Urban Utilities Planning: Water Supply, Sanitation and Drainage
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Module - 03
Collection of water
Lecture - 15
Surface Water Intakes

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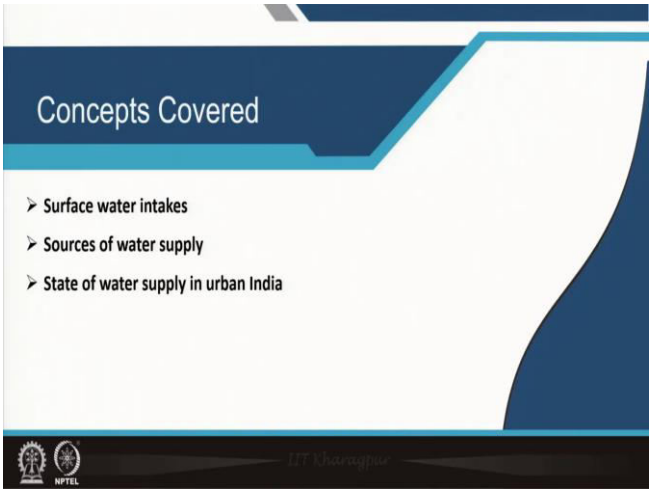

The different concepts that will be covered in this lecture~~s~~ are ~~on~~ surface water intakes, sources of water supply, and state of water supply in urban India.

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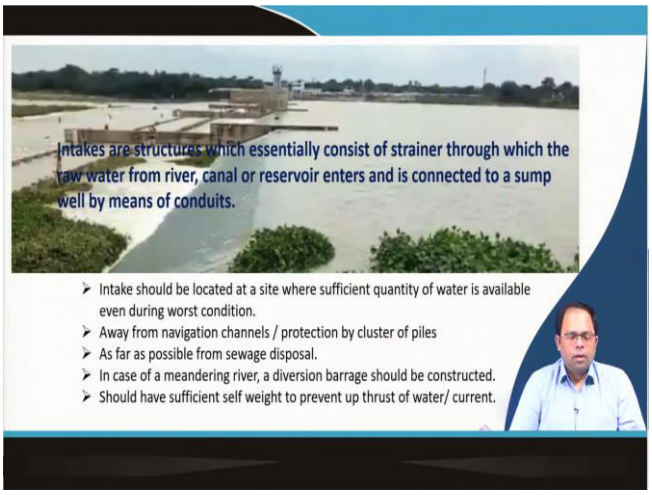

Intakes are structures ~~which~~ that essentially consist of a strainer (similar to a screen) through which the raw water from the river, canal or reservoir enters and is connected to a ~~sump,~~ sump well ~~by means of~~using conduits. ~~Strainer~~ The strainer prevents the entry of impurities or big sized particles. ~~–~~Sump stores the water before it is pumped into a treatment unit or for other purposes.

Design of the intakes should be done as per different engineering design principles. ~~Now, the actual location of these particular~~Location of intakes for a ~~particular~~ stream, river, or canal~~,~~ depends on ~~many~~ few technical criteria such as:

- ~~. But in from the planning perspective I would like to say that I~~intake should be located at a site where a sufficient quantity of water is available even during the worst condition.

~~So, at least the general area could be determined right. Then actual construction, design has to be done as per different engineering design principles.~~

- ~~But we have to find the most suitable location along a particular stream. So, it has to be located at a site where sufficient quantity of water is available even during the worst situation.~~ It should be away from navigation channels and should be protected by a cluster of piles: This does not become an issue for intakes built onto the dams. ~~.~~If it is~~-~~ put inside a ~~a, there are different kinds of intakes some~~

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~~intakes are built into the dams, some in that case this is not a issue. But some intakes are just put inside the~~ river or a big lake~~, then~~, it has to be protected~~.~~. ~~So, these are independent structures, and we have to protect them, and sometimes we use piles to protect them.~~

– As far as possible from the sewage disposal - B ~~b~~ecause ~~there are~~of ~~the presence~~ of– continuous urban areas along a particular river body, there may be disposals into the river at multiple locations.~~.~~ So, ~~there are disposals from different urban areas, we have to be make sure that~~ the intake location for a ~~particular~~ specific urban area ~~does not matches with the, or it is not near to a disposal of another urban area or from the same areas as well.~~should avoid ~~location~~sites of disposal.

