Engineering & Expertise

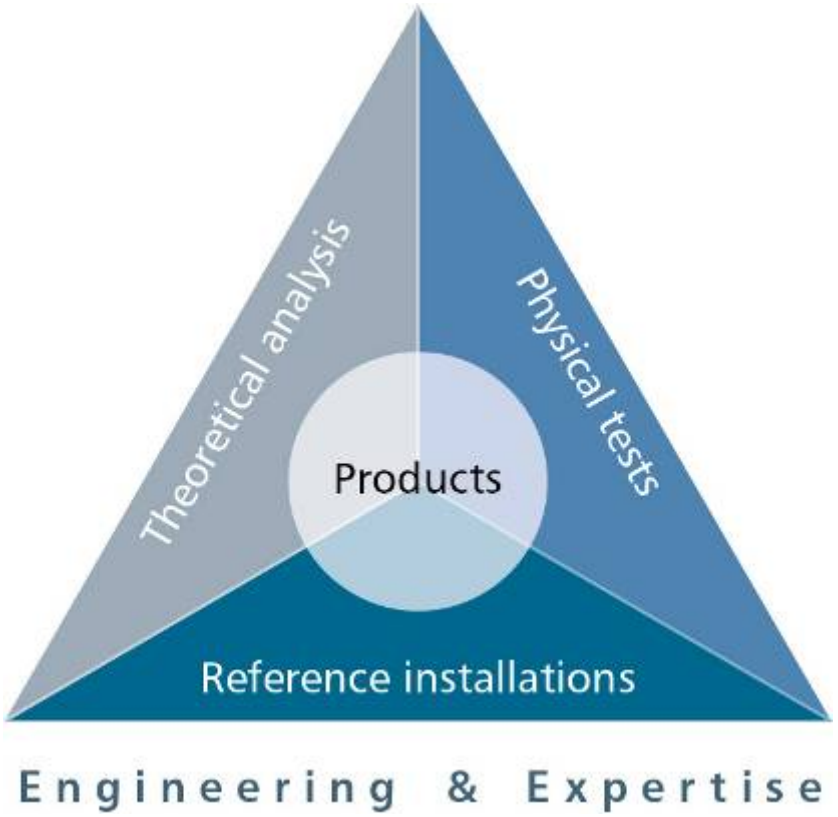
Designing pump sumps

Large submersible centrifugal pumps

What we'll talk about today

- Total solution engineering
- Introduction
  - Large centrifugal pumps
  - Station design
- Design conditions
  - Adverse hydraulic phenomena
  - Contaminated media
- Flygt pump station design
  - Standard sump designs
  - Alternative sump designs
- Reference installations

