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ICPSR 4538

Chitwan Valley [Nepal] Family Study: Changing Social Contexts and Family Formation

Guide to the Western Chitwan ArcGIS Map Document

Chitwan Valley [Nepal] Family Study: Changing Social Contexts and Family Formation

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Prepared by Stephen A. Matthews

July 31, 2004

The GIS data files: brief history

The original data files contained in the Western Chitwan MXD file were created between 1997 and 2000. The majority of the data files were originally created in either ArcInfo (typically the GIS data layers digitized of topographic and land use maps) or in Arcview 3.x.

In July 2004 all ArcInfo "coverages" were converted into shapefiles and all original GIS data layers were re-created for use in ArcGIS 8.x. The re-creation of files included the use of a consistent map projection for all data layers.

Projection

All GIS data layers are projected based on the following coordinate system:

Transverse_Mercator
False_Easting: 500036.000000
False_Northing: -831.000000
Central_Meridian: 87.000000
Scale_Factor: 0.999900
Latitude_Of_Origin: 0.000000
GCS_Everest_Adj_1937
Datum: D_Everest_Adj_1937
Prime Meridian: 0

Map Sources

For the most part the data included in this GIS project come from one of two sources.

First, we relied on existing paper maps to generate many data layers, specifically using:

a) Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal (in cooperation with the Government of Finland) – the specific map sheets used were:

   i. No. 2784 05D (Meghauli)
   ii. No. 2784 06A (Rampur)
   iii. No. 2784 06B (Bharatpur)
   iv. No. 2784 06C (Kasara)
   v. No. 2784 06D (Gitanagar)
      and
   vi. *No. 2784 05B (Kanauli)*

05B	06A	06B
05D	06C	06D

b) Land System and Land Capability maps (1:50,000) prepared under the Canadian Assistance Program to Nepal by the Topographical Survey Branch, Survey Department of the Ministry of Land Reform of His Majesty's Government of Nepal and Kenting Earth Sciences Limited of Ottawa, Canada. The specific map sheets used were:

    i. No. 72 A/2
   ii. No. 72 A/6

72 A 2	72 A 6

Second, the Chitwan Valley Family Study and the Population Environment Study field teams collected primary data on specific locations throughout the Western Chitwan study area (e.g., neighborhoods, health posts, schools, bus routes). These data were gathered using the Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal, using global positioning systems, and during neighborhood mapping and flora surveys.

The Western Chitwan area is bounded to the…

    West by longitude 84°7'30" East
    East by longitude 84°30' East
    North by latitude 27°45' North
    South by latitude 27°30' North

27°45' N

84°7'30" E   84°30' E

27°30' N
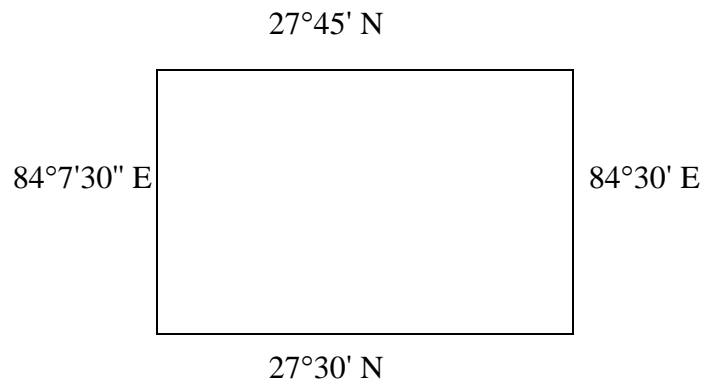
Below each GIS layer is discussed separately and specific information as to source is provided.

The Western_Chitwan.mxd file

The Western_Chitwan.mxd file includes many GIS data layers. Usually within a GIS the data layers are "ordered" with area or polygon files at the bottom of a list (i.e., first layers drawn on a map), followed by linear features and then with point features at the top (drawn last on a map). This is the structure followed here.

When the Western_Chitwan.mxd file is opened in ArcGIS 8.x the screen would look similar to Figure 1 below.

Figure 1.
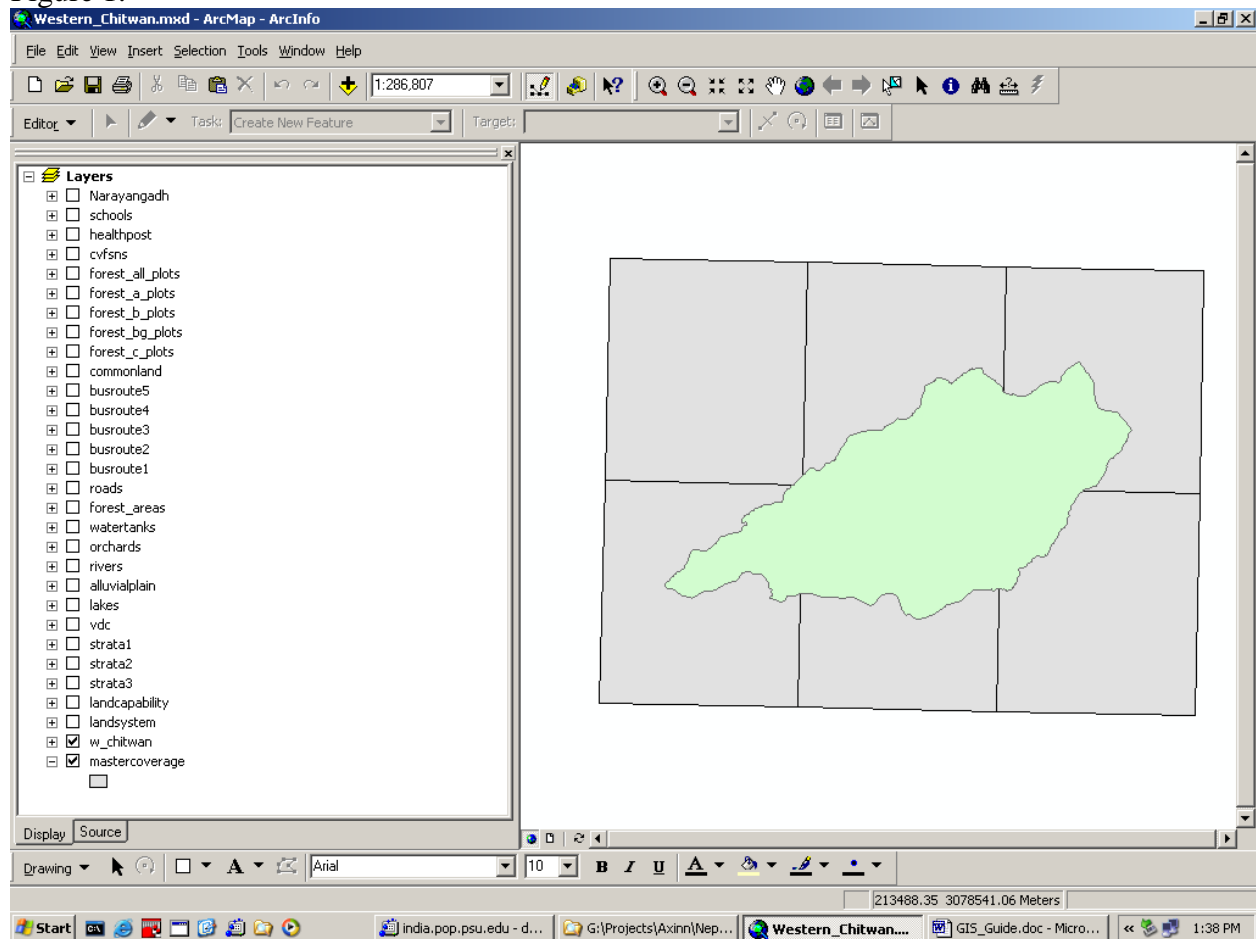
In the map document only two layers are visible (mapped): "mastercoverage" and "w_chitwan." A good way to think about the **mastercoverage** layer is as the "reference" map. Mastercoverage includes six tiles, where each tile represents one of topographic map sheets used to generate many of the other layers in this GIS project and used to consult to verify coordinate locations if discrepancies were found.

The **w_chitwan** layer was derived from the topographic map sheets and represents the boundary of the Chitwan Valley study area.

VDC areas
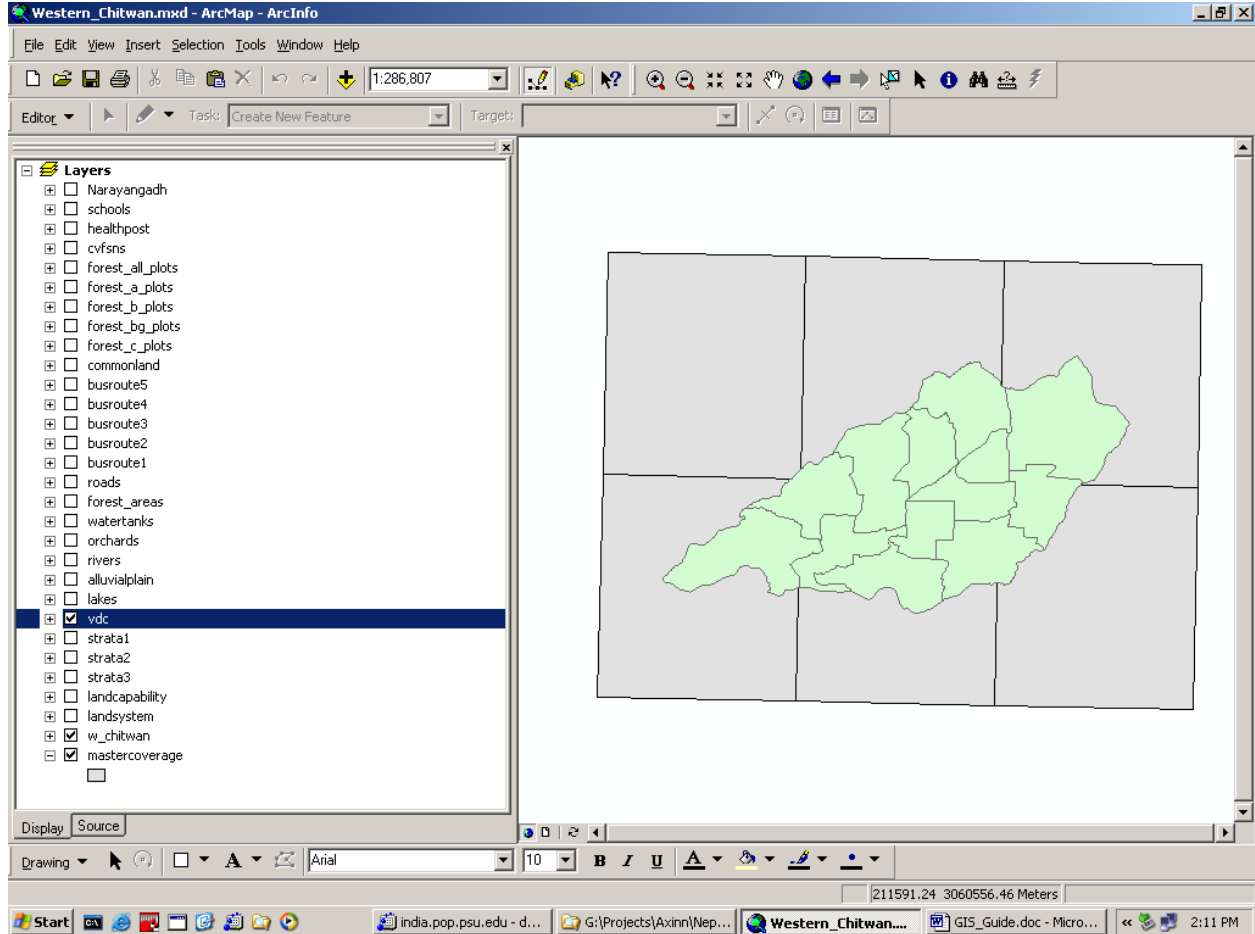
VDC areas were derived from the Topographic Map sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal (in cooperation with the Government of Finland). In the Western Chitwan study area there are thirteen VDCs (listed below by their CVFS strata):

