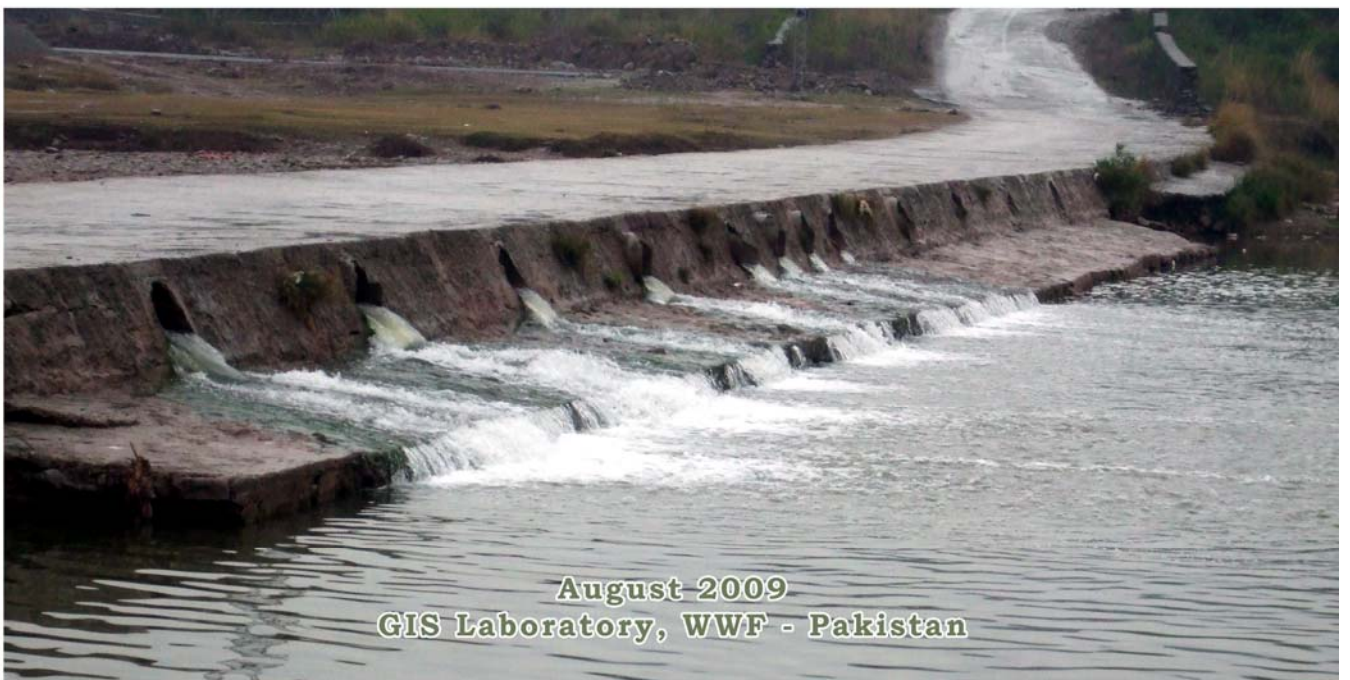
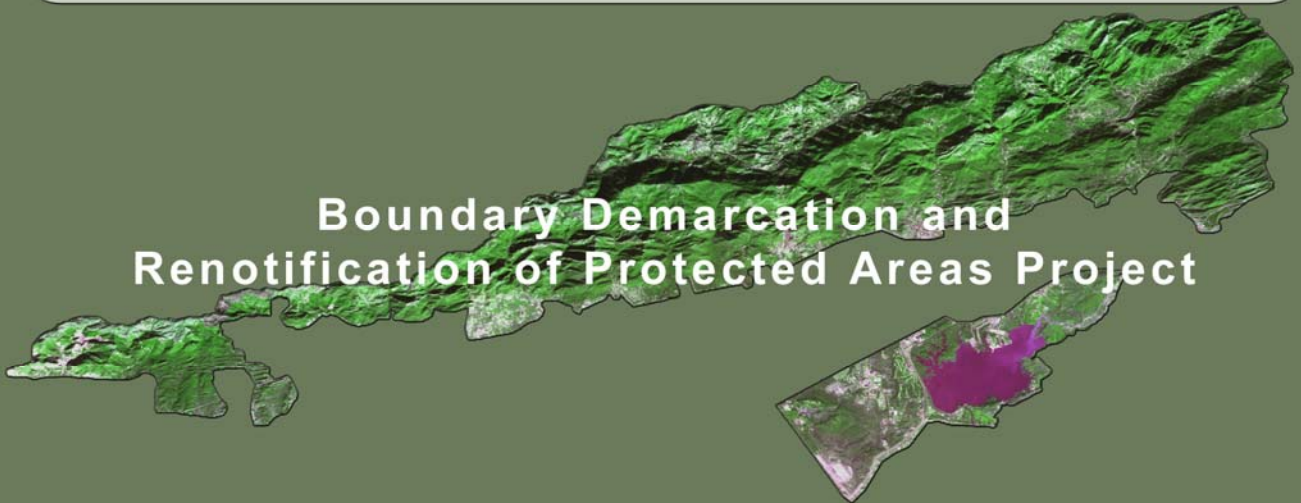




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Boundary Delineation of Margallah Hills National Park



August 2009

GIS Laboratory, WWF - Pakistan

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List of Abbreviations

ASC	Area Specific Committee
CDA	Capital Development Authority
CP	Chir Pine
DEM	Digital Elevation Model
DRGs	Digital Raster Graphics
ERDAS	Earth Resources Data Analysis System
FCC	False Color Composite
GIS	Geographical Information System
GPS	Global Positioning System
GR	Game Reserve
ha	Hectare
IAPs	Invasive Alien Plant Species
ICT	Islamabad Capital Territory
IUCN	International Union for Conservation of Nature
Km	Kilometer
LC	Land Cover
mm	Millimeter
MHNP	Margallah Hills National Park
MoE	Ministry of Environment
NP	National Park
OBIA	Object Based Image Analysis
PA	Protected Area
PA	Protected Area
PPEPCA	Pakistan Petroleum Exploration & Production Companies Association
RF	Reserved Forest
RS	Remote Sensing
SPOT	<i>Satellite pour Observation de la Terre</i>
TIN	Triangulated Irregular Network
WWF	World Wide Fund for Nature

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Urooj Saeed
GIS Coordinator

Summary

The study deals with the boundary delineation of Margallah Hill National Park (MHNP) by using GIS/RS techniques. WWF – Pakistan has conducted this study in collaboration with the Ministry of Environment (MoE), Pakistan Petroleum Exploration and Production Companies Association (PPEPCA) under the “Boundary Demarcation and Renotification of Protected Areas” Project. MHNP is located in Himalayan foothills of the Northern Pakistan. It hosts a highly diverse ecosystem with beautiful landscape.

For the accurate boundary delineation of MHNP, an Area Specific Committee (ASC) was formulated. ASC comprises of representatives from the Capital Development Authority, Zoo & Wildlife Department, Haggler Bailey and WWF – Pakistan.

SPOT satellite images and topographic layers were used to delineate MHNP extent. For this purpose references from existing MHNP notification were used to translate the boundary into a GIS format. A2 size maps on different scales were developed to conduct field surveys. During the surveys, Global Positioning System (GPS) coordinates were collected for the boundary references and land cover mapping.

The Object Based Image Analysis (OBIA) technique was used for the landcover mapping. Eleven major land cover classes were identified from SPOT - 5 (2.5m) imagery. The output thematic map provides information about the spatial pattern and area coverage of the eleven land cover classes.

Delineated boundary significantly defines the MHNP extent considering physical as well as geographical references. Water channels, ridges and hills are the main boundary references on the north, east, west and south directions. The boundary covers an area of 16,838 hectares.

Furthermore, a draft notification format was developed which contains three parts i.e. textual description, a GIS map and list of boundary coordinates.

1 INTRODUCTION

1.1 Background

Protected Area is defined as “An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means” (IUCN, 1994).

In Pakistan, there are more than 230 Protected Areas (PAs) which cover almost 11% (2,753,357 hectares) of the country’s land. These PAs represent almost every ecological, terrestrial and aquatic ecosystem and are considerably important for their ecological and socio-economic services.

Currently available information about the boundaries of PAs is available only in the form of notifications and sketch maps. Most of the notifications are without any references, whereas, in some notifications localities, roads, water channels or any other landmarks are considered as references. Such references are not reliable in the long run as land conditions change with the passage of time i.e. a shift in a water channel or migration of a certain locality. These references are much generalized and hence cause inaccuracies in positions as well as in areas. On the other hand, GIS provides an opportunity to define the boundary of a region with constant reference i.e. geographic coordinates. Hence, to avoid ambiguities and errors, the need of a GIS based notification was identified.

Considering the issue, World Wide Fund for Nature - Pakistan (WWF - P) in collaboration with the Federal Ministry of Environment (MoE) and with the financial assistance of Pakistan Petroleum Exploration & Production Companies Association (PPEPCA) organized a three day National Consultative Workshop on “Boundary Demarcation and Renotification of Protected Areas”. Key stakeholders and partners of the workshop included; senior and mid-career government officials from the Ministry of Environment, Provincial/Territorial Wildlife and Forest Departments, Survey of Pakistan (SoP), Capital Development Authority (CDA), Ministry of Petroleum – DGPC, Petroleum exploration and production companies, independent consultants and Pakistan Environmental Protection Agency.

As an outcome of this workshop, “Boundary Delineation and Renotification of Protected Areas” Project was launched. Under this Project, WWF - P is delineating boundaries of seven selected PAs (Figure 1). So far, the boundaries, and notifications of Ayubia, Machiara and Hingol National Parks have been finalized. This report describes the procedures adopted for the GIS based boundary delineation of Margallah Hills National Park (MHNP).

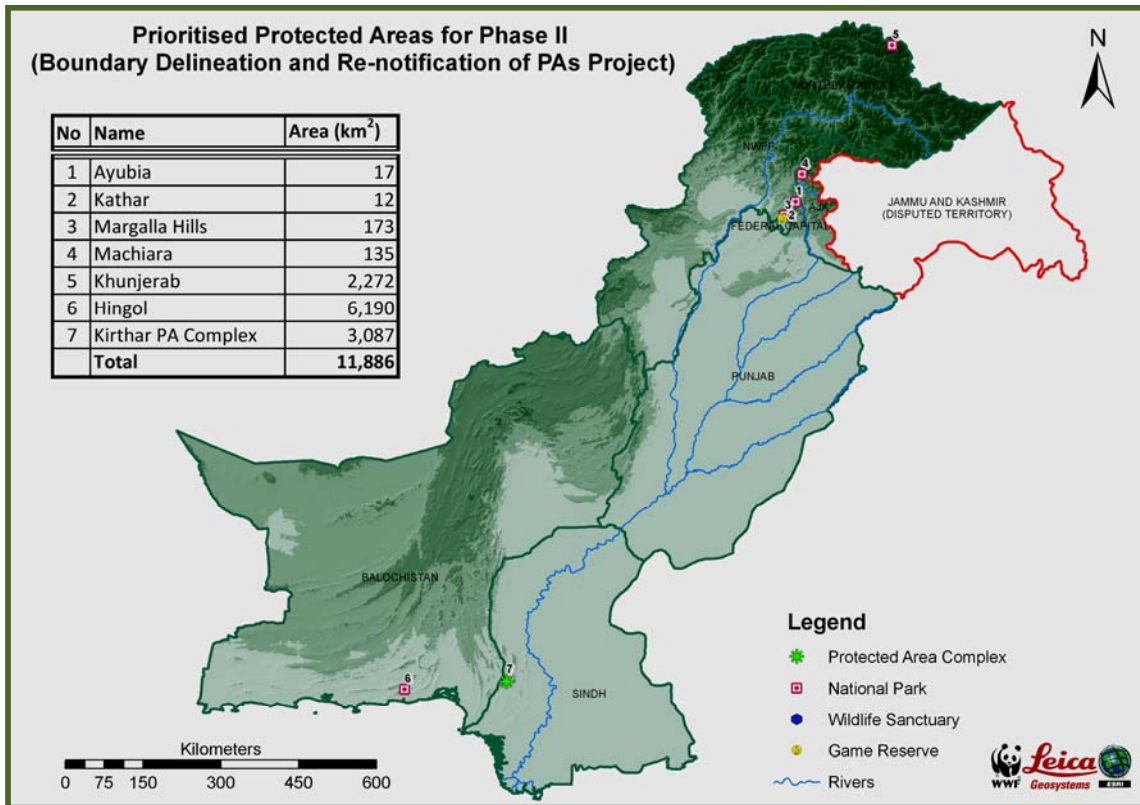


Figure 1: Seven prioritized Protected Areas

1.2 Study Area

The Margallah Hills National Park (MHNP) is located in the foothills of the Himalayan range. It contains the hill ranges immediately to the north of the Federal Capital of Islamabad and the adjacent areas of the Rawal Lake and Shakar Parian Hills. The geographical coordinates of Margallah Hills and Rawal Lake are 73°7'3.32"E, 33°41'59.61"N and 73°1'34.07"E, 33°45'2.87"N respectively (Fig.1).



