



Module 10 – (L38 – L40):
“Water Conservation & Recycling”:
Water Conservation, Perspective on recycle and reuse, Waste water reclamation .

WATERSHED MANAGEMENT

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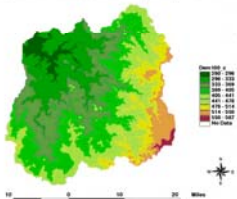
Department of Civil Engineering,
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Lecture No- **40** **Water Reclamation & Reuse**

L40— Water Reclamation & Reuse

- **Topics Covered**
- Reclaimed water, Reclamation processes, Reuse of water
- **Keywords:** Water reclamation, water reuse

Digital Elevation Model Anas river watershed (Jhabsa), India



Introduction – Reclaimed Water

- **Reclaimed water or recycled water** - former wastewater - treated to remove solids & certain impurities, & used in sustainable landscaping irrigation or to recharge groundwater aquifers.
- **Purpose** - sustainability & water conservation, rather than discharging treated water to surface waters such as rivers & oceans.
- **Reclaimed water** - “End product of wastewater reclamation - meets water quality requirements for biodegradable materials, suspended matter & pathogens - uses such as agriculture & sundry industry uses.

Introduction – Reclaimed Water

- For maximum water reuse/reclamation/recovery strategies such as water pinch analysis (WPA - systematic technique for reducing water consumption & wastewater generation through integration of water-using activities or processes) - it help a user to target the minimum freshwater consumption & wastewater target. It also helps in designing the network that achieves the target.
- Cost of reclaimed water exceeds that of potable water in many regions of the world
- Using reclaimed water for non-potable uses saves potable water for drinking
- Usage of water reclamation decreases the pollution sent to sensitive environments

Reclaimed Water - Concerns

- **Reclaimed water** - highly engineered for safety & reliability so that the quality of reclaimed water is more predictable than many existing surface & groundwater sources.
- Reclaimed water - safe when appropriately used.
- **Reclaimed water** planned for use in recharging aquifers or augmenting surface water receives adequate & reliable treatment before mixing with natural water & undergoing natural restoration processes.
- **Some of this water eventually becomes** part of drinking water supplies.
- **Reclaimed water** is often distributed with a dual piping network that keeps reclaimed water pipes completely separate from potable water pipes.

Reclamation Processes

- **Preliminary treatment** – Bar screen- solids removal
- **Primary Treatment - Settling Tanks** - Readily settable and floatable solids are removed from the wastewater
- **Biological Treatment** - uses microorganisms- bacteria which digest the sludge and reduce the nutrient content
- **Secondary Treatment - Settling Tanks** - microorganisms to settle to the bottom- other small particles suspended in the water are picked up, leaving behind clear wastewater.
- **Tertiary Treatment** - Deep-bed, single-media, gravity sand filters receive water from the secondary basins and filter out the remaining solids.
- **Disinfection - Chlorine Contact Tanks**

