Ground Water Hydrology
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Module No # 05
Lecture No # 23
Ground Water Pollution from Miscellaneous Sources (Contd.), Attenuation and Underground Distribution of Pollutants

Welcome to this lecture 23 on ground water hydrology.

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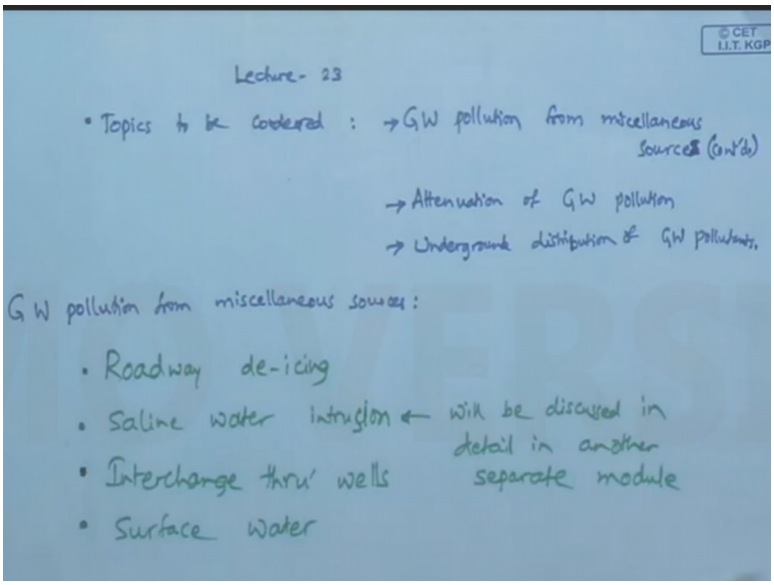

And here in this lecture we will complete from miscellaneous sources which we have started in the previous lecture. So that will be completing that we will be continuing with and completing then followed by attenuation of this ground water pollution and underground distribution of ground water pollutant of these are the topics which will be covering in this lecture and moving on to this ground water pollution from miscellaneous sources.

So we will be in the previous class okay in the previous class in the previous lecture we discussed about the various causes such as urbanization the miscellaneous causes of ground water pollution such as urbanization surface discharges stock piles and septic tanks cesspools. Today we will go to this roadway deicing followed by saline water intrusion this is just listed here.

So will be discussed in detail it will be discussed in detail in another module another separate module we are just listing here. So it will be followed by two more the causes miscellaneous causes that is that is a interchange through wells followed by surface water so these are the four remaining causes under the miscellaneous sources we will be discussing today.

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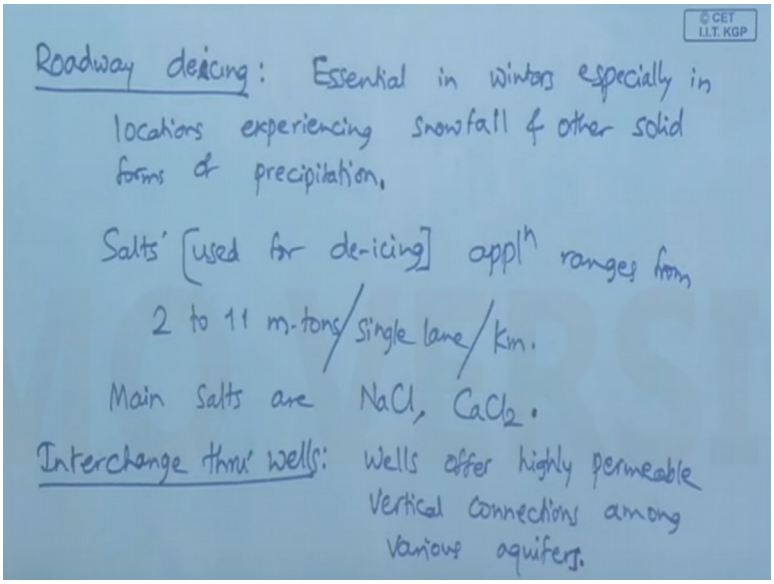

Now coming to this roadway deicing. So this is very essential in winters especially in areas in locations experiencing snow fall snowfall and other solid forms of precipitation. So in this so to remove the ice certain deicing agents has spread on the road roadways and this one so the so certain salts are spread on the roadways so as to remove the ice from the roads and this the salt application salts used for deicieng.