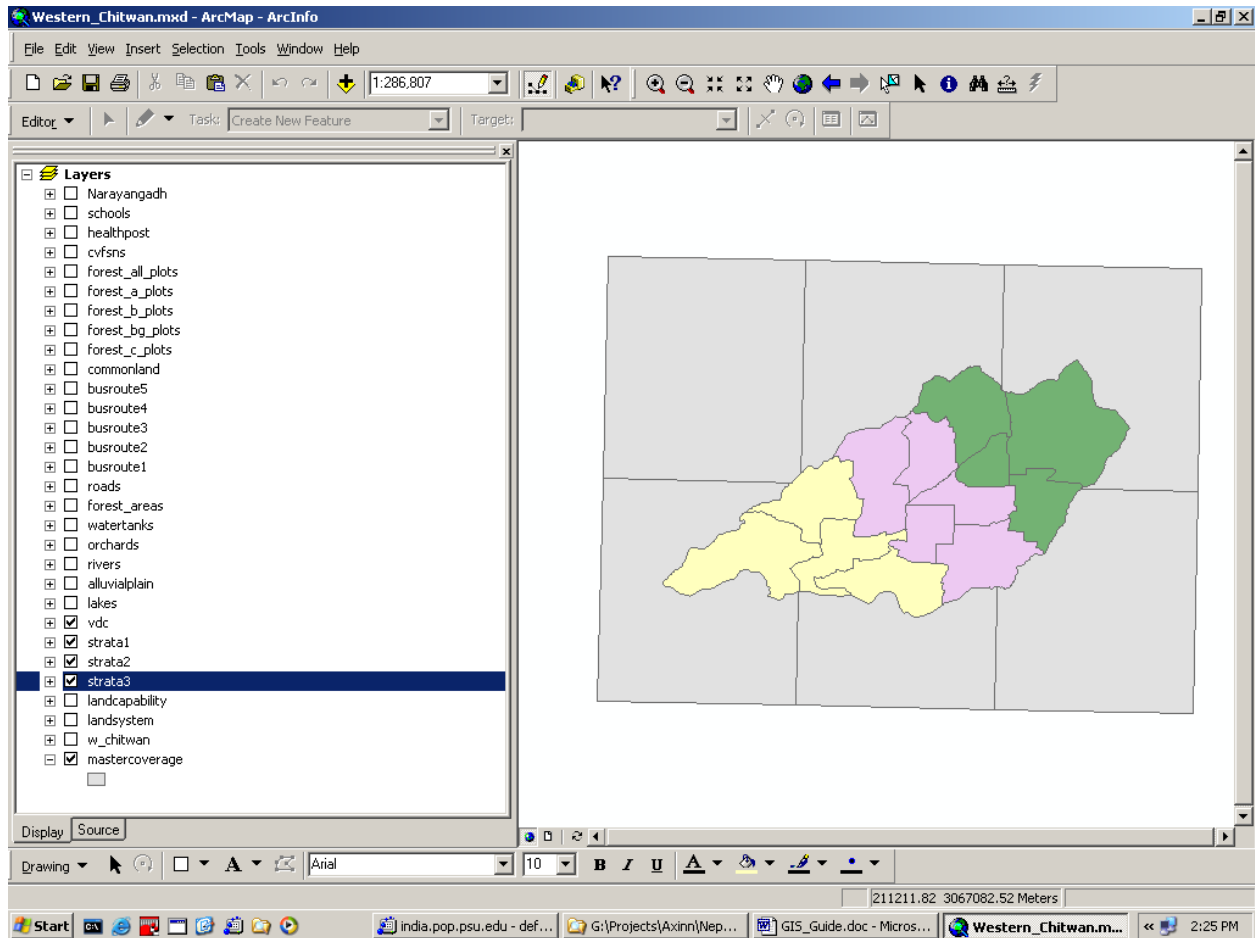| Strata 1:	Bharatapur	Gitanagar	Mangalpur	Phulbari	
Strata 2:	Gunjanagar	Patihani	Parbatipur	Sharadanagar	Shivanagar
Strata 3:	Dibyanagar	Jagatpur	Meghauli	Shukranagar	

The **VDC** layer includes the VCD name and the strata ID.

The 13 **VDC** areas aggregated (or dissolved) together is the equivalent of the **W_Chitwan** boundary.

Strata1, Strata2, and Strata3

The CVFS is designed around three **strata.** These strata boundaries are derived from the Topographic Map sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal (in cooperation with the Government of Finland).

Strata1 is closest to the main town of Narayangadh and includes the following four VDCs: Bharatapur, Gitanagar, Mangalpur, and Phulbari.

Strata2 lies beyond strata 1 and includes five VDCs: Gunjanagar, Patihani, Parbatipur, Sharadanagar, and Shivanagar.

Strata3 includes the four VDCs furthest from Narayangadh: Dibyanagar, Jagatpur , Meghauli, and Shukranagar.

The three strata layers include 4, 5 and 4 polygons respectively with each polygon equivalent to a VDC area. Each strata layer includes an attribute indicating VDC name.

The three strata layers together are the equivalent of the **VDC** boundary.

Narayangadh
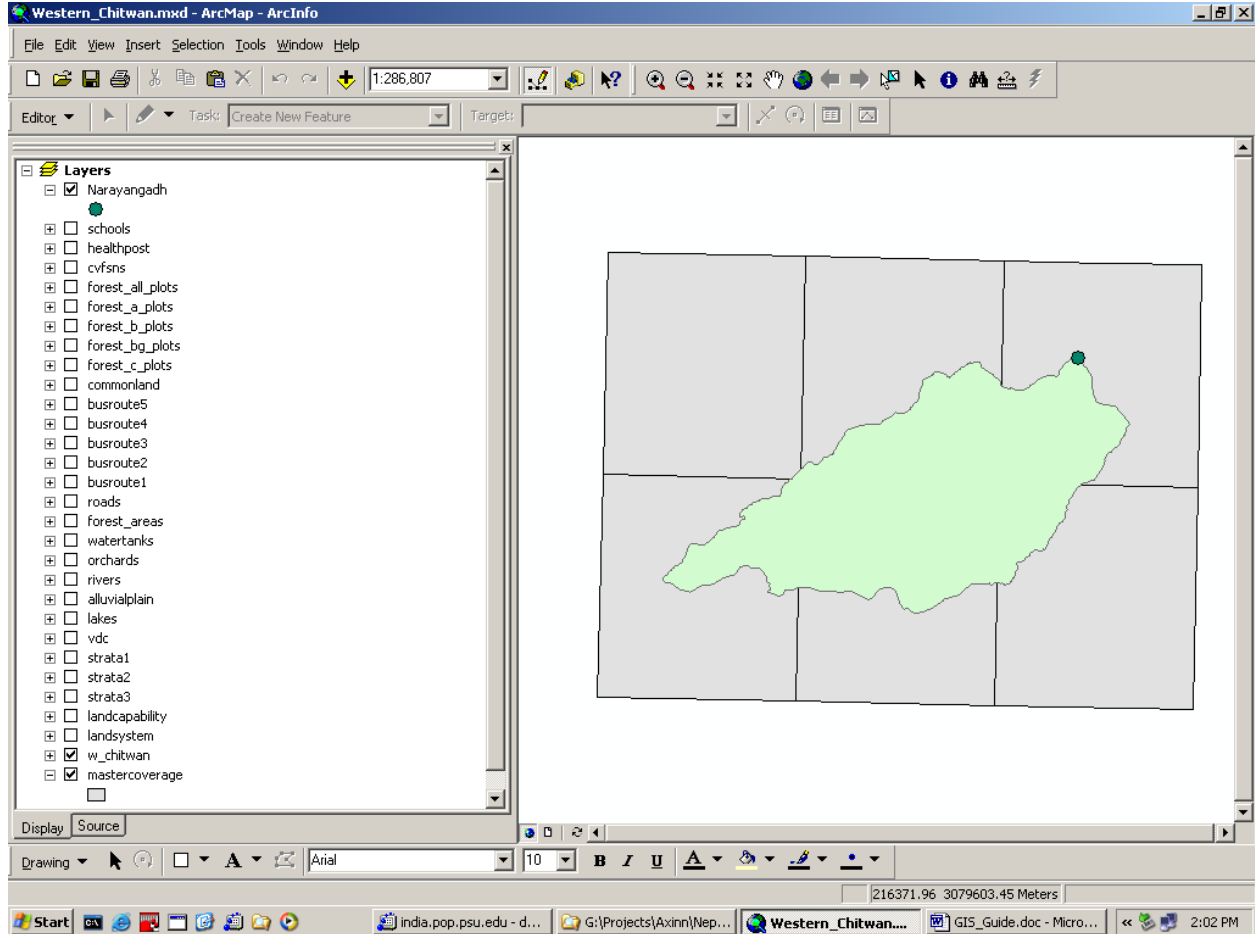
Narayangadh (Bharatpur) is the main town and industrial center of the Western Chitwan. As there was interest in proximity or distance of each CVFS neighborhood to this main town a single "reference point" was chosen to represent Narayangadh. The point selected was the location of neighborhood 0101001 (a neighborhood in the Pulchok area of Narayangadh). The attribute "distance to Narayangadh" is found in the **CVFSNS** (CVFS neighborhood) file.

CVFSNS (Chitwan Valley Family Study Neighborhoods)
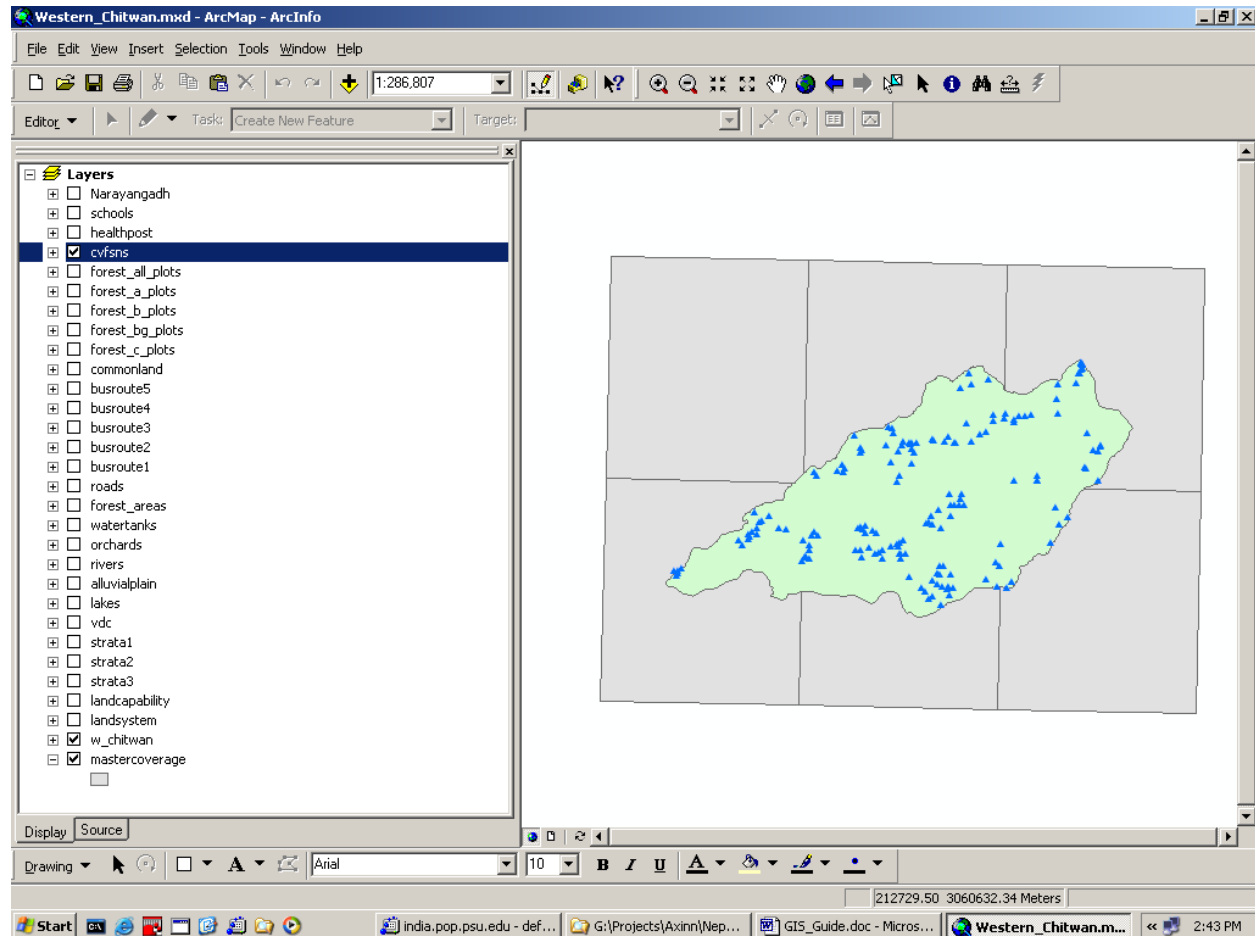
There are 171 Chitwan Valley Family Study neighborhoods and their geographic locations are found in the GIS layer **cvfsns**. This GIS layer includes the CVFS neighborhood ID variable (e.g., 0101001) that would allow a user to link any attribute of neighborhoods (including any derived variables and even model residuals) in to a map.