Total solution engineering increases operational efficiency

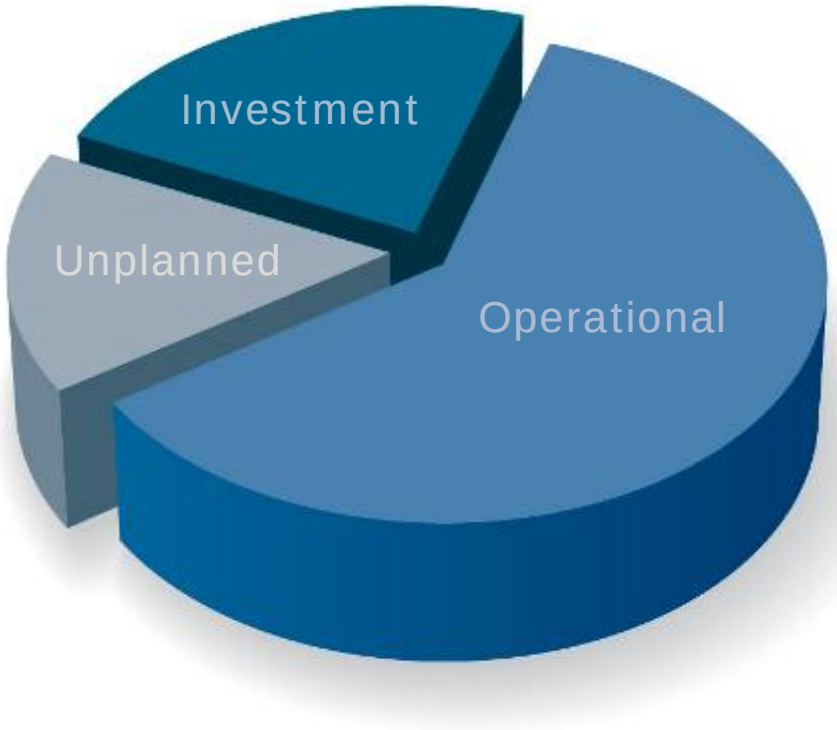


Achieving lowest total cost of ownership

Minimal sedimentation and floating debris

Optimal hydraulic conditions

Optimal sump size

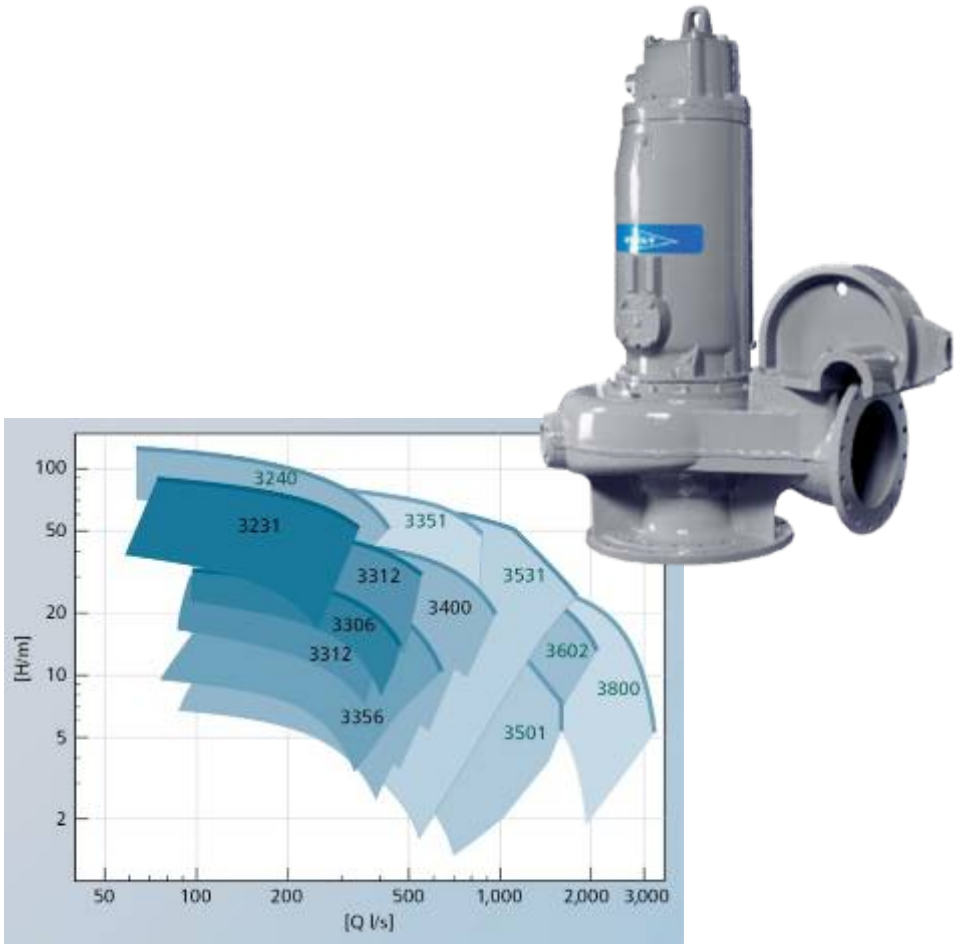


Source: HI/Europump

Flygt large centrifugal pumps

Reliable pump station designs

- Sustained high efficiency
- Self-cleaning capabilities
- Compact, modular design
- Low noise and vibration levels
- Flood-proof pump stations
- Quick, easy installation
- Minimal station superstructure