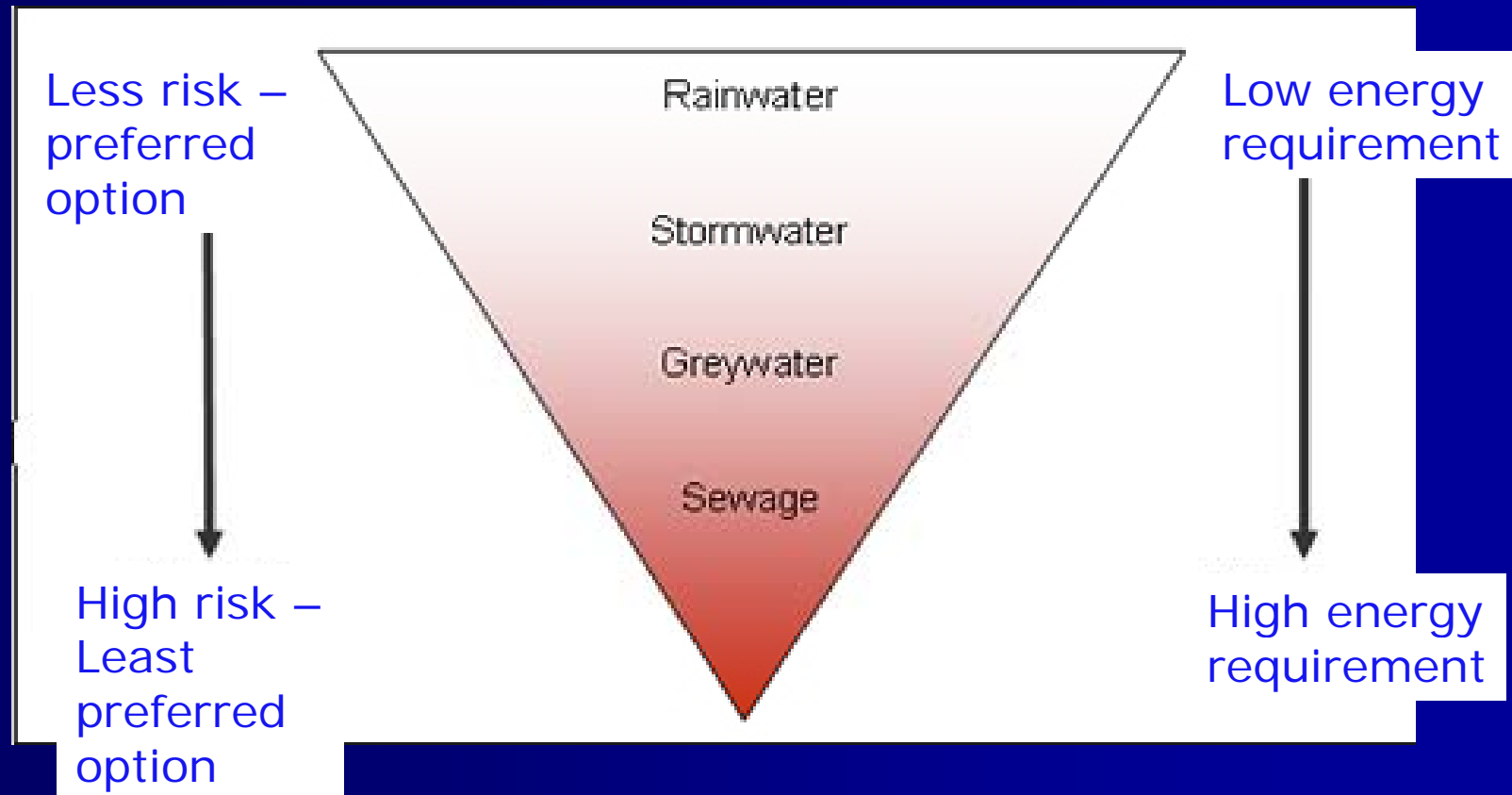
Concept of Reuse of Water

- **Reuse** is most applicable – where large volumes of water are reused & wastes are not too contaminated
- Location of treatment plant and possible transport of renovated water – **Important considerations**
- **Treatment Processes** – Efficient and economical when flow is steady
- Generally in urban areas – Irregular flow
- **Wastewater Reclamation**: Treatment or processing waste water to make it reusable
- **Water Reuse**: Use of treated wastewater for beneficial use

Concept of Reuse of Water

- **Direct wastewater reuse:** requires pipes or other conveyance facilities for delivering reclaimed water
- **Indirect use:** Discharge of an effluent to receiving water for assimilation and withdrawals downstream
- **Pulp & Paper Industry-** Water reuse -Predominantly practiced
- **Domestic reuse:** Best recycle opportunity but amount of water recycled falls short of the total amount of water reused
- **Warm dry areas** – Suitable for domestic reuse where there is a large difference between supplied water and waste water due to losses

