

# RECLAMATION

*Managing Water in the West*

## Overview of River Diversion Methods and Considerations

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# Purpose of this presentation

- Provide a general overview of diversion methods
- Discuss engineering challenges and considerations
- Brief summary of advantages and disadvantages of each



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# Bureau of Reclamation

- Built large water projects throughout 17 western states
- Constructed more than 600 dams and reservoirs including Hoover Dam on the Colorado River and Grand Coulee on the Columbia River
- Largest wholesaler of water in the country
- Second largest producer of hydroelectric power in US
- Design capability and expertise to develop large water projects, including dams, canals, pipelines, etc
- The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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# Diversion and Irrigation Rights

- **Current New Mexico Gila River diversion rights**
  - Diversions use existing diversion structures
  - Existing conveyance ditches have limited flow capacity, ~25 cfs
- **Globe Equity 59 Decree diversion rights**
  - Governs use of Gila R water from Virden to Salt River
  - With storage, could divert during winter months when ag use is minimal and store for later use
- **AWSA diversion rights**
  - Up to 350 cfs starting once river flows reach 150 cfs. At full diversion of 350 cfs when river flows are about 500 cfs

# Diversion Requirements

- **Develop enough depth of discharge to achieve desired flow into canals or ditches.**
- **AWSA flows need to be accurately measured.**
- **May need to take, measure, and quantify more than one kind of diversion water rights at one time.**

# Existing Diversions

- **Push-up diversions**
  - Upper Gila
  - Ft West
  - Gila Farm
  - Riverside and Clark
- **Diversions using other materials**
  - Sunset (concrete)
  - Virden (concrete, tires, cabled)
  - Freeport (concrete w/ wing wall across floodplain)



**Fort West Diversion**

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**Upper Gila Diversion**

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**Sunset Diversion**

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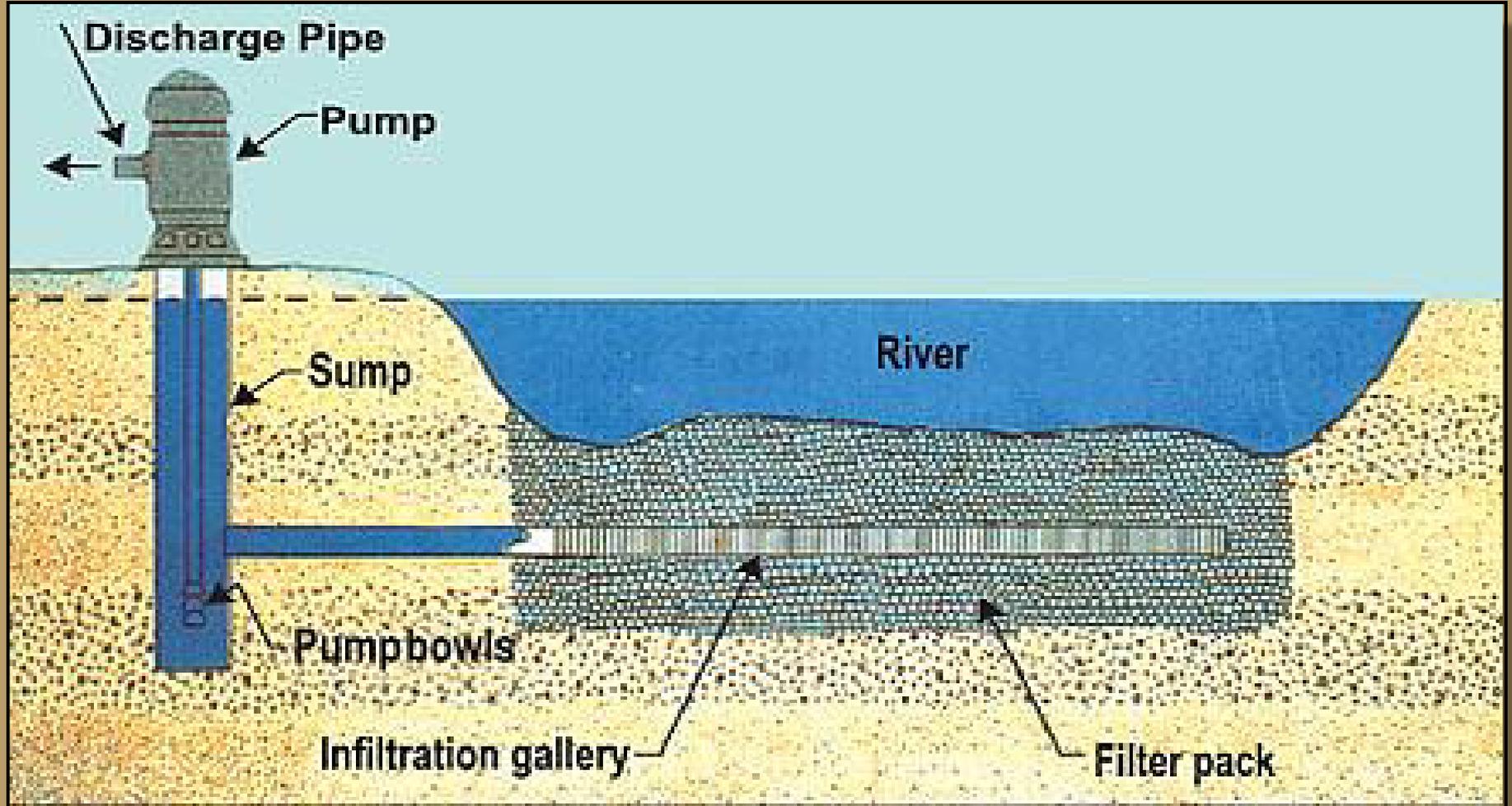
## Freeport-McMoRan Diversion

