" N	88° 31' 24.537" E
20	27° 2' 37.627" N	88° 31' 25.270" E
21	27° 2' 36.480" N	88° 31' 26.406" E
22	27° 2' 35.721" N	88° 31' 27.404" E
23	27° 2' 35.635" N	88° 31' 30.601" E
24	27° 2' 36.799" N	88° 31' 32.427" E
25	27° 2' 37.171" N	88° 31' 33.401" E
26	27° 2' 38.446" N	88° 31' 34.787" E
27	27° 2' 39.051" N	88° 31' 35.484" E
28	27° 2' 39.344" N	88° 31' 35.865" E
29	27° 2' 39.553" N	88° 31' 36.064" E
30	27° 2' 41.898" N	88° 31' 38.766" E

KPG_KPG1_RL_5A		
POINT NO	**LATITUDE**	**LONGITUDE**
31	27° 2' 45.205" N	88° 31' 41.821" E
32	27° 2' 47.352" N	88° 31' 42.426" E
33	27° 2' 47.403" N	88° 31' 42.419" E
34	27° 2' 48.117" N	88° 31' 42.667" E
35	27° 2' 50.197" N	88° 31' 42.067" E
36	27° 2' 51.316" N	88° 31' 41.925" E
37	27° 2' 49.790" N	88° 31' 44.363" E
38	27° 2' 45.992" N	88° 31' 44.433" E

KPG_KPG1_RL_5B		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 2' 37.364" N	88° 31' 8.260" E
2	27° 2' 36.108" N	88° 31' 11.249" E
3	27° 2' 36.101" N	88° 31' 11.270" E
4	27° 2' 35.607" N	88° 31' 12.088" E
5	27° 2' 35.167" N	88° 31' 13.090" E
6	27° 2' 34.491" N	88° 31' 15.155" E
7	27° 2' 32.952" N	88° 31' 14.366" E
8	27° 2' 32.142" N	88° 31' 13.328" E
9	27° 2' 32.115" N	88° 31' 13.256" E
10	27° 2' 32.472" N	88° 31' 12.501" E
11	27° 2' 33.007" N	88° 31' 11.505" E
12	27° 2' 34.142" N	88° 31' 9.946" E
13	27° 2' 34.330" N	88° 31' 9.187" E
14	27° 2' 35.467" N	88° 31' 7.601" E
15	27° 2' 36.494" N	88° 31' 4.811" E
16	27° 2' 36.310" N	88° 31' 2.735" E
17	27° 2' 36.816" N	88° 31' 0.437" E
18	27° 2' 36.899" N	88° 30' 59.344" E
19	27° 2' 37.103" N	88° 30' 58.482" E
20	27° 2' 38.539" N	88° 30' 56.101" E
21	27° 2' 38.983" N	88° 30' 55.376" E
22	27° 2' 40.805" N	88° 30' 54.115" E
23	27° 2' 43.510" N	88° 30' 52.077" E
24	27° 2' 45.373" N	88° 30' 52.508" E
25	27° 2' 45.363" N	88° 30' 52.621" E
26	27° 2' 43.110" N	88° 30' 55.394" E
27	27° 2' 41.344" N	88° 30' 56.802" E
28	27° 2' 39.932" N	88° 30' 58.569" E
29	27° 2' 39.278" N	88° 31' 0.582" E

KPG_KPG1_RL_5B		
POINT NO	**LATITUDE**	**LONGITUDE**
30	27° 2' 38.249" N	88° 31' 2.939" E
31	27° 2' 38.208" N	88° 31' 4.625" E
32	27° 2' 38.151" N	88° 31' 5.070" E
33	27° 2' 37.493" N	88° 31' 7.843" E

KPG_KPG1_RL_6		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 2' 57.121" N	88° 30' 24.129" E
2	27° 2' 55.934" N	88° 30' 27.830" E
3	27° 2' 55.931" N	88° 30' 28.517" E
4	27° 2' 55.853" N	88° 30' 28.727" E
5	27° 2' 55.489" N	88° 30' 30.798" E
6	27° 2' 54.566" N	88° 30' 32.694" E
7	27° 2' 53.492" N	88° 30' 33.479" E
8	27° 2' 52.703" N	88° 30' 33.784" E
9	27° 2' 50.659" N	88° 30' 34.362" E
10	27° 2' 49.896" N	88° 30' 33.050" E
11	27° 2' 51.475" N	88° 30' 31.654" E
12	27° 2' 51.898" N	88° 30' 30.560" E
13	27° 2' 52.603" N	88° 30' 29.566" E
14	27° 2' 53.559" N	88° 30' 24.610" E
15	27° 2' 53.539" N	88° 30' 24.298" E
16	27° 2' 53.606" N	88° 30' 23.385" E
17	27° 2' 53.812" N	88° 30' 20.566" E
18	27° 2' 55.513" N	88° 30' 17.439" E
19	27° 2' 57.470" N	88° 30' 15.958" E
20	27° 2' 58.732" N	88° 30' 15.268" E
21	27° 3' 0.627" N	88° 30' 14.251" E
22	27° 3' 1.207" N	88° 30' 14.000" E
23	27° 3' 1.731" N	88° 30' 14.018" E
24	27° 3' 3.644" N	88° 30' 14.230" E
25	27° 3' 7.726" N	88° 30' 14.356" E
26	27° 3' 9.255" N	88° 30' 14.064" E
27	27° 3' 10.067" N	88° 30' 13.689" E
28	27° 3' 10.961" N	88° 30' 13.631" E
29	27° 3' 11.522" N	88° 30' 13.618" E
30	27° 3' 11.555" N	88° 30' 14.821" E
31	27° 3' 10.415" N	88° 30' 15.296" E
32	27° 3' 8.444" N	88° 30' 16.278" E
33	27° 3' 7.099" N	88° 30' 16.692" E

KPG_KPG1_RL_6		
POINT NO	**LATITUDE**	**LONGITUDE**
34	27° 3' 3.410" N	88° 30' 16.700" E
35	27° 3' 0.204" N	88° 30' 17.435" E
36	27° 2' 59.430" N	88° 30' 19.816" E
37	27° 2' 59.425" N	88° 30' 19.828" E
38	27° 2' 59.242" N	88° 30' 20.009" E
39	27° 2' 57.121" N	88° 30' 24.129" E
40	27° 3' 11.508" N	88° 30' 13.119" E
41	27° 3' 11.312" N	88° 30' 13.114" E
42	27° 3' 11.505" N	88° 30' 13.025" E
43	27° 3' 11.508" N	88° 30' 13.119" E

KPG_KPG1_RL_7		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 1' 49.289" N	88° 29' 23.634" E
2	27° 1' 48.499" N	88° 29' 22.711" E
3	27° 1' 49.845" N	88° 29' 22.268" E
4	27° 1' 52.262" N	88° 29' 22.992" E
5	27° 1' 53.848" N	88° 29' 24.280" E
6	27° 1' 55.066" N	88° 29' 26.197" E
7	27° 1' 56.229" N	88° 29' 28.401" E
8	27° 1' 57.077" N	88° 29' 31.120" E
9	27° 1' 57.944" N	88° 29' 33.013" E
10	27° 1' 58.187" N	88° 29' 33.153" E
11	27° 1' 58.209" N	88° 29' 33.210" E
12	27° 1' 58.464" N	88° 29' 33.312" E
13	27° 1' 59.448" N	88° 29' 33.878" E
14	27° 2' 1.127" N	88° 29' 34.476" E
15	27° 2' 2.745" N	88° 29' 34.344" E
16	27° 2' 3.861" N	88° 29' 32.900" E
17	27° 2' 5.610" N	88° 29' 30.081" E
18	27° 2' 8.152" N	88° 29' 27.195" E
19	27° 2' 9.749" N	88° 29' 25.719" E
20	27° 2' 12.472" N	88° 29' 25.140" E
21	27° 2' 16.662" N	88° 29' 25.733" E
22	27° 2' 18.340" N	88° 29' 26.447" E
23	27° 2' 19.404" N	88° 29' 27.258" E
24	27° 2' 20.319" N	88° 29' 28.537" E
25	27° 2' 19.584" N	88° 29' 29.737" E
26	27° 2' 18.298" N	88° 29' 29.375" E
27	27° 2' 16.482" N	88° 29' 27.910" E

KPG_KPG1_RL_7		
POINT NO	**LATITUDE**	**LONGITUDE**
28	27° 2' 14.996" N	88° 29' 26.998" E
29	27° 2' 12.803" N	88° 29' 27.084" E
30	27° 2' 11.327" N	88° 29' 27.554" E
31	27° 2' 9.915" N	88° 29' 29.437" E
32	27° 2' 9.266" N	88° 29' 30.180" E
33	27° 2' 8.092" N	88° 29' 31.501" E
34	27° 2' 7.775" N	88° 29' 31.857" E
35	27° 2' 6.708" N	88° 29' 32.649" E
36	27° 2' 4.550" N	88° 29' 34.291" E
37	27° 2' 2.727" N	88° 29' 35.851" E
38	27° 2' 1.459" N	88° 29' 36.295" E
39	27° 1' 59.918" N	88° 29' 35.670" E
40	27° 1' 57.791" N	88° 29' 34.375" E
41	27° 1' 57.160" N	88° 29' 33.811" E
42	27° 1' 55.885" N	88° 29' 32.099" E
43	27° 1' 54.900" N	88° 29' 30.363" E
44	27° 1' 54.474" N	88° 29' 28.484" E
45	27° 1' 52.972" N	88° 29' 26.592" E
46	27° 1' 52.003" N	88° 29' 25.571" E
47	27° 1' 51.602" N	88° 29' 24.442" E

KPG_KPG1_RL_8		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 1' 40.367" N	88° 29' 25.337" E
2	27° 1' 38.384" N	88° 29' 24.379" E
3	27° 1' 37.165" N	88° 29' 21.819" E
4	27° 1' 37.036" N	88° 29' 18.419" E
5	27° 1' 37.329" N	88° 29' 17.475" E
6	27° 1' 37.610" N	88° 29' 16.733" E
7	27° 1' 38.432" N	88° 29' 15.146" E
8	27° 1' 39.711" N	88° 29' 13.693" E
9	27° 1' 40.396" N	88° 29' 12.320" E
10	27° 1' 41.051" N	88° 29' 11.378" E
11	27° 1' 41.633" N	88° 29' 12.423" E
12	27° 1' 41.483" N	88° 29' 14.408" E
13	27° 1' 40.506" N	88° 29' 16.584" E
14	27° 1' 39.017" N	88° 29' 18.408" E
15	27° 1' 38.458" N	88° 29' 20.013" E
16	27° 1' 38.594" N	88° 29' 21.772" E
17	27° 1' 38.892" N	88° 29' 21.890" E

18	27° 1' 38.850" N	88° 29' 22.283" E
19	27° 1' 40.459" N	88° 29' 22.578" E
20	27° 1' 40.601" N	88° 29' 22.566" E
21	27° 1' 40.777" N	88° 29' 22.636" E
22	27° 1' 43.978" N	88° 29' 22.390" E
23	27° 1' 45.608" N	88° 29' 22.251" E
24	27° 1' 46.141" N	88° 29' 22.145" E
25	27° 1' 47.162" N	88° 29' 22.086" E
26	27° 1' 47.218" N	88° 29' 23.355" E
27	27° 1' 45.789" N	88° 29' 24.315" E
28	27° 1' 44.129" N	88° 29' 25.244" E
29	27° 1' 42.370" N	88° 29' 25.682" E

KPG_KPG1_RL_9		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 1' 29.207" N	88° 29' 9.350" E
2	27° 1' 26.933" N	88° 29' 7.304" E
3	27° 1' 26.050" N	88° 29' 5.674" E
4	27° 1' 25.699" N	88° 29' 4.316" E
5	27° 1' 25.493" N	88° 29' 3.520" E
6	27° 1' 25.773" N	88° 28' 59.329" E
7	27° 1' 25.860" N	88° 28' 59.024" E
8	27° 1' 26.403" N	88° 28' 56.439" E
9	27° 1' 27.288" N	88° 28' 53.225" E
10	27° 1' 26.419" N	88° 28' 50.045" E
11	27° 1' 24.337" N	88° 28' 49.269" E
12	27° 1' 24.216" N	88° 28' 49.255" E
13	27° 1' 24.182" N	88° 28' 49.198" E
14	27° 1' 21.039" N	88° 28' 48.609" E
15	27° 1' 19.501" N	88° 28' 48.054" E
16	27° 1' 16.576" N	88° 28' 46.575" E
17	27° 1' 14.941" N	88° 28' 44.522" E
18	27° 1' 14.632" N	88° 28' 43.864" E
19	27° 1' 13.646" N	88° 28' 40.661" E
20	27° 1' 12.399" N	88° 28' 36.613" E
21	27° 1' 11.161" N	88° 28' 34.149" E
22	27° 1' 9.254" N	88° 28' 31.445" E
23	27° 1' 6.438" N	88° 28' 29.421" E
24	27° 1' 3.910" N	88° 28' 28.299" E
25	27° 1' 0.139" N	88° 28' 25.699" E
26	27° 0' 58.520" N	88° 28' 24.334" E
27	27° 0' 57.306" N	88° 28' 21.150" E

KPG_KPG1_RL_9		
POINT NO	**LATITUDE**	**LONGITUDE**
28	27° 0' 53.680" N	88° 28' 14.383" E
29	27° 0' 53.261" N	88° 28' 13.523" E
30	27° 0' 51.070" N	88° 28' 9.021" E
31	27° 0' 49.422" N	88° 28' 7.908" E
32	27° 0' 43.976" N	88° 28' 4.231" E
33	27° 0' 42.494" N	88° 28' 2.960" E
34	27° 0' 38.192" N	88° 27' 59.938" E
35	27° 0' 36.326" N	88° 27' 59.423" E
36	27° 0' 35.997" N	88° 27' 59.226" E
37	27° 0' 33.291" N	88° 27' 56.555" E
38	27° 0' 32.942" N	88° 27' 55.881" E
39	27° 0' 31.914" N	88° 27' 53.497" E
40	27° 0' 30.743" N	88° 27' 49.660" E
41	27° 0' 29.698" N	88° 27' 40.714" E
42	27° 0' 29.423" N	88° 27' 39.401" E
43	27° 0' 29.292" N	88° 27' 37.706" E
44	27° 0' 28.725" N	88° 27' 32.716" E
45	27° 0' 26.696" N	88° 27' 29.350" E
46	27° 0' 23.959" N	88° 27' 26.943" E
47	27° 0' 23.356" N	88° 27' 25.936" E
48	27° 0' 21.781" N	88° 27' 23.832" E
49	27° 0' 20.540" N	88° 27' 22.175" E
50	27° 0' 17.704" N	88° 27' 20.410" E
51	27° 0' 17.183" N	88° 27' 20.266" E
52	27° 0' 16.067" N	88° 27' 19.537" E
53	27° 0' 11.926" N	88° 27' 18.389" E
54	27° 0' 8.739" N	88° 27' 17.311" E
55	27° 0' 4.641" N	88° 27' 14.494" E
56	26° 59' 59.959" N	88° 27' 8.214" E
57	26° 59' 58.497" N	88° 27' 5.535" E
58	27° 0' 0.593" N	88° 27' 3.712" E
59	27° 0' 3.275" N	88° 27' 5.923" E
60	27° 0' 4.381" N	88° 27' 6.926" E
61	27° 0' 8.059" N	88° 27' 11.839" E
62	27° 0' 12.375" N	88° 27' 13.546" E
63	27° 0' 18.719" N	88° 27' 15.355" E
64	27° 0' 25.155" N	88° 27' 21.620" E
65	27° 0' 25.489" N	88° 27' 21.855" E
66	27° 0' 26.442" N	88° 27' 23.122" E
67	27° 0' 27.685" N	88° 27' 23.395" E

KPG_KPG1_RL_9		
POINT NO	**LATITUDE**	**LONGITUDE**
68	27° 0' 29.559" N	88° 27' 24.710" E
69	27° 0' 32.377" N	88° 27' 31.581" E
70	27° 0' 33.088" N	88° 27' 37.703" E
71	27° 0' 33.128" N	88° 27' 38.452" E
72	27° 0' 33.334" N	88° 27' 41.719" E
73	27° 0' 33.594" N	88° 27' 42.065" E
74	27° 0' 33.703" N	88° 27' 43.002" E
75	27° 0' 39.082" N	88° 27' 52.825" E
76	27° 0' 42.241" N	88° 27' 57.037" E
77	27° 0' 42.422" N	88° 27' 57.464" E
78	27° 0' 44.797" N	88° 28' 0.605" E
79	27° 0' 46.884" N	88° 28' 1.669" E
80	27° 0' 48.152" N	88° 28' 1.650" E
81	27° 0' 48.532" N	88° 28' 1.875" E
82	27° 0' 50.191" N	88° 28' 1.977" E
83	27° 0' 51.789" N	88° 28' 2.923" E
84	27° 0' 56.225" N	88° 28' 6.283" E
85	27° 0' 57.173" N	88° 28' 7.755" E
86	27° 0' 57.452" N	88° 28' 10.677" E
87	27° 0' 57.443" N	88° 28' 11.507" E
88	27° 0' 57.415" N	88° 28' 12.056" E
89	27° 0' 57.434" N	88° 28' 12.349" E
90	27° 0' 57.420" N	88° 28' 13.671" E
91	27° 0' 57.697" N	88° 28' 16.824" E
92	27° 0' 57.734" N	88° 28' 16.946" E
93	27° 0' 57.749" N	88° 28' 17.172" E
94	27° 0' 57.876" N	88° 28' 17.418" E
95	27° 0' 58.395" N	88° 28' 19.137" E
96	27° 0' 59.500" N	88° 28' 22.031" E
97	27° 1' 0.034" N	88° 28' 22.863" E
98	27° 1' 0.323" N	88° 28' 23.815" E
99	27° 1' 1.235" N	88° 28' 24.249" E
100	27° 1' 3.691" N	88° 28' 25.772" E
101	27° 1' 7.534" N	88° 28' 26.552" E
102	27° 1' 8.281" N	88° 28' 26.701" E
103	27° 1' 9.958" N	88° 28' 27.380" E
104	27° 1' 11.744" N	88° 28' 28.527" E
105	27° 1' 13.710" N	88° 28' 31.241" E
106	27° 1' 14.603" N	88° 28' 32.786" E
107	27° 1' 15.676" N	88° 28' 35.985" E

KPG_KPG1_RL_9		
POINT NO	**LATITUDE**	**LONGITUDE**
108	27° 1' 16.047" N	88° 28' 37.953" E
109	27° 1' 16.771" N	88° 28' 41.073" E
110	27° 1' 17.115" N	88° 28' 41.650" E
111	27° 1' 17.455" N	88° 28' 43.076" E
112	27° 1' 19.730" N	88° 28' 45.050" E
113	27° 1' 20.538" N	88° 28' 45.218" E
114	27° 1' 22.945" N	88° 28' 45.954" E
115	27° 1' 26.087" N	88° 28' 45.543" E
116	27° 1' 26.199" N	88° 28' 45.583" E
117	27° 1' 28.157" N	88° 28' 47.405" E
118	27° 1' 29.780" N	88° 28' 50.076" E
119	27° 1' 30.344" N	88° 28' 52.042" E
120	27° 1' 29.869" N	88° 28' 54.724" E
121	27° 1' 28.877" N	88° 28' 57.476" E
122	27° 1' 27.163" N	88° 29' 0.218" E
123	27° 1' 27.070" N	88° 29' 2.483" E
124	27° 1' 28.140" N	88° 29' 5.415" E
125	27° 1' 28.177" N	88° 29' 5.457" E
126	27° 1' 28.193" N	88° 29' 5.610" E
127	27° 1' 29.224" N	88° 29' 6.905" E
128	27° 1' 29.678" N	88° 29' 7.030" E
129	27° 1' 30.901" N	88° 29' 7.717" E
130	27° 1' 32.931" N	88° 29' 7.629" E
131	27° 1' 33.542" N	88° 29' 7.395" E
132	27° 1' 33.771" N	88° 29' 7.383" E
133	27° 1' 34.046" N	88° 29' 7.203" E
134	27° 1' 34.485" N	88° 29' 7.035" E
135	27° 1' 36.948" N	88° 29' 5.737" E
136	27° 1' 36.996" N	88° 29' 5.723" E
137	27° 1' 38.774" N	88° 29' 5.711" E
138	27° 1' 39.484" N	88° 29' 6.234" E
139	27° 1' 39.768" N	88° 29' 6.445" E
140	27° 1' 40.713" N	88° 29' 9.242" E
141	27° 1' 39.657" N	88° 29' 9.084" E
142	27° 1' 38.889" N	88° 29' 8.498" E
143	27° 1' 37.528" N	88° 29' 7.933" E
144	27° 1' 36.366" N	88° 29' 8.062" E
145	27° 1' 33.856" N	88° 29' 8.778" E
146	27° 1' 31.655" N	88° 29' 9.641" E
147	27° 1' 30.389" N	88° 29' 9.798" E

POTENTIAL BLOCKS ON PALLA RIVER

KPG_KPG2_PL_1A		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 2' 41.926" N	88° 32' 29.907" E
2	27° 2' 40.240" N	88° 32' 27.158" E
3	27° 2' 39.509" N	88° 32' 25.224" E
4	27° 2' 38.975" N	88° 32' 21.455" E
5	27° 2' 41.462" N	88° 32' 21.217" E
6	27° 2' 41.553" N	88° 32' 21.909" E
7	27° 2' 41.459" N	88° 32' 23.102" E
8	27° 2' 41.969" N	88° 32' 25.961" E
9	27° 2' 42.718" N	88° 32' 27.347" E
10	27° 2' 43.116" N	88° 32' 28.636" E
11	27° 2' 43.826" N	88° 32' 29.513" E
12	27° 2' 44.369" N	88° 32' 30.603" E
13	27° 2' 43.847" N	88° 32' 31.143" E

KPG_KPG2_PL_1B		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 2' 41.485" N	88° 32' 3.359" E
2	27° 2' 39.196" N	88° 32' 2.443" E
3	27° 2' 39.527" N	88° 32' 0.768" E
4	27° 2' 39.575" N	88° 31' 56.361" E
5	27° 2' 38.724" N	88° 31' 53.959" E
6	27° 2' 38.360" N	88° 31' 52.476" E
7	27° 2' 38.068" N	88° 31' 48.545" E
8	27° 2' 38.253" N	88° 31' 47.444" E
9	27° 2' 38.267" N	88° 31' 47.381" E
10	27° 2' 40.997" N	88° 31' 48.308" E
11	27° 2' 40.869" N	88° 31' 48.861" E
12	27° 2' 41.215" N	88° 31' 50.996" E
13	27° 2' 41.204" N	88° 31' 51.065" E
14	27° 2' 41.228" N	88° 31' 51.080" E
15	27° 2' 41.304" N	88° 31' 51.545" E
16	27° 2' 42.393" N	88° 31' 53.404" E
17	27° 2' 43.636" N	88° 31' 53.756" E
18	27° 2' 43.936" N	88° 31' 56.057" E
19	27° 2' 43.633" N	88° 32' 0.460" E
20	27° 2' 42.735" N	88° 32' 2.194" E

POTENTIAL BLOCKS ON CHEL RIVER

KPG_GB_CHL_1		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 0' 25.232" N	88° 41' 30.106" E
2	27° 0' 23.879" N	88° 41' 27.471" E
3	27° 0' 24.021" N	88° 41' 27.189" E
4	27° 0' 27.842" N	88° 41' 25.056" E
5	27° 0' 28.876" N	88° 41' 27.238" E

KPG_GB_CHL_2		
POINT NO	**LATITUDE**	**LONGITUDE**
1	27° 0' 11.321" N	88° 41' 36.698" E
2	27° 0' 11.278" N	88° 41' 40.300" E
3	27° 0' 4.912" N	88° 41' 40.582" E
4	26° 59' 57.620" N	88° 41' 39.062" E
5	26° 59' 51.821" N	88° 41' 39.026" E
6	26° 59' 47.315" N	88° 41' 38.530" E
7	26° 59' 47.012" N	88° 41' 35.528" E
8	26° 59' 58.772" N	88° 41' 35.175" E
9	27° 0' 8.164" N	88° 41' 36.576" E

KPG_GB_CHL_3		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 59' 31.004" N	88° 41' 43.927" E
2	26° 59' 30.889" N	88° 41' 42.314" E
3	26° 59' 35.065" N	88° 41' 40.235" E
4	26° 59' 39.997" N	88° 41' 38.769" E
5	26° 59' 40.953" N	88° 41' 38.485" E
6	26° 59' 41.382" N	88° 41' 39.609" E
7	26° 59' 41.182" N	88° 41' 39.760" E
8	26° 59' 39.087" N	88° 41' 40.628" E
9	26° 59' 36.847" N	88° 41' 41.914" E
10	26° 59' 35.124" N	88° 41' 42.176" E
11	26° 59' 33.892" N	88° 41' 42.806" E
12	26° 59' 33.889" N	88° 41' 42.807" E
13	26° 59' 33.612" N	88° 41' 42.883" E
14	26° 59' 32.201" N	88° 41' 43.870" E

KPG_GB_CHL_4		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 59' 8.151" N	88° 41' 43.761" E
2	26° 59' 8.128" N	88° 41' 43.761" E

3	26° 59' 8.506" N	88° 41' 42.331" E
4	26° 59' 13.293" N	88° 41' 42.000" E
5	26° 59' 15.698" N	88° 41' 42.791" E
6	26° 59' 17.046" N	88° 41' 43.290" E
7	26° 59' 14.225" N	88° 41' 43.348" E
8	26° 59' 14.018" N	88° 41' 43.386" E
9	26° 59' 13.842" N	88° 41' 43.369" E
10	26° 59' 11.558" N	88° 41' 43.814" E
11	26° 59' 11.382" N	88° 41' 43.833" E
12	26° 59' 10.207" N	88° 41' 43.807" E
13	26° 59' 9.303" N	88° 41' 43.696" E
14	26° 59' 8.260" N	88° 41' 43.741" E

KPG_GB_CHL_5		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 56' 56.567" N	88° 40' 53.744" E
2	26° 56' 52.859" N	88° 40' 48.497" E
3	26° 56' 58.587" N	88° 40' 43.835" E
4	26° 56' 59.256" N	88° 40' 45.168" E
5	26° 57' 0.717" N	88° 40' 46.941" E
6	26° 57' 2.835" N	88° 40' 50.721" E
7	26° 57' 4.288" N	88° 40' 52.740" E
8	26° 57' 5.861" N	88° 40' 55.186" E
9	26° 57' 7.100" N	88° 40' 58.605" E
10	26° 57' 7.299" N	88° 40' 59.222" E
11	26° 57' 7.799" N	88° 41' 0.534" E
12	26° 57' 8.611" N	88° 41' 2.772" E
13	26° 57' 9.545" N	88° 41' 5.351" E
14	26° 57' 6.875" N	88° 41' 7.280" E

KPG_GB_CHL_6		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 56' 54.195" N	88° 40' 40.729" E
2	26° 56' 50.002" N	88° 40' 45.903" E
3	26° 56' 42.156" N	88° 40' 37.820" E
4	26° 56' 35.684" N	88° 40' 28.862" E
5	26° 56' 33.956" N	88° 40' 22.347" E
6	26° 56' 38.873" N	88° 40' 17.004" E
7	26° 56' 47.409" N	88° 40' 27.783" E
8	26° 56' 54.195" N	88° 40' 40.729" E

KPG_GB_CHL_7A		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 55' 54.355" N	88° 40' 3.430" E
2	26° 55' 53.013" N	88° 40' 2.909" E
3	26° 55' 55.595" N	88° 39' 52.728" E
4	26° 56' 14.400" N	88° 40' 1.624" E
5	26° 56' 20.004" N	88° 40' 4.275" E
6	26° 56' 23.572" N	88° 40' 6.921" E
7	26° 56' 24.249" N	88° 40' 12.179" E
8	26° 56' 13.484" N	88° 40' 10.051" E
9	26° 56' 2.869" N	88° 40' 5.374" E
10	26° 55' 54.652" N	88° 40' 3.548" E
11	26° 55' 54.355" N	88° 40' 3.430" E

KPG_GB_CHL_7B		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 55' 34.740" N	88° 39' 55.812" E
2	26° 55' 30.509" N	88° 39' 54.038" E
3	26° 55' 31.615" N	88° 39' 40.000" E
4	26° 55' 46.791" N	88° 39' 47.563" E
5	26° 55' 53.299" N	88° 39' 50.806" E
6	26° 55' 50.979" N	88° 40' 2.216" E
7	26° 55' 49.862" N	88° 40' 2.152" E
8	26° 55' 40.092" N	88° 39' 58.056" E
9	26° 55' 39.266" N	88° 39' 57.252" E
10	26° 55' 37.966" N	88° 39' 56.903" E

POTENTIAL BLOCKS ON GEET RIVER

KPG_KPG1_GT_1		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 58' 21.960" N	88° 36' 31.770" E
2	26° 58' 19.522" N	88° 36' 29.804" E
3	26° 58' 20.974" N	88° 36' 27.627" E
4	26° 58' 22.107" N	88° 36' 26.313" E
5	26° 58' 24.578" N	88° 36' 24.426" E
6	26° 58' 26.329" N	88° 36' 23.588" E
7	26° 58' 30.172" N	88° 36' 25.825" E
8	26° 58' 32.658" N	88° 36' 28.380" E
9	26° 58' 33.680" N	88° 36' 29.234" E
10	26° 58' 37.372" N	88° 36' 31.653" E

KPG_KPG1_GT_1		
POINT NO	**LATITUDE**	**LONGITUDE**
11	26° 58' 39.804" N	88° 36' 35.414" E
12	26° 58' 40.298" N	88° 36' 37.235" E
13	26° 58' 40.565" N	88° 36' 37.949" E
14	26° 58' 42.249" N	88° 36' 39.585" E
15	26° 58' 42.795" N	88° 36' 39.593" E
16	26° 58' 43.434" N	88° 36' 40.336" E
17	26° 58' 40.069" N	88° 36' 45.044" E
18	26° 58' 38.673" N	88° 36' 45.855" E
19	26° 58' 36.310" N	88° 36' 39.203" E
20	26° 58' 33.569" N	88° 36' 35.592" E
21	26° 58' 32.946" N	88° 36' 34.381" E
22	26° 58' 30.831" N	88° 36' 31.832" E
23	26° 58' 30.179" N	88° 36' 30.863" E
24	26° 58' 29.358" N	88° 36' 30.058" E
25	26° 58' 28.917" N	88° 36' 29.526" E
26	26° 58' 28.527" N	88° 36' 29.242" E
27	26° 58' 28.394" N	88° 36' 29.111" E
28	26° 58' 28.292" N	88° 36' 29.070" E
29	26° 58' 26.700" N	88° 36' 27.911" E
30	26° 58' 24.974" N	88° 36' 28.462" E
31	26° 58' 24.323" N	88° 36' 29.170" E
32	26° 58' 23.964" N	88° 36' 29.288" E
33	26° 58' 22.545" N	88° 36' 31.105" E
34	26° 58' 22.101" N	88° 36' 31.588" E

KPG_KPG1_GT_2		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 57' 52.205" N	88° 36' 31.955" E
2	26° 57' 50.917" N	88° 36' 31.469" E
3	26° 57' 51.332" N	88° 36' 30.608" E
4	26° 57' 53.118" N	88° 36' 28.738" E
5	26° 57' 53.342" N	88° 36' 28.565" E
6	26° 57' 55.443" N	88° 36' 28.299" E
7	26° 57' 55.699" N	88° 36' 28.318" E
8	26° 57' 57.734" N	88° 36' 28.811" E
9	26° 57' 57.903" N	88° 36' 28.871" E
10	26° 57' 59.300" N	88° 36' 30.136" E
11	26° 58' 0.989" N	88° 36' 30.904" E
12	26° 58' 2.675" N	88° 36' 30.064" E
13	26° 58' 4.046" N	88° 36' 28.621" E

KPG_KPG1_GT_2		
POINT NO	**LATITUDE**	**LONGITUDE**
14	26° 58' 4.095" N	88° 36' 28.537" E
15	26° 58' 5.398" N	88° 36' 27.623" E
16	26° 58' 7.121" N	88° 36' 27.871" E
17	26° 58' 8.386" N	88° 36' 28.778" E
18	26° 58' 9.646" N	88° 36' 29.516" E
19	26° 58' 11.327" N	88° 36' 30.955" E
20	26° 58' 14.197" N	88° 36' 31.883" E
21	26° 58' 14.688" N	88° 36' 31.919" E
22	26° 58' 13.840" N	88° 36' 33.752" E
23	26° 58' 9.992" N	88° 36' 32.315" E
24	26° 58' 7.907" N	88° 36' 31.218" E
25	26° 58' 5.113" N	88° 36' 31.179" E
26	26° 58' 4.500" N	88° 36' 32.177" E
27	26° 58' 3.488" N	88° 36' 33.168" E
28	26° 58' 2.993" N	88° 36' 33.427" E
29	26° 58' 1.832" N	88° 36' 33.507" E
30	26° 58' 0.724" N	88° 36' 32.579" E
31	26° 57' 58.631" N	88° 36' 31.446" E
32	26° 57' 56.738" N	88° 36' 31.385" E
33	26° 57' 56.127" N	88° 36' 31.291" E
34	26° 57' 54.055" N	88° 36' 31.298" E
35	26° 57' 53.345" N	88° 36' 31.275" E
36	26° 57' 52.309" N	88° 36' 31.644" E

KPG_GB_GT_3		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 57' 45.897" N	88° 36' 40.572" E
2	26° 57' 43.682" N	88° 36' 39.562" E
3	26° 57' 44.192" N	88° 36' 37.646" E
4	26° 57' 44.748" N	88° 36' 37.654" E
5	26° 57' 47.285" N	88° 36' 37.642" E
6	26° 57' 48.804" N	88° 36' 36.392" E
7	26° 57' 50.645" N	88° 36' 36.730" E
8	26° 57' 49.903" N	88° 36' 39.046" E
9	26° 57' 48.528" N	88° 36' 40.463" E
10	26° 57' 47.873" N	88° 36' 40.697" E

KPG_KPG1_GT_4		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 57' 37.249" N	88° 36' 36.803" E

2	26° 57' 36.561" N	88° 36' 35.618" E
3	26° 57' 37.634" N	88° 36' 33.834" E
4	26° 57' 40.094" N	88° 36' 34.877" E
5	26° 57' 41.495" N	88° 36' 36.432" E
6	26° 57' 42.900" N	88° 36' 37.627" E
7	26° 57' 42.556" N	88° 36' 39.041" E
8	26° 57' 41.856" N	88° 36' 38.709" E
9	26° 57' 38.836" N	88° 36' 36.970" E

KPG_KPG1_GT_5		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 57' 29.091" N	88° 36' 36.858" E
2	26° 57' 25.032" N	88° 36' 37.708" E
3	26° 57' 24.277" N	88° 36' 36.917" E
4	26° 57' 23.842" N	88° 36' 36.133" E
5	26° 57' 22.637" N	88° 36' 34.363" E
6	26° 57' 23.135" N	88° 36' 32.218" E
7	26° 57' 24.050" N	88° 36' 30.389" E
8	26° 57' 24.584" N	88° 36' 28.861" E
9	26° 57' 23.743" N	88° 36' 27.161" E
10	26° 57' 21.867" N	88° 36' 25.791" E
11	26° 57' 21.894" N	88° 36' 23.450" E
12	26° 57' 22.986" N	88° 36' 22.925" E
13	26° 57' 23.121" N	88° 36' 22.900" E
14	26° 57' 23.691" N	88° 36' 22.796" E
15	26° 57' 27.553" N	88° 36' 21.367" E
16	26° 57' 28.852" N	88° 36' 22.057" E
17	26° 57' 29.058" N	88° 36' 25.111" E
18	26° 57' 28.536" N	88° 36' 28.156" E
19	26° 57' 28.153" N	88° 36' 29.488" E
20	26° 57' 28.201" N	88° 36' 30.213" E
21	26° 57' 28.126" N	88° 36' 31.411" E
22	26° 57' 28.646" N	88° 36' 34.124" E
23	26° 57' 28.709" N	88° 36' 36.101" E

KPG_KPG1_GT_6		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 57' 1.883" N	88° 36' 26.280" E
2	26° 57' 1.683" N	88° 36' 24.913" E
3	26° 57' 1.822" N	88° 36' 23.569" E
4	26° 57' 3.163" N	88° 36' 20.380" E
5	26° 57' 4.922" N	88° 36' 20.363" E

6	26° 57' 9.940" N	88° 36' 21.552" E
7	26° 57' 11.588" N	88° 36' 21.976" E
8	26° 57' 11.945" N	88° 36' 22.225" E
9	26° 57' 12.780" N	88° 36' 22.281" E
10	26° 57' 14.851" N	88° 36' 22.813" E
11	26° 57' 17.087" N	88° 36' 23.187" E
12	26° 57' 17.499" N	88° 36' 23.340" E
13	26° 57' 18.000" N	88° 36' 23.339" E
14	26° 57' 18.867" N	88° 36' 23.484" E
15	26° 57' 20.450" N	88° 36' 23.466" E
16	26° 57' 20.518" N	88° 36' 26.139" E
17	26° 57' 18.763" N	88° 36' 26.591" E
18	26° 57' 14.743" N	88° 36' 26.227" E
19	26° 57' 12.310" N	88° 36' 25.463" E
20	26° 57' 11.810" N	88° 36' 25.529" E
21	26° 57' 11.455" N	88° 36' 25.390" E
22	26° 57' 10.856" N	88° 36' 25.155" E
23	26° 57' 9.649" N	88° 36' 25.425" E
24	26° 57' 8.392" N	88° 36' 26.319" E
25	26° 57' 8.285" N	88° 36' 26.948" E

KPG_GB_GT_7		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 57' 4.552" N	88° 36' 42.220" E
2	26° 57' 2.718" N	88° 36' 46.185" E
3	26° 57' 0.070" N	88° 36' 51.002" E
4	26° 56' 59.556" N	88° 36' 51.887" E
5	26° 56' 57.590" N	88° 36' 54.527" E
6	26° 56' 56.634" N	88° 36' 55.133" E
7	26° 56' 56.301" N	88° 36' 55.235" E
8	26° 56' 54.949" N	88° 36' 55.341" E
9	26° 56' 53.719" N	88° 36' 55.240" E
10	26° 56' 52.817" N	88° 36' 55.166" E
11	26° 56' 52.727" N	88° 36' 55.141" E
12	26° 56' 53.228" N	88° 36' 52.170" E
13	26° 56' 56.377" N	88° 36' 50.488" E
14	26° 56' 57.048" N	88° 36' 48.733" E
15	26° 56' 57.674" N	88° 36' 48.370" E
16	26° 56' 58.491" N	88° 36' 46.440" E
17	26° 56' 58.696" N	88° 36' 46.146" E
18	26° 57' 0.191" N	88° 36' 44.709" E
19	26° 57' 1.528" N	88° 36' 42.081" E

KPG_GB_GT_7		
POINT NO	**LATITUDE**	**LONGITUDE**
20	26° 57' 3.378" N	88° 36' 39.689" E
21	26° 57' 3.617" N	88° 36' 36.814" E
22	26° 57' 3.605" N	88° 36' 34.857" E
23	26° 57' 2.863" N	88° 36' 30.587" E
24	26° 57' 2.608" N	88° 36' 29.254" E
25	26° 57' 7.845" N	88° 36' 29.872" E
26	26° 57' 7.777" N	88° 36' 30.449" E
27	26° 57' 7.462" N	88° 36' 31.285" E
28	26° 57' 6.498" N	88° 36' 38.882" E
29	26° 57' 6.464" N	88° 36' 39.050" E

KPG_KPG1_GT_8		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 55' 37.607" N	88° 36' 38.832" E
2	26° 55' 34.798" N	88° 36' 36.211" E
3	26° 55' 39.423" N	88° 36' 35.752" E
4	26° 55' 41.738" N	88° 36' 36.265" E
5	26° 55' 43.443" N	88° 36' 37.034" E
6	26° 55' 43.453" N	88° 36' 37.042" E
7	26° 55' 43.492" N	88° 36' 37.056" E
8	26° 55' 45.031" N	88° 36' 37.751" E
9	26° 55' 46.763" N	88° 36' 40.461" E
10	26° 55' 48.248" N	88° 36' 42.209" E
11	26° 55' 50.534" N	88° 36' 45.311" E
12	26° 55' 50.570" N	88° 36' 45.354" E
13	26° 55' 50.571" N	88° 36' 45.373" E
14	26° 55' 54.133" N	88° 36' 49.702" E
15	26° 55' 54.718" N	88° 36' 49.945" E
16	26° 55' 56.068" N	88° 36' 51.068" E
17	26° 55' 51.751" N	88° 36' 51.816" E
18	26° 55' 50.384" N	88° 36' 50.066" E
19	26° 55' 49.133" N	88° 36' 48.130" E
20	26° 55' 46.969" N	88° 36' 44.915" E
21	26° 55' 46.805" N	88° 36' 44.661" E
22	26° 55' 45.750" N	88° 36' 42.940" E
23	26° 55' 45.103" N	88° 36' 42.036" E
24	26° 55' 44.434" N	88° 36' 41.003" E
25	26° 55' 44.241" N	88° 36' 40.829" E
26	26° 55' 43.084" N	88° 36' 39.209" E
27	26° 55' 41.335" N	88° 36' 39.053" E

KPG_KPG1_GT_8		
POINT NO	**LATITUDE**	**LONGITUDE**
28	26° 55' 40.367" N	88° 36' 38.797" E
29	26° 55' 39.310" N	88° 36' 38.873" E
30	26° 55' 37.973" N	88° 36' 38.753" E

KPG_KPG1_GT_9		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 54' 47.516" N	88° 36' 46.322" E
2	26° 54' 42.554" N	88° 36' 41.263" E
3	26° 54' 44.904" N	88° 36' 39.625" E
4	26° 54' 51.602" N	88° 36' 38.665" E
5	26° 54' 58.785" N	88° 36' 38.695" E
6	26° 55' 1.140" N	88° 36' 38.991" E
7	26° 55' 5.906" N	88° 36' 40.796" E
8	26° 55' 8.350" N	88° 36' 40.954" E
9	26° 55' 8.623" N	88° 36' 40.972" E
10	26° 55' 10.085" N	88° 36' 41.066" E
11	26° 55' 9.544" N	88° 36' 45.583" E
12	26° 55' 5.180" N	88° 36' 47.122" E

KPG_GB_GT_10		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 54' 32.828" N	88° 37' 8.215" E
2	26° 54' 30.443" N	88° 37' 1.950" E
3	26° 54' 39.702" N	88° 36' 44.701" E
4	26° 54' 45.584" N	88° 36' 50.670" E
5	26° 54' 45.258" N	88° 36' 51.661" E
6	26° 54' 37.023" N	88° 37' 4.055" E
7	26° 54' 33.259" N	88° 37' 7.948" E

KPG_KPG1_GT_11		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 54' 12.115" N	88° 37' 18.097" E
2	26° 53' 55.634" N	88° 37' 6.359" E
3	26° 54' 8.608" N	88° 37' 1.305" E
4	26° 54' 14.228" N	88° 36' 58.039" E
5	26° 54' 14.430" N	88° 36' 57.922" E
6	26° 54' 21.556" N	88° 36' 53.780" E
7	26° 54' 27.411" N	88° 36' 51.406" E
8	26° 54' 29.560" N	88° 36' 58.358" E