The **cvfsns** file includes attributes pertaining to the distance calculations to

(a) Narayangadh (main town)

(b) the nearest school in 2051 (1996)

(c) the nearest open health posts in each year between 2013 and 2051 (Nepali calendar) and the health post ID for the specific year. That is, combined these data can be used to create a time-varying measure of distance to nearest health post, and with the health post ID researchers can link to other attributes of the health post (e.g., method of contraceptives available, staff numbers, etc.).

(d) the nearest bus route in 2051

(e) the nearest forest plot (A, B, BG or C forest area plots).

NB: the CVFS ID variable is hierarchical in structure. The first two digits refer to the strata number, the second two digits to a settlement number and the last three digits to a code for each neighborhood within a settlement.

The coordinate locations for CVFS neighborhoods were collected through the use of both GPS units and through cross-referencing against the Topographic Map sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal (in cooperation with the Government of Finland).

Even though each neighborhood is represented as a single point, the neighborhood varies in size. The coordinate used to represent the neighborhood is the south-western-most corner of the designated neighborhood area, a point determined by the Neighborhood Mapping Teams.

Healthposts
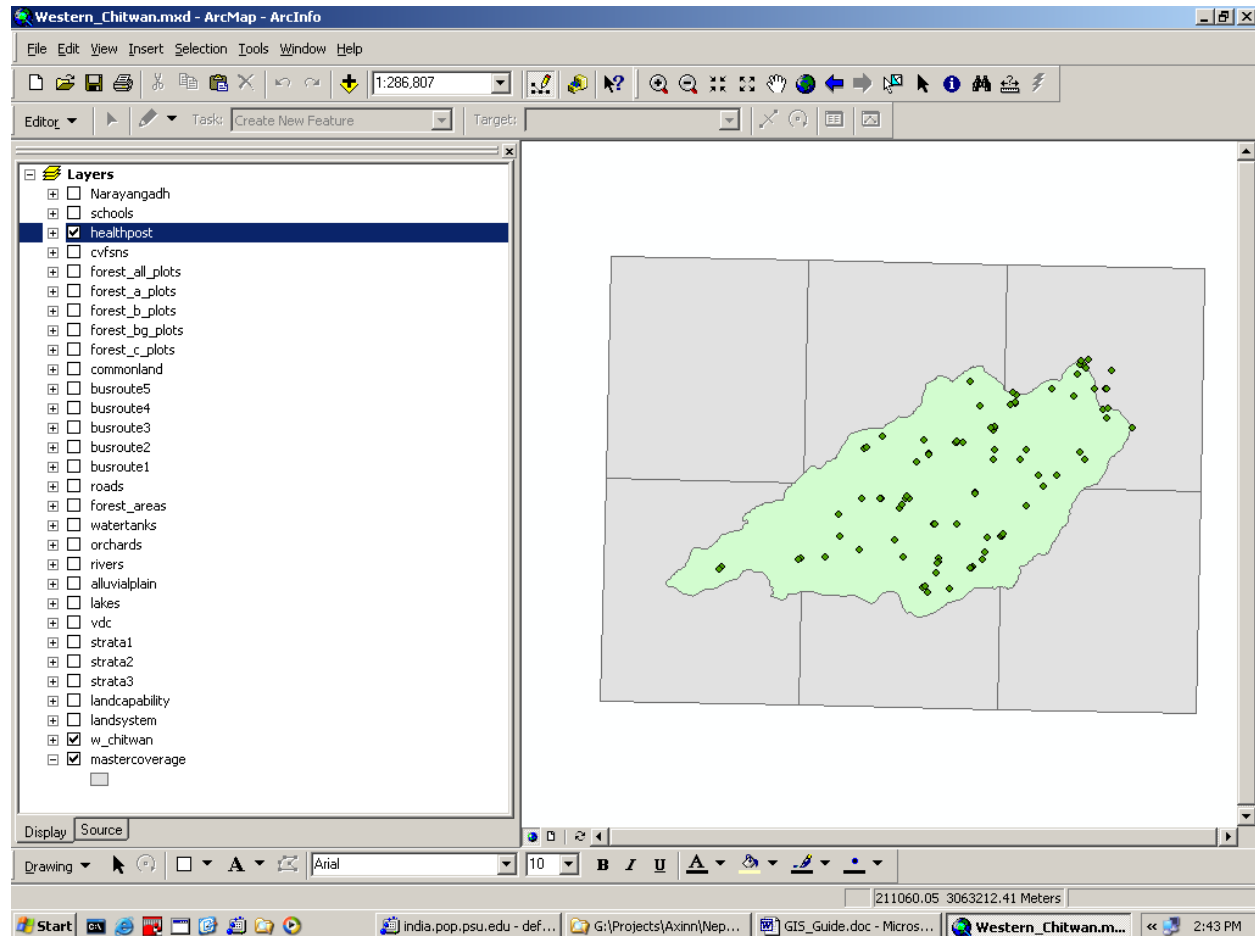
Between Nepali years 2013 and 2051 there were 116 healthposts (health clinics) in operation. However, at the beginning of this time period only a small number of healthposts were open, and others were open for just a few years. In addition, some healthposts opened at the same location where another one had closed.

The **healthpost** layer includes:

      x-y coordinates (X_COORD and Y_COORD)
      Health post ID (HLTHID)
      First year open (HLTHBYR)
      Last year open (HLTHEYR)
      Year 2013 (YR2013) – where 1 = open, 0 = did not exist/closed
      …
   Year 2051 (YR2051) – where 1 = open, 0 = did not exist/closed

The map above shows the locations of all 116 healthposts. While not included in the Western_Chitwan.mxd file separate GIS layers (or shapefiles) were created that indicate the location of "open" health clinics by each Nepali year 2013 through 2051.

Schools
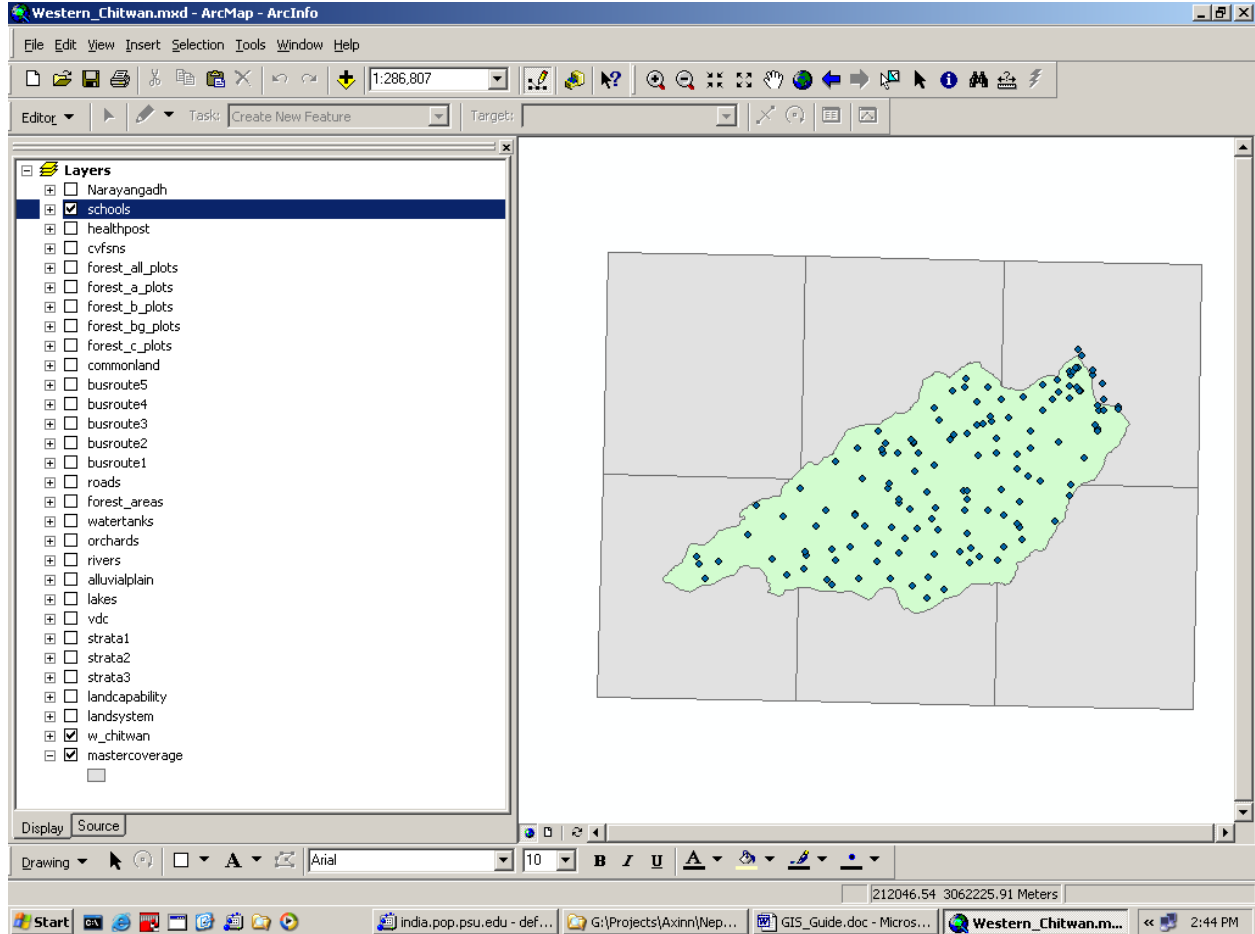
There were 151 schools reported by CVFS fieldworkers. The GIS layer, **schools** includes X and Y coordinates (X_COORD and Y_COORD) and a school ID variable (SCH_ID). Of the 151 schools five have missing SCH_ID values ('9999').