Figure 2: Location map of Margallah Hills National Park

There are two famous stories about the name of the area. According to one, Margallah is a combination of two words; Mar means snake and Galla means herd. Other narration relates Margallah to a gang that used to rule this area [1].

The geography of the area is rough, with several valleys and numerous steeps [5]. The climate and terrain of the area are excellent for hiking. The best season for the activity is February to April [1].

Some of the popular picnic spots of MHNP are:

- Daman-e-Koh;
- Pir Sohawa;
- Gokeena;
- Mount Happiness;
- Loh-i-Dandi;
- Saidpur Village;
- Nicholson's obelisk;
- The Islamabad Zoo;
- Shakkar Parian and
- Rawal Lake

The hills are an extension of the Himalayan range and form the northern boundary of the Potohar plateau. The area is drained by the River Kurang and its tributaries, which flow into the Soan River [2]. The altitude of MHNP ranges from 1,347ft. to 3,907ft.



Figure 3: Digital photographs of Margallah Hills National Park

The Margallah Hills comprises of subtropical, dry, semi-ever green forest and pine trees. The semi-evergreen forest is dominated by Phulai, Kao, Sanatha, Granda and Ber. The subtropical pine forest exists above 1,000 m, Chir pine being the characteristic canopy species. The area also hosts number of Non Timber Forest Products (NTFPs) including invasive species of medicinal value, *Lantana Camara* being one of them.

Seventeen hundred species of flowering plants, fifty-three ferns and more than fifty species of grass exist in the area. In spring, the area gets carpeted with flowers such as tulips, dandelions, buttercups, poppies, and many other perennial plants [3].

The Park was setup to provide refuge to the Gray Goral, Barking deer and the Leopard. Rhesus monkeys, jackals (often heard cackling at night near the hills), wild boars, porcupines, mongoose and the pangolin or scaly anteater exists in the area [4].

2 MATERIALS AND METHODS

Field data, habitat maps, topographic layers and land cover maps were used to delineate the draft MHNP boundary. ASC meetings lead to rectification of the draft GIS layer. The workflow diagram is shown in Figure 4.

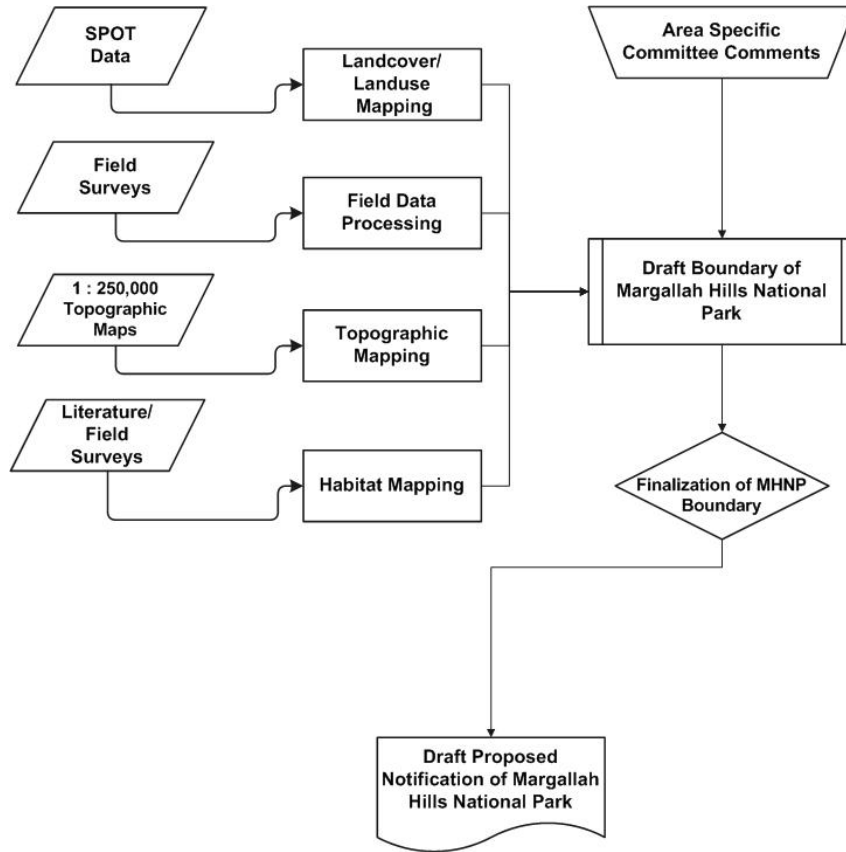


Figure 4: Flow chart

2.1 Satellite Data Procurement

For boundary delineation and land cover mapping of the MHNP, SPOT 5 image of 23rd December 2008 was procured. The acquired image was in the Universal Transverse Mercator (UTM) coordinate system, Zone 43 with Spheroid and Datum as WGS 84. The image was acquired in multispectral and panchromatic mode. The characteristic details of the satellite image are given in Table 1.

Table 1: SPOT Data Characteristics

Satellite	Acquisition Date	Spatial Resolution (m)	Spectral Bands
SPOT 5	23-12-2008	10	4
SPOT 5	23-12-2008	2.5	1

2.2 Software Used

For boundary delineation and maps formulation, ArcGIS 9.0® was used. Whereas, for satellite images interpretation and processing Digital Image Processing (DIP) software ERDAS Imagine 8.7® and Definien Developer 7.0® were used. Microsoft Word and Microsoft Excel were used for documentation and graphical analysis. Field maps, Garmin GPS 76 CSX receiver and digital camera were used for field navigation and data recording.

2.3 Pre-processing

2.3.1 Import

The images were acquired in Tagged Image File Format (.tiff). For easy handling and processing, the images were imported in ERDAS Imagine native image format i.e. .img.

2.3.2 High resolution merge

SPOT 5 multispectral image has lower spatial resolution (10 m) and four spectral bands as compared to its panchromatic layer that characterizes higher spatial resolution (2.5 m) and a single spectral band. Multispectral image provides greater details due to four spectral bands (coloured display) but less spatial details. It was merged with a high resolution panchromatic image (black and white display) to get a high resolution coloured image. High-resolution merge with multiplicative and bilinear interpolation were used to improve the visual interpretability of the datasets. Output high resolution (2.5 m) pan-sharpened image is shown in Figure 5 (c).



Figure 5: SPOT (a) multispectral, (b) panchromatic and (c) high resolution merged imagery

2.3.3 Satellite Image Enhancement

Image enhancement is a technique that improves a low contrast satellite image to enhance its interpretation level. For this study, Standard Deviation Stretch and Brightness Contrast Control utility were applied on the images.

2.4 Topographic Mapping

Spot heights, populated places, drainages, roads, catchments area and sea water marks were digitized from 1:250 000 topographic sheet (Figure 5). The attribute

information was attached with each feature and output file was saved in GIS format.

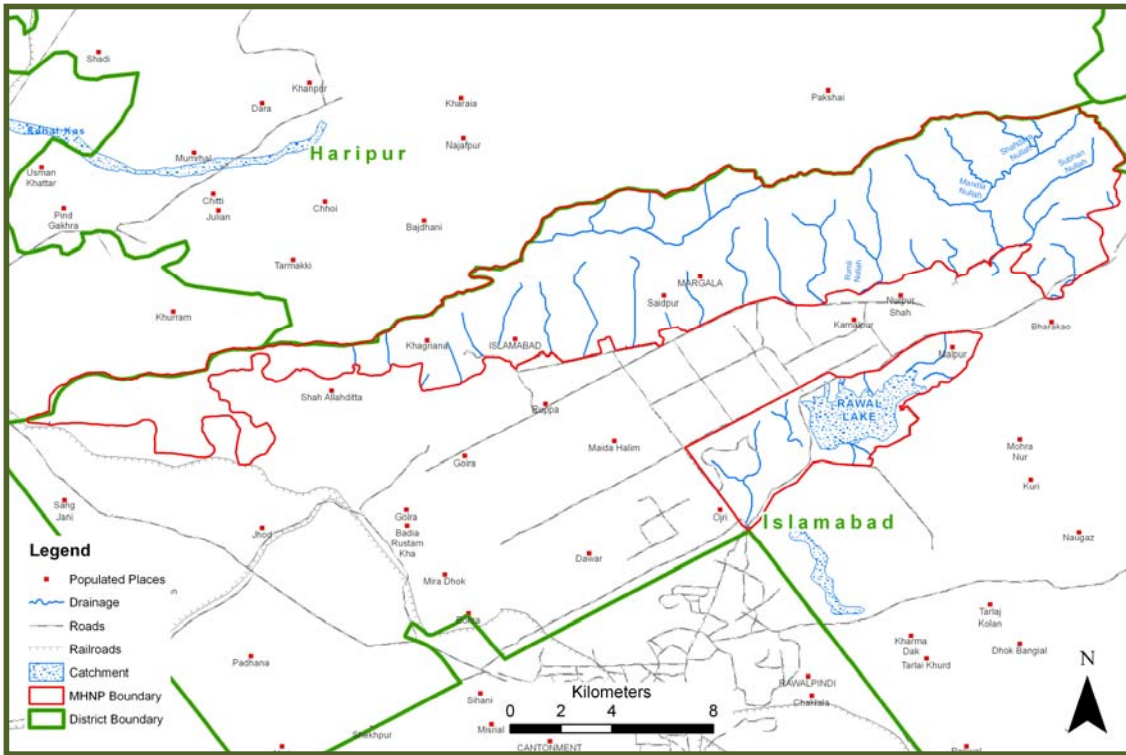


Figure 6: Topographic map of MHNPP

2.5 Ground Truthing and Field Data Collection

Field visit of MHNPP was conducted from the 1st to 5th January, 2009. The main purpose of the field visit was to collect Ground Control Points (GCPs) for boundary delineation and land cover mapping. A3 size maps of ASTER satellite data were developed at a scale of 1: 50 000 with 1' grid intervals.

Second field visit was arranged from the 7th to 11th April, 2009 to collect GPS points at confusing areas. Meetings with CDA staff were also conducted to finalize the boundary.

Three hundred and thirty seven waypoints were collected during the field surveys. The survey team comprised of representatives from following departments/organizations;

- Capital Development Authority
- Islamabad Capital Territory
- WWF - Pakistan

Wildlife inspectors helped in GPS data collection and forest compartments identification. The survey team also visited Shahdara and Shah Allah Ditta villages to collect Global Positioning System (GPS) coordinates of land ownership details. Waypoints collected during the survey are shown in Figure 7.