Flygt large centrifugal pumps

Broad range of applications

- Wastewater pumping
- Raw water pumping
- Cooling water
- Stormwater
- Flood control
- Industrial effluent handling
- Irrigation
- Process water

Methods of installation

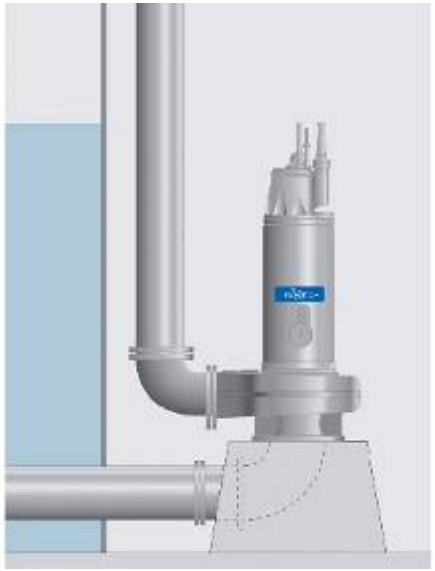
P

For semi-permanent wet well installation

S

For semi-permanent free-standing installation

T



A vertically-mounted, permanent dry well or in-line installation

Z

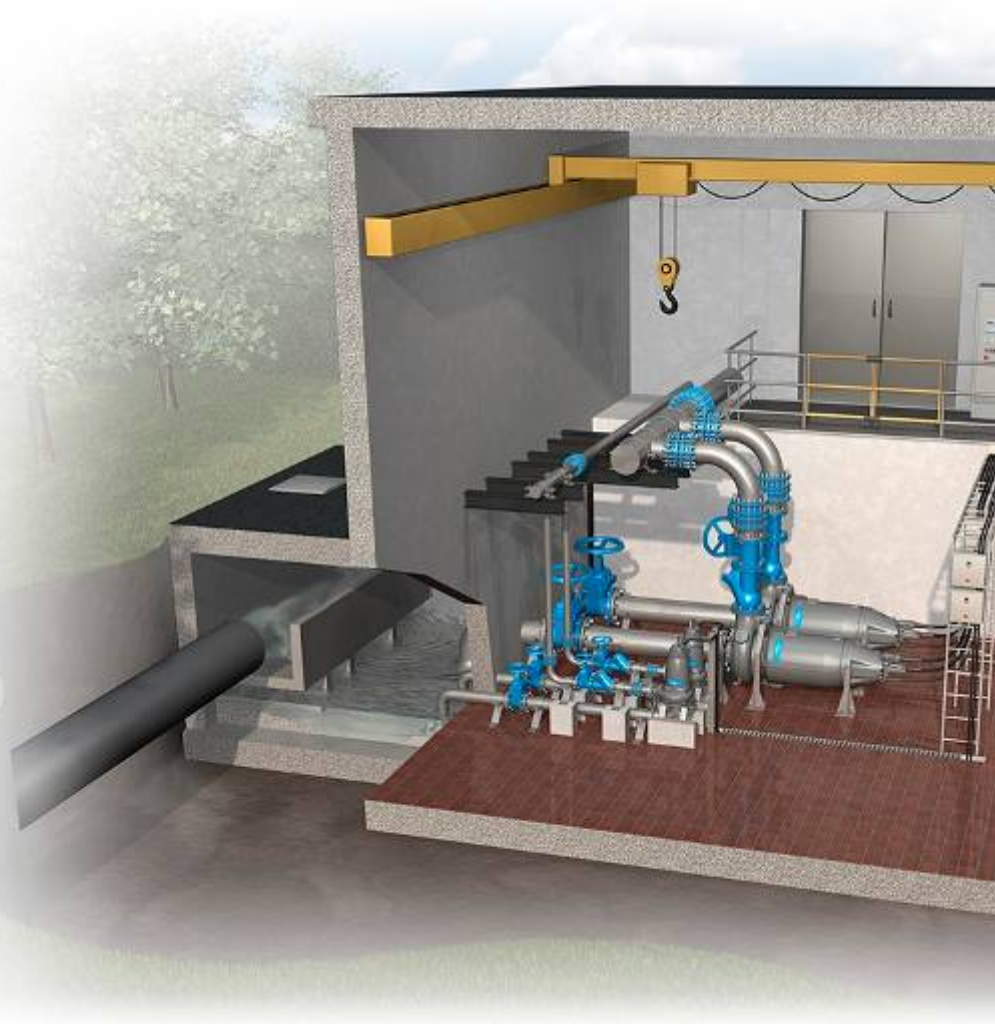
A horizontally-mounted, permanent dry well or in-line installation

