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WATER · MINERAL · ENERGY

Fixed-Screen Surface Water Intake Systems – Trenchless Construction

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“Intakes” Outline

- Conceptual Intake Components
- History – Evolution of the concept
- Advantages
- Siting & Design Issues
- Construction Process
- Typical Examples

EPA Development Document (1973)

Radial Well Intake: "…has the advantage of being the most environmentally sound intake system because it does not have any direct impact on the waterway"

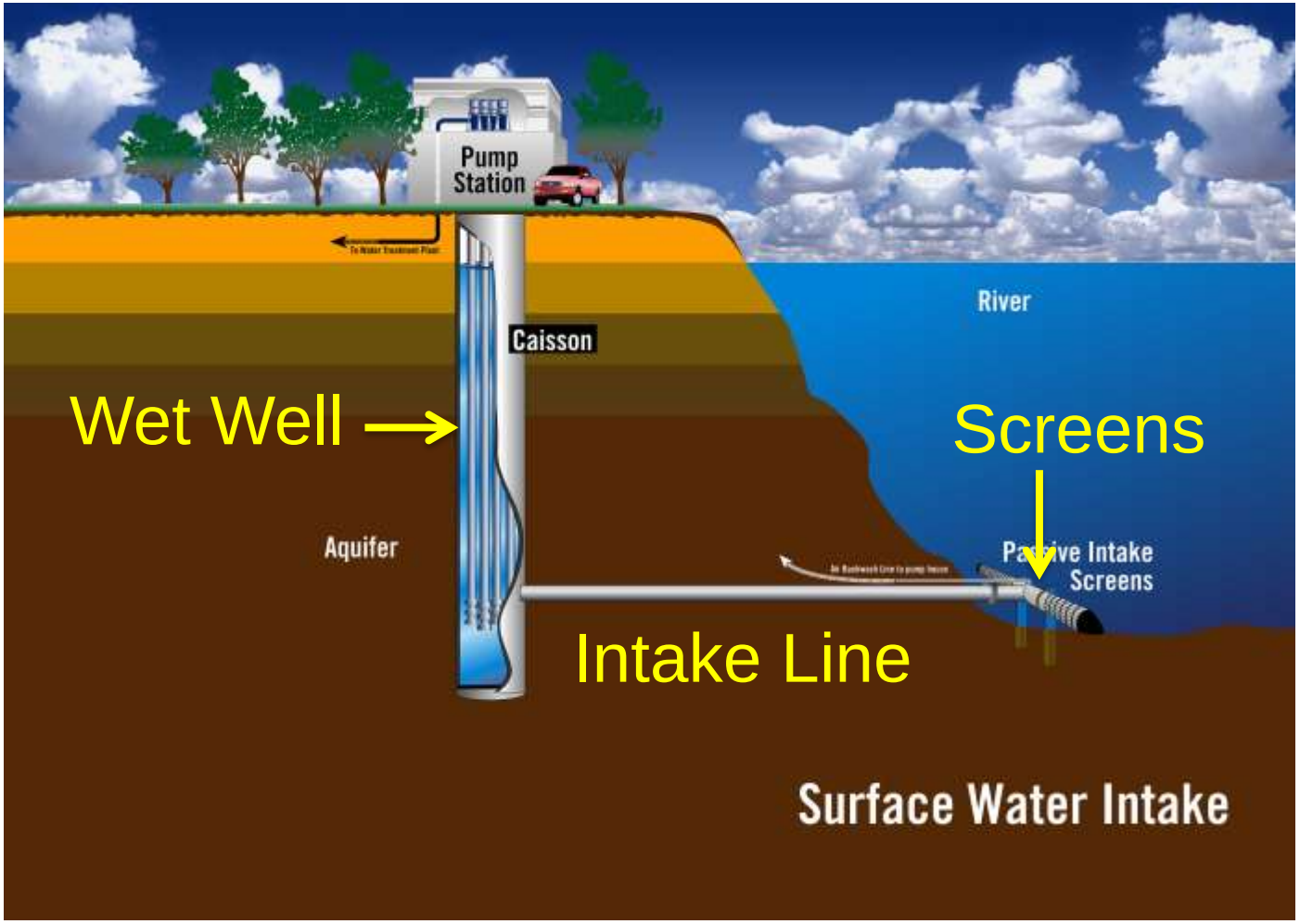
Perforated Pipe Screens: "In this manner large quantities of water may be handled at what may be substantially less cost and greater fish protection effectiveness than presently used conventional screens"

Development Document for Proposed Best Technology Available for Minimizing Adverse Environmental Impact of Cooling Water Structures, USEPA, December 1973.