- In the case of a meandering river, a diversion barrage should be constructed – ~~.~~ ~~So, in this particular image, you can see sort of a diversion barrage where some amount of prevention is there, so that water is stored. And why water is stored?~~ Diversion barrage stores water to be used during dry months or when water is ~~not~~ unavailable at some river sections. Dams can also be ~~constructed~~built for the same purpose.~~So, that you are able to get that water during their different seasons even when the river remained as along its course, at certain times of the year it is, the water is not available in certain sections. So, dam actually prevents that to happen.~~

~~– And also dam actually stores water when there is low water, then it actually ensures that there is some amount of water. So, it could be a dam or it could be as in this particular case in this particular image that you can see it is just a diversion barrage where could be also constructed.~~

- Should~~, this particular intake structure should also~~ have sufficient self-weight to prevent the up thrust of water or ~~current or~~ current.~~,~~ B~~b~~ecause of buoyancy, any structure that ~~you build~~is built inside the river channel ~~it would be~~may get lifted up. –This can be avoided with sufficient self-weight~~So, it should have certain weight, so that is not; that does not happen. So, this is water intake is~~.

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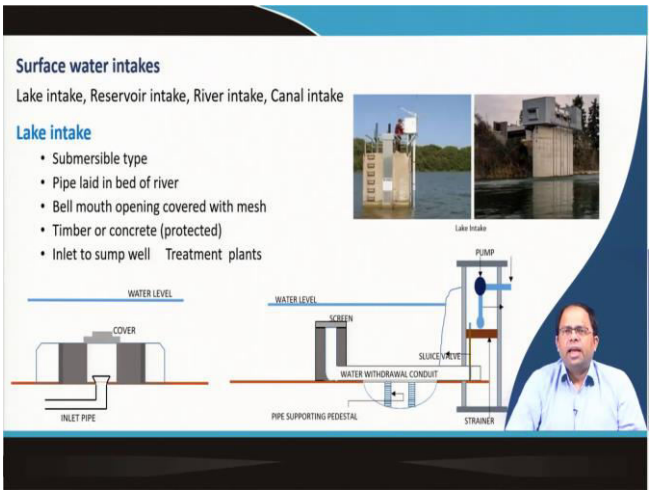

Surface water Intakes

The different kinds of surface water include~~s~~

Lake Intake

- Submersible type: this consist of a concrete structure under-water (refer to the above figure), mainly consisting of a cover with a screen and an inlet pipe.
- Inlet pipe is laid in the bed of the river and draws water from the lake.
- Bell-mouth opening is covered with mesh to prevent the entry of impurities.
- Timber or concrete (protected) shell protects the arrangement
- Water from the Inlet is ~~pumped to a sump well generally~~generally pumped to a sump well or a treatment plant directly when its height is less. Otherwise, the water is first pumped to the sump well from the lake initially followed by the pumping of water from the sump well to the treatment plant

~~And then there are different kinds of intakes. These are for surface water intakes, there are lake intakes, there are reservoir intakes, then there are river intakes, canal intakes and so on. So, in this particular image, you can see some structures which are like, these are sort of lake intakes or like over here you can see that this is the structure when there are certain equipment at the top and this is the you know concrete structure which is going below.~~

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~~Now, lake intakes are of different kinds like for example, you can have both the, like for in the drawing below, you can see that in this particular case this is a pipe which is drawing water from the lake – this one inlet pipe.~~

~~And this is just a structure which is below water level. It is a concrete, it is a submersible type structure. And it is and the pipe is of course laid in the bed of the river. And the pipe has got a bell mouth opening and it is covered with mesh to prevent a entry of impurities.~~

Water which is drawn through the inlet pipe is conveyed through pipes laid underground or over ground to the sump well located at the river bank where it can be stored. ~~And the surrounding is protected by a concrete or a timber shell and which actually you know it is a sort of a cap which protects this entry. And from here the pipe actually is takes a water to a sump well or to a directly to a treatment plant depending on the height of that particular treatment plant. So, usually it is taken to a sump well from there it is pumped to a treatment plant, and that is what is shown over here.~~

~~Like this is again you can see it like the same thing you can see from another direction. So, this is the section. So, this is the maybe the pipelines over here. And water enters through this particular screen. And once the water is transported, this is transported, this is underground.~~

This could be transported over the ground as well. ~~The entry of water is controlled by a sluice valve~~A sluice valve controls the entry of water. The figure given in the right bottom of the above figure shows a strainer~~, which is placed to restrict impurities and a pump which~~ placed to restrict impurities and a pump that lifts water from the level of the water withdrawal conduit.