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# Future Diversion Options

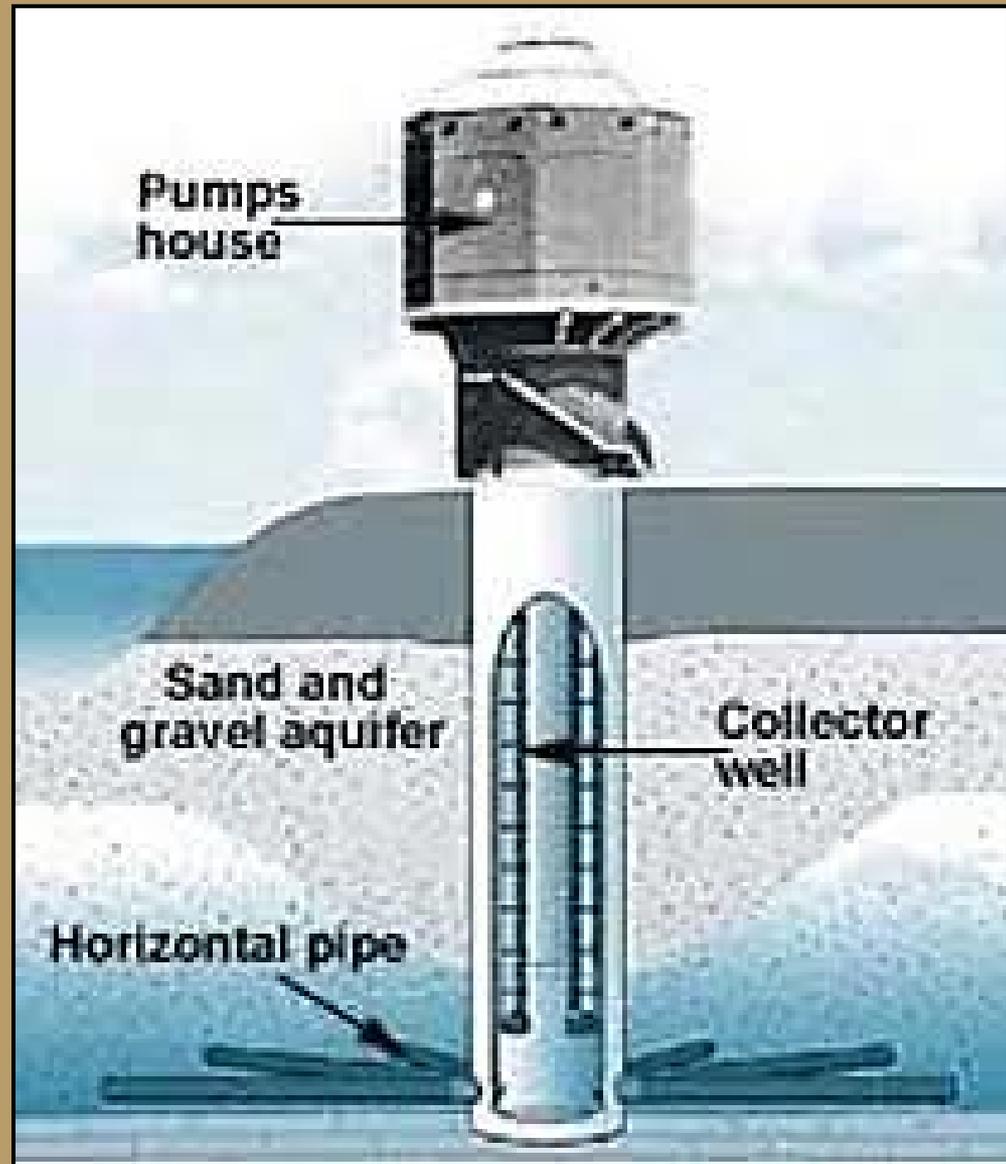
- **Continue with push-up diversions**
  - **Advantages**
    - Experienced with - Inexpensive - Easy to repair - Use on-site materials to construct and repair - Minor environmental construction impacts
    - Maintain water elevation for gravity flow conveyance and storage options
    - Can be configured to take full 350 cfs AWSA flow
    - Natural river sediment transport maintained
    - Allows fish movement
  - **Disadvantages**
    - i. Frequent repairs
    - ii. May be challenging to accurately intake and measure AWSA flows
    - iii. May have sediment and debris problems when diverting AWSA flows

Future Diversion Options - Below ground infiltration galleries/collector pipes, Raney Wells



Cross section of pump placed in sump of infiltration gallery.