Concept of Reuse of Water



<http://www.epa.vic.gov.au/water/reuse/default.asp>

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Reuse of Water

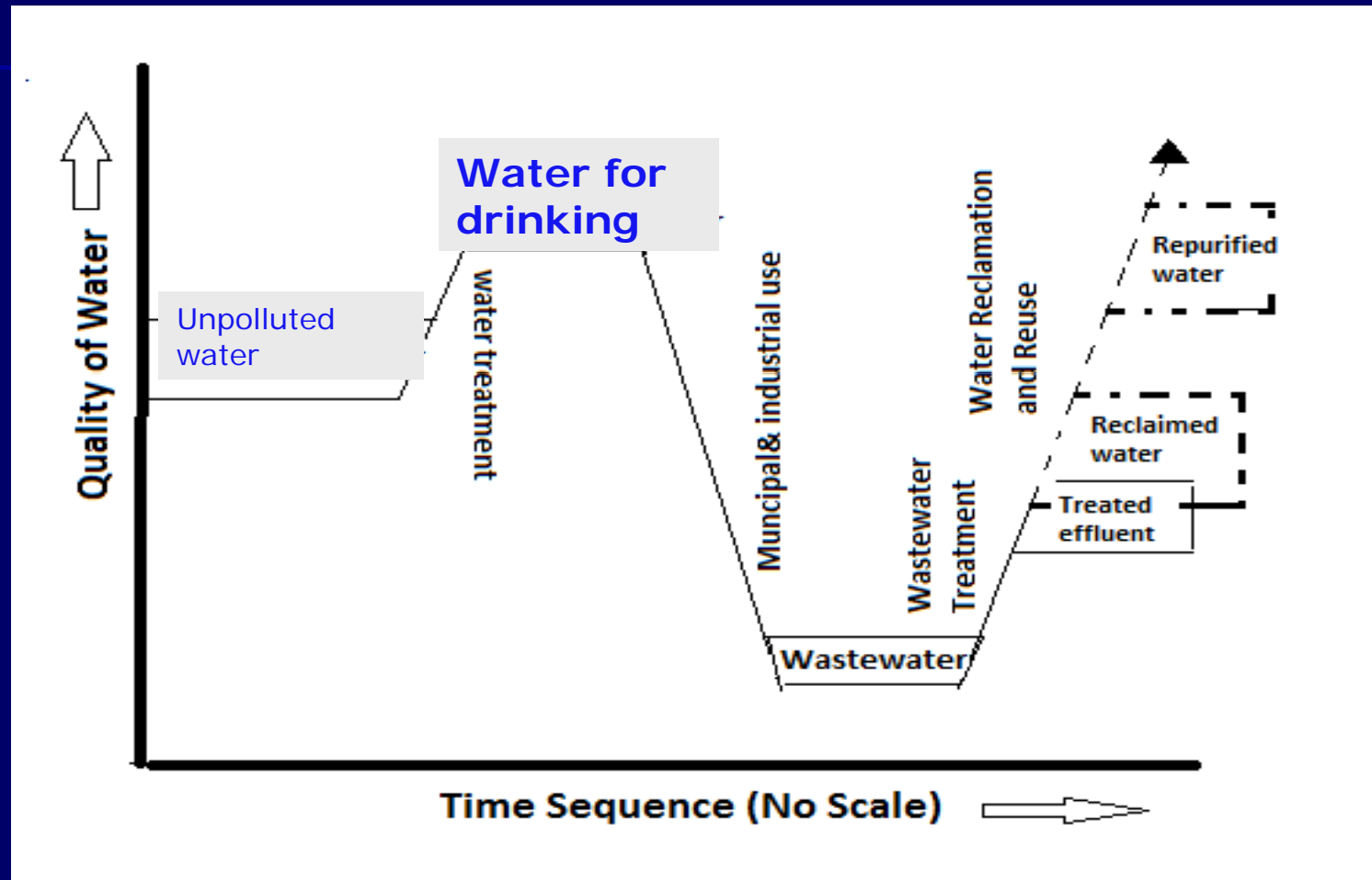


Fig: Quality changes during municipal use of water & concept of wastewater reclamation & reuse (Mc Gauhey, 2006)

Water Reclamation & Reuse

- Water treatment for drinking water – meets standards for drinking water
- Municipal & industrial uses degrade the water quality
- **Wastewater treatment:** Treatment is carried out to the point required by regulatory agencies for protection of other beneficial uses
- Dashed line in figure represents increased quality for reuse
- **Concept of reclamation and reuse** will come after wastewater reaches the natural unpolluted water

