Environmental Impact Assessment
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Lecture 34
EIA Methods – Soil, Land, and Geology

Welcome to the course environmental impact assessment. Today we will discuss methods to assess the impact on soils, land, and geology. They are important components of EIA, and they also play an important role in other Impact Assessments, such as when you assess water, ecology, ecosystem services, livelihoods, health, resource efficiency, and so on. We may also note that now conservation and management of soils, land, and geology are given significant importance within the United Nations Sustainable Development Goals SDG's.

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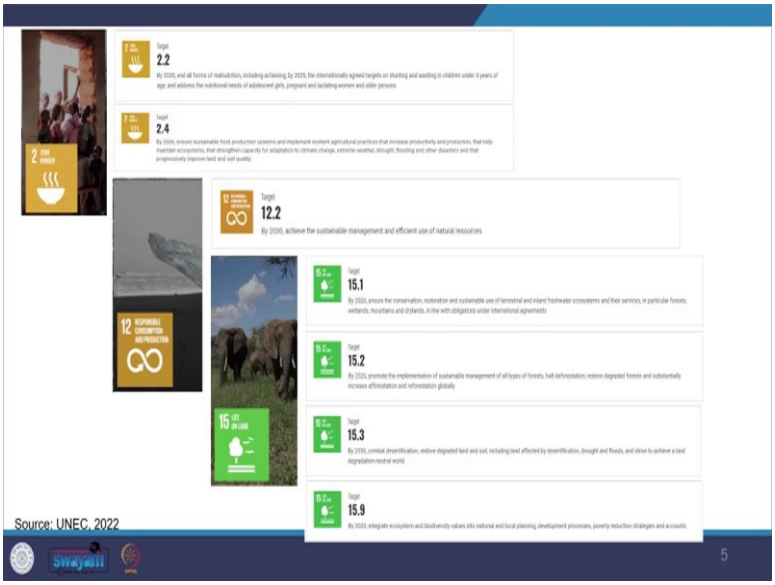

The SDG's entered into force in January 2016. We see that soils and land appear in several of the SDG's you see these concerns in goals 2, 12 and 15, because of this, such targets apply to all countries. Looking at the legislations and legal applications within soil protection and conservation, most countries have laws and controlling procedures for the protection of land. In particular, the development that displaces soil and converts land from agriculture or forestry to urban use or infrastructure.

Further, we see that contaminated land development activities can introduce new receptors, which means new receptors that can get contaminated through the contaminated land. For example, housing blocks can bring occupants as new receptors and they can be blockage to the contaminated land that can be created by development activities such as removal of soil from the contaminated place or soil replacement and that contaminated land.

Therefore, whenever development is proposed, it is important to assess whether the changes introduced by the development will be significant or not. Development has the potential to convert contaminated land to

uncontaminated land and also has the potential to convert uncontaminated land to contaminated land and it might not change the chemistry of the ground at the depth.

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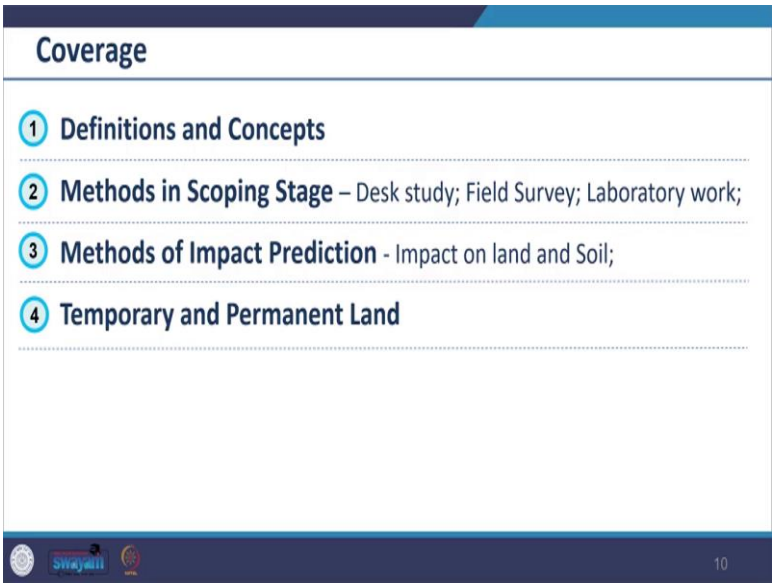

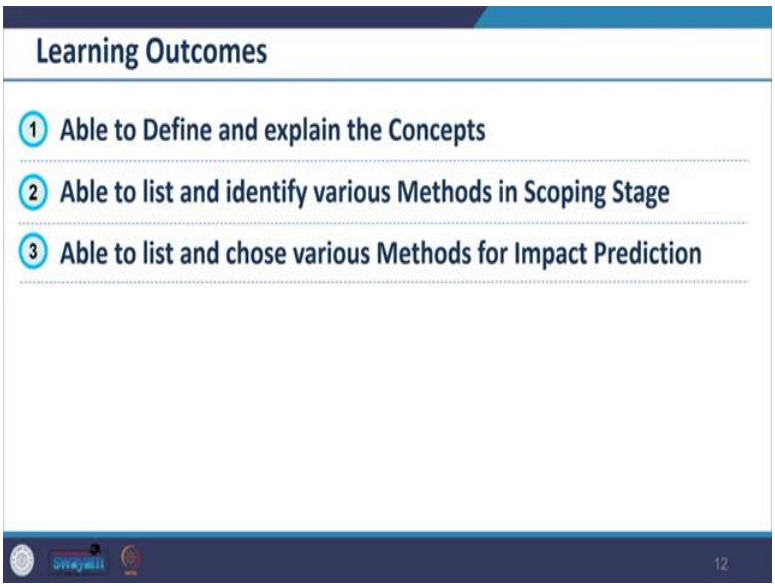

So, accordingly, our coverage will include definitions and concepts where we look at geology and geomorphology, land, soil, soil properties, soil profile, classification, structure, color, fertility, and land evaluation. Further, we look into methods in the scoping stage, and then we look into methods for impact prediction. So, that will be our coverage.

Accordingly, our learning outcomes, the expected learning outcomes from you after completion of this session will include that you should be able to define and explain the concepts of geology and geomorphology and you should be able to define land, and soil, differentiate between them, should be able to define soil properties, soil profile, classification, structure, color and so on.

You should be able to list and identify various methods used in scoping stages, particularly at the desk study, and field survey laboratory work, for you should be able to list and choose various methods for impact

prediction on land and soil, such as temporary land taken soil displacement, permanent land taken soil displacement, damages to soil structure, soil pollution and critical loads on.

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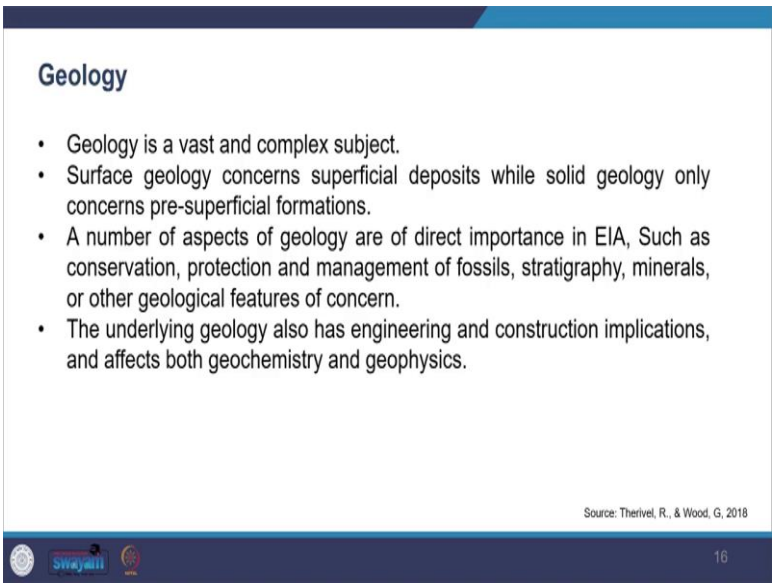

We are now, moving on to definitions and concepts. Let us first see geology and geomorphology. Geology is a vast and complex subject and only a few aspects that we see in the EIA process. Surface geology concerns superficial deposits such as drifts, glacier deposits, and river gravel, while when we see solid geology only concerns pre-superficial formations.

Several aspects of geology are of direct importance in the EIA process such as conservation, protection, and management of fossils, stratigraphy, minerals, or other geological features, which are of concern. The underlying geology has Engineering and Construction implications and affects both geochemistry and geophysics.

Some geological aspects are of indirect importance in assessment, for example, both the storage and movement of the ground and surface water and water geochemistry these all are influenced as we had also

seen in the water chapter. It also influences the potential for onsite and offsite pollution as a result of development and it also influences the pathways for any pollution that may have occurred in the path.

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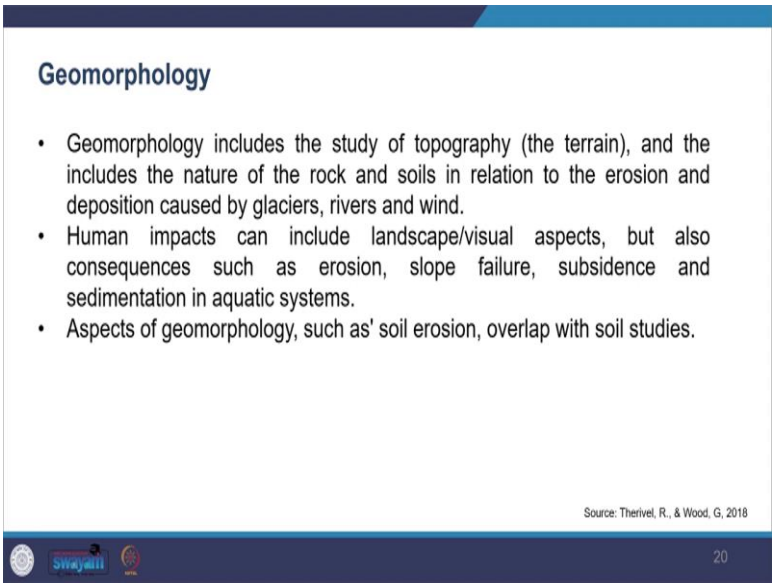

Geomorphology includes the study of topography, and the terrain and includes the nature of rocks and soils about the erosion and the possession caused by glacier rivers and wind. We see that human impacts can include landscape visual aspects, but also their consequences such as erosion, slope failure, subsistence, sedimentation, and aquatic systems can happen. Some aspects of geomorphology such as soil erosions, also overlap with soil studies.

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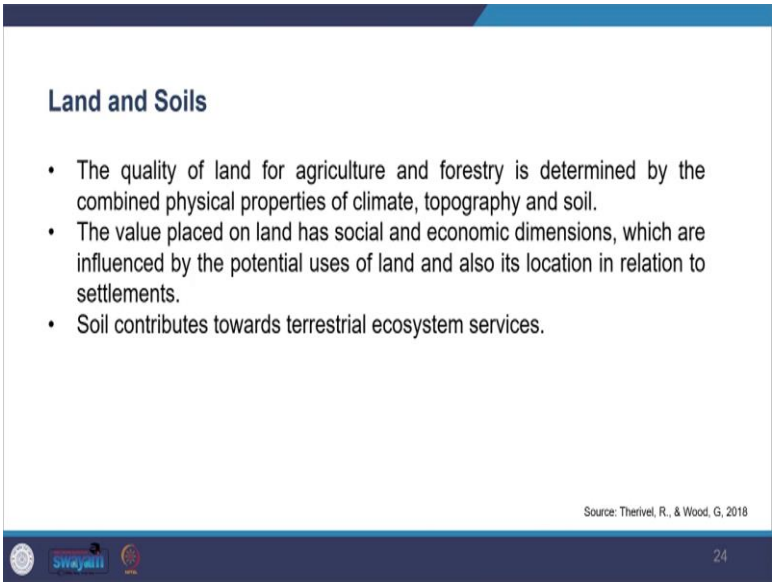

Further now, we look into land and soil. Land and soil are often considered to be the same things, so, they are sometimes taken as the same but there is an important difference between these terms. The quality of land for agriculture and forestry is determined by the combined physical properties of climate, topography, and soil. Whereas, the value placed on land also has social and economic dimensions, which are influenced by the potential uses of land and also the location where the land is located about the settlements.