The application ranges from this two to say 11 metric tons per iam sorry this is British ton which almost is the same of the metric ton so that is per single lane or say per lane per kilo meter in the winter season. So therefore what this does is so the main salts are NACL sodium that is sodium chloride and followed by CACL 2 and this one so these salts they will peculate into the ground water and then they will increase the salinity as well as the chloride and sodium and calcium content.

So that is it is very important to consider his in the that is abatement or reduction of the pollutants so next that is saline water intrusion so that will be discussed separately in module and

a new module then now we will go to the interchange through wells. So here so this well offer vertical connection highly permeable vertical connections among various aquifers.

So in this so therefore what happens is so through wells. So the pollutants enter from one aquifer to another aquifer through the through these wells.

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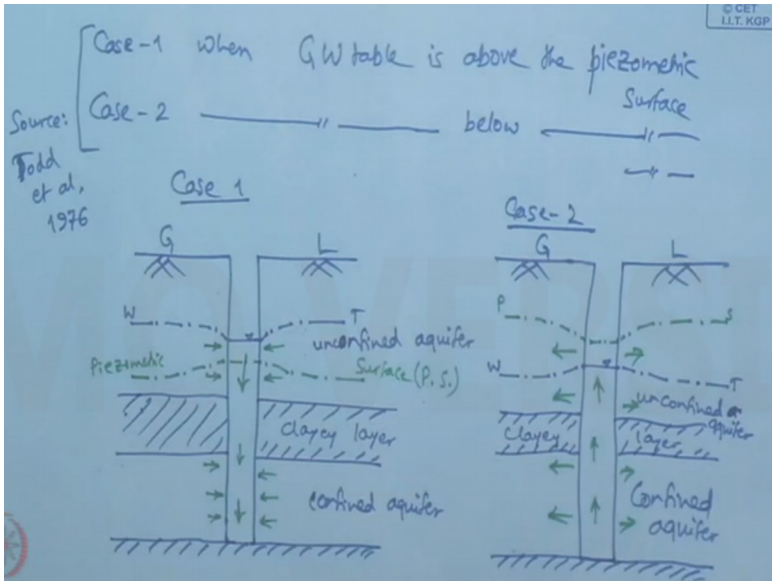

Now let us discuss two separate cases given by this one that is they so they so ground water pollution through wells. So the first case is when they case one when ground water table is above the piezometric surface so again for this both is case two say when the ground water table is below the piezometric surface and for both this cases they are taken from the same source toward at all from this 1976.

Now let us consider this case one so here. So this is the ground surface the this is a well in this case so this is the water table whereas the piezometric surface that is below the water table so this is the piezometric surface let us indicate this as PS. So in this case so this is confined aquifer and in-between this clay layer and then let us consider one confined aquifer and one unconfined aquifer.

So here what happens is so because the piezometeric is below the water table. So there will be flow into the well so this is the ground water flow and along with this the pollutants also are flowing so this is the unconfined aquifer here it is the confined aquifer and this is the impervious

strata and such case what happens is this along with ground water so they the pollutants will move that is a downward direction and then so they get distributed to this lower confined aquifers.

So this is case one then the ground water table is above the piezometric surface now let us also consider this case two when this grounds water table is below the piezometeric surface you so this is the ground level and then in this case the water table piezometric surface is above so this is the piezometric surface which is indicated by the abbreviation VS then so there is water table which is below the piezometric surface and there is a let us consider one.