Pump station design

Pump station design

Objectives

- Smallest possible footprint with the lowest possible cost
- Elimination of sedimentation and buildup of other debris
- Reliable handling of variable inflow
- Necessary conditions for optimal pumping
- Ease of installation, maintenance and repair



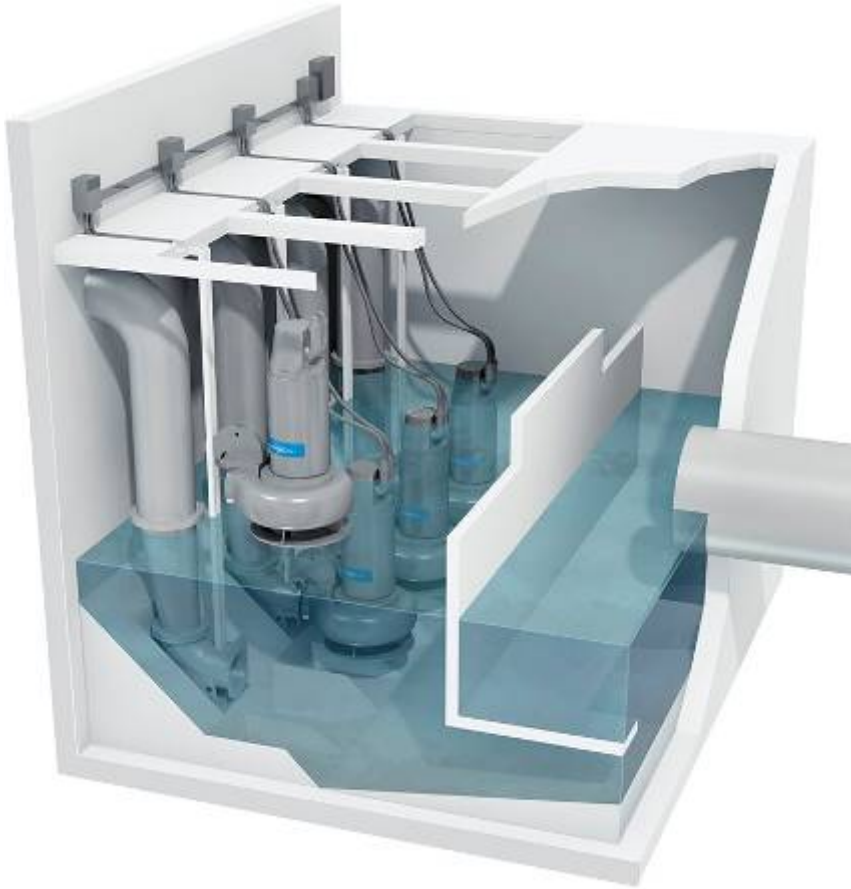
Sump design fundamentals

Proper sump design ensures:

- Reliable pump operation
- Specified performance is met
- Minimal sedimentation and floating debris

General considerations

- Type of pumped media
- Site conditions
- Local regulations and practices



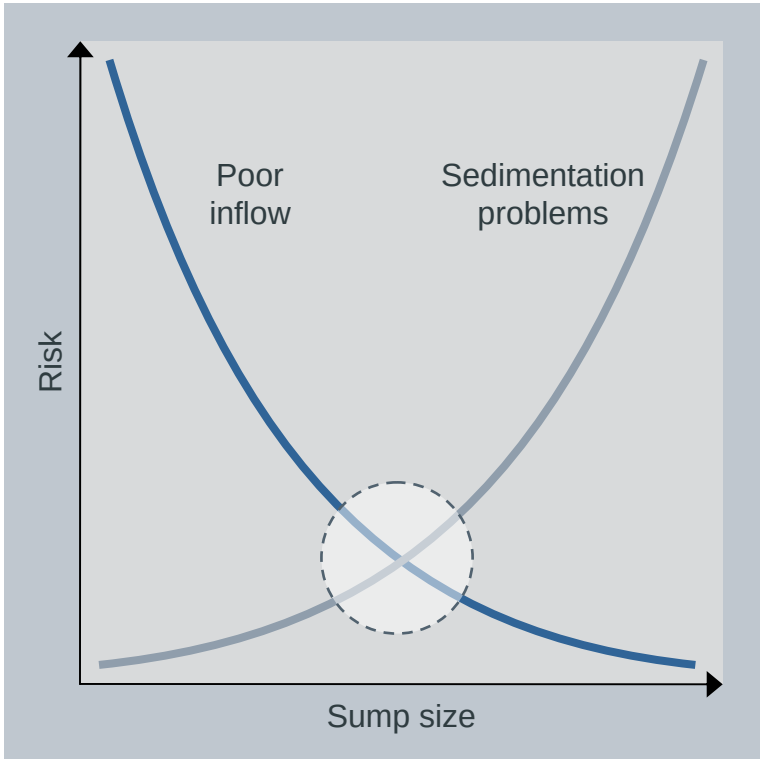
Optimal sump sizing criteria

Two important factors to consider are sedimentation and poor inflow

Small sump – High risk of poor inflow
Large sump – Low risk of poor inflow

Small sump – Low risk of sedimentation problems
Large sump – High risk of sedimentation problems