Green Construction Approach

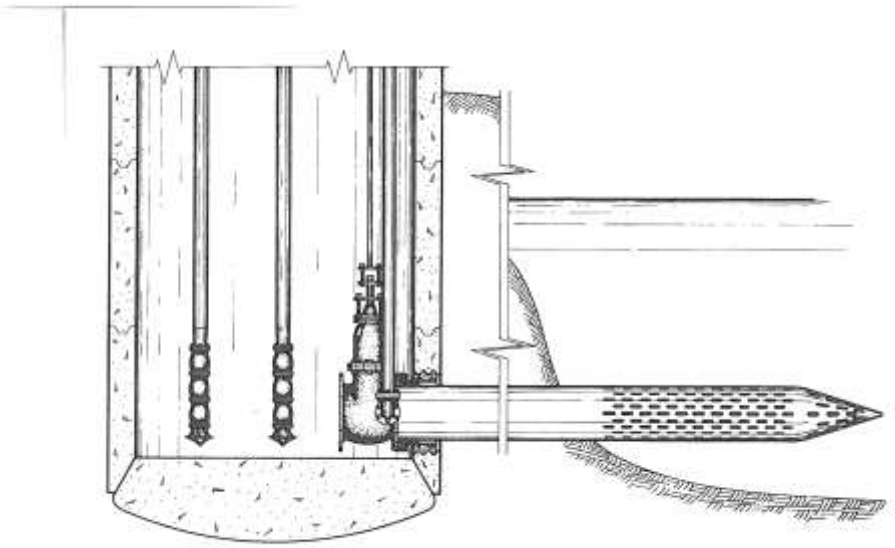
- Trenchless construction – low environmental impact during construction, may simplify permitting
- Optimal protection to fish & aquatic life – EPA Rule 316b compliant
- Sustainable Structures – rehabilitation approaches to restore efficiency and extend facility life
- Supply Sustainability – developing water supplies from sustainable resources
- If the geology is suitable, radial collector wells – no physical contact with the source water