Reservoir Intake~~And then this water is taken to a sump well which is at the bank of the river, this is the bank of the river. And there water enters and stored and from here we can obviously control the entry of water using a sluice valve. So, this is the sluice valve over here.~~

~~And this is the pump and this pump actually draws water from this particular level. And this is the strain, sorry this is the strainer that is this allows only you know the impurities it is not allowed to go up, and then the water level reaches somewhere around here~~

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because this is the water level in the river. And from here, the water is actually drawn by this particular pump, and then send to a treatment plant.

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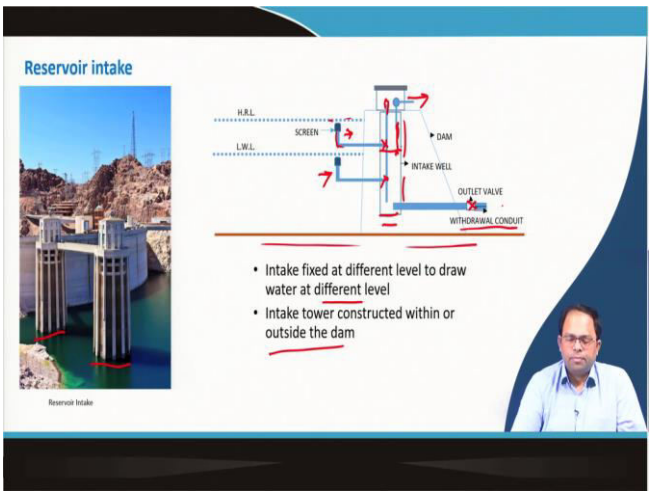

As shown in the above figure, RSo, this is the reservoir intakes are built inbuilt within the reservoir (image on the right) or are separately constructed as intake towers near the dam (image on the left). . So, there is a dam at the back, you can see. There are different kinds of reservoir intake, it could be either you know a separate structure or it could be a structure which is inbuilt inside the reservoir. Like in this particular image, you can see that the structure is inbuilt inside the reservoir.

Like this is the you know opening. This is the Iintake is which we, this is that has been fixed at different level to draw water from different water levels due to seasonal variation such as during summer, monsoons to draw water from different water levels due to seasonal variation during summer, monsoon,designed etc. Intakes consist of a screen, and . pipelines connect the intakes to the sump well from where the stored water is conveyed to the treatment unit. And there are this kind of you know pipelines which allow entry of water. And there are different of this entry points intakes you know, this is these are this particular entry lines are at different levels. Valves can be used to

For example; to ensure that during summer, water enters from this level; during other seasons sorry summer water enters from this level; during rainy season maybe water enters from this level. So, there is this screen and this this allows water to get inside. And

~~then this could be actually, then this could be these are valves; you can use valves to~~ control the entry of water. ~~And once the water is stored either then we can use a pump, then this is the level, this is the pump over here.~~Pumps

~~And this pump can actually~~ draw ~~-~~water from the ~~this particular~~ sump well for storage to the treatment unit.~~,~~ For cleaning of the sump well at certain intervals, a withdrawal conduit and ~~land~~ an outlet valve is employed.

~~from where water is actually stored. And then the using this pump, the water would be transported to a treatment unit. And for cleaning of this particular sump well for at certain intervals, we have a withdrawal conduit like over here. This is the outlet valve using this we can also clean this particular well as well.~~

~~So, this is how reservoir is, intake is designed. So, intake tower constructed within the reservoir in this particular case.~~

~~And it could be also outside the reservoir as you can see this image it is outside the reservoir the intake towers, and intakes points this kind are fixed at different levels to draw water at different levels during different you know this is low water level, high you know this high river level. So, this is the high water line. So, from here we so at different season, we will use different intakes to draw water.~~

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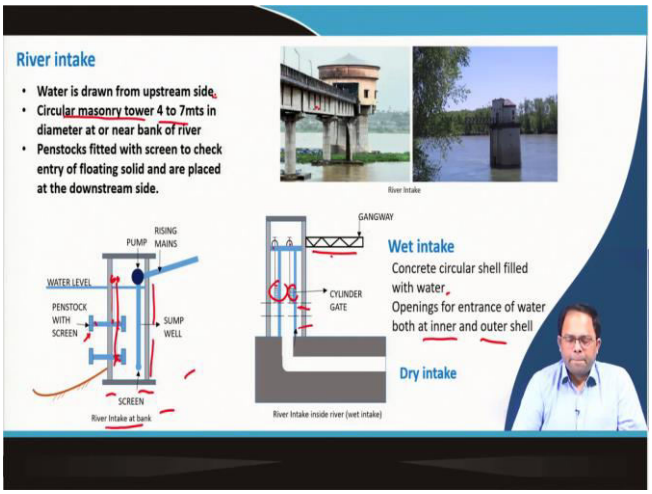