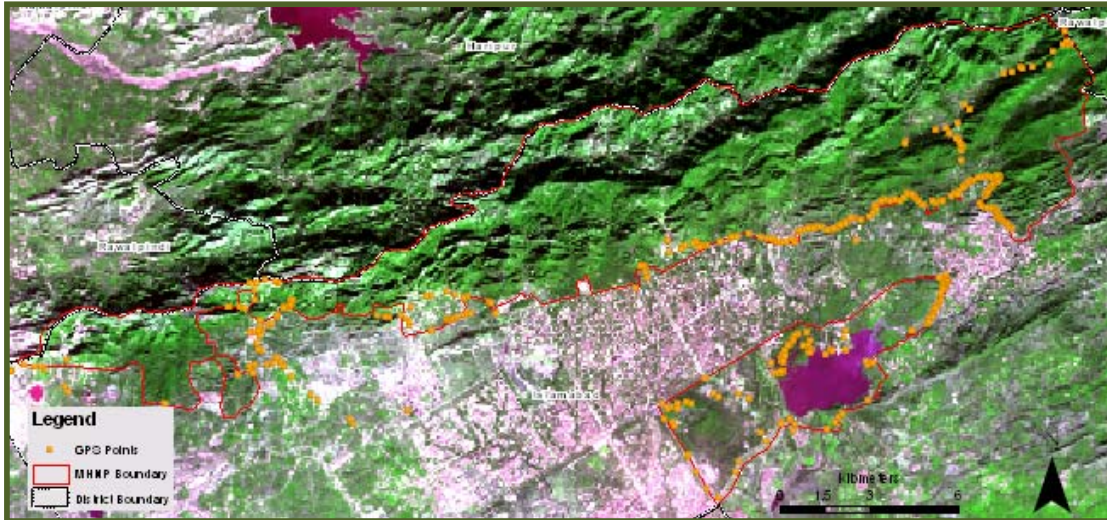


Figure 7: Field observation points of MHNPs

Survey team comprised of Mr. Sohail Ahmad (Assistant Director Wildlife, CDA), Mr. Muhammad Jamil (Range Forest Officer, CDA.), Mr. Muhammad Hussain (Forester, CDA), Mr. Tariq (*Patwari*, Shah Allah Dita village, ICT), Mr. Ghulam Ali (Naib Tehsildar, CDA), Mr. Asim (*Patwari*, Shahdara village, ICT), Ms. Kaif Gill and Mr. Naeem Shahzad (GIS Laboratory, WWF – Pakistan).

2.6 Field Observation Points

Historically, the area was covered with reserve forest of two categories i.e, *rakhs* (military grass farms) and *chaks* (private holdings). These areas were taken controlled by the Capital Development Authority (CDA) in 1960s. Illegal grazing and collection of fuel wood are the persistent problems. The loss of grass habitat on southern slopes (former *rakhs*) is likely to be associated with the disappearance of cheer pheasant (Young, 1986).

A large number of residents from Islamabad and Rawalpindi, as well as foreigners, visit the Park. It is attracted by the visitors due to its easy accessibility and the presence of Marghazar Zoo (Figure 8) near the Park entrance.

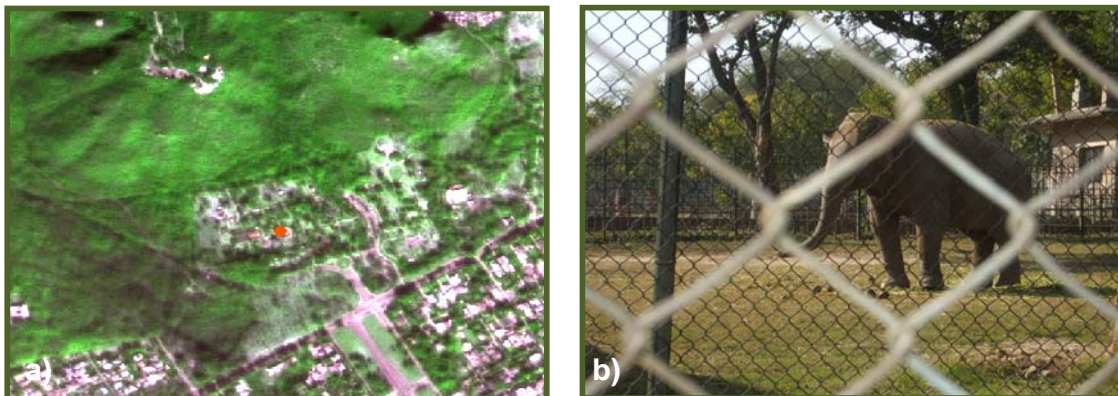


Figure 8: Marghazar Zoo (a) Satellite Image and (b) Digital photograph

In the Rawal Lake area pure patches of Paper Mulberry were observed. Some mixed patches of Mulberry and Chirpine were also identified along the banks of the lake (Figure 9).

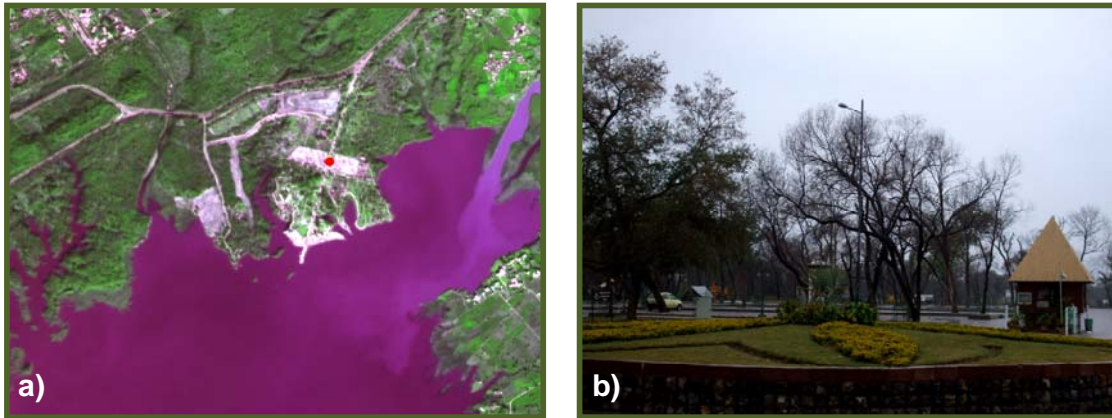


Figure 9: Lake View park (a) Satellite image and (b) Digital photograph

Trails of the area are the famous for hiking. Enthusiasts visit the trails and enjoy a glorious panoramic view of the city. Along the trails, Lantana and Phullai were the dominating vegetation types (Figure 10).



Figure 10: Trail 3 (a) Satellite image (b) Digital photograph

Most of the area of the Park is occupied by Invasive Alien Plant Species (IAPs). These include Lantana Camara Shrub and Paper Mulberry (Figure 11). These plants decrease the density of the native species of the Park; furthermore most of the residents of the Capital are allergic to the pollen of this plant. These plants have a high water consumption rate which is decreasing the water table [5].

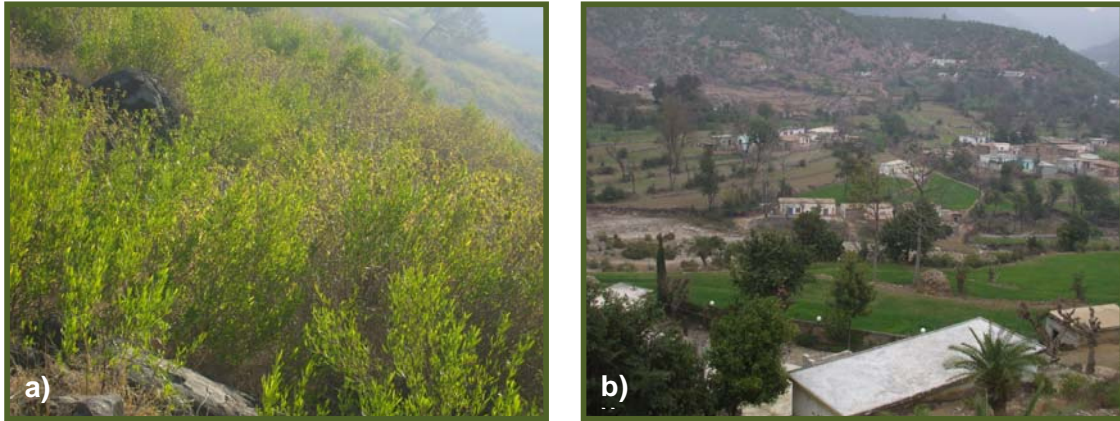


Figure 11: (a) Lantana spp. and (b) agriculture fields

Rawal Lake, a part of the National Park and the main source of drinking water for Rawalpindi is threatened by pollution caused by human habitations in the catchment area and all around the lake (Figure 12).

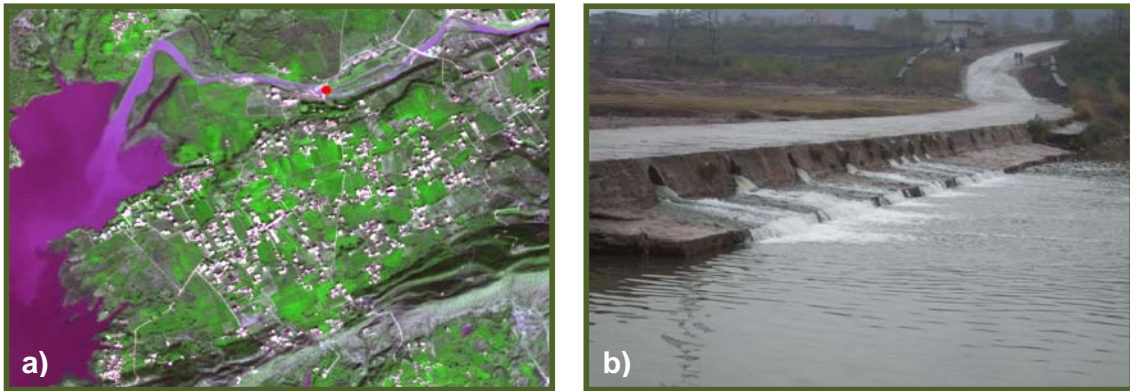


Figure 12: Kurang Nullah (a) GPS point and (b) Digital photograph

There are 4 to 6 annual evidences of forest fire (pers. comm. January, 2009). To prevent the spread of the fire each year, CDA set up a fire line which is approx. 5-6 feet wide bare land. It is developed by clearing the bushes and grasses from the ridge lines. A digital photograph of forest fire is shown in Figure 13.



Figure 13: Forest fire

3 Landcover Mapping

A Satellite sensor records electromagnetic radiations coming from the reflections of different ground features in the form of digital numbers. Each feature on earth has a specific uniqueness with respect to a brightness value.

For the land cover mapping, different conventional classification techniques (unsupervised classification, supervised classification, hybrid classification etc.) are being used by the GIS Professionals. In this study advanced and the most recent classification technique i.e. Object Based Image Analysis (OBIA) technique was applied on the satellite image.

The following fundamental steps were adopted for forest mapping using Object Based Classification in Definen Developer®;

- Satellite image segmentation;
- Selection of training samples;
- Accuracy of training samples and
- Thematic layer generation

In OBIA, segments were formed on the bases of parameters such as; scale, size and compactness. Eleven major landcover/landuse classes were identified from the SPOT – 5 satellite image. The area covered by each landcover/landuse class is shown in Table 2.