Roads
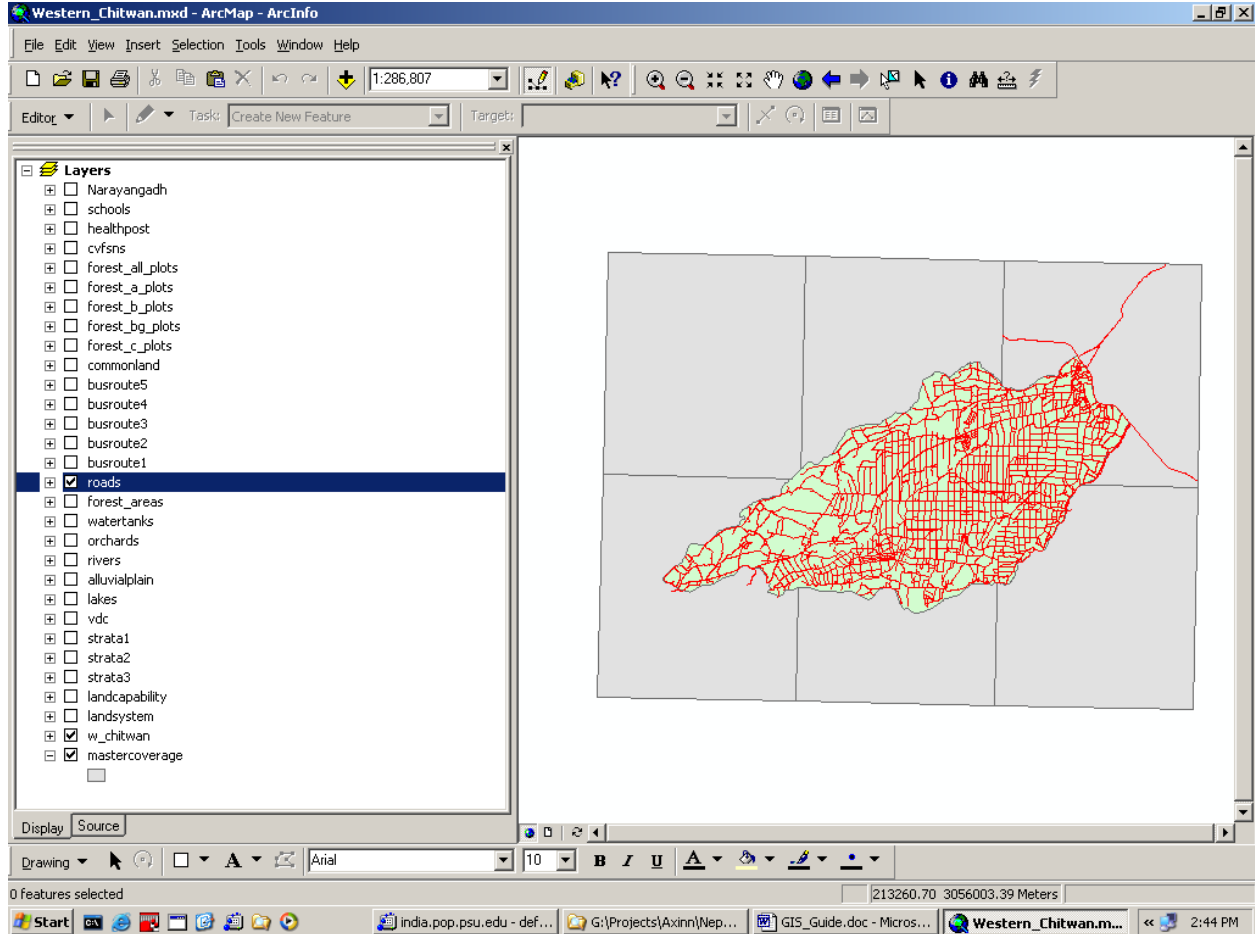
The **road** layer was digitized from the five primary Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal (in cooperation with the Government of Finland) – the specific map sheets used were:

iii.   No. 2784 05D (Meghauli)
iv.   No. 2784 06A (Rampur)
v.   No. 2784 06B (Bharatpur)
vi.   No. 2784 06C (Kasara)
vii.   No. 2784 06D (Gitanagar)

In all, 2794 road segments were digitized from the five topographic maps.

Bus Routes
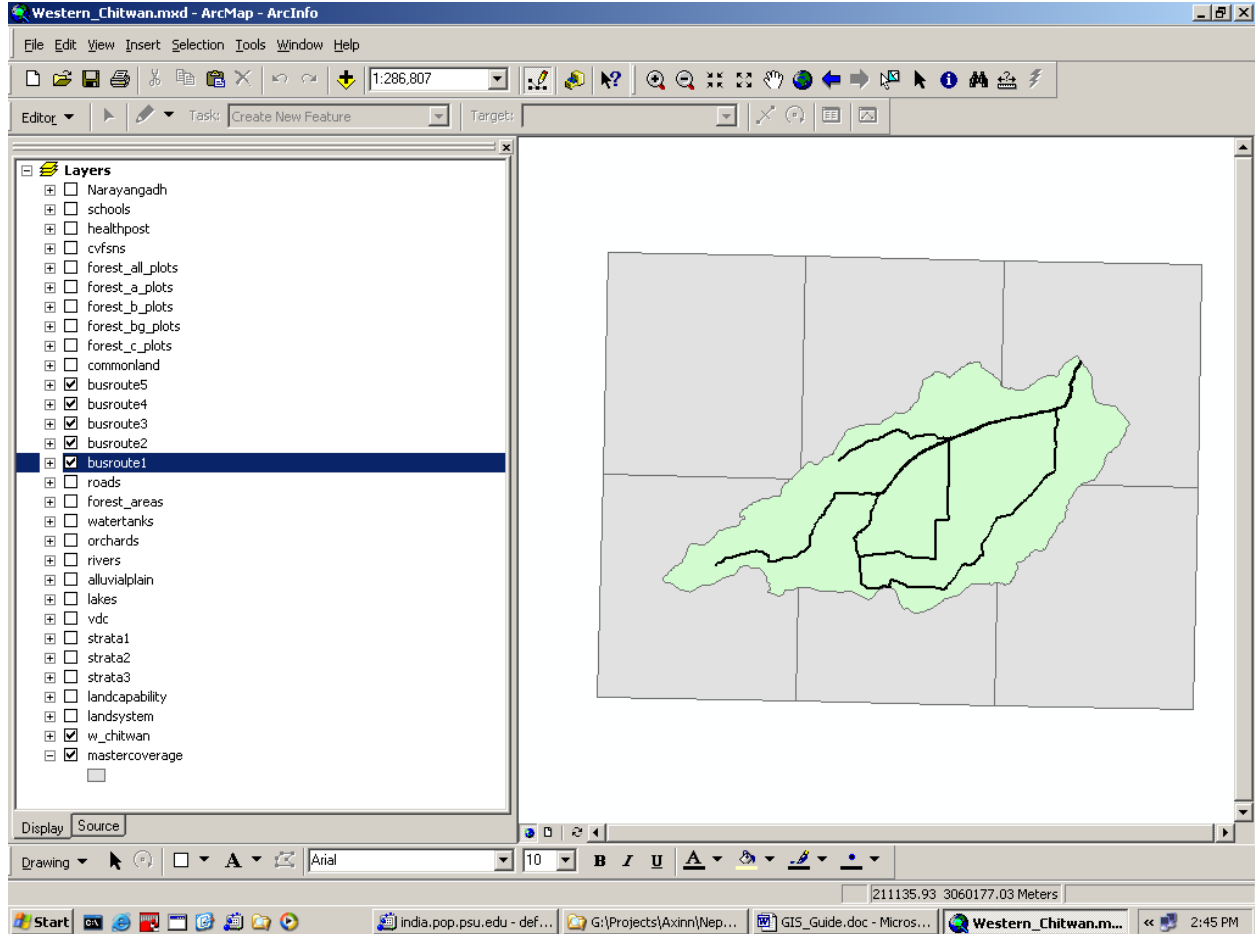
The CVFS fieldteam collected data on five bus routes that existed in Nepali year 2051 that began in Narayangadh. These five routes were individually compiled from the road network layer and are labeled **busroute1**, **busroute2**, **busroute3**, **busroute4**, and **busroute5**.

A combined **busroutes** layer was also created (not shown here) and used to generate a measure of distance between the CVFS neighborhoods (CVFSNS) and the nearest bus route.

Commonland plots
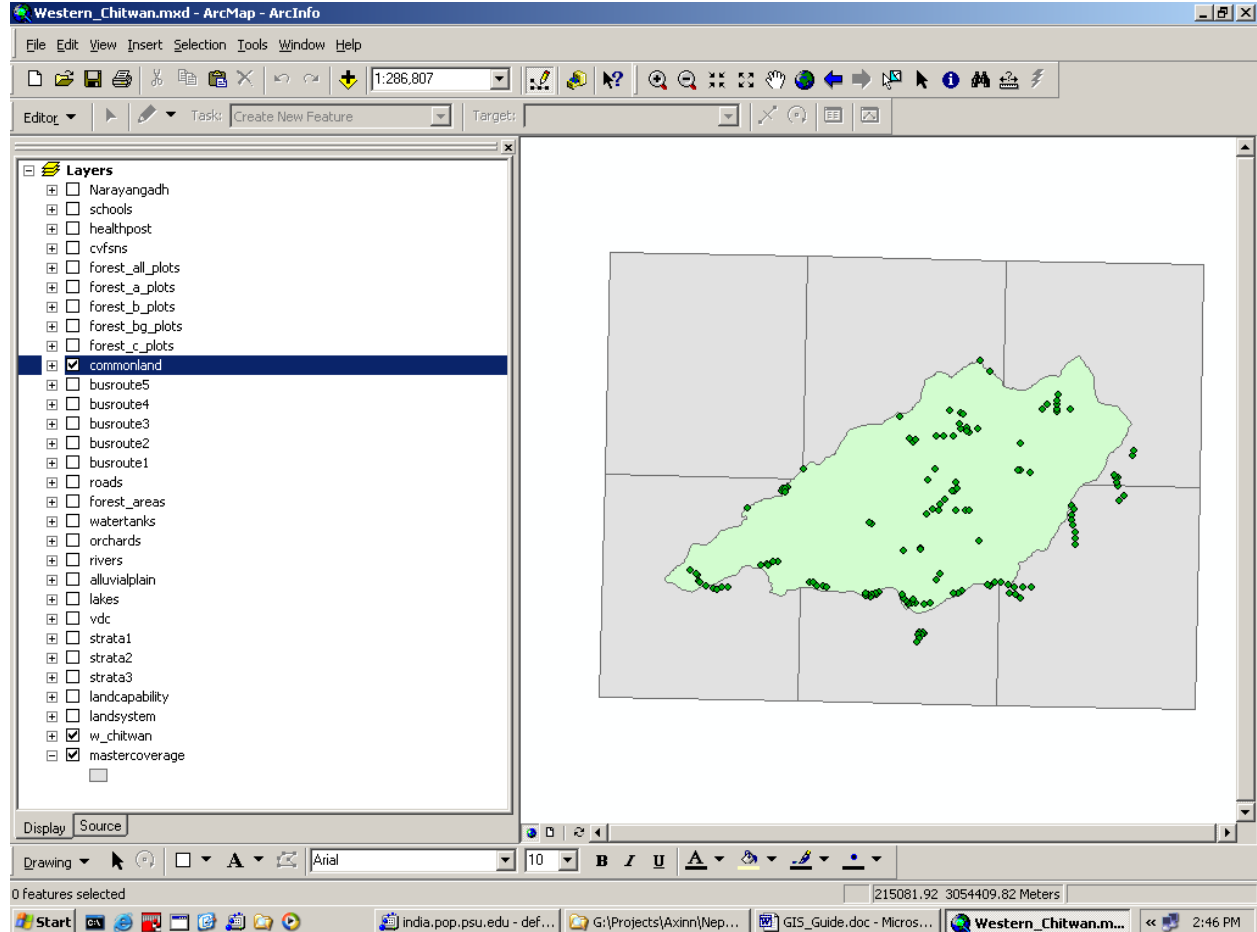
The Population and Environment field teams conducted "flora" surveys at 138 commonland plots. These commonland plots represent a diverse set of areas throughout the Western Chitwan including, plantation areas, flood affected areas, common grazing areas, Barandavar (Tikauli) Forest area grazing and grass cutting areas, school grounds and airport areas, Pokhari and Ghole (ponds and wetland) areas, road ways and canal ways.

The location of each commonland plot was confirmed by reference to the Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal.