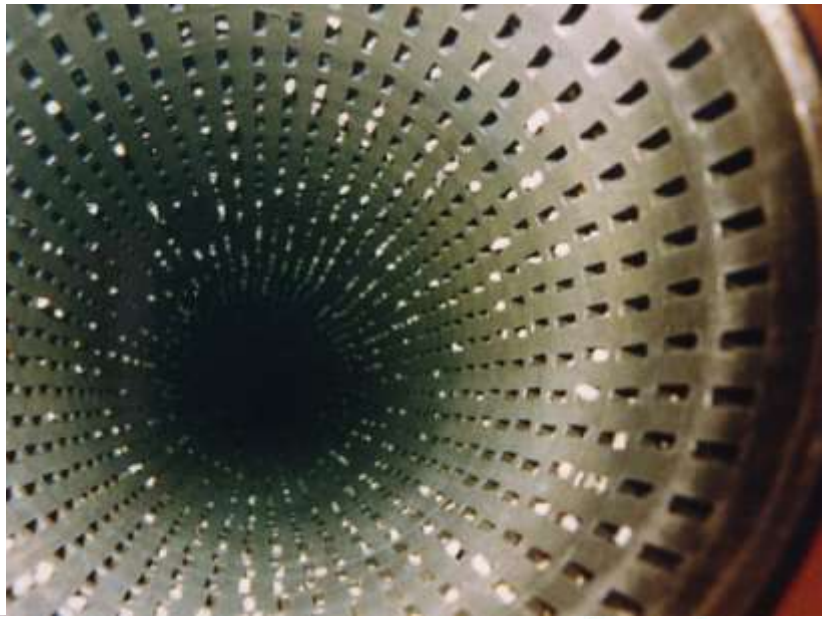
Ranney Passive Intake Systems



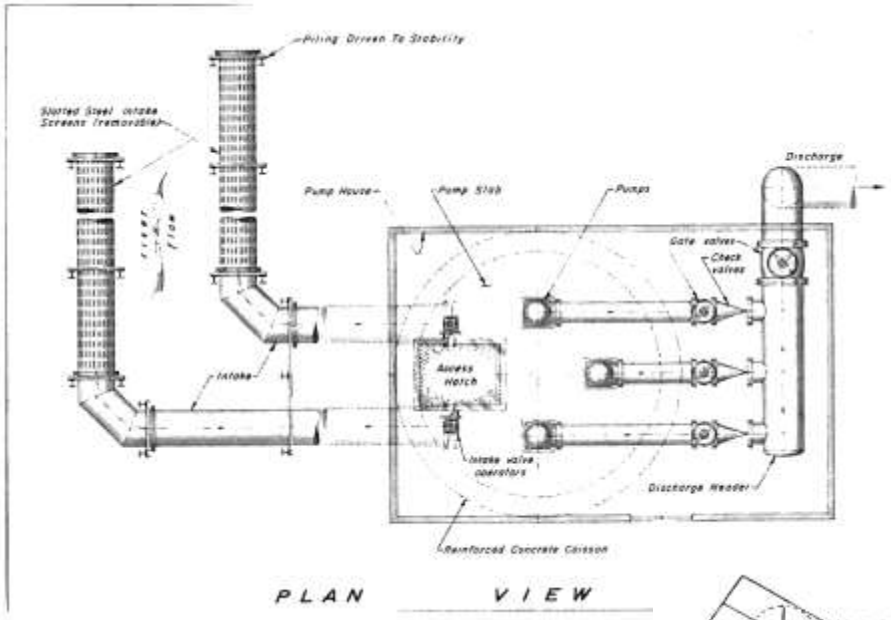
History

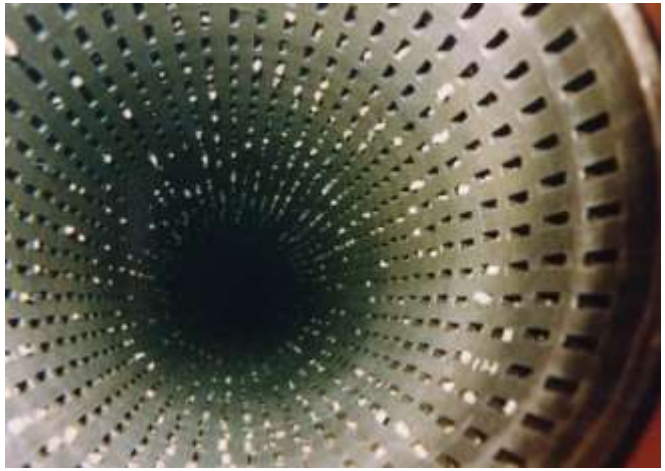
- 1957: Perforated pipe with head pushed out through riverbank into river

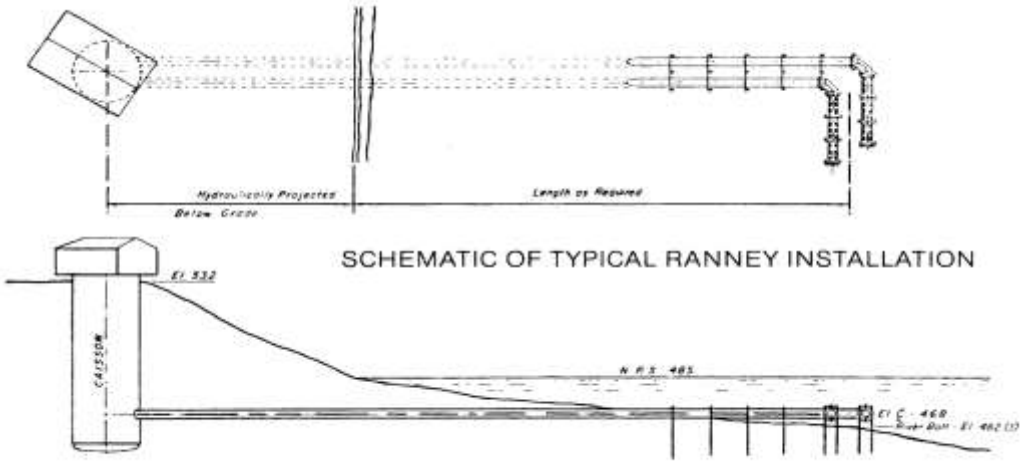




Turned Screens Parallel to Flow







SCHEMATIC OF TYPICAL RANNEY INSTALLATION

First (?) Passive Intake

- Steel Mill – Coke Plant
- Installed in 1960
- Capacity: 100,000 gpm
- Caisson diameter – 24 feet I.D.
- 2 Intake Lines
  48 inch diameter
- Perforated Pipe
  Screen