Table 2: Area covered by each landcover/landuse class of MHNP

Landcover Classes	Area (ha)	Percentage Area
Chir Pine/Shadow	2,641	15.5
Agriculture land	219	1.3
Paper Mulberry	1,990	11.7
Paper Mulberry - <i>Acacia Modesta</i>	4,676	27.5
<i>Acacia Modesta</i> - Kau- <i>Dodonea</i> spp.	2,584	15.2
<i>Lantana</i> spp.	1,675	9.9
<i>Lantana</i> spp. - <i>Dadonea</i> spp. – Grasses	925	5.4
Grasses	443	2.6
<i>Saccharum</i> spp. - <i>Typha</i> spp.	31	0.2
Buildup Area/Bare Rocks	1,259	7.4
Water	552	3.2

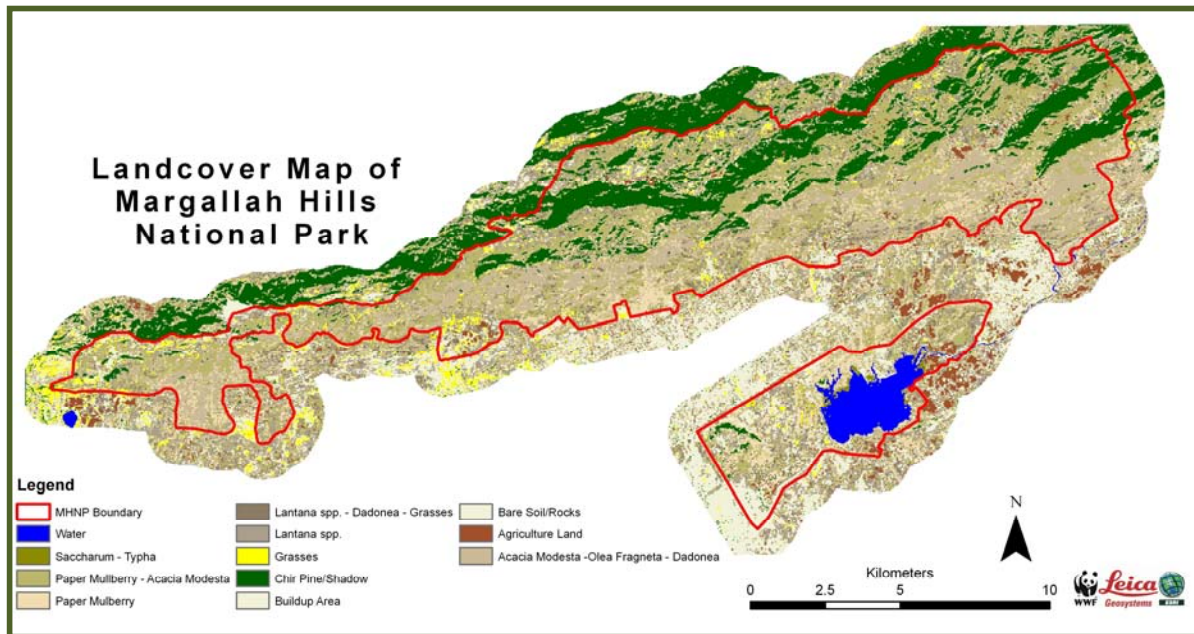


Figure 14: Landcover Map of Margallah Hills National Park

3.1 Class description of the Margallah Hills National Park

Chir pine/Shadow

Chir pine (*Pinus Roxburghii*) is an evergreen tree type which covers about 15.5% (2,641 ha) of the total area of the National Park. Chir pine are the needle like trees which mostly exist above 900 m.

Paper Mulberry

Paper Mulberry, commonly known as Vilaiti Shahtoot, is a deciduous tree which grows up to 15 meters (49 ft) tall, and is native to eastern Asia. It is a fast growing and highly invasive species which distress the natural ecosystem. Paper Mulberry has replaced much of the vegetation around Rawal Lake and is a growing threat to the natural vegetation of the area. According to the classification results, this class covers about 1,990 ha (11.7%). This class mostly exists in a mixed form (see paper mulberry – acacia modesta class). However, some pure patches of the class were also picked from the satellite image.

Paper Mulberry - Acacia Modesta

Paper Mullberry and Acacia Modest are one of the dominating classes of the area. Dense patches of this mixed class were present in Margallah Hills National Park. It covers an area of about 4,676 ha (27.5%).

Acacia Modesta - Kao - *Dodoneae* spp.

The Acacia modesta, Dodoneae spp. community is present on the southern slopes. The north facing slopes have a greater diversity of this class as compared to the southern aspects. Olea ferruginea, commonly known as “Kao” is mostly present on the slopes [6].

Dodoneae spp. is the most common shrub of the area. This mixed class of vegetation covers an area of 2,584 ha (15.2%).

Lantana spp.

Lantana camera is invasive species of shrub having medicinal value. It generally grows best in open, unshaded situations such as wastelands, rainforest edges and beachfronts. It covers an area of 1,675 ha (9.9%). This specific type of vegetation is mostly present in the north-western aspects of the hills.

Lantana spp./Dodonea spp./Grasses

Dodoneae spp. being the dry subtropical species of shrubs is mostly present at low altitudes. Dadonea was mostly found in the mixed form with lantana spp. and grasses. This class covers an area of about 925 ha (5.4%).

Agriculture land

Agriculture is the main source of livelihood for the communities living in the peripheries of the Park. The Agricultural land cover class covers an area of 219 ha (1.3%).

Grasses

Classification of grasses is dependent upon the acquisition window (season/time) of the satellite imagery. Grasses cover was about 443 ha (2.6%) at the time of acquisition of image.

Saccharum spp. - Typha spp.

Saccharum spp and Typha spp. are aquatic vegetation mostly present along, and in the water bodies. In MHNP, Saccharum spp and Typha spp are present in the peripheries of the Rawal Lake, covering an area of about 31 ha (0.2%).

Buildup Area/Bare Rocks

Buildup area includes buildings, houses, roads and some barren patches of the rocks. This specific type of landcover class covers an area of about 1,259 ha (7.4%).

Water

In Margallah Hills National Park, there are certain seasonal water channels. The Rawal Lake and other feeding water channels cover an area of about 552 ha (3.3%) of the Park.

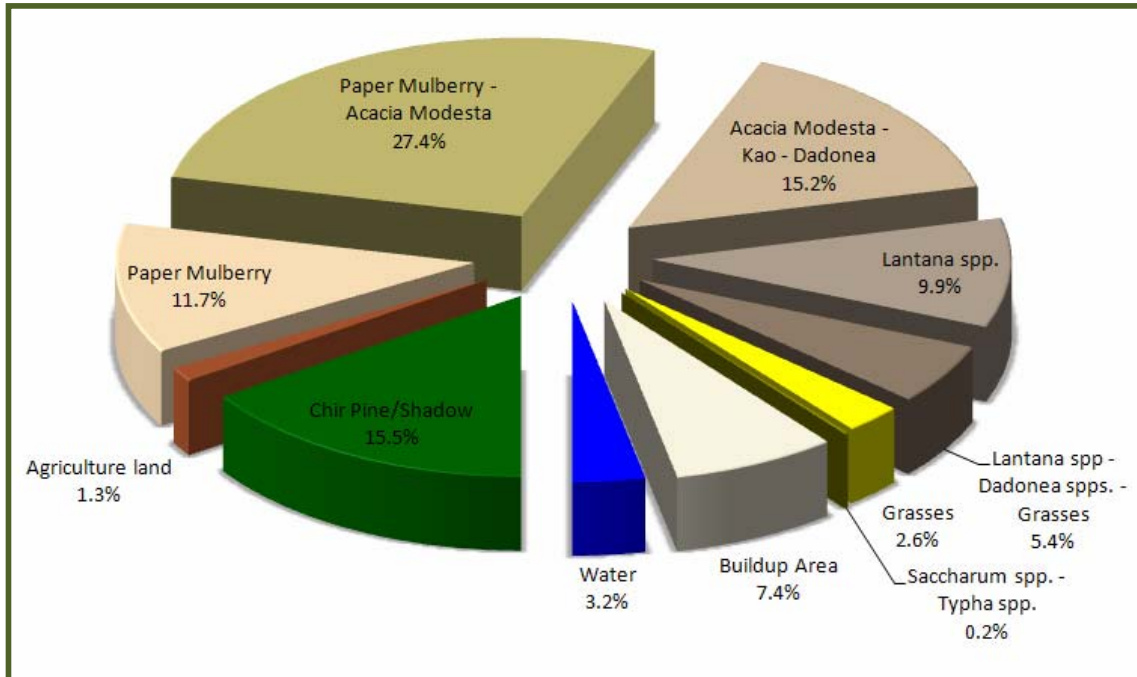


Figure 15: Pie chart showing percentage areas of different land covers classes

4 Habitat Mapping

5 Boundary Delineation

MHNP was declared as Wildlife Sanctuary under the West Pakistan Wildlife Protection Ordinance, 1959. Subsequently, it was declared as National Park on 27th April 1980 under Section 21(1) of the Islamabad Wildlife Protection, Conservation and Management Ordinance, 1979.

According to the current notification, total area of the Park is 17,386 ha. The Park comprises of compartments 2-5, 7-23, 28, 30-38(i) and 41(ii) of Margallah Reserve Forest, 1 to 25 of the Military Grass Farm together with Rawal Lake and its buffer area of 2km from the highest water mark.

5.1 Area Specific Committee (ASC) meetings

For the accurate boundary delineation, an Area Specific Committee (ASC) was formulated which comprised of following members;

- Dr. Ejaz Ahmad, Deputy Director General, WWF - Pakistan
- Mr. Malik Aulya Khan, Director Environment Regional, CDA
- Mr. Muhammad Waseem Shamshad, Director Land and Rehabilitation, CDA
- Mr. Raja Muhammad Javed, Director Zoo and Wildlife Department, CDA
- Mr. Vaqar Zakaria, General Manager, Haggler Bailey

A number of meetings with the Park management staff and CDA officials were also arranged. Discussions with MHNP field staff and officials as well as ASC meetings were very useful for the boundary delineation.

It was suggested by the ASC to include ICT in the boundary delineation process to check the land ownership with the relevant *Patwaris*. Considering that the land ownership mapping is beyond the scope of the Project, it was decided that land ownership mapping will be done for a sample area to develop a model. For this purpose two villages were selected i.e. Shah Allah Ditta and Shahdara. Hence, ICT staff were engaged during the surveys of these two areas so that a segmented map of land ownership could be developed.



Figure 16: (a) Boundary fencing at Rawal Lake and (b) Boundary pillar

5.2 Participatory GIS Session

After delineating the draft boundary, a participatory GIS session was arranged with the CDA staff. More than fifteen foresters, range officers and guards from the four boundary ranges i.e. Shahdara and Rawal Lake, Noorpur, Saidpur and Shah Allah Ditta attended the session. Each and every section of the delineated boundary was discussed with the respective range staff. The session helped to rectify the boundary extent in detail. Some areas with no or less references were identified and visited to collect the ground control points.

5.3 GIS based boundary of MHNP

GPS field observations of boundary references (Figure 15) were overlaid on the SPOT 5 (2.5 m) satellite image, DEM, TIN and bio-physical GIS layers such as roads, ridges, settlements, nullahs, forest etc. were used as a base layer for the boundary delineation. GPS data significantly helped to delineate the boundary by using ArcGIS 9.0®. The boundary was delineated in Geographic Projection System. To calculate the area covered by the boundary, it was re-projected in Zone 43 of Universal Transverse Mercator (UTM) Projection with Spheroid and Datum as WGS 84.

For the land ownership map suggested by the ASC, *latha* maps acquired from ICT were scanned to get a digital copy. Those maps were in raw form and did not provide any geographic coordinates. To register the maps with the real world, the maps were rectified so that it can be overlaid with other GIS layers.

Fifteen Ground Control Points (GCPs) were used to rectify the *latha* maps. Rectification of the maps did not provide any appealing result. Following limitations were observed during the process;

- i. The *latha* maps are small scale maps and contain certain discrepancies in terms of scale. Fifteen points are not sufficient for the rectification of such types of maps. It was analyzed that at least 40-50 points (a field survey of roughly ten days) are required which need dedicated human and financial resources.
- ii. After the rectification process, next step is digitization and designing/formulation of a proper database. *Latha* maps contain information regarding the owner of the land of the specific parcel which is in the form of khasra number. This information changes due to day to day land transfer business.