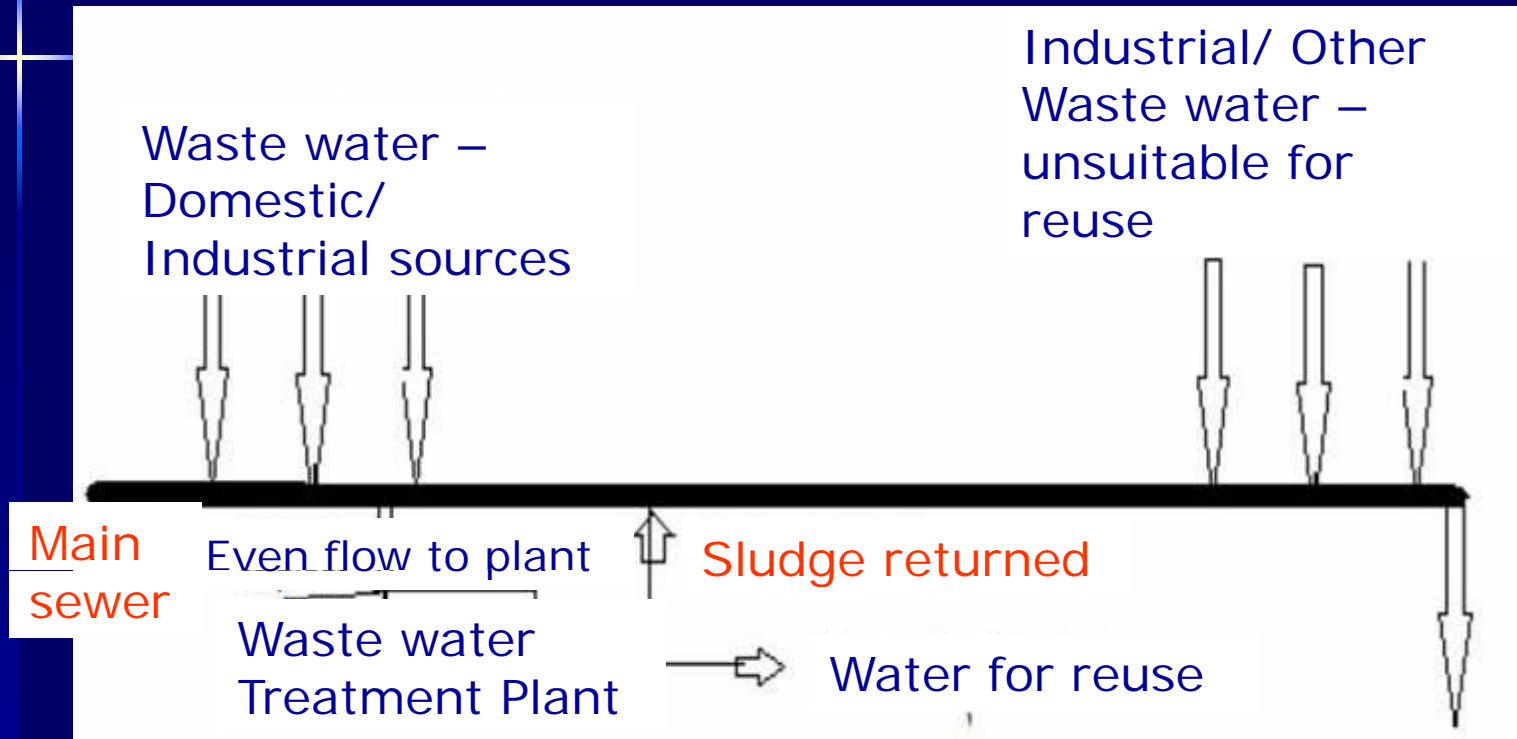
Water Reclamation & Reuse

- **Repurified Water:**
- Generated by further advanced wastewater reclamation technologies
- Carbon adsorption, Advanced oxidation & reverse osmosis
- Generate much higher quality than conventional drinking water
- Character of wastewater entering in renovated plant – Important and especially industrial waste water
- EX: Ordinary salt brines, undesirable for if the renovated to be demineralized

Water Reuse Schemes

- Reuse from various sources – Rainwater, Drainage systems, sewer systems etc.
- Scheme depends on intended reuse
- Reuse of waste water
- Source of wastewater
- Survey of the sewer system- for finding wastewater availability for reuse
- Highly contaminated with metals or containing a high total concentration of dissolved solids- unacceptable
- Deliberate use of treated waste water in planned way is important

Water Reuse Schemes



- Scheme for Reuse from various sources.