You may reflect soil has many purposes for us humans. The productive value of soil is determined by several important physical and chemical properties and appreciation of the development's impact on soil requires an understanding of basic soil properties.

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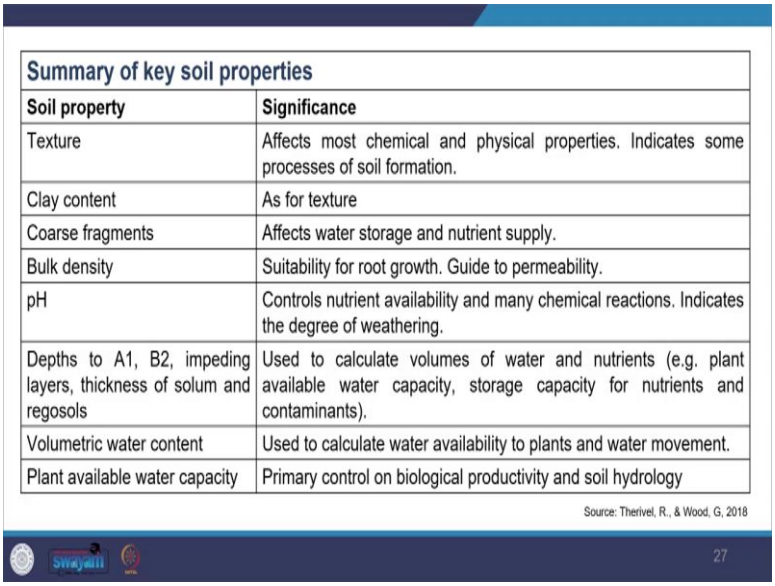

So, we will look at the soil properties. So, we see here the summary of key soil properties like you see the texture, you see the clay content, course fragments, bulk density, pH value, and depth, and then also look at volumetric water content, plant availability, and then the water capacity accordingly.

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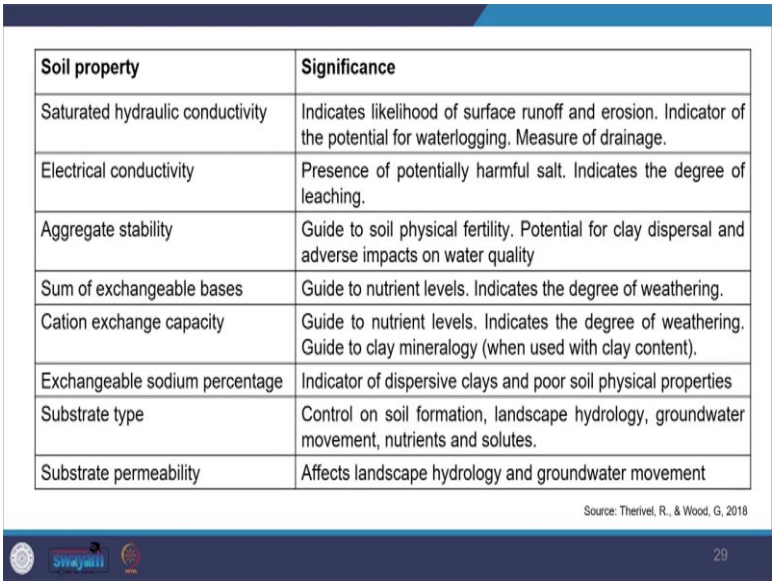

Then we also look see the saturated hydraulic conductivity, electrical conductivity, aggregate stability, and so on.

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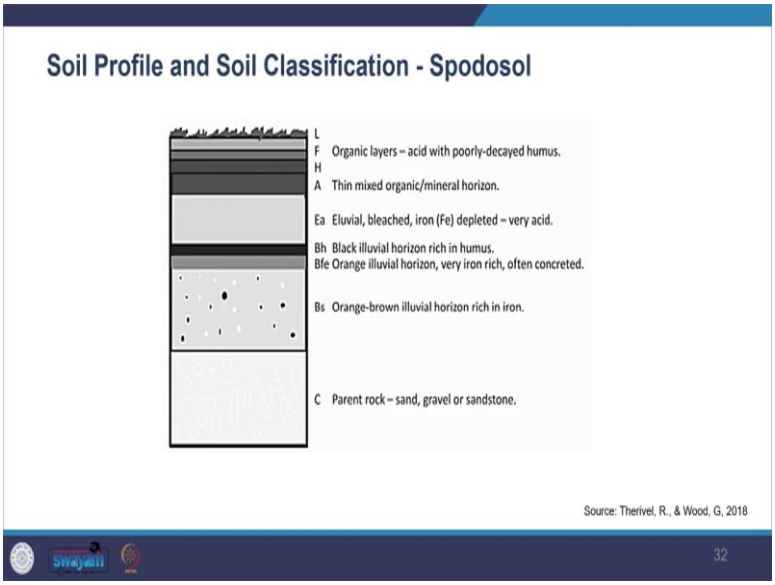

For the soil profile and soil classification, it is important to know the type of soil in the study area, a pit dug helps to understand the topsoil and the subsoil layers, such as the vertical section is called a soil profile. Each layer is called a horizon. Two different soil profiles are shown, as you can see in the image, not all these subsoil horizons are always present and the horizons are frequently subdivided.

So, you also see subdivisions within the horizons. Here you may note the profile of a typical spodosol. These types occur more in the cold and wet higher ground on wide and relatively flat enter fluids and low-lying receiving sites. They can occur in some freely drained sandy parent material and low nutrients in lowland areas. The typical vegetation cover is coniferous forest.

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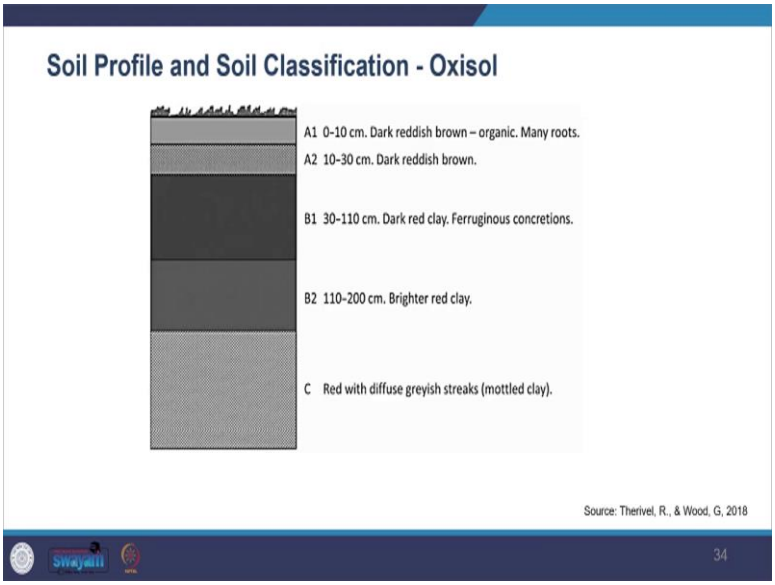

Here you may note the profile of a typical Oxisol as specified these soils are highly weathered forming in tropical zones with hot and wet moist climates. They are typically soils they are typical soils of tropical rainforests. Oxisol has a low nutrient status but is well drained and suitable for agriculture production where fertilizer inputs are available and can be managed in a way that maintains ecosystem services.

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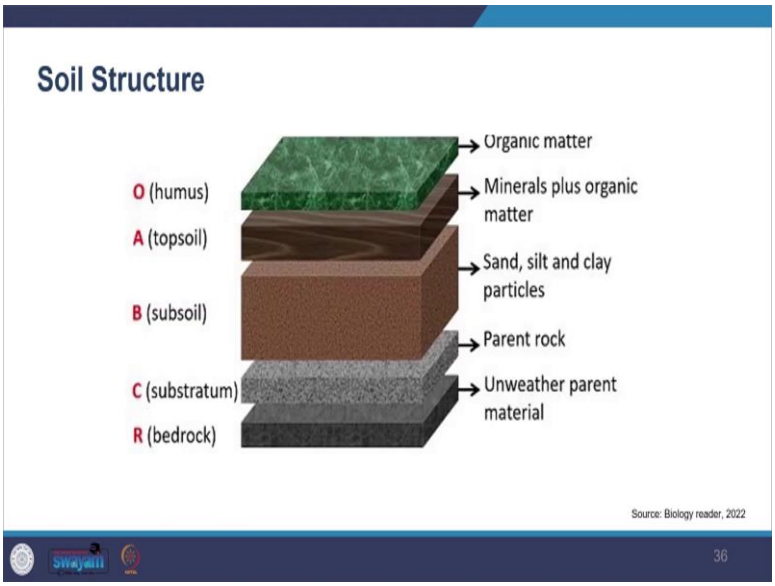

Now looking at the soil structure, in most soils, the soil particles or separates are organized into aggregates. Soil structures called pads vary in size and shape. Each soil horizon in a soil type usually contains the type of texture and one shape and size of the structure, but structure frequently varies with the depth. For example, angular and mainly sub-angular blocky structures in looms become coarser with the depth as you go deeper.

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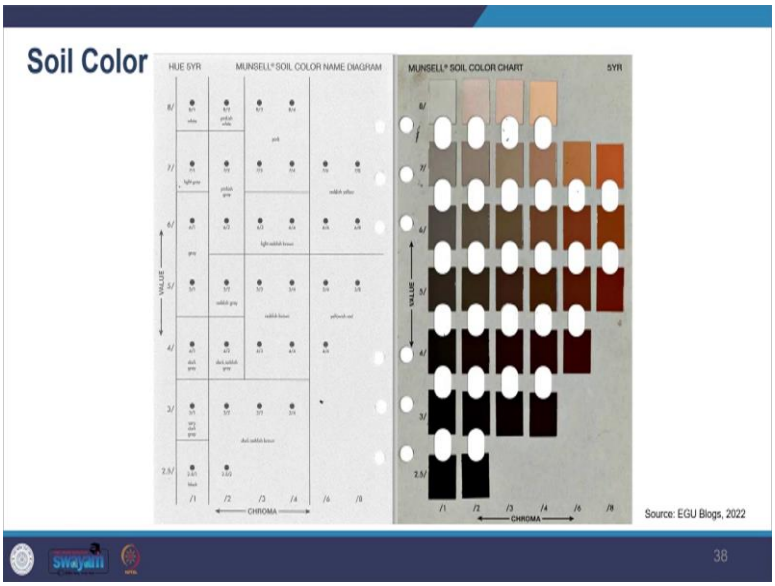

Moving on we see soil color, field observation of color can be a clue to soil composition after seeing the color you can tell what is the soil composition, parent material, and soil drainage status, like how is the drainage in that particular area. So, soil charts provide standard examples of the normal range of size colors.

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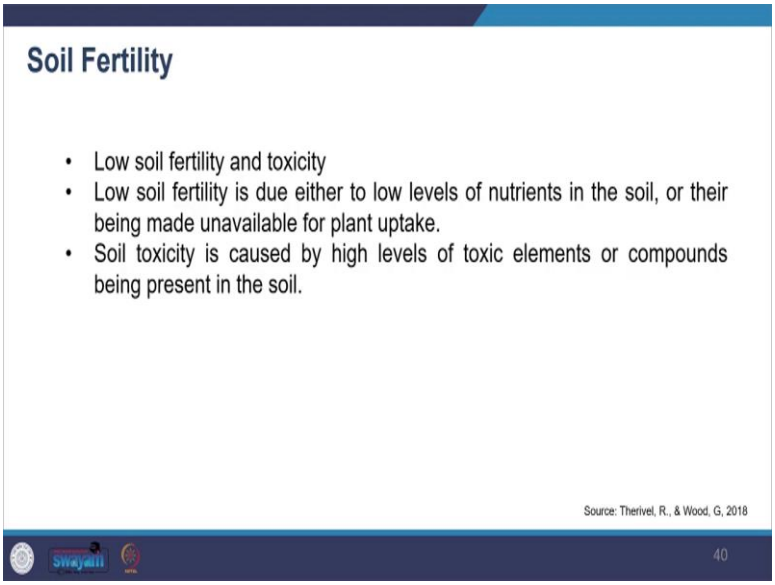

Now, looking at the soil fertility, two major soil chemistry issues that are of importance in an EIA, are low soil fertility and toxicity, both of which will lead to poor plant growth. Low soil fertility is due to the low level of nutrients, so there is nutrient level is very low. For example, nitrogen, phosphorus, potassium, and magnesium are low in the soil or they are being made unavailable for plant uptake.