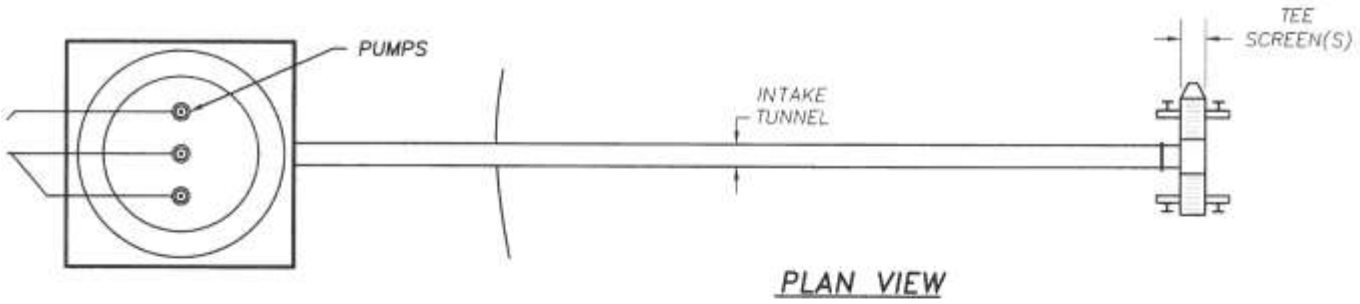
Others soon followed

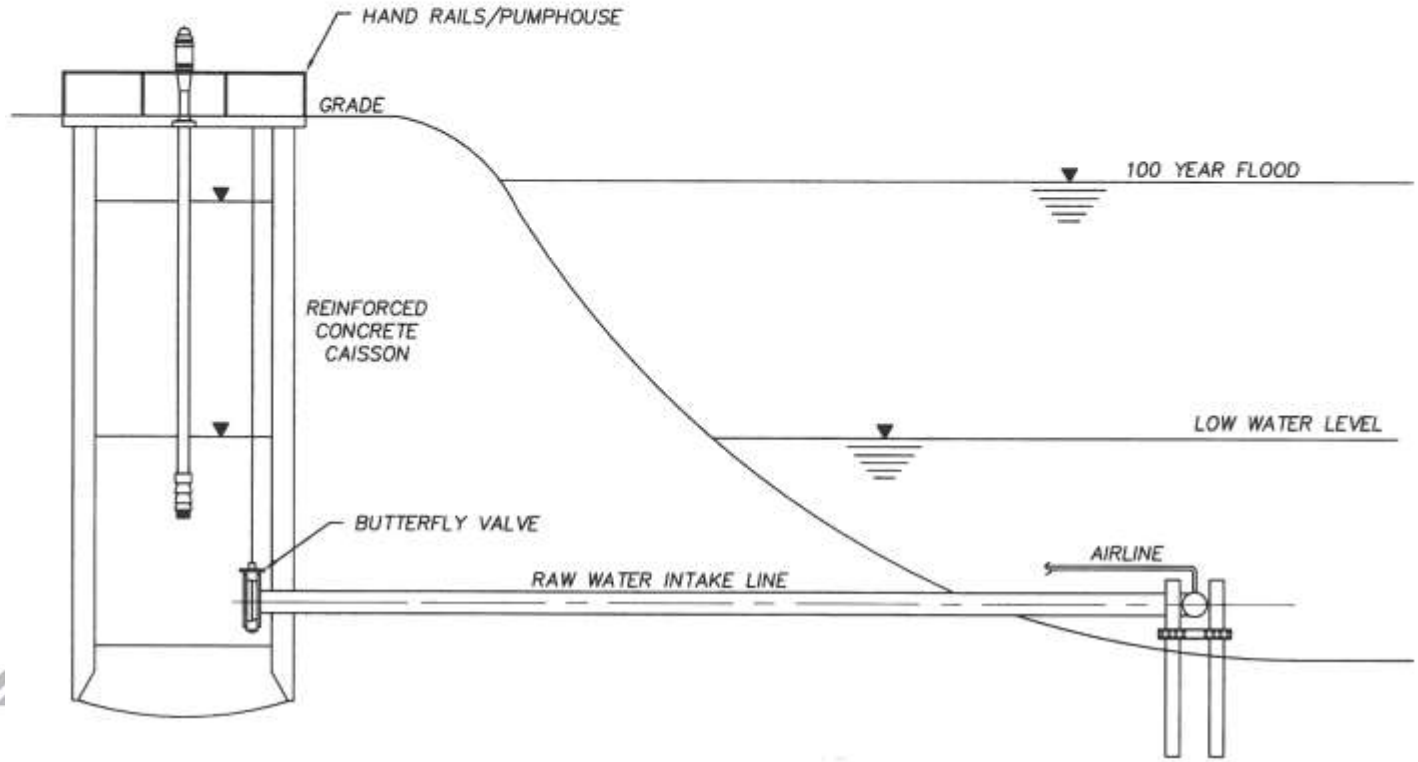
- 1962 - Armco Steel – 150,000 gpm
- 1967 – Vulcan Materials – 10,000 gpm
- 1968 – AEP – 60,000 gpm
- 1968 – Corning – 5,000 gpm
- 1969 – Int'l Paper – 100,000 gpm
- 1970 – Westvaco – 150,000 gpm
- 1975 – American Water – 15,000 gpm
- Single Unit capacity to 450,000 gpm
- Multi-unit capacity to 1,000,000 gpm