River Intake

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~~Then this is the river intake, you can see the images as well. So, this is the river. This is the river intake which is constructed and from there, we can actually pump the water out. And so, this river intake over here, so this R~~river intake ~~is at the bank roughly at the bank,~~can be located at the river bank premises. These are usually circular masonry towers of 4 to 7 meters in diameter at or near the bank of the river. A gangway connects to reach the river intake structure when it is ~~a~~ located within the waterbody (to ensure water availability). The structure has a control chamber ~~which~~that allows to control the entry of the water. Sluice valves regulate the entry of the water. In the image of the River intake at the bank shown in the above figure, penstocks with a screen can be observed, which is the intake. The screens check the entry of floating solid and are placed at the downstream side. Valves regulate the entry of water into specific penstocks. Water is generally drawn from the upstream side because the downstream sides may have sewage disposal locations ie, the direct water coming into the structure is not drawn in instead, water from the opposite side the water is drawn.

Wet Intake ~~it could be just at the bank, or it could be a little bit inside.~~

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~~Like if it is little bit inside, then there is a gangway over here, like you can see over in this image. There is a gangway that means you can walk into this particular chamber from where you can control the entry of water. So, these are the slice valves which allow entry of water.~~

~~So, in this particular case, we are using one chamber, this in the first case this is one chamber. And these are the intakes the penstocks. These are, this allows entry of water from below in most cases and these are also fitted with screens, and then there are these valves which allow entry of water into this particular penstocks. And water is drawn from upstream side in this particular rivers, it is usually drawn from the upstream side.~~

~~And why so that we prevent in the downstream, usually we find all the sewage disposal point. So, it is basically better to take the water from the upstream side. And these are usually circular masonry towers of 4 to 7 meters in diameter at or near the bank of the river.~~

~~So, either they are at the bank of the river as you can see in this image, or they could be near the bank of the river just a little bit inside. It is to ensure that at this intake always~~

~~gets water. So, penstocks, these are the penstocks fitted with screens to check entry of floating solid and are placed at the downstream side.~~

~~So, it is usually on the back side, that means, water these are fitted in a such away, so that the direct water coming into this particular structure this is not getting in. It is coming from the opposite side the water is getting inside.~~

~~So, in addition to this kind of river intakes, we also have got other structures like these are this is the weight intake where we have got two cylinders.~~It consists of a concrete shell filled with water and has openings for allowing water to enter both at inner and outer shell or cylinders. Water from the river gets inside the outer cylinder and from which the entry of clean water to the inner cylinder can be controlled using sluice valves. ~~And for the outer cylinder is basically the one from where the water enters, and then we can control the entry of water from there.~~

Water from the inner cylinder is then transported.

~~And then the inner cylinder we can allow once the clean water is there, we would allow the using the slice valves, we can enter allow water to enter into the inner cylinder, and from there the water is transported. So and concrete circular shell filled with water. And openings for so this is the circular shell which is filled with water, and openings for entrance of water both at inner and outer shell.~~

~~So, this is the sort of intake which we usually see in, again the~~ Ddesign of ~~this~~ intakes ~~are again there are~~follow different manuals or ~~different~~ engineering designs ~~for each of this different kind of intakes,~~based on the kind.

Dry Intake

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Canal Intake

~~_so that is beyond the purview of this particular course. So, that is, but what we will know that these are the different kind of structures, and these are the locations of those, these kind of intake points are there, so that we can draw surface water for treatment.~~

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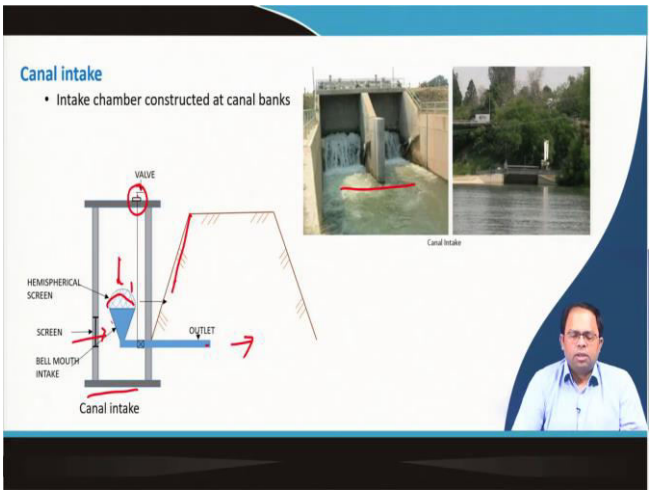