So this is a clayey layer and then so this is the unconfined aquifer this is the confined aquifer so in this case because the piezometeric surface is above the water table so in this case there will be flow from the well into the aquifer and in this case because the piezometric surface is above so the pollutants move from that ids the an upward direction and so this pollutant is get distributed in the upper aquifers.

So like this so the wells so they result in this they cause pollution through that that is a when then two cases the first on is the ground water table is above the piezometric surface and the second case is when the ground water table is below the piezometric surface.

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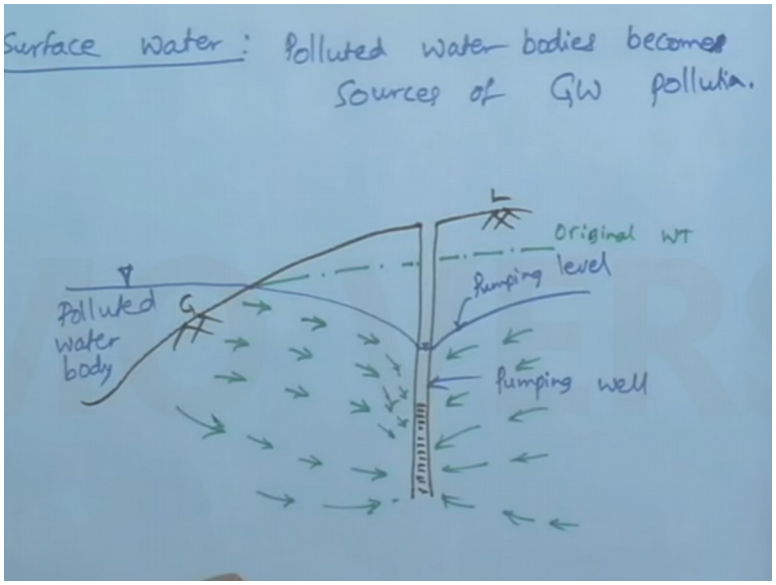

Now let us come to the last cause of among the miscellaneous sources that is the surface water so in this surface water so this pollutant surface water bodies pollutant water bodies become sources of this ground water pollution. So in this case let us say there is a so this is the ground surface then so there is a well with a strainer here so this is a ground surface and here so there is a polluted surface water body.

So this is a polluted water body and in this case and so this is a pumping well and through this so this is the water level in the pumping well here. So below this so this is the pumping water level so this is the pumping level and suppose the original so this is the original water table so in this case from below the this pumping level this so the ground water enters they from the polluted water body obviously.

So therefore the pollutants they will enter the well and then so they will cause they will cause the ground water pollution. So these are some of the causes of the miscellaneous sources of ground water pollution.

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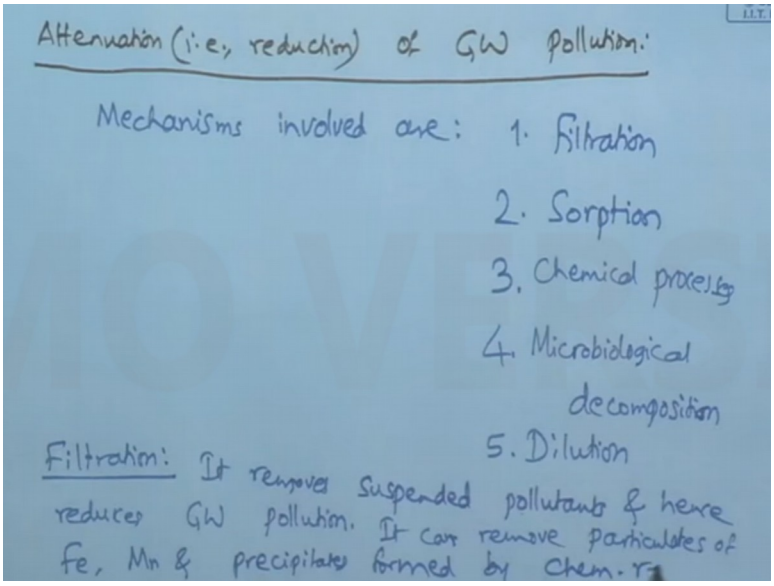

Now we will move on to this attenuation of attenuation so this reduction of ground water pollution so this reduction. So this whenever there is a polluted ground water we need to take all appropriate measures. So that we can reduce this attenuate this ground water pollution and there are various mechanism and there and so these mechanism. So they are firstly filtration then second one is the absorption third one third mechanism is the chemical processes.