Next, we see soil toxicity, it is caused by high levels of toxic elements or compounds being present in the soil, usually as a result of human activities such as spraying of pesticides, deposition of industrial waste, fuel spillage, and spreading of farm manure, slurries, and sewage sludge. So, because of that the soil toxicity can increase in levels.

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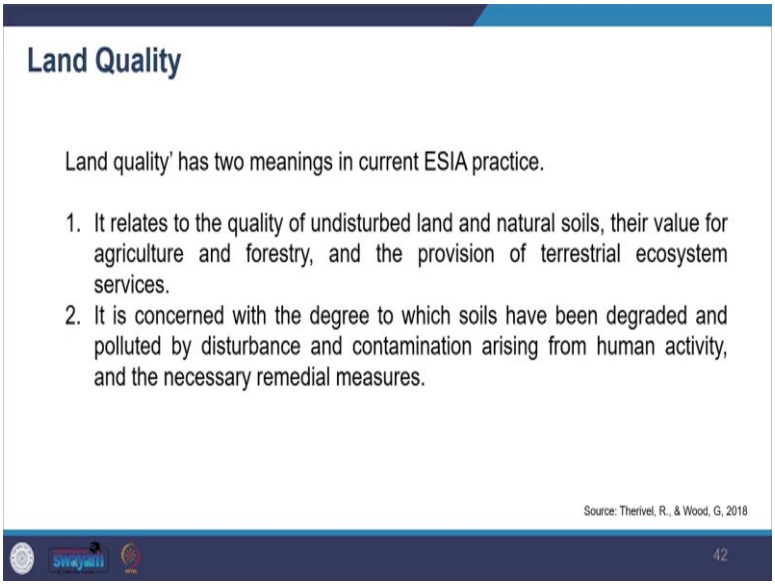

Further, we see land quality has two meanings when we look at EIA practice. First, it relates to the quality of undisturbed land and natural soils, their value for agriculture and forestry, and the provision of terrestrial ecosystem services. So, what quality does it offer? Secondly, we look at the degree to which wet soils have been degraded and polluted by the disturbances and contamination arising from human activities. So, what is

the level of disturbance and then the necessary remedial measures, so, what kind of interventions do we need to take?

So, while doing land evaluation, we focus on natural land quality, primarily the physical properties that cannot be changed by land management. So, far in the evaluation process, for land use planning purposes, the focus has been on estimating the relative productive value of different areas of land for agriculture and forestry, so, we just take the productive value.

The concept of sustainable development has introduced the need to protect the other functions of the soil. So, not just the productive value, but you also need to look at the other functions of the soil within the hydrological and carbon cycles, supporting habitats and biodiversity and maintaining terrestrial ecosystem services.

Now, let us see physical land evaluation methodology, we find land capability classification LCC developed by the United States Department of Agriculture USDA, which classifies land quality according to long-term climatic, topographic, and soil limitations to agriculture. So, that is one classification that is available for usage, while classification purpose, other we see is by FAO.

FAO has developed an evaluation methodology combining physical and social-economic land evaluation, which also considers social and economic factors and the overarching concept of sustainability. So, it has many more aspects than what we see in the LLC developed by the United States.

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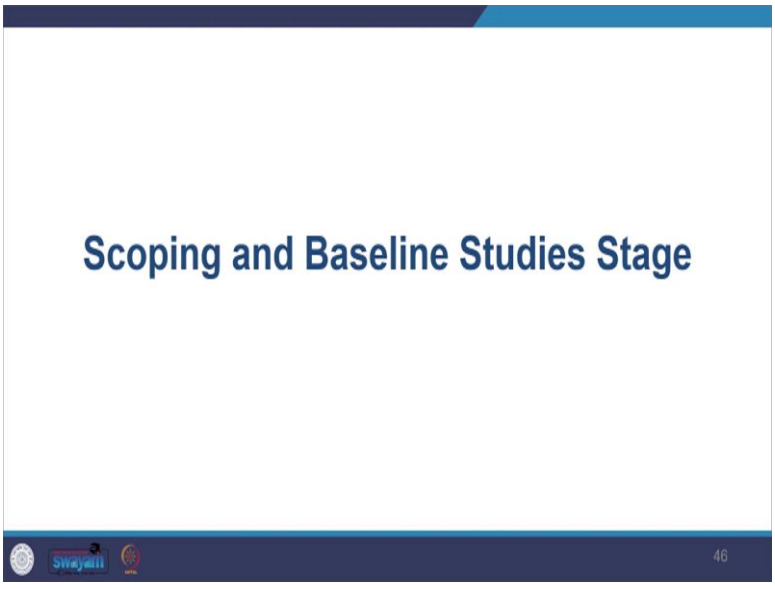

Moving on now, let us look at how to go about scoping and baseline studies for the domain particular domain, at this stage you will decide like you are scoping you are seeing what all kinds of studies have to be done.

So, you will decide what study has to be done and to what extent it has to be done or what details the study has to undertake. At this stage, you will essentially decide if you are going to undertake a test study, work

from your computer or report or undertake a strategic field survey, go to the field and look at selective things or you have to undertake a detailed field survey and also undertake field laboratory analysis of soils if required.

Usually at this stage of scoping, when you take site visits, it will be brief, it will be short site visits involving walkover surveys with your team to identify possible impact of development. So, you will look around and see what kind of possible impact can happen. For the site visit, you may require an understanding of geology, geomorphology, land use, and soils, you may assess the impact on the landscape, and you may also look at the visual impact impacts on water and ecology.

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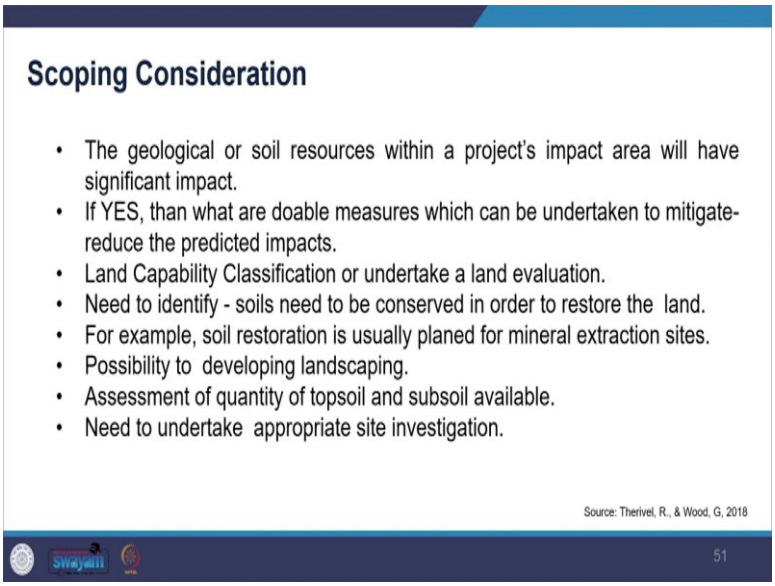

While undertaking scoping the most important aspect you need to consider is the significance of the impact. So, you need to look at how significant whatever impact you are predicting is going to happen, you need to see whether the geological or soil resources within a project impact area will have a significant impact and if yes, then what are doable measures which can be undertaken to mitigate reduce the predicted impact?

Whenever you predict a significant impact on land or soil, you may also consider taking a land capability classification or undertaking land evaluation as you have seen, you need to identify where soils need to be conserved to restore the lands you need to identify those areas. For example, soil restoration is usually planned for mineral extraction sites.

So, you do the restoration programs. You may also look at the possibility of developing landscaping in your project. In your field survey, you should include an assessment of the quantity of topsoil and subsoil available wherever you anticipate contamination, you need to undertake an appropriate site investigation.

Let us see very briefly the case example of Sacramento where widening project in Sacramento County, California. The US Army Corps of Engineers and its non-federal partners the state of California Central Valley Flood Protection Board and Sacramento Area Flood Control Agency proposed to widen the

Sacramento veer and bypass by constructing a new ware structure extending approximately 1500 feet upstream from the existing there.

So, this example is given to you as reading. This environmental impact statement describes the environmental resources in the project area and evaluates the direct, indirect, and cumulative environmental effects of three alternatives. So, it also looks at the alternatives including no-action alternatives, and describes avoidance, minimization, and compensation measures. Most potential adverse effects could be either short-term or would be avoided or reduced using best management practices.

So, we see the effects and mitigation measures of the proposed action under the falling titles. So, you can see how they have identified all mitigation measures under various headings. So, you can look at the geological resources you can look at the land use hydrological, hydrology and hydraulics, and so on.

Moving on further while you undertake desk study, you will be required to review and understand the existing data on geology, geomorphology, soils, land quality and also site history, and local climate. This will allow you to have a comprehensive understanding of the state and the potential impact. You may also look around nearby areas for possible contamination of the land.

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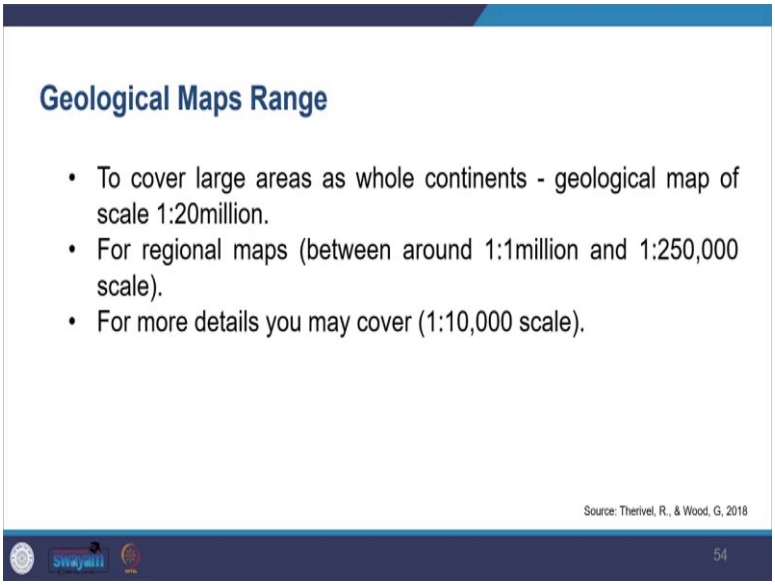

We may note that geological maps, range in area, and details we have covered. To cover large areas as a whole continent you may look at a geological map of scale 1 to 20 million. For regional maps, you can look at maps of scale 1 to 1 million and 1 is 250,000 scale. For more detail, you may cover 1 to 10,000 scales. So, all these scales are available. So, as per your requirement, you can look at those maps, you may note that for maps of areas of special interest to geologists, you may find the following sources.

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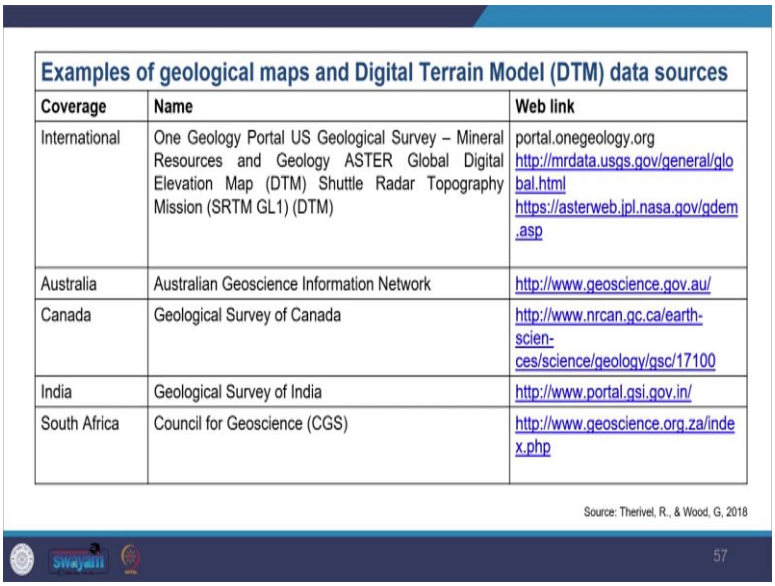

So, this list has been provided to you, you can see that at the international level, you have one geology portal, the US Geology Survey. You can see here the web link is provided to you and the entire reference is given to you for this purpose.