## Raney Well



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# Future Diversion Options

- **Below ground infiltration galleries/collector pipes, Raney Wells**

- **Advantages**

- **Active river channel natural appearance - Natural river sediment transport maintained - No impacts to recreationists - Allows fish movement**
- **Collected water nearly sediment free**
- **Floods, flood debris doesn't impact operations**

- **Disadvantages**

- **Construction impacts significant, though temporary.**
- **Lose ~30 feet in elevation for gravity flow conveyance & storage options**
- **Pumping system often used, electrical costs**
- **Significant underground collection system required to produce AWSA max flow of 350 cfs.**

# Future Diversion Options

Rock cross vane weirs and grouted boulder weirs



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# Future Diversion Options

- **Rock cross vane weirs and grouted boulder weirs**

- **Advantages**

- **Active river channel natural appearance - Natural river sediment transport maintained - Minor impacts to recreationists – May allow fish movement**
- **Less expensive than concrete structures**
- **Maintain water elevation for gravity flow conveyance and storage options**
- **Non-grouted fairly easy to repair, though rock likely to be imported.**
- **Can be configured to take full 350 cfs AWSA flow**

- **Disadvantages**

- **Frequent maintenance likely, large flows will move rock cross vanes - if grouted boulders not designed to scour depth, will undercut and fail**
- **May be challenging to accurately intake and measure AWSA flows - may have sediment and debris problems when diverting AWSA flows**

# Future Diversion Options

- **Concrete Structures**
  - Standard structural concrete diversions
  - Coanda screen structures (Tilted wedge wire screen)
  - Rubber dams
- **All require:**
  - Stable concrete bases to protect infrastructure from scour
  - Structure or wing walls tie to abutments to prevent lateral river movement and abandon structure
- **Examples in Valley – Sunset and Freeport diversions**



**Sunset Diversion**

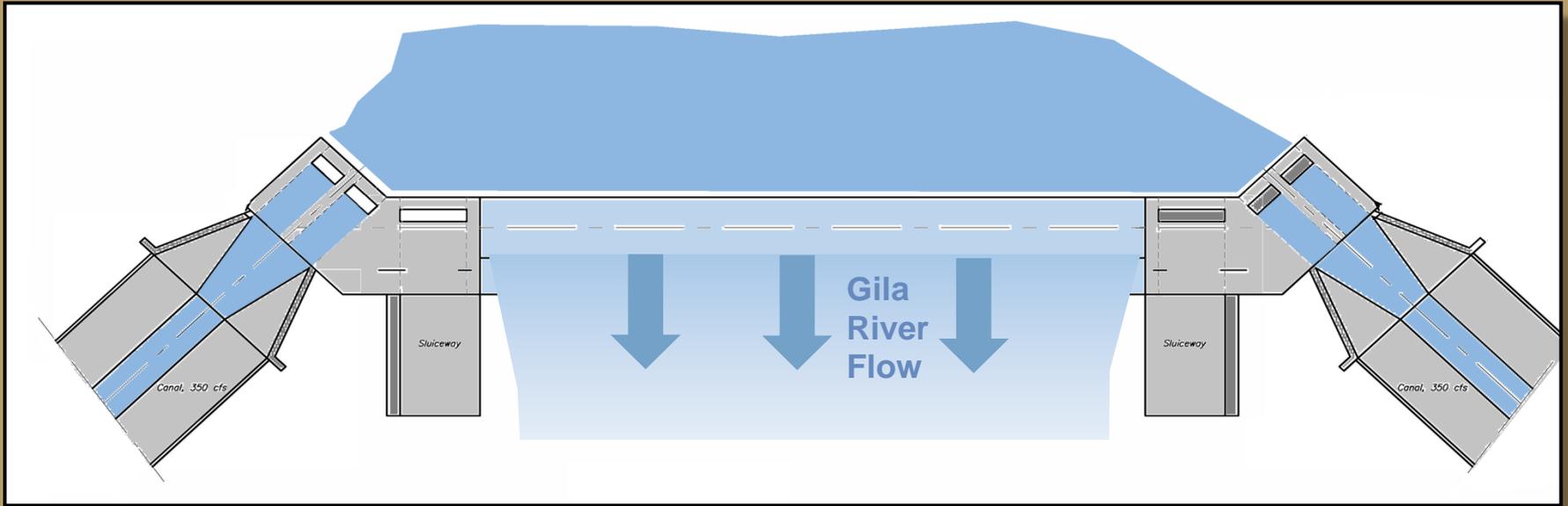
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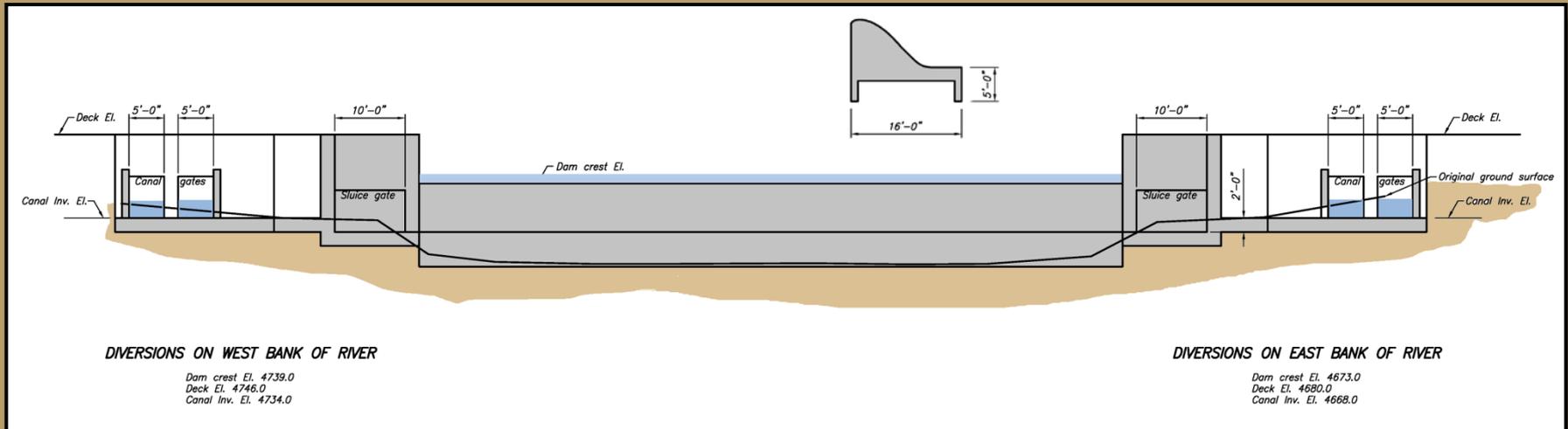
## Freeport-McMoRan Diversion