POTENTIAL BLOCKS ON LEESH RIVER

KPG_KPG1_LH_1		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 57' 30.396" N	88° 30' 53.431" E
2	26° 57' 29.177" N	88° 30' 49.636" E
3	26° 57' 33.082" N	88° 30' 45.296" E
4	26° 57' 43.920" N	88° 30' 47.783" E
5	26° 57' 47.717" N	88° 30' 48.596" E
6	26° 57' 48.512" N	88° 30' 48.561" E
7	26° 57' 49.043" N	88° 30' 48.670" E
8	26° 57' 49.341" N	88° 30' 48.730" E
9	26° 57' 49.712" N	88° 30' 48.510" E
10	26° 57' 49.791" N	88° 30' 48.506" E
11	26° 57' 50.112" N	88° 30' 51.093" E
12	26° 57' 49.823" N	88° 30' 51.200" E
13	26° 57' 44.640" N	88° 30' 50.617" E
14	26° 57' 42.987" N	88° 30' 50.121" E
15	26° 57' 40.278" N	88° 30' 49.893" E
16	26° 57' 38.710" N	88° 30' 49.761" E
17	26° 57' 38.338" N	88° 30' 49.885" E
18	26° 57' 33.014" N	88° 30' 51.657" E
19	26° 57' 30.842" N	88° 30' 53.236" E

KPG_KPG1_LH_2		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 56' 42.542" N	88° 31' 52.622" E
2	26° 56' 36.836" N	88° 31' 52.112" E
3	26° 56' 37.378" N	88° 31' 48.383" E
4	26° 56' 37.684" N	88° 31' 48.205" E
5	26° 56' 38.688" N	88° 31' 48.486" E
6	26° 56' 46.707" N	88° 31' 51.149" E
7	26° 56' 47.165" N	88° 31' 51.200" E
8	26° 56' 48.508" N	88° 31' 51.675" E
9	26° 56' 48.467" N	88° 31' 53.457" E
10	26° 56' 46.168" N	88° 31' 53.242" E
11	26° 56' 43.604" N	88° 31' 52.717" E

KPG_KPG1_LH_3		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 56' 17.219" N	88° 31' 53.179" E
2	26° 56' 14.850" N	88° 31' 48.580" E
3	26° 56' 15.835" N	88° 31' 48.399" E

KPG_KPG1_LH_3		
POINT NO	**LATITUDE**	**LONGITUDE**
4	26° 56' 19.223" N	88° 31' 47.706" E
5	26° 56' 23.736" N	88° 31' 49.776" E
6	26° 56' 24.934" N	88° 31' 51.314" E
7	26° 56' 28.227" N	88° 31' 52.140" E
8	26° 56' 30.466" N	88° 31' 53.243" E
9	26° 56' 29.853" N	88° 31' 57.179" E
10	26° 56' 29.281" N	88° 31' 57.801" E
11	26° 56' 29.086" N	88° 31' 57.939" E
12	26° 56' 25.155" N	88° 31' 58.911" E
13	26° 56' 20.414" N	88° 31' 58.115" E
14	26° 56' 19.219" N	88° 31' 56.287" E
15	26° 56' 18.471" N	88° 31' 54.739" E
16	26° 56' 17.712" N	88° 31' 53.639" E
17	26° 56' 17.482" N	88° 31' 53.424" E

KPG_KPG1_LH_4A		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 55' 35.865" N	88° 32' 17.882" E
2	26° 55' 33.636" N	88° 32' 15.174" E
3	26° 55' 33.689" N	88° 32' 14.362" E
4	26° 55' 33.611" N	88° 32' 11.774" E
5	26° 55' 42.960" N	88° 32' 3.341" E
6	26° 55' 48.958" N	88° 31' 57.931" E
7	26° 55' 50.122" N	88° 31' 56.680" E
8	26° 55' 50.432" N	88° 31' 56.424" E
9	26° 55' 57.447" N	88° 31' 51.737" E
10	26° 55' 59.902" N	88° 31' 50.581" E
11	26° 56' 0.781" N	88° 31' 51.974" E
12	26° 56' 0.717" N	88° 31' 52.114" E
13	26° 56' 0.683" N	88° 31' 52.138" E
14	26° 56' 0.005" N	88° 31' 53.232" E
15	26° 55' 59.374" N	88° 31' 55.052" E
16	26° 55' 59.125" N	88° 31' 55.597" E
17	26° 55' 56.699" N	88° 32' 0.042" E
18	26° 55' 55.857" N	88° 32' 1.065" E
19	26° 55' 54.763" N	88° 32' 2.179" E
20	26° 55' 53.857" N	88° 32' 3.101" E
21	26° 55' 51.397" N	88° 32' 5.969" E
22	26° 55' 49.266" N	88° 32' 8.266" E
23	26° 55' 42.818" N	88° 32' 14.102" E

24	26° 55' 38.278" N	88° 32' 16.535" E
25	26° 55' 37.167" N	88° 32' 17.911" E
26	26° 55' 36.549" N	88° 32' 18.905" E

KPG_KPG1_LH_4B		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 55' 20.630" N	88° 32' 32.082" E
2	26° 55' 20.480" N	88° 32' 30.066" E
3	26° 55' 24.903" N	88° 32' 26.577" E
4	26° 55' 30.533" N	88° 32' 22.769" E
5	26° 55' 31.066" N	88° 32' 21.756" E
6	26° 55' 31.990" N	88° 32' 21.102" E
7	26° 55' 32.779" N	88° 32' 18.689" E
8	26° 55' 33.462" N	88° 32' 18.300" E
9	26° 55' 35.502" N	88° 32' 20.486" E
10	26° 55' 32.433" N	88° 32' 25.912" E
11	26° 55' 28.656" N	88° 32' 29.361" E
12	26° 55' 23.836" N	88° 32' 31.050" E
13	26° 55' 21.863" N	88° 32' 31.611" E
14	26° 55' 21.521" N	88° 32' 31.797" E

KPG_KPG1_LH_4C		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 55' 15.326" N	88° 32' 35.232" E
2	26° 55' 9.230" N	88° 32' 38.921" E
3	26° 55' 6.232" N	88° 32' 40.699" E
4	26° 55' 2.393" N	88° 32' 42.976" E
5	26° 54' 56.608" N	88° 32' 46.937" E
6	26° 54' 55.766" N	88° 32' 47.513" E
7	26° 54' 54.204" N	88° 32' 48.505" E
8	26° 54' 52.526" N	88° 32' 45.991" E
9	26° 54' 59.145" N	88° 32' 40.636" E
10	26° 55' 12.734" N	88° 32' 33.942" E
11	26° 55' 12.682" N	88° 32' 33.941" E
12	26° 55' 14.603" N	88° 32' 33.440" E

KPG_KPG1_LH_5		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 54' 16.462" N	88° 33' 7.923" E
2	26° 54' 16.460" N	88° 33' 5.786" E
3	26° 54' 22.783" N	88° 33' 3.501" E
4	26° 54' 27.974" N	88° 32' 59.210" E

5	26° 54' 30.011" N	88° 32' 57.716" E
6	26° 54' 31.959" N	88° 32' 57.216" E
7	26° 54' 32.463" N	88° 32' 59.125" E
8	26° 54' 30.229" N	88° 32' 59.446" E
9	26° 54' 28.692" N	88° 33' 1.983" E
10	26° 54' 27.437" N	88° 33' 3.368" E
11	26° 54' 23.346" N	88° 33' 6.550" E
12	26° 54' 22.521" N	88° 33' 7.131" E
13	26° 54' 19.243" N	88° 33' 8.019" E
14	26° 54' 17.321" N	88° 33' 7.952" E
15	26° 54' 16.809" N	88° 33' 7.889" E
16	26° 54' 16.669" N	88° 33' 7.930" E

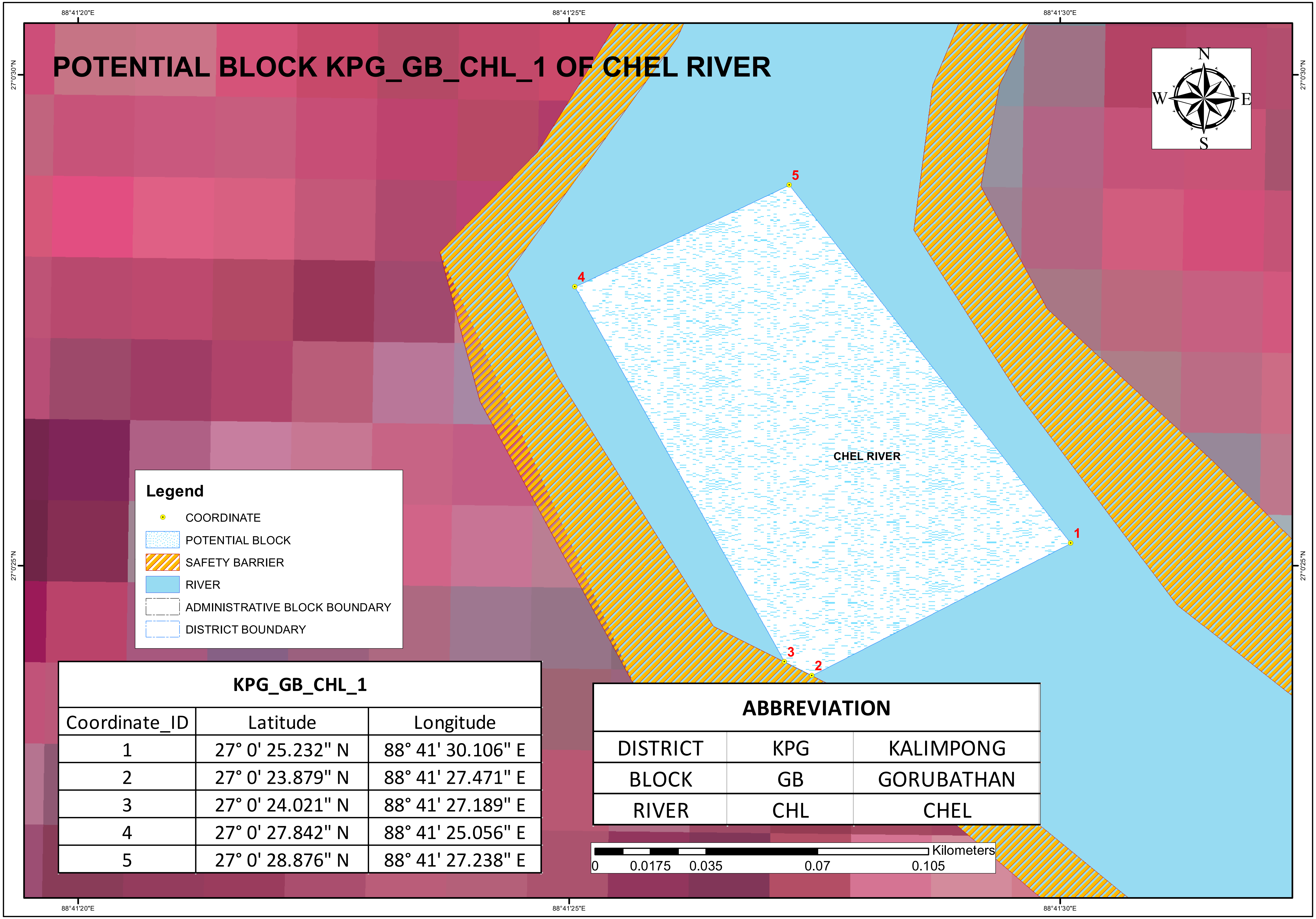
KPG_KPG1_LH_6		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 53' 44.678" N	88° 33' 38.591" E
2	26° 53' 42.811" N	88° 33' 36.385" E
3	26° 53' 49.997" N	88° 33' 28.068" E
4	26° 53' 59.642" N	88° 33' 19.831" E
5	26° 54' 1.631" N	88° 33' 22.560" E
6	26° 53' 56.754" N	88° 33' 27.417" E
7	26° 53' 52.230" N	88° 33' 32.116" E
8	26° 53' 49.765" N	88° 33' 34.602" E

KPG_KPG1_LH_7A		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 53' 17.207" N	88° 33' 48.492" E
2	26° 53' 16.085" N	88° 33' 41.991" E
3	26° 53' 28.372" N	88° 33' 36.280" E
4	26° 53' 40.292" N	88° 33' 34.207" E
5	26° 53' 41.557" N	88° 33' 36.679" E
6	26° 53' 43.371" N	88° 33' 39.616" E
7	26° 53' 41.643" N	88° 33' 40.971" E
8	26° 53' 40.126" N	88° 33' 42.164" E
9	26° 53' 35.529" N	88° 33' 45.777" E
10	26° 53' 32.071" N	88° 33' 47.942" E
11	26° 53' 28.559" N	88° 33' 50.140" E
12	26° 53' 19.795" N	88° 33' 53.471" E
13	26° 53' 18.252" N	88° 33' 53.963" E

KPG_KPG1_LH_7B		
POINT NO	**LATITUDE**	**LONGITUDE**
1	26° 52' 58.942" N	88° 34' 0.665" E
2	26° 52' 45.819" N	88° 33' 41.517" E
3	26° 52' 49.492" N	88° 33' 39.841" E
4	26° 52' 59.245" N	88° 33' 38.406" E
5	26° 53' 1.040" N	88° 33' 38.974" E
6	26° 53' 3.225" N	88° 33' 39.627" E
7	26° 53' 6.523" N	88° 33' 39.862" E
8	26° 53' 8.323" N	88° 33' 40.255" E
9	26° 53' 9.846" N	88° 33' 40.099" E
10	26° 53' 12.246" N	88° 33' 40.269" E
11	26° 53' 12.727" N	88° 33' 40.132" E
12	26° 53' 16.866" N	88° 33' 54.405" E
13	26° 53' 10.563" N	88° 33' 56.413" E
14	26° 53' 3.270" N	88° 33' 58.853" E

Annexure 4
Map showing of Potential Blocks of Kalimpong District

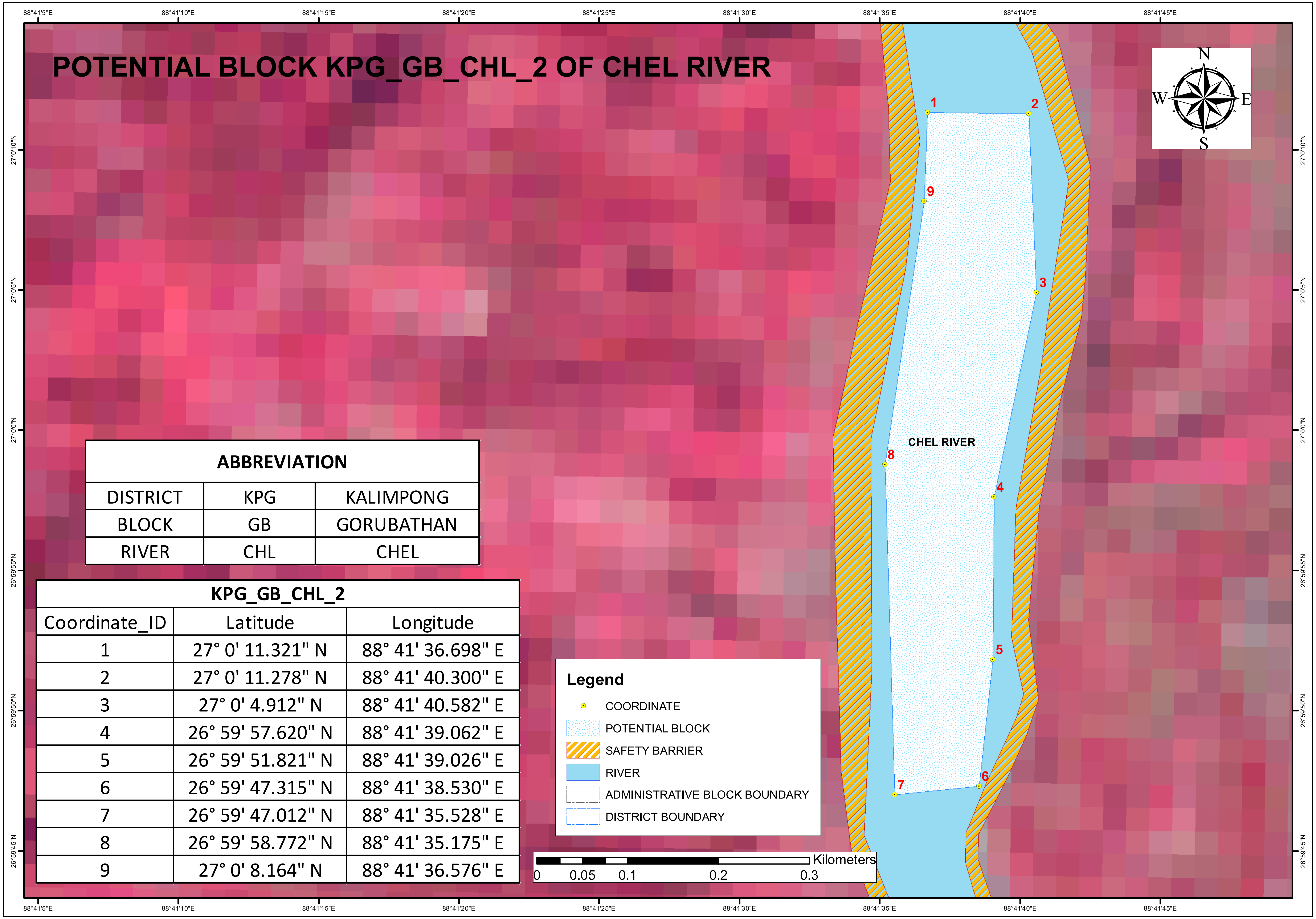
POTENTIAL BLOCK KPG_GB_CHL_1 OF CHEL RIVER



KPG_GB_CHL_1		
Coordinate_ID	Latitude	Longitude
1	27° 0' 25.232" N	88° 41' 30.106" E
2	27° 0' 23.879" N	88° 41' 27.471" E
3	27° 0' 24.021" N	88° 41' 27.189" E
4	27° 0' 27.842" N	88° 41' 25.056" E
5	27° 0' 28.876" N	88° 41' 27.238" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	CHL	CHEL

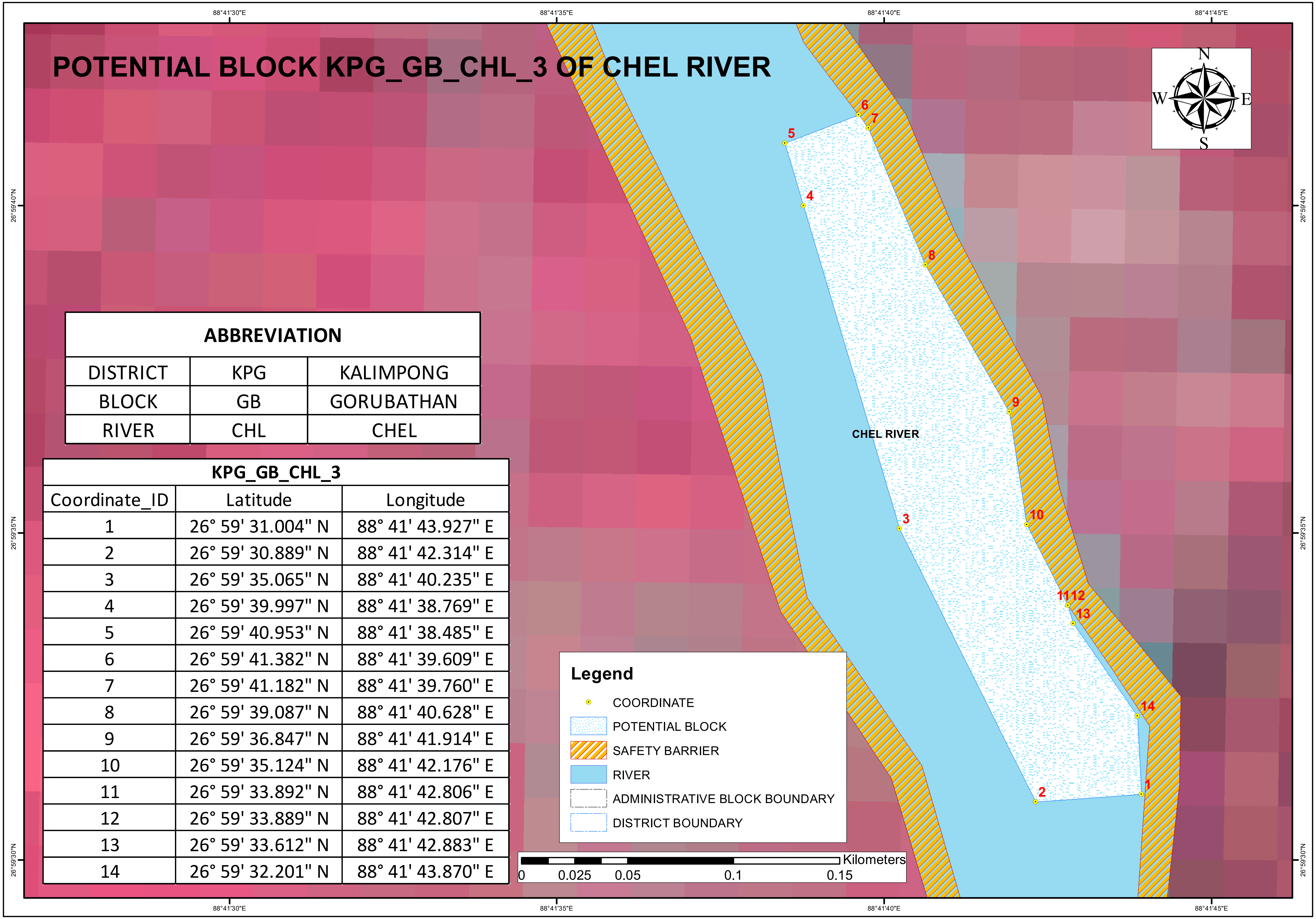
POTENTIAL BLOCK KPG_GB_CHL_2 OF CHEL RIVER



ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	CHL	CHEL

KPG_GB_CHL_2		
Coordinate_ID	Latitude	Longitude
1	27° 0' 11.321" N	88° 41' 36.698" E
2	27° 0' 11.278" N	88° 41' 40.300" E
3	27° 0' 4.912" N	88° 41' 40.582" E
4	26° 59' 57.620" N	88° 41' 39.062" E
5	26° 59' 51.821" N	88° 41' 39.026" E
6	26° 59' 47.315" N	88° 41' 38.530" E
7	26° 59' 47.012" N	88° 41' 35.528" E
8	26° 59' 58.772" N	88° 41' 35.175" E
9	27° 0' 8.164" N	88° 41' 36.576" E

POTENTIAL BLOCK KPG_GB_CHL_3 OF CHEL RIVER



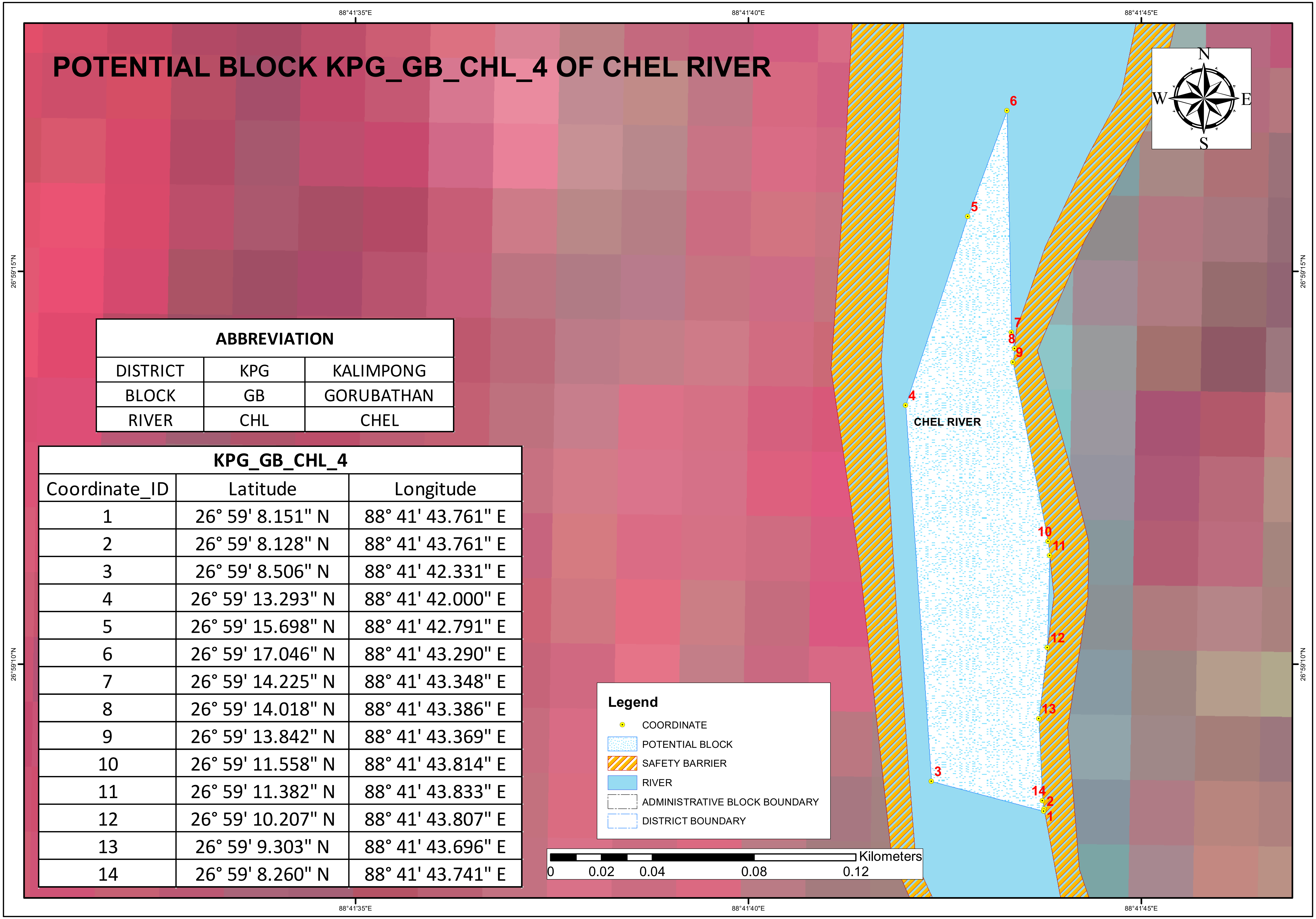
ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	CHL	CHEL

KPG_GB_CHL_3		
Coordinate_ID	Latitude	Longitude
1	26° 59' 31.004" N	88° 41' 43.927" E
2	26° 59' 30.889" N	88° 41' 42.314" E
3	26° 59' 35.065" N	88° 41' 40.235" E
4	26° 59' 39.997" N	88° 41' 38.769" E
5	26° 59' 40.953" N	88° 41' 38.485" E
6	26° 59' 41.382" N	88° 41' 39.609" E
7	26° 59' 41.182" N	88° 41' 39.760" E
8	26° 59' 39.087" N	88° 41' 40.628" E
9	26° 59' 36.847" N	88° 41' 41.914" E
10	26° 59' 35.124" N	88° 41' 42.176" E
11	26° 59' 33.892" N	88° 41' 42.806" E
12	26° 59' 33.889" N	88° 41' 42.807" E
13	26° 59' 33.612" N	88° 41' 42.883" E
14	26° 59' 32.201" N	88° 41' 43.870" E

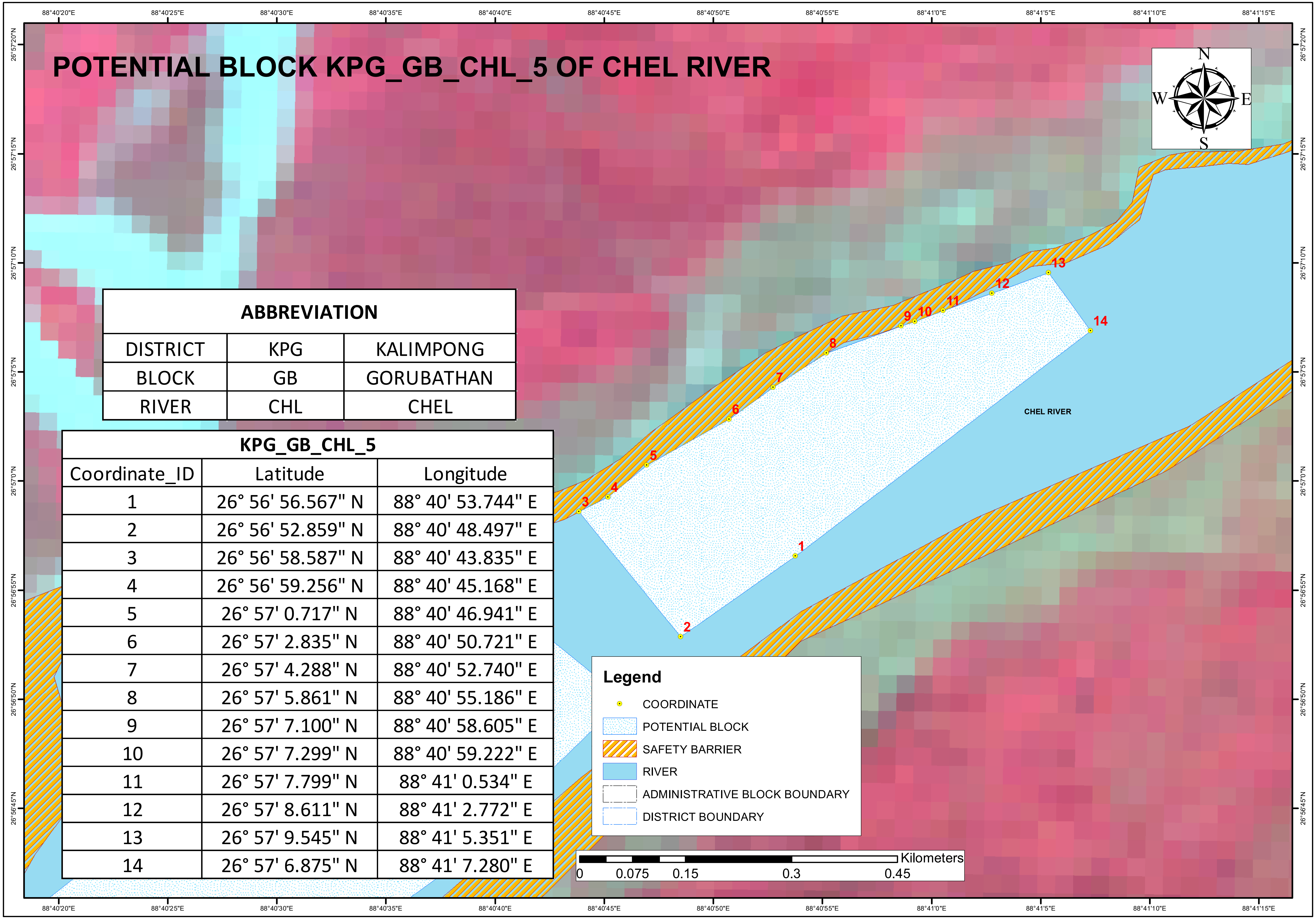
POTENTIAL BLOCK KPG_GB_CHL_4 OF CHEL RIVER

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	CHL	CHEL

KPG_GB_CHL_4		
Coordinate_ID	Latitude	Longitude
1	26° 59' 8.151" N	88° 41' 43.761" E
2	26° 59' 8.128" N	88° 41' 43.761" E
3	26° 59' 8.506" N	88° 41' 42.331" E
4	26° 59' 13.293" N	88° 41' 42.000" E
5	26° 59' 15.698" N	88° 41' 42.791" E
6	26° 59' 17.046" N	88° 41' 43.290" E
7	26° 59' 14.225" N	88° 41' 43.348" E
8	26° 59' 14.018" N	88° 41' 43.386" E
9	26° 59' 13.842" N	88° 41' 43.369" E
10	26° 59' 11.558" N	88° 41' 43.814" E
11	26° 59' 11.382" N	88° 41' 43.833" E
12	26° 59' 10.207" N	88° 41' 43.807" E
13	26° 59' 9.303" N	88° 41' 43.696" E
14	26° 59' 8.260" N	88° 41' 43.741" E



POTENTIAL BLOCK KPG_GB_CHL_5 OF CHEL RIVER

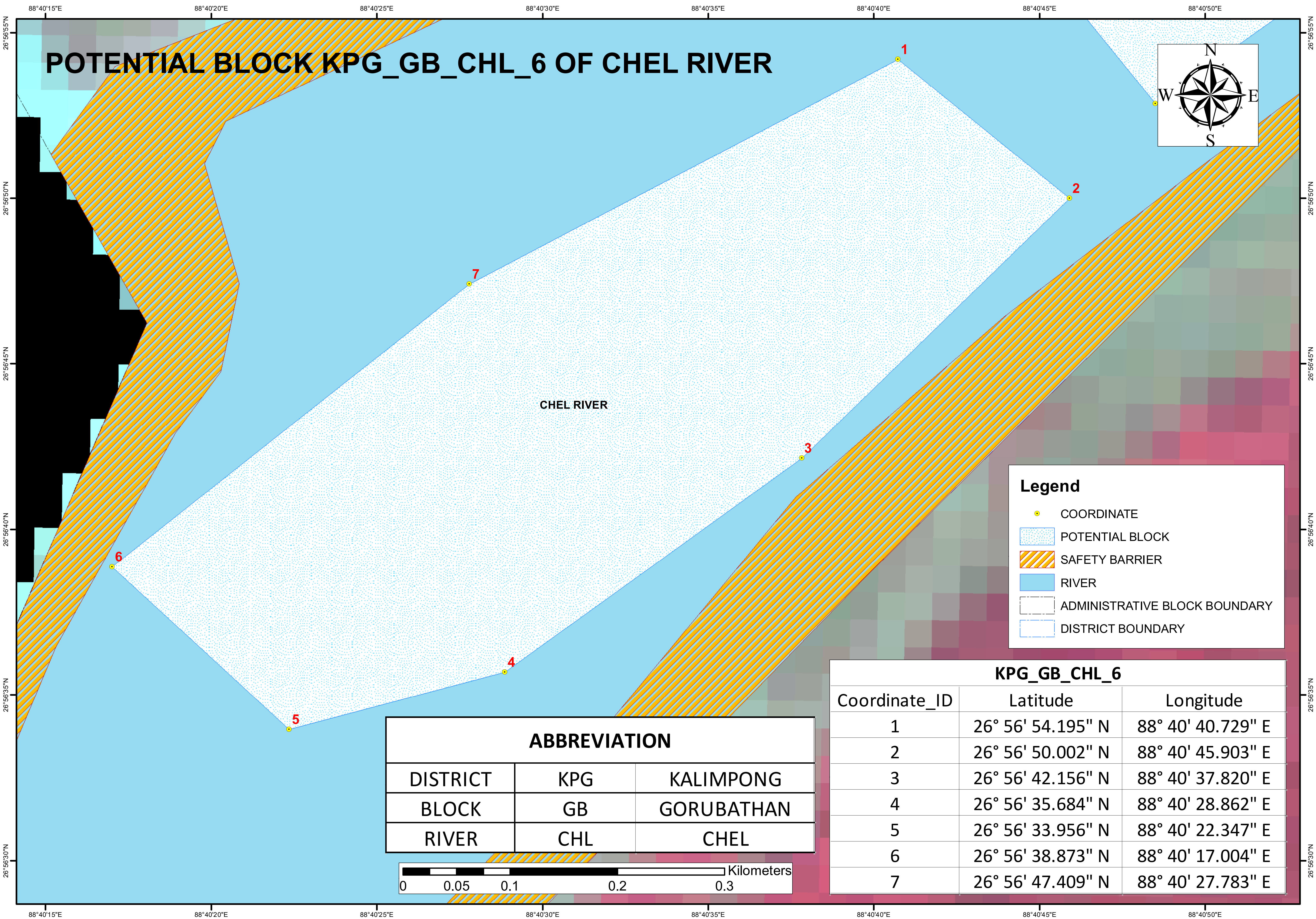


ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	CHL	CHEL

KPG_GB_CHL_5

Coordinate_ID	Latitude	Longitude
1	26° 56' 56.567" N	88° 40' 53.744" E
2	26° 56' 52.859" N	88° 40' 48.497" E
3	26° 56' 58.587" N	88° 40' 43.835" E
4	26° 56' 59.256" N	88° 40' 45.168" E
5	26° 57' 0.717" N	88° 40' 46.941" E
6	26° 57' 2.835" N	88° 40' 50.721" E
7	26° 57' 4.288" N	88° 40' 52.740" E
8	26° 57' 5.861" N	88° 40' 55.186" E
9	26° 57' 7.100" N	88° 40' 58.605" E
10	26° 57' 7.299" N	88° 40' 59.222" E
11	26° 57' 7.799" N	88° 41' 0.534" E
12	26° 57' 8.611" N	88° 41' 2.772" E
13	26° 57' 9.545" N	88° 41' 5.351" E
14	26° 57' 6.875" N	88° 41' 7.280" E

POTENTIAL BLOCK KPG_GB_CHL_6 OF CHEL RIVER



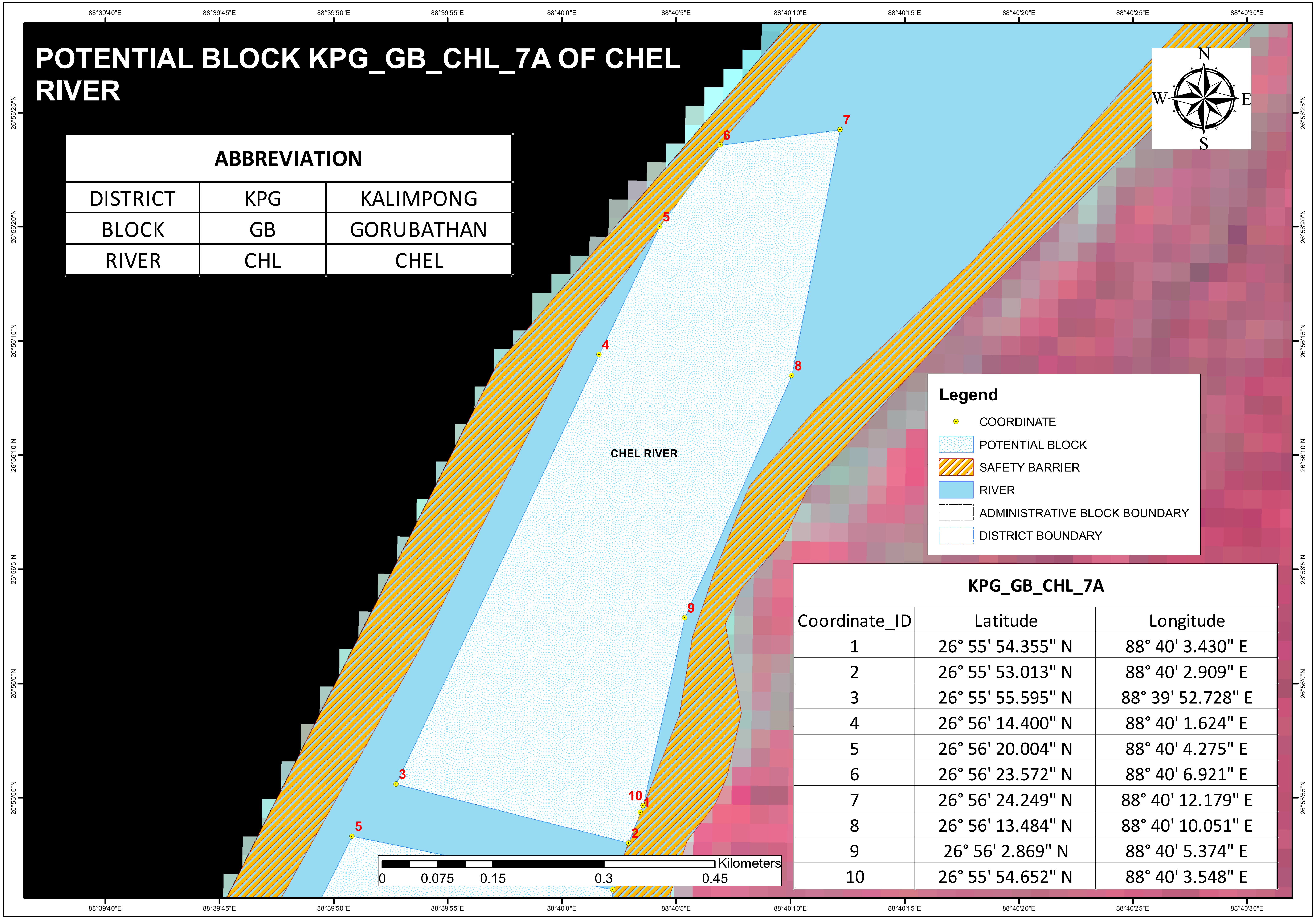
KPG_GB_CHL_6

Coordinate_ID	Latitude	Longitude
1	26° 56' 54.195" N	88° 40' 40.729" E
2	26° 56' 50.002" N	88° 40' 45.903" E
3	26° 56' 42.156" N	88° 40' 37.820" E
4	26° 56' 35.684" N	88° 40' 28.862" E
5	26° 56' 33.956" N	88° 40' 22.347" E
6	26° 56' 38.873" N	88° 40' 17.004" E
7	26° 56' 47.409" N	88° 40' 27.783" E

ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	CHL	CHEL

POTENTIAL BLOCK KPG_GB_CHL_7A OF CHEL RIVER



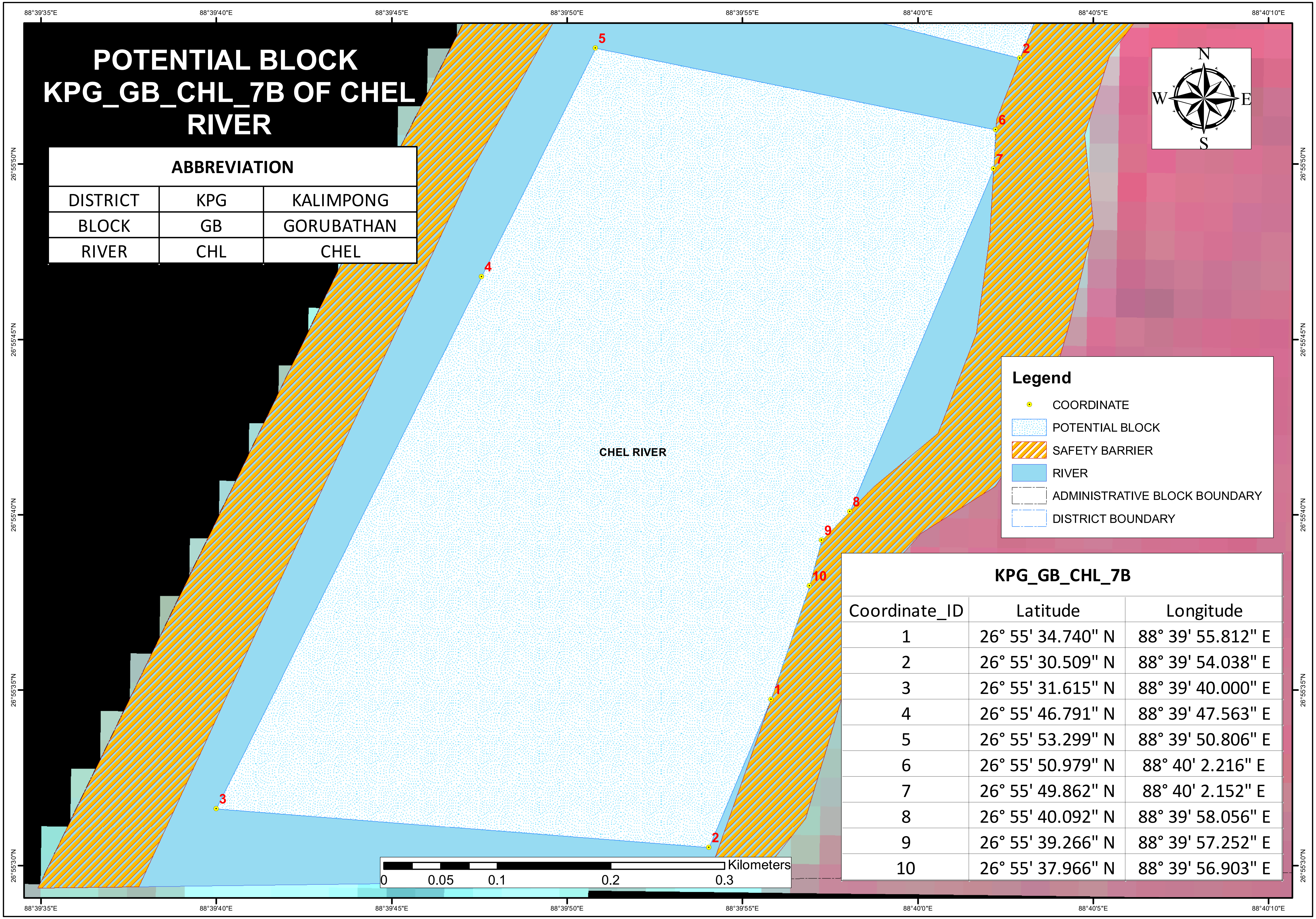
ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	CHL	CHEL

KPG_GB_CHL_7A

Coordinate_ID	Latitude	Longitude
1	26° 55' 54.355" N	88° 40' 3.430" E
2	26° 55' 53.013" N	88° 40' 2.909" E
3	26° 55' 55.595" N	88° 39' 52.728" E
4	26° 56' 14.400" N	88° 40' 1.624" E
5	26° 56' 20.004" N	88° 40' 4.275" E
6	26° 56' 23.572" N	88° 40' 6.921" E
7	26° 56' 24.249" N	88° 40' 12.179" E
8	26° 56' 13.484" N	88° 40' 10.051" E
9	26° 56' 2.869" N	88° 40' 5.374" E
10	26° 55' 54.652" N	88° 40' 3.548" E

POTENTIAL BLOCK KPG_GB_CHL_7B OF CHEL RIVER

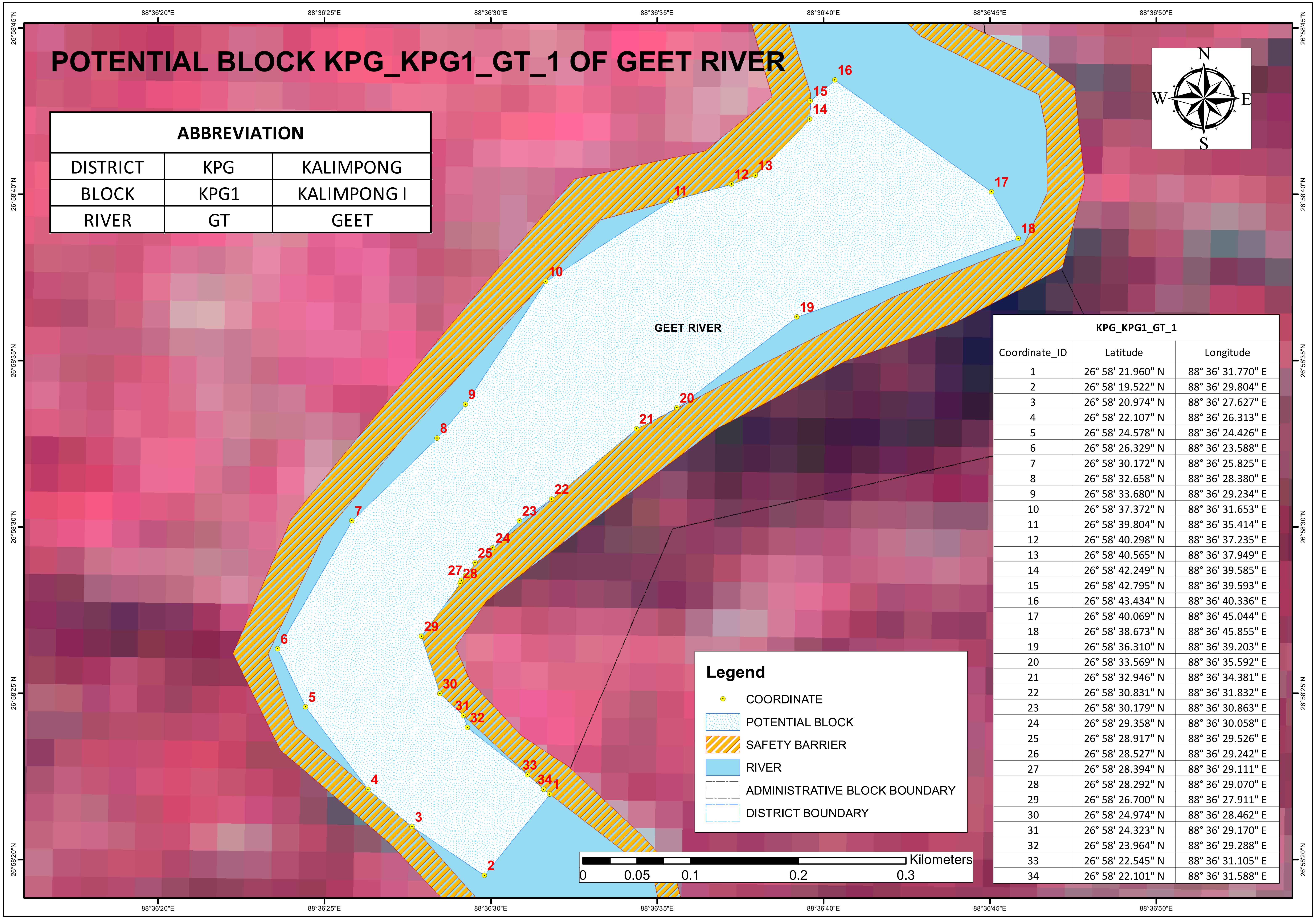
ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	CHL	CHEL



KPG_GB_CHL_7B		
Coordinate_ID	Latitude	Longitude
1	26° 55' 34.740" N	88° 39' 55.812" E
2	26° 55' 30.509" N	88° 39' 54.038" E
3	26° 55' 31.615" N	88° 39' 40.000" E
4	26° 55' 46.791" N	88° 39' 47.563" E
5	26° 55' 53.299" N	88° 39' 50.806" E
6	26° 55' 50.979" N	88° 40' 2.216" E
7	26° 55' 49.862" N	88° 40' 2.152" E
8	26° 55' 40.092" N	88° 39' 58.056" E
9	26° 55' 39.266" N	88° 39' 57.252" E
10	26° 55' 37.966" N	88° 39' 56.903" E

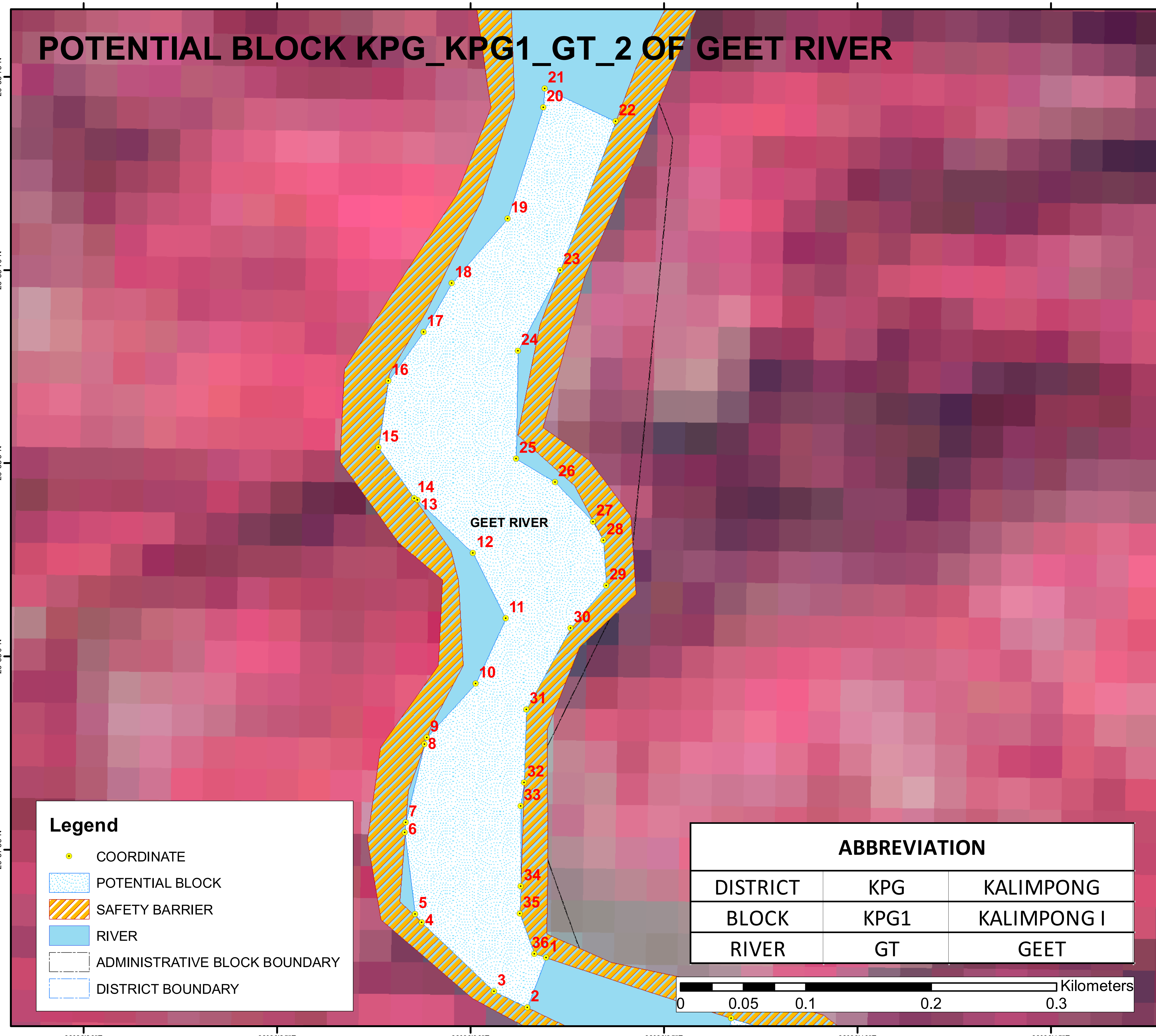
POTENTIAL BLOCK KPG_KPG1_GT_1 OF GEET RIVER

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	GT	GEET



KPG_KPG1_GT_1		
Coordinate_ID	Latitude	Longitude
1	26° 58' 21.960" N	88° 36' 31.770" E
2	26° 58' 19.522" N	88° 36' 29.804" E
3	26° 58' 20.974" N	88° 36' 27.627" E
4	26° 58' 22.107" N	88° 36' 26.313" E
5	26° 58' 24.578" N	88° 36' 24.426" E
6	26° 58' 26.329" N	88° 36' 23.588" E
7	26° 58' 30.172" N	88° 36' 25.825" E
8	26° 58' 32.658" N	88° 36' 28.380" E
9	26° 58' 33.680" N	88° 36' 29.234" E
10	26° 58' 37.372" N	88° 36' 31.653" E
11	26° 58' 39.804" N	88° 36' 35.414" E
12	26° 58' 40.298" N	88° 36' 37.235" E
13	26° 58' 40.565" N	88° 36' 37.949" E
14	26° 58' 42.249" N	88° 36' 39.585" E
15	26° 58' 42.795" N	88° 36' 39.593" E
16	26° 58' 43.434" N	88° 36' 40.336" E
17	26° 58' 40.069" N	88° 36' 45.044" E
18	26° 58' 38.673" N	88° 36' 45.855" E
19	26° 58' 36.310" N	88° 36' 39.203" E
20	26° 58' 33.569" N	88° 36' 35.592" E
21	26° 58' 32.946" N	88° 36' 34.381" E
22	26° 58' 30.831" N	88° 36' 31.832" E
23	26° 58' 30.179" N	88° 36' 30.863" E
24	26° 58' 29.358" N	88° 36' 30.058" E
25	26° 58' 28.917" N	88° 36' 29.526" E
26	26° 58' 28.527" N	88° 36' 29.242" E
27	26° 58' 28.394" N	88° 36' 29.111" E
28	26° 58' 28.292" N	88° 36' 29.070" E
29	26° 58' 26.700" N	88° 36' 27.911" E
30	26° 58' 24.974" N	88° 36' 28.462" E
31	26° 58' 24.323" N	88° 36' 29.170" E
32	26° 58' 23.964" N	88° 36' 29.288" E
33	26° 58' 22.545" N	88° 36' 31.105" E
34	26° 58' 22.101" N	88° 36' 31.588" E

POTENTIAL BLOCK KPG_KPG1_GT_2 OF GEET RIVER

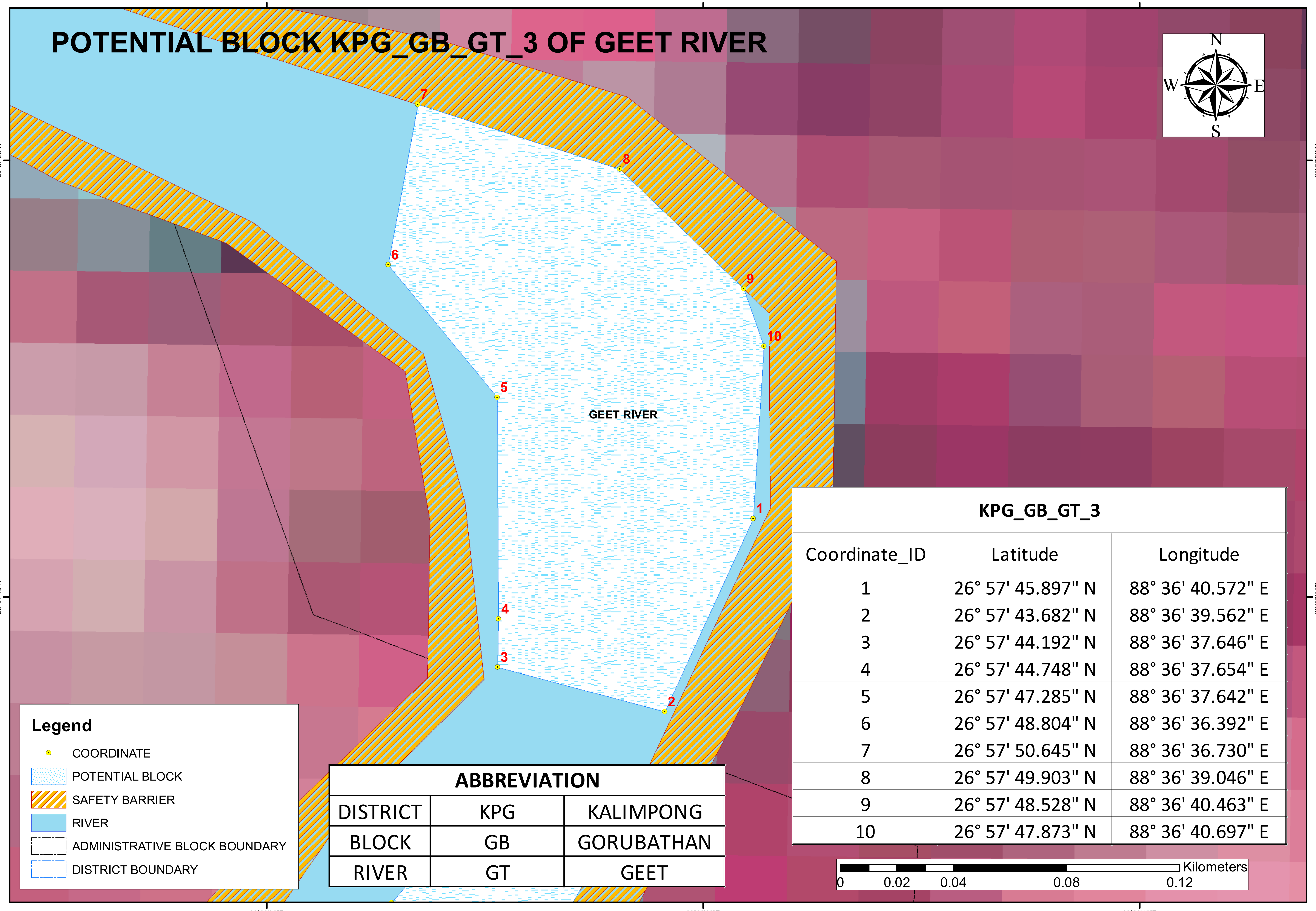


ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	GT	GEET

KPG_KPG1_GT_2

Coordinate_ID	Latitude	Longitude
1	26° 57' 52.205" N	88° 36' 31.955" E
2	26° 57' 50.917" N	88° 36' 31.469" E
3	26° 57' 51.332" N	88° 36' 30.608" E
4	26° 57' 53.118" N	88° 36' 28.738" E
5	26° 57' 53.342" N	88° 36' 28.565" E
6	26° 57' 55.443" N	88° 36' 28.299" E
7	26° 57' 55.699" N	88° 36' 28.318" E
8	26° 57' 57.734" N	88° 36' 28.811" E
9	26° 57' 57.903" N	88° 36' 28.871" E
10	26° 57' 59.300" N	88° 36' 30.136" E
11	26° 58' 0.989" N	88° 36' 30.904" E
12	26° 58' 2.675" N	88° 36' 30.064" E
13	26° 58' 4.046" N	88° 36' 28.621" E
14	26° 58' 4.095" N	88° 36' 28.537" E
15	26° 58' 5.398" N	88° 36' 27.623" E
16	26° 58' 7.121" N	88° 36' 27.871" E
17	26° 58' 8.386" N	88° 36' 28.778" E
18	26° 58' 9.646" N	88° 36' 29.516" E
19	26° 58' 11.327" N	88° 36' 30.955" E
20	26° 58' 14.197" N	88° 36' 31.883" E
21	26° 58' 14.688" N	88° 36' 31.919" E
22	26° 58' 13.840" N	88° 36' 33.752" E
23	26° 58' 9.992" N	88° 36' 32.315" E
24	26° 58' 7.907" N	88° 36' 31.218" E
25	26° 58' 5.113" N	88° 36' 31.179" E
26	26° 58' 4.500" N	88° 36' 32.177" E
27	26° 58' 3.488" N	88° 36' 33.168" E
28	26° 58' 2.993" N	88° 36' 33.427" E
29	26° 58' 1.832" N	88° 36' 33.507" E
30	26° 58' 0.724" N	88° 36' 32.579" E
31	26° 57' 58.631" N	88° 36' 31.446" E
32	26° 57' 56.738" N	88° 36' 31.385" E
33	26° 57' 56.127" N	88° 36' 31.291" E
34	26° 57' 54.055" N	88° 36' 31.298" E
35	26° 57' 53.345" N	88° 36' 31.275" E
36	26° 57' 52.309" N	88° 36' 31.644" E

POTENTIAL BLOCK KPG_GB_GT_3 OF GEET RIVER



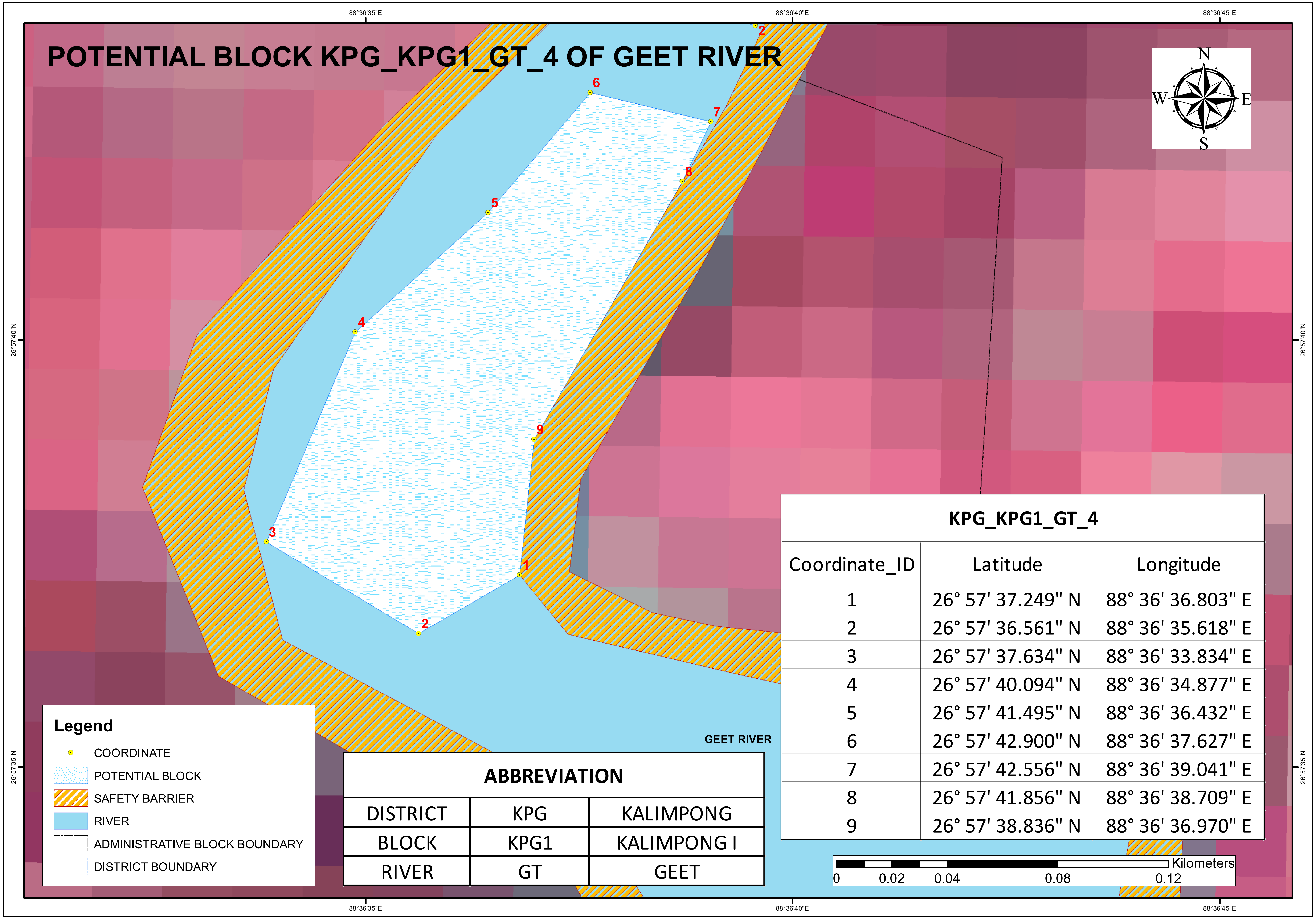
KPG_GB_GT_3

Coordinate_ID	Latitude	Longitude
1	26° 57' 45.897" N	88° 36' 40.572" E
2	26° 57' 43.682" N	88° 36' 39.562" E
3	26° 57' 44.192" N	88° 36' 37.646" E
4	26° 57' 44.748" N	88° 36' 37.654" E
5	26° 57' 47.285" N	88° 36' 37.642" E
6	26° 57' 48.804" N	88° 36' 36.392" E
7	26° 57' 50.645" N	88° 36' 36.730" E
8	26° 57' 49.903" N	88° 36' 39.046" E
9	26° 57' 48.528" N	88° 36' 40.463" E
10	26° 57' 47.873" N	88° 36' 40.697" E

ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	GT	GEET

POTENTIAL BLOCK KPG_KPG1_GT_4 OF GEET RIVER

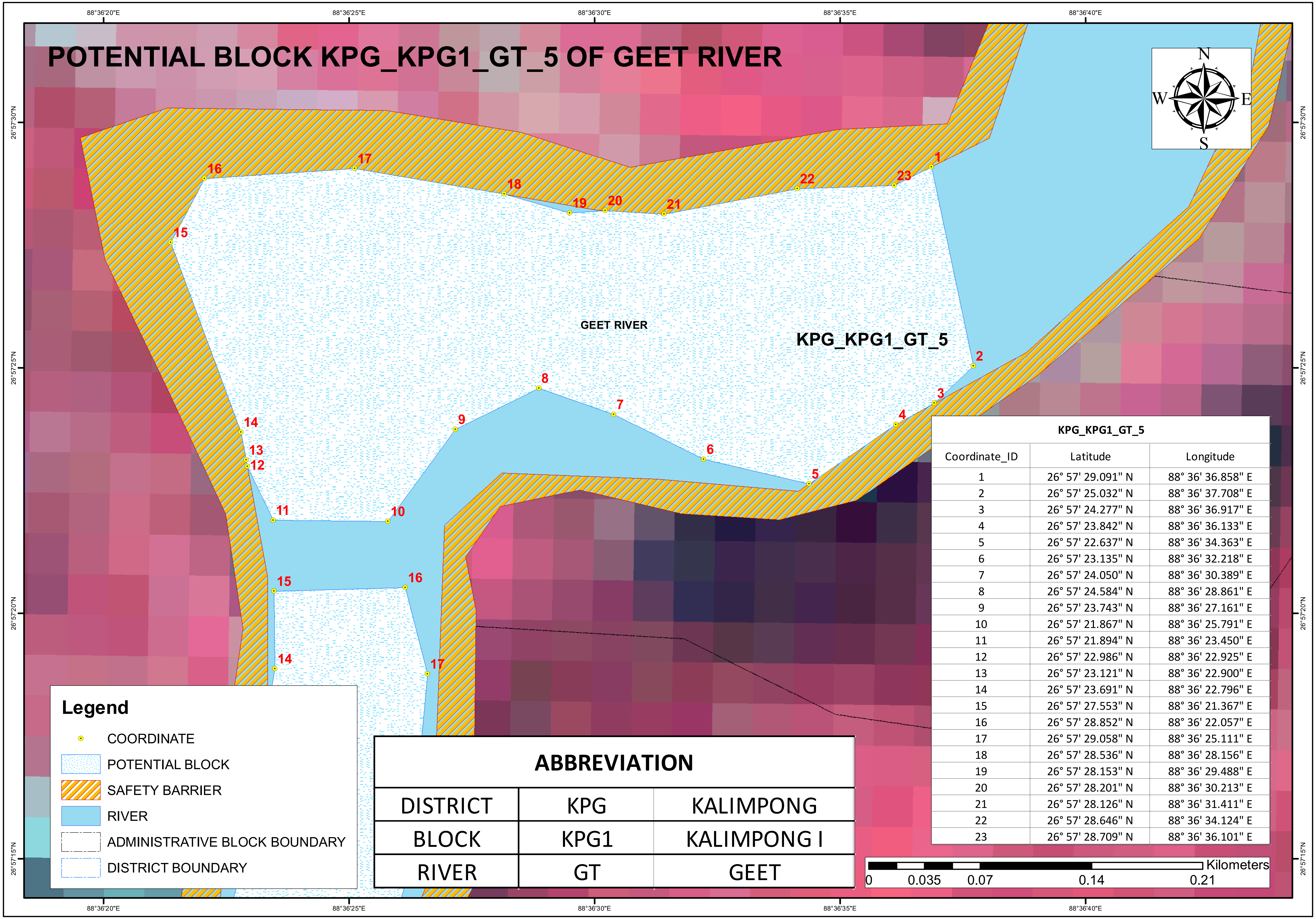


ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	GT	GEET

KPG_KPG1_GT_4

Coordinate_ID	Latitude	Longitude
1	26° 57' 37.249" N	88° 36' 36.803" E
2	26° 57' 36.561" N	88° 36' 35.618" E
3	26° 57' 37.634" N	88° 36' 33.834" E
4	26° 57' 40.094" N	88° 36' 34.877" E
5	26° 57' 41.495" N	88° 36' 36.432" E
6	26° 57' 42.900" N	88° 36' 37.627" E
7	26° 57' 42.556" N	88° 36' 39.041" E
8	26° 57' 41.856" N	88° 36' 38.709" E
9	26° 57' 38.836" N	88° 36' 36.970" E

POTENTIAL BLOCK KPG_KPG1_GT_5 OF GEET RIVER



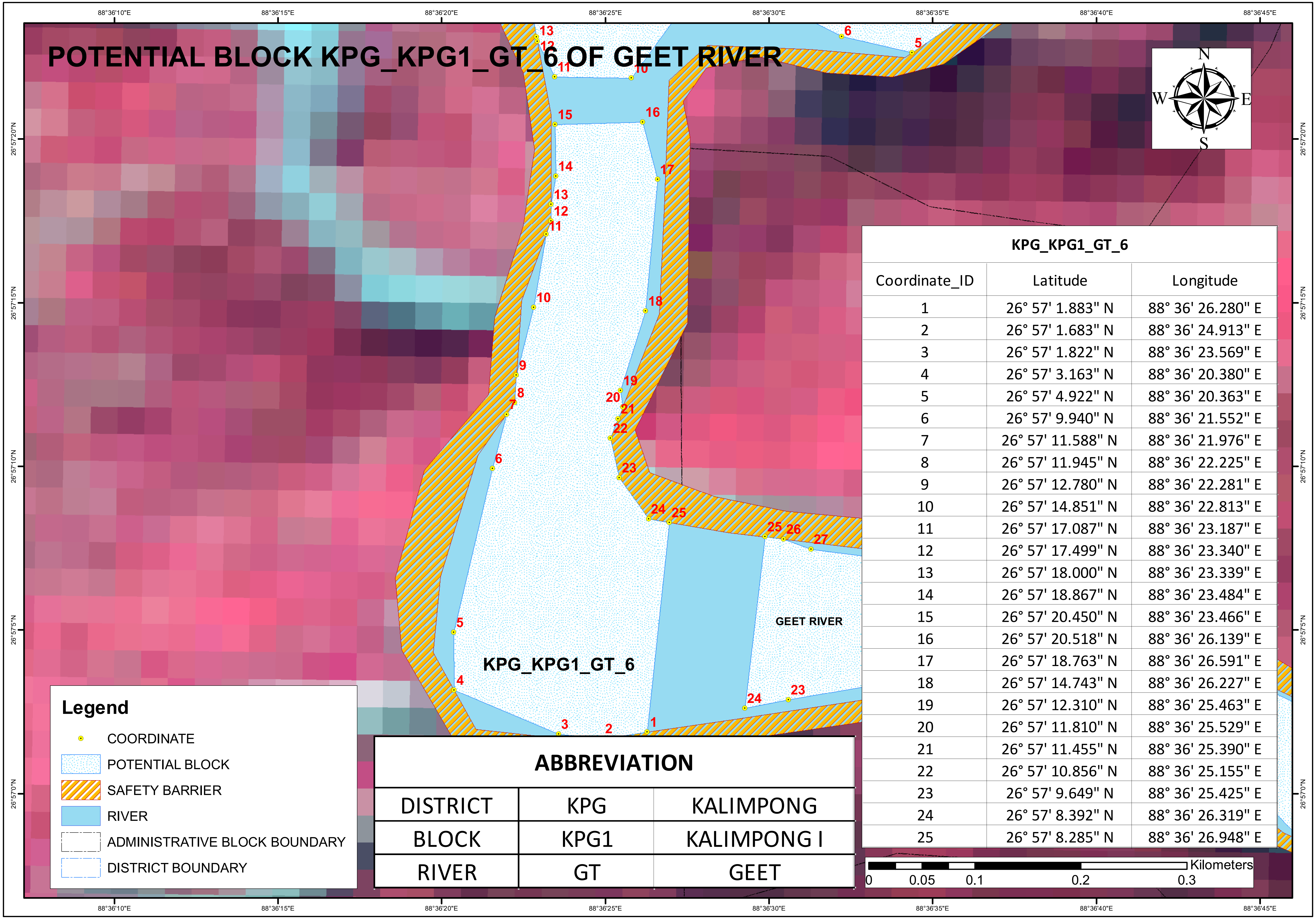
KPG_KPG1_GT_5

Coordinate_ID	Latitude	Longitude
1	26° 57' 29.091" N	88° 36' 36.858" E
2	26° 57' 25.032" N	88° 36' 37.708" E
3	26° 57' 24.277" N	88° 36' 36.917" E
4	26° 57' 23.842" N	88° 36' 36.133" E
5	26° 57' 22.637" N	88° 36' 34.363" E
6	26° 57' 23.135" N	88° 36' 32.218" E
7	26° 57' 24.050" N	88° 36' 30.389" E
8	26° 57' 24.584" N	88° 36' 28.861" E
9	26° 57' 23.743" N	88° 36' 27.161" E
10	26° 57' 21.867" N	88° 36' 25.791" E
11	26° 57' 21.894" N	88° 36' 23.450" E
12	26° 57' 22.986" N	88° 36' 22.925" E
13	26° 57' 23.121" N	88° 36' 22.900" E
14	26° 57' 23.691" N	88° 36' 22.796" E
15	26° 57' 27.553" N	88° 36' 21.367" E
16	26° 57' 28.852" N	88° 36' 22.057" E
17	26° 57' 29.058" N	88° 36' 25.111" E
18	26° 57' 28.536" N	88° 36' 28.156" E
19	26° 57' 28.153" N	88° 36' 29.488" E
20	26° 57' 28.201" N	88° 36' 30.213" E
21	26° 57' 28.126" N	88° 36' 31.411" E
22	26° 57' 28.646" N	88° 36' 34.124" E
23	26° 57' 28.709" N	88° 36' 36.101" E

ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	GT	GEET

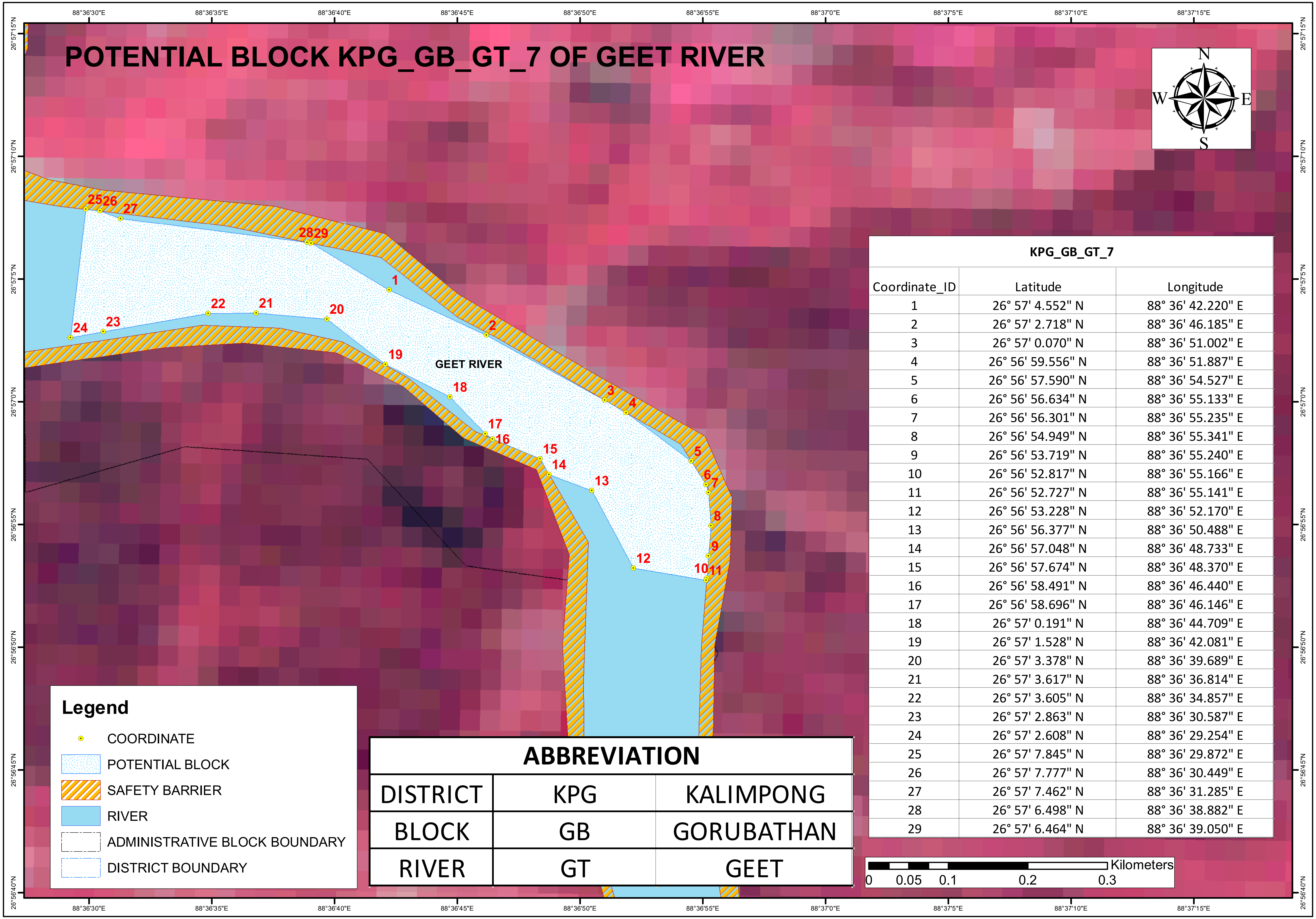
POTENTIAL BLOCK KPG_KPG1_GT_6 OF GEET RIVER



KPG_KPG1_GT_6		
Coordinate_ID	Latitude	Longitude
1	26° 57' 1.883" N	88° 36' 26.280" E
2	26° 57' 1.683" N	88° 36' 24.913" E
3	26° 57' 1.822" N	88° 36' 23.569" E
4	26° 57' 3.163" N	88° 36' 20.380" E
5	26° 57' 4.922" N	88° 36' 20.363" E
6	26° 57' 9.940" N	88° 36' 21.552" E
7	26° 57' 11.588" N	88° 36' 21.976" E
8	26° 57' 11.945" N	88° 36' 22.225" E
9	26° 57' 12.780" N	88° 36' 22.281" E
10	26° 57' 14.851" N	88° 36' 22.813" E
11	26° 57' 17.087" N	88° 36' 23.187" E
12	26° 57' 17.499" N	88° 36' 23.340" E
13	26° 57' 18.000" N	88° 36' 23.339" E
14	26° 57' 18.867" N	88° 36' 23.484" E
15	26° 57' 20.450" N	88° 36' 23.466" E
16	26° 57' 20.518" N	88° 36' 26.139" E
17	26° 57' 18.763" N	88° 36' 26.591" E
18	26° 57' 14.743" N	88° 36' 26.227" E
19	26° 57' 12.310" N	88° 36' 25.463" E
20	26° 57' 11.810" N	88° 36' 25.529" E
21	26° 57' 11.455" N	88° 36' 25.390" E
22	26° 57' 10.856" N	88° 36' 25.155" E
23	26° 57' 9.649" N	88° 36' 25.425" E
24	26° 57' 8.392" N	88° 36' 26.319" E
25	26° 57' 8.285" N	88° 36' 26.948" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	GT	GEET

POTENTIAL BLOCK KPG_GB_GT_7 OF GEET RIVER

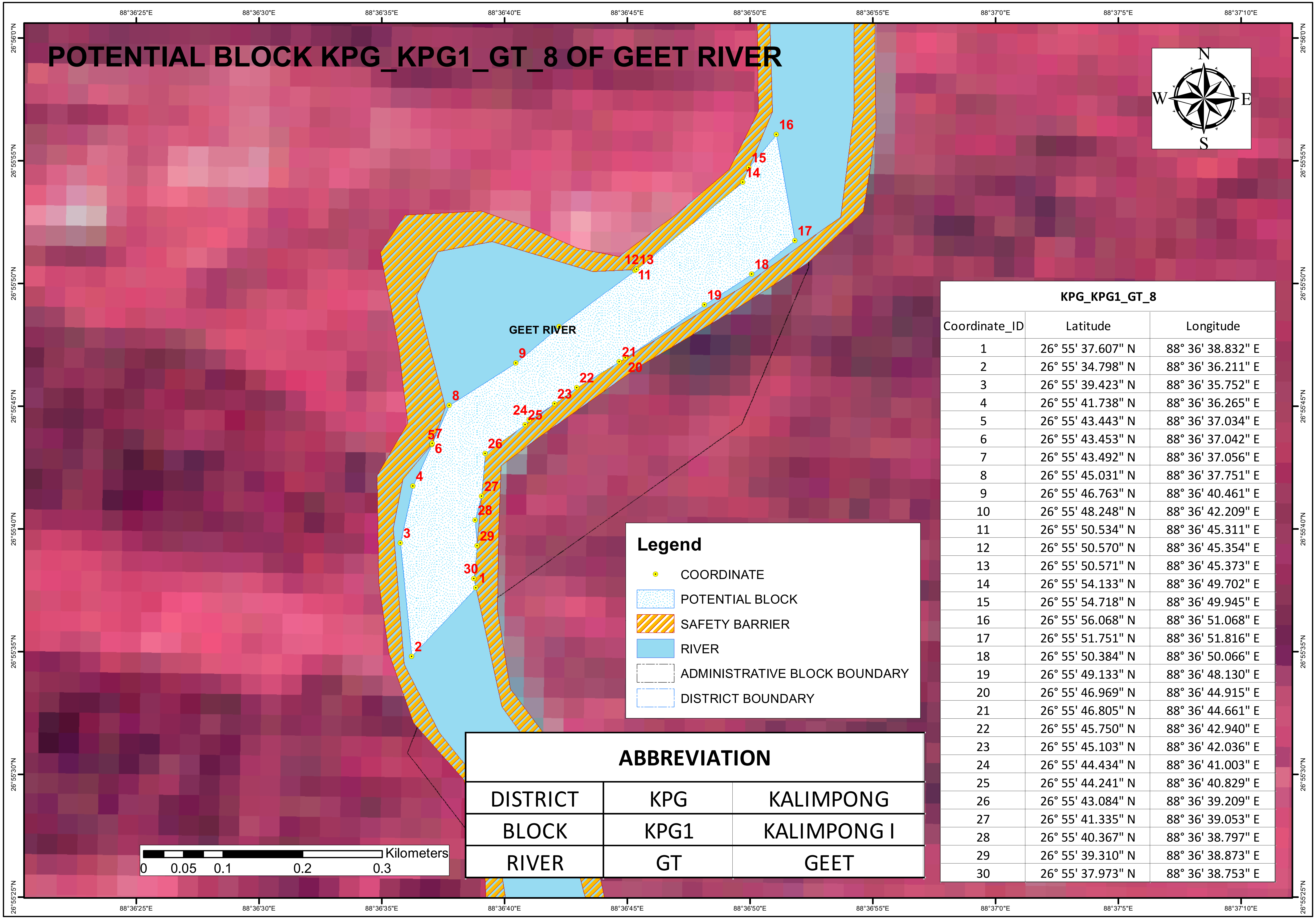


ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	GT	GEET

KPG_GB_GT_7

Coordinate_ID	Latitude	Longitude
1	26° 57' 4.552" N	88° 36' 42.220" E
2	26° 57' 2.718" N	88° 36' 46.185" E
3	26° 57' 0.070" N	88° 36' 51.002" E
4	26° 56' 59.556" N	88° 36' 51.887" E
5	26° 56' 57.590" N	88° 36' 54.527" E
6	26° 56' 56.634" N	88° 36' 55.133" E
7	26° 56' 56.301" N	88° 36' 55.235" E
8	26° 56' 54.949" N	88° 36' 55.341" E
9	26° 56' 53.719" N	88° 36' 55.240" E
10	26° 56' 52.817" N	88° 36' 55.166" E
11	26° 56' 52.727" N	88° 36' 55.141" E
12	26° 56' 53.228" N	88° 36' 52.170" E
13	26° 56' 56.377" N	88° 36' 50.488" E
14	26° 56' 57.048" N	88° 36' 48.733" E
15	26° 56' 57.674" N	88° 36' 48.370" E
16	26° 56' 58.491" N	88° 36' 46.440" E
17	26° 56' 58.696" N	88° 36' 46.146" E
18	26° 57' 0.191" N	88° 36' 44.709" E
19	26° 57' 1.528" N	88° 36' 42.081" E
20	26° 57' 3.378" N	88° 36' 39.689" E
21	26° 57' 3.617" N	88° 36' 36.814" E
22	26° 57' 3.605" N	88° 36' 34.857" E
23	26° 57' 2.863" N	88° 36' 30.587" E
24	26° 57' 2.608" N	88° 36' 29.254" E
25	26° 57' 7.845" N	88° 36' 29.872" E
26	26° 57' 7.777" N	88° 36' 30.449" E
27	26° 57' 7.462" N	88° 36' 31.285" E
28	26° 57' 6.498" N	88° 36' 38.882" E
29	26° 57' 6.464" N	88° 36' 39.050" E