~~So, similarly we have got canal intakes.~~ In many cases, ~~we do not draw a water directly from the river. We first draw water inside~~water is drawn into the canals instead of drawing it directly from the river. ~~canals.~~ The canals bring the water to a point from where the water is drawn through ~~these~~ canal intakes, and then taken to treatment plants. In some types, ~~And sometimes this kind of you know~~ gates ~~could be possible through which~~allow the water from the river ~~gets into the canals, and then there are a different canal intakes as well.~~to get into the canal as shown in the above figure. In the image given at the left bottom of the figure, it can be seen that the bell mouth intake with the screen is present inside structure. This could be

~~And so over here you can see this is the bank of the canal – this one. And we can fit a structure like this where we have a chamber, and then we have this you know inlet structure which could be~~ controlled by a valve. Water after entering the ~~And this is the again, this is the bell mouth with covered with screen.~~

~~And water enters into this particular structure, and then gets through the~~ bell mouth ~~, and then it~~ is then transported to ~~the~~ the treatment plant. ~~. So, these are simple structures that are used for taking drawing water from surface waters, surface sources.~~

Sources of water supply in urban areas

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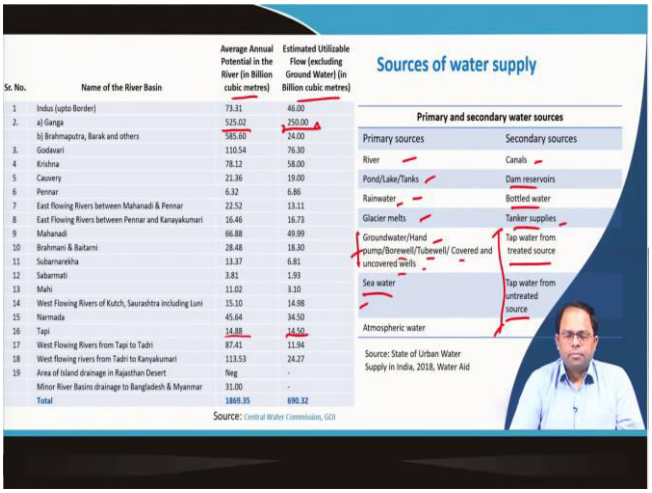

Sr. No.	Name of the River Basin	Average Annual Potential in the River (in Billion cubic metres)	Estimated Utilizable Flow (excluding Ground Water) (in Billion cubic metres)
1	Indus (upto Border)	73.31	46.00
2.	a) Ganga	525.02	250.00
	b) Brahmaputra, Barak and others	585.60	24.00
3.	Godavari	110.54	76.30
4	Krishna	78.12	58.00
5	Cauvery	21.36	19.00
6	Pennar	6.32	6.86
7	East flowing Rivers between Mahanadi & Pennar	22.52	13.11
8	East Flowing Rivers between Pennar and Kanyakumari	16.46	16.73
9	Mahanadi	66.88	49.99
10	Brahmani & Baitarni	28.48	18.30
11	Subarnarekha	13.37	6.81
12	Sabarmati	3.81	1.93
13	Mahi	11.02	3.10
14	West Flowing Rivers of Kutch, Saurashtra including Luni	15.10	14.98
15	Narmada	45.64	34.50
16	Tapi	14.88	14.50
17	West Flowing Rivers from Tapi to Tadri	87.41	11.94
18	West flowing rivers from Tadri to Kanyakumari	113.53	24.27
19	Area of Island drainage in Rajasthan Desert	Neg	-
	Minor River Basins drainage to Bangladesh & Myanmar	31.00	-
	Total	1869.35	690.32

Source: Central Water Commission, GOI

Sources of water supply can be ~~Now, looking at the different sources of water supply in urban areas, there are both~~ primary ~~and~~ or secondary sources. ~~P~~, ~~for example, p~~rimary sources ~~are~~ constitutes rivers, ponds, lakes ~~and~~ or tanks, ~~it could be~~ rain-water, ~~it could be~~ glacier melts, ~~and it could be also~~ ground-water (drawn by— hand pumps, bore well, tube wells, covered and uncovered wells.), sea water or atmospheric water.