Forest A plots
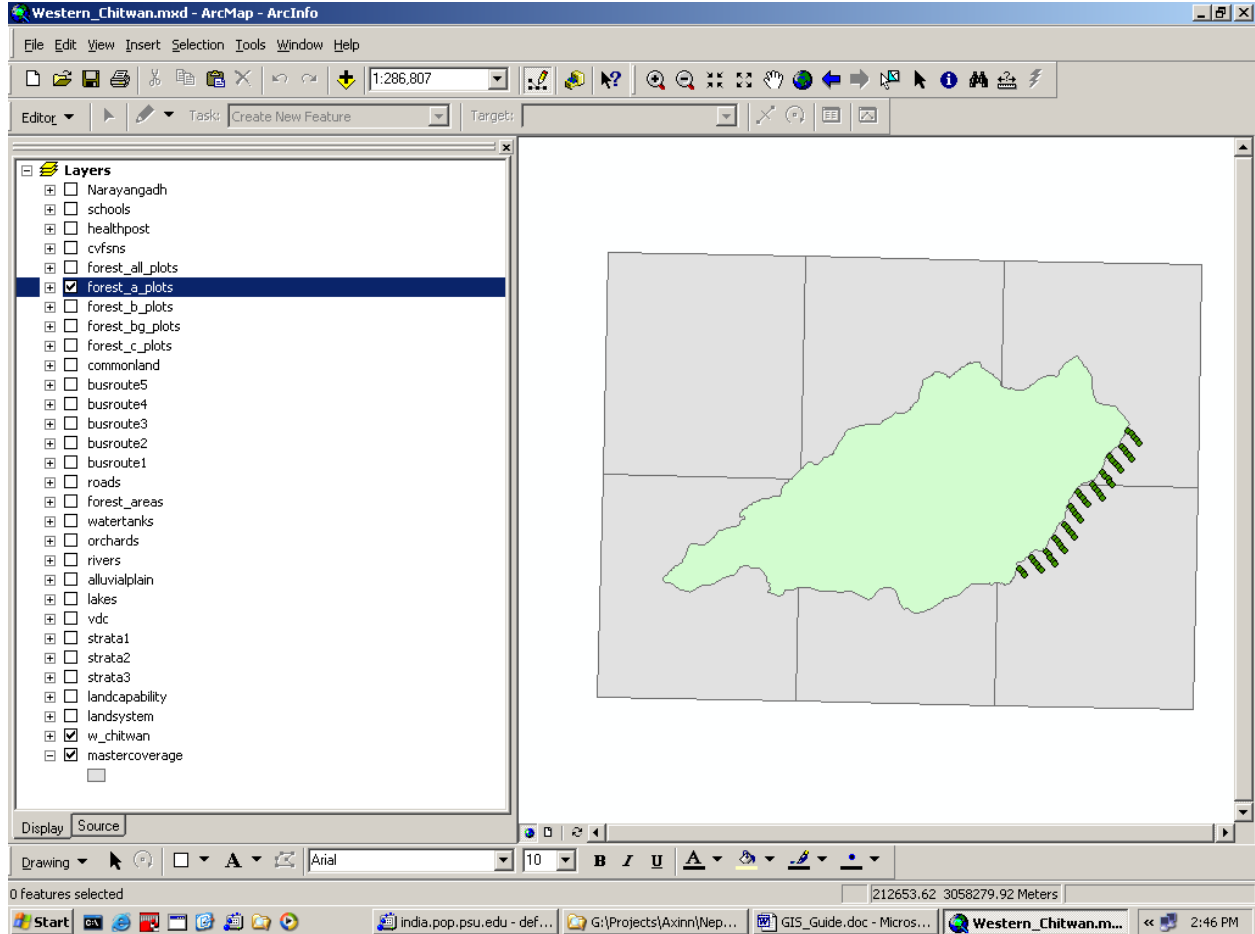
The Population and Environment field teams conducted "flora" surveys in forest areas on the periphery of the settled Western Chitwan area. Forest A refers to the Barandavar (Tikauli) Forest to the east of the study area. Flora samples were recorded along 12 transects, one kilometer apart, with measurements taken 250, 500, 750, 1000 and 1250 meters in to the forested areas.

In Forest A there were 58 flora plots. The location of each plot was recorded by the flora and mapping teams and confirmed by reference to the Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal.

Data on Forest A flora plots at time 1 and time 2 can be linked to the GIS project by using the PLOT_ID variable.
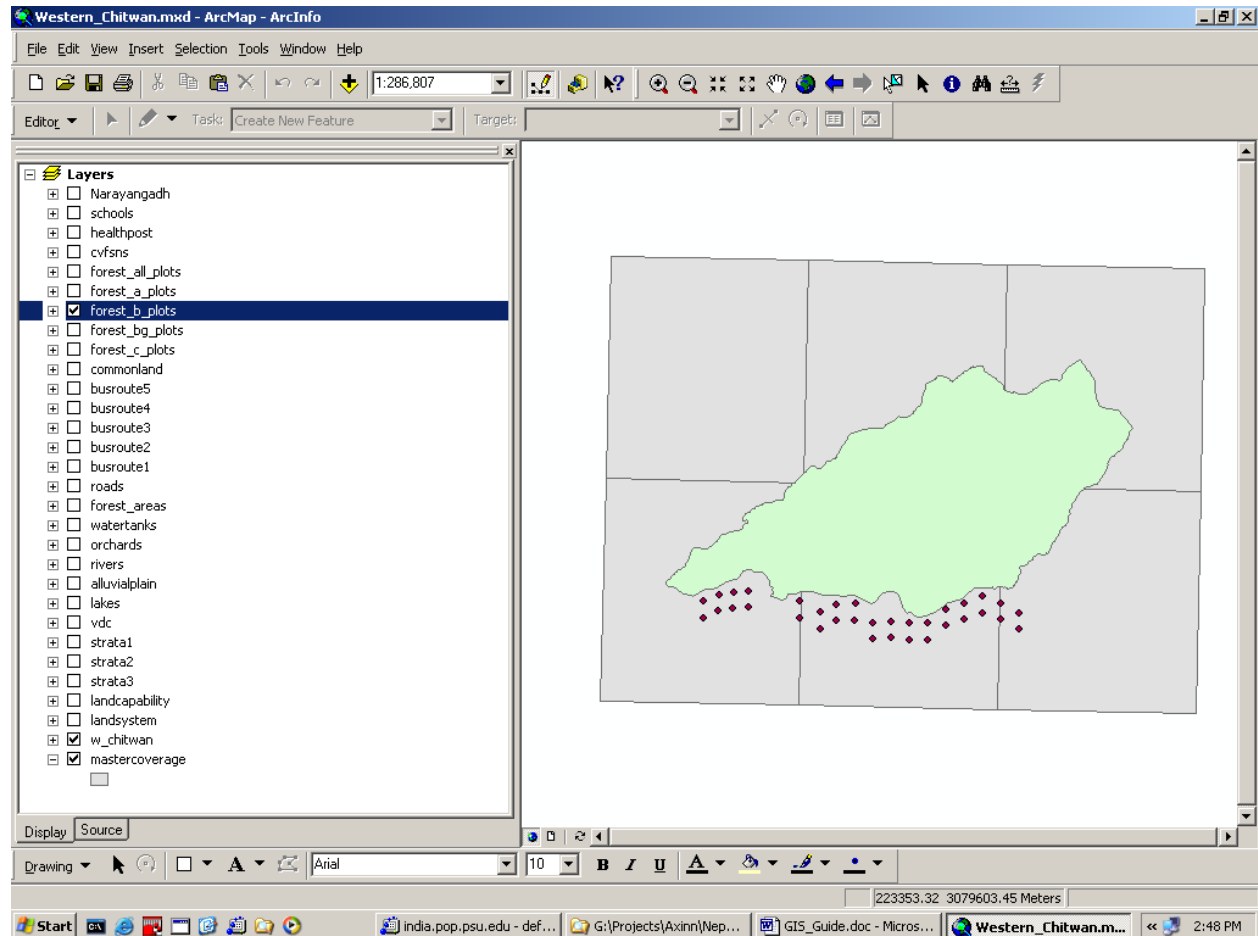
Forest B plots

The Population and Environment field teams conducted "flora" surveys in forest areas on the periphery of the settled Western Chitwan area. Forest B refers to the Royal Chitwan National Park to the south of the study area. Flora samples were recorded along seventeen (17) transects one kilometer apart, with measurements taken 250 and 1250 meters in to the forested areas south of the Rapti River.

In Forest B there were 34 flora plots. The location of each plot was recorded by the flora and mapping teams and confirmed by reference to the Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal.

Data on Forest B flora plots at time 1 and time 2 can be linked to the GIS project by using the PLOT_ID variable.
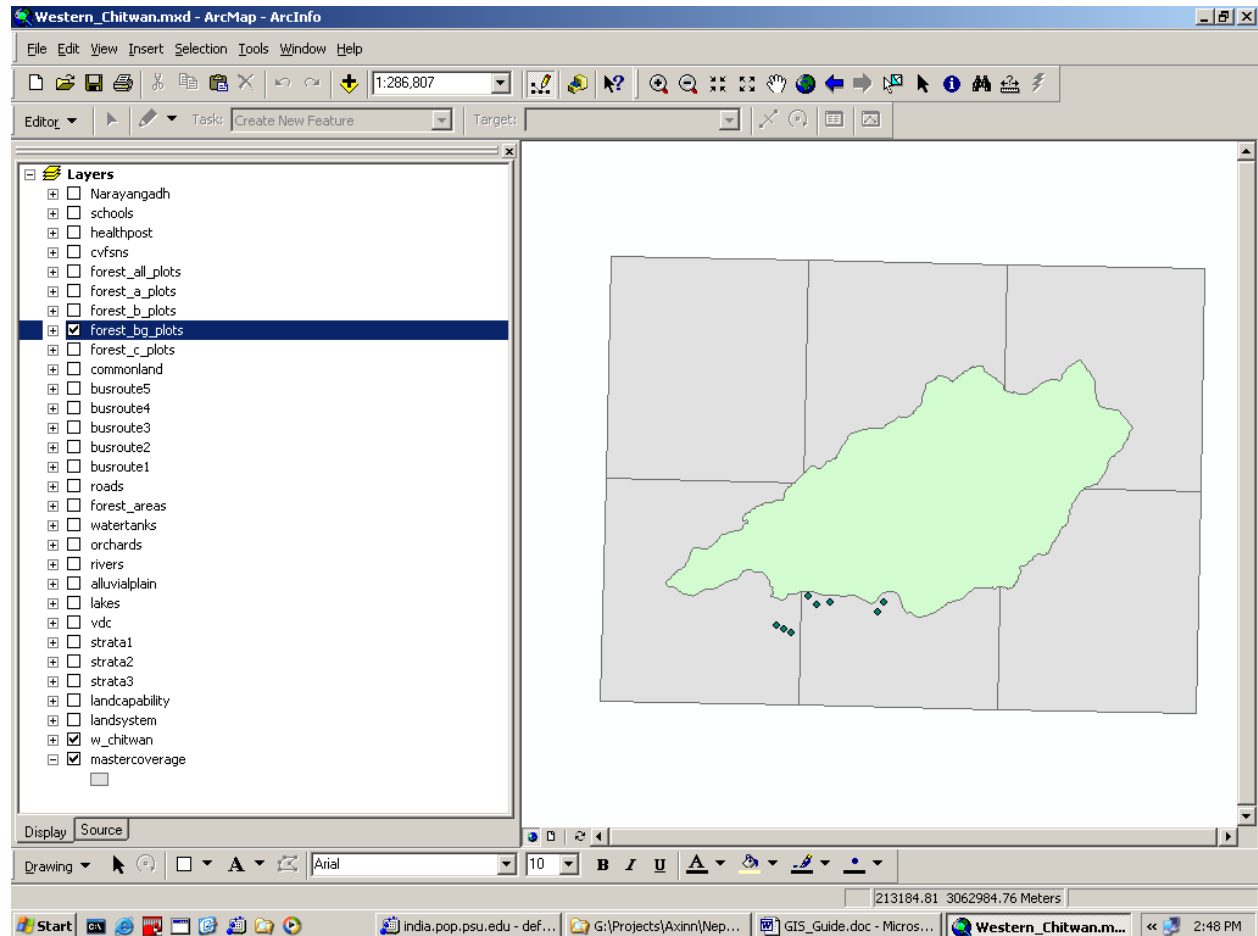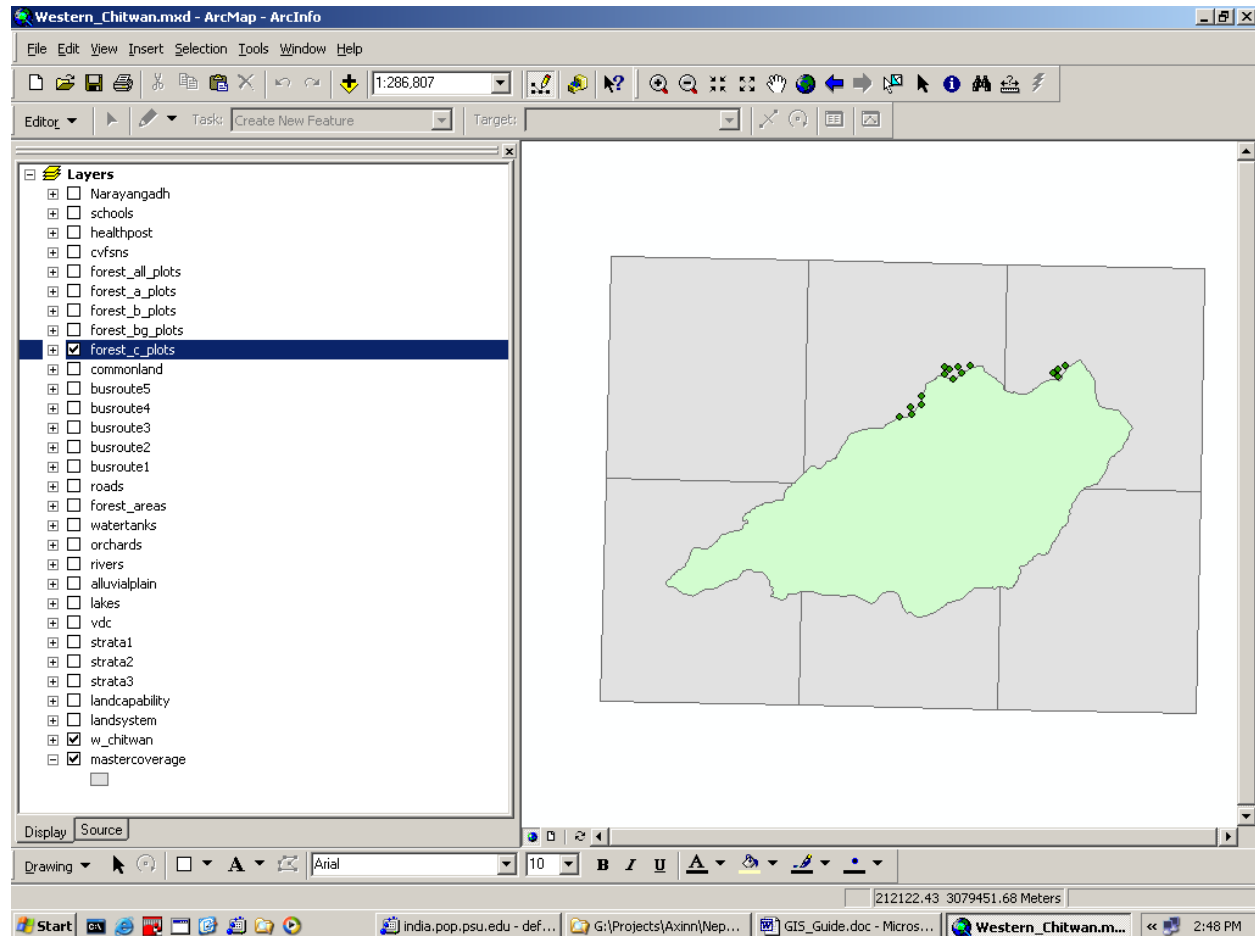
Forest BG (grassland) plots