POTENTIAL BLOCK KPG_KPG1_GT_8 OF GEET RIVER



KPG_KPG1_GT_8

Coordinate_ID	Latitude	Longitude
1	26° 55' 37.607" N	88° 36' 38.832" E
2	26° 55' 34.798" N	88° 36' 36.211" E
3	26° 55' 39.423" N	88° 36' 35.752" E
4	26° 55' 41.738" N	88° 36' 36.265" E
5	26° 55' 43.443" N	88° 36' 37.034" E
6	26° 55' 43.453" N	88° 36' 37.042" E
7	26° 55' 43.492" N	88° 36' 37.056" E
8	26° 55' 45.031" N	88° 36' 37.751" E
9	26° 55' 46.763" N	88° 36' 40.461" E
10	26° 55' 48.248" N	88° 36' 42.209" E
11	26° 55' 50.534" N	88° 36' 45.311" E
12	26° 55' 50.570" N	88° 36' 45.354" E
13	26° 55' 50.571" N	88° 36' 45.373" E
14	26° 55' 54.133" N	88° 36' 49.702" E
15	26° 55' 54.718" N	88° 36' 49.945" E
16	26° 55' 56.068" N	88° 36' 51.068" E
17	26° 55' 51.751" N	88° 36' 51.816" E
18	26° 55' 50.384" N	88° 36' 50.066" E
19	26° 55' 49.133" N	88° 36' 48.130" E
20	26° 55' 46.969" N	88° 36' 44.915" E
21	26° 55' 46.805" N	88° 36' 44.661" E
22	26° 55' 45.750" N	88° 36' 42.940" E
23	26° 55' 45.103" N	88° 36' 42.036" E
24	26° 55' 44.434" N	88° 36' 41.003" E
25	26° 55' 44.241" N	88° 36' 40.829" E
26	26° 55' 43.084" N	88° 36' 39.209" E
27	26° 55' 41.335" N	88° 36' 39.053" E
28	26° 55' 40.367" N	88° 36' 38.797" E
29	26° 55' 39.310" N	88° 36' 38.873" E
30	26° 55' 37.973" N	88° 36' 38.753" E

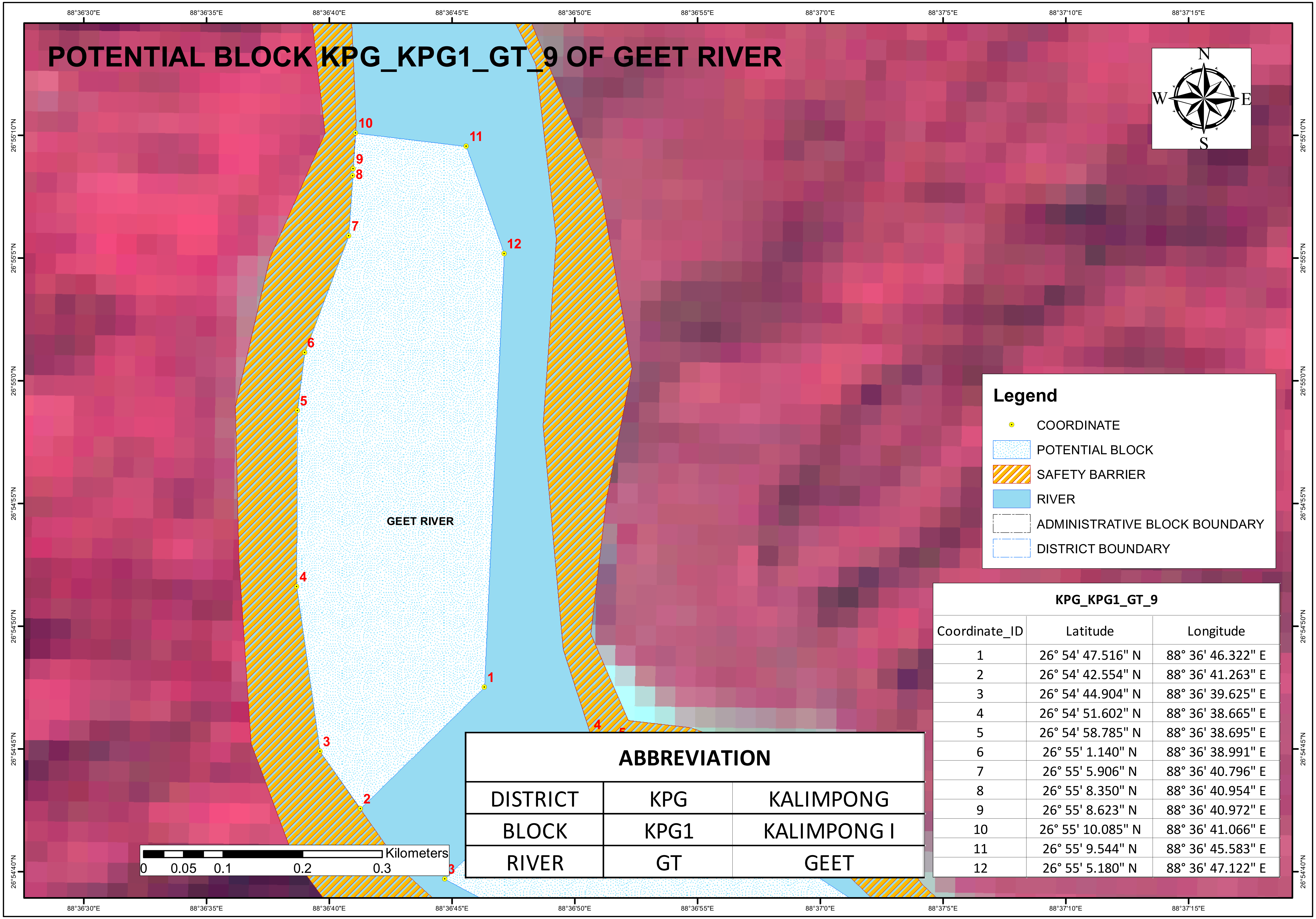
Legend

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	GT	GEET

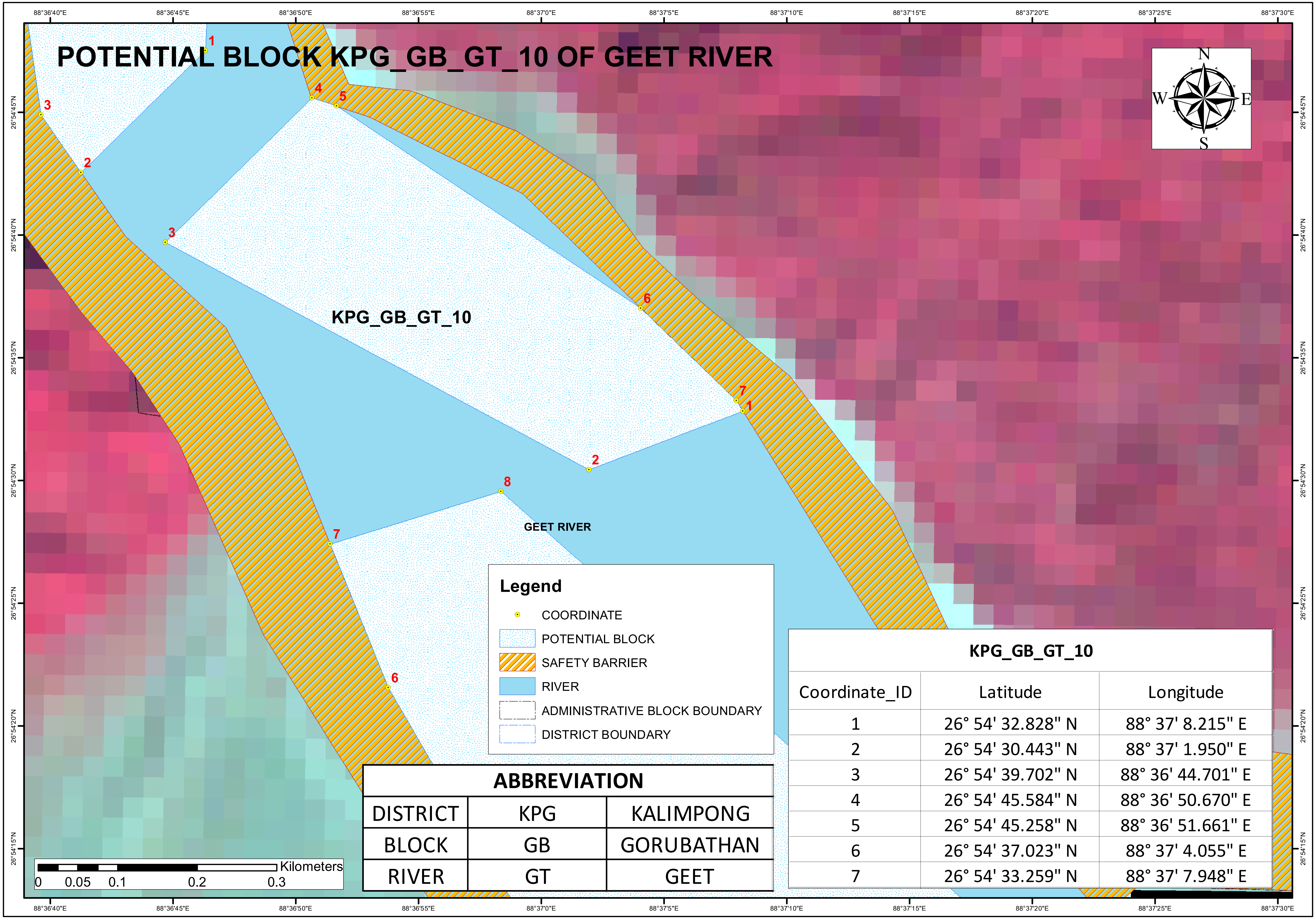
POTENTIAL BLOCK KPG_KPG1_GT_9 OF GEET RIVER



KPG_KPG1_GT_9		
Coordinate_ID	Latitude	Longitude
1	26° 54' 47.516" N	88° 36' 46.322" E
2	26° 54' 42.554" N	88° 36' 41.263" E
3	26° 54' 44.904" N	88° 36' 39.625" E
4	26° 54' 51.602" N	88° 36' 38.665" E
5	26° 54' 58.785" N	88° 36' 38.695" E
6	26° 55' 1.140" N	88° 36' 38.991" E
7	26° 55' 5.906" N	88° 36' 40.796" E
8	26° 55' 8.350" N	88° 36' 40.954" E
9	26° 55' 8.623" N	88° 36' 40.972" E
10	26° 55' 10.085" N	88° 36' 41.066" E
11	26° 55' 9.544" N	88° 36' 45.583" E
12	26° 55' 5.180" N	88° 36' 47.122" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	GT	GEET

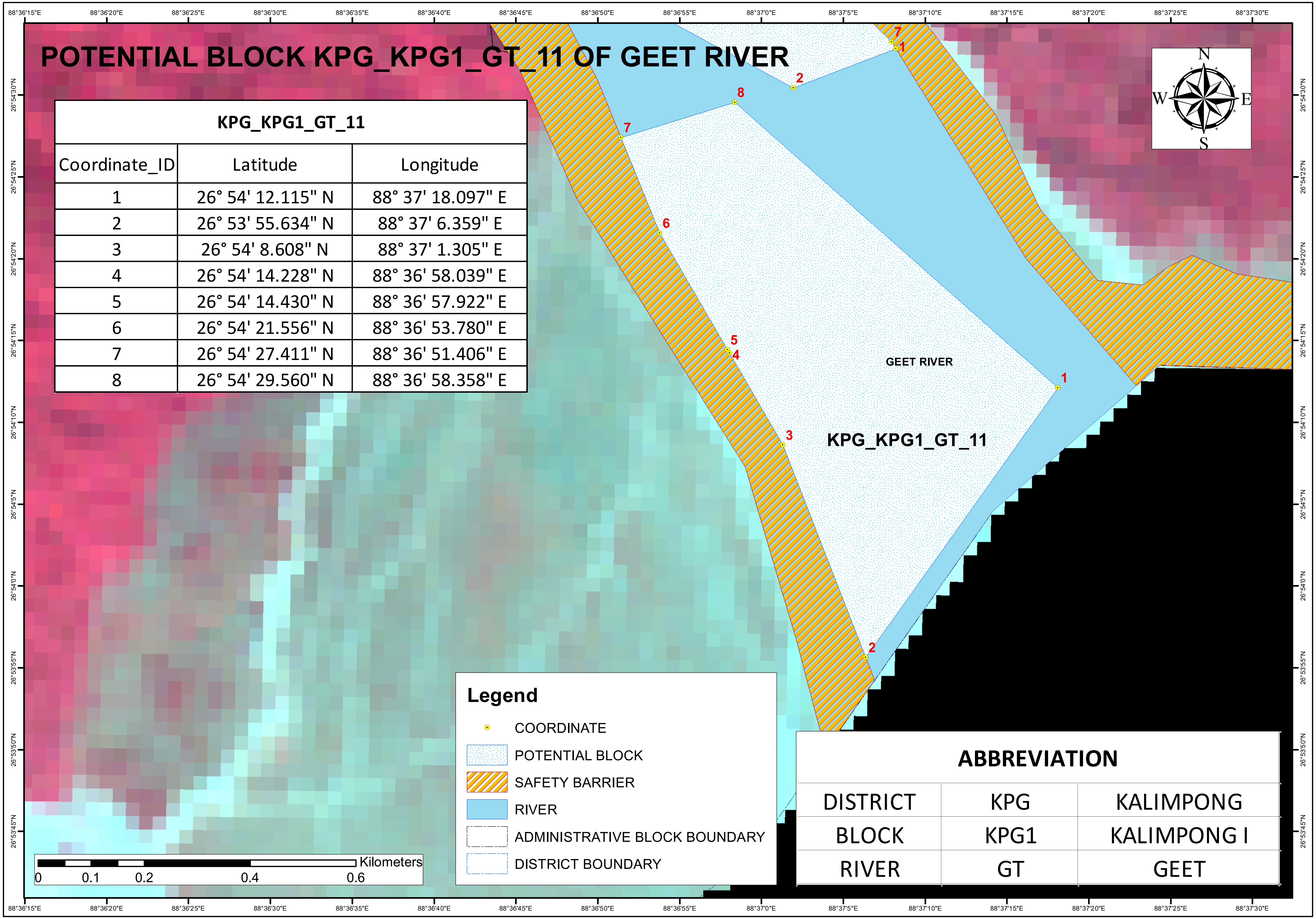
POTENTIAL BLOCK KPG_GB_GT_10 OF GEET RIVER



KPG_GB_GT_10		
Coordinate_ID	Latitude	Longitude
1	26° 54' 32.828" N	88° 37' 8.215" E
2	26° 54' 30.443" N	88° 37' 1.950" E
3	26° 54' 39.702" N	88° 36' 44.701" E
4	26° 54' 45.584" N	88° 36' 50.670" E
5	26° 54' 45.258" N	88° 36' 51.661" E
6	26° 54' 37.023" N	88° 37' 4.055" E
7	26° 54' 33.259" N	88° 37' 7.948" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	GB	GORUBATHAN
RIVER	GT	GEET

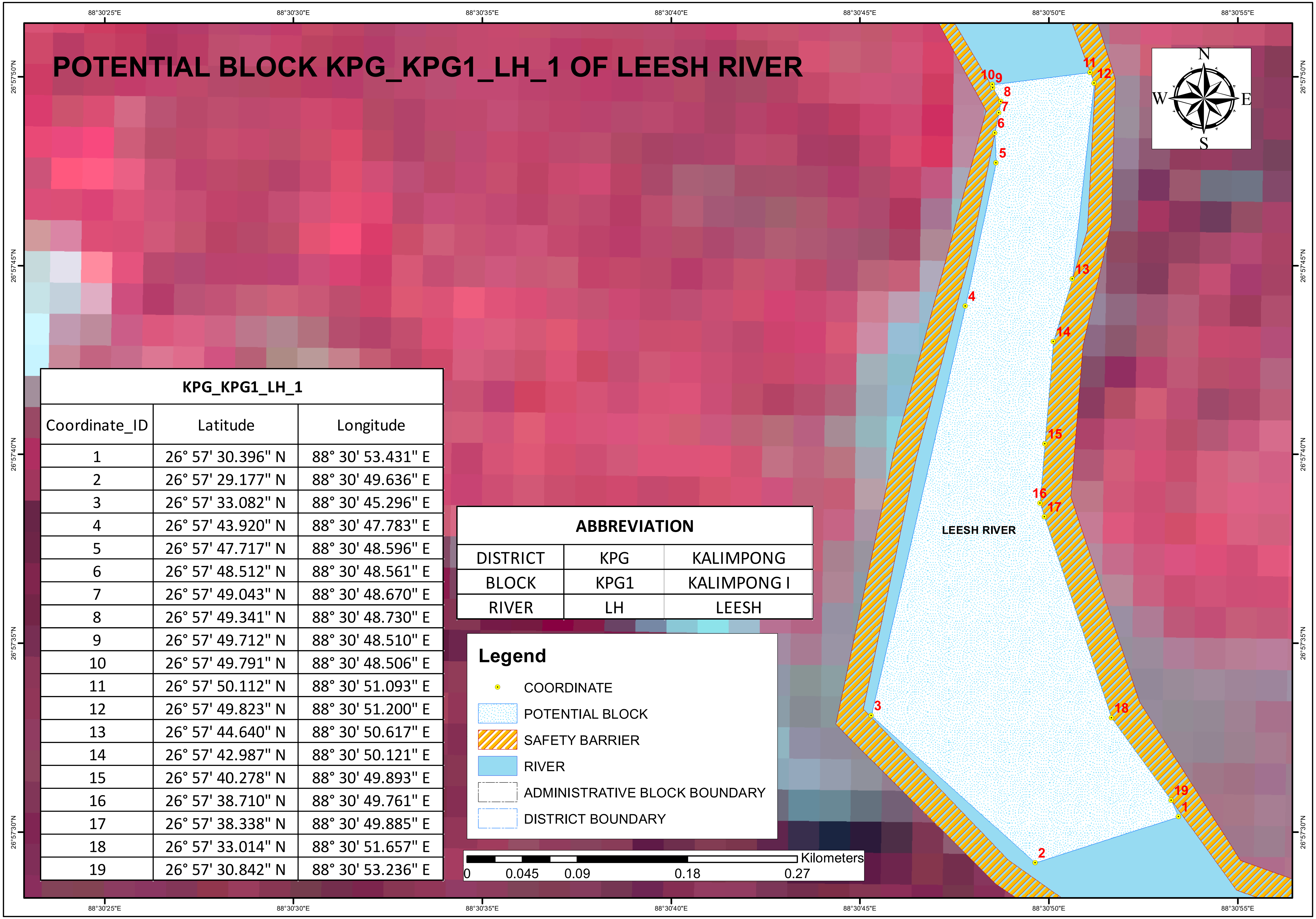
POTENTIAL BLOCK KPG_KPG1_GT_11 OF GEET RIVER



KPG_KPG1_GT_11		
Coordinate_ID	Latitude	Longitude
1	26° 54' 12.115" N	88° 37' 18.097" E
2	26° 53' 55.634" N	88° 37' 6.359" E
3	26° 54' 8.608" N	88° 37' 1.305" E
4	26° 54' 14.228" N	88° 36' 58.039" E
5	26° 54' 14.430" N	88° 36' 57.922" E
6	26° 54' 21.556" N	88° 36' 53.780" E
7	26° 54' 27.411" N	88° 36' 51.406" E
8	26° 54' 29.560" N	88° 36' 58.358" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	GT	GEET

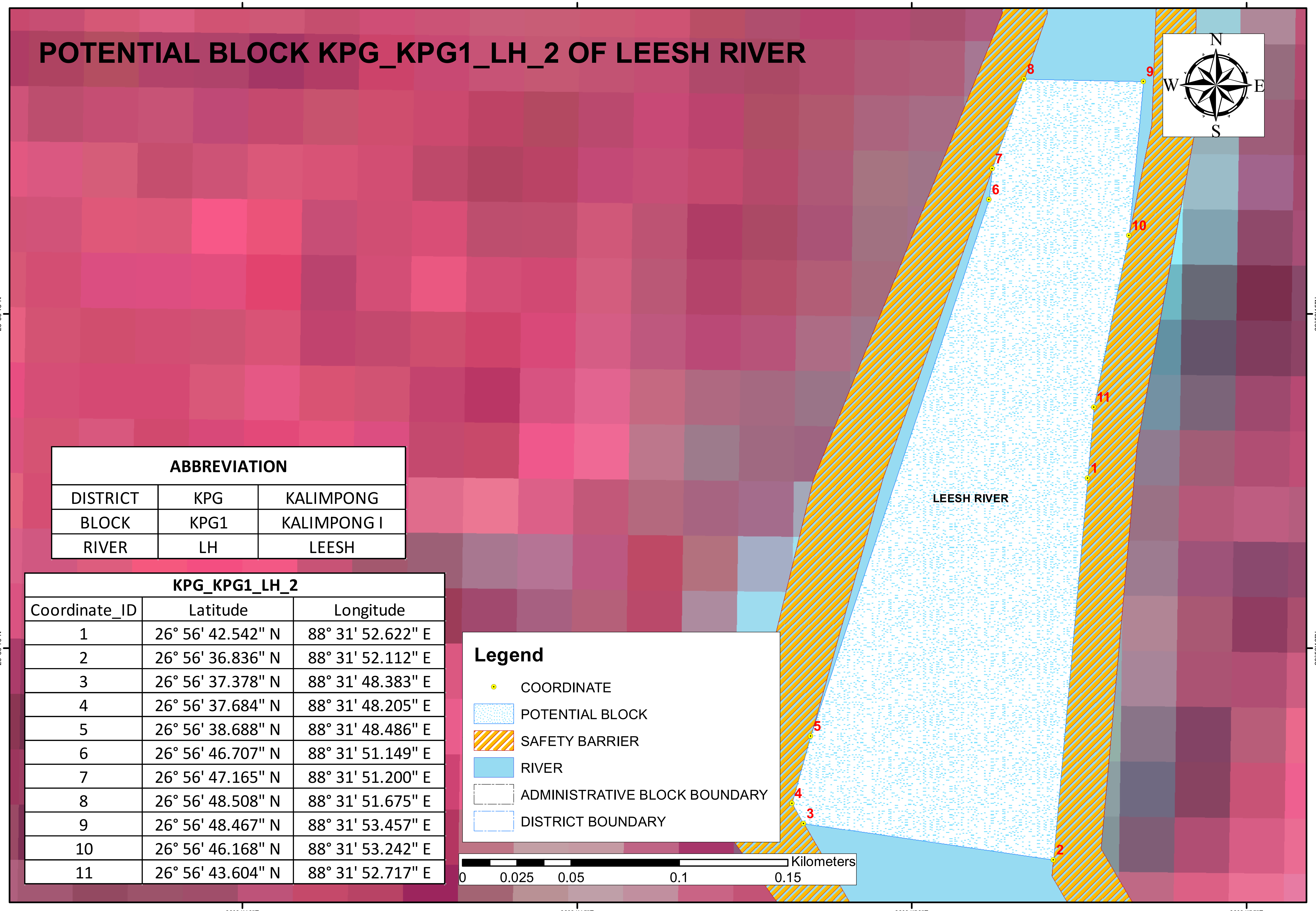
POTENTIAL BLOCK KPG_KPG1_LH_1 OF LEESH RIVER



KPG_KPG1_LH_1		
Coordinate_ID	Latitude	Longitude
1	26° 57' 30.396" N	88° 30' 53.431" E
2	26° 57' 29.177" N	88° 30' 49.636" E
3	26° 57' 33.082" N	88° 30' 45.296" E
4	26° 57' 43.920" N	88° 30' 47.783" E
5	26° 57' 47.717" N	88° 30' 48.596" E
6	26° 57' 48.512" N	88° 30' 48.561" E
7	26° 57' 49.043" N	88° 30' 48.670" E
8	26° 57' 49.341" N	88° 30' 48.730" E
9	26° 57' 49.712" N	88° 30' 48.510" E
10	26° 57' 49.791" N	88° 30' 48.506" E
11	26° 57' 50.112" N	88° 30' 51.093" E
12	26° 57' 49.823" N	88° 30' 51.200" E
13	26° 57' 44.640" N	88° 30' 50.617" E
14	26° 57' 42.987" N	88° 30' 50.121" E
15	26° 57' 40.278" N	88° 30' 49.893" E
16	26° 57' 38.710" N	88° 30' 49.761" E
17	26° 57' 38.338" N	88° 30' 49.885" E
18	26° 57' 33.014" N	88° 30' 51.657" E
19	26° 57' 30.842" N	88° 30' 53.236" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

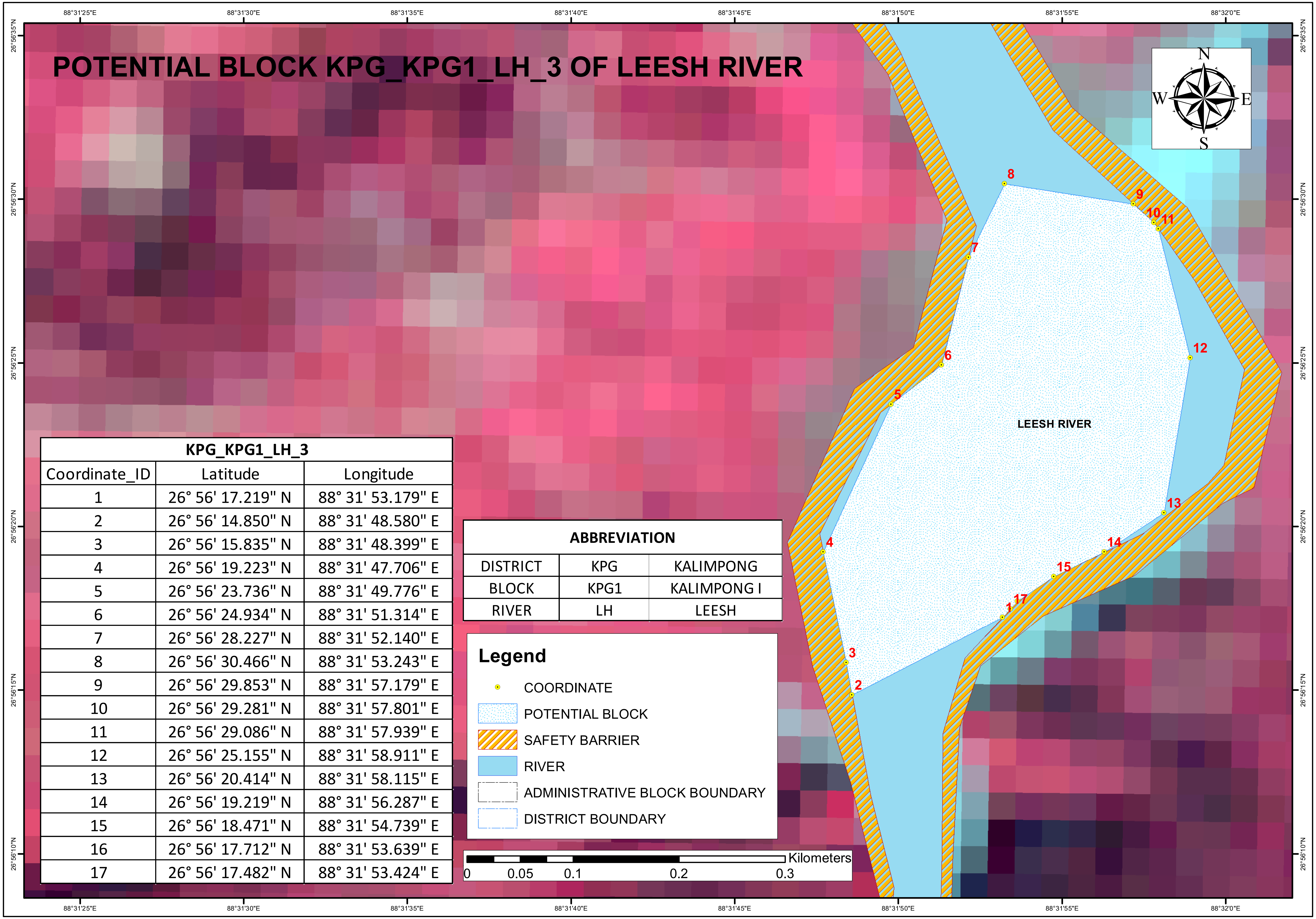
POTENTIAL BLOCK KPG_KPG1_LH_2 OF LEESH RIVER



ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

KPG_KPG1_LH_2		
Coordinate_ID	Latitude	Longitude
1	26° 56' 42.542" N	88° 31' 52.622" E
2	26° 56' 36.836" N	88° 31' 52.112" E
3	26° 56' 37.378" N	88° 31' 48.383" E
4	26° 56' 37.684" N	88° 31' 48.205" E
5	26° 56' 38.688" N	88° 31' 48.486" E
6	26° 56' 46.707" N	88° 31' 51.149" E
7	26° 56' 47.165" N	88° 31' 51.200" E
8	26° 56' 48.508" N	88° 31' 51.675" E
9	26° 56' 48.467" N	88° 31' 53.457" E
10	26° 56' 46.168" N	88° 31' 53.242" E
11	26° 56' 43.604" N	88° 31' 52.717" E

POTENTIAL BLOCK KPG_KPG1_LH_3 OF LEESH RIVER



KPG_KPG1_LH_3		
Coordinate_ID	Latitude	Longitude
1	26° 56' 17.219" N	88° 31' 53.179" E
2	26° 56' 14.850" N	88° 31' 48.580" E
3	26° 56' 15.835" N	88° 31' 48.399" E
4	26° 56' 19.223" N	88° 31' 47.706" E
5	26° 56' 23.736" N	88° 31' 49.776" E
6	26° 56' 24.934" N	88° 31' 51.314" E
7	26° 56' 28.227" N	88° 31' 52.140" E
8	26° 56' 30.466" N	88° 31' 53.243" E
9	26° 56' 29.853" N	88° 31' 57.179" E
10	26° 56' 29.281" N	88° 31' 57.801" E
11	26° 56' 29.086" N	88° 31' 57.939" E
12	26° 56' 25.155" N	88° 31' 58.911" E
13	26° 56' 20.414" N	88° 31' 58.115" E
14	26° 56' 19.219" N	88° 31' 56.287" E
15	26° 56' 18.471" N	88° 31' 54.739" E
16	26° 56' 17.712" N	88° 31' 53.639" E
17	26° 56' 17.482" N	88° 31' 53.424" E

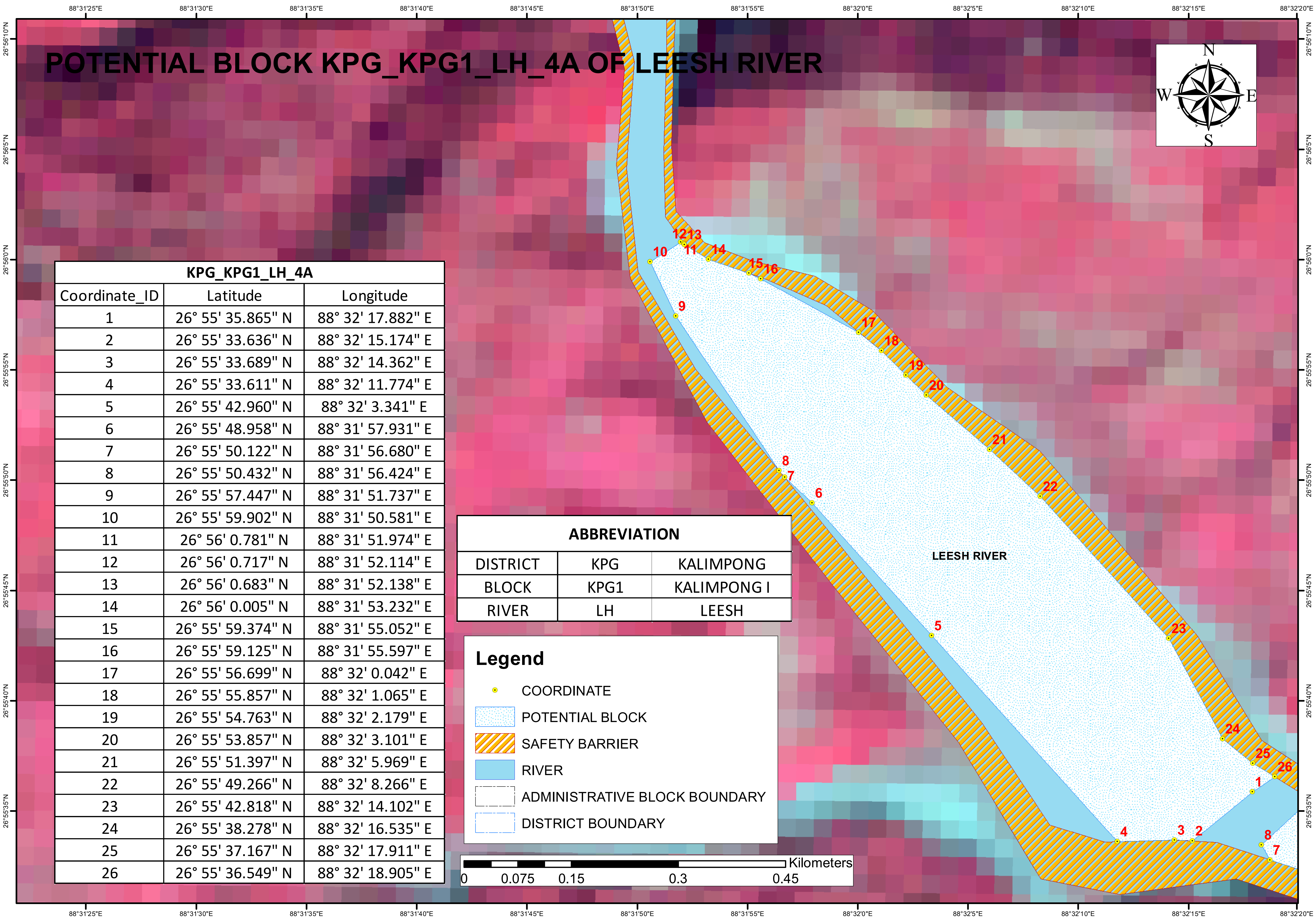
ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

Legend

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

Kilometers: 0, 0.05, 0.1, 0.2, 0.3

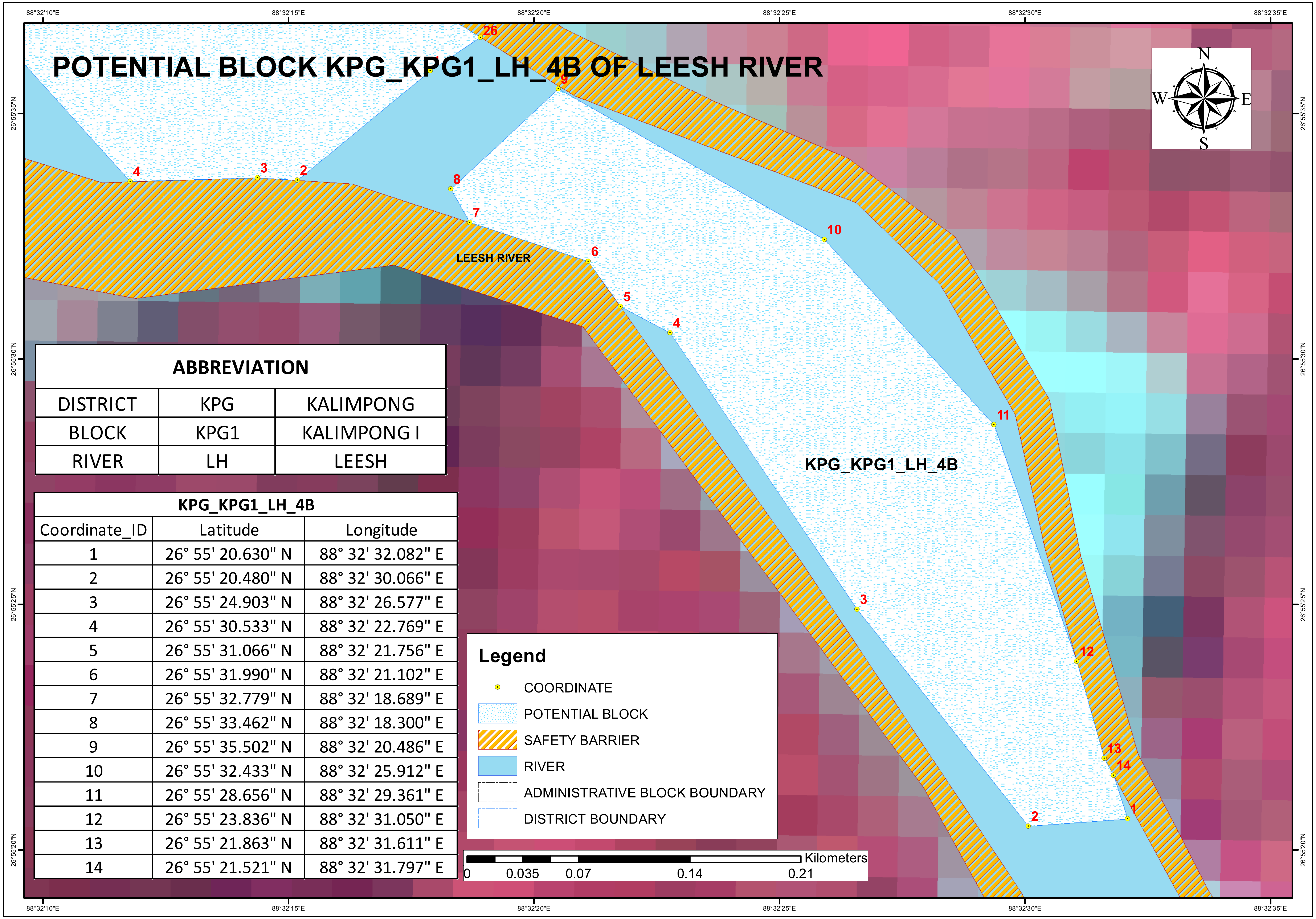
POTENTIAL BLOCK KPG_KPG1_LH_4A OF LEESH RIVER



KPG_KPG1_LH_4A		
Coordinate_ID	Latitude	Longitude
1	26° 55' 35.865" N	88° 32' 17.882" E
2	26° 55' 33.636" N	88° 32' 15.174" E
3	26° 55' 33.689" N	88° 32' 14.362" E
4	26° 55' 33.611" N	88° 32' 11.774" E
5	26° 55' 42.960" N	88° 32' 3.341" E
6	26° 55' 48.958" N	88° 31' 57.931" E
7	26° 55' 50.122" N	88° 31' 56.680" E
8	26° 55' 50.432" N	88° 31' 56.424" E
9	26° 55' 57.447" N	88° 31' 51.737" E
10	26° 55' 59.902" N	88° 31' 50.581" E
11	26° 56' 0.781" N	88° 31' 51.974" E
12	26° 56' 0.717" N	88° 31' 52.114" E
13	26° 56' 0.683" N	88° 31' 52.138" E
14	26° 56' 0.005" N	88° 31' 53.232" E
15	26° 55' 59.374" N	88° 31' 55.052" E
16	26° 55' 59.125" N	88° 31' 55.597" E
17	26° 55' 56.699" N	88° 32' 0.042" E
18	26° 55' 55.857" N	88° 32' 1.065" E
19	26° 55' 54.763" N	88° 32' 2.179" E
20	26° 55' 53.857" N	88° 32' 3.101" E
21	26° 55' 51.397" N	88° 32' 5.969" E
22	26° 55' 49.266" N	88° 32' 8.266" E
23	26° 55' 42.818" N	88° 32' 14.102" E
24	26° 55' 38.278" N	88° 32' 16.535" E
25	26° 55' 37.167" N	88° 32' 17.911" E
26	26° 55' 36.549" N	88° 32' 18.905" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