~~So, these are the different kind of surface water sources that are used in urban areas surface as well as ground water sources, and it could be also seawater.~~

In places such as ~~So, sometimes like places like in, the in some~~ Singapore, ~~or places where like in~~ UAE etc., seawater is desalined and used.~~,~~ Rainwater can be used after storage and treatment~~we have seen that they utilize lot of sea water, they actually remove the salt and then they can actually use it. So, ground water, sea water as well as you know direct rain water. And of course, rain water is not used directly, but after storing it, and then after some treatment we can use it. And or for different of the streams like rivers and then for ponds and lakes, we can actually use this water.~~

~~What are the~~ Ssecondary sources of water consists of ~~in urban areas? c~~Canals, ~~because river is the natural one, canal is artificial which we construct. And then~~ dams along the rivers, bottled water, tanker supplies, ~~certain areas are supplied by with tankers where~~

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there is not adequate water, then taps from tap water from treated sources, and tap water from untreated sources. The table given in the above figure details the average annual potential in the river (in billion cubic metres) and the estimated utilizable flow excluding ground water (in billion cubic metres) of the different river basins of India such as the

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So, these are the different sources of water that we actually use in urban areas. And these are the second resources. So, these are direct sources, and these are secondary sources from where residents get their water.

Now, looking into the different river basins, this gives you an idea about the different river basins in India, starting from Indus, then we have got Ganges, and Brahmaputra, then we have Godavari, Krishna, Cauvery, Pennar etc.. And on this side, you can see the average annual potential in the river in terms of amount of water that is available in billion cubic meters. For example – From the

And then out of this, how much water it can be utilized excluding the ground water part that comes into the river that also given in billion cubic meters. And we can see that this is the amount of water for example, you take Ganges river basin, 525 billion cubic meters of water is available, out of that we can actually utilize only 250 billion cubic meters is utilized; In case of.

And then, from then another take another example like for example, the Tapi river, around you know most of the water is available for use. So, this is how we can actually determine the different surface water sources and the other sources that are there in an urban area.

So, So, once we know the intake points for the different rivers, we can, we for each river we can set up intake points can be set up understanding such details and based on the need of course. ,F like for the example, there is anfor an urban area, the sources has to be first identified such as we will first we will pdetermine what are the nearby sources, is it a pond, is it a lake, or it could be a combination of a river, a pond, a lake, and so on. etc., then, the intake points can be decided.

And then we can determine where we should put on the intake points. And as you can see we have shown you the different kind of intakes both ground water intakes as well as surface water intakes, ground water intakes could be like tube wells and all.

~~So, we have to determine on a mix of these sources for an urban area. So, not all water is available from, you know it maybe I am in a river where very little amount of water is available. So, I have to depend on other sources as well.~~ So, design has to ~~we have to design~~ consider a mix of all the~~se~~ different sources for an urban area because utilisation from just one water source may not be sufficient.~~.~~

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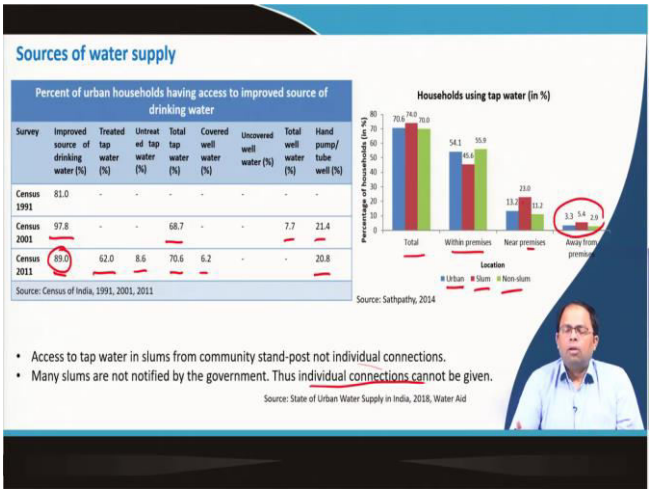

Percent of urban households having access to an improved source of drinking water based on census data (1991, 2001, 2011) is given in the table in the above figure. The definition keeps changing ~~To see the status of water supply in urban areas, we have discussed this to some extent also and where we see that as per census 1991, 2001 and 2011 what we see is like improved sources of drinking water this is, there are different ways how you define improved sources like in 2001 the definition was different from 2011 that is why you see a difference in the values.~~and that sometimes ~~becomes the~~lead to change in values. Improved source constitutes of ~~But roughly what we see there is water from~~ tap water, ~~there is water from~~ well water, ~~and then there is~~ hand pumps and tube well. ~~So, this is the you know the other part.~~I