Passive Intake Advantages

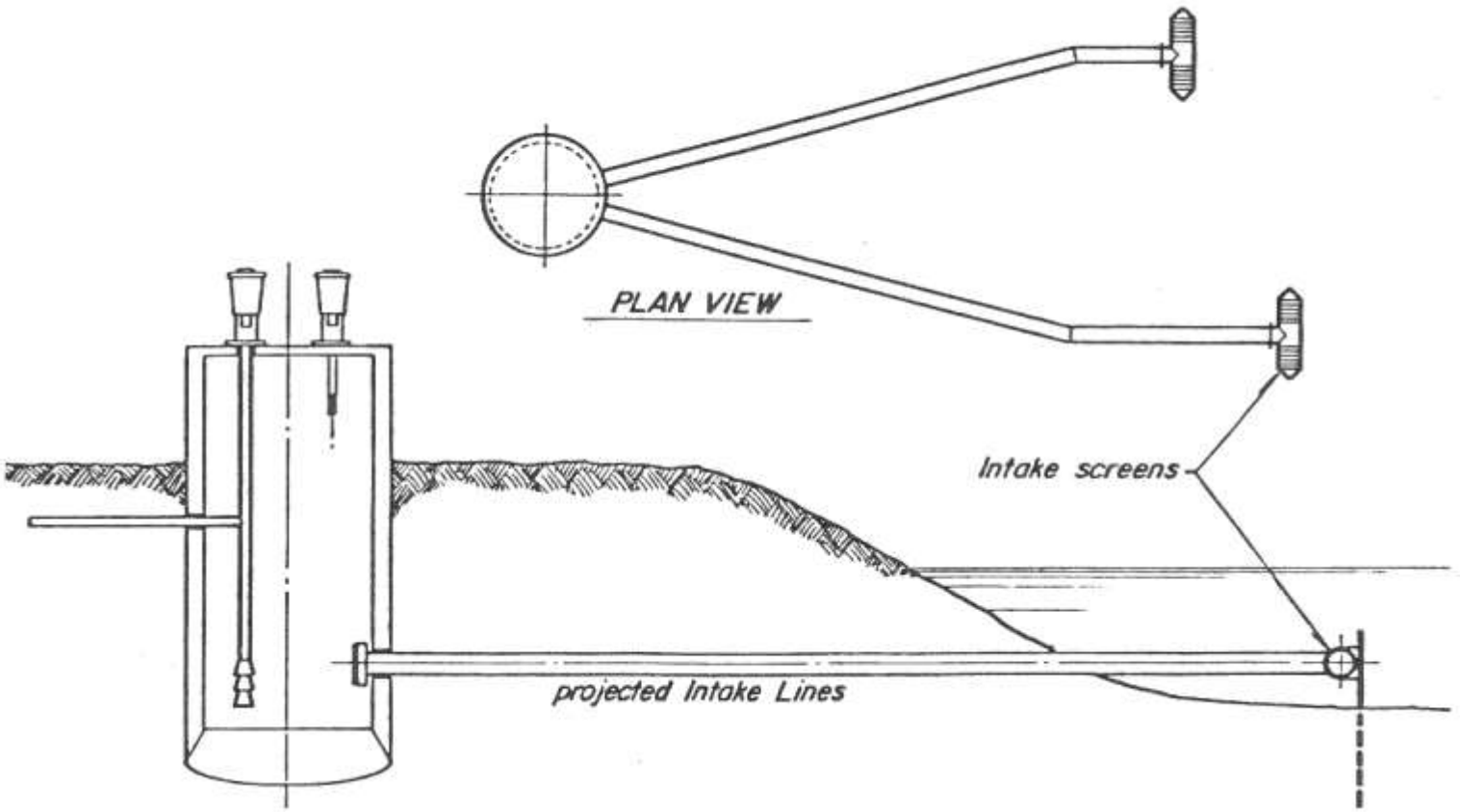
- Essentially - No moving parts
- Low O&M
- Simpler to permit (?)
- Rock and soft ground
- No cofferdams, dewatering , open or trenched excavation
- Low environmental impact during construction & operation
- Low visual impact
- Fish-friendly designs
- Ability to go under archaeological sites
- Cost –effective compared to traditional

Standard Design – single line, single screen





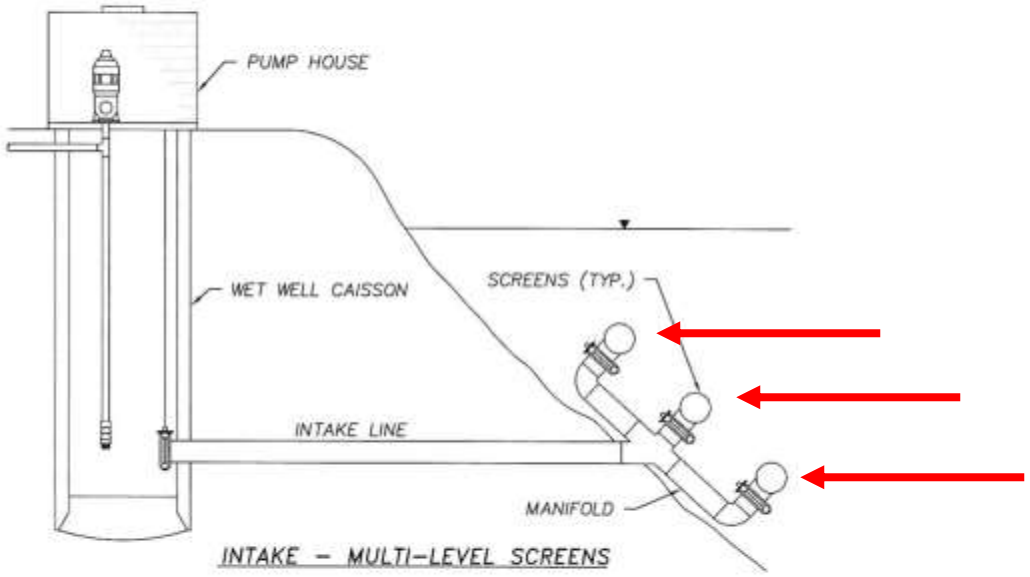
Split-Intake Lines



Lines split and staggered for redundancy

Multi-level Intake

Selected withdrawal zones for seasonal variances (due to stratification)