The Population and Environment field teams conducted "flora" surveys in forest areas on the periphery of the settled Western Chitwan area. Forest BG refers to grassland areas along the Rapti River near the Royal Chitwan National Park to the south of the study area. Flora samples were recorded at eight locations, five along the river and three in the main grassland area on the edge of the Royal Chitwan National Park .

In Forest BG there were eight flora plots. The location of each plot was recorded by the flora and mapping teams and confirmed by reference to the Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal.

Data on Forest BG flora plots at time 1 and time 2 can be linked to the GIS project by using the PLOT_ID variable.
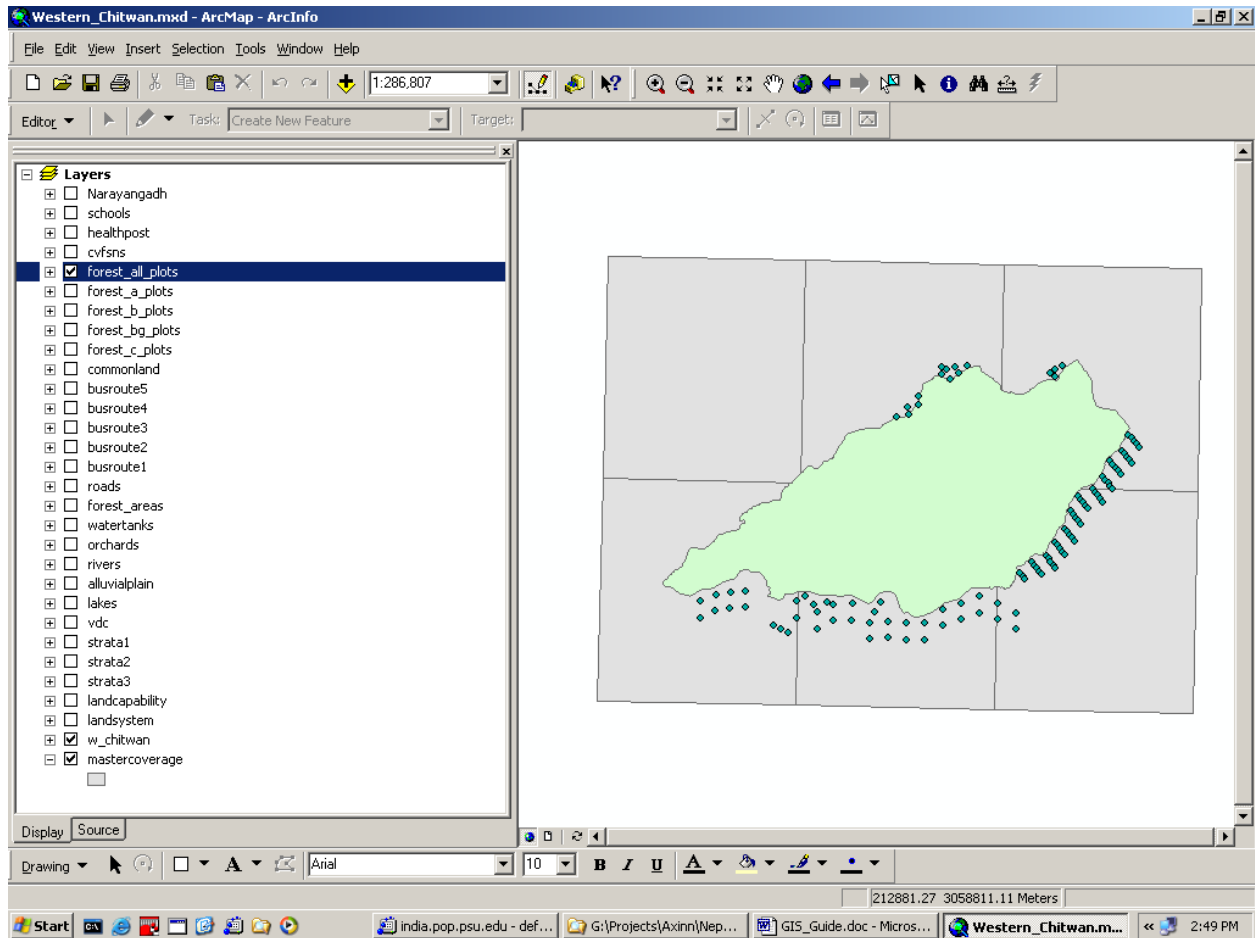
Forest C plots

The Population and Environment field teams conducted "flora" surveys in forest areas on the periphery of the settled Western Chitwan area. Forest C refers to three sisau and acacia forest areas along the Narayani River to the north of the study area. Flora samples were recorded in these sisau and acacia forest areas. There are four flora plot sites on an easily reached island in the Narayani River just west of Narayangadh (C1), seven plots in a large forest area to the north of the Mangalpur VDC (C2), and five plots in a forest area to the west of Mangalpur VDC (C3).

In Forest C there were sixteen flora plots. The location of each plot was recorded by the flora and mapping teams and confirmed by reference to the Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal.
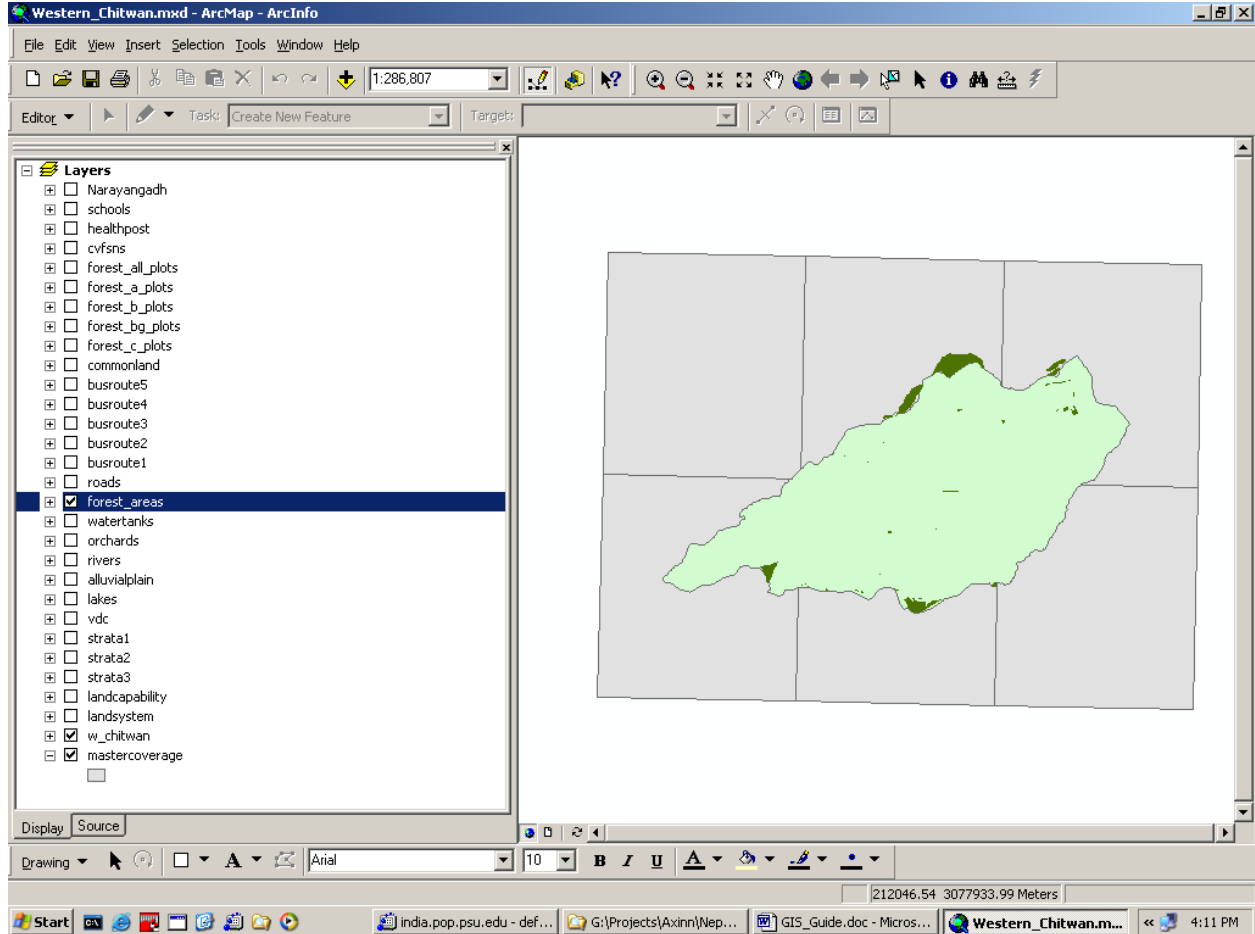
Data on Forest C flora plots at time 1 and time 2 can be linked to the GIS project by using the PLOT_ID variable.