POTENTIAL BLOCK KPG_KPG1_LH_4B OF LEESH RIVER



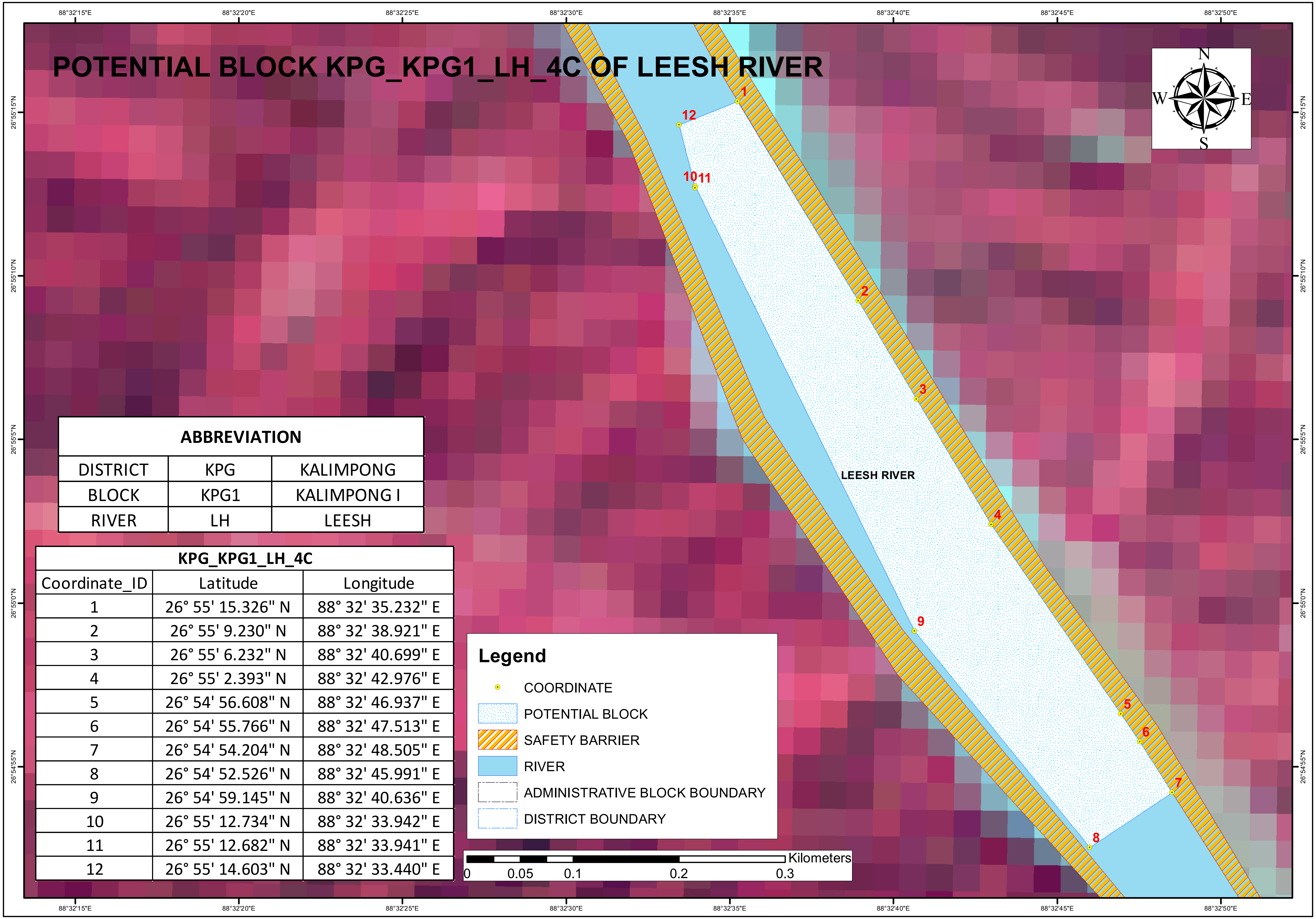
ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

KPG_KPG1_LH_4B		
Coordinate_ID	Latitude	Longitude
1	26° 55' 20.630" N	88° 32' 32.082" E
2	26° 55' 20.480" N	88° 32' 30.066" E
3	26° 55' 24.903" N	88° 32' 26.577" E
4	26° 55' 30.533" N	88° 32' 22.769" E
5	26° 55' 31.066" N	88° 32' 21.756" E
6	26° 55' 31.990" N	88° 32' 21.102" E
7	26° 55' 32.779" N	88° 32' 18.689" E
8	26° 55' 33.462" N	88° 32' 18.300" E
9	26° 55' 35.502" N	88° 32' 20.486" E
10	26° 55' 32.433" N	88° 32' 25.912" E
11	26° 55' 28.656" N	88° 32' 29.361" E
12	26° 55' 23.836" N	88° 32' 31.050" E
13	26° 55' 21.863" N	88° 32' 31.611" E
14	26° 55' 21.521" N	88° 32' 31.797" E

Legend

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

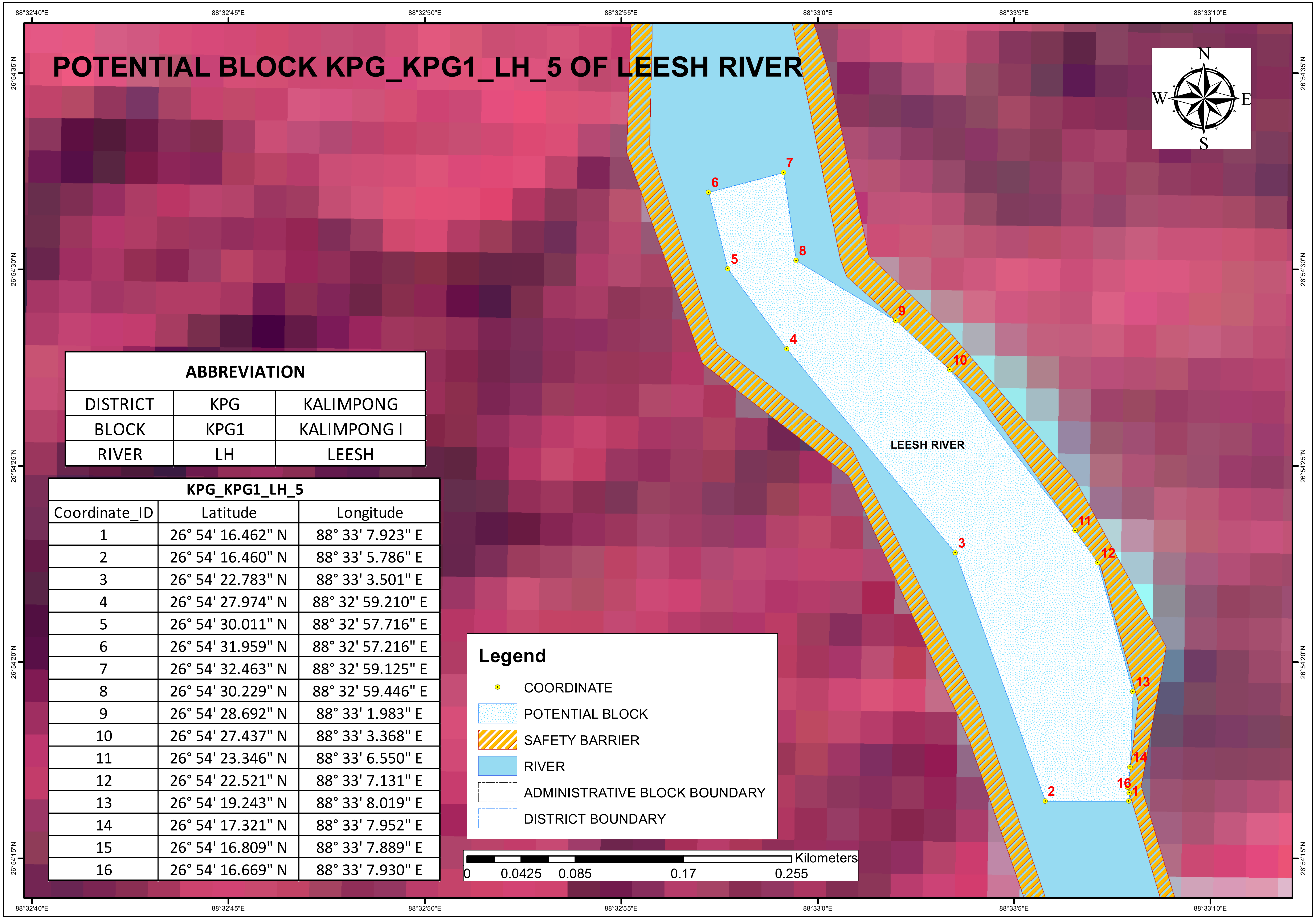
POTENTIAL BLOCK KPG_KPG1_LH_4C OF LEESH RIVER



ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

KPG_KPG1_LH_4C		
Coordinate_ID	Latitude	Longitude
1	26° 55' 15.326" N	88° 32' 35.232" E
2	26° 55' 9.230" N	88° 32' 38.921" E
3	26° 55' 6.232" N	88° 32' 40.699" E
4	26° 55' 2.393" N	88° 32' 42.976" E
5	26° 54' 56.608" N	88° 32' 46.937" E
6	26° 54' 55.766" N	88° 32' 47.513" E
7	26° 54' 54.204" N	88° 32' 48.505" E
8	26° 54' 52.526" N	88° 32' 45.991" E
9	26° 54' 59.145" N	88° 32' 40.636" E
10	26° 55' 12.734" N	88° 32' 33.942" E
11	26° 55' 12.682" N	88° 32' 33.941" E
12	26° 55' 14.603" N	88° 32' 33.440" E

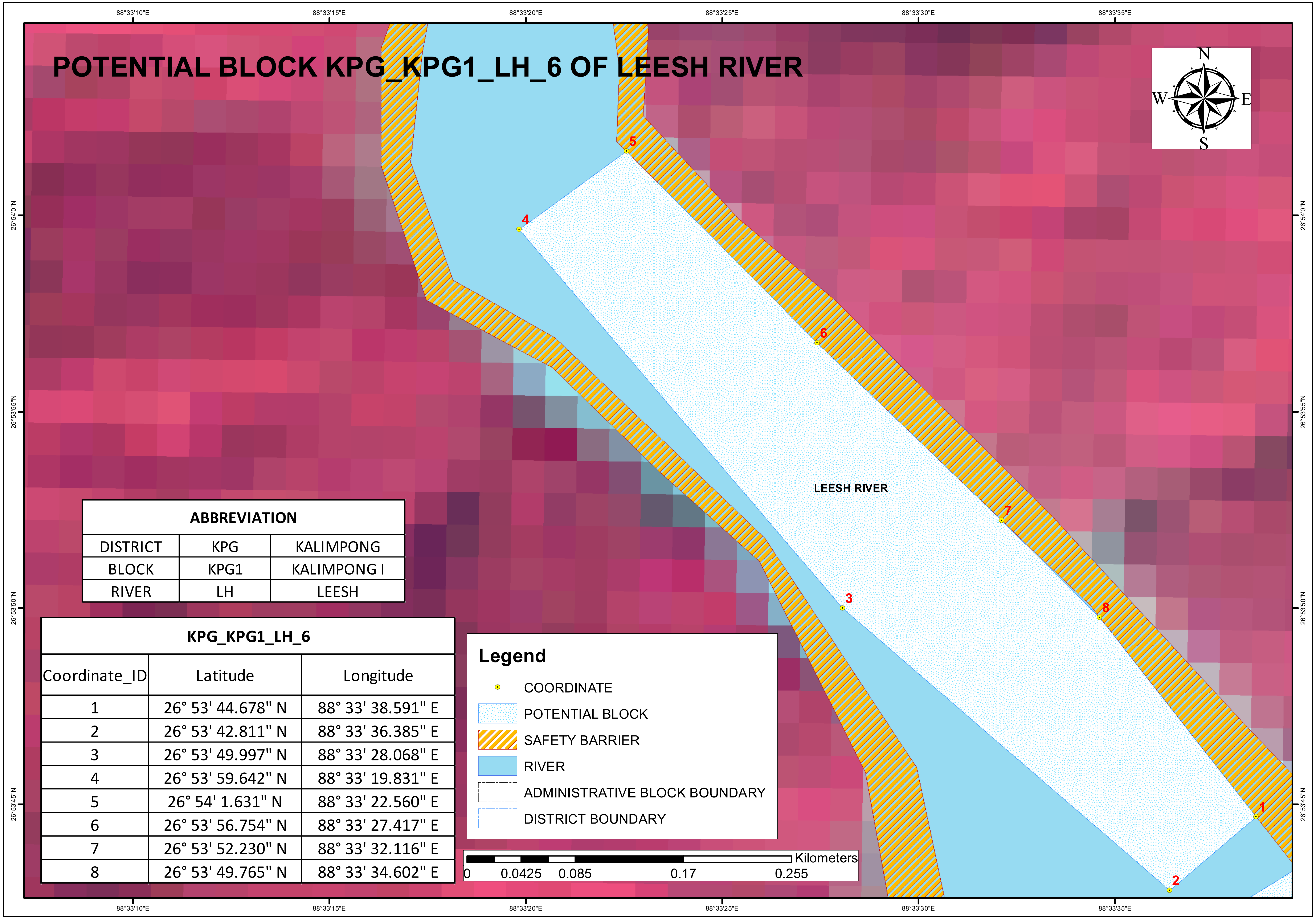
POTENTIAL BLOCK KPG_KPG1_LH_5 OF LEESH RIVER



ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

KPG_KPG1_LH_5		
Coordinate_ID	Latitude	Longitude
1	26° 54' 16.462" N	88° 33' 7.923" E
2	26° 54' 16.460" N	88° 33' 5.786" E
3	26° 54' 22.783" N	88° 33' 3.501" E
4	26° 54' 27.974" N	88° 32' 59.210" E
5	26° 54' 30.011" N	88° 32' 57.716" E
6	26° 54' 31.959" N	88° 32' 57.216" E
7	26° 54' 32.463" N	88° 32' 59.125" E
8	26° 54' 30.229" N	88° 32' 59.446" E
9	26° 54' 28.692" N	88° 33' 1.983" E
10	26° 54' 27.437" N	88° 33' 3.368" E
11	26° 54' 23.346" N	88° 33' 6.550" E
12	26° 54' 22.521" N	88° 33' 7.131" E
13	26° 54' 19.243" N	88° 33' 8.019" E
14	26° 54' 17.321" N	88° 33' 7.952" E
15	26° 54' 16.809" N	88° 33' 7.889" E
16	26° 54' 16.669" N	88° 33' 7.930" E

POTENTIAL BLOCK KPG_KPG1_LH_6 OF LEESH RIVER

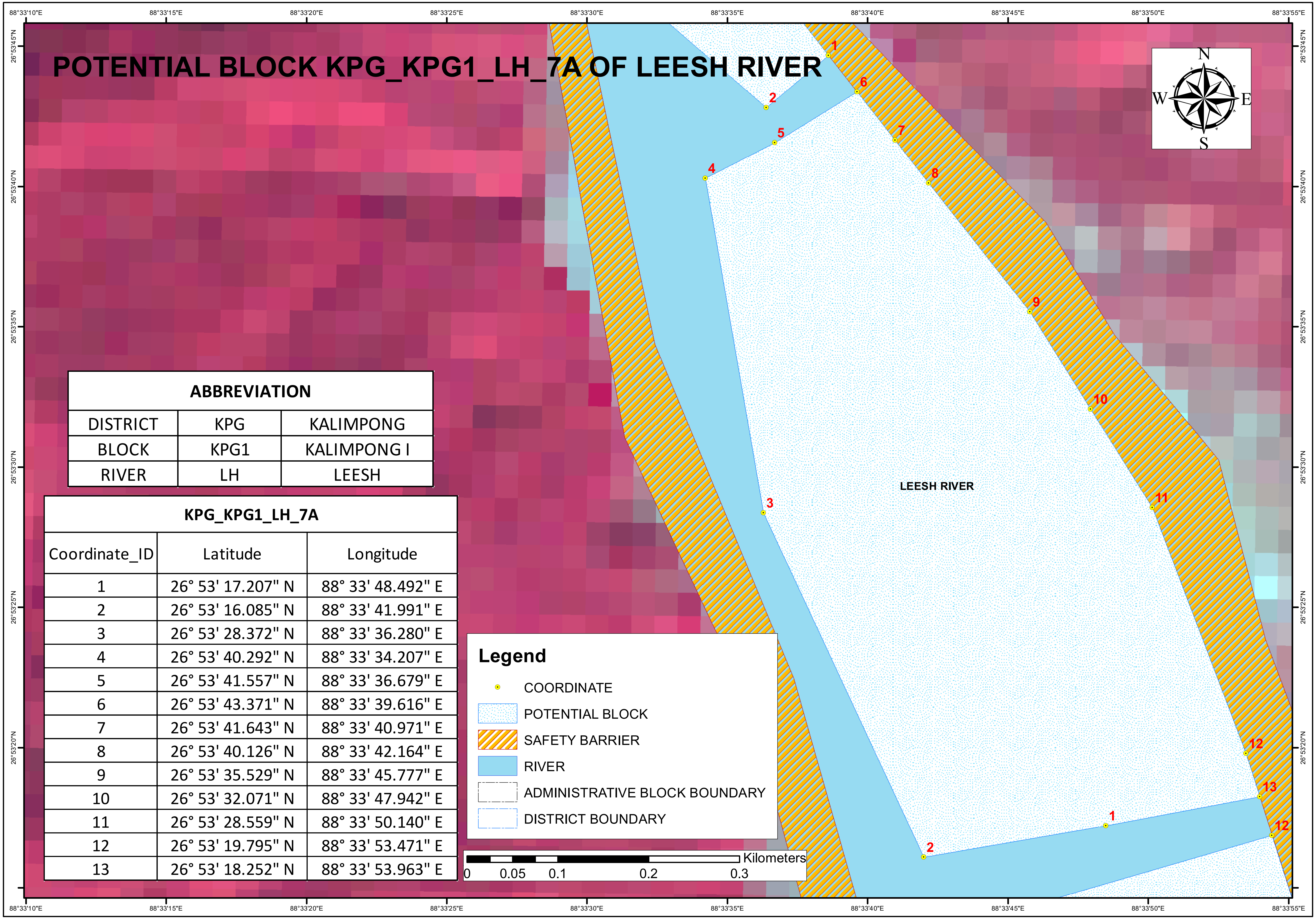


ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

KPG_KPG1_LH_6

Coordinate_ID	Latitude	Longitude
1	26° 53' 44.678" N	88° 33' 38.591" E
2	26° 53' 42.811" N	88° 33' 36.385" E
3	26° 53' 49.997" N	88° 33' 28.068" E
4	26° 53' 59.642" N	88° 33' 19.831" E
5	26° 54' 1.631" N	88° 33' 22.560" E
6	26° 53' 56.754" N	88° 33' 27.417" E
7	26° 53' 52.230" N	88° 33' 32.116" E
8	26° 53' 49.765" N	88° 33' 34.602" E

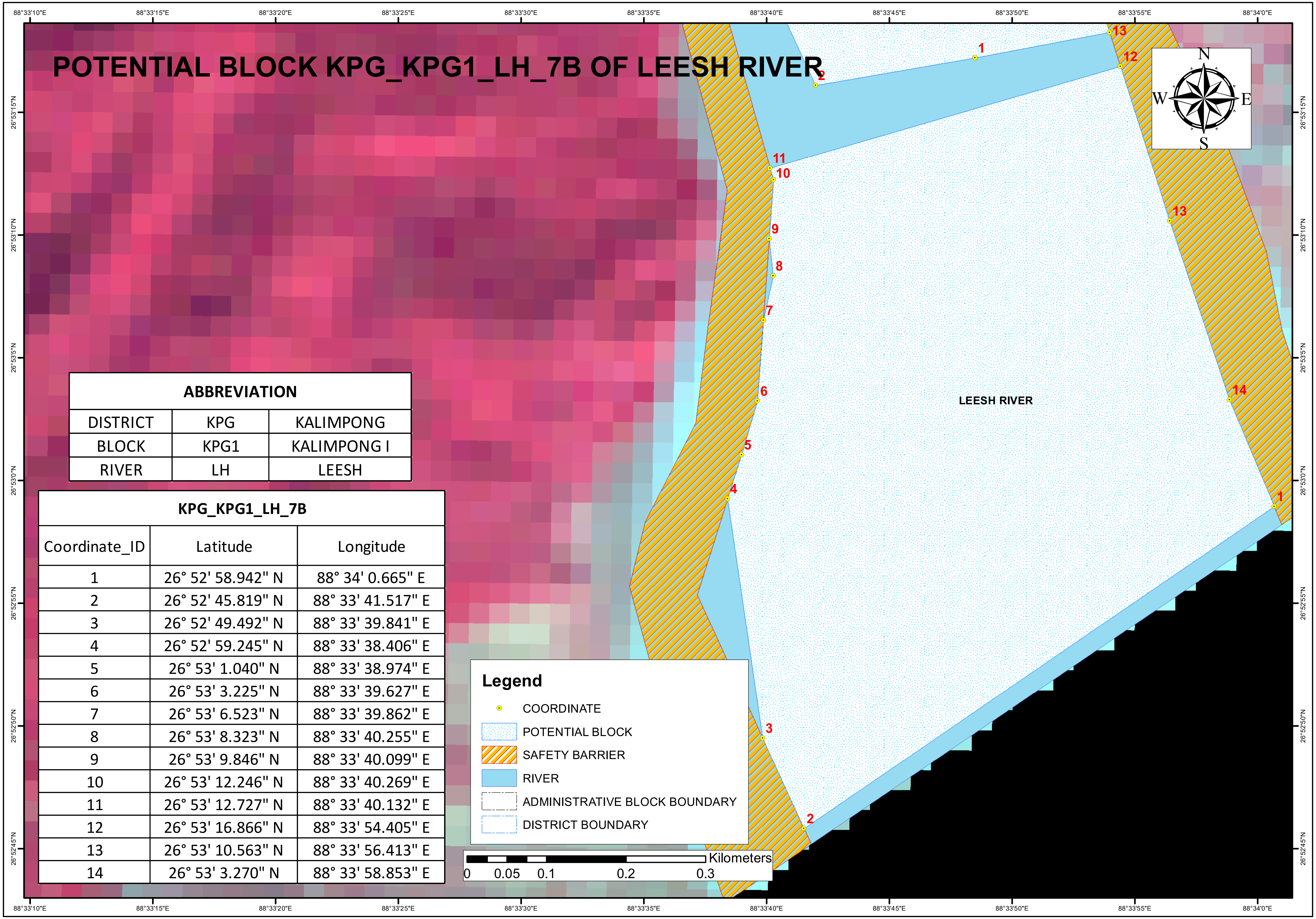
POTENTIAL BLOCK KPG_KPG1_LH_7A OF LEESH RIVER



ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

KPG_KPG1_LH_7A		
Coordinate_ID	Latitude	Longitude
1	26° 53' 17.207" N	88° 33' 48.492" E
2	26° 53' 16.085" N	88° 33' 41.991" E
3	26° 53' 28.372" N	88° 33' 36.280" E
4	26° 53' 40.292" N	88° 33' 34.207" E
5	26° 53' 41.557" N	88° 33' 36.679" E
6	26° 53' 43.371" N	88° 33' 39.616" E
7	26° 53' 41.643" N	88° 33' 40.971" E
8	26° 53' 40.126" N	88° 33' 42.164" E
9	26° 53' 35.529" N	88° 33' 45.777" E
10	26° 53' 32.071" N	88° 33' 47.942" E
11	26° 53' 28.559" N	88° 33' 50.140" E
12	26° 53' 19.795" N	88° 33' 53.471" E
13	26° 53' 18.252" N	88° 33' 53.963" E

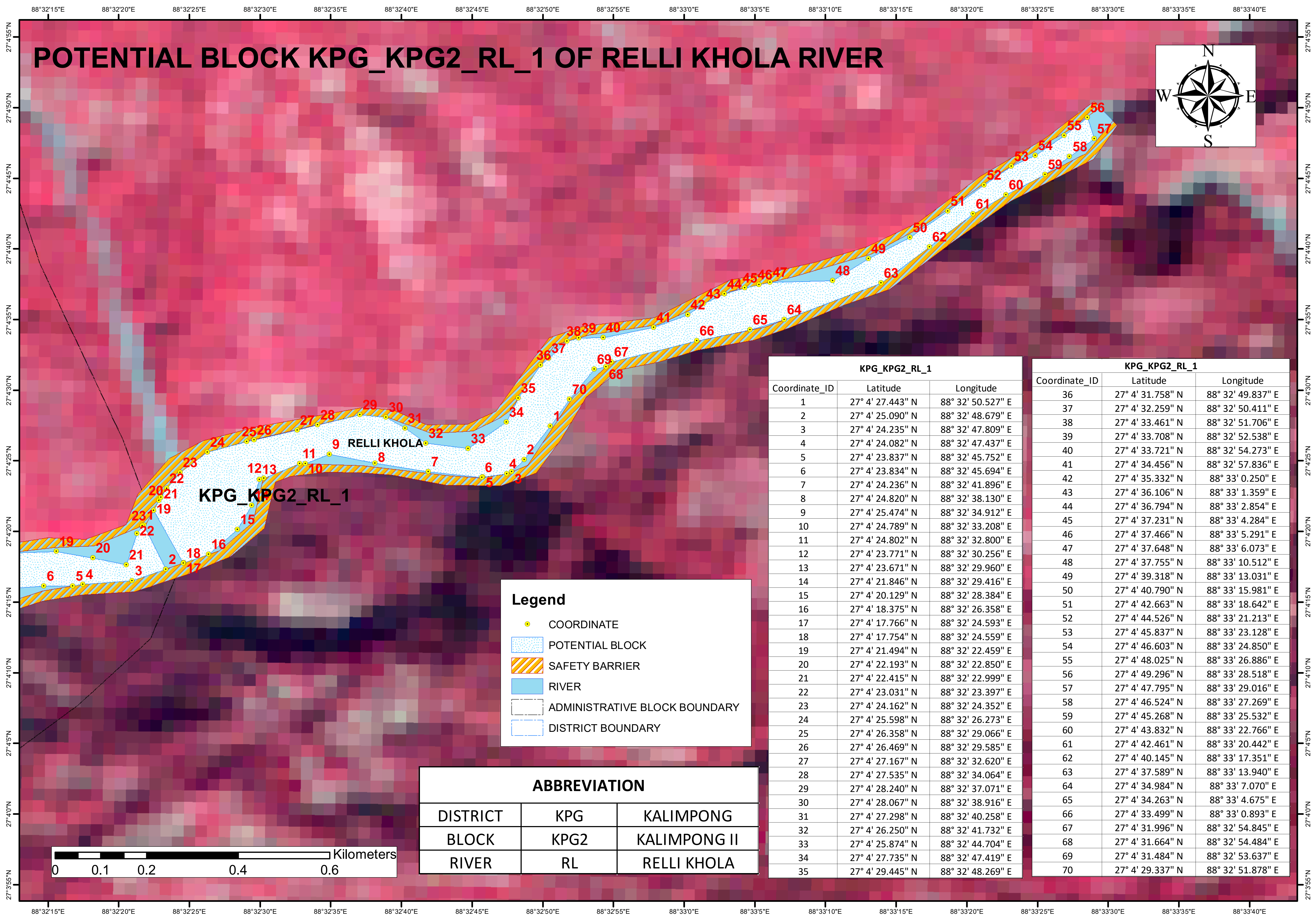
POTENTIAL BLOCK KPG_KPG1_LH_7B OF LEESH RIVER



ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	LH	LEESH

KPG_KPG1_LH_7B		
Coordinate_ID	Latitude	Longitude
1	26° 52' 58.942" N	88° 34' 0.665" E
2	26° 52' 45.819" N	88° 33' 41.517" E
3	26° 52' 49.492" N	88° 33' 39.841" E
4	26° 52' 59.245" N	88° 33' 38.406" E
5	26° 53' 1.040" N	88° 33' 38.974" E
6	26° 53' 3.225" N	88° 33' 39.627" E
7	26° 53' 6.523" N	88° 33' 39.862" E
8	26° 53' 8.323" N	88° 33' 40.255" E
9	26° 53' 9.846" N	88° 33' 40.099" E
10	26° 53' 12.246" N	88° 33' 40.269" E
11	26° 53' 12.727" N	88° 33' 40.132" E
12	26° 53' 16.866" N	88° 33' 54.405" E
13	26° 53' 10.563" N	88° 33' 56.413" E
14	26° 53' 3.270" N	88° 33' 58.853" E

POTENTIAL BLOCK KPG_KPG2_RL_1 OF RELLI KHOLA RIVER



ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RL	RELLI KHOLA

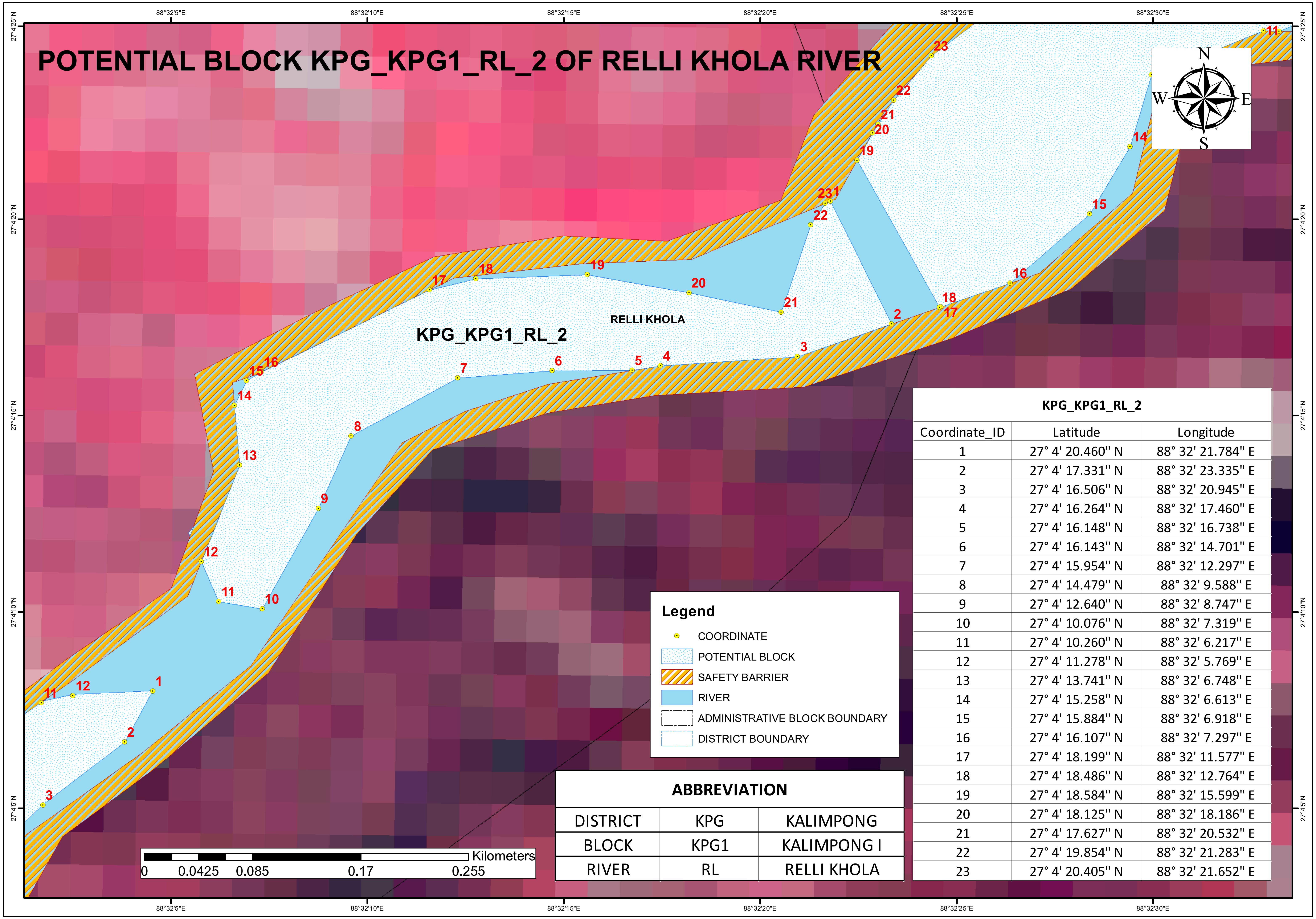
KPG_KPG2_RL_1

Coordinate_ID	Latitude	Longitude
1	27° 4' 27.443" N	88° 32' 50.527" E
2	27° 4' 25.090" N	88° 32' 48.679" E
3	27° 4' 24.235" N	88° 32' 47.809" E
4	27° 4' 24.082" N	88° 32' 47.437" E
5	27° 4' 23.837" N	88° 32' 45.752" E
6	27° 4' 23.834" N	88° 32' 45.694" E
7	27° 4' 24.236" N	88° 32' 41.896" E
8	27° 4' 24.820" N	88° 32' 38.130" E
9	27° 4' 25.474" N	88° 32' 34.912" E
10	27° 4' 24.789" N	88° 32' 33.208" E
11	27° 4' 24.802" N	88° 32' 32.800" E
12	27° 4' 23.771" N	88° 32' 30.256" E
13	27° 4' 23.671" N	88° 32' 29.960" E
14	27° 4' 21.846" N	88° 32' 29.416" E
15	27° 4' 20.129" N	88° 32' 28.384" E
16	27° 4' 18.375" N	88° 32' 26.358" E
17	27° 4' 17.766" N	88° 32' 24.593" E
18	27° 4' 17.754" N	88° 32' 24.559" E
19	27° 4' 21.494" N	88° 32' 22.459" E
20	27° 4' 22.193" N	88° 32' 22.850" E
21	27° 4' 22.415" N	88° 32' 22.999" E
22	27° 4' 23.031" N	88° 32' 23.397" E
23	27° 4' 24.162" N	88° 32' 24.352" E
24	27° 4' 25.598" N	88° 32' 26.273" E
25	27° 4' 26.358" N	88° 32' 29.066" E
26	27° 4' 26.469" N	88° 32' 29.585" E
27	27° 4' 27.167" N	88° 32' 32.620" E
28	27° 4' 27.535" N	88° 32' 34.064" E
29	27° 4' 28.240" N	88° 32' 37.071" E
30	27° 4' 28.067" N	88° 32' 38.916" E
31	27° 4' 27.298" N	88° 32' 40.258" E
32	27° 4' 26.250" N	88° 32' 41.732" E
33	27° 4' 25.874" N	88° 32' 44.704" E
34	27° 4' 27.735" N	88° 32' 47.419" E
35	27° 4' 29.445" N	88° 32' 48.269" E

KPG_KPG2_RL_1

Coordinate_ID	Latitude	Longitude
36	27° 4' 31.758" N	88° 32' 49.837" E
37	27° 4' 32.259" N	88° 32' 50.411" E
38	27° 4' 33.461" N	88° 32' 51.706" E
39	27° 4' 33.708" N	88° 32' 52.538" E
40	27° 4' 33.721" N	88° 32' 54.273" E
41	27° 4' 34.456" N	88° 32' 57.836" E
42	27° 4' 35.332" N	88° 33' 0.250" E
43	27° 4' 36.106" N	88° 33' 1.359" E
44	27° 4' 36.794" N	88° 33' 2.854" E
45	27° 4' 37.231" N	88° 33' 4.284" E
46	27° 4' 37.466" N	88° 33' 5.291" E
47	27° 4' 37.648" N	88° 33' 6.073" E
48	27° 4' 37.755" N	88° 33' 10.512" E
49	27° 4' 39.318" N	88° 33' 13.031" E
50	27° 4' 40.790" N	88° 33' 15.981" E
51	27° 4' 42.663" N	88° 33' 18.642" E
52	27° 4' 44.526" N	88° 33' 21.213" E
53	27° 4' 45.837" N	88° 33' 23.128" E
54	27° 4' 46.603" N	88° 33' 24.850" E
55	27° 4' 48.025" N	88° 33' 26.886" E
56	27° 4' 49.296" N	88° 33' 28.518" E
57	27° 4' 47.795" N	88° 33' 29.016" E
58	27° 4' 46.524" N	88° 33' 27.269" E
59	27° 4' 45.268" N	88° 33' 25.532" E
60	27° 4' 43.832" N	88° 33' 22.766" E
61	27° 4' 42.461" N	88° 33' 20.442" E
62	27° 4' 40.145" N	88° 33' 17.351" E
63	27° 4' 37.589" N	88° 33' 13.940" E
64	27° 4' 34.984" N	88° 33' 7.070" E
65	27° 4' 34.263" N	88° 33' 4.675" E
66	27° 4' 33.499" N	88° 33' 0.893" E
67	27° 4' 31.996" N	88° 32' 54.845" E
68	27° 4' 31.664" N	88° 32' 54.484" E
69	27° 4' 31.484" N	88° 32' 53.637" E
70	27° 4' 29.337" N	88° 32' 51.878" E

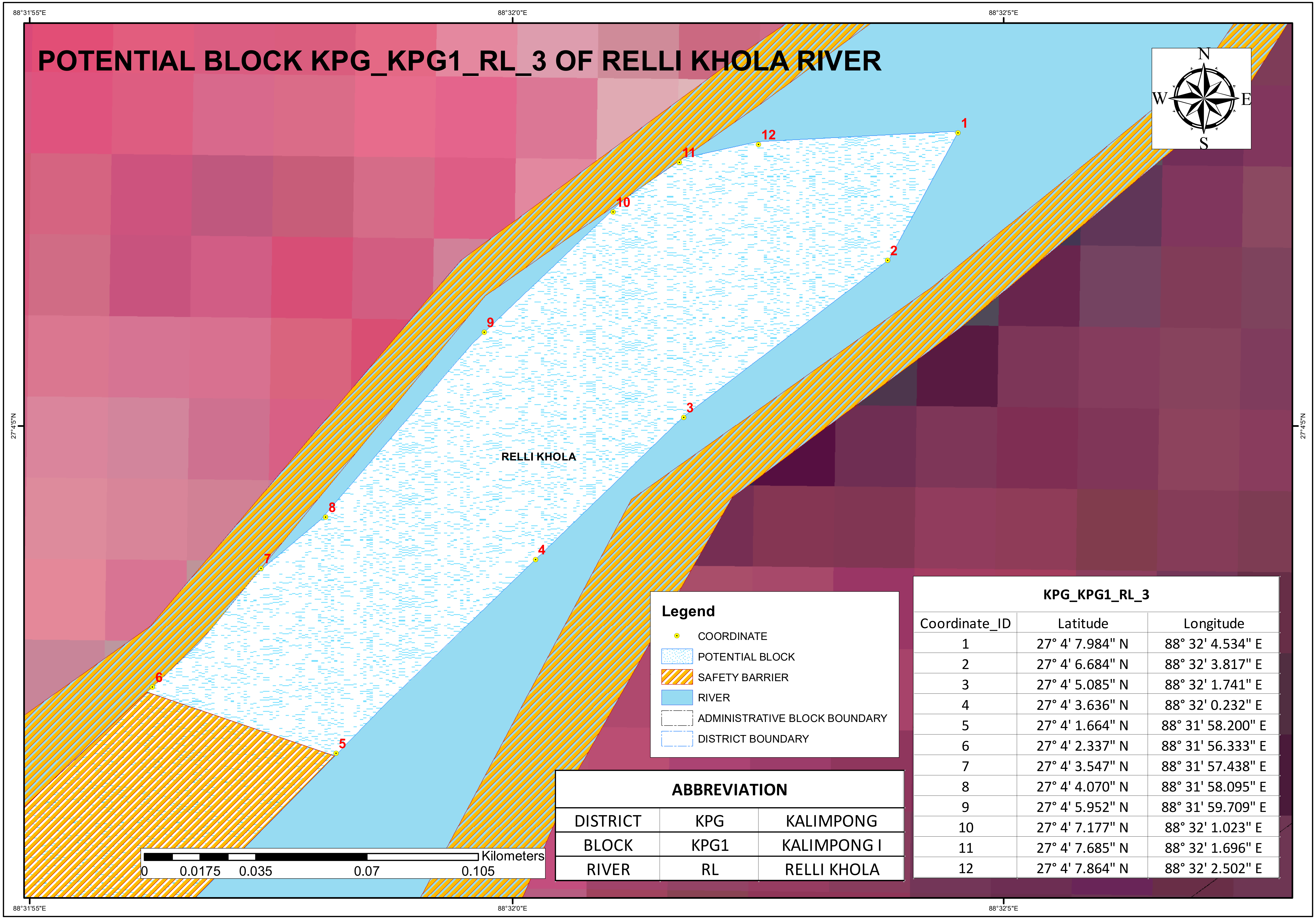
POTENTIAL BLOCK KPG_KPG1_RL_2 OF RELLI KHOLA RIVER



KPG_KPG1_RL_2		
Coordinate_ID	Latitude	Longitude
1	27° 4' 20.460" N	88° 32' 21.784" E
2	27° 4' 17.331" N	88° 32' 23.335" E
3	27° 4' 16.506" N	88° 32' 20.945" E
4	27° 4' 16.264" N	88° 32' 17.460" E
5	27° 4' 16.148" N	88° 32' 16.738" E
6	27° 4' 16.143" N	88° 32' 14.701" E
7	27° 4' 15.954" N	88° 32' 12.297" E
8	27° 4' 14.479" N	88° 32' 9.588" E
9	27° 4' 12.640" N	88° 32' 8.747" E
10	27° 4' 10.076" N	88° 32' 7.319" E
11	27° 4' 10.260" N	88° 32' 6.217" E
12	27° 4' 11.278" N	88° 32' 5.769" E
13	27° 4' 13.741" N	88° 32' 6.748" E
14	27° 4' 15.258" N	88° 32' 6.613" E
15	27° 4' 15.884" N	88° 32' 6.918" E
16	27° 4' 16.107" N	88° 32' 7.297" E
17	27° 4' 18.199" N	88° 32' 11.577" E
18	27° 4' 18.486" N	88° 32' 12.764" E
19	27° 4' 18.584" N	88° 32' 15.599" E
20	27° 4' 18.125" N	88° 32' 18.186" E
21	27° 4' 17.627" N	88° 32' 20.532" E
22	27° 4' 19.854" N	88° 32' 21.283" E
23	27° 4' 20.405" N	88° 32' 21.652" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	RL	RELLI KHOLA

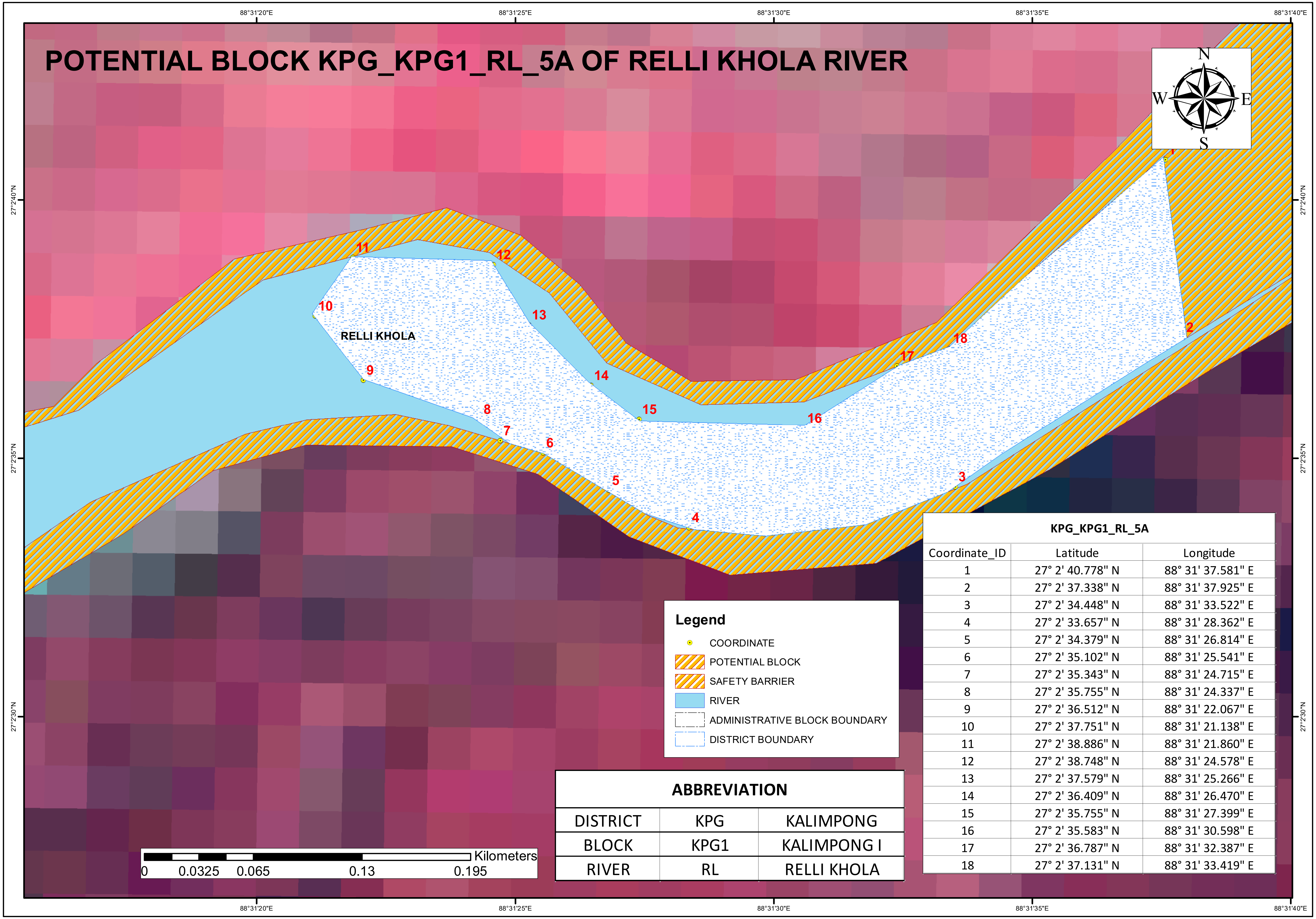
POTENTIAL BLOCK KPG_KPG1_RL_3 OF RELLI KHOLA RIVER