Water Reuse – Schemes

- **Unplanned** - cities draw water supplies from rivers that receive wastewater u/s. Water from these rivers -reused, treated, & piped into the water supply a number of times before the last d/s user withdraws the water.
- **Planned** - developed with the goal of beneficially reusing a recycled water supply.
- **The water reuse may be for**
 - **Agricultural purposes**- for agricultural reuse- preliminary, primary and secondary treatment steps - fit for discharge to the environment.
 - **Industrial or domestic purposes**- may be tertiary treatment required to remove the more residual pollutants, especially the dissolved and refractory substances & micro-organisms depending on the use contemplated.

Types of Wastewater Reuse

- Reuse of urban wastewater in agriculture and horticulture from sewerage areas.
- Reuse of urban wastewater from polluted nallahs draining unsewered areas.
- Reuse in industrial and commercial establishments to meet the water shortage.
- Reuse in industry to meet various other objectives besides relief from water shortage such as 'zero discharge'.
- Reuse for major urban & community development purposes; eg. to augment public water supplies.

Reuse in Industries

Typical strategy followed by most of the industries is as follows:

- Firstly, practice as much conservation of water as possible.
- Secondly, recycle the fraction of waste water which is in relatively good condition & can be recycled back with little or no treatment.
- Thirdly, arrange more 'reuse' after some treatment to make the industry's own wastewater fit for reuse.
- Lastly, if more reuse is needed, get the external sources of wastewater, such as municipal sewage.

Water Reuse in India – Example 1

Madras Refineries & Madras Fertilizers Ltd., Chennai:

- Madras Refineries is producing 12 Mld of reusable water and Madras Fertilizer is producing 16 Mld of reusable water since 1991.
- Here the Chennai Metro Water Board supplies secondary treated sewage (with about 120 mg/L BOD) and the Industries provide the further required treatment depending on their end-use.

Secondary Treated Wastewater -> Additional Secondary Biological Treatment -> Chemically Aided Settling + Pressure Filtration + Ammonia Stripping, Carbonation, Clarification, Pressure Filtration-> Chlorination -> Sodium Bisulfite Dosing -> Multimedia Filtration -> Cartridge Filtration -> Reverse Osmosis -> Permeate for Reuse in Industry.

Water Reuse in India – Example 2

Vadodara Pilot Plant, Gujarat:

- This plant uses highly polluted wastewater from a “effluent disposal channel” into which several industries (such as refineries, fertilizers, petrochemicals) discharge their raw wastes with a capacity of 3 Mld freshwater.
- The plant shows that at least 75% of wastewater could be made reusable at an operating cost of Rs. 36/ 1000 litres. The flow sheet adopted in the plant include:

Wastewater -> Chem-feeds (Lime, Polyelec, Soda Ash) -> Clarification-> HCl -> Pressure Filtration -> Sodium Biosulfite -> Cartridge Filters -> Reverse Osmosis -> Degasser to Remove CO2 -> for Reuse in Industry

Future of Water Reuse

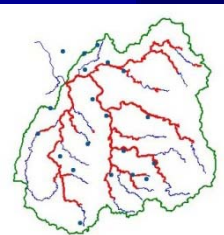
- **Due to water scarcity** - Water reuse increasing
- **Reuse** – through recycling/ reclamation found to be effective and successful.
- **Primarily - Nonpotable reuse** - widely accepted practice that will continue to grow.
- **More advances technologies in recycling/ reclamation**
- Indirect potable reuse.
- **More energy efficient**
- Sustainable water management/ watershed management
- **Public participation & awareness important.**

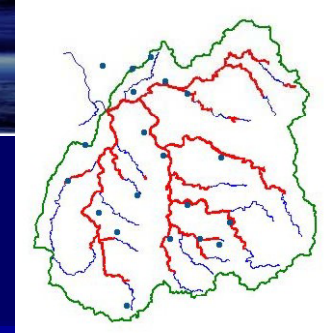
References

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- CSE (2005), "A Wastewater Recycling Manual", CSE Publications, New Delhi.
- Valentina Lazarova and Akica Bahri, (2004), "Water Reuse for Irrigation", CRC Press, London.
- P.H. McGauhey "Man Made Contamination Hazards", J. Groundwater, July 2006.
- <http://wrmin.nic.in>
- www.epa.gov
- <http://waterrecycling.com/>

Tutorials - Question!?.