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Then you see mineral resources and geology. Again, at the international level, you can see here you can access this website and then you can access this information.

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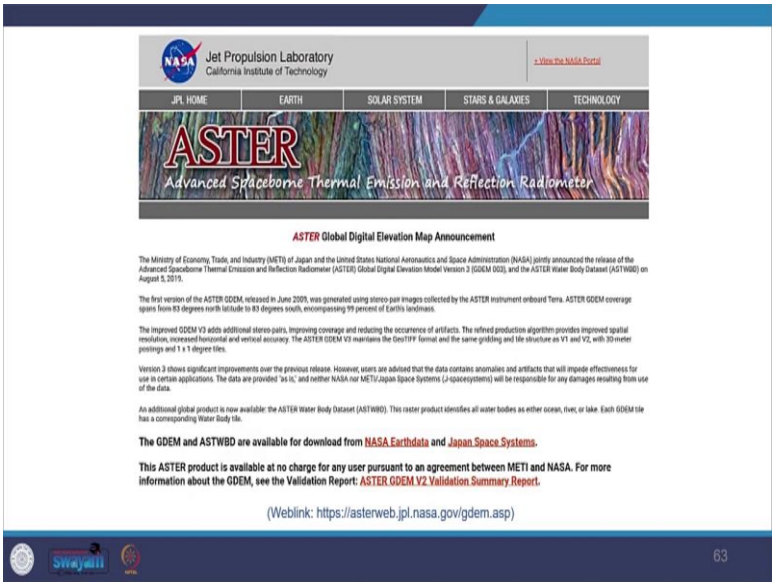

Then you can also see Aster's global digital elevation map which can be acquired again at the international level.

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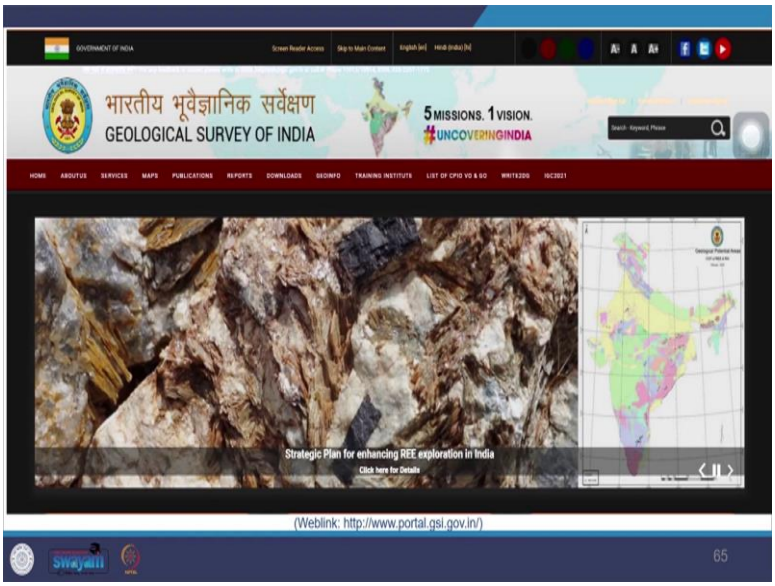

In India, if you want to cover India you have the Geological Survey of India from where you can acquire the data.

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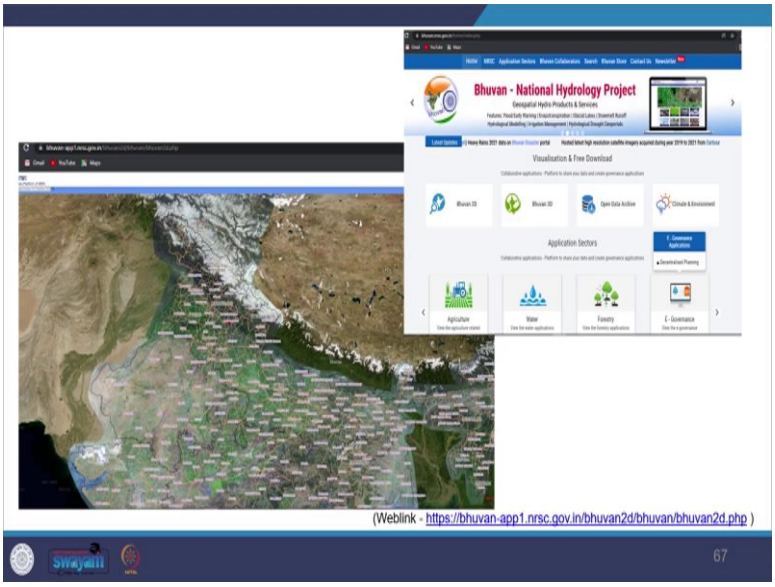

In the Indian context, you may also find data from the Bhuvan national hydrologic project.

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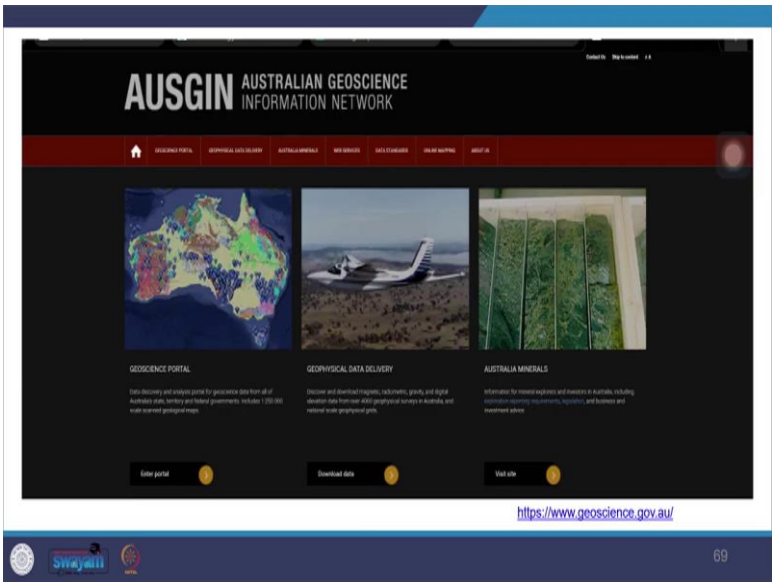

In Australia similarly, you can see Australian Geoscience Information Network.

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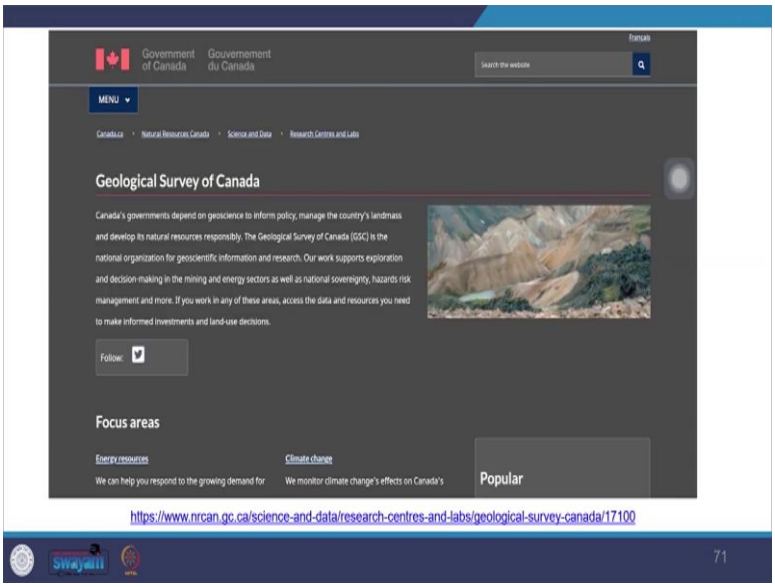

Likewise in Canada, you have the Geological Survey of Canada. Likewise in Canada, you have the Geological Survey of Canada.

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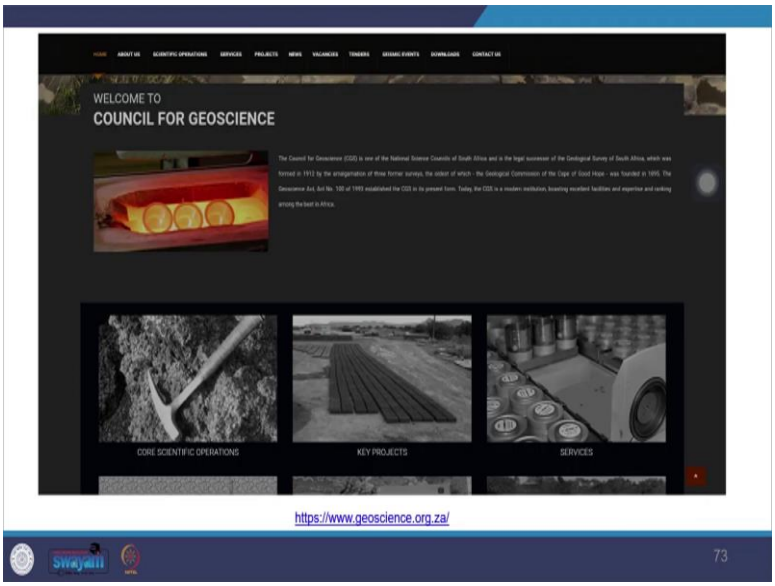
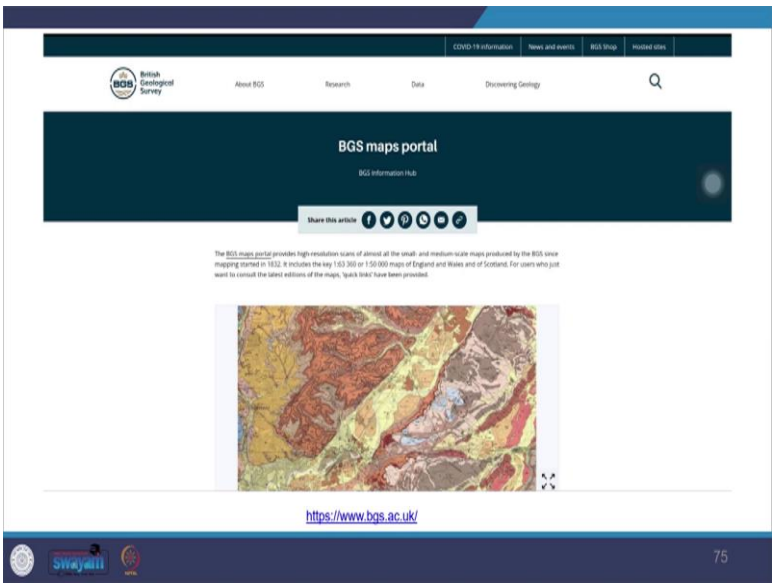


https://www.geoscience.org.za/



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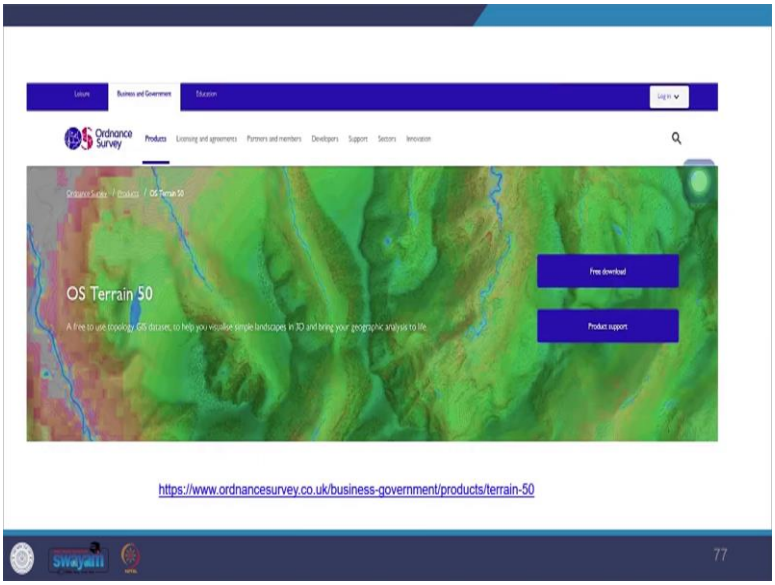
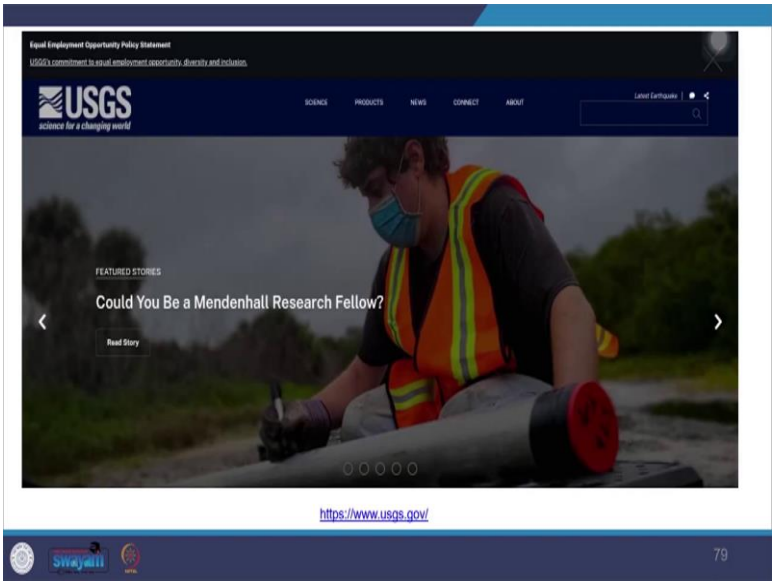


https://www.ordnancesurvey.co.uk/business-government/products/terrain-50



Similarly, in South Africa, you have counsel for geoscience CGS. So, you can also see the British Geological Survey at the international level. Likewise, you can see the ordinance survey OS Terrain 50, a digital terrain model that covers the United Kingdom UK. So, you can see here. You have the US Geological Survey, which covers only the USA. So, you saw a range of sources that are available free data available for analysis, these maps can be used in combination with geological and soil maps. Topographical data and digital terrain models can be created to understand the geomorphology of your study area.