KPG_KPG1_RL_3		
Coordinate_ID	Latitude	Longitude
1	27° 4' 7.984" N	88° 32' 4.534" E
2	27° 4' 6.684" N	88° 32' 3.817" E
3	27° 4' 5.085" N	88° 32' 1.741" E
4	27° 4' 3.636" N	88° 32' 0.232" E
5	27° 4' 1.664" N	88° 31' 58.200" E
6	27° 4' 2.337" N	88° 31' 56.333" E
7	27° 4' 3.547" N	88° 31' 57.438" E
8	27° 4' 4.070" N	88° 31' 58.095" E
9	27° 4' 5.952" N	88° 31' 59.709" E
10	27° 4' 7.177" N	88° 32' 1.023" E
11	27° 4' 7.685" N	88° 32' 1.696" E
12	27° 4' 7.864" N	88° 32' 2.502" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	RL	RELLI KHOLA

POTENTIAL BLOCK KPG_KPG1_RL_5A OF RELLI KHOLA RIVER



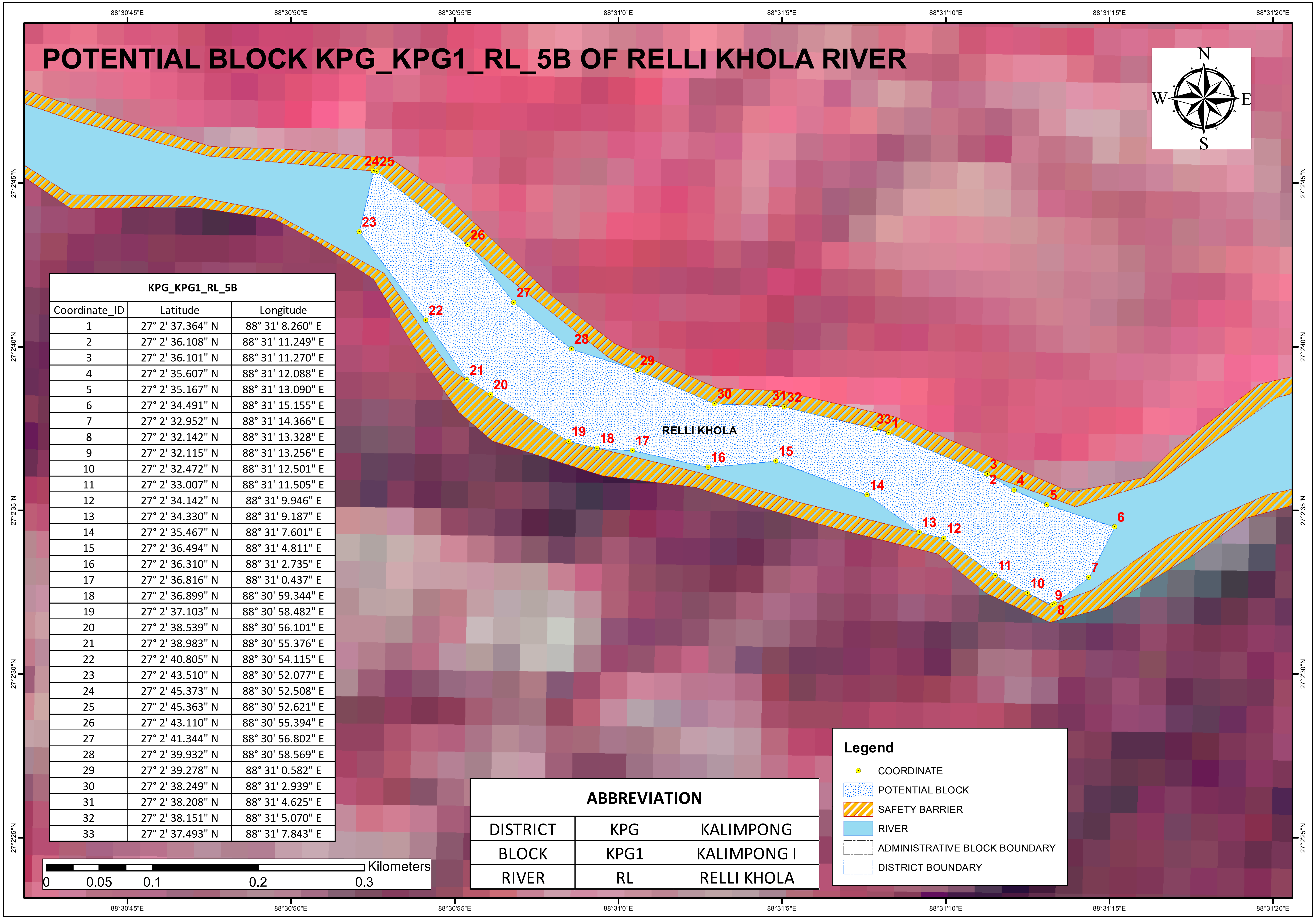
KPG_KPG1_RL_5A

Coordinate_ID	Latitude	Longitude
1	27° 2' 40.778" N	88° 31' 37.581" E
2	27° 2' 37.338" N	88° 31' 37.925" E
3	27° 2' 34.448" N	88° 31' 33.522" E
4	27° 2' 33.657" N	88° 31' 28.362" E
5	27° 2' 34.379" N	88° 31' 26.814" E
6	27° 2' 35.102" N	88° 31' 25.541" E
7	27° 2' 35.343" N	88° 31' 24.715" E
8	27° 2' 35.755" N	88° 31' 24.337" E
9	27° 2' 36.512" N	88° 31' 22.067" E
10	27° 2' 37.751" N	88° 31' 21.138" E
11	27° 2' 38.886" N	88° 31' 21.860" E
12	27° 2' 38.748" N	88° 31' 24.578" E
13	27° 2' 37.579" N	88° 31' 25.266" E
14	27° 2' 36.409" N	88° 31' 26.470" E
15	27° 2' 35.755" N	88° 31' 27.399" E
16	27° 2' 35.583" N	88° 31' 30.598" E
17	27° 2' 36.787" N	88° 31' 32.387" E
18	27° 2' 37.131" N	88° 31' 33.419" E

ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	RL	RELLI KHOLA

POTENTIAL BLOCK KPG_KPG1_RL_5B OF RELLI KHOLA RIVER



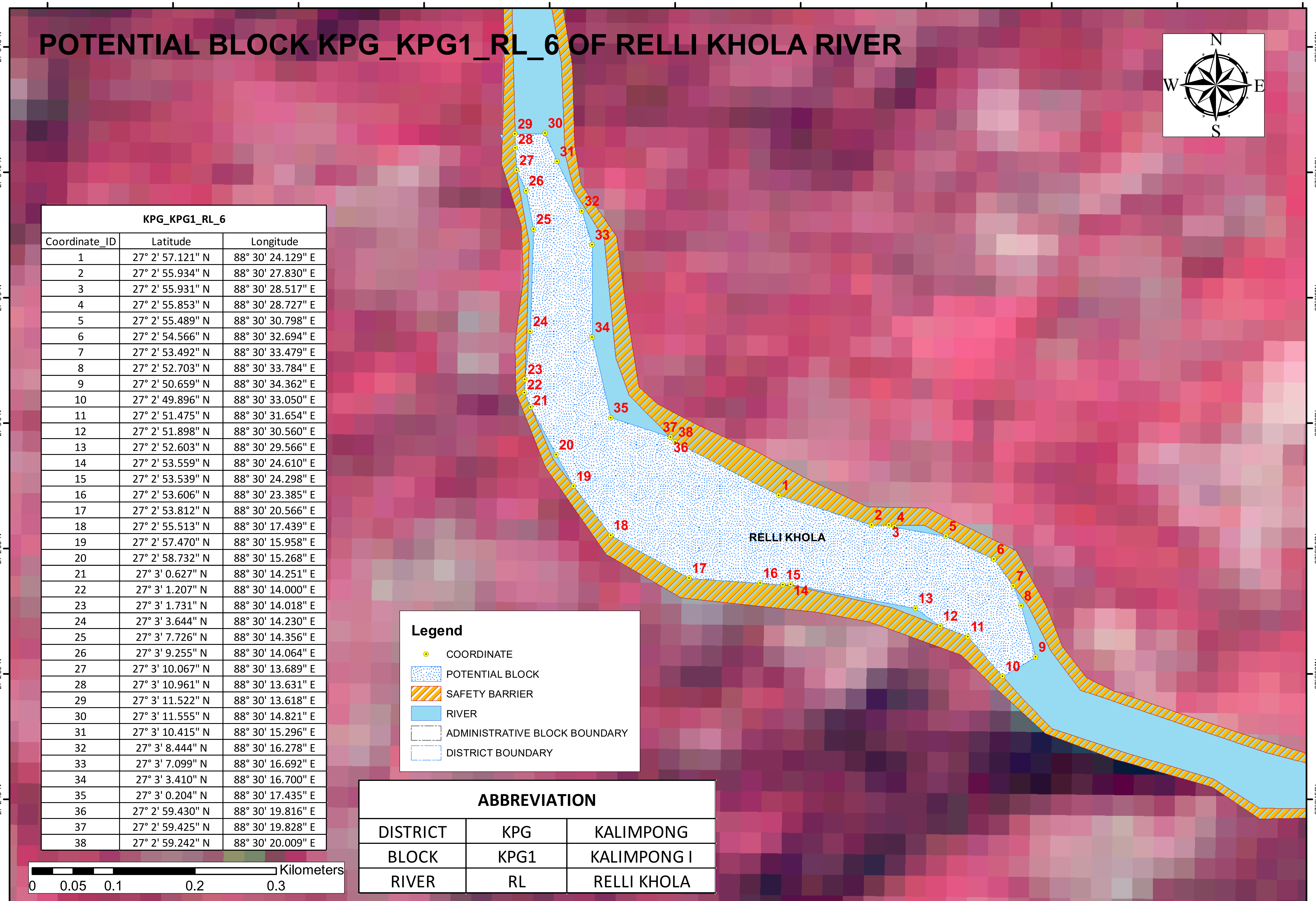
KPG_KPG1_RL_5B

Coordinate_ID	Latitude	Longitude
1	27° 2' 37.364" N	88° 31' 8.260" E
2	27° 2' 36.108" N	88° 31' 11.249" E
3	27° 2' 36.101" N	88° 31' 11.270" E
4	27° 2' 35.607" N	88° 31' 12.088" E
5	27° 2' 35.167" N	88° 31' 13.090" E
6	27° 2' 34.491" N	88° 31' 15.155" E
7	27° 2' 32.952" N	88° 31' 14.366" E
8	27° 2' 32.142" N	88° 31' 13.328" E
9	27° 2' 32.115" N	88° 31' 13.256" E
10	27° 2' 32.472" N	88° 31' 12.501" E
11	27° 2' 33.007" N	88° 31' 11.505" E
12	27° 2' 34.142" N	88° 31' 9.946" E
13	27° 2' 34.330" N	88° 31' 9.187" E
14	27° 2' 35.467" N	88° 31' 7.601" E
15	27° 2' 36.494" N	88° 31' 4.811" E
16	27° 2' 36.310" N	88° 31' 2.735" E
17	27° 2' 36.816" N	88° 31' 0.437" E
18	27° 2' 36.899" N	88° 30' 59.344" E
19	27° 2' 37.103" N	88° 30' 58.482" E
20	27° 2' 38.539" N	88° 30' 56.101" E
21	27° 2' 38.983" N	88° 30' 55.376" E
22	27° 2' 40.805" N	88° 30' 54.115" E
23	27° 2' 43.510" N	88° 30' 52.077" E
24	27° 2' 45.373" N	88° 30' 52.508" E
25	27° 2' 45.363" N	88° 30' 52.621" E
26	27° 2' 43.110" N	88° 30' 55.394" E
27	27° 2' 41.344" N	88° 30' 56.802" E
28	27° 2' 39.932" N	88° 30' 58.569" E
29	27° 2' 39.278" N	88° 31' 0.582" E
30	27° 2' 38.249" N	88° 31' 2.939" E
31	27° 2' 38.208" N	88° 31' 4.625" E
32	27° 2' 38.151" N	88° 31' 5.070" E
33	27° 2' 37.493" N	88° 31' 7.843" E

ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	RL	RELLI KHOLA

POTENTIAL BLOCK KPG_KPG1_RL_6 OF RELLI KHOLA RIVER



KPG_KPG1_RL_6

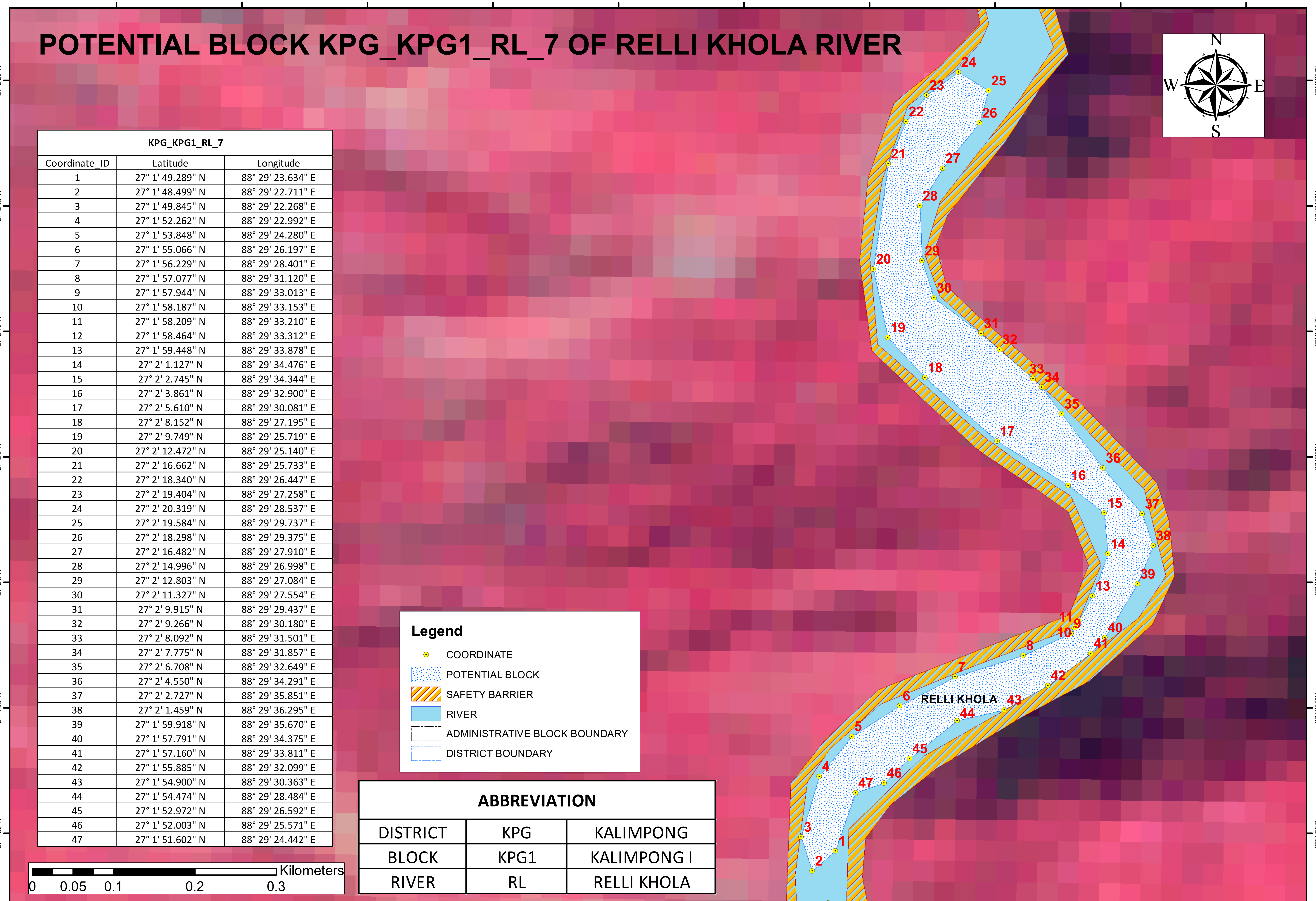
Coordinate_ID	Latitude	Longitude
1	27° 2' 57.121" N	88° 30' 24.129" E
2	27° 2' 55.934" N	88° 30' 27.830" E
3	27° 2' 55.931" N	88° 30' 28.517" E
4	27° 2' 55.853" N	88° 30' 28.727" E
5	27° 2' 55.489" N	88° 30' 30.798" E
6	27° 2' 54.566" N	88° 30' 32.694" E
7	27° 2' 53.492" N	88° 30' 33.479" E
8	27° 2' 52.703" N	88° 30' 33.784" E
9	27° 2' 50.659" N	88° 30' 34.362" E
10	27° 2' 49.896" N	88° 30' 33.050" E
11	27° 2' 51.475" N	88° 30' 31.654" E
12	27° 2' 51.898" N	88° 30' 30.560" E
13	27° 2' 52.603" N	88° 30' 29.566" E
14	27° 2' 53.559" N	88° 30' 24.610" E
15	27° 2' 53.539" N	88° 30' 24.298" E
16	27° 2' 53.606" N	88° 30' 23.385" E
17	27° 2' 53.812" N	88° 30' 20.566" E
18	27° 2' 55.513" N	88° 30' 17.439" E
19	27° 2' 57.470" N	88° 30' 15.958" E
20	27° 2' 58.732" N	88° 30' 15.268" E
21	27° 3' 0.627" N	88° 30' 14.251" E
22	27° 3' 1.207" N	88° 30' 14.000" E
23	27° 3' 1.731" N	88° 30' 14.018" E
24	27° 3' 3.644" N	88° 30' 14.230" E
25	27° 3' 7.726" N	88° 30' 14.356" E
26	27° 3' 9.255" N	88° 30' 14.064" E
27	27° 3' 10.067" N	88° 30' 13.689" E
28	27° 3' 10.961" N	88° 30' 13.631" E
29	27° 3' 11.522" N	88° 30' 13.618" E
30	27° 3' 11.555" N	88° 30' 14.821" E
31	27° 3' 10.415" N	88° 30' 15.296" E
32	27° 3' 8.444" N	88° 30' 16.278" E
33	27° 3' 7.099" N	88° 30' 16.692" E
34	27° 3' 3.410" N	88° 30' 16.700" E
35	27° 3' 0.204" N	88° 30' 17.435" E
36	27° 2' 59.430" N	88° 30' 19.816" E
37	27° 2' 59.425" N	88° 30' 19.828" E
38	27° 2' 59.242" N	88° 30' 20.009" E

ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	RL	RELLI KHOLA

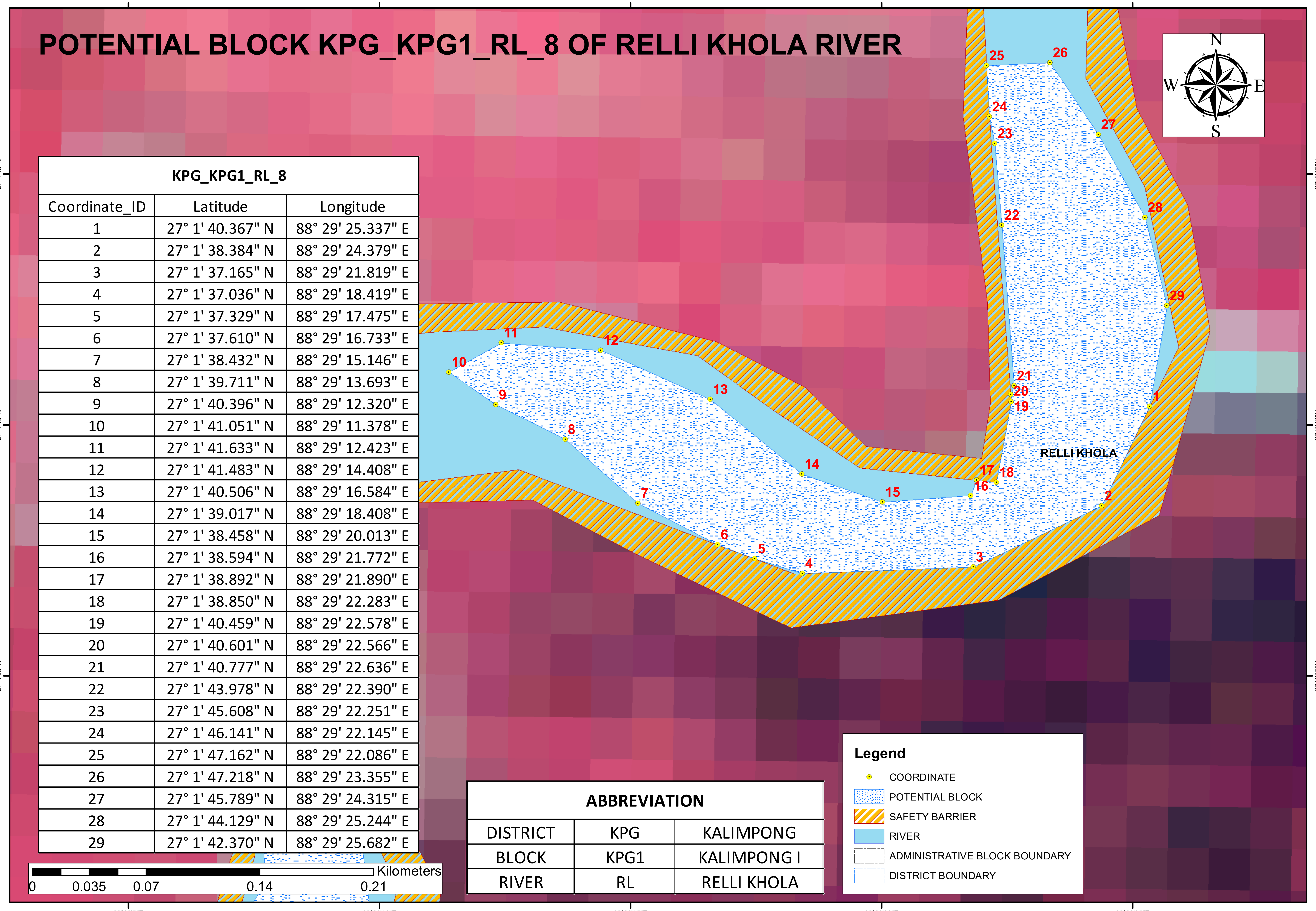
POTENTIAL BLOCK KPG_KPG1_RL_7 OF RELLI KHOLA RIVER

KPG_KPG1_RL_7		
Coordinate_ID	Latitude	Longitude
1	27° 1' 49.289" N	88° 29' 23.634" E
2	27° 1' 48.499" N	88° 29' 22.711" E
3	27° 1' 49.845" N	88° 29' 22.268" E
4	27° 1' 52.262" N	88° 29' 22.992" E
5	27° 1' 53.848" N	88° 29' 24.280" E
6	27° 1' 55.066" N	88° 29' 26.197" E
7	27° 1' 56.229" N	88° 29' 28.401" E
8	27° 1' 57.077" N	88° 29' 31.120" E
9	27° 1' 57.944" N	88° 29' 33.013" E
10	27° 1' 58.187" N	88° 29' 33.153" E
11	27° 1' 58.209" N	88° 29' 33.210" E
12	27° 1' 58.464" N	88° 29' 33.312" E
13	27° 1' 59.448" N	88° 29' 33.878" E
14	27° 2' 1.127" N	88° 29' 34.476" E
15	27° 2' 2.745" N	88° 29' 34.344" E
16	27° 2' 3.861" N	88° 29' 32.900" E
17	27° 2' 5.610" N	88° 29' 30.081" E
18	27° 2' 8.152" N	88° 29' 27.195" E
19	27° 2' 9.749" N	88° 29' 25.719" E
20	27° 2' 12.472" N	88° 29' 25.140" E
21	27° 2' 16.662" N	88° 29' 25.733" E
22	27° 2' 18.340" N	88° 29' 26.447" E
23	27° 2' 19.404" N	88° 29' 27.258" E
24	27° 2' 20.319" N	88° 29' 28.537" E
25	27° 2' 19.584" N	88° 29' 29.737" E
26	27° 2' 18.298" N	88° 29' 29.375" E
27	27° 2' 16.482" N	88° 29' 27.910" E
28	27° 2' 14.996" N	88° 29' 26.998" E
29	27° 2' 12.803" N	88° 29' 27.084" E
30	27° 2' 11.327" N	88° 29' 27.554" E
31	27° 2' 9.915" N	88° 29' 29.437" E
32	27° 2' 9.266" N	88° 29' 30.180" E
33	27° 2' 8.092" N	88° 29' 31.501" E
34	27° 2' 7.775" N	88° 29' 31.857" E
35	27° 2' 6.708" N	88° 29' 32.649" E
36	27° 2' 4.550" N	88° 29' 34.291" E
37	27° 2' 2.727" N	88° 29' 35.851" E
38	27° 2' 1.459" N	88° 29' 36.295" E
39	27° 1' 59.918" N	88° 29' 35.670" E
40	27° 1' 57.791" N	88° 29' 34.375" E
41	27° 1' 57.160" N	88° 29' 33.811" E
42	27° 1' 55.885" N	88° 29' 32.099" E
43	27° 1' 54.900" N	88° 29' 30.363" E
44	27° 1' 54.474" N	88° 29' 28.484" E
45	27° 1' 52.972" N	88° 29' 26.592" E
46	27° 1' 52.003" N	88° 29' 25.571" E
47	27° 1' 51.602" N	88° 29' 24.442" E



ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	RL	RELLI KHOLA

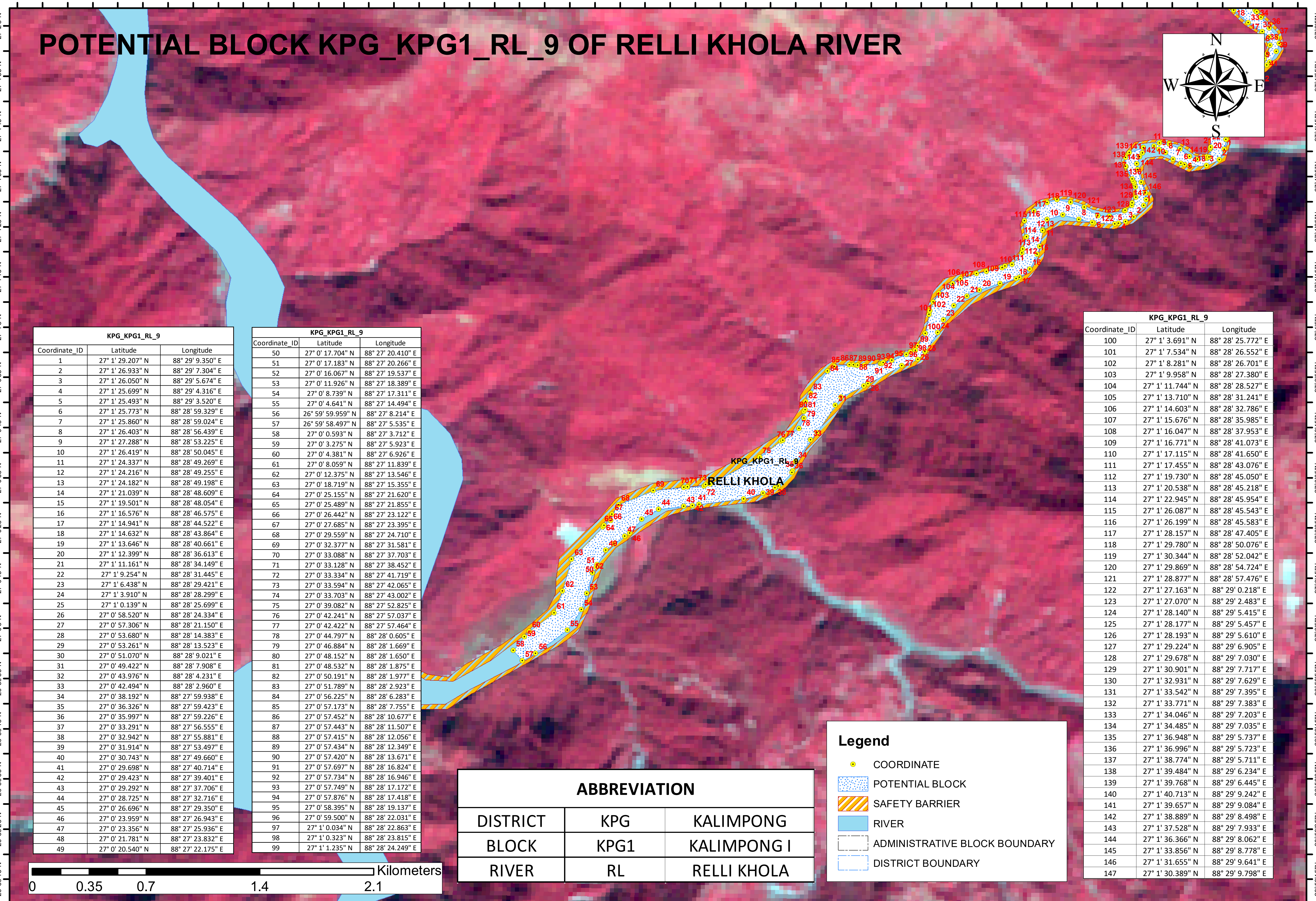
POTENTIAL BLOCK KPG_KPG1_RL_8 OF RELLI KHOLA RIVER



KPG_KPG1_RL_8		
Coordinate_ID	Latitude	Longitude
1	27° 1' 40.367" N	88° 29' 25.337" E
2	27° 1' 38.384" N	88° 29' 24.379" E
3	27° 1' 37.165" N	88° 29' 21.819" E
4	27° 1' 37.036" N	88° 29' 18.419" E
5	27° 1' 37.329" N	88° 29' 17.475" E
6	27° 1' 37.610" N	88° 29' 16.733" E
7	27° 1' 38.432" N	88° 29' 15.146" E
8	27° 1' 39.711" N	88° 29' 13.693" E
9	27° 1' 40.396" N	88° 29' 12.320" E
10	27° 1' 41.051" N	88° 29' 11.378" E
11	27° 1' 41.633" N	88° 29' 12.423" E
12	27° 1' 41.483" N	88° 29' 14.408" E
13	27° 1' 40.506" N	88° 29' 16.584" E
14	27° 1' 39.017" N	88° 29' 18.408" E
15	27° 1' 38.458" N	88° 29' 20.013" E
16	27° 1' 38.594" N	88° 29' 21.772" E
17	27° 1' 38.892" N	88° 29' 21.890" E
18	27° 1' 38.850" N	88° 29' 22.283" E
19	27° 1' 40.459" N	88° 29' 22.578" E
20	27° 1' 40.601" N	88° 29' 22.566" E
21	27° 1' 40.777" N	88° 29' 22.636" E
22	27° 1' 43.978" N	88° 29' 22.390" E
23	27° 1' 45.608" N	88° 29' 22.251" E
24	27° 1' 46.141" N	88° 29' 22.145" E
25	27° 1' 47.162" N	88° 29' 22.086" E
26	27° 1' 47.218" N	88° 29' 23.355" E
27	27° 1' 45.789" N	88° 29' 24.315" E
28	27° 1' 44.129" N	88° 29' 25.244" E
29	27° 1' 42.370" N	88° 29' 25.682" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	RL	RELLI KHOLA

POTENTIAL BLOCK KPG_KPG1_RL_9 OF RELLI KHOLA RIVER



KPG_KPG1_RL_9

Coordinate_ID	Latitude	Longitude
1	27° 1' 29.207" N	88° 29' 9.350" E
2	27° 1' 26.933" N	88° 29' 7.304" E
3	27° 1' 26.050" N	88° 29' 5.674" E
4	27° 1' 25.699" N	88° 29' 4.316" E
5	27° 1' 25.493" N	88° 29' 3.520" E
6	27° 1' 25.773" N	88° 28' 59.329" E
7	27° 1' 25.860" N	88° 28' 59.024" E
8	27° 1' 26.403" N	88° 28' 56.439" E
9	27° 1' 27.288" N	88° 28' 53.225" E
10	27° 1' 26.419" N	88° 28' 50.045" E
11	27° 1' 24.337" N	88° 28' 49.269" E
12	27° 1' 24.216" N	88° 28' 49.255" E
13	27° 1' 24.182" N	88° 28' 49.198" E
14	27° 1' 21.039" N	88° 28' 48.609" E
15	27° 1' 19.501" N	88° 28' 48.054" E
16	27° 1' 16.576" N	88° 28' 46.575" E
17	27° 1' 14.941" N	88° 28' 44.522" E
18	27° 1' 14.632" N	88° 28' 43.864" E
19	27° 1' 13.646" N	88° 28' 40.661" E
20	27° 1' 12.399" N	88° 28' 36.613" E
21	27° 1' 11.161" N	88° 28' 34.149" E
22	27° 1' 9.254" N	88° 28' 31.445" E
23	27° 1' 6.438" N	88° 28' 29.421" E
24	27° 1' 3.910" N	88° 28' 28.299" E
25	27° 1' 0.139" N	88° 28' 25.699" E
26	27° 0' 58.520" N	88° 28' 24.334" E
27	27° 0' 57.306" N	88° 28' 21.150" E
28	27° 0' 53.680" N	88° 28' 14.383" E
29	27° 0' 53.261" N	88° 28' 13.523" E
30	27° 0' 51.070" N	88° 28' 9.021" E
31	27° 0' 49.422" N	88° 28' 7.908" E
32	27° 0' 43.976" N	88° 28' 4.231" E
33	27° 0' 42.494" N	88° 28' 2.960" E
34	27° 0' 38.192" N	88° 27' 59.938" E
35	27° 0' 36.326" N	88° 27' 59.423" E
36	27° 0' 35.997" N	88° 27' 59.226" E
37	27° 0' 33.291" N	88° 27' 56.555" E
38	27° 0' 32.942" N	88° 27' 55.881" E
39	27° 0' 31.914" N	88° 27' 53.497" E
40	27° 0' 30.743" N	88° 27' 49.660" E
41	27° 0' 29.698" N	88° 27' 40.714" E
42	27° 0' 29.423" N	88° 27' 39.401" E
43	27° 0' 29.292" N	88° 27' 37.706" E
44	27° 0' 28.725" N	88° 27' 32.716" E
45	27° 0' 26.696" N	88° 27' 29.350" E
46	27° 0' 23.959" N	88° 27' 26.943" E
47	27° 0' 23.356" N	88° 27' 25.936" E
48	27° 0' 21.781" N	88° 27' 23.832" E
49	27° 0' 20.540" N	88° 27' 22.175" E

KPG_KPG1_RL_9

Coordinate_ID	Latitude	Longitude
50	27° 0' 17.704" N	88° 27' 20.410" E
51	27° 0' 17.183" N	88° 27' 20.266" E
52	27° 0' 16.067" N	88° 27' 19.537" E
53	27° 0' 11.926" N	88° 27' 18.389" E
54	27° 0' 8.739" N	88° 27' 17.311" E
55	27° 0' 4.641" N	88° 27' 14.494" E
56	26° 59' 59.959" N	88° 27' 8.214" E
57	26° 59' 58.497" N	88° 27' 5.535" E
58	27° 0' 0.593" N	88° 27' 3.712" E
59	27° 0' 3.275" N	88° 27' 5.923" E
60	27° 0' 4.381" N	88° 27' 6.926" E
61	27° 0' 8.059" N	88° 27' 11.839" E
62	27° 0' 12.375" N	88° 27' 13.546" E
63	27° 0' 18.719" N	88° 27' 15.355" E
64	27° 0' 25.155" N	88° 27' 21.620" E
65	27° 0' 25.489" N	88° 27' 21.855" E
66	27° 0' 26.442" N	88° 27' 23.122" E
67	27° 0' 27.685" N	88° 27' 23.395" E
68	27° 0' 29.559" N	88° 27' 24.710" E
69	27° 0' 32.377" N	88° 27' 31.581" E
70	27° 0' 33.088" N	88° 27' 37.703" E
71	27° 0' 33.128" N	88° 27' 38.452" E
72	27° 0' 33.334" N	88° 27' 41.719" E
73	27° 0' 33.594" N	88° 27' 42.065" E
74	27° 0' 33.703" N	88° 27' 43.002" E
75	27° 0' 39.082" N	88° 27' 52.825" E
76	27° 0' 42.241" N	88° 27' 57.037" E
77	27° 0' 42.422" N	88° 27' 57.464" E
78	27° 0' 44.797" N	88° 28' 0.605" E
79	27° 0' 46.884" N	88° 28' 1.669" E
80	27° 0' 48.152" N	88° 28' 1.650" E
81	27° 0' 48.532" N	88° 28' 1.875" E
82	27° 0' 50.191" N	88° 28' 1.977" E
83	27° 0' 51.789" N	88° 28' 2.923" E
84	27° 0' 56.225" N	88° 28' 6.283" E
85	27° 0' 57.173" N	88° 28' 7.755" E
86	27° 0' 57.452" N	88° 28' 10.677" E
87	27° 0' 57.443" N	88° 28' 11.507" E
88	27° 0' 57.415" N	88° 28' 12.056" E
89	27° 0' 57.434" N	88° 28' 12.349" E
90	27° 0' 57.420" N	88° 28' 13.671" E
91	27° 0' 57.697" N	88° 28' 16.824" E
92	27° 0' 57.734" N	88° 28' 16.946" E
93	27° 0' 57.749" N	88° 28' 17.172" E
94	27° 0' 57.876" N	88° 28' 17.418" E
95	27° 0' 58.395" N	88° 28' 19.137" E
96	27° 0' 59.500" N	88° 28' 22.031" E
97	27° 1' 0.034" N	88° 28' 22.863" E
98	27° 1' 0.323" N	88° 28' 23.815" E
99	27° 1' 1.235" N	88° 28' 24.249" E

KPG_KPG1_RL_9

Coordinate_ID	Latitude	Longitude
100	27° 1' 3.691" N	88° 28' 25.772" E
101	27° 1' 7.534" N	88° 28' 26.552" E
102	27° 1' 8.281" N	88° 28' 26.701" E
103	27° 1' 9.958" N	88° 28' 27.380" E
104	27° 1' 11.744" N	88° 28' 28.527" E
105	27° 1' 13.710" N	88° 28' 31.241" E
106	27° 1' 14.603" N	88° 28' 32.786" E
107	27° 1' 15.676" N	88° 28' 35.985" E
108	27° 1' 16.047" N	88° 28' 37.953" E
109	27° 1' 16.771" N	88° 28' 41.073" E
110	27° 1' 17.115" N	88° 28' 41.650" E
111	27° 1' 17.455" N	88° 28' 43.076" E
112	27° 1' 19.730" N	88° 28' 45.050" E
113	27° 1' 20.538" N	88° 28' 45.218" E
114	27° 1' 22.945" N	88° 28' 45.954" E
115	27° 1' 26.087" N	88° 28' 45.543" E
116	27° 1' 26.199" N	88° 28' 45.583" E
117	27° 1' 28.157" N	88° 28' 47.405" E
118	27° 1' 29.780" N	88° 28' 50.076" E
119	27° 1' 30.344" N	88° 28' 52.042" E
120	27° 1' 29.869" N	88° 28' 54.724" E
121	27° 1' 28.877" N	88° 28' 57.476" E
122	27° 1' 27.163" N	88° 29' 0.218" E
123	27° 1' 27.070" N	88° 29' 2.483" E
124	27° 1' 28.140" N	88° 29' 5.415" E
125	27° 1' 28.177" N	88° 29' 5.457" E
126	27° 1' 28.193" N	88° 29' 5.610" E
127	27° 1' 29.224" N	88° 29' 6.905" E
128	27° 1' 29.678" N	88° 29' 7.030" E
129	27° 1' 30.901" N	88° 29' 7.717" E
130	27° 1' 32.931" N	88° 29' 7.629" E
131	27° 1' 33.542" N	88° 29' 7.395" E
132	27° 1' 33.771" N	88° 29' 7.383" E
133	27° 1' 34.046" N	88° 29' 7.203" E
134	27° 1' 34.485" N	88° 29' 7.035" E
135	27° 1' 36.948" N	88° 29' 5.737" E
136	27° 1' 36.996" N	88° 29' 5.723" E
137	27° 1' 38.774" N	88° 29' 5.711" E
138	27° 1' 39.484" N	88° 29' 6.234" E
139	27° 1' 39.768" N	88° 29' 6.445" E
140	27° 1' 40.713" N	88° 29' 9.242" E
141	27° 1' 39.657" N	88° 29' 9.084" E
142	27° 1' 38.889" N	88° 29' 8.498" E
143	27° 1' 37.528" N	88° 29' 7.933" E
144	27° 1' 36.366" N	88° 29' 8.062" E
145	27° 1' 33.856" N	88° 29' 8.778" E
146	27° 1' 31.655" N	88° 29' 9.641" E
147	27° 1' 30.389" N	88° 29' 9.798" E