Can also project multiple intake lines

Reinforced concrete caisson sinking

- 10-40+ foot ID
- 30-150+ feet deep
- Open-end sinking method
- Hydraulic-assisted pull-down
- Wall port for intake line

Intake Line Projection

- Typically trenchless
- Diameters up to 60 - 72”
- Intake lines up to 1000 feet +
- Projected into water body from caisson
- Recover drilling machine

Intake Line Installation

- Trenchless installation:
  - Boring & Jacking
  - Microtunneling
  - Hydraulic Projection
- Pressure-balance control allows daylighting without cofferdams or trenching, balancing:
  - soil & ground water
  - surface water heads

Marine Work

- Recover drilling machine from water
- Connect transition / manifold piping
- Set intake screens and supports

Intake Screen Placement

- Within water column: Typically above streambed & submerged – ½ diameter (manufacturers recommendations)
- Within stream: offshore away from habitat and breeding areas
- Preferably in current for sweeping velocity
- In-Channel - consider navigational issues

Intake Screen Design

- Capacity – determines # and diameter
- 316b Inlet velocities (0.5 fps maximum)
- Materials of construction - coatings
- Chemical feed – bactericide needs

Intake Screen Design

- Low entrance/approach velocities (EPA Rule 316b)
  - State/Site Specific
    - VA – 0.25 fps, 1 mm slot
    - PA – 0.5 fps, 0.100” slot
    - WA - Eulachon smelt
- Screen Material:
  - Z-alloy, stainless, alloys
  - Coated
- Backwash capability
- Chemical feed (?)
- Deflector Cone/Soldier Piling