Considering time and resources required, the proposed activity seems to be out of the scope of the Project.

Boundary delineated with assistance of MHNP field staff, habitat mapping, topographic mapping and field data covers an area of 16,979 ha (169.79 Km²) whereas area mentioned in the current notification is 17,386 ha (173.86 Km²). There is a difference of -476 ha (4.76 Km²).

For further discussion the boundary has been sub-classified into five major sections (Figure 17).

Northern Part

Northern part of the Margallah Hills National Park follows the Haripur - Islamabad and Rawalpindi - Islamabad district boundaries.

Western Part

Western part of the boundary follows the forest compartments boundary of 37RF and 41RF.

Southern Part

Southern part of the boundary moves with the boundaries of forest compartments, existing boundary pillars, Siachen and Margallah road and in some places it follows the centre line of the nullahs (Rumli, Mandla etc).

Eastern Part

Eastern part of the National Park boundary follows the forest compartment boundary along with the Rawalpindi - Islamabad district boundary.

Rawal Lake Area

Boundary of Rawal Lake follows the Kashmir Highway, Murree road, Shaker Parian, highest water mark of Rawal Lake with 2km buffer and at some places CDA pillars.

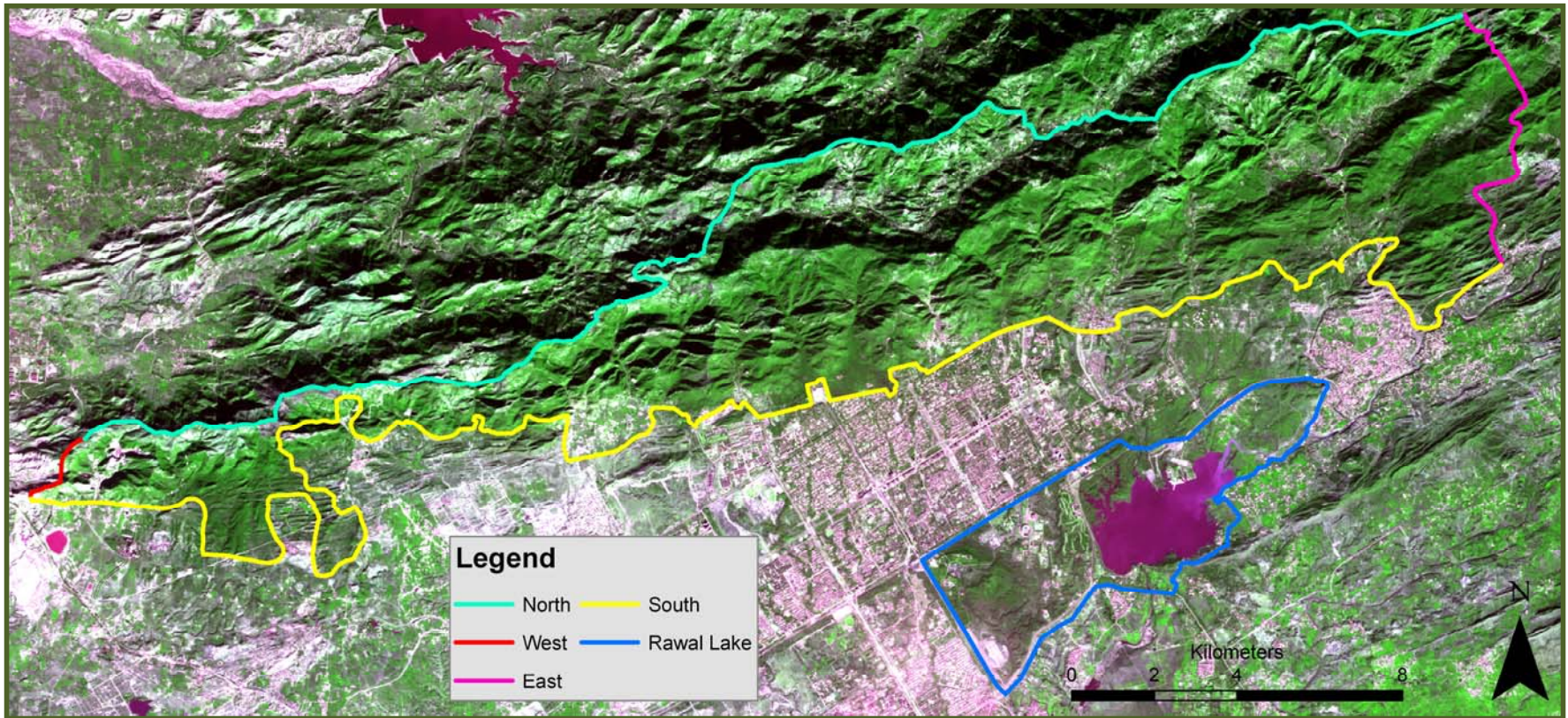


Figure 17: Various sections of the MHNPs defined for the delineation of boundary

5.4 Formulation of Notification Format

The old notification of Margallah Hills National Park contains vague references with limited details. On the basis of delineated boundary, a notification was developed. The proposed notification format has three parts;

- Textual description
- A comprehensive GIS map
- List of the coordinate along the boundary

The proposed notification format of MHNP is shown below;

FEDERAL GOVERNMENT ENVIRONMENT AND CAPITAL DEVELOPMENT AUTHORITY

Dated: 05-06-2009

NOTIFICATION

No. 3(15)/76_CDA. III. (4)

In exercise of the powers conferred by sub-section (1) of section 21 of the Islamabad Wildlife (Protection, Conservation and Management) Ordinance 1979 (LXX of 1979), the Federal Government is pleased to revise the boundaries of the Margallah Hills National Park specified in the schedule given below with immediate effect.

SCHEDULE

- | | |
|----------------|---|
| 1) District(s) | : Islamabad |
| 2) Tehsil(s) | : Islamabad |
| 3) Locality | : Margallah Hills National Park (Mangial, Malach Dakhli, Phulgran, Subhan, Mandla, Jhang Bagial, Malpur, Rumli, Narias, Padoh Dakhli, Noorpur Shahan, Ratta Hottar, Saidpur, Dhok Jiwan, Gandiar, Kalinjar and Saniari) |
| 4) Area | : 16,979 hectare (approx. 170 km ²) |
| 5) Coordinates | : 72° 50' 11.91" to 73° 13' 14.97" E and 33° 42' 14.03" to 33° 47' 50.95" N |

BOUNDARIES

The Margallah Hills National Park is divided into two sections; one comprises of a Reserve Forest and Military Farms whereas the other section contains the Rawal Lake area. In this notification both sections are described separately.

1. Reserve Forest and Military Farms

North:

The Northern side starts from grid reference point N1 (73°12'17.71", 33°48'44.40") and follows the Haripur - Islamabad district boundary up to grid reference point N2 (73°55'00.26", 33°43'44.16"). From grid reference point N2 (73°55'00.26", 33°43'44.16") to grid reference point N3/W1 (73°50'50.24", 33°43'00.72") the boundary follows the Rawalpindi - Islamabad district boundary.

West:

The Western side starts from the grid reference point N3/W1 (73°50'50.24", 33°43'00.72") and moves south-westward with forest compartments 37RF and 41RF reaching grid reference point W2/S1 (72°49'59.59", 33°42'09.36").

South:

The Southern side starts from grid reference point W2/S1 (72°49'59.59", 33°42'09.36") running eastward with forest compartments 41RF, 38RF, 36RF, 34RF, 33RF, 31RF, 30RF, 28RF and 23RF reaching the grid reference point S2 (72°55'38.31", 33°43'14.64"). From grid reference point S2 (72°55'38.31", 33°43'14.64") to grid reference point S3 (72°55'58.04", 33°43'15.30") the boundary follows the existing demarcation pillars fixed by CDA in 1986. From grid reference point S3 (72°55'58.04", 33°43'15.30") to the grid reference point S4 (72°58'20.85", 33°43'24.66") the boundary follows the forest compartments 22RF, 21RF and 25MF. From grid reference point S4 (72°58'20.85", 33°43'24.66") to grid reference point S5 (72°59'40.20", 33°43'31.20") the National Park boundary includes Sanjari village and follows the pillars fixed by Army. From grid reference point S5 (72°59'40.20", 33°43'31.20") to grid reference point S6 (73°2'09.31", 33°43'38.28") the boundary follows the Siachen road. Boundary runs from grid reference point S6 (73°02'09.31", 33°43'38.28") to grid reference point S7 (73°02'27.06", 33°43'40.26") excluding the Faisal mosque area. From grid reference point S8 (73°03'28.15", 33°43'48.12") to grid reference point S9 (73°06'56.34", 33°44'42.06") the boundary follows the Margallah Road apart from the Zoo area. From grid reference point S9 (73°06'56.34", 33°44'42.06") to grid reference point S10 (73°07'37.02", 33°44'51.72") the boundary follows the pillars raised by CDA in 1986. From grid reference point S10 (73°07'37.02", 33°44'51.72") to grid reference point S11 (73°08'08.59", 33°45'05.88") the boundary moves with Rumli *nullah*. From grid reference point S11 (73°08'08.62", 33°45'05.94") to grid reference point S12 (73°08'36.60", 33°45'17.22") boundary moves on pillars put up by CDA in 1986. From grid reference point S12 (73°08'36.56", 33°45'17.22") to grid reference point S13 (73°09'16.66", 33°45'34.98") the boundary follows the forest compartment 12RF. From grid reference point S13 (73°09'16.66", 33°45'34.98") to grid reference point S14 (73°09'38.73", 33°45'22.08") the National Park boundary runs on pillars fixed by CDA in 1986. From grid reference point S14 (73°09'38.73", 33°45'22.08") to grid reference point S15 (73°10'23.95", 33°45'36.00") the boundary moves with Barakaho road. From grid reference point S15 (73°10'23.95", 33°45'36.00") to grid reference point S16 (73°10'37.59", 33°45'47.58") boundary moves with Mandla *nullah*. From grid reference point S16 (73°10'37.59", 33°45'47.58") to grid reference point S17 (73°11'17.05", 33°45'52.98") the boundary follows the National Park CDA pillars. From grid reference point S17 to grid reference point S18/E1 (73°12'55.33", 33°45'35.88") the boundary follows the forest compartments 8RF, 7RF and 6RF.

East:

The Eastern boundary starts from grid reference point S18/E1 (73°12'55.33", 33°45'35.88") and follows the forest compartment boundary 6RF, 5RF, 4RF and 2RF reaching grid reference point E2 (73°12'48.24", 33°48'22.80"). From grid reference point E2 (73°12'48.27", 33°48'22.74") to grid reference point N1 (73°12'17.71", 33°48'44.40") the boundary follows the Rawalpindi - Islamabad district boundary.

2. Rawal Lake

From grid reference point R1 (73°3'56.08", 33°41'36.96") to grid reference point R2 (73°9'56.77", 33°44'05.04") the boundary moves with Kashmir Highway and Murree road. From grid reference point R2 (73°09'56.77", 33°44'05.04") to grid reference point R3 (73°09'50.72", 33°43'17.82") the boundary follows the CDA pillars. From grid reference point R3 (73°09'50.72", 33°43'17.82") to grid reference point R4 (73°08'56.51", 33°42'45.36") the boundary goes behind the CDA pillars. From grid reference point R4

(73°08'56.51", 33°42'45.36") to grid reference point R5 (73°08'31.88", 33°42'25.8") the boundary follows the highest water mark of the Rawal lake. the boundary follows the Park Road from grid reference point R5 (73°08'31.88", 33°42'25.80") to grid reference point R6 (73°06'38.55", 33°41'18.84"). From grid reference point R6 (73°06'38.55", 33°41'18.84") to grid reference point R7 (73°05'15.79", 33°39'52.38") boundary includes 600ft buffer of the Murree Road. The boundary moves along the Islamabad Highway from grid reference point R7 (73°05'15.79", 33°39'52.38") to grid reference point R1 (73°03'56.08", 33°41'36.96").