We see that generalized medium to small scale mapping is required that is from 1 is to 50,000 to 1 is to 1 million scales, which may be appropriate for use in studies involving larger areas, when you are studying larger areas, for example, if you are studying pipeline or electricity transmission line, so on. So, you can create maps at that scale, but when you study a smaller area, then these might be not that useful, then you might need detailed and precise pictures for the purpose and have given these sources in the chapter reading.

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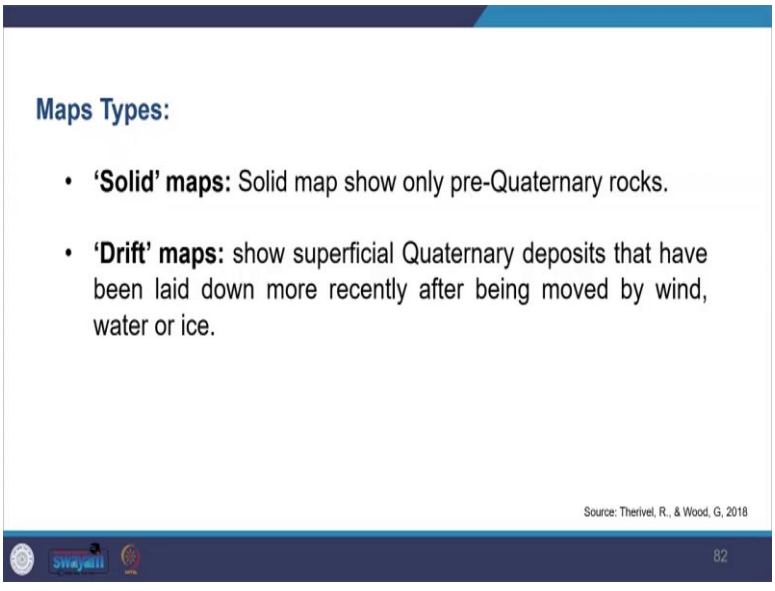

Let us familiarize ourselves with two kinds of maps in particular. We see Solid Maps, Solid Maps show only pre-quaternary rocks, whereas Drift Maps show superficial quaternary deposits that have been laid down more recently after being moved by wind, water, or ice. It is suggested that the drift maps provide considerable information on soil parent material in the survey area.

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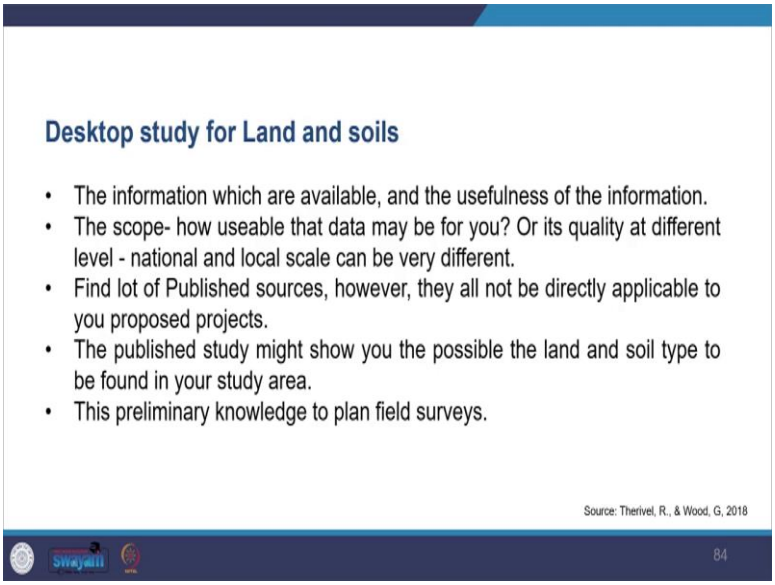

You are now looking at the desktop study for land and soils. So, when you do desktop study, you first look into the information that is available and the usefulness of the information, you may be mindful of the scope of how usable the data may be for you or its quality at a different level, national and local scale they can be difference in that, so, how useful is that data for you? You might find a lot of published sources however, they are all not directly applicable to your proposed project, but they do give you a direction in which you further need to find out.

There are a range of data sources for land cover and soil maps as well. For example, ISRIC will soil information shows the distribution of individual soil types using either the USDA or world reference base classification plus other soil characteristics including pH, bulk density, organic, carbon and sand, silt, clay content, and so on. You need to be very cautious about what information you are looking for how you want to apply and what scale you want to use it in.

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Examples of land cover and soil map data sources

Coverage	Name	Web link
International, national, regional	Global Land Cover by National Mapping Organizations (GLCNMO)	http://www.iscgm.org/gm/glcnmo.html
Africa	SRIC AfSoilGrids250m (webGIS)	http://www.isric.org/data/AfSoilGrids-250m
Australia	Australian Soil Resource Information System (ASRIS)	http://www.asris.csiro.au/
Europe	European Soil Data Centre (ESDAC)	http://www.esdac.jrc.ec.europa.eu/
United State	Soil Survey Geographic (SSURGO)	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053627

Source: Therivel, R., & Wood, G, 2018

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Certain examples are given at the international level the continent level and different countries level which data are available for analysis purposes.

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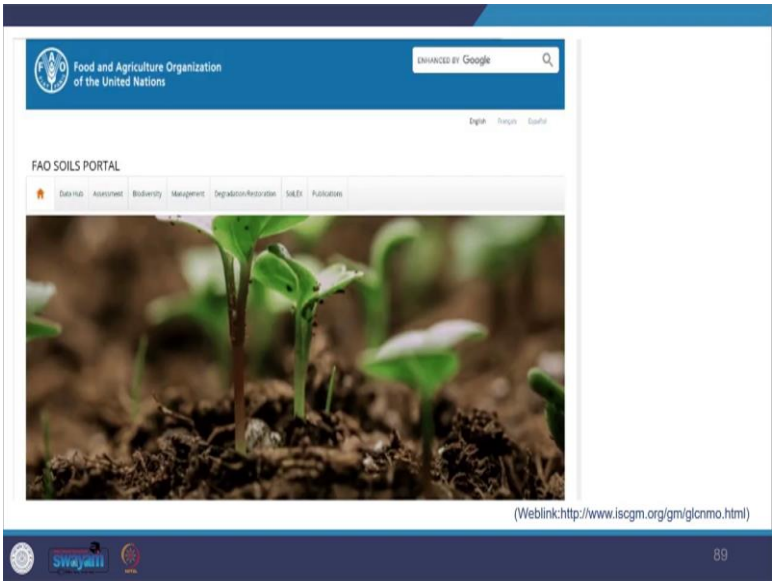

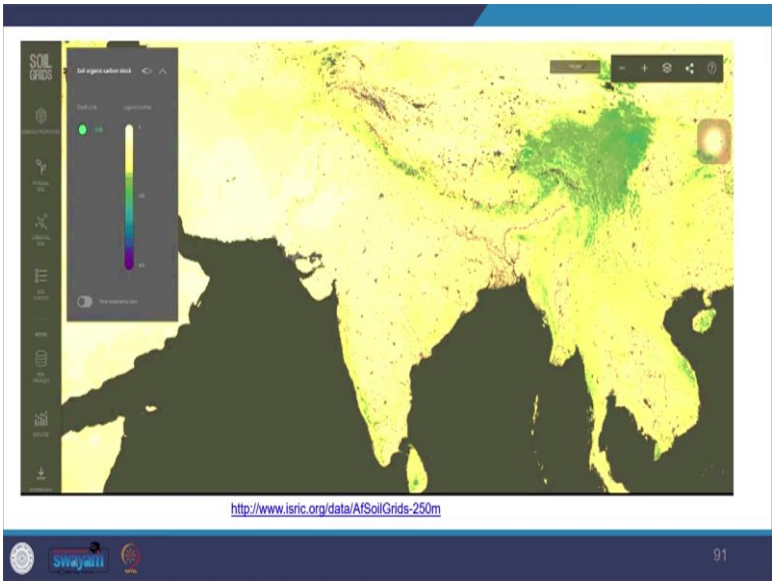

So, we see Food and Agriculture Organization FAO has a soil portal in the International region. Likewise, you see the soil grids of 1-kilometer international level as well as national and regional level, it is web GI that gives you information.

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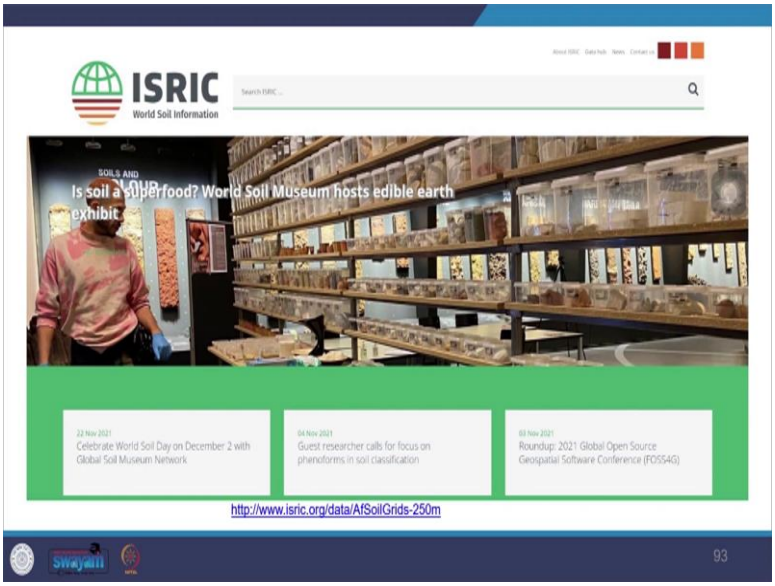