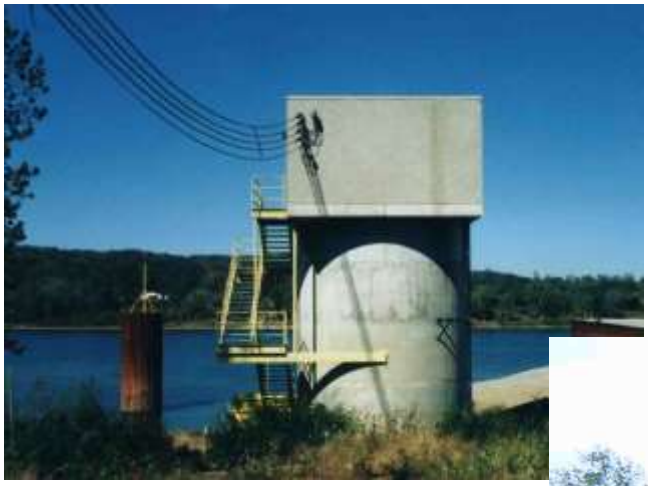
Courtesy Bilfinger/Johnson

Typical Pump Station

Airburst backwash

28,000 + GPM

Intake Pumping Stations Completions



Siphon Intake

Siphon design minimized wet well depth and simplified construction

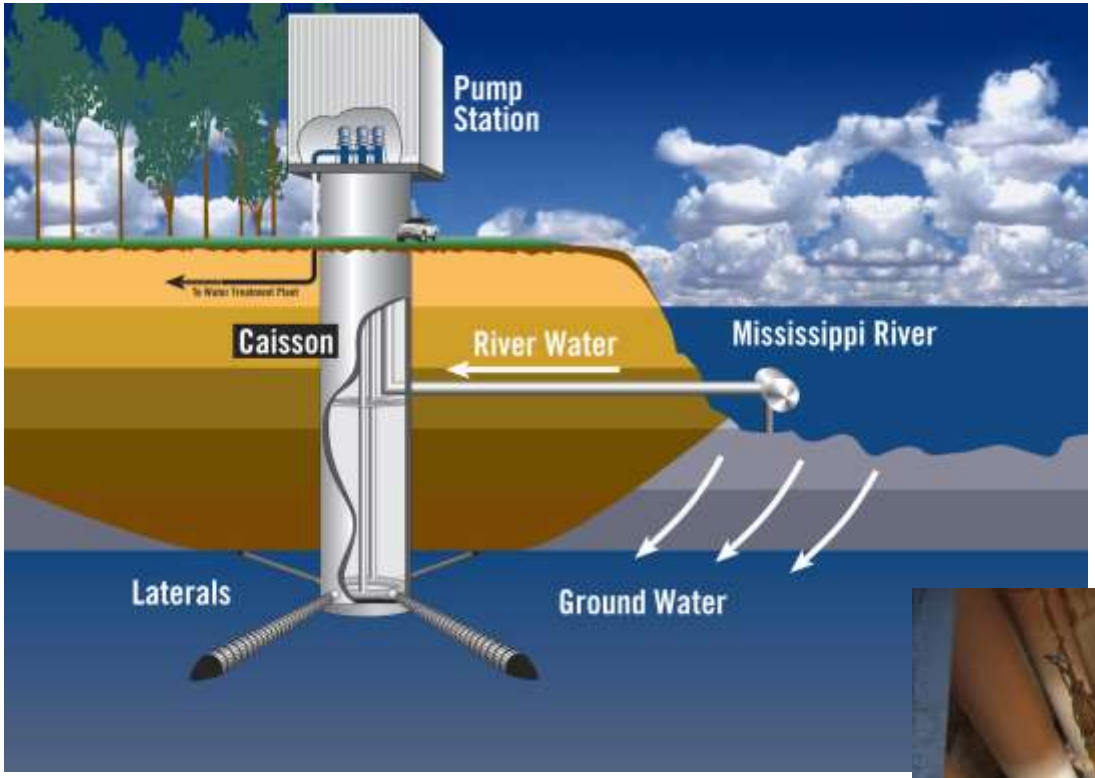
Built in Rock

- Capacity: 3,500 gpm, expandable to 7,000 gpm
- Rock shaft (wet well) 155 feet deep in hard rock
- Pump house located across road – easy access

Open-Air Intake

- 33,000 gallons per minute capacity
- Open-air pumping station completion
- Marine work assisted from land

Combination Intake Design



Constructed as both river intake and collector well

Manifold isolates water sources – can be selective

Existing Intake Structure Retrofit

- Aging structure needed updates
- Sediment creep
- Debris issues
- Corrosion, scale, mussels
- Impacts on pumps

* Also applicable for helping downcutting impacts

Intake Retrofit

- U/W Inspection
- New bulkhead
- Passive Screen (bio-adverse) & air backwash system
- Extended intake further offshore

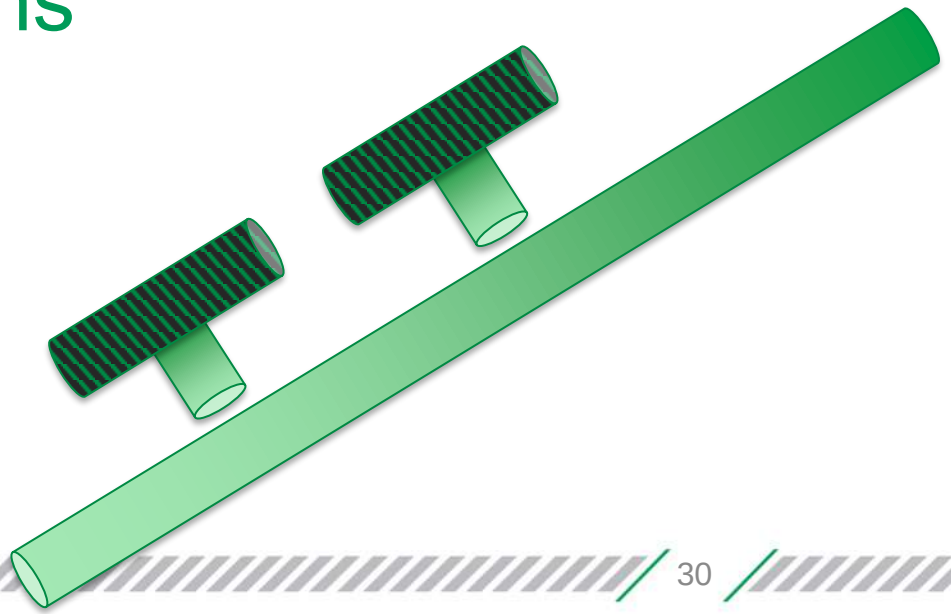
Retrofit Example Results

Project Drivers: Rule 316b & replace existing

- New screens meet Rule 316b entrance velocities
- Location of screens helps avoid intake of debris, also away from aquatic habitat areas
- Raised intake location limits intake of silt and sediment into structure
- Eliminated travelling screens
- Lower O&M for screening system
- Cost-effective solution

Lake Intake Retrofit – Open End Pipe

- 245 MGD Cooling Water
- 40 feet of water
- Remove open pipe section
- 8 – 96” Tee Screens
- Manifold
- 316b Compliant



“Intake” Summary

- Proven intake technology for over 50 years
- Simplistic design and operation
- Very low O&M needs and cost
- Simplified permitting?
- Cost-effective compared to more traditional
- Flexible design options
- Is the Geology Right? - Collector Wells ?
  - Consistent water quality & temperature
  - Low turbidity – reduced pretreatment
  - Optimal fish protection
  - Simpler to permit

Why Screen?