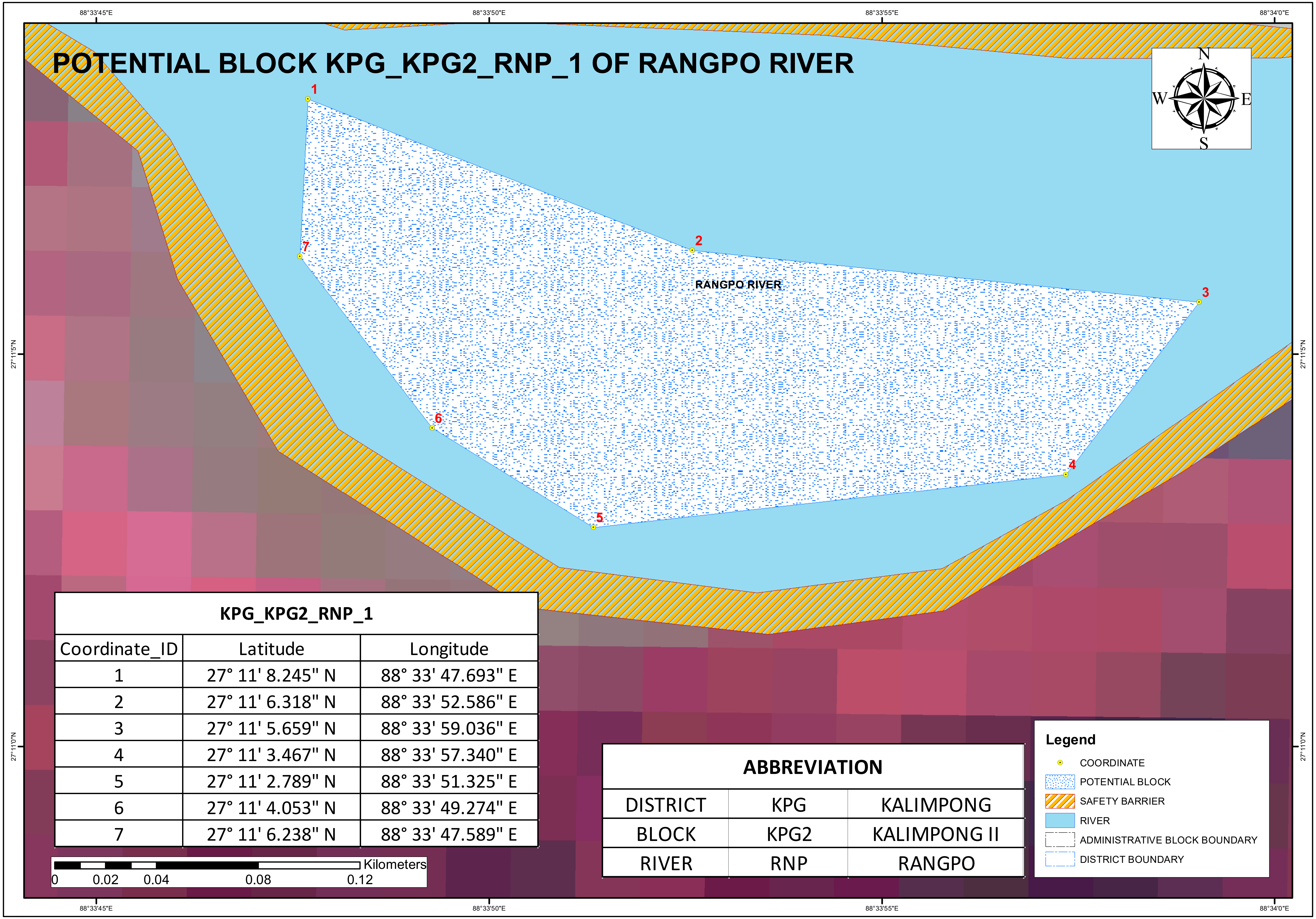
ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	KPG1	KALIMPONG I
RIVER	RL	RELLI KHOLA

Legend

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

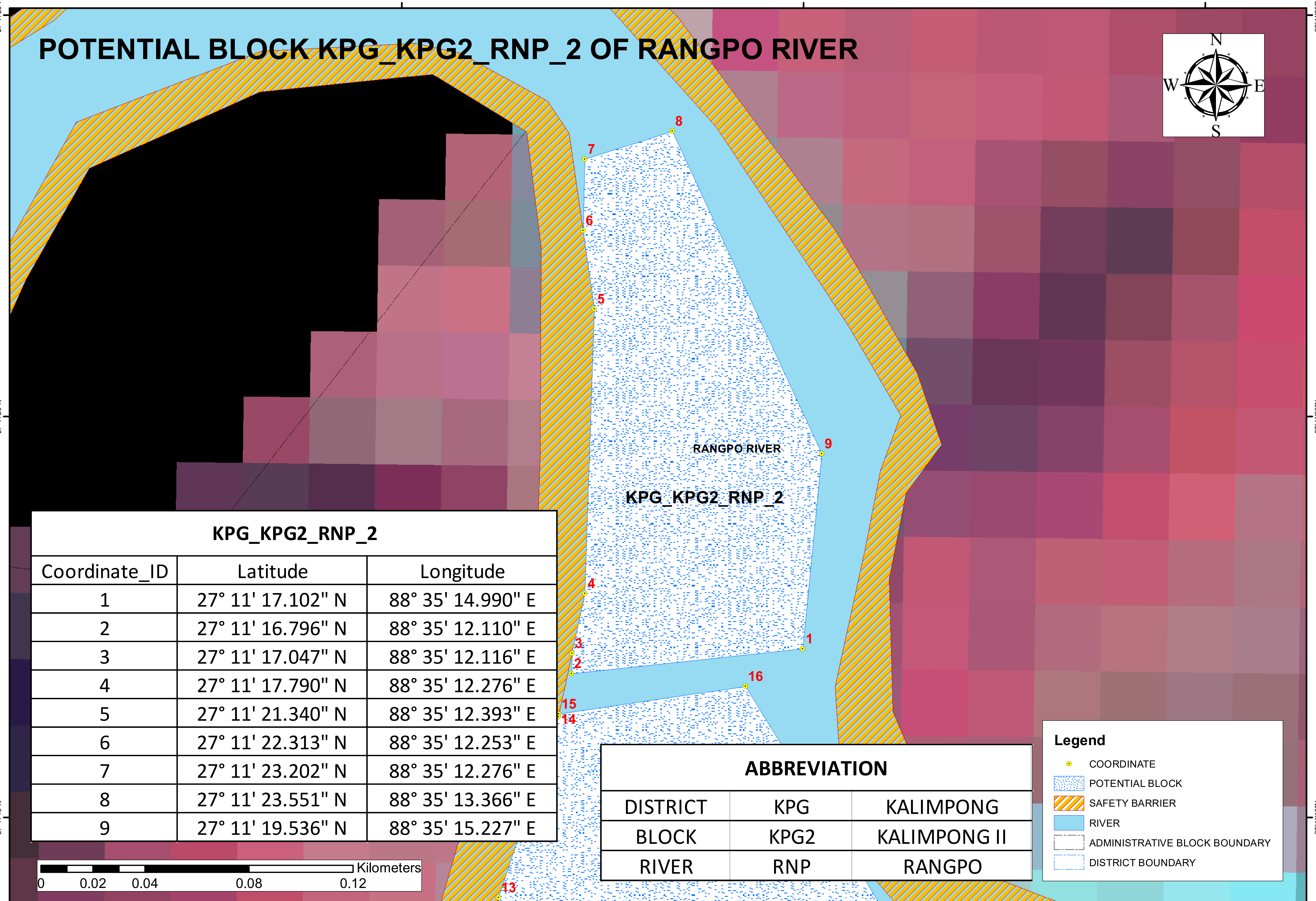
POTENTIAL BLOCK KPG_KPG2_RNP_1 OF RANGPO RIVER



KPG_KPG2_RNP_1		
Coordinate_ID	Latitude	Longitude
1	27° 11' 8.245" N	88° 33' 47.693" E
2	27° 11' 6.318" N	88° 33' 52.586" E
3	27° 11' 5.659" N	88° 33' 59.036" E
4	27° 11' 3.467" N	88° 33' 57.340" E
5	27° 11' 2.789" N	88° 33' 51.325" E
6	27° 11' 4.053" N	88° 33' 49.274" E
7	27° 11' 6.238" N	88° 33' 47.589" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RNP	RANGPO

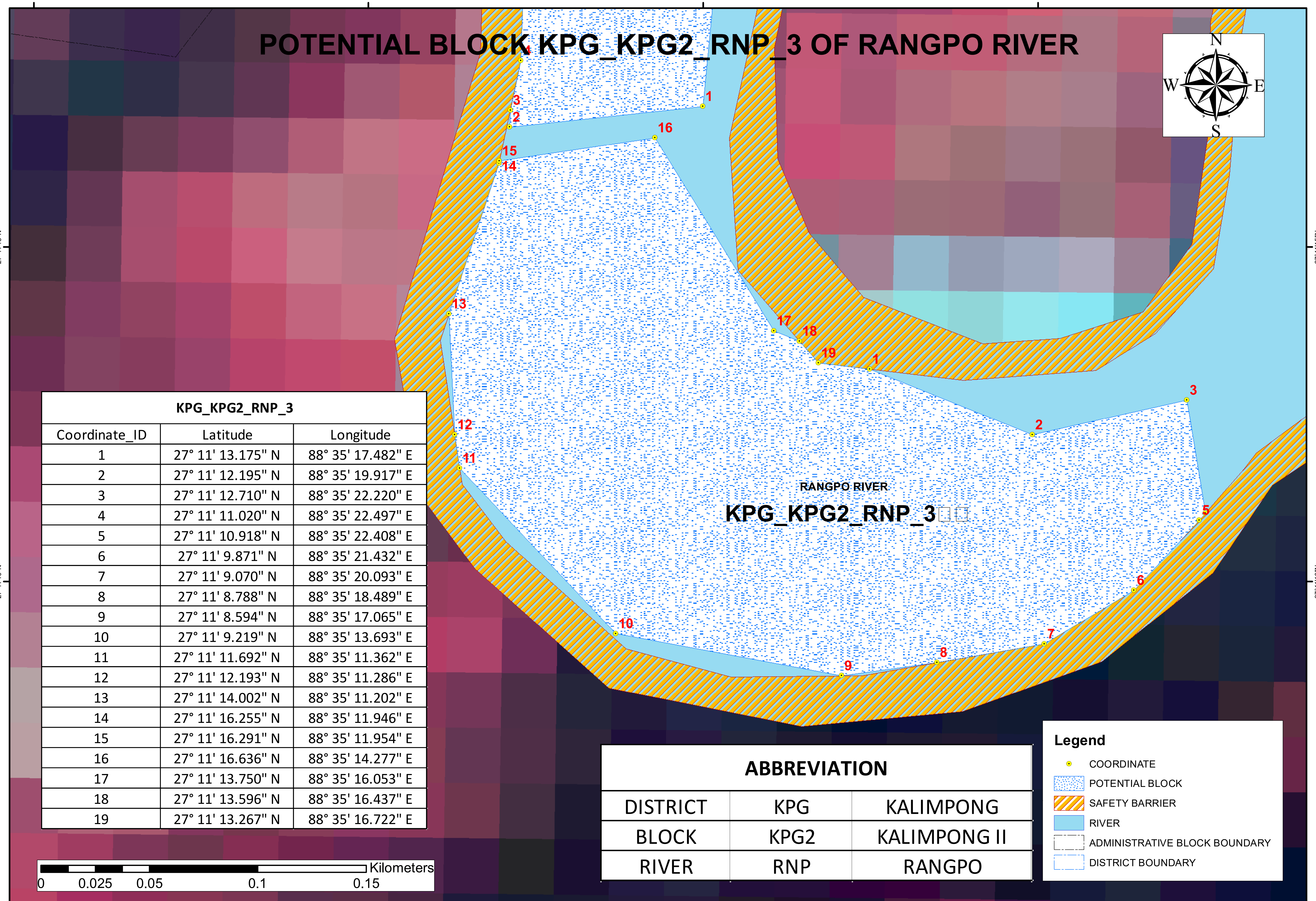
POTENTIAL BLOCK KPG_KPG2_RNP_2 OF RANGPO RIVER



KPG_KPG2_RNP_2		
Coordinate_ID	Latitude	Longitude
1	27° 11' 17.102" N	88° 35' 14.990" E
2	27° 11' 16.796" N	88° 35' 12.110" E
3	27° 11' 17.047" N	88° 35' 12.116" E
4	27° 11' 17.790" N	88° 35' 12.276" E
5	27° 11' 21.340" N	88° 35' 12.393" E
6	27° 11' 22.313" N	88° 35' 12.253" E
7	27° 11' 23.202" N	88° 35' 12.276" E
8	27° 11' 23.551" N	88° 35' 13.366" E
9	27° 11' 19.536" N	88° 35' 15.227" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RNP	RANGPO

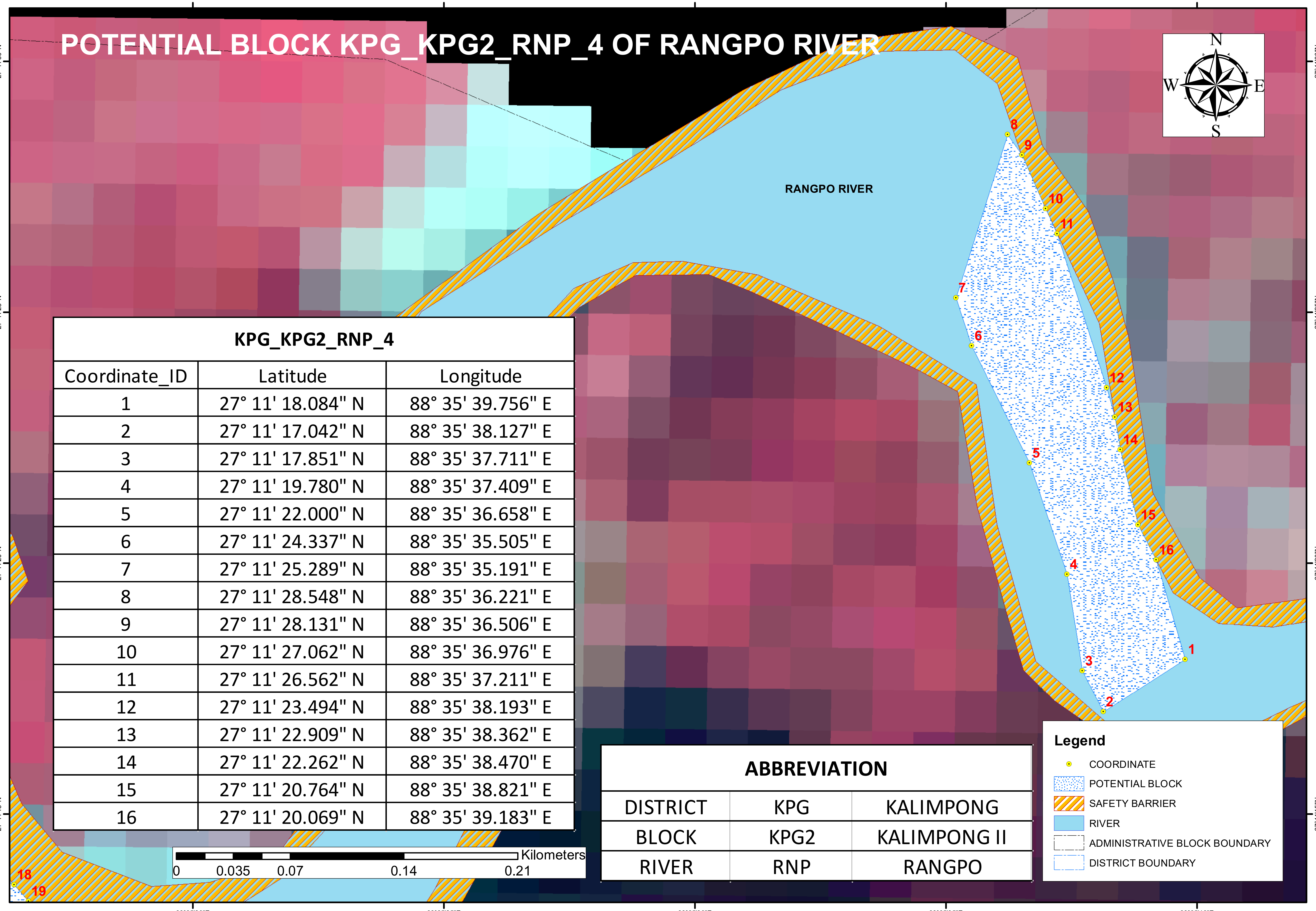
POTENTIAL BLOCK KPG_KPG2_RNP_3 OF RANGPO RIVER



KPG_KPG2_RNP_3		
Coordinate_ID	Latitude	Longitude
1	27° 11' 13.175" N	88° 35' 17.482" E
2	27° 11' 12.195" N	88° 35' 19.917" E
3	27° 11' 12.710" N	88° 35' 22.220" E
4	27° 11' 11.020" N	88° 35' 22.497" E
5	27° 11' 10.918" N	88° 35' 22.408" E
6	27° 11' 9.871" N	88° 35' 21.432" E
7	27° 11' 9.070" N	88° 35' 20.093" E
8	27° 11' 8.788" N	88° 35' 18.489" E
9	27° 11' 8.594" N	88° 35' 17.065" E
10	27° 11' 9.219" N	88° 35' 13.693" E
11	27° 11' 11.692" N	88° 35' 11.362" E
12	27° 11' 12.193" N	88° 35' 11.286" E
13	27° 11' 14.002" N	88° 35' 11.202" E
14	27° 11' 16.255" N	88° 35' 11.946" E
15	27° 11' 16.291" N	88° 35' 11.954" E
16	27° 11' 16.636" N	88° 35' 14.277" E
17	27° 11' 13.750" N	88° 35' 16.053" E
18	27° 11' 13.596" N	88° 35' 16.437" E
19	27° 11' 13.267" N	88° 35' 16.722" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RNP	RANGPO

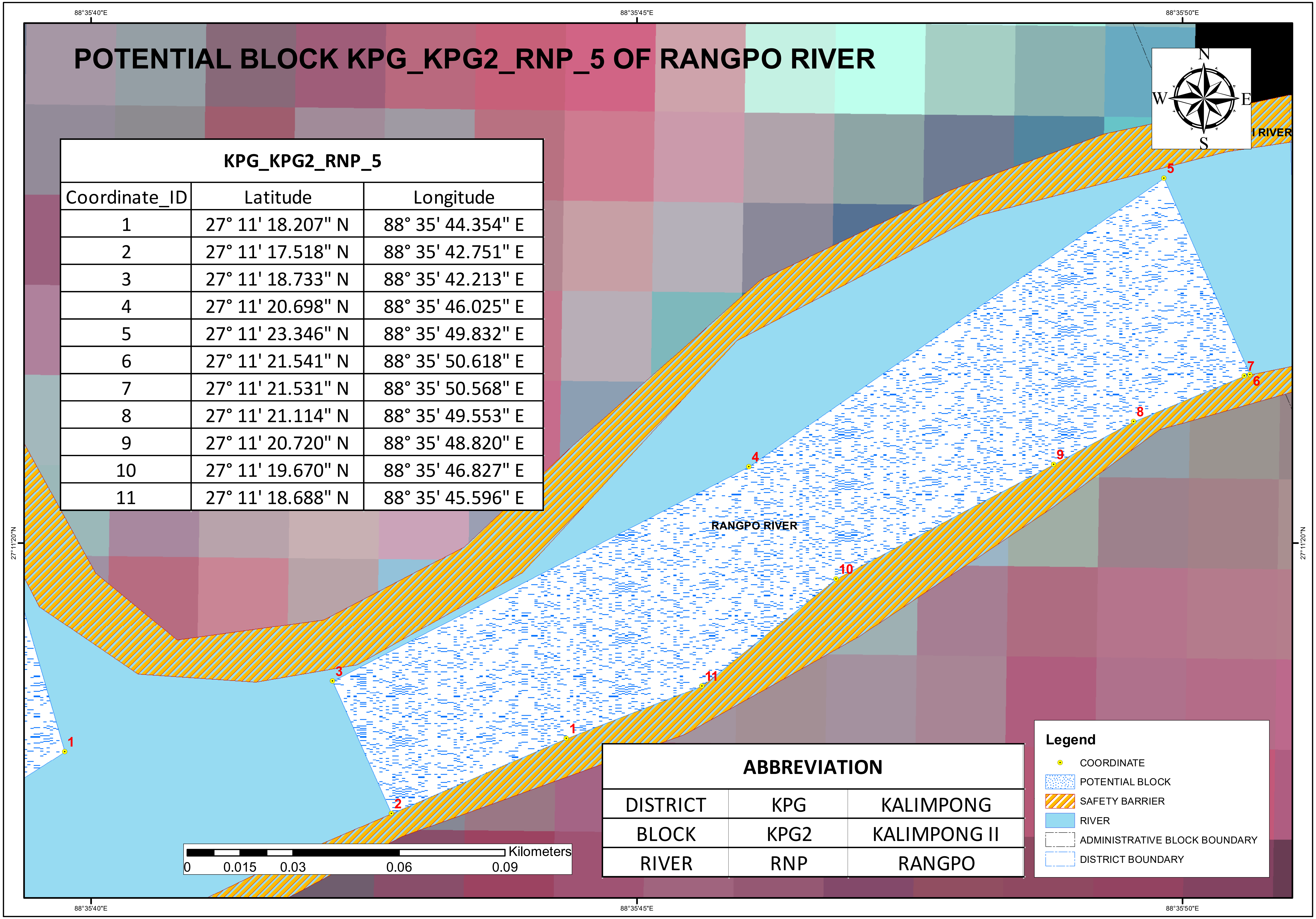
POTENTIAL BLOCK KPG_KPG2_RNP_4 OF RANGPO RIVER



KPG_KPG2_RNP_4		
Coordinate_ID	Latitude	Longitude
1	27° 11' 18.084" N	88° 35' 39.756" E
2	27° 11' 17.042" N	88° 35' 38.127" E
3	27° 11' 17.851" N	88° 35' 37.711" E
4	27° 11' 19.780" N	88° 35' 37.409" E
5	27° 11' 22.000" N	88° 35' 36.658" E
6	27° 11' 24.337" N	88° 35' 35.505" E
7	27° 11' 25.289" N	88° 35' 35.191" E
8	27° 11' 28.548" N	88° 35' 36.221" E
9	27° 11' 28.131" N	88° 35' 36.506" E
10	27° 11' 27.062" N	88° 35' 36.976" E
11	27° 11' 26.562" N	88° 35' 37.211" E
12	27° 11' 23.494" N	88° 35' 38.193" E
13	27° 11' 22.909" N	88° 35' 38.362" E
14	27° 11' 22.262" N	88° 35' 38.470" E
15	27° 11' 20.764" N	88° 35' 38.821" E
16	27° 11' 20.069" N	88° 35' 39.183" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RNP	RANGPO

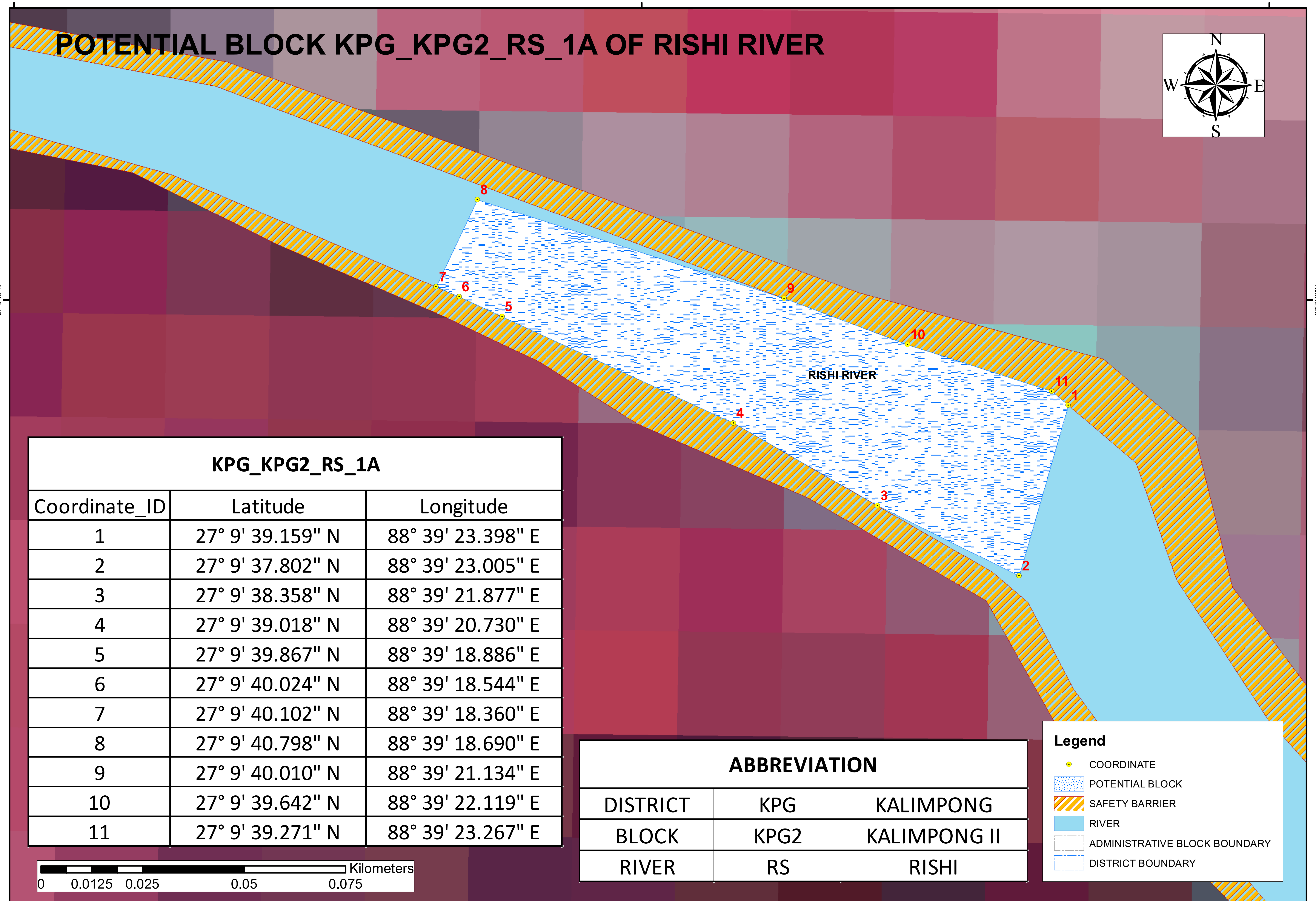
POTENTIAL BLOCK KPG_KPG2_RNP_5 OF RANGPO RIVER



KPG_KPG2_RNP_5		
Coordinate_ID	Latitude	Longitude
1	27° 11' 18.207" N	88° 35' 44.354" E
2	27° 11' 17.518" N	88° 35' 42.751" E
3	27° 11' 18.733" N	88° 35' 42.213" E
4	27° 11' 20.698" N	88° 35' 46.025" E
5	27° 11' 23.346" N	88° 35' 49.832" E
6	27° 11' 21.541" N	88° 35' 50.618" E
7	27° 11' 21.531" N	88° 35' 50.568" E
8	27° 11' 21.114" N	88° 35' 49.553" E
9	27° 11' 20.720" N	88° 35' 48.820" E
10	27° 11' 19.670" N	88° 35' 46.827" E
11	27° 11' 18.688" N	88° 35' 45.596" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RNP	RANGPO

POTENTIAL BLOCK KPG_KPG2_RS_1A OF RISHI RIVER



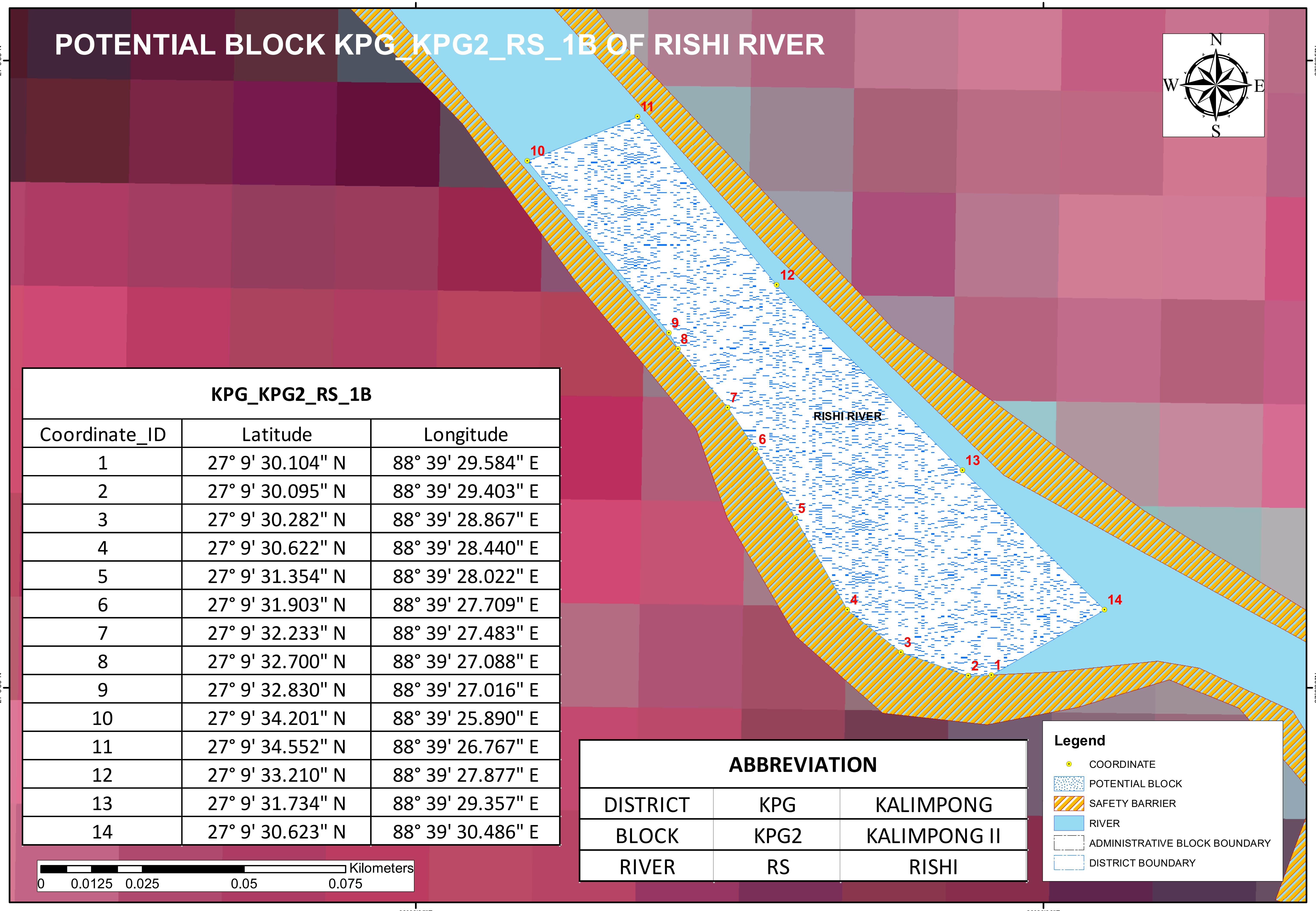
KPG_KPG2_RS_1A

Coordinate_ID	Latitude	Longitude
1	27° 9' 39.159" N	88° 39' 23.398" E
2	27° 9' 37.802" N	88° 39' 23.005" E
3	27° 9' 38.358" N	88° 39' 21.877" E
4	27° 9' 39.018" N	88° 39' 20.730" E
5	27° 9' 39.867" N	88° 39' 18.886" E
6	27° 9' 40.024" N	88° 39' 18.544" E
7	27° 9' 40.102" N	88° 39' 18.360" E
8	27° 9' 40.798" N	88° 39' 18.690" E
9	27° 9' 40.010" N	88° 39' 21.134" E
10	27° 9' 39.642" N	88° 39' 22.119" E
11	27° 9' 39.271" N	88° 39' 23.267" E

ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RS	RISHI

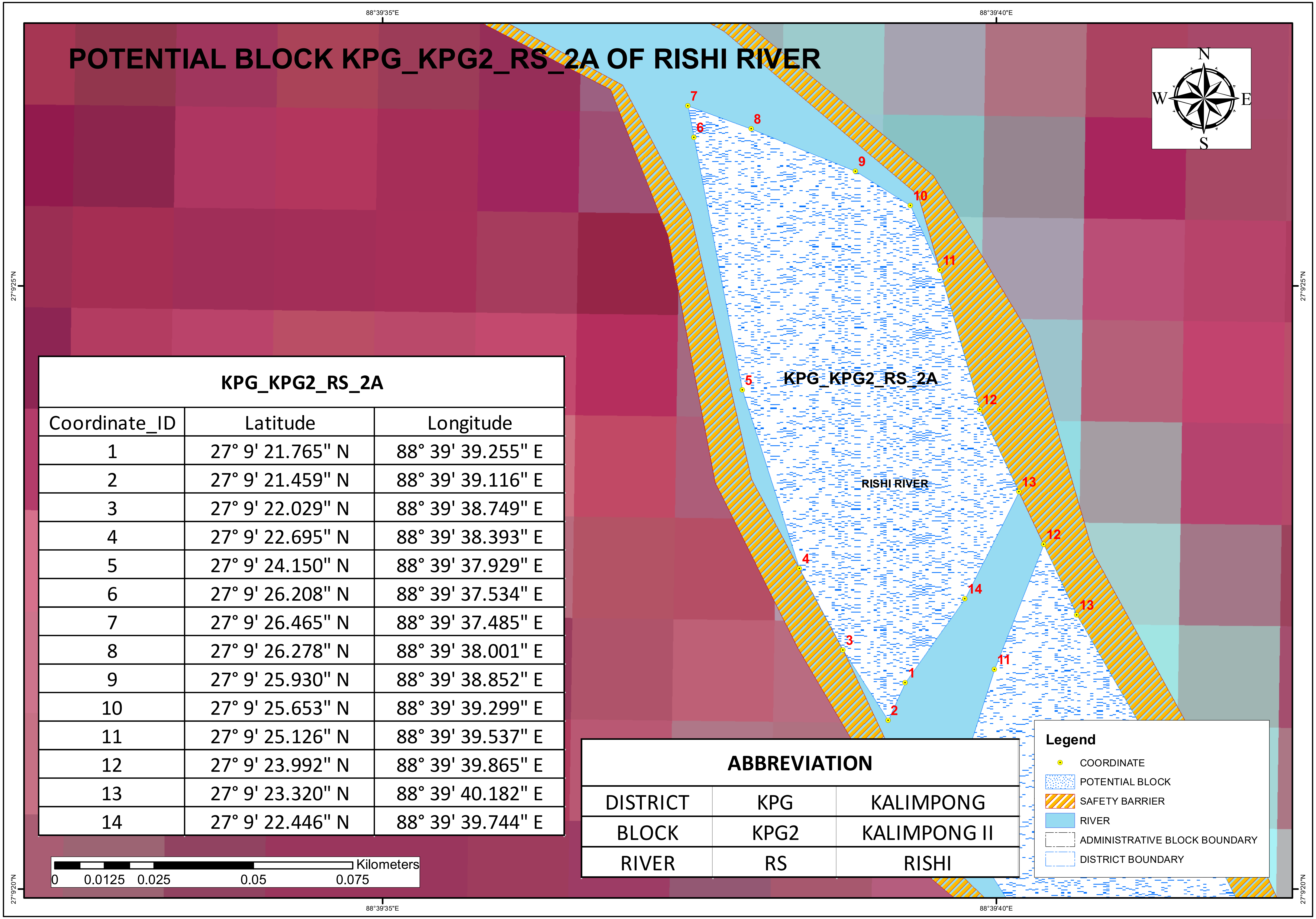
POTENTIAL BLOCK KPG_KPG2_RS_1B OF RISHI RIVER



KPG_KPG2_RS_1B		
Coordinate_ID	Latitude	Longitude
1	27° 9' 30.104" N	88° 39' 29.584" E
2	27° 9' 30.095" N	88° 39' 29.403" E
3	27° 9' 30.282" N	88° 39' 28.867" E
4	27° 9' 30.622" N	88° 39' 28.440" E
5	27° 9' 31.354" N	88° 39' 28.022" E
6	27° 9' 31.903" N	88° 39' 27.709" E
7	27° 9' 32.233" N	88° 39' 27.483" E
8	27° 9' 32.700" N	88° 39' 27.088" E
9	27° 9' 32.830" N	88° 39' 27.016" E
10	27° 9' 34.201" N	88° 39' 25.890" E
11	27° 9' 34.552" N	88° 39' 26.767" E
12	27° 9' 33.210" N	88° 39' 27.877" E
13	27° 9' 31.734" N	88° 39' 29.357" E
14	27° 9' 30.623" N	88° 39' 30.486" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RS	RISHI

POTENTIAL BLOCK KPG_KPG2_RS_2A OF RISHI RIVER



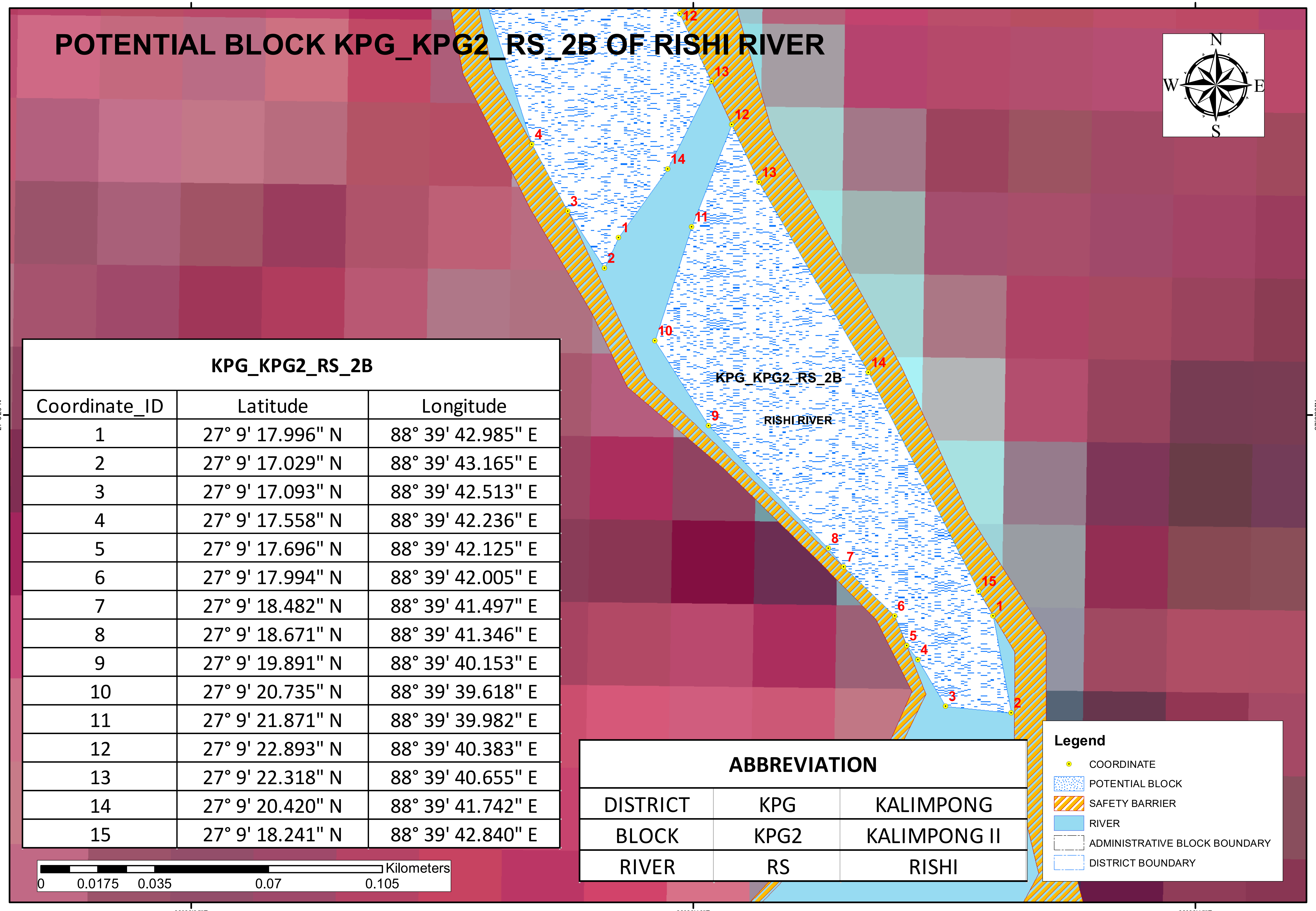
KPG_KPG2_RS_2A

Coordinate_ID	Latitude	Longitude
1	27° 9' 21.765" N	88° 39' 39.255" E
2	27° 9' 21.459" N	88° 39' 39.116" E
3	27° 9' 22.029" N	88° 39' 38.749" E
4	27° 9' 22.695" N	88° 39' 38.393" E
5	27° 9' 24.150" N	88° 39' 37.929" E
6	27° 9' 26.208" N	88° 39' 37.534" E
7	27° 9' 26.465" N	88° 39' 37.485" E
8	27° 9' 26.278" N	88° 39' 38.001" E
9	27° 9' 25.930" N	88° 39' 38.852" E
10	27° 9' 25.653" N	88° 39' 39.299" E
11	27° 9' 25.126" N	88° 39' 39.537" E
12	27° 9' 23.992" N	88° 39' 39.865" E
13	27° 9' 23.320" N	88° 39' 40.182" E
14	27° 9' 22.446" N	88° 39' 39.744" E

ABBREVIATION

DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RS	RISHI

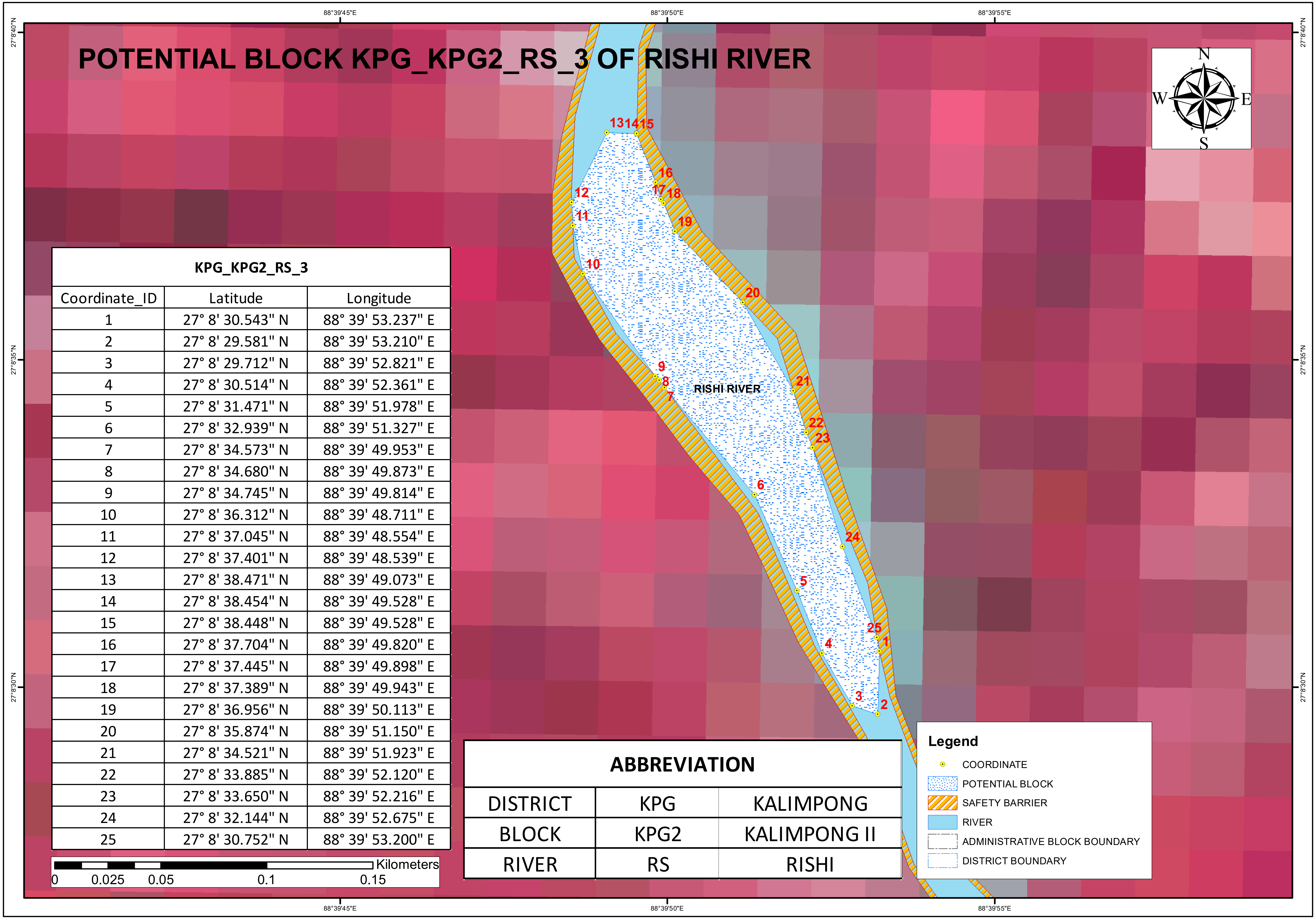
POTENTIAL BLOCK KPG_KPG2_RS_2B OF RISHI RIVER