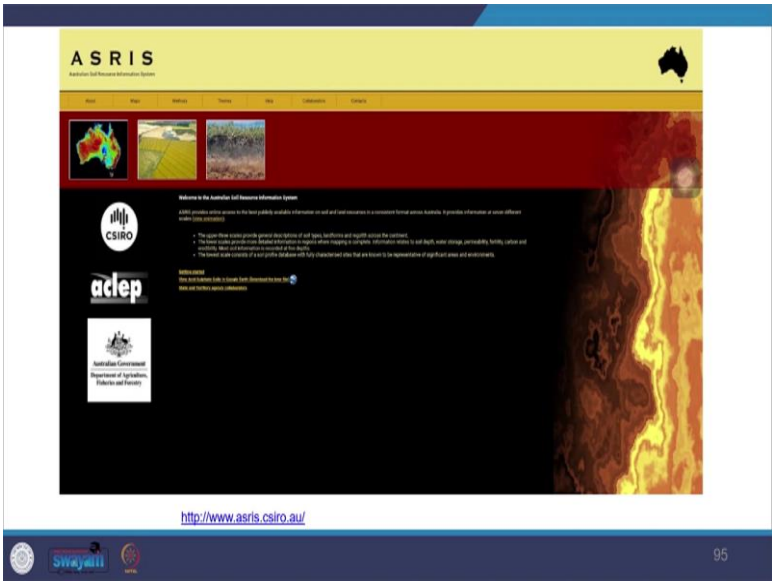

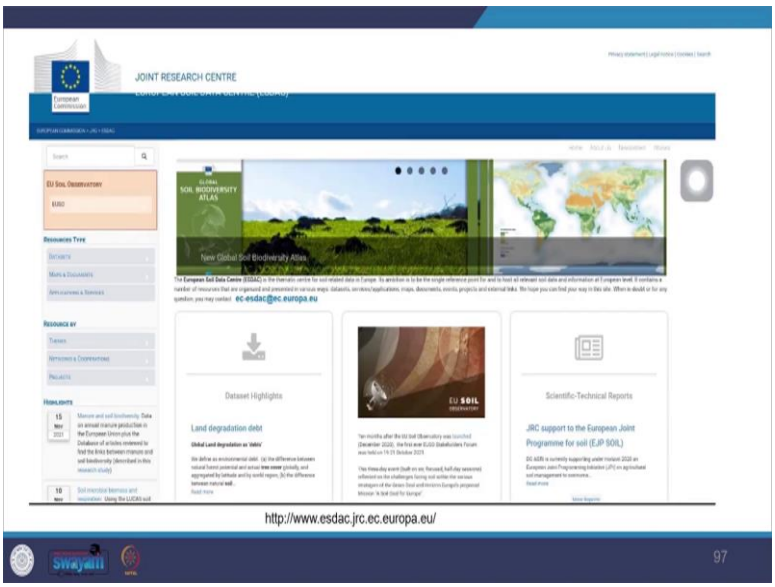

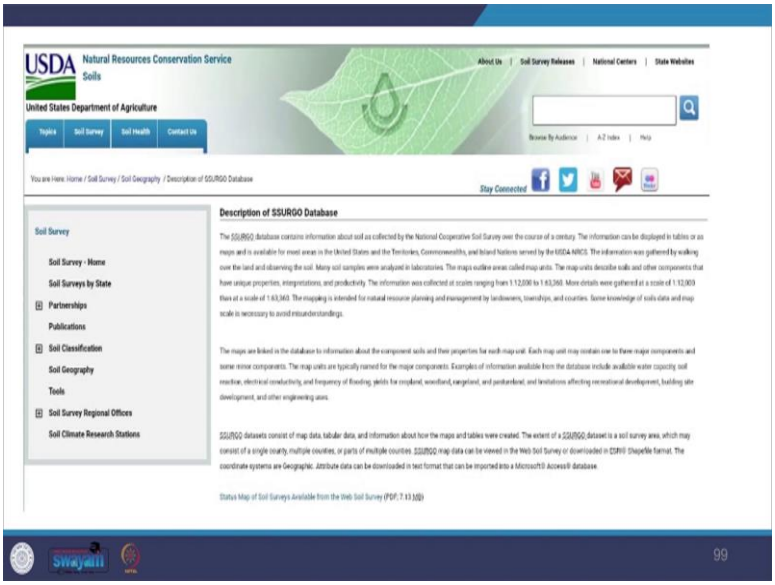

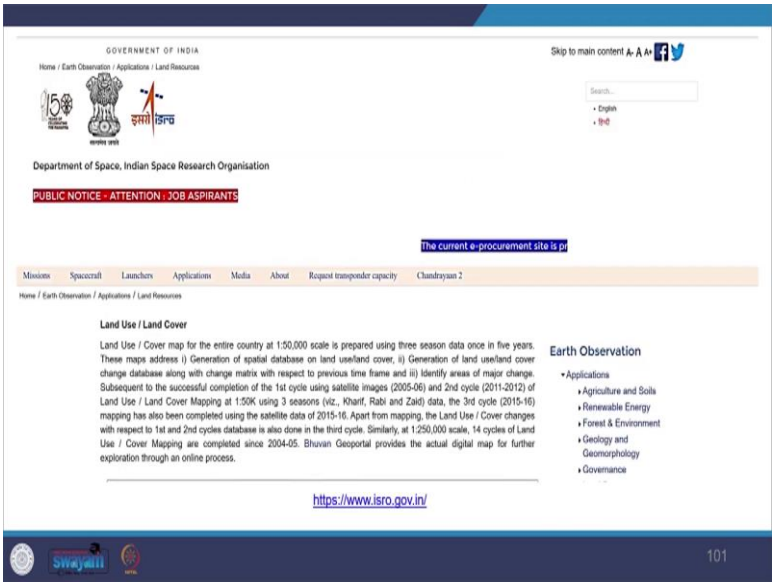

Likewise, you can see ISRIC as soil grids of 250 meters, web GIS for the coverages for Africa then likewise, you can see for Australia, you can see Europe, soil data center, then you can look at the United States, all these references have been provided to you in the chapter reading. You can see India, India has a department of space, the Indian Space Research Organization ISRO from where you can avail data.

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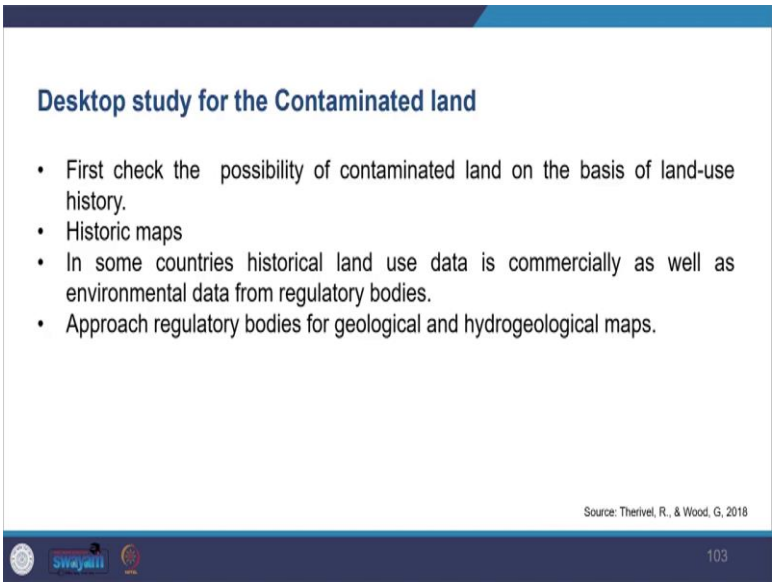

So, now moving on desktop study for contaminated land, we will look into that, you would first check the possibility of contaminated land based on the land use history. So, you might look at the secondary data and like to look at what the land history has been, and land use history has been, and you may get historical maps wherever available.

In some countries, historic land use data is commercial as well as environmental data are available from regulatory bodies. You may also approach regulatory bodies for geological hydrological maps, this is important information looking at the history and the other context it helps you to develop an initial conceptual site model.

You see that in New South Wales Government in Australia and different environmental agencies in the UK have produced guidelines on carrying out a preliminary survey of potentially contaminated sites. So, they give you a guideline. So, you can look at those guidelines on how to undertake this preliminary study, you may note that type, what type of contamination and to what extent it occurs in the site, and how far the land is contaminated on a site will depend upon the previous uses of the site.

The operational process, what process had been undertaken by the previous users, and the effectiveness of environmental protection measures adopted by them. So, how their processes were, determined the contamination level and extent in your site? You may also check for any possibility of pollution of the subsurface or neighboring plot because they can travel into your study area.

So, you need to ensure to record all possible activities and management practices adopted and types of chemicals used on-site and around the site, not only on-site but around the site. No matter how intensive your study is, there might be some limitations that you should record in your baseline assessment.

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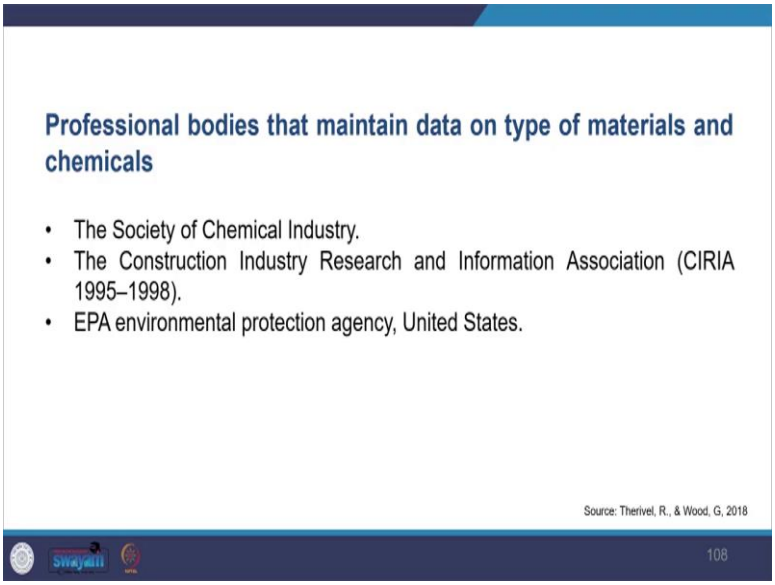

Numerous professional bodies maintain data on the type of material and chemicals that are used for a wide range of commercial activities and also publish it. So, you can look at society for chemical industry, construction, industry research and information, and also EPA Environmental Protection Agency. So, they also provide data guidelines and procedures for gathering information concerning previous land users and potential contamination.

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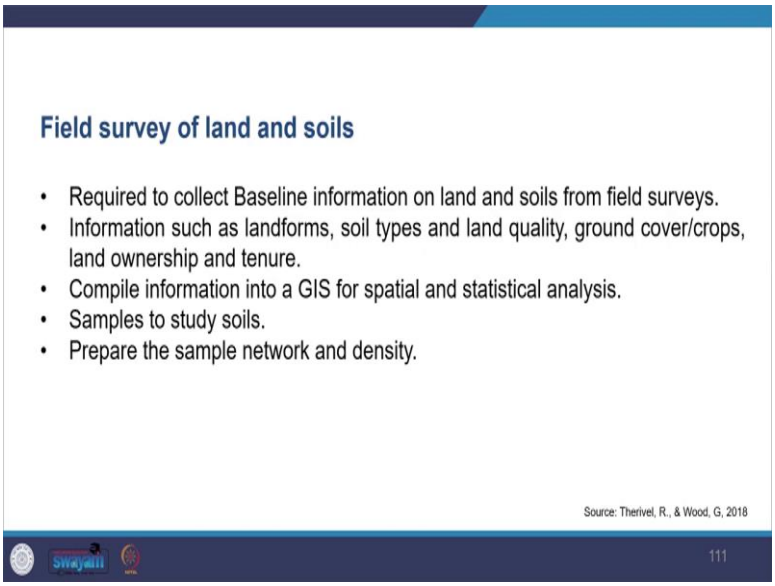

Now, moving on to the field survey, you would be required to collect baseline information on land and soil from the field survey. Information such as landforms, soil types, land quality, ground cover, land cover, and tenure, may compile this information into GIS for spatial and statistical analysis. Moreover, it is important to use land in the study of the area.

Further to study soil, you may take note of from where samples are to be taken, you may prepare this sample network and density so that it represents the soil variations within the survey area. References for the detailed soil survey methods and detailed statistical methods are provided to you in the link. Some geological and geomorphology can be complex with variations in small areas, which may create challenges

for soil surveyors, for field observation, you may use a soil auger to take samples from sequential distances within a soil profile.

So, we see that as per the international best practices for EIA, it is required that land, soil, and water are considered natural resources and should be dealt with in totality. Therefore, whenever you investigate, you should try to identify contamination that might exist in three phases soil, liquid as well and vapor. So, you look into all these when you look at the contamination, and the countries provide guidelines on this. So, that is there and you may look at the international guidelines on soil quality and sampling in the ISO 18 400 series of documents.

You would be required to hire a suitably qualified person to undertake all land contamination studies, investigation, and risk assessment, also an experienced practitioner will help us to identify health, safety, and environmental risks from potentially contaminated sites. So, you may facilitate digging for soil pits to observe soil structure and extent of crop roots in each of the main soil types for surface mines, topsoil, and subsoil resource maps obtained from soil surveys.