The next mechanism is the micro microbial or microbiological decomposition ands last but not the lest is the dilution so these are the mechanisms which will reduce the ground water pollution now let us discuss these mechanisms one by one. So firstly we will consider this filtration so this filtration. So it removes the suspended materials or suspended pollutants and hence reduces this ground water pollution.

So in this case so it can remove particulates of FE iron or manganese and precipitates formed by chemical reactions so this filtration basically there will be a filter substance filter layer and that filter layer will remove the surface pollutants or these are the suspended pollutants and that is very important in case of the surface pollutant surface water infiltrating into the ground water and then causing pollution.

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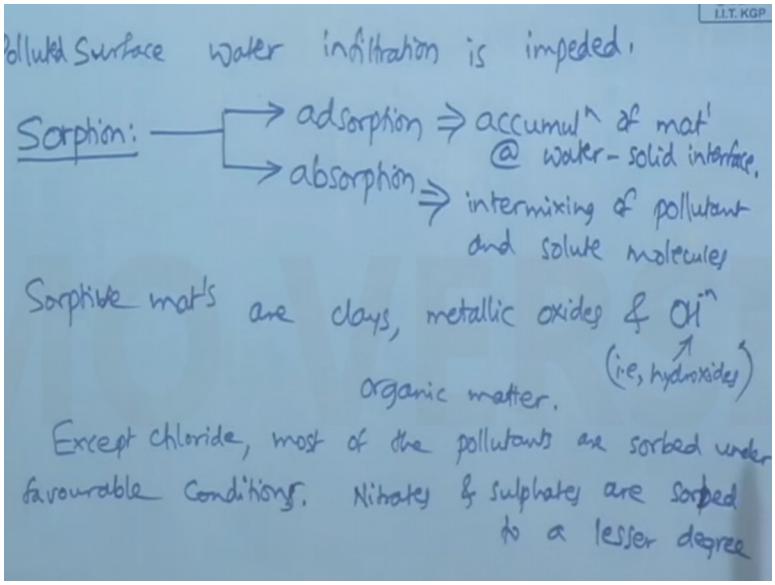

So that this filtration take care of that term okay .So in this filtration so the polluted surface water infiltration is impeded now let us come to the second mechanism of attenuation or reduction of this ground water pollution that is the sorption and within the sorption so basically here that is there are two types of sorption are there so first one is the adsorption and second one is the absorption.

So here this adsorption it is the so this adsorption so the accumulation of material so in this case the pollutant band water solid interface so that is adsorption adsorption so this absorption is the

intermixing of pollutant and solute molecules that is known as absorption. So in this option process so they met the pollutants the sort to materials are clays metallic oxides and hydroxide and hydroxides.

So that is hydroxides then this organic matter so they are used to facilitate the process of sorption or the main induce the mechanism of sorption so here except chloride this chloride is double so the most of the materials are most of the pollutants are sorbed that means either adsorbed or absorbed under favorable conditions and of course this one the nitrate and sulphate are sorbed to a lesser degree.

So in this case so using this sorptive materials that is clays metallic oxides hydroxides as well as organic matter so most of the materials most of the pollutants are made to undergo either adsorption or absorption and thereby so it is removed so this is the second mechanism of attenuation or reduction of this ground water pollution.