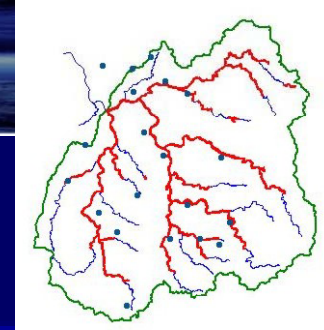
- Critically analyze and study the scope of water reuse in India.
- Do the urban water scarcity can be reduced by reuse of water?.
- Study and compare various case studies available on reuse and evaluate the benefits/costs.
- (Ref: Arceivala, S.J., and Asolekar, S.R., (2007), "Wastewater Treatment for Pollution Control and Reuse", Tata-McGraw-Hill, New Delhi.)





Self Evaluation - Questions!.

- Describe the importance of reuse of recycled/ reclaimed water.
- What are the important reclamation processes?
- Illustrate the "water reuse schemes".
- Discuss various issues related to "Water reuse" in Industries.



Assignment- Questions?.

- What are the main concerns about the reclaimed water?.
- Illustrate the concept of “reuse” of water.
- Describe the types of “waste water reuse”.
- Which are the places where reuse is possible?.

WATERSHED MANAGEMENT

Summary– Course on “Watershed Management”

- Introduce “Watershed Management” & establish its relevance & concepts.
- Present the fundamental principles, Theories, Modeling, Analyses & applications
- Demonstrate how these are used in the field of “Watershed Management”.
- Discussed various aspects of watershed & its management – Integrated Watershed Management Approach.
- Consists of 40 lectures presenting the concepts, theory, applications & case studies

WATERSHED MANAGEMENT

Summary – Course on “Watershed Management”

- **Course** - discussed various aspects of watershed development and management.
- **Watershed resources** – Land, water, Forests, Agriculture, Flora & Fauna.
- **Watershed Management**: technological, social, ecological, environmental, sustainable issues.
- **Course Focus** - technical aspects of WM; perspectives on land & water management; analyze complex issues in water management and on specific knowledge on issues of WM; **Use of Modern techniques in Watershed Management.**

WATERSHED MANAGEMENT

Summary – Course on “Watershed Management”

- **Course Modules -10 (40L)**
- 1) Introduction and Basic Concepts - 3
- 2) Sustainable Watershed Approach & Watershed Management Practices - 4
- 3) Integrated Watershed Management - 4
- 4) Watershed Modeling - 7
- 5) Social Aspects of Watershed Management - 3
- 6) Use of modern techniques in watershed management -5
- 7) Management of Water Quality -4
- 8) Storm Water and Flood Management -4
- 9) Drought Management -3
- 10) Water Conservation and Recycling -3

Concluding Remarks

- Importance of “Watershed Management”
- “Holistic approach” – needed
- Watershed Management -Different aspects & approaches
- Course - all aspects of “Watershed” & related issues
- Theoretical aspects covered in the best possible way
- Number of case studies from various sources given
- Tutorial, self evaluation, assignment & unsolved questions provided
- Video course will be useful for systematic study of ‘Watershed Management’

Concluding Remarks

- Course will be useful to students - “**Bachelor, Masters & Ph.D.**” Levels – Civil, Agriculture, Geography, Geology, Resources, Environmental Engineering, Humanities, Management etc.
- Course will be also useful to “**Teachers**” – teaching “Watershed & Water Management” related topics.
- Also useful - “**NGOs, Field Engineers, Practitioners, Scientists, Policy & Decision Makers, Gov. agencies & for all working in the area of Watershed Management**”.

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THANK YOU

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