So, when you make a detailed soil map, it is usually shown on a scale of 1 to 10,000 and it can be interpreted with a reasonable degree of precision. So, with those maps you can make you may be able to measure soil properties through the soil depth, you can also look at other properties just by estimation by eye, you can also use quantified standard techniques for the purpose and these all your decision will depend on the degree of precision required for the purpose, so what precision you are requiring.

So, you can use very simple things like for example, simple seem when weighing scales can be used for estimating stone content. Soil texture can be determined by hand, but would need experience, you might also require adjustment with standard samples and may need laboratory analysis.

You should identify soil resources that would be required for conservation and land restoration. Your survey should provide information on soil depth, volume, and physical characteristics of available topsoil, subsoil, and soil formation material and also the description of the original landform and terrain. So, whenever you prepare, prepare the reporting you give this information.

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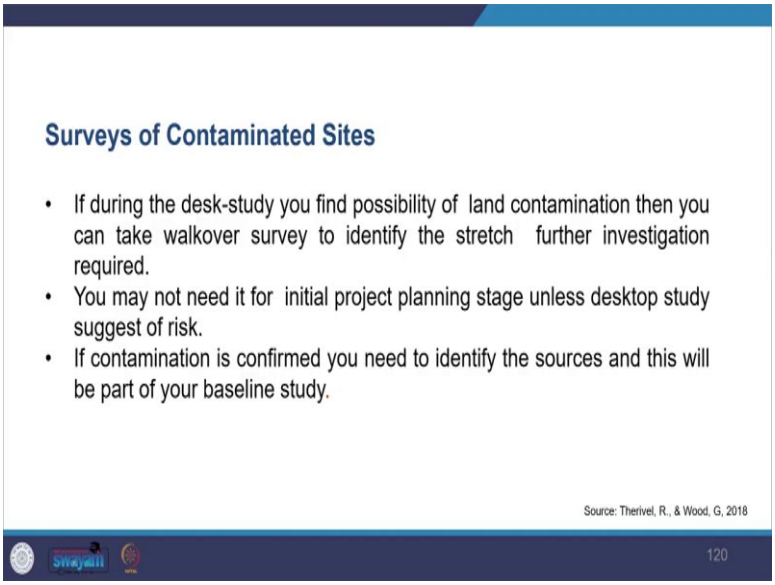

Looking at now a survey of the contaminated sites, if during the desktop study, you find the possibility of land contamination, then you can take a walk-over survey to identify stretch to find out whether further investigation is required or not. Such observations are important for scoping studies, you may not need them for initial project planning stages unless a desktop study suggests the risk. So, only if it is suggested then only take when you gather from your desk study.

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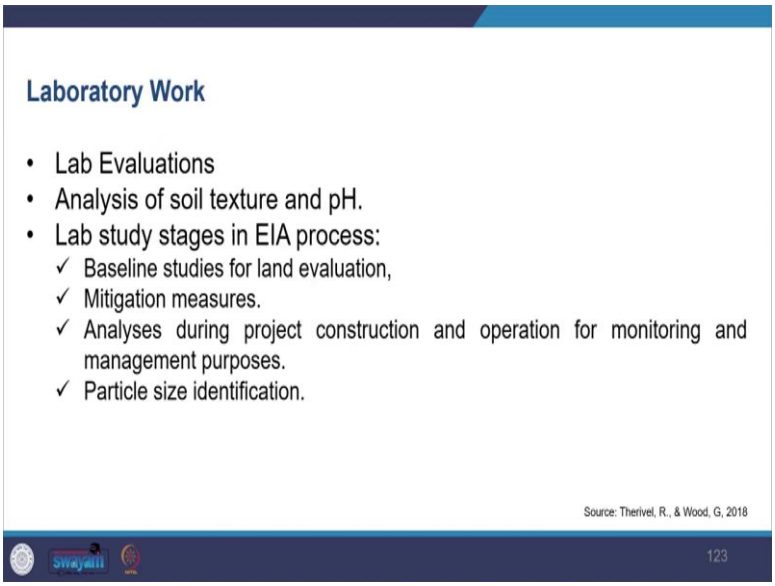

Now moving on, we will look at the laboratory work. So, if the project requires greater precision, if you need information of greater precision in the information of grading of the land quality, then you may go for the lab evaluation. For example, analysis of soil texture and pH, and lab analysis are expensive. So, only when it is required do you undertake that lab studies are taken at very number of stages in the EIA process, it is taken at the baseline study level as well for land evaluation, and are also taken at the mitigation measure level to decide what kind of treatment will be given.

Also, the analysis is undertaken during the project construction and operation for monitoring and management purposes. So, you do take soil samples at different levels, and different stages. So, for

measurement of contaminants for meaningful assessment the soils must be analyzed for all the contaminants potential in the ground within the site. Investigations of contaminated sites are often hindered by an incomplete understanding of the polluting activities, so, you need to take care of that.

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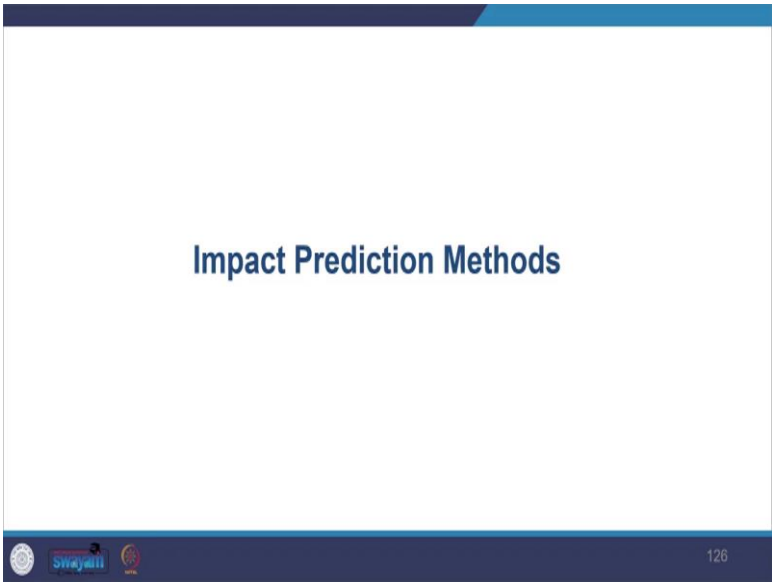

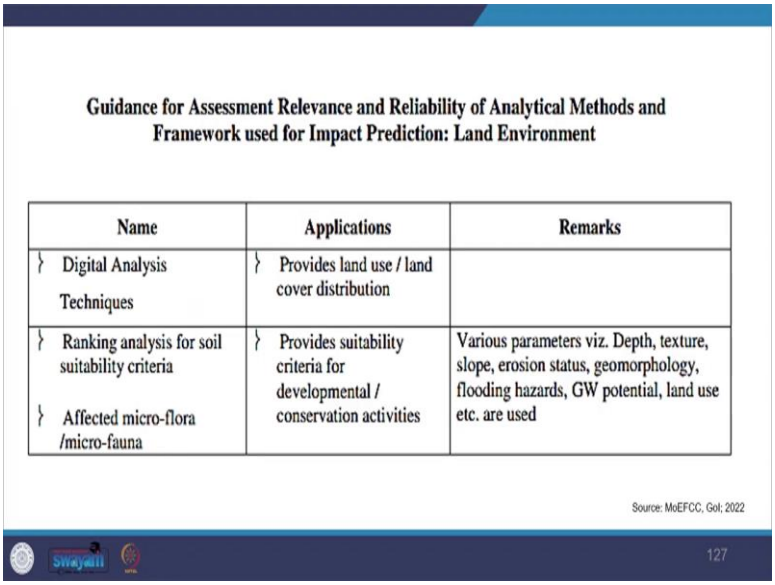

Moving on, we will now look at impact prediction methods. So, we will see how the impacts are predicted mostly we do EIA within the legal context of the country. So, based on that only we identify the impact, you can see the guidelines given by the MOEFCC government of India, which suggests some of the tool's frameworks for impact assessment for the land environment. Many governments may consider mineral extraction as part of sustainable development and because it provides raw material to industries, so, the site if not managed well, such mineral sites can result in groundwater pollution by leachates.

There are significant seismic risks, in mining activities like hydraulic fracturing, fracking can lead to significant geological problems, they can be if we try to understand the fracking process when it involves pumping liquids into if you try to understand the fracking process, then it involves pumping liquid under pressure into rock formations to force shale gas out. In the process, the main geological risk is that expelled

gas might contaminate the underground aquifer and will also cause small earthquakes and then there is a larger risk of earthquake due to wastewater disposal by injection into deep wells.

So, we can see one of the examples, there was an earthquake of magnitude of 5.7 in central Oklahoma in the United States in November 2011, which destroyed 14 homes and injured people. So, in some countries, even if volcanic risk is considered, you also need to look into subsistence and slope stability. So, they can be subsistence by underground mining and are usually associated with traditional coalfield areas. And they can be issues with natural slope stability, which is very common.

Your purpose in EIA would be to avoid the construction of new developments in unstable areas. Reference to more information related to planning issues about subsistence and slope stability is provided to you in the chapter reading. Road development can have a direct impact on geology and geomorphology by displacing rocks and changing landforms, it may also have indirect effects and might change the hydrology such as diversion of streams. So, by the road, the streams can get diverted, which eventually affects the recharging of the aquifer.

Further, we see that it is extensively difficult to preserve geomorphological features and the best of these is to avoid the proposed development. Further, we see the impact on land and soil impact on offer activities, such as deforestation, poor planning and management of urban and industrial development lead to problems, such as soil erosion degradation due to loss, poor environmental management, and also inappropriate development causes permanent loss of land and soil which could be avoided.

So, whenever you start EIA, first you should identify the study area within which significant impacts are most likely to occur and then you determine the appropriate temporal scope of the duration of construction, operation, and restoration phase. So, you look at all those things and then you predict the magnitude of the potential permanent and temporary impact of land including displacement of soil.

So, your assessment of land will be based on selected physical criteria, your evaluation methodology should be out and should set out a range of quantified values as class limits for magnitudes and sensitivity categories. You can adjust these class limits as per the scale of the development project.

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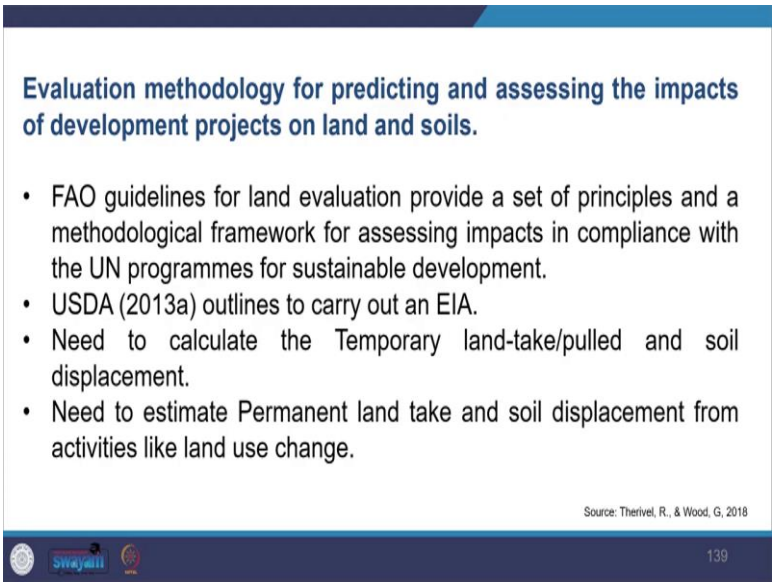

So, there are numerous evaluation methodologies, you can see FAO guidelines for land evaluation, which is given, which provides a set of principles. You also see USDA also provides an outline of how to carry out EIA. You need to calculate the temporary land-take pulled and soil displaced. So, when you are doing this, you need to see how much temporary land is taken away or the soil is displaced, as well as you need to see how much permanent land is taken away and the soil is displaced.

You also need to take note of the soil erosion by wind and water which is a serious threat to soil resources. More soil erosion occurs as a result of agricultural land management practices. You may note that they are not subject to development planning controls, nor do they fall in the scope of EIA.