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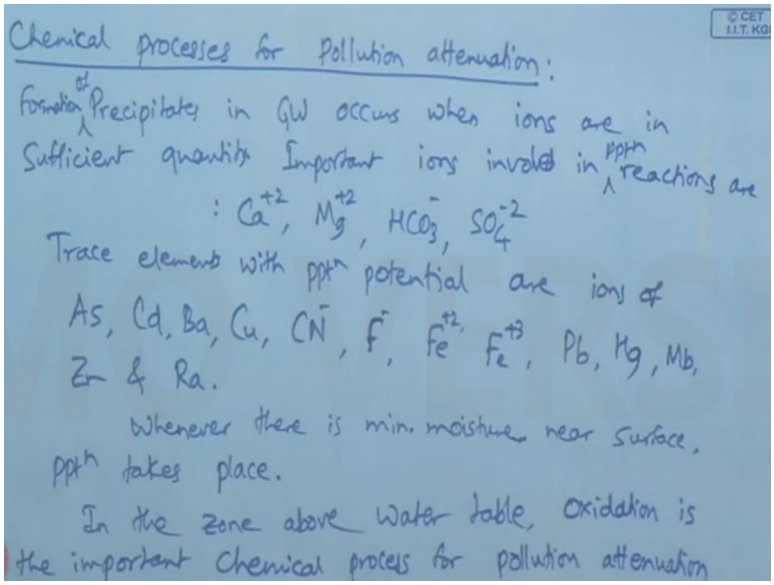

So now we will go to the third mechanism that is the chemical processes for pollution attenuation so in this the precipitation or say formation of precipitates in ground water occurs when ions are insufficient one so this is important ions involved. So the important ions involved in precipitation reactions are this precipitates so there are they are calcium CA +2 MG +2 then the bicarbonate sulphate and of course the trace elements.

Involved are trace elements with precipitation potential are arsenic ions so ions of arsenic cadmium barium copper cyanide. So fluoride FE ferrous and comma ferric lead the mercury molybdenum zinc and radium so the ions of these metals as well as these compounds so this radicals. So they also have potential for precipitation so in this case wherever see whenever there is minimum moisture near free surface near the surface.

So this precipitation takes place so this chemical process so which is mainly precipitation and in the zone above water table this oxidation is the important chemical process for the pollution attenuation.

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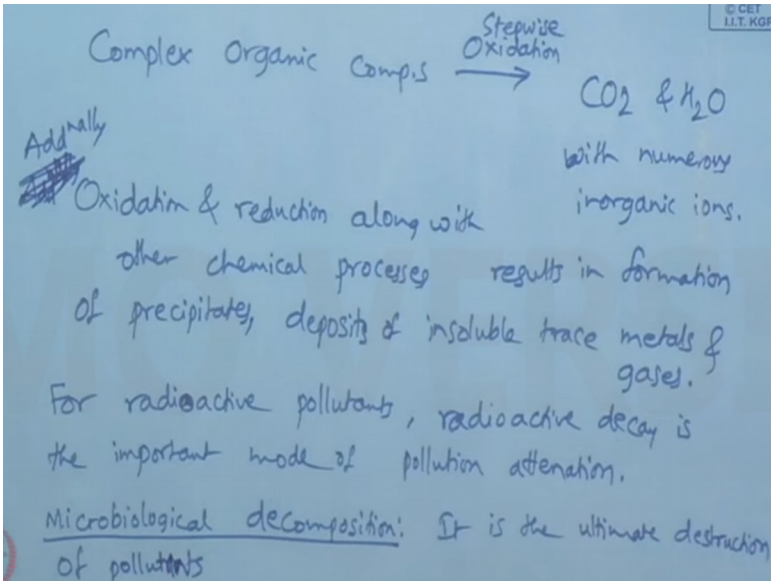

So here in this case this complex organic compounds. So they undergo oxidation that is the step wise oxidation and eventually they are ready they are get themselves converted to CO2 and H2O carbon dioxide and water along with numerous inorganic ions so this is a stepwise oxidation process and here .So this additionally oxidation so this is additionally oxidation and reduction.