~~So, i~~n ~~senses~~ census 2011, ~~you can see~~the percentage contributed by hand pump or tube wells is around 20.8 percent,~~-~~ while it was 6.2 %~~and~~ covered well, 70.6 % of ~~around 6.2 percent; and~~ total tap wate~~r~~r (~~was 70.6 percent,~~ out of that 8.6 percent was not treated and 62 percent was treated).~~-~~ So, the total improved source was estimated to be around 89 percent ~~right~~. ~~So, this is for drinking water for in case of India.~~

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It should also be noted that even ~~Then within that,~~ within the same urban areas, ~~also~~ there ~~are also~~could be difference in the~~of~~ access to water. ~~And as we can see that in urban areas, there are S~~slums ~~and then~~ and ~~there are non slum~~non-slum ~~areas~~ regions are present in urban areas~~.~~. T ~~So, definitely we can see that t~~he percentage of houses using tap water ~~in slums is sometimes over here within~~available *~~within~~ premises* is 45.6 percent for the slum dwellers, and 55.9 percent for non-slum dwellers. It is~~this is the total water that is being used.~~ 23 percent of slum dwellers, and 11.2 percent of non-slum dwellers when availability in near premises is considered. Thus, access to water is also not uniform all throughout. So, people living in the slums generally obtain water from stand post. Since many slums are not notified by the government and thus, individual connections cannot be given. So, these are some of the challenges in urban areas which has to be considered when supply of water to a particular urban area is studied.

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~~And then in within premises we can see that around 50, 45.6 percent of the slum dwellers, and 55.9 percent of non-slum dwellers have tap within their premises. And near premises 23 percent of slum dwellers, and 11.2 percent of non-slum dwellers use water from near premises. And from away from their premises, we can also see these percentages.~~

~~So, access to water is also not uniform all throughout. So, most access to slums are from stand post, and individual connections. And many slums are not notified by the government. Thus, individual connections cannot be given to this particular slums. So, these are some of the challenges that are there in urban areas which we need to work on when we determine supply of water to a particular urban area.~~

~~So, first we determine what sort of intakes are there. And then from there of course we will do treatment, we will do the distribution network which we will be taken care of in other lectures, but we need to determine what could be the sources. But if it is ground water sources it could be also you know every some real estate projects, or some buildings could have ground water sources even inside their premises as well.~~

~~Otherwise, we can also as you can see from this particular figures, we have got this is the status currently in India and we are try and T~~the current government is also working on schemes to provide tap water access to all families in all households in the entire urban areas.

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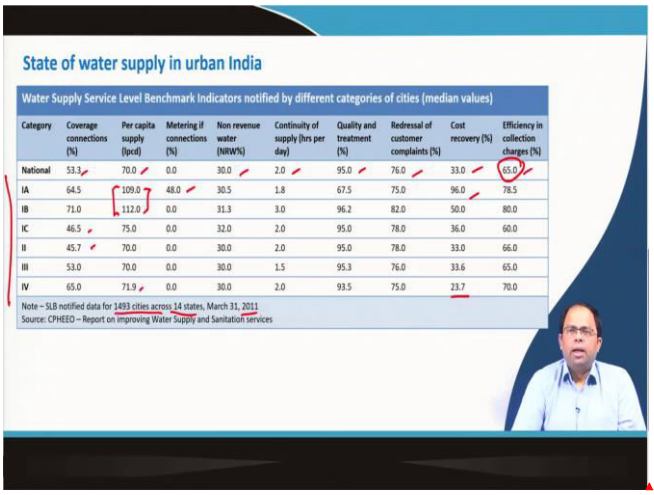

State of water supply in urban India

Water Supply Service Level Benchmark Indicators notified by different categories of cities (median values) is given in the above figure based on 2011 study. In case the National level scenario, ~~So, state of so then looking into the different service level benchmarks, and this is the data this is the study from 2011, it was found that for different categories of cities class this is 1 A, 1B, 1C, then II, III and IV, these are the different categories of cities, we can see that this connect, this~~ percentage of connections in urban areas ~~we is~~can ~~see that average national is~~ around 53.3 percent, per~~.~~

~~Whereas per~~ capita~~l~~ ~~LPCD~~ supply is obtained as ~~is~~ 70 lpcd, ~~d. m~~Metering is noted as almost negligible,~~.~~ n~~N~~on-revenue water or unaccounted water ~~is around~~accounts to 30 percent, ~~that means this is unaccounted water; that means, this water is either getting lost or stolen. And~~ continuity ~~around averaged hours per day suppliesof supply is around~~ observed around 2 hours per day,~~.~~ and the