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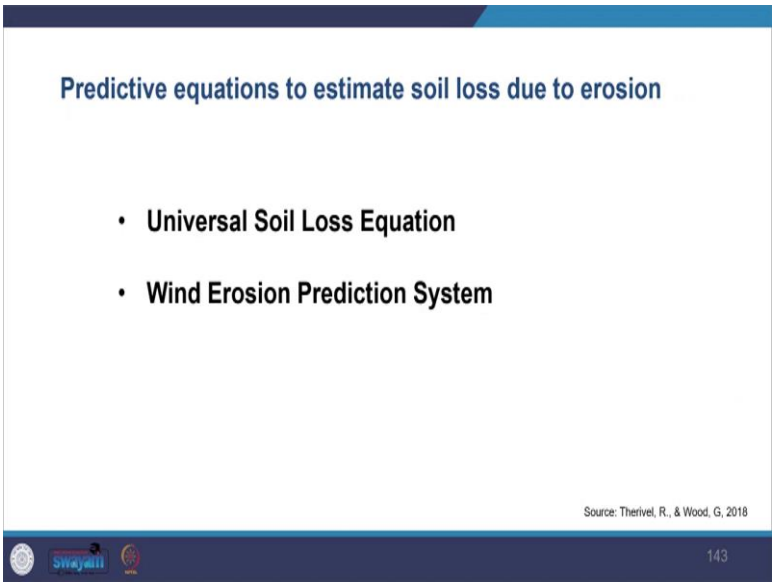

There are several predictive equations to estimate soil loss during erosions. You may find the universal soil loss equation, which helps you to calculate water erosion assessment and conservation helps you to plan your conservation.

You will also find wind erosion prediction systems like land management practices and crop rotation, you need to estimate the damage to soil structure because of the construction activities, vehicles, and mechanics machinery, such damages lead to reduced infiltration, increased runoff, and erosion. We see that the UK Government as well as the United States government published legislation and guidance in this regard.

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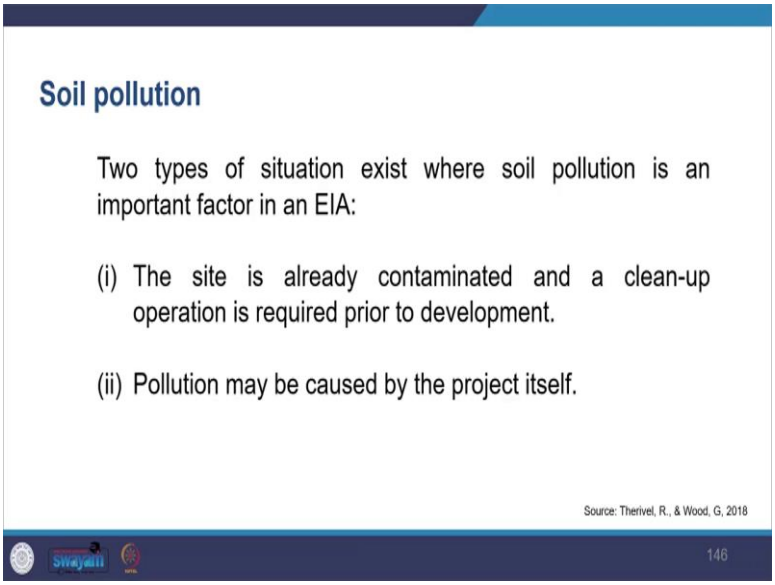

You need to estimate the soil pollution, there are two types of situations that we see in matters of soil pollution. First, where the site is already contaminated a cleanup operation is required. Second, where pollution may be caused by the project itself.

If you observe in the baseline survey that the ground below the site contains contaminants, risk assessment is based on the pollutant linkages like the source pathway receptor, which we had talked about in the previous class. A model should be carried out to determine significance, significance may be estimated in terms of risks to the receptors, and the baseline should be substantial to inform the project activities.

So, whatever assessment you do, should inform the project activities. And take note that the proposed project can have both positive and negative impacts. You can also undertake a qualitative risk assessment to establish pollutant linkages, you may use modeling to capture the pollutant path.

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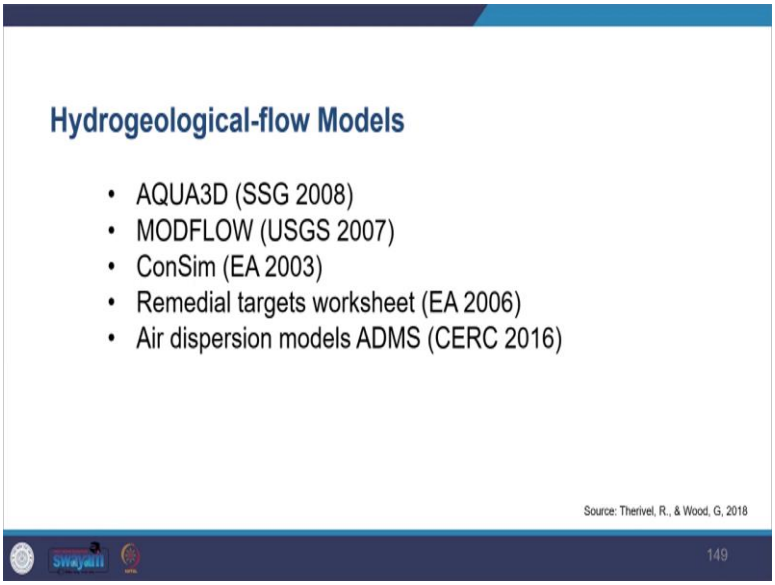

Modeling techniques like this are the list of modeling techniques, you can use here. You can assess the risk to human health by a range of modeling tools such as the contaminated land exposure assessment tool, you can look at USA-based risk-based correction action. And then, there is another terminology in which you would like to see critical loads. Critical loads provide a means to estimate the vulnerability of land to atmospheric pollution.

So, how much pollution can take about the receptor soil, geology, freshwater, and vegetation? So, the United Nations Economic Commission for Europe has specified critical loads for the position in sensitive ecosystem and a critical load database for the United States is also available, all of the above impacts can have serious effects on soil, but the soil types outline here will be affected to different extent by each.

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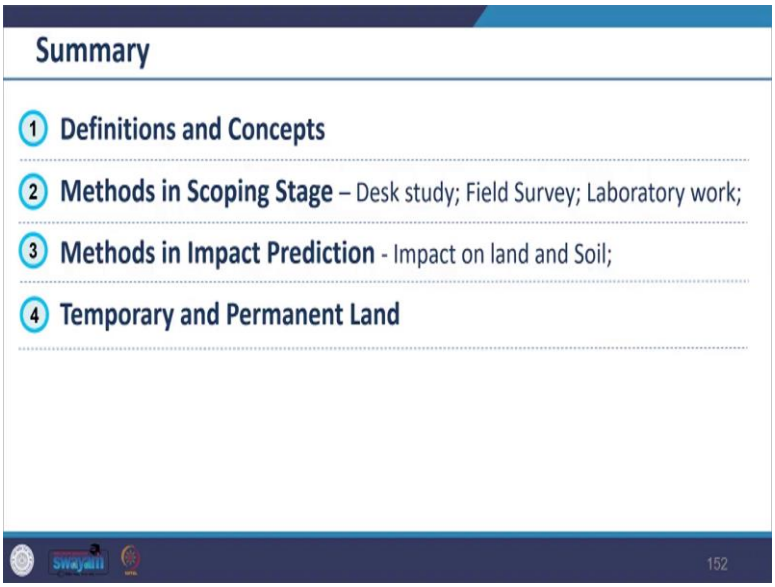

So, we have seen all of these. So, summarizing what we covered today, we looked at the definitions and concepts of geology, geomorphology, land soil, and so on. We also looked at methods in scoping stages, what we used what was the purpose, and how what are the different methods available to us. Similar way we

looked at impact prediction and the methods that we can take and several tools that are available for the purpose.

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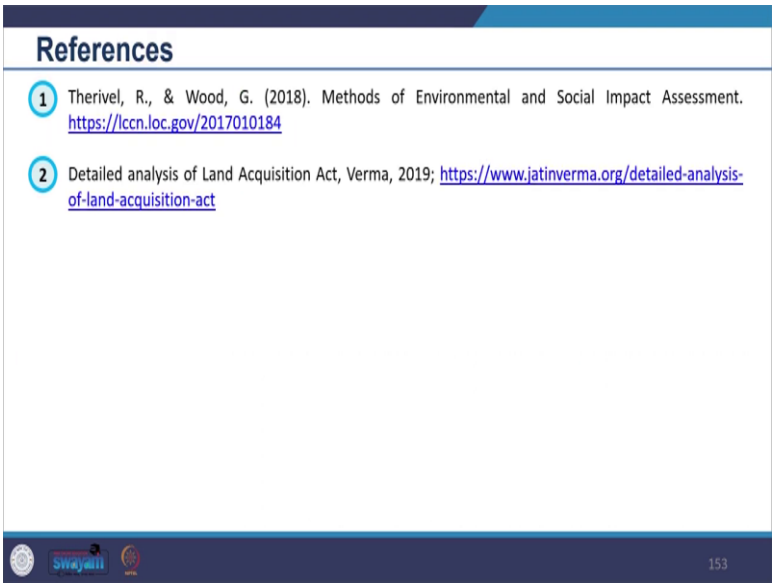

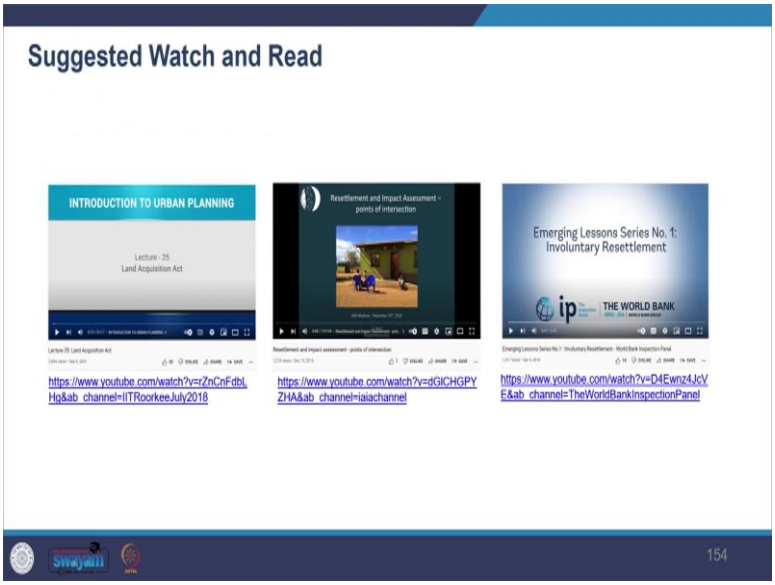

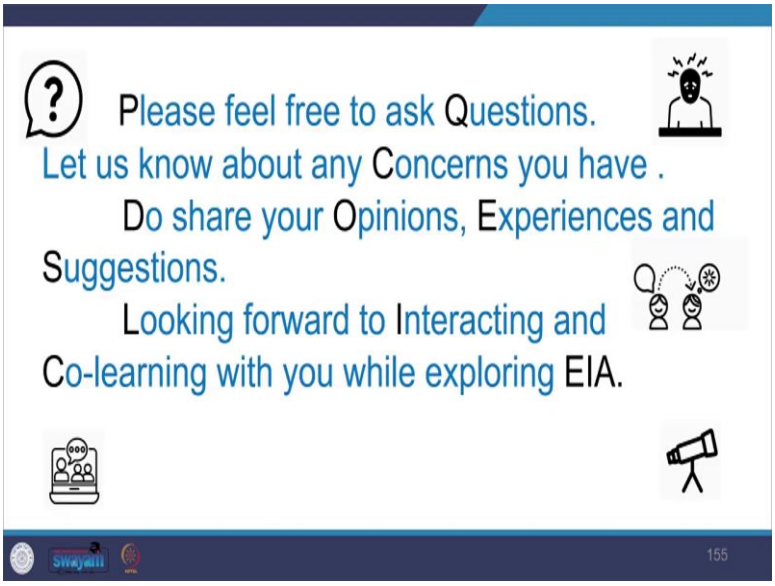

So, that is all for today. These were the references used and these are the suggested watch and read because our coverage is very limited. So, you can read more if you are interested and explore further. Please feel free to ask questions. Let us know about any concerns you have to share your opinions, experiences, and suggestions looking forward to interacting and co-learning with you while exploring EIA. So, that is all for today. Thank you.