It occurs along with other chemical processes results in formation of precipitates comma deposits of insoluble waste metals and gases so thereby this for radioactive pollutants so this radioactive decay is the important mode of pollution attenuation as we all know half life period means particular radioactive material it will decay thereby this volume will be reduced half.

So now let us go to the other that is mechanism of attenuation of pollution that is microbial force a microbiological decomposition so here basically so it is the ultimate destruct destruction of pollutants due to micro organisms.

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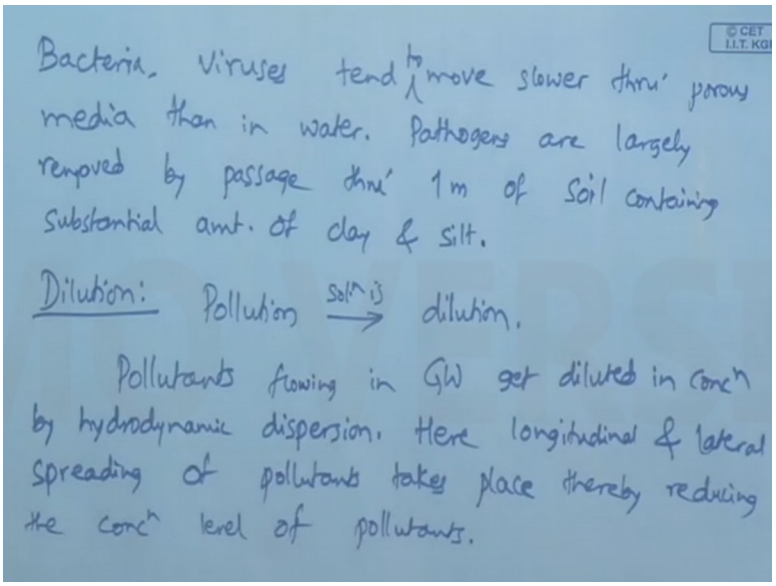

So here this bacteria comma viruses say they tend to move slower through porous media then in water so this pathogens are largely removed by passage through say one ,meter of soil containing substantial amount of clay and silt basically when this clay and silt so they are fine texture soil. So when they are present and so when this bacteria and virus they are made to pass through them.

So they are obviously so they are retained there and there by the pollution is reduced and we will know come to the last is one that is the dilution and we all know that pollutants and there is a very famous say that pollution solution is dilution that is a solution to pollution is dilution so in this case the pollutants which are flowing pollutants flowing in ground water get diluted concentration by hydrodynamic dispersion.

So here longitudinal and lateral spreading of pollutants takes place thereby thereby reducing the concentration level of pollutants so this is also very important mechanism of attenuation of pollution.

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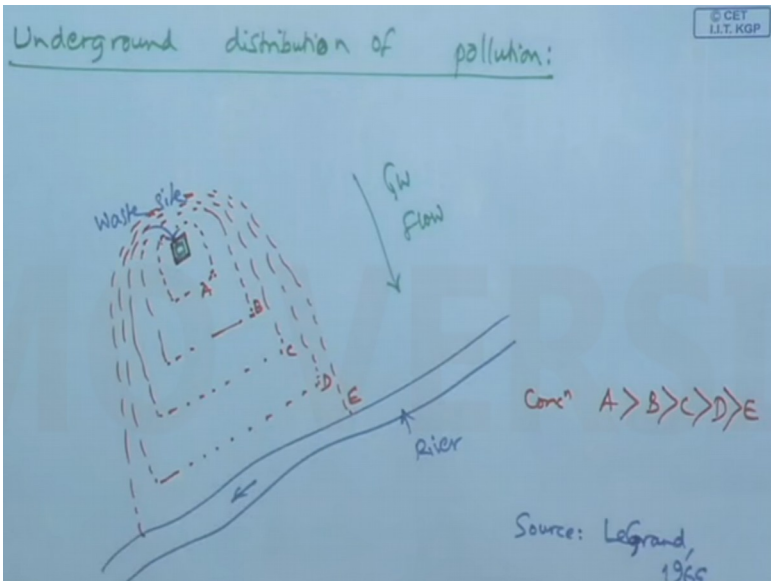

So now we will go to the last one of last topic to be covered in this lecture is the underground distribution of pollution so here suppose there is a waste site and let us say this is the waste site and then this is the direction of ground water flow direction then what happens is and of course let us say here there is a river. So this is a river in this case so the concentration you so this is A B this is C so this is D so this is E.