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# Standard Structural Concrete Diversion

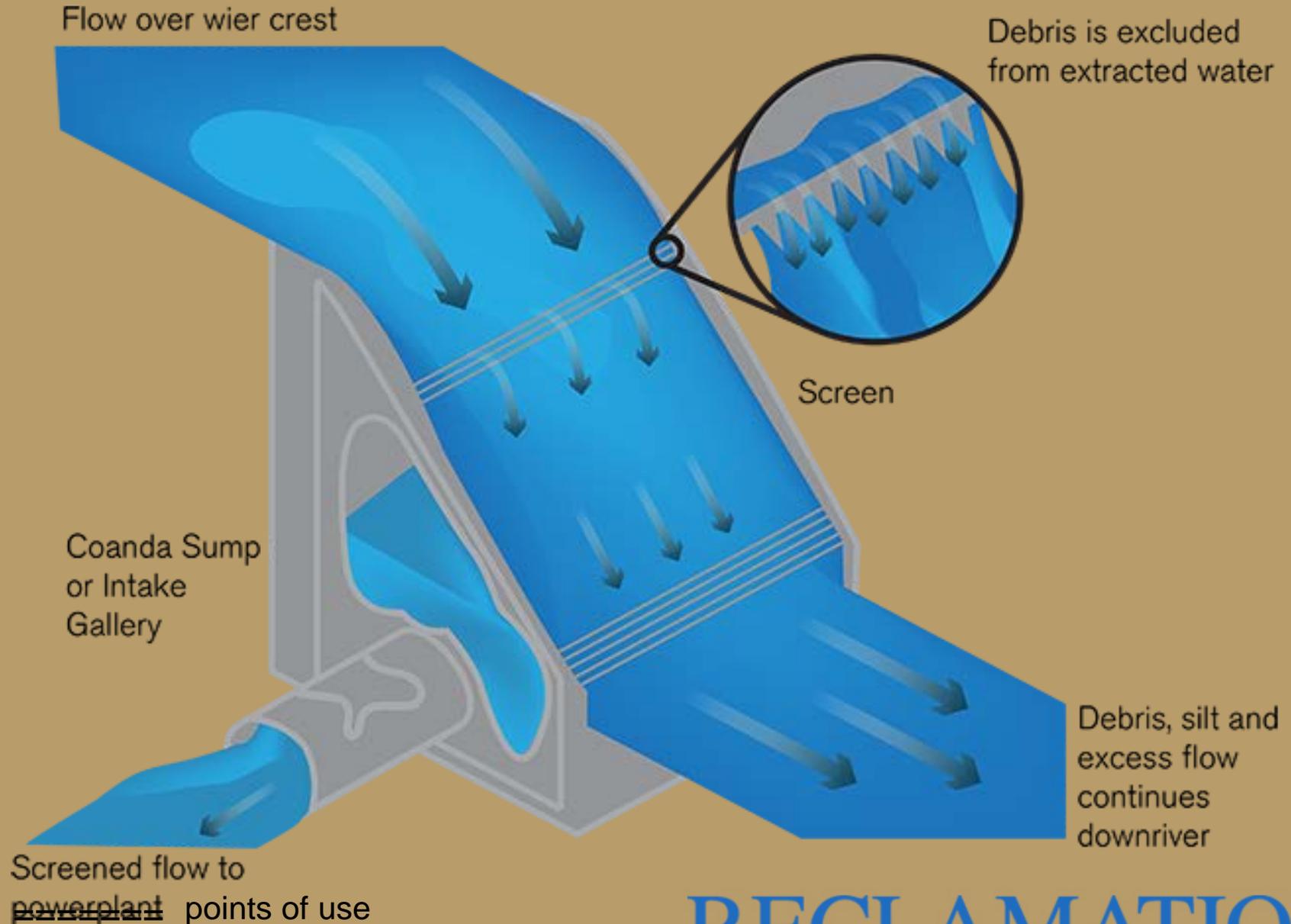


Plan View



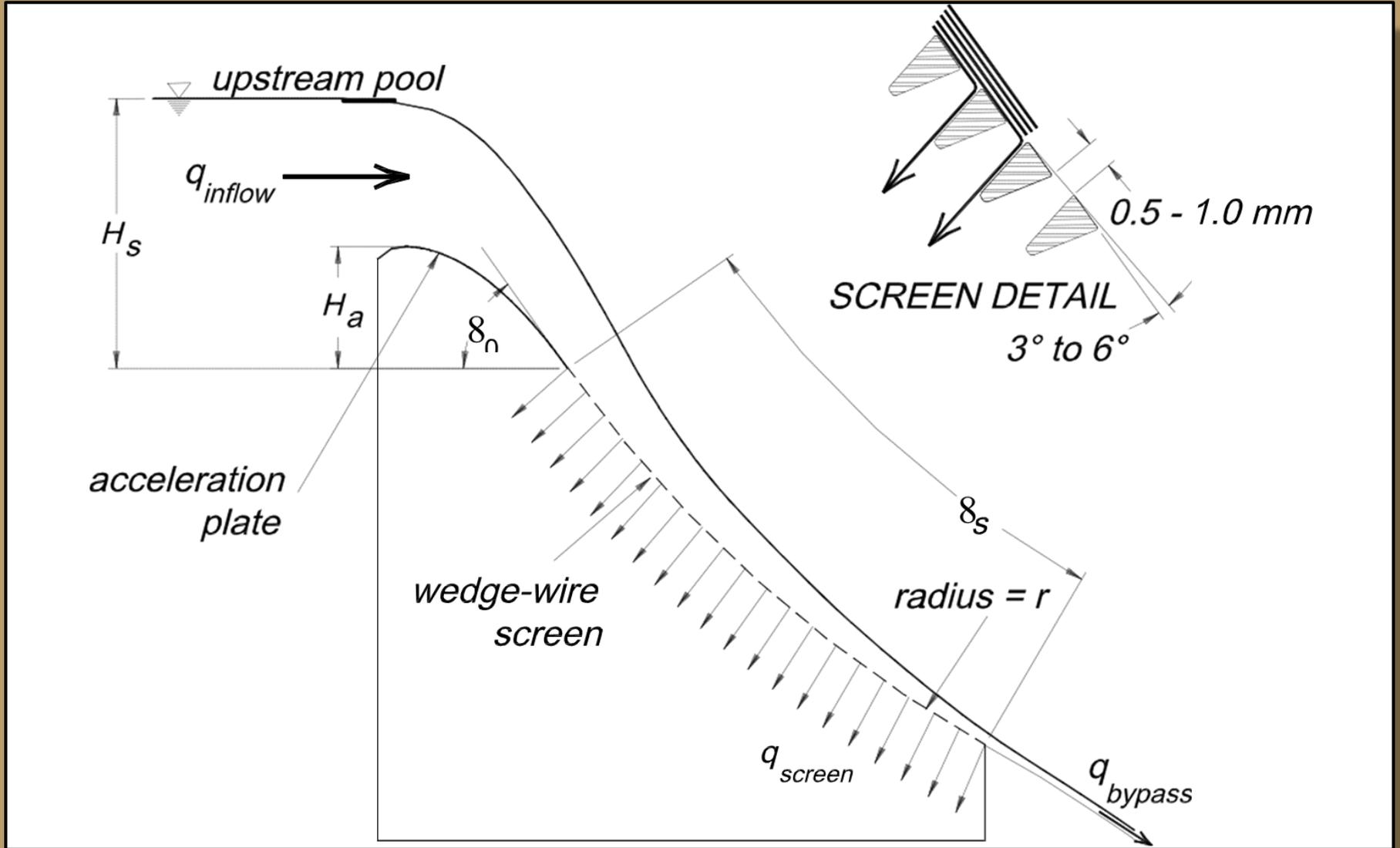
Cross-Section View

# Coanda Screen (Tilted wedge wire screen)



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# Coanda Screen





**Coanda Screen**

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MWRD COANDA SCREEN

55° INCLINE 18"