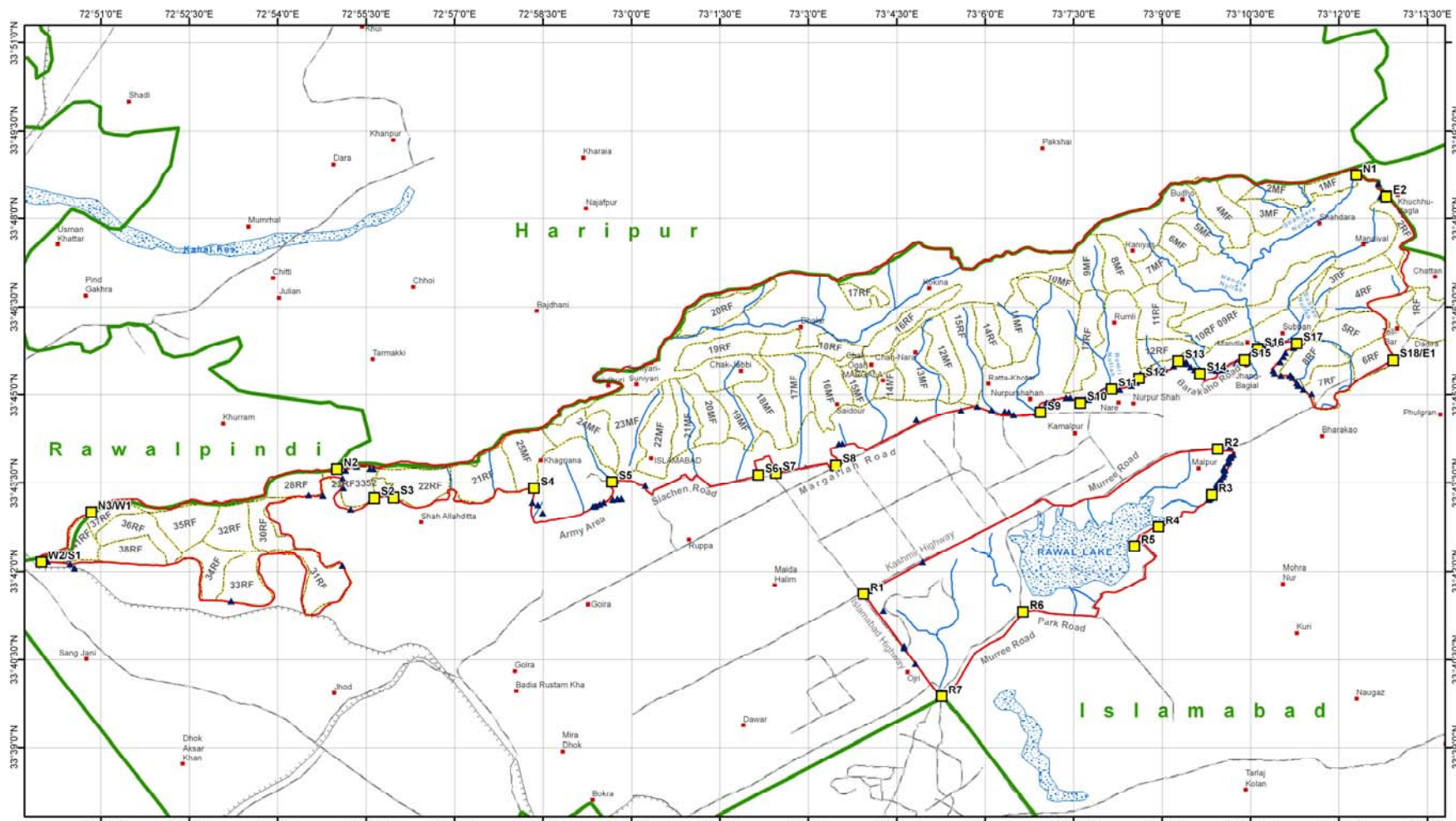
REFERENCE

Geo-Rectified SPOT (2.5 m) Satellite Image
1: 250,000 Survey of Pakistan Maps
Projection: Geographic Coordinate System
Spheroid & Datum: World Geodetic System (WGS) 84
(Single frequency GPS receiver was used for the field data collection)
Forest Compartment Boundary

(Authority)
Federal Government

A copy is forwarded to the:-

- 1. _____
- 2. _____
- 3. _____
- 4. _____

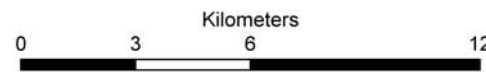


Legend

- Grid References
- Drainages
- Catchments
- Old Boundary Pillars
- Roads
- Forest Compartment Boundary
- Populated Places
- Railroads
- District Boundary
- MHNP Boundary



Data Source:
 SPOT Satellite Image (2.5m)
 250,000 SoP Sheets



GIS Map of Margallah Hills National Park Boundary with Grid Reference Points

List of Selective Boundary Coordinates

No.	Longitude	Latitude
1	73°3'56.09"	33°41'36.98"
2	73°6'57.34"	33°43'12.84"
3	73°7'1.14"	33°43'12.85"
4	73°7'9.92"	33°43'7.83"
5	73°7'27.05"	33°43'7.33"
6	73°7'41.54"	33°43'13.08"
7	73°8'3.987"	33°43'16.27"
8	73°8'32.61"	33°43'38.51"
9	73°9'3.25"	33°43'56.63"
10	73°9'19.03"	33°44'1.54"
11	73°9'57.88"	33°44'5.20"
12	73°10'1.66"	33°44'3.16"
13	73°10'9.51"	33°44'2.87"
14	73°10'13.87"	33°44'1.13"
15	73°10'14.16"	33°43'57.64"
16	73°10'10.96"	33°43'53.86"
17	73°10'7.76"	33°43'47.17"
18	73°10'3.11"	33°43'34.37"
19	73°9'55.84"	33°43'26.81"
20	73°9'55.55"	33°43'22.73"
21	73°9'53.82"	33°43'19.03"
22	73°9'42.97"	33°43'8.86"
23	73°9'38.34"	33°43'6.80"
24	73°9'34.02"	33°43'1.70"
25	73°9'31.00"	33°43'0.28"
26	73°9'21.20"	33°43'1.08"
27	73°9'18.39"	33°42'55.31"
28	73°9'11.01"	33°42'54.37"
29	73°9'6.18"	33°42'48.74"
30	73°9'0.81"	33°42'46.32"
31	73°8'49.27"	33°42'43.37"
32	73°8'37.81"	33°42'36.93"
33	73°8'34.19"	33°42'31.16"
34	73°8'31.77"	33°42'29.69"
35	73°8'29.22"	33°42'30.09"
36	73°8'32.98"	33°42'25.93"
37	73°8'38.62"	33°42'29.95"
38	73°8'53.91"	33°42'15.46"
39	73°8'51.90"	33°42'12.11"
40	73°8'42.91"	33°42'5.13"

No.	Longitude	Latitude
41	73°8'43.18"	33°41'53.39"
42	73°8'12.59"	33°41'38.37"
43	73°8'4.94"	33°41'38.90"
44	73°8'0.650"	33°41'38.23"
45	73°7'58.50"	33°41'36.62"
46	73°7'59.04"	33°41'34.74"
47	73°7'50.89"	33°41'24.35"
48	73°7'55.40"	33°41'22.46"
49	73°7'54.24"	33°41'17.23"
50	73°7'52.04"	33°41'13.98"
51	73°7'5.566"	33°41'17.23"
52	73°6'52.15"	33°41'20.26"
53	73°6'39.65"	33°41'18.97"
54	73°6'18.37"	33°40'53.11"
55	73°6'5.28"	33°40'47.01"
56	73°5'49.35"	33°40'37.03"
57	73°5'30.93"	33°40'5.40"
58	73°5'16.90"	33°39'52.51"
59	73°5'8.342"	33°39'59.40"
60	73°3'56.09"	33°41'36.98"
61	73°11'15.97"	33°48'35.95"
62	73°11'25.57"	33°48'36.46"
63	73°12'16.85"	33°48'52.05"
64	73°12'19.23"	33°48'48.02"
65	73°12'19.59"	33°48'44.40"
66	73°12'23.34"	33°48'43.10"
67	73°12'25.45"	33°48'40.59"
68	73°12'30.28"	33°48'38.88"
69	73°12'37.61"	33°48'38.78"
70	73°12'39.82"	33°48'37.87"
71	73°12'37.91"	33°48'34.30"
72	73°12'38.77"	33°48'31.38"
73	73°12'43.35"	33°48'28.97"
74	73°12'43.94"	33°48'23.95"
75	73°12'48.26"	33°48'22.80"
76	73°12'55.97"	33°48'14.98"
77	73°13'13.8"	33°47'50.52"
78	73°13'16.15"	33°47'44.49"
79	73°13'16.20"	33°47'42.16"
80	73°13'5.17"	33°47'35.23"

No.	Longitude	Latitude
81	73°13'2.20"	33°47'30.29"
82	73°13'3.33"	33°47'28.42"
83	73°13'8.91"	33°47'27.45"
84	73°13'11.32"	33°47'25.00"
85	73°13'9.30"	33°47'19.56"
86	73°13'6.06"	33°47'16.43"
87	73°13'3.46"	33°47'10.02"
88	73°13'3.25"	33°47'6.52"
89	73°13'5.55"	33°47'3.52"
90	73°13'6.18"	33°47'0.03"
91	73°13'5.67"	33°46'57.6"
92	73°13'7.43"	33°46'53.52"
93	73°13'10.01"	33°46'50.53"
94	73°13'9.04"	33°46'47.49"
95	73°13'6.54"	33°46'44.81"
96	73°13'1.95"	33°46'42.77"
97	73°12'39.51"	33°46'38.69"
98	73°12'31.85"	33°46'36.14"
99	73°12'28.79"	33°46'34.09"
100	73°12'29.30"	33°46'31.54"
101	73°12'34.40"	33°46'26.44"
102	73°12'42.57"	33°46'21.34"
103	73°12'47.67"	33°46'15.73"
104	73°12'48.69"	33°46'9.10"
105	73°12'45.12"	33°46'1.96"
106	73°12'47.16"	33°45'54.81"
107	73°12'51.75"	33°45'45.12"
108	73°12'55.32"	33°45'40.02"
109	73°12'55.32"	33°45'35.88"
110	73°12'28.70"	33°45'21.71"
111	73°12'11.54"	33°45'8.90"
112	73°12'9.467"	33°45'5.41"
113	73°11'57.04"	33°45'1.59"
114	73°11'55.26"	33°44'57.70"
115	73°11'58.12"	33°44'54.79"
116	73°11'58.12"	33°44'51.67"
117	73°11'57.60"	33°44'48.55"
118	73°11'54.79"	33°44'47.30"
119	73°11'49.17"	33°44'45.84"
120	73°11'43.34"	33°44'45.74"

No.	Longitude	Latitude
121	73°11'35.43"	33°44'47.09"
122	73°11'28.98"	33°45'0.52"
123	73°11'16.71"	33°45'9.88"
124	73°11'12.07"	33°45'17.24"
125	73°11'9.15"	33°45'19.81"
126	73°10'55.75"	33°45'19.98"
127	73°10'52.83"	33°45'21.19"
128	73°10'51.46"	33°45'26.51"
129	73°11'3.83"	33°45'40.26"
130	73°11'6.40"	33°45'45.58"
131	73°11'14.31"	33°45'49.36"
132	73°11'17.06"	33°45'52.97"
133	73°11'16.20"	33°45'55.38"
134	73°11'7.43"	33°45'54.86"
135	73°11'3.65"	33°45'53.66"
136	73°10'58.84"	33°45'54.34"
137	73°10'53.52"	33°45'52.45"
138	73°10'46.65"	33°45'51.94"
139	73°10'34.28"	33°45'45.93"
140	73°10'27.23"	33°45'40.77"
141	73°10'23.94"	33°45'36.03"
142	73°10'23.82"	33°45'34.37"
143	73°10'25.73"	33°45'32.46"
144	73°10'25.61"	33°45'29.01"
145	73°10'22.99"	33°45'32.34"
146	73°10'17.16"	33°45'36.27"
147	73°9'58.32"	33°45'26.23"
148	73°9'54.75"	33°45'18.10"
149	73°9'43.24"	33°45'14.33"
150	73°9'42.10"	33°45'20.24"
151	73°9'33.06"	33°45'24.33"
152	73°9'22.77"	33°45'34.45"
153	73°9'16.66"	33°45'35.00"
154	73°9'12.99"	33°45'32.11"
155	73°9'8.99"	33°45'26.45"
156	73°8'36.58"	33°45'17.23"
157	73°8'34.88"	33°45'16.22"
158	73°8'32.76"	33°45'11.89"
159	73°8'25.86"	33°45'8.25"
160	73°8'15.06"	33°45'5.603"