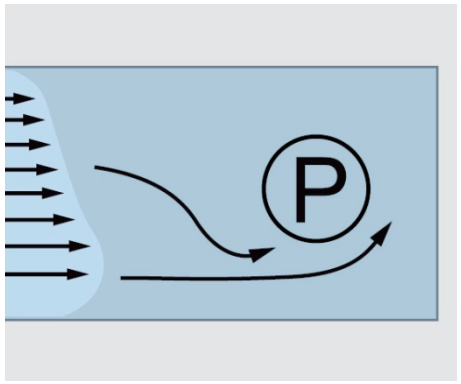
Optimal sump size

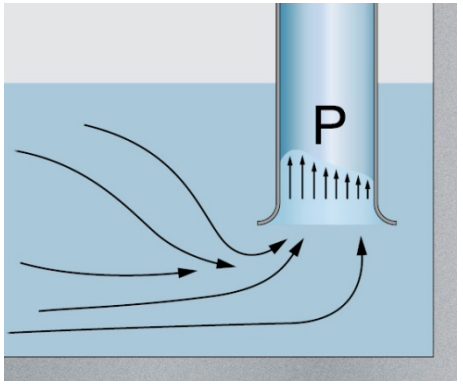


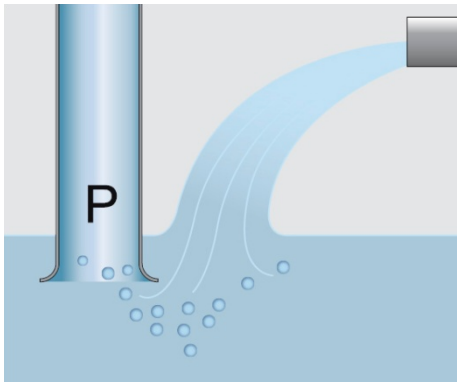
Design conditions

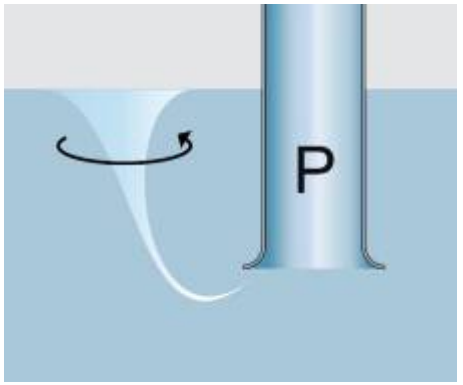
Adverse hydraulic phenomena

- Excessive pre-swirl
- Uneven velocity at the pump intake
- Entrained air
- Vortices







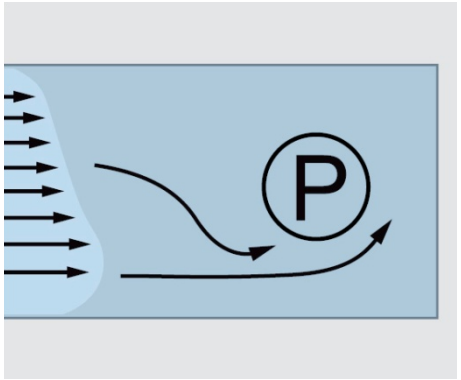


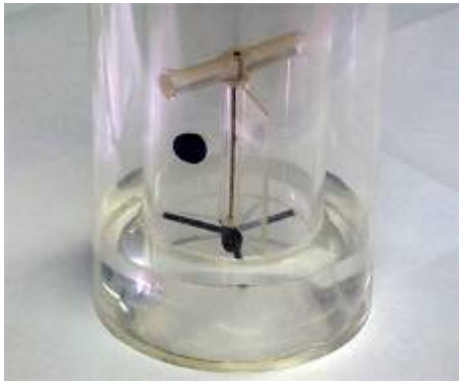
Adverse hydraulic phenomena

Excessive pre-swirl

- Change in efficiency
- Change in performance
- Cavitation
- Vibration
- Overloading of the motor

Hydraulic Institute performance criteria:
Velocity angle < 5 degrees
Angular momentum < 3 %



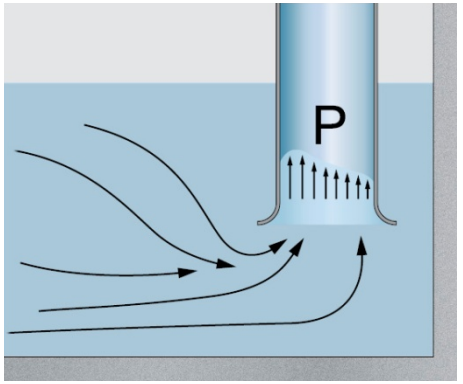


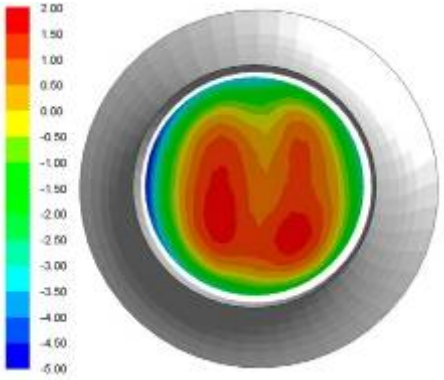
Adverse hydraulic phenomena

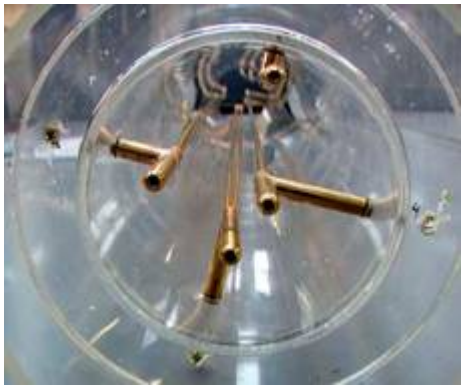
Uneven velocity distribution at the pump intake