$Q_{SC} = 4.39$  CFS

$Q_{OV} = 0.13$  CFS

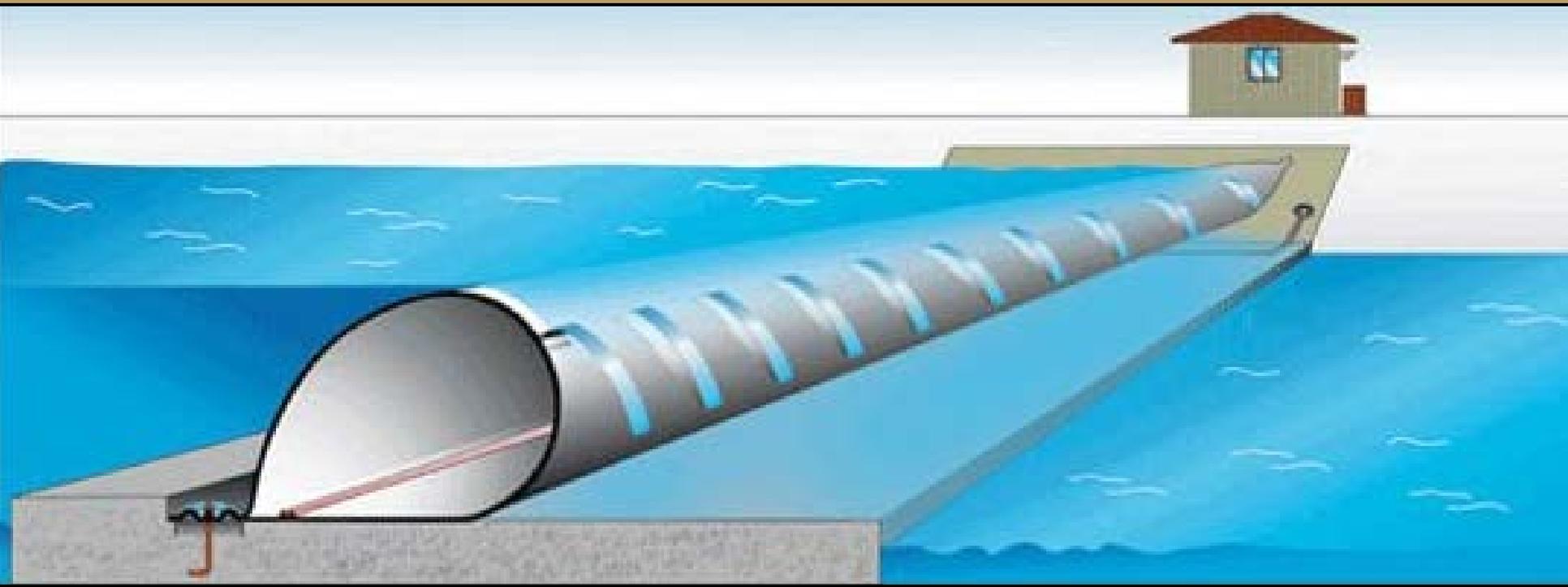
**Coanda Screen**

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**Coanda Screen**

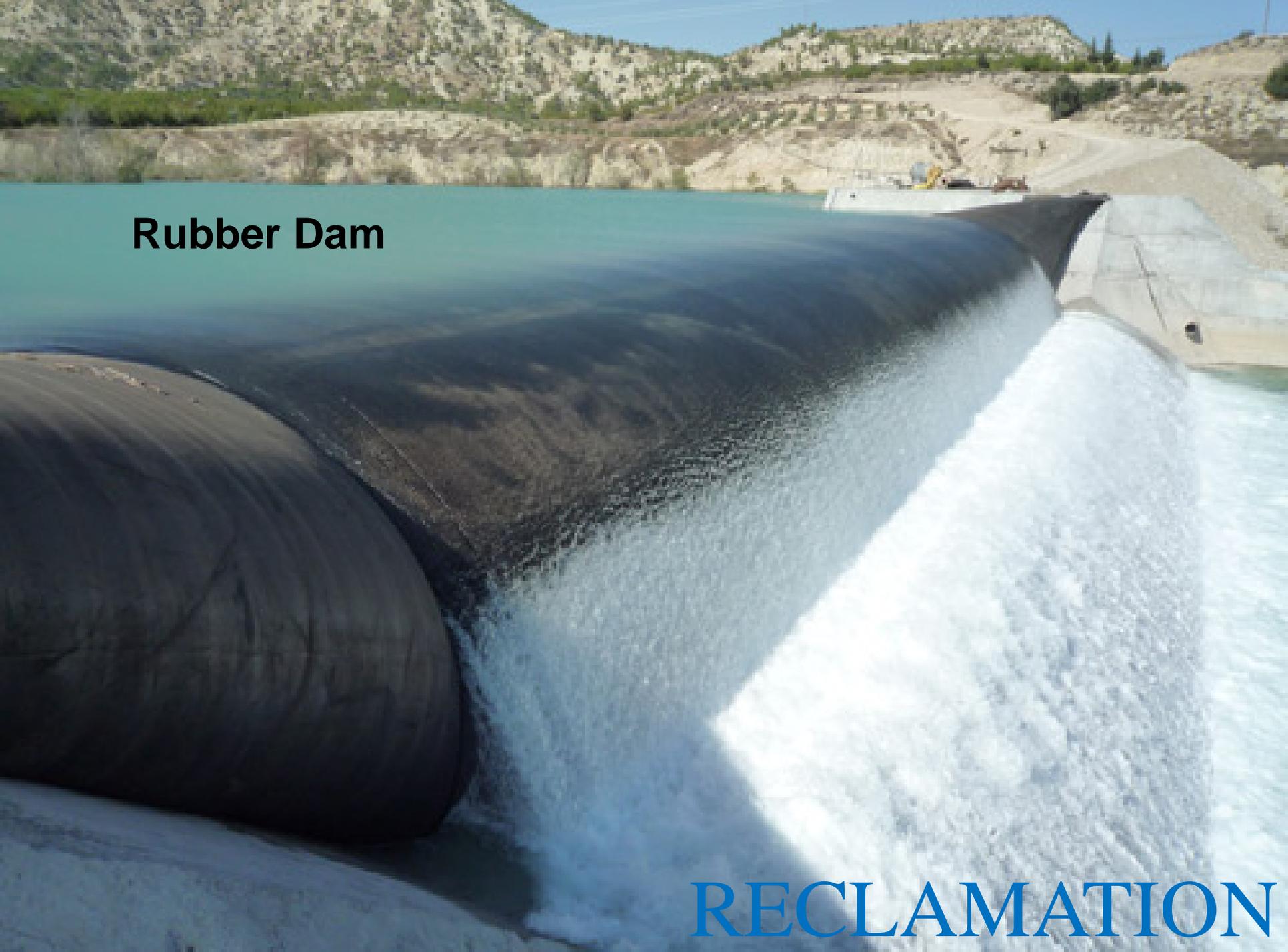
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## Rubber Dams

- Filled with air or water
- Can be raised or lowered as needed

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A photograph of a rubber dam in operation. The dam is a long, dark, curved structure made of a flexible material, likely rubber or a similar synthetic material, supported by concrete abutments. Water is flowing over the dam, creating a white, turbulent cascade. The background shows a rocky, hilly landscape under a clear blue sky. The text "Rubber Dam" is overlaid in the upper left, and "RECLAMATION" is overlaid in the bottom right.

**Rubber Dam**

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Another application for rubber bladders – Can be lowered to allow sediment transport, maybe fish passage