No.	Longitude	Latitude
161	73°8'0.76"	33°45'5.568"
162	73°7'48.95"	33°44'56.98"
163	73°7'39.78"	33°44'52.08"
164	73°7'37.01"	33°44'51.76"
165	73°7'31.25"	33°44'55.07"
166	73°7'21.76"	33°44'57.41"
167	73°7'9.615"	33°44'55.39"
168	73°6'58.31"	33°44'52.19"
169	73°6'55.00"	33°44'49.42"
170	73°6'56.60"	33°44'45.15"
171	73°6'56.35"	33°44'42.10"
172	73°6'51.62"	33°44'40.38"
173	73°6'40.57"	33°44'38.41"
174	73°6'17.13"	33°44'38.92"
175	73°6'9.55"	33°44'40.63"
176	73°5'52.22"	33°44'47.93"
177	73°5'47.78"	33°44'48.21"
178	73°5'23.82"	33°44'42.34"
179	73°5'0.821"	33°44'34.98"
180	73°3'57.87"	33°44'3.61"
181	73°3'56.75"	33°44'5.53"
182	73°3'51.14"	33°44'6.49"
183	73°3'46.81"	33°44'10.91"
184	73°3'22.53"	33°44'5.215"
185	73°3'23.65"	33°43'58.80"
186	73°3'28.70"	33°43'55.59"
187	73°3'28.94"	33°43'52.47"
188	73°3'27.33"	33°43'50.06"
189	73°3'28.14"	33°43'48.14"
190	73°3'22.69"	33°43'44.85"
191	73°3'18.76"	33°43'50.06"
192	73°2'27.07"	33°43'40.30"
193	73°2'20.11"	33°43'57.62"
194	73°2'15.76"	33°43'56.79"
195	73°2'14.11"	33°43'54.56"
196	73°2'5.17"	33°43'52.09"
197	73°2'9.06"	33°43'37.26"
198	73°1'20.16"	33°43'26.56"
199	73°1'6.14"	33°43'38.16"
200	73°1'2.151"	33°43'33.47"

No.	Longitude	Latitude
201	73°0'59.83"	33°43'33.53"
202	73°0'55.91"	33°43'37.14"
203	73°0'55.24"	33°43'38.93"
204	73°0'53.44"	33°43'38.71"
205	73°0'50.30"	33°43'37.42"
206	73°0'50.30"	33°43'36.05"
207	73°0'48.58"	33°43'34.62"
208	73°0'22.79"	33°43'22.72"
209	73°0'21.27"	33°43'18.09"
210	73°0'19.05"	33°43'18.74"
211	73°0'14.79"	33°43'22.42"
212	73°0'14.52"	33°43'25.33"
213	73°0'11.48"	33°43'27.76"
214	73°0'8.079"	33°43'27.54"
215	73°0'0.549"	33°43'31.88"
216	72°59'42.02"	33°43'32.46"
217	72°59'38.28"	33°43'28.52"
218	72°59'41.59"	33°43'22.14"
219	72°59'40.66"	33°43'18.06"
220	72°59'35.39"	33°43'11.52"
221	72°59'25.27"	33°43'8.63"
222	72°59'8.120"	33°42'57.99"
223	72°58'32.47"	33°42'50.66"
224	72°58'22.33"	33°42'49.58"
225	72°58'20.36"	33°42'51.09"
226	72°58'17.69"	33°43'2.169"
227	72°58'20.96"	33°43'20.05"
228	72°58'20.23"	33°43'25.01"
229	72°58'4.129"	33°43'20.63"
230	72°57'53.45"	33°43'20.63"
231	72°57'43.74"	33°43'23.72"
232	72°57'40.93"	33°43'21.11"
233	72°57'39.12"	33°43'14.48"
234	72°57'36.52"	33°43'14.16"
235	72°57'28.69"	33°43'9.94"
236	72°57'15.41"	33°43'9.15"
237	72°57'5.695"	33°43'11.74"
238	72°56'59.64"	33°43'12.13"
239	72°56'58.89"	33°43'13.65"
240	72°57'1.26"	33°43'18.83"

No.	Longitude	Latitude
241	72°57'1.12"	33°43'21.28"
242	72°56'57.55"	33°43'23.08"
243	72°56'54.75"	33°43'23.04"
244	72°56'52.95"	33°43'22.36"
245	72°56'52.46"	33°43'19.93"
246	72°56'54.81"	33°43'18.24"
247	72°56'52.72"	33°43'13.02"
248	72°56'40.33"	33°43'11.98"
249	72°56'33.55"	33°43'7.287"
250	72°56'20.11"	33°43'4.809"
251	72°56'8.31"	33°43'8.57"
252	72°55'59.4"	33°43'14.80"
253	72°55'54.61"	33°43'17.02"
254	72°55'51.47"	33°43'16.75"
255	72°55'49.11"	33°43'18.05"
256	72°55'45.23"	33°43'15.45"
257	72°55'41.27"	33°43'17.25"
258	72°55'25.61"	33°43'4.64"
259	72°55'14.40"	33°43'1.33"
260	72°55'9.823"	33°43'4.13"
261	72°55'2.690"	33°43'5.40"
262	72°54'59.63"	33°43'7.95"
263	72°54'56.82"	33°43'14.39"
264	72°54'58.07"	33°43'17.32"
265	72°55'6.415"	33°43'26.71"
266	72°55'5.842"	33°43'32.44"
267	72°55'4.123"	33°43'35.30"
268	72°54'51.32"	33°43'36.07"
269	72°54'42.95"	33°43'32.55"
270	72°54'44.71"	33°43'16.92"
271	72°54'39.60"	33°43'16.06"
272	72°54'30.96"	33°43'17.32"
273	72°54'24.99"	33°43'15.52"
274	72°54'15.37"	33°43'15.91"
275	72°54'1.735"	33°43'10.48"
276	72°53'51.25"	33°43'9.65"
277	72°53'48.66"	33°43'6.01"
278	72°53'48.99"	33°43'1.98"
279	72°53'51.34"	33°42'58.26"
280	72°53'50.97"	33°42'54.21"

No.	Longitude	Latitude
281	72°54'1.05"	33°42'48.77"
282	72°54'3.43"	33°42'38.07"
283	72°54'10.04"	33°42'37.57"
284	72°54'13.65"	33°42'35.95"
285	72°54'15.40"	33°42'33.58"
286	72°54'15.90"	33°42'26.47"
287	72°54'17.61"	33°42'23.97"
288	72°54'21.09"	33°42'22.63"
289	72°54'33.80"	33°42'22.79"
290	72°54'42.59"	33°42'17.74"
291	72°54'43.29"	33°42'9.74"
292	72°54'47.43"	33°42'4.97"
293	72°54'49.73"	33°42'4.09"
294	72°55'2.540"	33°42'9.42"
295	72°55'6.993"	33°42'4.89"
296	72°55'13.51"	33°41'50.42"
297	72°55'11.53"	33°41'43.18"
298	72°55'1.13"	33°41'29.07"
299	72°54'51.27"	33°41'25.83"
300	72°54'47.59"	33°41'23.59"
301	72°54'42.81"	33°41'17.76"
302	72°54'36.36"	33°41'15.64"
303	72°54'27.79"	33°41'16.39"
304	72°54'26.49"	33°41'19.37"
305	72°54'23.88"	33°41'29.80"
306	72°54'23.88"	33°41'33.35"
307	72°54'29.14"	33°42'0.99"
308	72°54'24.48"	33°42'7.77"
309	72°54'23.02"	33°42'11.97"
310	72°54'17.61"	33°42'17.61"
311	72°54'15.19"	33°42'18.60"
312	72°53'45.89"	33°42'16.91"
313	72°53'43.51"	33°42'16.59"
314	72°53'41.82"	33°42'14.93"
315	72°53'40.87"	33°42'13.24"
316	72°53'41.57"	33°42'7.44"
317	72°53'40.71"	33°41'59.64"
318	72°53'47.29"	33°41'47.03"
319	72°53'55.72"	33°41'37.53"
320	72°53'56.38"	33°41'33.00"

No.	Longitude	Latitude
321	72°53'51.22"	33°41'26.73"
322	72°53'42.14"	33°41'24.73"
323	72°53'3.34"	33°41'29.89"
324	72°52'41.08"	33°41'30.22"
325	72°52'39.90"	33°41'34.65"
326	72°52'40.82"	33°41'39.68"
327	72°52'40.07"	33°41'46.95"
328	72°52'42.13"	33°41'57.83"
329	72°52'41.85"	33°42'3.77"
330	72°52'38.89"	33°42'10.25"
331	72°52'33.28"	33°42'13.13"
332	72°52'24.49"	33°42'13.02"
333	72°52'17.26"	33°42'8.33"
334	72°52'4.349"	33°42'5.46"
335	72°51'39.43"	33°42'6.11"
336	72°51'8.397"	33°42'8.97"
337	72°50'38.33"	33°42'8.60"
338	72°50'29.12"	33°42'6.72"
339	72°50'21.12"	33°42'8.31"
340	72°49'59.60"	33°42'9.35"
341	72°49'58.38"	33°42'10.87"
342	72°49'57.98"	33°42'14.11"
343	72°49'59.05"	33°42'15.88"
344	72°50'25.51"	33°42'23.85"
345	72°50'26.82"	33°42'42.67"
346	72°50'34.66"	33°42'52.46"
347	72°50'40.22"	33°42'56.45"
348	72°50'48.73"	33°42'59.34"
349	72°50'53.16"	33°43'4.53"
350	72°51'5.14"	33°43'8.65"
351	72°51'12.18"	33°43'12.38"
352	72°51'36.65"	33°43'13.39"
353	72°51'46.01"	33°43'7.63"
354	72°51'53.66"	33°43'4.53"
355	72°52'3.115"	33°43'5.11"
356	72°52'9.988"	33°43'3.75"
357	72°52'15.62"	33°43'5.86"
358	72°52'16.82"	33°43'5.46"
359	72°52'21.94"	33°43'9.15"
360	72°52'32.85"	33°43'13.18"