- In-river Screens
- Pump Suction Strainers

This system had neither

Municipal Drinking Water

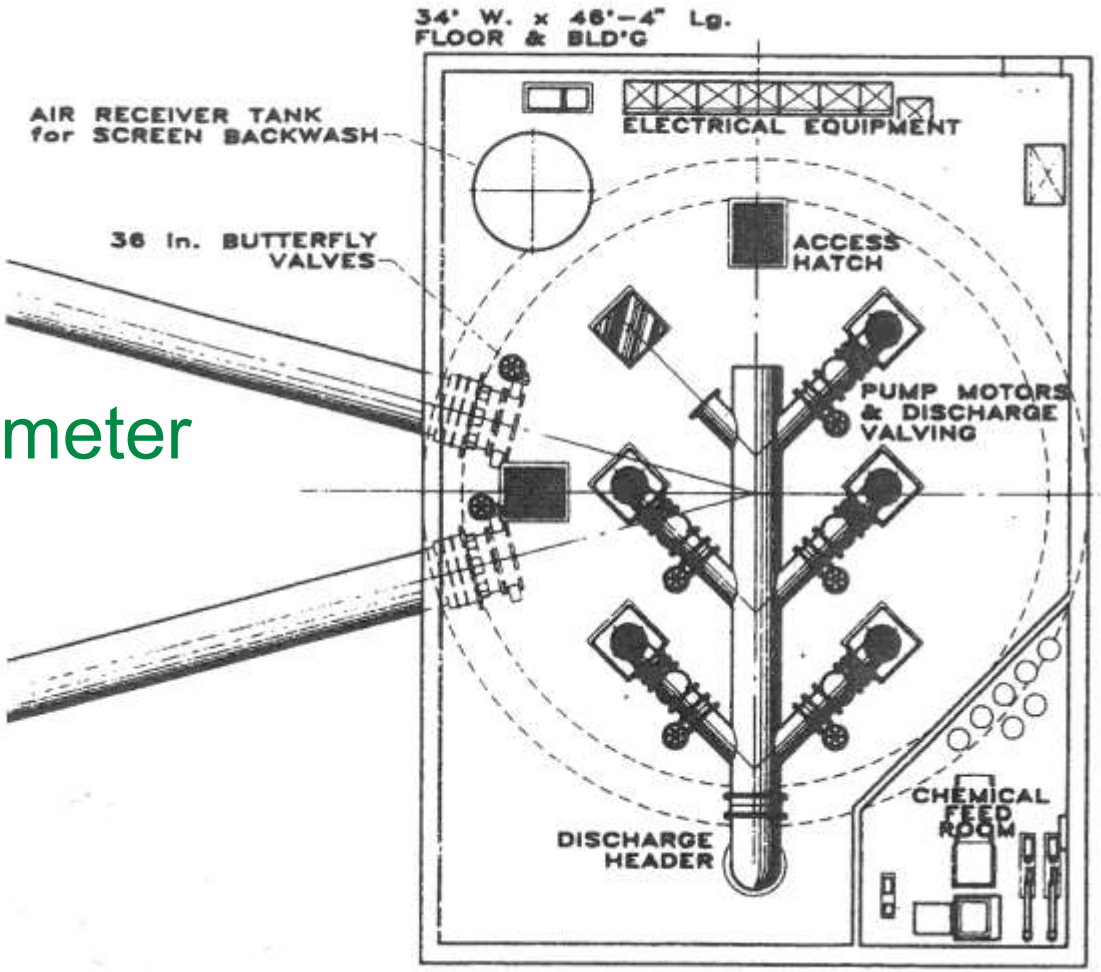
- PA-American Water, Clarion, PA – 15,000 gpm
- WEB Water Development, Lake Oahe, 6000 gpm
- Grand Strand Water & Sewer – 14-28,000 gpm
- Caesars Creek, Ohio (line only) – 5,000 gpm
- SW Pennsylvania Water – 12,000 gpm
- WV-American Water – 3,500 gpm
- Jackson County, MS – 20,000 gpm
- Puerto Rico Water & Sewer (2) – 1,400 gpm each
- Victoria, Texas – 33,000 gpm
- Moon Township, PA – 5,000 gpm

Grand Strand, Conway, SC

- Built in 1991
- Capacity of 21 MGD
- Expandable - 42 MGD
- 30’ ID x 34’ OD x 37’
- Twin 36” diameter lines
- 42” Passive Tee-Screen
- Chemical feed room
- Automatic air-backwash

Grand Strand Wet Well – Pump Station

Twin 36” diameter Intake Lines



Anderson Joint Water, SC

- Built in 2013
- Capacity – 7.8 MGD
- 23’ ID caisson 60’ deep
- 36” diameter intake line 250’ microtunnel
- 3 – 36” diameter tee-screens
- 3 Vertical turbine pumps

Thank You

Questions ?

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