KPG_KPG2_RS_2B		
Coordinate_ID	Latitude	Longitude
1	27° 9' 17.996" N	88° 39' 42.985" E
2	27° 9' 17.029" N	88° 39' 43.165" E
3	27° 9' 17.093" N	88° 39' 42.513" E
4	27° 9' 17.558" N	88° 39' 42.236" E
5	27° 9' 17.696" N	88° 39' 42.125" E
6	27° 9' 17.994" N	88° 39' 42.005" E
7	27° 9' 18.482" N	88° 39' 41.497" E
8	27° 9' 18.671" N	88° 39' 41.346" E
9	27° 9' 19.891" N	88° 39' 40.153" E
10	27° 9' 20.735" N	88° 39' 39.618" E
11	27° 9' 21.871" N	88° 39' 39.982" E
12	27° 9' 22.893" N	88° 39' 40.383" E
13	27° 9' 22.318" N	88° 39' 40.655" E
14	27° 9' 20.420" N	88° 39' 41.742" E
15	27° 9' 18.241" N	88° 39' 42.840" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RS	RISHI

POTENTIAL BLOCK KPG_KPG2_RS_3 OF RISHI RIVER



KPG_KPG2_RS_3		
Coordinate_ID	Latitude	Longitude
1	27° 8' 30.543" N	88° 39' 53.237" E
2	27° 8' 29.581" N	88° 39' 53.210" E
3	27° 8' 29.712" N	88° 39' 52.821" E
4	27° 8' 30.514" N	88° 39' 52.361" E
5	27° 8' 31.471" N	88° 39' 51.978" E
6	27° 8' 32.939" N	88° 39' 51.327" E
7	27° 8' 34.573" N	88° 39' 49.953" E
8	27° 8' 34.680" N	88° 39' 49.873" E
9	27° 8' 34.745" N	88° 39' 49.814" E
10	27° 8' 36.312" N	88° 39' 48.711" E
11	27° 8' 37.045" N	88° 39' 48.554" E
12	27° 8' 37.401" N	88° 39' 48.539" E
13	27° 8' 38.471" N	88° 39' 49.073" E
14	27° 8' 38.454" N	88° 39' 49.528" E
15	27° 8' 38.448" N	88° 39' 49.528" E
16	27° 8' 37.704" N	88° 39' 49.820" E
17	27° 8' 37.445" N	88° 39' 49.898" E
18	27° 8' 37.389" N	88° 39' 49.943" E
19	27° 8' 36.956" N	88° 39' 50.113" E
20	27° 8' 35.874" N	88° 39' 51.150" E
21	27° 8' 34.521" N	88° 39' 51.923" E
22	27° 8' 33.885" N	88° 39' 52.120" E
23	27° 8' 33.650" N	88° 39' 52.216" E
24	27° 8' 32.144" N	88° 39' 52.675" E
25	27° 8' 30.752" N	88° 39' 53.200" E

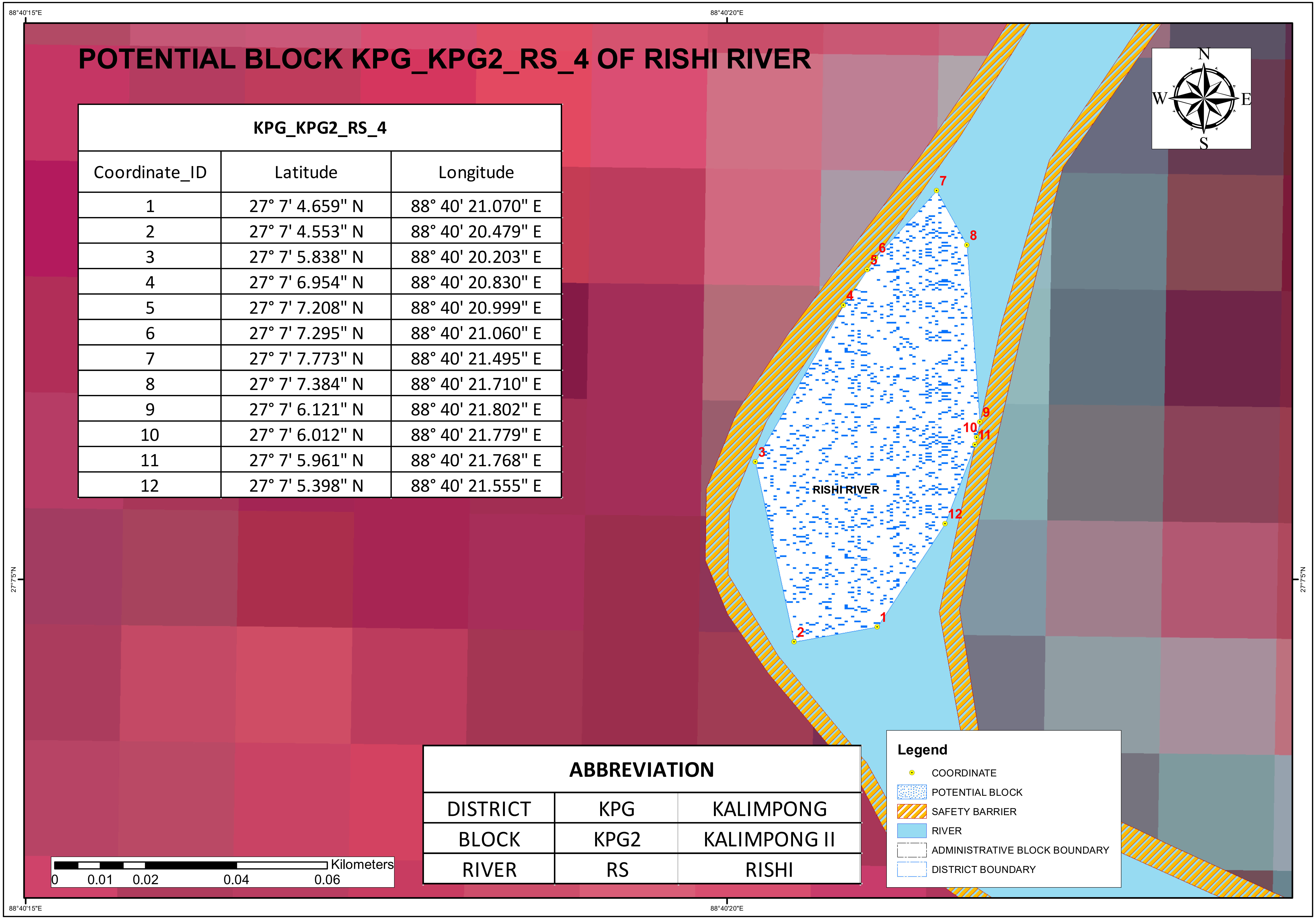
ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RS	RISHI

Legend

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

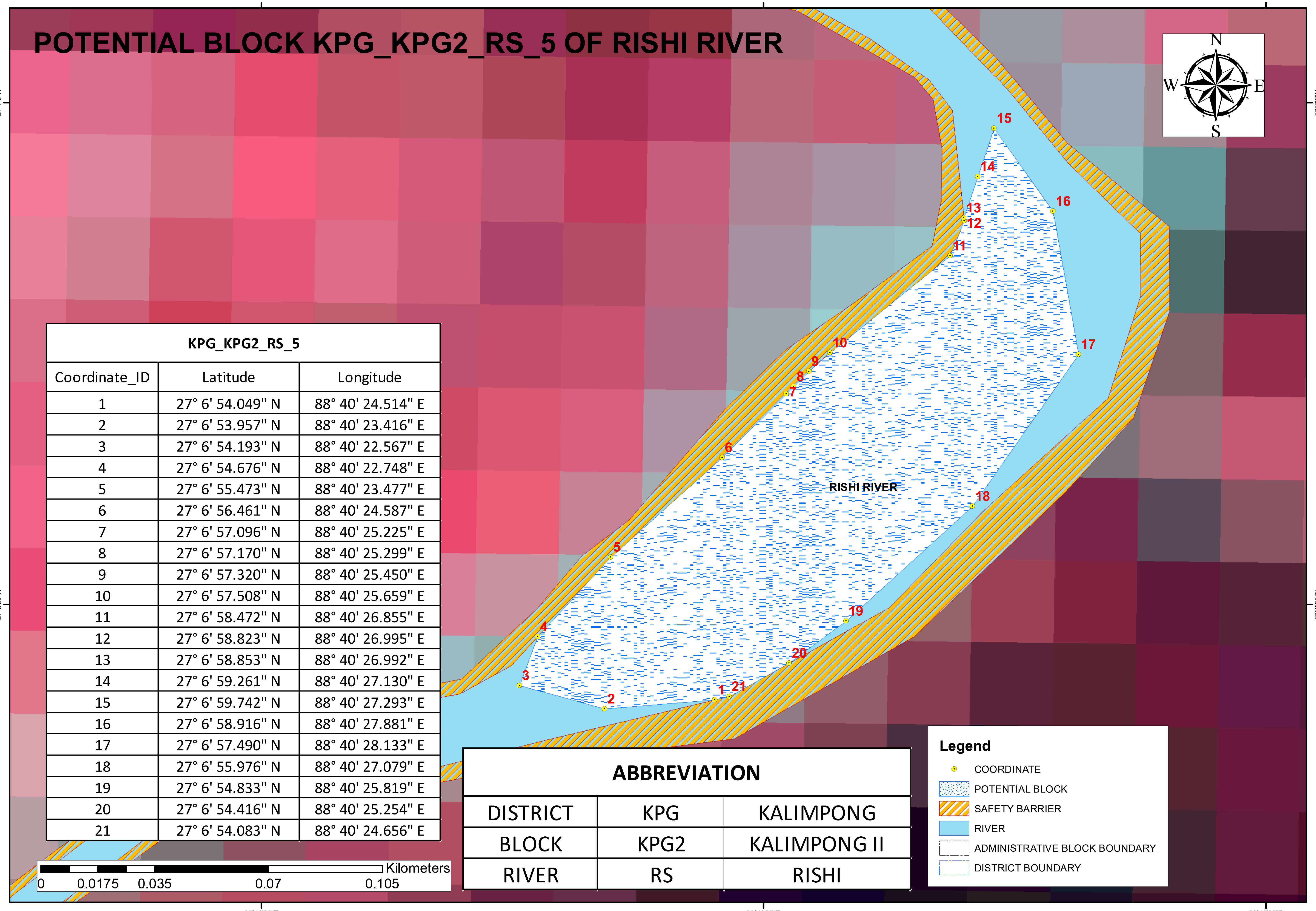
POTENTIAL BLOCK KPG_KPG2_RS_4 OF RISHI RIVER

KPG_KPG2_RS_4		
Coordinate_ID	Latitude	Longitude
1	27° 7' 4.659" N	88° 40' 21.070" E
2	27° 7' 4.553" N	88° 40' 20.479" E
3	27° 7' 5.838" N	88° 40' 20.203" E
4	27° 7' 6.954" N	88° 40' 20.830" E
5	27° 7' 7.208" N	88° 40' 20.999" E
6	27° 7' 7.295" N	88° 40' 21.060" E
7	27° 7' 7.773" N	88° 40' 21.495" E
8	27° 7' 7.384" N	88° 40' 21.710" E
9	27° 7' 6.121" N	88° 40' 21.802" E
10	27° 7' 6.012" N	88° 40' 21.779" E
11	27° 7' 5.961" N	88° 40' 21.768" E
12	27° 7' 5.398" N	88° 40' 21.555" E



ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RS	RISHI

POTENTIAL BLOCK KPG_KPG2_RS_5 OF RISHI RIVER



KPG_KPG2_RS_5		
Coordinate_ID	Latitude	Longitude
1	27° 6' 54.049" N	88° 40' 24.514" E
2	27° 6' 53.957" N	88° 40' 23.416" E
3	27° 6' 54.193" N	88° 40' 22.567" E
4	27° 6' 54.676" N	88° 40' 22.748" E
5	27° 6' 55.473" N	88° 40' 23.477" E
6	27° 6' 56.461" N	88° 40' 24.587" E
7	27° 6' 57.096" N	88° 40' 25.225" E
8	27° 6' 57.170" N	88° 40' 25.299" E
9	27° 6' 57.320" N	88° 40' 25.450" E
10	27° 6' 57.508" N	88° 40' 25.659" E
11	27° 6' 58.472" N	88° 40' 26.855" E
12	27° 6' 58.823" N	88° 40' 26.995" E
13	27° 6' 58.853" N	88° 40' 26.992" E
14	27° 6' 59.261" N	88° 40' 27.130" E
15	27° 6' 59.742" N	88° 40' 27.293" E
16	27° 6' 58.916" N	88° 40' 27.881" E
17	27° 6' 57.490" N	88° 40' 28.133" E
18	27° 6' 55.976" N	88° 40' 27.079" E
19	27° 6' 54.833" N	88° 40' 25.819" E
20	27° 6' 54.416" N	88° 40' 25.254" E
21	27° 6' 54.083" N	88° 40' 24.656" E

ABBREVIATION		
DISTRICT	KPG	KALIMPONG
BLOCK	KPG2	KALIMPONG II
RIVER	RS	RISHI

<u>ANNEXURE 5.1</u>

Compliance to the Observations
Government of West Bengal
Office of the Additional District Magistrate And
District Land & Land Reforms Officer, Kalimpong
District Survey Report, Kalimpong, West Bengal
Memo No. 262/DLLRO/KPG/2021, dated 19.08.2021

SL NO	OBSERVATIONS	COMPLIANCE
1	No comments/ objections/ suggestions have been received	Not Applicable

Based on potential zone of Riverbed mineral documented in DSR, Kalimpong district team has identified potential blocks and clubbed these blocks into clusters. Details are as below:

Sl. No.	Name of Block	Name of the River	Mouza (JL No.)	Plot No	Name of Mining Block	Area (in Ha)	Cluster No.	Area of Cluster (in Ha)	Remarks
1	Kalimpong-I	Relli	Yokprintam (58)	56(P)	KPG YOKPRINTAM 2	1.50	1	4.90	
2	Kalimpong-I	Relli	Yokprintam (58)	56(P), 501(P)	KPG YOKPRINTAM 3	1.40			
3	Kalimpong-I	Relli	Yokprintam (58)	501(P)	KPG YOKPRINTAM 4	1.20			
4	Kalimpong-I&II	Relli	PudungKM(46) &Kankebong KM (42)	1926(P) Pudung 562 (P) Kankebong	KPG PUDUNGKANKEBONG 1	1.70	2	3.40	
5	Kalimpong-I&II	Relli	PudungKM(46) &Kankebong KM (42)	1926(P) Pudung 562 (P) Kankebong	KPG PUDUNGKANKEBONG 2	1.00			
6	Kalimpong-I&II	Palla	PudungKM(43) &Kankebong KM (42)	18(P)Palla 563(P) Kankebong	KPG PALA KANKEBONG 1	1.40	3	9.90	
7	Kalimpong-I&II	Palla	PudungKM(43) &Kankebong KM (42)	18(P)Palla 563(P) Kankebong	KPG PALA KANKEBONG 2	1.60			

Sl. No.	Name of Block	Name of the River	Mouza (JL No.)	Plot No	Name of Mining Block	Area (in Ha)	Cluster No.	Area of Cluster (in Ha)	Remarks
8	Kalimpong-I&II	Palla	PudungKM(43) &Kankebong KM (42)	115(P)Palla 563(P) Kankebong	KPG PALA KANKEBONG 3	1.00			
9	Kalimpong-I&II	Palla	PudungKM(43) &Kankebong KM (42)	115(P)Palla 563(P) Kankebong	KPG PALA KANKEBONG 4	1.60			
10	Kalimpong-I&II	Palla	PudungKM(43) &Kankebong KM (42)	115(P)Palla 563(P) Kankebong	KPG PALA KANKEBONG 5	2.00			
11	Kalimpong-I&II	Palla	PudungKM(43) &Kankebong KM (42)	115(P)Palla 601(P) Kankebong	KPG PALA KANKEBONG 6	0.80			
12	Kalimpong-I&II	Relli	PudungKM(46) &Lolay KM (44)	RS 942 (P) Pudung& LR 1(P) Lolay	KPG PUDUNGLOLEY 1	2.00	4	2.00	
13	Kalimpong-I&II	Relli	PudungKM(46) &Lolay KM (44)	LR 1926(P) Pudung& LR 1(P) Lolay	KPG PUDUNGLOLEY 3	1.80	5	1.80	
14	Kalimpong-I&II	Relli	Icha KM(45) &Lolay KM (44)	3034 (P) Icha & 1303(P) Loaly	KPG ICHA LOLEY 2	1.80	6	1.80	
15	Gorubathan	Geet	Pagrangbong (17)	LR 1901 (P)	KPG PAGRANGBONG 1	2.50	7	14.20	

Sl. No.	**Name of Block**	**Name of the River**	**Mouza (JL No.)**	**Plot No**	**Name of Mining Block**	**Area (in Ha)**	**Cluster No.**	**Area of Cluster (in Ha)**	**Remarks**
16	Gorubathan	Geet	Pagrangbong (17)	LR 1901 (P)	KPG PAGRANGBONG 2	2.50			
17	Gorubathan	Geet	Pagrangbong (17)	LR 1901 (P)	KPG PAGRANGBONG 3	2.50			
18	Gorubathan	Geet	Pagrangbong (17)	LR 1901 (P)	KPG PAGRANGBONG 4	2.50			
19	Gorubathan	Chel	Mal KM (29)	LR 15(P)	KPG MAL 1	1.20	8	20.00	
20	Gorubathan	Chel	Mal KM (29)	LR 15(P)	KPG MAL 2	2.50			
21	Gorubathan	Chel	Mal KM (29)	LR 15(P)	KPG MAL 3	3.00			
22	Gorubathan	Chel	Mal KM (29)	LR 15(P)	KPG MAL 4	3.00			
23	Gorubathan	Chel	Mal KM (29)	LR 15(P)	KPG MAL 5	3.00			
24	Kalimpong-II	Rangpo				2.00	9	2.00	
25	Kalimpong-II	Rishi	Lingsekha KM	1001 (P)		2.00	10	2.00	

ANNEXURE 5.2

Compliance to the Minutes of the twenty-eighth meeting of the reconstituted State Level Expert Appraisal Committee, West Bengal held on 08.01.2022 at 10:30 a.m. at the Conference Room, Paribesh Bhawan, Kolkata

Sl. No.	Observations	Compliance
1	In the drainage map watersheds and micro-watersheds should be marked	The watershed level upto 3rd order streams are marked in the drainage map and is depicted in Plate No. 3A
2	Hydrographs at key intersections along the entire stretch of the river falling in the particular district along with a discussion on the runoff of the river in the upstream and downstream within the district.	Given in section 3.6 page no 23 to 24. Depth of mining has been selected in accordance with the depth to water level depicting from the Hydrographs.
3	A separate map showing locations of dams, barrages, bridge, river bed tube wells, river bed collector wells and infiltration galleries.	Given as Plate no 1B. All major bridges, Barrages, river bed wells, and other hydraulic structures are marked in the drainage map of the district and also labelled.
4	Depth to base flow in the riverbed sand mining areas, present and proposed, in pre-monsoon and post-monsoon periods.	Depth of the base flow is below proposed mining depth as observed from the field study. During study period, no mining activity commenced.
5	Field photographs showing activities of replenishment study.	Representative Photographs of Survey of the River bed profile used for replenishment and aggradation measurement study is being furnished in Plate No. 4.
6	A map showing long-term (10-year or more) erosion-accretion areas on both the banks of the rivers which would help to identify no-mining zone on the river bed along with a discussion.	Given in Plate no 5A & 5B. Though all the rivers of the district doesn't shows much difference when studied the image archives from 1985 to 2021, however, a stretch of Geet River is being furnished as one of the representative image detection study.
7	In each proposed block, the RL of the sand surface (pre and post Monsoon) will be useful and the suggested mining depth corresponds to a particular RL of the deepest layer mined (not depth on absolute terms in case replenished quantity is different)	Elevation levels for each potential zones are furnished in Annexure-2. However, DGPS survey of each blocks shall be carried while preparation of the Mining Plans and final adjustment of depth parameters shall be done accordingly. In no circumstances, mining depth shall be increased beyond the depth suggested for each potential zone in this DSR.
8	Depth of mining considered for calculation of potential reserve. It presumes that base flow depth is more than the mining depth in pre-monsoon period. That needs to be substantiated with data for each block.	Depth of Mining Considered for each potential zones are furnished on the basis of average and is given in Table no 7.9, Page no 81. However, after finalization of the sand Blocks, each blocks shall be surveyed again during the course of Mining Plan preparation and final depths shall be suggested accordingly.
9	Ground water level pre and post monsoon in the watershed (of district) may be put in a map.	Complied with. The same has been furnished as Plate no 3B and 3C.
10	It was also suggested to show in maps the approach roads (accessibility plan complying with guidelines) for the blocks.	The major transport networks for the district are depicted in Figure no 10.2, Page no 99. The accessibility from each block shall be detailed in the

Sl. No.	Observations	Compliance
		Mining Plan.
11	Sand mining in designated upstream blocks may affect the replenishment in blocks downstream and this consideration may be relevant for estimating the percentage of replenishment. What should be the percentage for minable reserve with respect to potential reserve of sand?	This study shall be undertaken by the Mines Branch, Dep. of Industry, Commerce & Enterprise, GoWB in subsequent years and annual reports shall be generated covering these points. However, as per the EMGSM, 2020, not more than 60% of the area will be covered under extraction plan.
12	Data on river flow on all seasons and the sediment load data (especially during seasons of replenishment) will constitute a baseline condition to judge any effect of increased mining on the river flow characteristics.	This study shall be undertaken by the Mines Branch, Dep. of Industry, Commerce & Enterprise, GoWB in subsequent years and annual reports shall be generated covering these points.
13	Existing mining leases may be shown on river map along with potential blocks	Existing Mining Leases having Environmental Clearance as on 31st January, 2022 are furnished in Plate no 2A and 2B.
14	On the river map, potential new blocks and existing blocks may also be designated by serial or code number so that it matches with the tables.	Furnished in Plate no 2A and 2B
15	It will be appropriate if the methodology adopted (not only the available theory) for annual replenishment estimation is clearly and objectively narrated with applicable data and sample calculations.	Change detection through satellite imagery study, Field evidences and empirical formulae are utilized for replenishment study. Detail discussions are done in section 7 of this report.
16	Representative satellite and/or drone photography, if used for surveying, may also be produced in DSR.	All the plates are satellite imagery based and are furnished in Plate no 2A and 2B.
17	The suggested mining depth should be indicated for each block in the table (not done for PurbaBardhaman).	Complied with. Suggested mining depths are furnished in Table no 7.9, Page no 81.
18	Order of sections in the report are not logical in some reports.	Corrected and as per specified format of DSR.
19	A table showing all general compliances in DSR as per the Mining Rules may be furnished.	Complied with. Given as Annexure-1.
20	For existing mines (sand and other minerals), minable reserve has not been mentioned.	Details of the mining leases given in Table no 8.1& 8.2, Page no 92-95.
21	All the documents leave much to be desired in respect of reserve assessment and replenishments estimations.	Given in section 7.2/V, page no 64-79.
22	Reserve assessment has been rudimentary and the replenishment estimation needs to be carried out using accepted methods and models available for the purpose.	No attempt has been done for mineable reserve assessment in this DSR. Efforts have been restricted to define the potential sand resources in each rivers of the district. Mineable reserve estimation shall be done once the Blocks are demarcated as per West

Sl. No.	Observations	Compliance
		Bengal Minor Mineral Concession Rules, 2016 and based on EMGSM 2020.
23	Rivers are one of the main sources to supply sand for construction projects. Depending on river morphology and hydraulic characteristics, its sediment transport capacity, and mining operation method, the extraction of river bed materials may affect its ecosystem through bank and bed erosion. This needs to be incorporated in the DSR.	Mining impact given in Chapter 11.
24	To advance the mechanisms of river pit infilling, the effects of various parameters (i.e., the distance between pits, the pit plan shape, the pit depth, sediment size, and approaching flow velocity) needs to be investigated.	This study shall be undertaken by the Mines Branch, Dep. of Industry, Commerce & Enterprise, GoWB in subsequent years and annual reports shall be generated covering these points.
25	Monitoring should provide data to evaluate the upstream and downstream effects of sand and gravel extraction activities, and long-term changes. A brief report summarizing the annual results of the physical and biological monitoring should document the evolution of the sites over time, and the cumulative effects of sand and gravel extraction. The summary should also recommend any maintenance or modification of extraction rates needed to minimize impacts of extraction.	This study shall be undertaken by the Mines Branch, Dep. of Industry, Commerce & Enterprise, GoWB in subsequent years and annual reports shall be generated covering these points.
26	Sand Replenishment, Geomorphology and Hydrology Physical monitoring requirements of sand and gravel extraction activities should include surveyed channel cross-sections, longitudinal profiles, bed material measurements, geomorphic maps, and discharge and sediment transport measurements. The physical data will illustrate bar replenishment and any changes in channel morphology, bank erosion, or particle size.	Explained in detailed in Chapter no 7.
27	With reference to (point no 4.1.1 g) of enforcement guidelines 2020 read with Standard environmental conditions for sand mining (point no 8 page 73) of SSMMG-2016, all DSRs so prepared, should contain a chapter on NO MINING ZONE with name of mouza, dag no and geo references along with areas of sensitivity. Appraisal of the DSRs should NOT be taken for consideration without the chapter on NO MINING ZONE and AREAS of SENSITIVITY.	Section on No mining zone is given in Page no 83-84.

Sl. No.	Observations	Compliance
28	The areas of sensitivity should contain those NON-FOREST AREAS which are in excellent line of habitat for wild animals, birds, turtles, dolphins and other aquatic life, which need be excluded from the list of mining areas on ecological and environmental grounds. This is utmost necessary and has to be done to avoid conflict about wetland use in near future.	ENVIS centre on Wildlife and Protection areas map as published in August 2020, shows wildlife habitat in the potential sand mining areas.
29	For example, low lying swamps by the side of river Ajay in Paschim Midnapur and Ahiran lake, pathanbeel, Bishnupur beel area in Murshidabad District provide an excellent nitche for migratory birds in the winter. Part of river Damodar and the confluence of Damodar and Hooghly in East Barddhaman District house one of the last surviving habitats of endangered gangetic dolphin (Platinista gangeticus), should be identified in consultation with the concerned forest circles of the Department of Forests and to be excluded from the list of mining areas.	Part of comment 30.
30	Though all the DSRs so prepared, have not followed the same format yet it is felt that necessary remedial measures to mitigate the effect of mining and a reclamation plan in mined out areas should be included, especially in those DSRs which have not yet mentioned the same.	DSR Format Compliance under Notification S. O. 3611 (E), Dated 25th July 2018, Appendix-X (I).
31	Data, satellite imageries and allied information in respect of flora, fauna and their habitat biological environment, if collected from ENVIS centre may be included in the DSRs for ready reference.	Source of all the secondary figures and tables included in the DSR.
32	DSR comprises of secondary data which are required to be endorsed by concerned Departments.	References for secondary data are furnished in the DSR under references.
33	Revision should be done every year and actual survey should be done.	This study shall be undertaken by the Mines Branch, Dep. of Industry, Commerce & Enterprise, GoWB in subsequent years and annual reports shall be generated covering these points.
34	It is to be clearly mentioned that there are no other minerals than sand in this district.	Noted.
35	Dates of NIC database and other data should be provided	Noted and given in page no 13-14.
36	Outcome / response to the public consultation should be mentioned	Given as compliance statements in the DSR.

Sl. No.	Observations	Compliance
37	No-Mining-Zone should be clearly mentioned with special mention to the ecologically and otherwise sensitive zones. Bridges and river-bed tubewells should also be clearly demarcated. Wildlife should also be considered	Restricted zone given as Plate no 2A and 2B. Location of bridges, dam given in 1B
38	Hydrographs of the rivers and volume of rain should be studied to correlate with the minable sand reserve	Incorporated in the Replenishment study section 7.2/V, page no 64-79.
39	Text parts (as in Chapter 6) should be provided with proper reference and citation of authentic books. Sources of Tables and figures should be mentioned. Some are very old data – those should be replaced by latest data	Source of all the secondary figures and tables included in the DSR.
40	Depth of mining and distance from banks should be clearly mentioned and highlighted	Given as Annexure-2.
41	Secondary (Collected) data/ map from other departments should be certified from the respective departments (e.g., Forest and wildlife data, demography, aquifer, transportation route to the blocks)	References used from Public Domain/ Websites are furnished in the Reference section in this DSR.
42	Evidence (like dated photographs) of surveying, collection of primary data to be provided	Field photographs are furnished in Plate 4.
43	Sample calculation and methodology for calculation for minable resource and replenishment data to be provided with proper units	Given in Table no 7.7 and Table no 7.9.
44	If any predictive model is used, its validity should be established	Predictive Model has been carried out based on EMGSM 2020. The validity checking requires consecutive study which needs to be undertaken by the concerned department.
45	Evidence for 4 times physical survey to be provided	Field photographs are furnished in Plate 4. Field registers are available at office and can be furnished on demand.
46	Land utilization and forests data are upto 2013/2014 – should be updated	Latest available data incorporated in the DSR.

ANNEXURE 5.3

Compliance to the SEAC members' comments received through mail on 25th March 2022

Sr. No.	Observations	Compliance
1	Inclusion executive summary at the beginning	Executive summary included in page no 2.
2	Compliance table of the DM/SEAC members' observations may be placed at the end. Instead, a table of compliance with the guidelines to be placed at the beginning indicating the page number	Complied with and given as separate document.
3	DSR specific observation should not be included in all in the compliance table of all theDSR.	Complied with.
4	DSR compliance table should come just after the executive summary	Complied with and given as Annexure-1.
5	Need to mention page number in the DSR compliance table.	Modified table furnished as Annexure-1.
6	Legend should be given for sand bar coding	Complied with and furnished as abbreviation in page no 70.
7	Citation of reference should be given for Empirical formula by which Replenishment calculated.	Complied with and given in page no 74 to 77.
8	Map Source to be given for each map such as Watershed, Transport, Location, Drainage etc.	Complied with and given in Plate no 1 and 3.
9	Mention conclusion and Recommendation instead Summary	Complied with and given in page no 107-111.
10	Reference should be in a standard referencing format	Complied with and given in page no 112-113.
11	Source and date of collecting data for satellite imagery should be given.	Complied with and given in Plate no 2.

ANNEXURE 5.4

Compliance to the Minutes of the 61st meeting of the SEIAA, West Bengal held on 23.05.2022 at Kolkata

Sl. No.	Observations	Compliance
1	List of definitions of technical terms used in the DSR to be included.	Complied with.
2	Each potential zone should have a unique code no. and area bearing all the coordinates of all the points defining the boundary.	Complied with. Please refer Annexure 3.
3	A map showing the potential zone with the legend, mentioning all the coordinates of the polygon, defining the zone to be attached as annexure in the DSR.	Complied with. Please refer Annexure 4.
4	Dept. of Industry, Commerce & Enterprises will issue unique code with reference to the original coding of potential zones to each lessee. This unique code issued to lessee should be reflected in the LoI.	Shall be complied with.
5	Dept. of Industry, Commerce & Enterprises will upload the updated map showing the location of the LoI issued against the area and sand mining lease areas in different colour coding.	Shall be complied with.
6	Date of approval should be mentioned in all the pages of the annexures of DSRs.	Noted.
7	The consultant is further requested to refer the DSRs prepared by other states in order to confirm that no relevant point is missed out in any of our DSRs.	Complied with.
8	The consultant may also refer to the baseline data available with Irrigation Dept.	At present Replenishment Study is being conducted for all the sand producing Districts of West Bengal. This will be covered in the relevant reports.

ANNEXURE 5.5

Compliance to the Minutes of the 66th meeting of the SEIAA, West Bengal held on 06.07.2022 at Kolkata

Sl. No.	Observations	Compliance
1	The format of all the DSRs should be uniform.	Complied with.
2	The corrections required to be done regarding Annexure-3.	Complied with. Please refer Annexure 3.
3	List of existing lease is attached with the documents in Chapter 8.2. The list should contain the date of issue and validity.	Complied with. The details of the existing leases updated as per the data provided from concern department.
4	Sequence of meetings and observation given by SEAC and SEIAA should be mentioned in chronological order and be a part of the whole document.	Complied with. Please refer Annexure-5.

Annexure 6

SEIAA 72nd Meeting (2nd September, 2022) Minutes of Meeting

--***--

State Environment Impact Assessment Authority
Pranisampad Bhawan, 5th Floor, Sector-III, Salt Lake, Kolkata - 700106
(West Bengal)
Minutes of SEIAA Meeting

--***--

Subject:- 72nd meeting of SEIAA

Venue:- Conference Room of Environment Department, Prani Sampad Bhavan, 5th Floor, LB Block, Sector III, Salt Lake, Kolkata 700106.

From :- 02 Sep 2022

To :- 02 Sep 2022

CONSIDERATION/RECONSIDERATION OF TOR PROPOSAL
(Extension/Amendment/Corrigendum)

1. Proposal No. :- **SIA/WB/IND2/277592/2022** File No- **EN/T-II-1/019/2022**
Proposed amendment in Terms of Reference for the Ethanol/Extra Natural Alcohol (ENA) Manufacturing Plant at Plot No- 35(P), 42(P),45(P), 46(P),47(P), 48(P), 49(P), 50(P), 51, 52, 53, 54(P), 55(P), 56(P), 57(P), 93(P), 128(P), 422(P), 426(P), J.L No. 93, Malda Industrial Growth Centre, Phase II, Opp. Jubilee Petrol Pump , Vill – Mandilpur, P. O. – Narayanpur, P. S. – Malda, PIN– 732141, West Bengal by **M/s. Gujarat Ambuja Exports Ltd.**

Type Of Project : **Amendement**

INTRODUCTION

This has reference to the online application vide proposal no. **SIA/WB/IND2/277592/2022** dated **20 Jun 2022** along with the copies of EIA/EMP seeking Modification of Terms of reference (TOR) under the provisions of the EIA Notification, 2006 for the above mentioned proposed project. The proposed project activity is listed under Category **B** of EIA Notification, 2006 and the proposal is appraised at state level.

The ToR was approved by SEIAA during its 58th meeting held on 11.05.2022. Accordingly the project proponent (PP) had obtained ToR vide no. 889/EN/T-II-1/019/2022 dated 18.05.2022 from SEIAA. Now the PP had applied for amendment in the ToR for addition of 4.9 MW Captive Power Plant along with the proposed ENA plant.

SEAC recommended for amendment in Terms of Reference with the condition that ESP should be provided as emission control device.

PROJECT DETAILS

The project of M/s **GUJARAT AMBUJA EXPORTS LTD** located in as follows :

State of the project			
S. No.	**State**	**District**	**Tehsil**
(1.)	West Bengal	Malda	Maldah (old)

The salient features of the project submitted by the project proponent is available at Report under online proposal no. **SIA/WB/IND2/277592/2022**

DELIBERATION IN SEIAA

SEIAA considered the recommendation of SEAC and accepted the same.

RECOMMENDATIONS OF SEIAA

Approved for amendment in Terms of Reference.

Conclusion :

Recommended

2. Proposal No. :- **SIA/WB/MIS/278136/2022** File No- **EN/T-II-1/030/2018** Validity extension of Terms of Reference for the residential complex 'SANKALPA II' at Premises No. 36, MAR (Plot No. BF/1, BF/2, BF/3), SANKALPA SITE – II, Action Area – I, New Town, Rajarhat, Kolkata - 700156, West Bengal by **M/s. West Bengal Infrastructure Development Finance Corporation Ltd.**

Type Of Project : **Extension**

INTRODUCTION

This has reference to the online application vide proposal no. **SIA/WB/MIS/278136/2022** dated **22 Jun 2022** along with the copies of EIA/EMP seeking Modification of Terms of reference (TOR) under the provisions of the EIA Notification, 2006 for the above mentioned proposed project. The proposed project activity is listed under Category **B** of EIA Notification, 2006 and the proposal is appraised at state level.

The ToR was issued by SEAC vide Memo No. 674-2N-100/2010(E) dated 03.12.2018. Now the PP had applied for extension of validity of ToR.

SEAC recommended validity extension of Terms of Reference up to 02.12.2022 as per the provision of Notification vide No. S.O. 751(E) dated 17.02.2020 issued by MoEF&CC.

PROJECT DETAILS

The project of M/s **WEST BENGAL INFRASTRUCTURE DEVELOPMENT FINANCE CORPORATION LIMITED** located in as follows :

State of the project			
S. No.	**State**	**District**	**Tehsil**
(1.)	West Bengal	North 24 Parganas	Rajarhat

The salient features of the project submitted by the project proponent is available at Report under online proposal no. **SIA/WB/MIS/278136/2022**

DELIBERATION IN SEIAA

SEIAA considered the recommendation of SEAC and accepted the same.

RECOMMENDATIONS OF SEIAA

Approved extension of validity of Terms of Reference.

Conclusion :

Recommended

3. Proposal No. :- **SIA/WB/MIS/278503/2022** File No- **EN/T-II-1/031/2018** Validity extension of Terms of Reference for the residential complex 'SANKALPA III' at Premises No. 23, MAR (Plot No. CA/12 to CA/17), SANKALPA SITE – III, Action Area-I, New Town, Rajarhat, Kolkata - 700156, West Bengal by **M/s. West Bengal Infrastructure Development Finance Corporation Ltd.**		Type Of Project : **Extension**

INTRODUCTION

This has reference to the online application vide proposal no. **SIA/WB/MIS/278503/2022** dated **22 Jun 2022** along with the copies of EIA/EMP seeking Modification of Terms of reference (TOR) under the provisions of the EIA Notification, 2006 for the above mentioned proposed project. The proposed project activity is listed under Category **B** of EIA Notification, 2006 and the proposal is appraised at state level.

The ToR was issued by SEAC vide Memo No. 715-2N-103/2010(E) dated 10.12.2018. Now the PP had applied for extension of validity of ToR.

SEAC recommended validity extension of Terms of Reference up to 09.12.2022 as per the provision of Notification vide No. S.O. 751(E) dated 17.02.2020 issued by MoEF&CC.

PROJECT DETAILS

The project of M/s **WEST BENGAL INFRASTRUCTURE DEVELOPMENT FINANCE CORPORATION LIMITED** located in as follows :

State of the project			
S. No.	**State**	**District**	**Tehsil**
(1.)	West Bengal	North 24 Parganas	Rajarhat

The salient features of the project submitted by the project proponent is available at Report under online proposal no. **SIA/WB/MIS/278503/2022**

DELIBERATION IN SEIAA

SEIAA considered the recommendation of SEAC and accepted the same.

RECOMMENDATIONS OF SEIAA

Approved extension of validity of Terms of Reference.

Conclusion :

Recommended

MISCELLANEOUS

1. Discussion on draft DSRs of Darjeeling, Jalpaiguri and Kalimpong.

   The DSRs of Darjeeling, Jalpaiguri and Kalimpong are approved.

2. Complaint received from Ankur Sharma about flouting of environmental norms at "Mayfair Tea Resort" at New Chumta Tea Garden, Siliguri, PIN : 734001, West Bengal by M/s. Lotus Projects Private Limited on about 26 acres of vested property.

   A complaint regarding construction activities in the name of "Mayfair Tea Resort" within the New Chumta Tea Garden, Siliguri, PIN : 734001 by M/s. Lotus Projects Private Limited without obtaining Environment Clearance nor the requisite permissions from the WBPCB. It is observed that the area also falls within the Designated Eco Sensitive Zone of Mahananda Wild Life Sanctuary.

   The following actions are suggested :-

   a) **An inquiry into the project activities by WBPCB and submission of a report thereof.**
   b) **A letter may be sent to the PCCF(Wild Life) and Chief Wild Life Warden, West Bengal to obtain his comments on the project.**

3. Reply received from M/s. Larica Estates Limited to show cause notice vide no. 1250/EN/T-/II-1/077/2012(Pt.-1) dated 30.06.2022 in respect of Premises no. 295/A, Ward No. 5, Mouza – Baluria, JL No. 37, Baluria Road, PS – Barasat, Dist. - North 24 Parganas, PIN: 700126, West Bengal.

   In the reply received from M/s. Larica Estates Limited, it is observed that they have refuted the inquiry conducted by WBPCB regarding the total built up area of the Larica Township Project. It is therefore decided that an assessment of the total built up area of the project be made by a Registered Surveyor to ascertain the fact. The Surveyor is also required to check from the land records of the project area for presence of any designated water body and the present status of the same. Member Secretary may arrange for engaging a Registered Surveyor for the purpose.

4. Reply received from M/s. Manya Dealtrade Pvt. Ltd. & Ors. to show cause notice vide no. 1669/EN/T-II-1/063/2018 dated 29.07.2022 in respect of "Srijan Botanica" at Holding No. 336, Dr. B. C. Roy Road, Ward No. 25, P.S. – Sonarpur, Rajpur-Sonarpur Municipality, Dist. – South 24 Parganas, PIN : 700152, West Bengal.

   On the basis of a complain received regarding filling up of water body in the project "Srijan Botanica" a show cause notice was sent to M/s. Srijan Realty Pvt. Ltd. However, the reply has been received from M/s. Manya Dealtrade Pvt. Ltd. & Ors. on the subject claiming that M/s. Srijan Realty Pvt. Ltd. is not the land owner of the project and M/s. Manya Dealtrade Pvt. Ltd. & Ors. are the land owners of the project. The project proponent claims to have received Consent to Establish from WBPCB and Sanctioned Building Plan from Rajpur-Sonarpur Municipality having a total built up area of 16,349.77 sq.m.

   In the light of above an inquiry into the project may please be conducted by WBPCB and submit a report.