Forest All plots (A, B, BG, and C combined)

Forest_all_plots refers to a GIS data layer that combines **forest_a_plots**, **fortest_b_plots**, **forest_bg_plots**, and **forest_c_plots**.
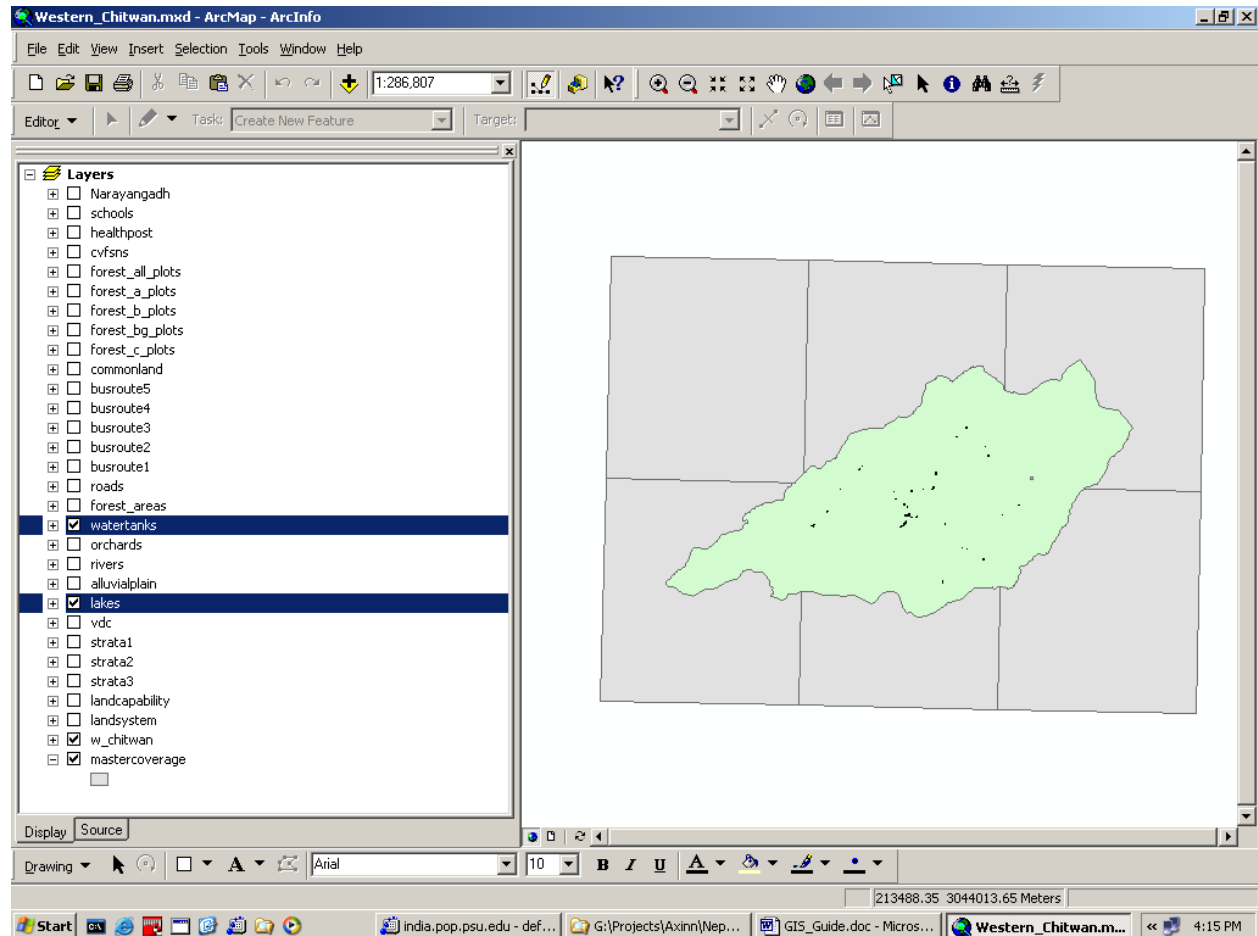
Forest areas (polygons)

The **forest-areas** layer represents areas of forest cover within the CVFS study area. These forest areas were digitized from the five primary Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal

In all, 38 forest polygons were digitized from the topographic maps.

**Water tanks (storage ponds) and Lakes**

The **watertank** layer represents water tanks or water storage areas within the CVFS study area. These water tanks/storage areas were digitized from the five primary Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal

In all, 42 polygons were digitized in the water tank file and one polygon in the **lakes** file.
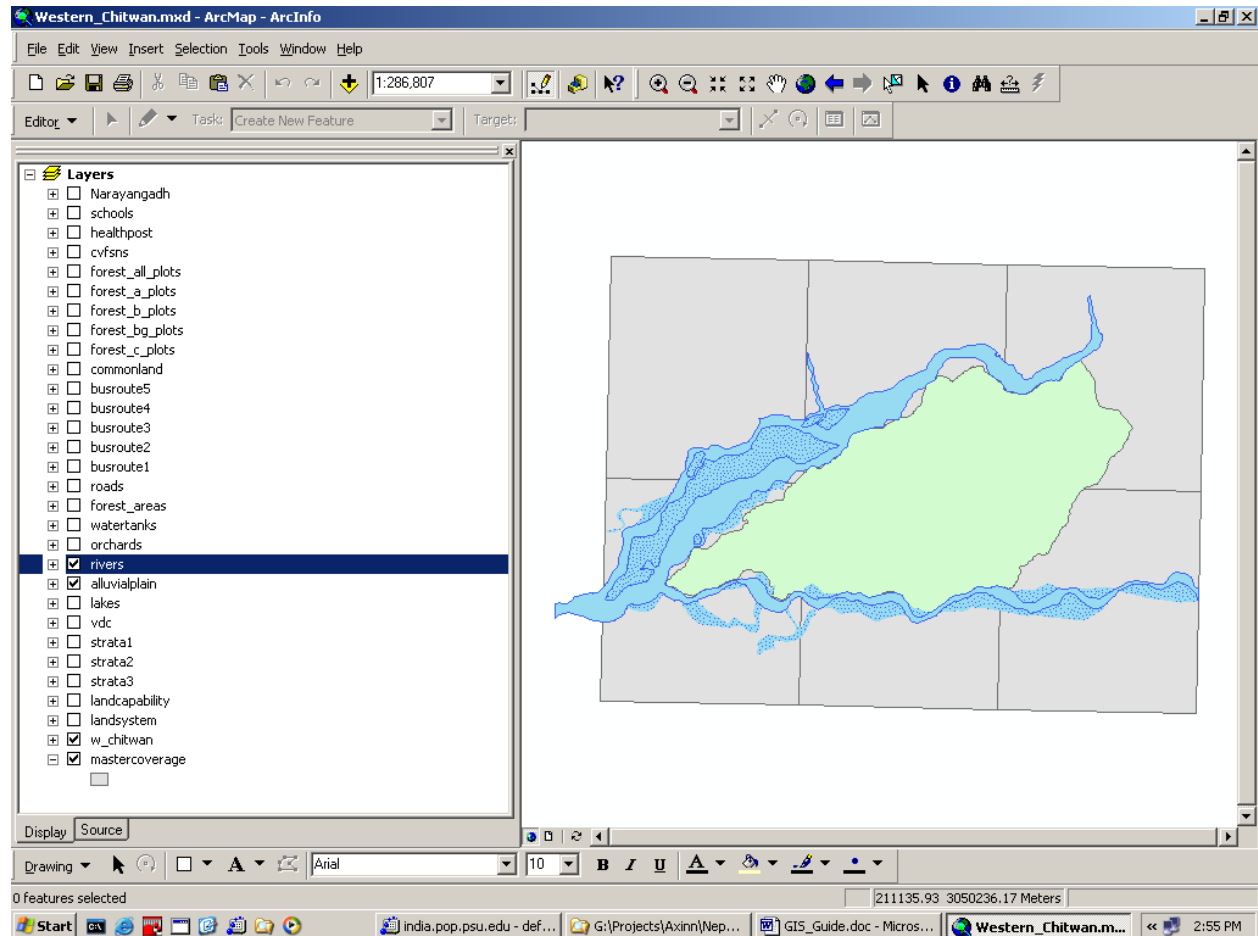
Orchards
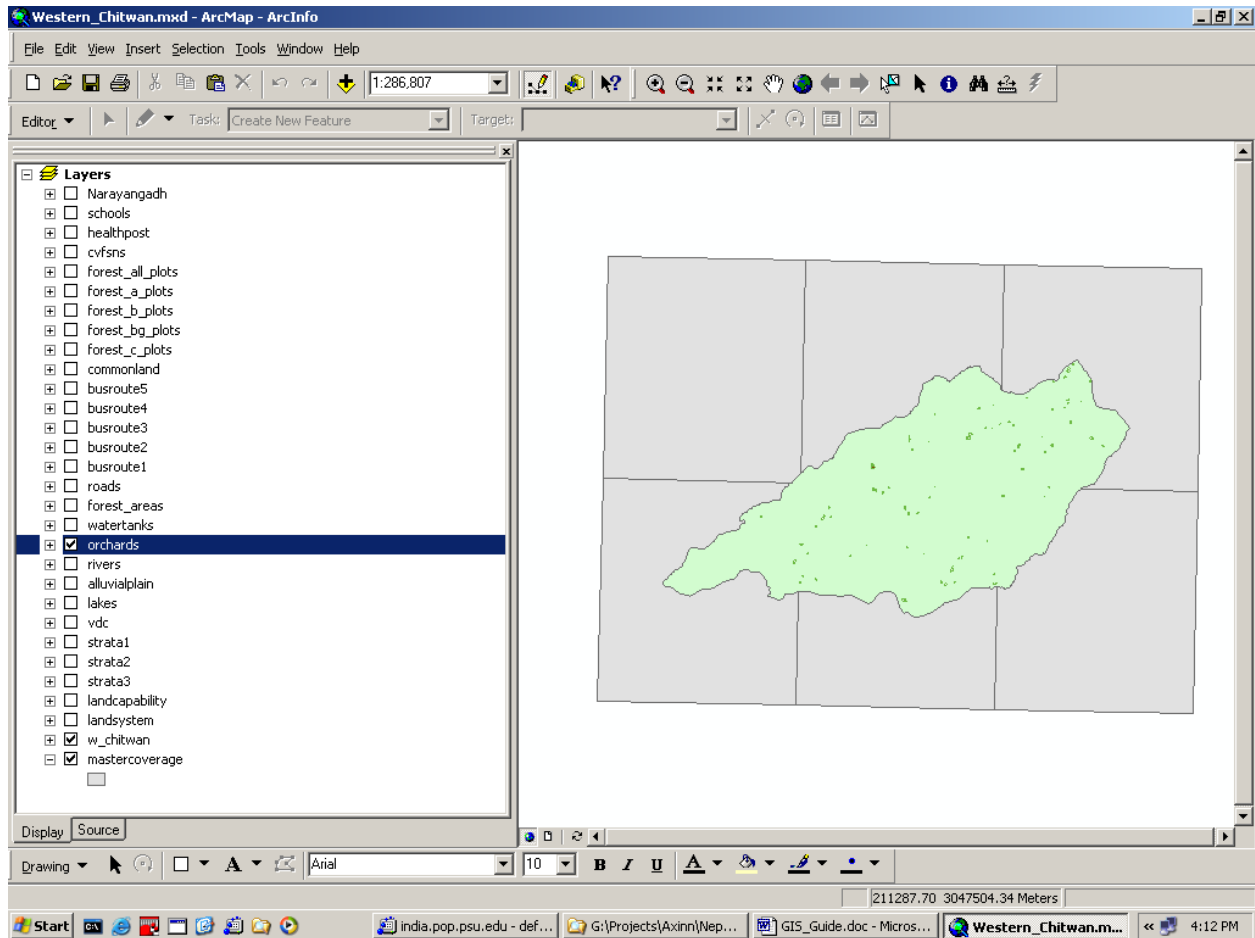
The **orchards** layer represents orchards and plantation areas within the CVFS study area. These orchards/plantations were digitized from the five primary Topographic Map Sheets (1:25,000) produced by the Survey Department of His Majesty's Government of Nepal

In all, 82 polygons were digitized in the orchard file.