- Noise and vibration
- Bearing wear
- Pulsating head
- Change in efficiency

Hydraulic Institute performance criteria:
Velocity distribution +/– 10%



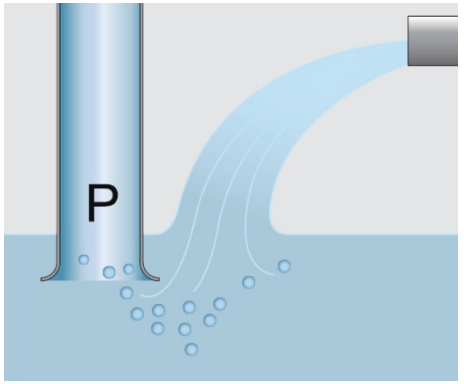




Adverse hydraulic phenomena

Entrained air

- Change in efficiency
- Noise and vibrations
- Uneven load
- Physical damage

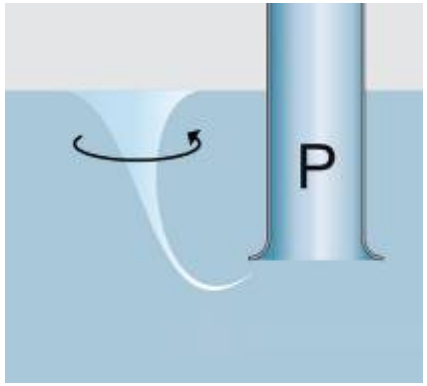


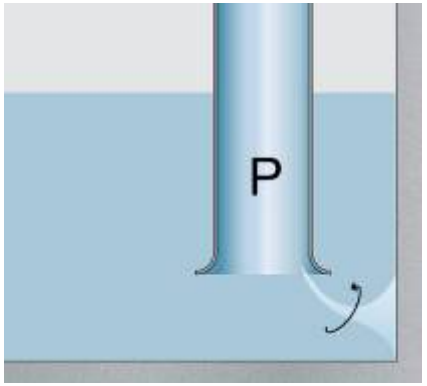
Adverse hydraulic phenomena

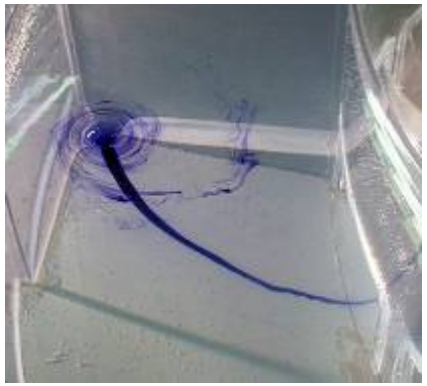
Vortices

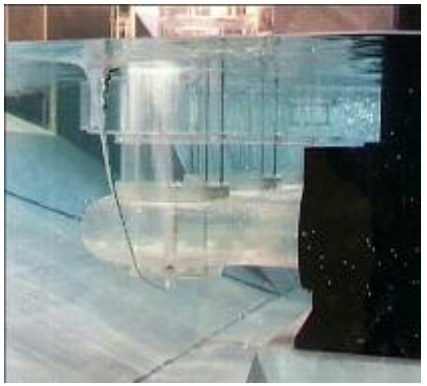
- Subpressure
- Cavitation
- Uneven load
- Noise and vibration
- Physical damage