No.	Longitude	Latitude
361	72°52'44.80"	33°43'10.05"
362	72°52'52.87"	33°43'10.08"
363	72°52'57.09"	33°43'11.27"
364	72°53'3.070"	33°43'9.96"
365	72°53'13.67"	33°43'12.67"
366	72°53'26.95"	33°43'12.53"
367	72°53'32.68"	33°43'15.30"
368	72°53'45.67"	33°43'17.14"
369	72°53'46.75"	33°43'17.65"
370	72°53'45.98"	33°43'23.56"
371	72°53'51.33"	33°43'35.43"
372	72°54'18.93"	33°43'43.22"
373	72°54'34.48"	33°43'41.17"
374	72°54'38.81"	33°43'43.74"
375	72°54'41.65"	33°43'43.89"
376	72°54'54.33"	33°43'42.01"
377	72°55'3.302"	33°43'45.39"
378	72°55'11.25"	33°43'45.43"
379	72°55'19.96"	33°43'47.99"
380	72°55'34.21"	33°43'47.70"
381	72°55'43.71"	33°43'46.06"
382	72°56'5.596"	33°43'52.05"
383	72°56'12.78"	33°43'51.98"
384	72°56'38.15"	33°43'47.94"
385	72°56'46.25"	33°43'48.66"
386	72°56'49.90"	33°43'47.17"
387	72°57'14.58"	33°43'52.17"
388	72°57'18.11"	33°43'53.76"
389	72°57'21.47"	33°43'57.80"
390	72°57'30.47"	33°44'3.105"
391	72°57'38.73"	33°44'5.156"
392	72°57'46.00"	33°44'11.69"
393	72°57'46.53"	33°44'13.61"
394	72°57'52.08"	33°44'19.26"
395	72°57'57.71"	33°44'22.33"
396	72°58'24.68"	33°44'23.56"
397	72°58'35.35"	33°44'30.94"
398	72°58'39.81"	33°44'36.16"
399	72°58'46.53"	33°44'39.72"
400	72°58'45.41"	33°44'44.62"

No.	Longitude	Latitude
401	72°58'50.64"	33°44'48.45"
402	72°58'58.05"	33°44'49.80"
403	72°59'6.799"	33°44'55.02"
404	72°59'12.73"	33°44'54.09"
405	72°59'38.64"	33°45'01.68"
406	72°59'50.29"	33°45'8.65"
407	72°59'50.82"	33°45'9.76"
408	72°59'49.87"	33°45'10.37"
409	72°59'43.28"	33°45'12.83"
410	72°59'37.53"	33°45'12.29"
411	72°59'32.30"	33°45'13.86"
412	72°59'26.82"	33°45'13.10"
413	72°59'22.99"	33°45'13.67"
414	72°59'20.98"	33°45'16.51"
415	72°59'20.94"	33°45'19.07"
416	72°59'25.41"	33°45'23.71"
417	72°59'27.71"	33°45'24.54"
418	72°59'40.85"	33°45'26.20"
419	72°59'45.75"	33°45'23.71"
420	72°59'48.91"	33°45'24.65"
421	72°59'51.15"	33°45'27.64"
422	72°59'53.99"	33°45'29.11"
423	72°59'56.15"	33°45'29.33"
424	72°59'58.45"	33°45'28.07"
425	73°0'6.955"	33°45'28.03"
426	73°0'12.46"	33°45'31.53"
427	73°0'20.56"	33°45'32.07"
428	73°0'25.48"	33°45'34.68"
429	73°0'26.16"	33°45'40.54"
430	73°0'33.08"	33°45'57.02"
431	73°0'39.78"	33°45'59.95"
432	73°0'47.97"	33°46'12.04"
433	73°0'51.18"	33°46'18.69"
434	73°0'53.25"	33°46'27.18"
435	73°0'56.46"	33°46'30.39"
436	73°1'4.033"	33°46'34.29"
437	73°1'10.45"	33°46'40.94"
438	73°1'14.35"	33°46'42.32"
439	73°1'33.16"	33°46'44.84"
440	73°1'41.42"	33°46'47.14"

No.	Longitude	Latitude
441	73°1'59.09"	33°46'48.97"
442	73°2'4.597"	33°46'52.18"
443	73°2'17.62"	33°46'55.76"
444	73°2'22.01"	33°46'59.37"
445	73°2'28.90"	33°47'2.85"
446	73°2'42.79"	33°47'5.52"
447	73°2'57.53"	33°47'3.00"
448	73°3'4.879"	33°47'2.81"
449	73°3'7.638"	33°47'1.73"
450	73°3'11.76"	33°47'2.41"
451	73°3'20.25"	33°47'1.27"
452	73°3'24.61"	33°46'57.60"
453	73°3'30.57"	33°46'57.83"
454	73°3'39.75"	33°47'3.33"
455	73°3'56.96"	33°47'5.40"
456	73°4'3.15"	33°47'7.46"
457	73°4'7.97"	33°47'10.90"
458	73°4'13.24"	33°47'12.26"
459	73°4'17.37"	33°47'14.55"
460	73°4'27.70"	33°47'23.50"
461	73°4'38.02"	33°47'27.86"
462	73°4'46.05"	33°47'34.74"
463	73°4'49.95"	33°47'36.11"
464	73°4'52.47"	33°47'35.43"
465	73°4'55.91"	33°47'31.99"
466	73°5'0.507"	33°47'30.38"
467	73°5'7.160"	33°47'29.23"
468	73°5'23.44"	33°47'29.23"
469	73°5'24.56"	33°47'27.27"
470	73°5'24.86"	33°47'19.92"
471	73°5'30.72"	33°47'19.77"
472	73°5'35.52"	33°47'9.86"
473	73°5'40.02"	33°47'9.41"
474	73°5'46.32"	33°47'9.41"
475	73°5'52.47"	33°47'14.51"
476	73°5'58.47"	33°47'17.81"
477	73°6'4.174"	33°47'17.96"
478	73°6'9.875"	33°47'22.02"
479	73°6'16.32"	33°47'22.02"
480	73°6'20.37"	33°47'26.07"

No.	Longitude	Latitude
481	73°6'22.62"	33°47'26.07"
482	73°6'25.62"	33°47'23.97"
483	73°6'28.92"	33°47'24.42"
484	73°6'40.03"	33°47'30.27"
485	73°6'44.08"	33°47'30.27"
486	73°6'50.68"	33°47'27.12"
487	73°6'59.98"	33°47'26.37"
488	73°7'4.48"	33°47'24.87"
489	73°7'9.13"	33°47'25.92"
490	73°7'27.43"	33°47'25.77"
491	73°7'32.33"	33°47'33.27"
492	73°7'39.58"	33°47'38.67"
493	73°7'40.81"	33°47'42.45"
494	73°7'54.35"	33°47'55.29"
495	73°8'0.10"	33°47'59.09"
496	73°8'5.89"	33°48'0.06"
497	73°8'22.85"	33°48'6.32"
498	73°8'45.51"	33°48'10.89"
499	73°8'58.35"	33°48'21.22"
500	73°8'58.81"	33°48'23.05"
501	73°8'57.09"	33°48'25.35"
502	73°9'9.08"	33°48'36.14"
503	73°9'16.65"	33°48'35.16"
504	73°9'18.32"	33°48'35.62"
505	73°9'18.86"	33°48'36.87"
506	73°9'22.80"	33°48'37.61"
507	73°9'32.69"	33°48'36.90"
508	73°9'41.72"	33°48'40.88"
509	73°9'50.09"	33°48'39.44"
510	73°10'3.32"	33°48'43.09"
511	73°10'13.74"	33°48'43.77"
512	73°10'21.34"	33°48'43.35"
513	73°10'36.68"	33°48'34.28"
514	73°10'46.57"	33°48'36.96"
515	73°10'56.30"	33°48'37.73"
516	73°11'15.97"	33°48'35.95"

6 Conclusions and Recommendations

This report is a useful document which provides information about the National Park boundary, topography, landcover and wildlife habitat of the area.

The MHNP boundary has been delineated by using topographic layers, landcover maps, habitat maps and field data. Delineated boundary covers an area of 16,979 ha (169.79 Km²) whereas area mentioned in the current notification is 17,386 ha (173.86 Km²). There is a difference of -476 ha (4.76 Km²).

There were extensive discussion sessions with the officials of CDA and ICT regarding NP boundary. GPS data were collected for the reference land marks which included natural features, forest compartment boundaries, historic pillars placed by the British Government and the pillars raised by CDA in 1986.

For the land ownership mapping suggested by the ASC, *latha* maps of Shah Allah Ditta and Shahdara were processed by using fifteen GPS points each. The output maps did not provide any appealing result. It was analysed that these small scale *latha* maps require at least 40-50 GPS points for registration with real world coordinates. It was concluded that this activity requires dedicated human and financial resources, which is out of the scope of this exercise and needs a separate devoted Project.

On the basis of delineated boundary, a notification format was developed. The proposed notification format has three parts i.e. textual description, a comprehensive GIS map and list of boundary coordinates. The notification format significantly describes the boundary with dual references i.e. the land features and geographic coordinates.

As the boundary is delineated on scientific basis and finalized by incorporating ASC comments, it is recommended to demarcate and re-notify the MHNP boundary with geographic coordinates.

7 References

- [1] http://en.wikipedia.org/wiki/Margallah_Hills
- [2] http://www.wildlifeofpakistan.com/national_parks.html
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- [4] Masud, R.M. (1979). Master plan for Margallah Hills National Park, Islamabad, Pakistan. National Council for Conservation of Wildlife, Islamabad. 48 pp
- [5] Backpacker November (2006). IAPs in Margallah Hills National Park
- [6] Stinson N J (1978). *Habitat Structure and rodent species diversity on North and South – facing slopes in the Colorado lower montane zone*, The southwestern Naturalist , 23(1).77-84 pp.

ANNEXURE 1. SPOT – 5 Data Characteristics

In the early 1978 the French government decided to undertake the development of the *Satellite Pour l'Observation de la Terre*, or SPOT, program. Spot has developed into a large- scale international program with ground receiving stations and data distribution outlets located in more than 20 countries. The first satellite was launched in 1986, after which a series of SPOT were launched with improved and advanced technology of scanning and capturing techniques. SPOT - 5 is a key asset for applications such as medium-scale mapping (at 1:25 000 and 1:10 000 locally), urban and rural planning, oil and gas exploration, and natural disaster management. Data specifications of SPOT – 5 data are shown below;

Band Numbers	Spectral Range (μm)	Spatial Resolution (m)	Swath Width (Km)
1	0.50 - 0.59	10	60
2	0.61 - 0.68	10	60
3	0.78 - 0.89	10	60
4	1.58 - 1.75	10	60
Pan		2.5	60

ANNEXURE 2. Glossary of Terms

False Color Composite (FCC)

In satellite image processing, false-color Composites (FCC) images are used as they increase the interpretability of the data. False color composite of ASTER data in which bands 3N, 2, 1 are represented in red, green and blue spectral ranges respectively, enhance the interpretation of vegetative biomass by presenting it in varying tones of red.

Global Positioning System

The Global Positioning System, usually called GPS (the US military refers to it as NAVSTAR GPS - Navigation Signal Timing and Ranging Global Positioning System), is a satellite navigation system is used for determining precise locations and providing a highly accurate time reference almost anywhere on Earth.

Ortho-rectification

Ortho-rectification is the process of removing the geometric distortion inherent in imagery caused by the camera/sensor orientation, topographic relief displacement and systematic errors associated with imagery (ASTER User Handbook JPL).

WGS-84

A consistent set of parameters describing the size and shape of the earth, the positions of a network of points with respect to the center of mass of the earth, transformations from major geodetic datums, and the potential of the earth (usually in terms of harmonic coefficients).

ANNEXURE 3. Scientific and Common Names of the MHNP Vegetation

	Common Name	Scientific Name
dry semi-evergreen forest	Phulai	<i>Acacia Modesta</i>
	Kao	<i>Olea Ferruginea</i>
	Sanatha	<i>Dodonaea Viscosa</i>
	Granda	<i>Carissa Spinarum</i>
	Ber	<i>Zizyphus Jujuba</i>
	Bhekar	<i>Justicia Adhatoda</i>
	Gunger	<i>Sageratia Thea,</i>
	Mullah	<i>Zizyphus Nummularia</i>
	Khokhal	<i>Myrsine Africana</i>
	Silver Oak	<i>Grevillea Robusta</i>
	Bottle brush	<i>Callistemon Viminalis</i>
	Sufaida	<i>Eucalyptus sp</i>
	Lantana	<i>Lantana Camara</i>
	Vilaiti Shahtoot	<i>Paper Mulberry</i>
Pine Forest	Chir Pine	<i>Pinus Roxburghii</i>

ANNEXURE 4. Field Observation Points