~~The~~ quality and treatment is ~~around~~ 95 percent. It is given that ~~of the water is actually treated. And customer complaint, around~~ 76 percent of the customer complaints are redressed and ~~.~~ 33 percent of the cost is recovered~~, and efficiency in collect 65 percent of the build water is being you know you can collect charges for those. So, this is the efficiency of collecting of charges.~~. These

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So, you can see that this percentagespPercentages vary in the different classes of categories of cities. And this vary significantly for example, the range starts from around per capita supply, it starts from around 110, 12, or this you know these are more or less say similar categories. And then it ranges to at least 70 litres per capita. So, there is wide difference .

Similarly, coverage in connections roughly some cities some category of cities it was observed to be around 46 percent, 45 percent which is pretty low. And similarly for metered connections in major cities, we have got around some cities have shown around lot of percentage has been covered through meter connection, but in many cities, it is not there.

Conclusion

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Quality of treatment more or less similar, redressal of customer complaints similar, cost recovery you can see that the lower the category of the city is the cost recovery is even less. So, in some higher order cities, we have got full cost recovery; in other cities we do not have. Now, similarly efficiency varies from around 60 to 70 percent.

Now, this data is based on 1493 cities across 14 states. So, it is not the national average of all cities. So, it is average of certain cities. And this is data is also for 2011, but this is to give you an idea about what are the different parameters and what is the status of water supply in urban India.

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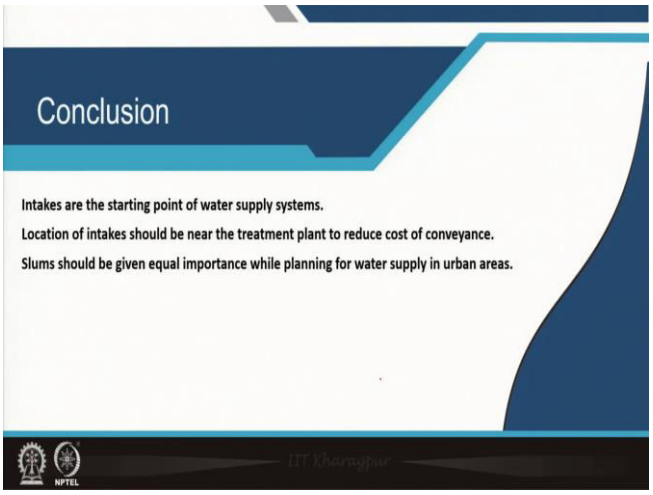

So, ~~to conclude~~ intakes are the starting point of water supply systems. T~~So, t~~his is ~~what we have to we~~where one has ~~have~~ to determine the locations or suitable locations for setting up the intakes. Also, l~~nd l~~ocation of intake can ~~should~~ be near to the treatment plant to reduce cost of conveyance ~~as much as possible, but it is not always possible~~. ~~Sometimes the treatment plant is far away from the intake point.~~ And slums should be given equal importance while planning for water supply in urban areas.

~~Because poor people are the most vulnerable and because we are not providing water supply either because of legal reasons or because of technical reasons directly into the you know tap connections into the streams. So, tap connection into these particular slums in this particular, so that has to be actually that leads to lot of coping charges for the slum dwellers. So, this has to be taken care of.~~

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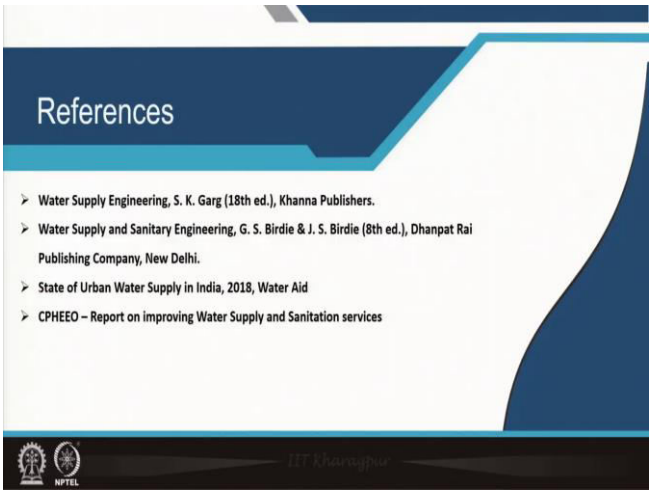

~~So, these are the references that you can study.~~

~~Thank you.~~

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