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# Future Diversion Options

- **Concrete Structures**

- **Advantages**

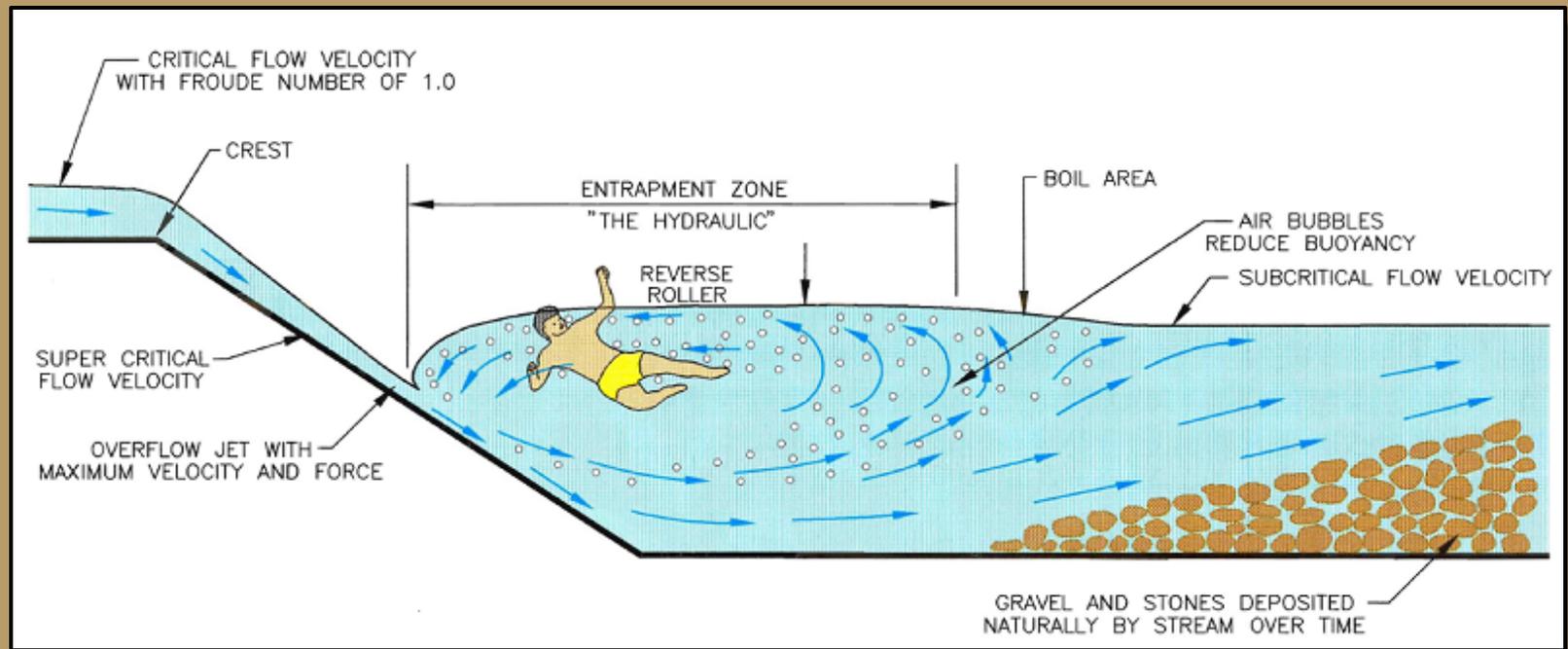
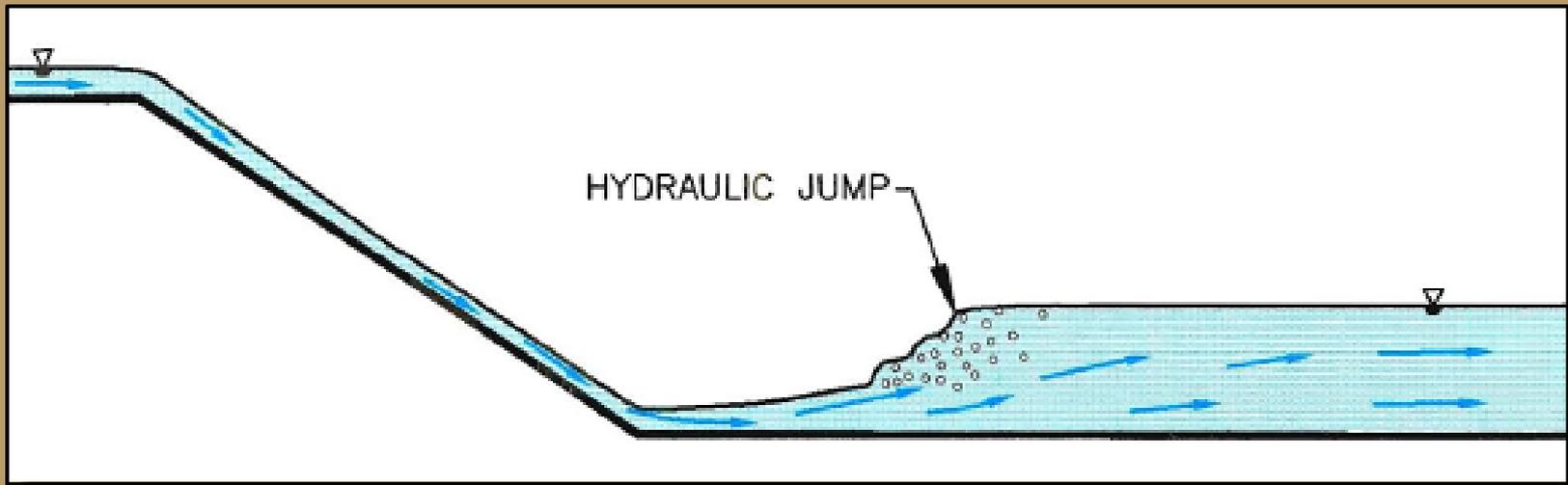
- Little to no structural maintenance – Designed to structurally withstand design flood and associated scour - Dependable, long functional life
    - Operational flexibility - Accurately intake and measure different water rights
    - Gain 5-10 feet of elevation above thalweg, except coanda at stream level

- **Disadvantages**

- Typically most expensive initial capital cost of the alternatives
    - Sedimentation O&M – Must address upstream sediment levels to keep gates operational
    - Impedes fish movement – possibly mitigate with bypass ladder, inflatable sections, or periodically move fish

# Other Considerations

- **Public Safety**
  - Swimmers, boaters – Ensure not exposed to hazardous drops or hydraulics (submerged hydraulic jumps)
  - Configure overflow to avoid dangerous hydraulics over complete range of flows



Courtesy of Wright Water Engineers, Inc. and ASDSO.

Source: Wright, Kenneth R., Kelly, Jonathan M., Houghtalen, Robert J., & Bonner, Mark R. "Emergency Rescues at Low-Head Dams." Paper presented at Dam Safety 1995, the 12th annual conference of the Association of State Dam Safety Officials, Atlanta, GA, September 1995.

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# Other Considerations

- **Fish Passage – Loach minnow and spikedace**
  - Fish can pass in downstream direction. Certain diversions impede movement upstream past the barrier
  - Fish ladder/lazy river bypass – untested for loach minnow and spikedace
  - Physically capture and transport fish U/S of diversion



**Spikedace**



**Loach  
Minnow**

# Questions?

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