Rivers and Alluvial Plains

Western Chitwan is bordered by the Narayani River to the north and north-west and by the Rapti River to the south.

The **rivers** and **alluvialplain** layers were extracted from the digitized files created from the Land Systems and Land Capability maps (1:50,000) prepared under the Canadian Assistance Program to Nepal by the Topographical Survey Branch, Survey Department of the Ministry of Land Reform of His Majesty's Government of Nepal and Kenting Earth Sciences Limited of Ottawa, Canada. The specific map sheets used were: No. 72 A/2 and No. 72 A/6.

Land system code 4, specifically 4a and 4b, refer to river channels and alluvial plains.

Land Capability
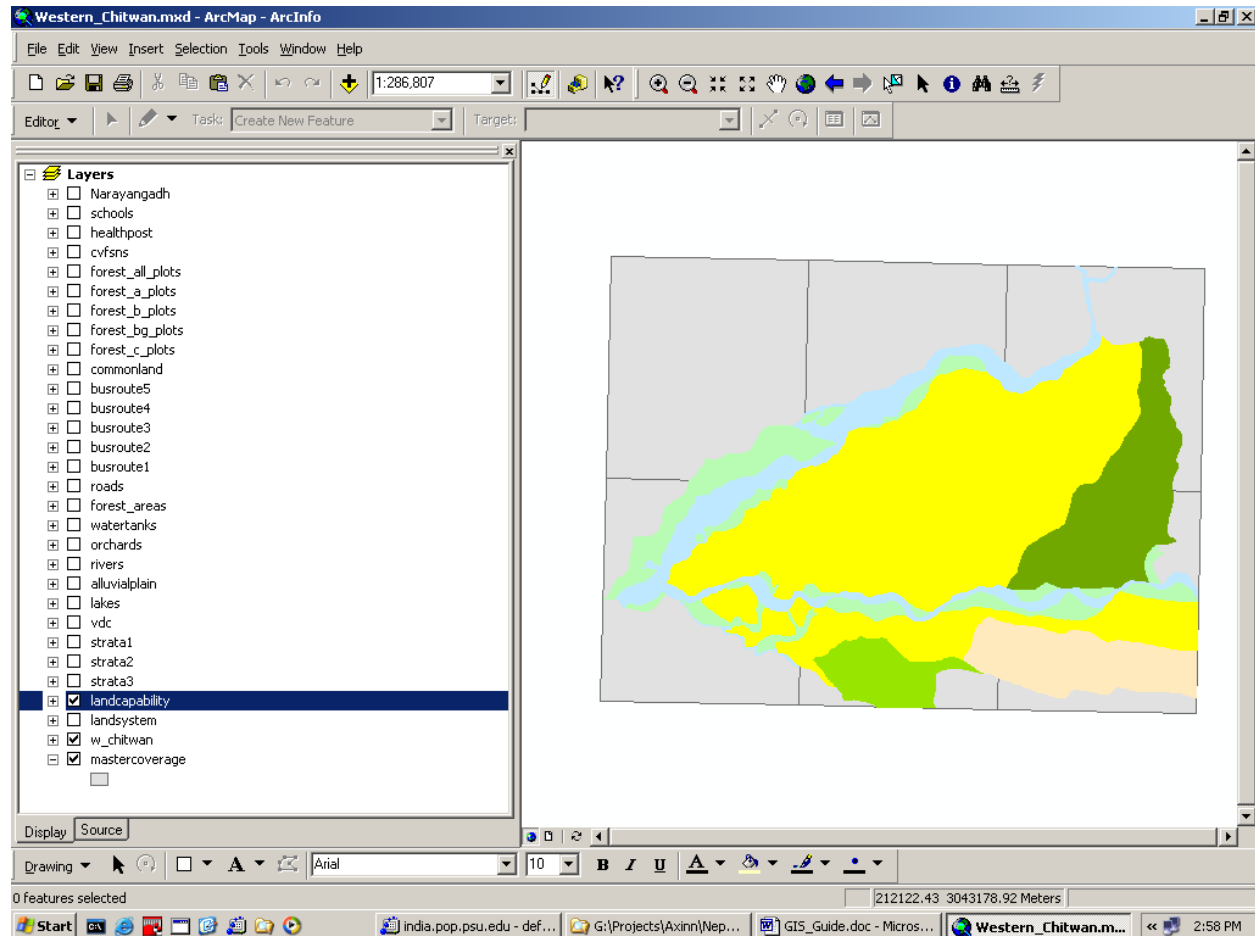
Land Capability maps (1:50,000) were prepared under the Canadian Assistance Program to Nepal by the Topographical Survey Branch, Survey Department of the Ministry of Land Reform of His Majesty's Government of Nepal and Kenting Earth Sciences Limited of Ottawa, Canada. The specific map sheets used to cover the Western Chitwan study area were: No. 72 A/2 and No. 72 A/6.

There are 27 distinct polygons in the **landcapability** layer. Attributes of these features include AREA (sq. meters), PERIMETER (meters), and CLASS, referring to the land capability classification. The CLASS attribute is labeled based on five codes and sub-codes, following the structure below

A B C/ D E

Where A = dominant code (for Western Chitwan the dominant codes are I, II and V).

Lands that can be cultivated
CLASS I – level ground, deep soils, few limitations for arable agriculture

CLASS II – gently sloping, deep and well-drained soils, terracing and contouring are necessary to control erosion when used for arable agriculture.

<u>Lands that cannot be cultivated</u>
CLASS V – In the Western Chitwan area this refers primarily to flood plains (frequently flooded). These lands are suitable for grazing.

B = subclass code (for Western Chitwan the only category of relevance is "sub-tropical < 1000 meters" or a).

C = sub-divisions (for Western Chitwan the only category of relevance is "humid" or h). following codes:

D = a number indicating irrigation suitability (the categories or relevance in the Western Chitwan are values 1, 2 and 5 – where 1 = diversified crops – arable (suitable); 2 = diversified crops – arable moderately suitable, and 5 = nonarable).

E = a subclass indicating deficiencies in soil, topography drainage (s = soil deficiency, t = topography deficiency, and d = drainage deficiency).
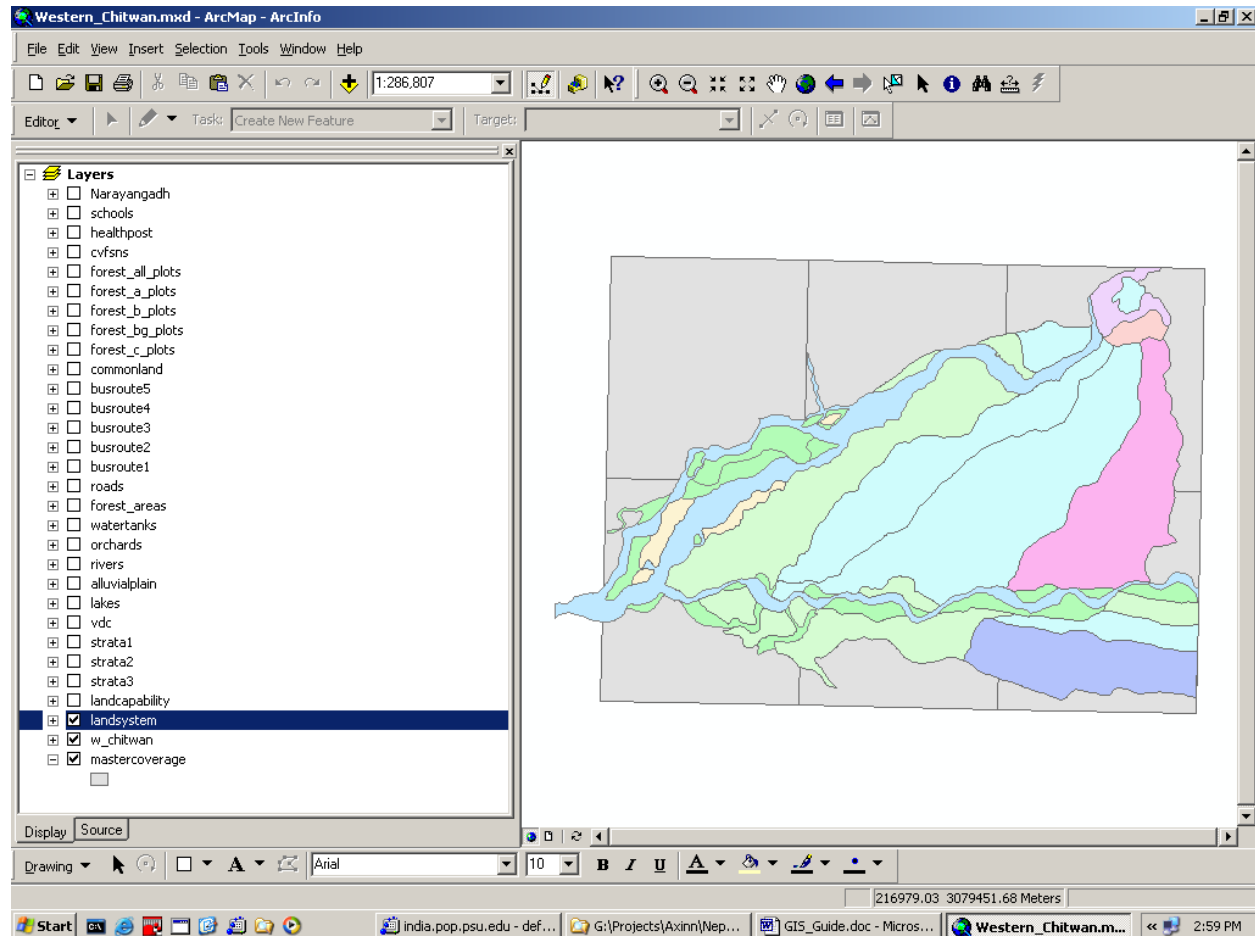
For example, a CLASS code of Iah/1 =

I = level ground, deep soils, few limitations for arable agriculture
a = subtropical
h = humid
1 = diversified crops – arable (suitable)

Land Systems

Land Systems and Land Capability maps (1:50,000) prepared under the Canadian Assistance Program to Nepal by the Topographical Survey Branch, Survey Department of the Ministry of Land Reform of His Majesty's Government of Nepal and Kenting Earth Sciences Limited of Ottawa, Canada. The specific map sheets used to cover the Western Chitwan study area were: No. 72 A/2 and No. 72 A/6.

There are 44 distinct polygons in the **landsystems** layer. Attributes of these features include AREA (sq. meters), PERIMETER (meters), and CLASS, referring to the land system classification. The CLASS attribute is labeled based on nine codes and sub-codes, indicated by a number (1-9) followed by a lower-case letter (a-d). In Western Chitwan only numbers 4, 5 and 6 are of relevance. Below is a listing of all codes that occur in the Western Chitwan study area.

4 = Active and recent alluvial plains
        a= sand and gravel bars – river channel
        b= low terrace subject to severe river flooding
        b*=denotes low terrace with mollic development and decreased flooding hazard
        c= higher undulating terrace, variable drainage with low areas subject to flooding

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5 = Fans, aprons and ancient river terraces
        a= very gentle slopes, moderately well drained
        b= gentle slopes , rapid drainage
        c= undulating slopes (1-5 degree slopes), well drained
        d= rolling hills (upto 20 degree slopes), rapid drainage

6 = Depositional Basins
        c= gently rolling slopes (1-5 degrees), variable drainage

<u>Using the GIS shapefiles in other ESRI products</u>

All files listed in the Western_Chitwan.mxd file are shapefiles and can be used in any earlier ESRI GIS software product such as ArcExplorer and Arcview 3.x.