So here this is taken from the source so this figure is taken from the source legrand 1965. So here the concentration A is greater than B is greater than C is greater than D which is greater than E so whenever there is a waste site and in the vicinity of that so there is a there is a stream or a river and then there is a this general groundwater direction groundwater flow direction then obviously so the concentration decreases as we move away from the waist towards the river.

So but still even the decreased concentration itself is many times quite significant to cause this pull you the distribution of the underground distribution of the pollutant as well as eventually pollution of the water in the river or the stream.

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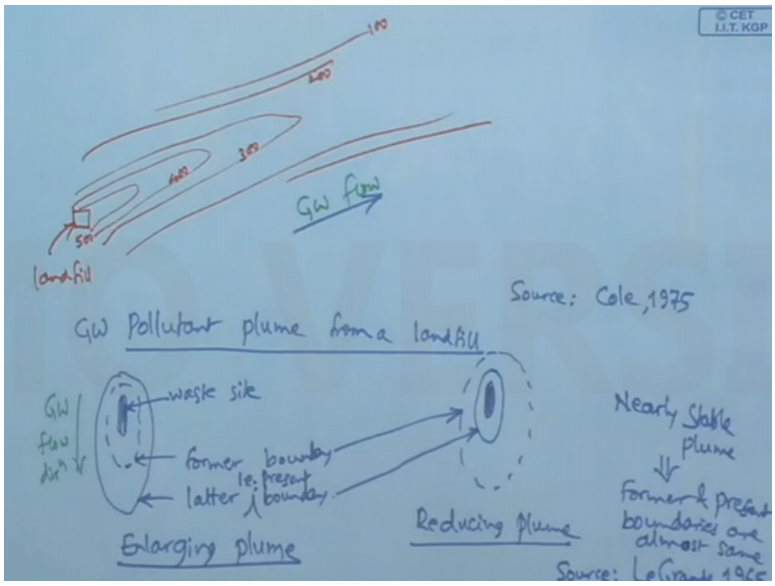

Similarly there have been other this one suppose there is a landfill so this is the say this is a landfill in this case so the concentration profiles which eliminate from this landfill. So they are gradually decrease as we move away from the landfill in this case. So this is taken from so this figure is taken from a so this is the pollutant plume from a landfill so this is taken from study by coal in 1975 in this case.

So this is the to the general ground water flow direction then in that direction. So they the pollutant tube will so this is the ground water pollutant blue similarly say here when there are is another so suppose this is the waste site this is a former boundary and then so this is the latter or say present boundary and this case. So this is the ground water flow direction. So this is the enlarging plume and for all this the source is the same study by like that in 1965.

Then so for a reducing plume if it is an enlarging plume then the area of this pollutant plume increases on the other hand if it is a reducing plume in this case suppose this is the waste side then they if the former boundary is this one and the present boundary so this is the present boundary and latter say that is present boundary so the present boundary will become shorter whereas the former boundary will become larger.

So this is a case of reducing and then so that can also be so also is nearly stable like that so that can be nearly stable bloom in which the former boundary as well as a present boundary is more or less the same so this in case nearly the stable bloom. So the former and the present boundary

are almost same so this is the source and of course a shrunken plume in that case. What happens is so it is a basically largely reducing plume.

Where in the present boundary of the plume is drastically reduced. So this is the regarding the groundwater pollution that is underground distribution of the groundwater pollution and in the next lecture we will move on to the ground water quality analysis thank you.