Hydraulic Institute performance criteria: < Dye-core vortices (Type 3 vortices)





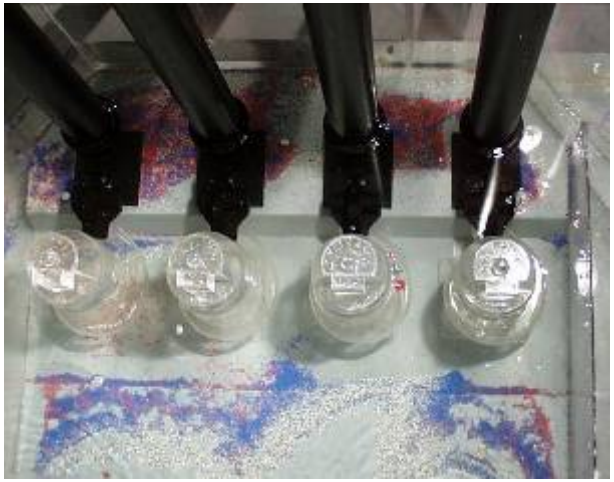




Contaminated media

Bottom sediment

- Costly and time consuming cleaning
- Clogging
- Odors



Contaminated media

Floating debris

- Costly and time-consuming cleaning
- Clogging
- Odors

Contaminated media

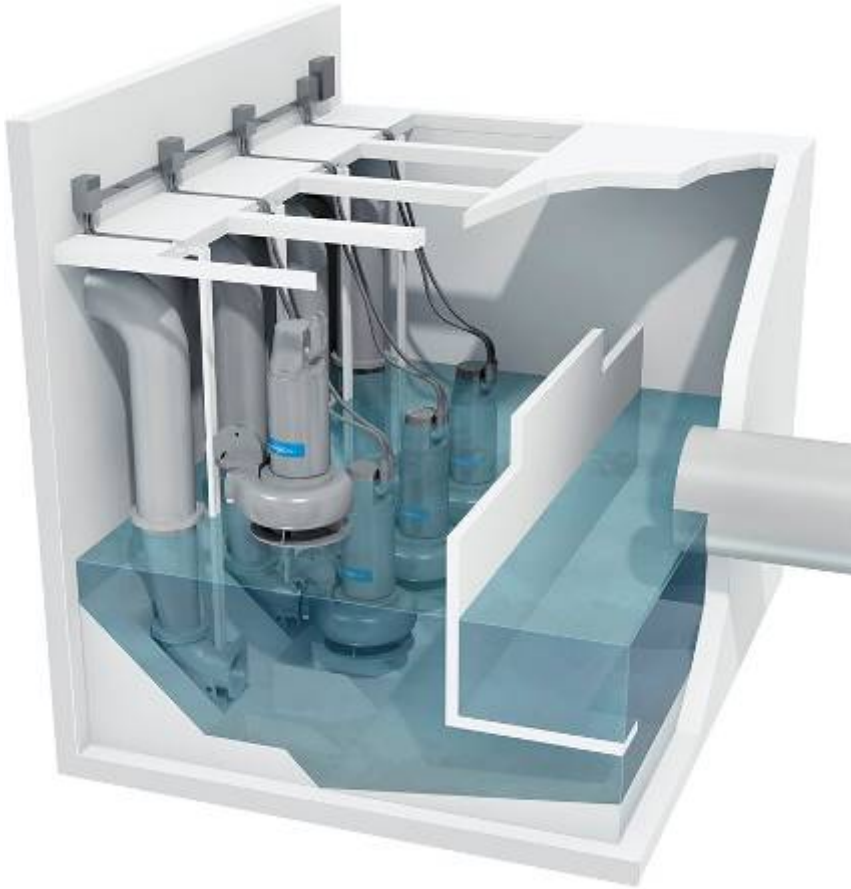
Clogging

- Pump failure
- Increased energy cost
- Increased service and maintenance

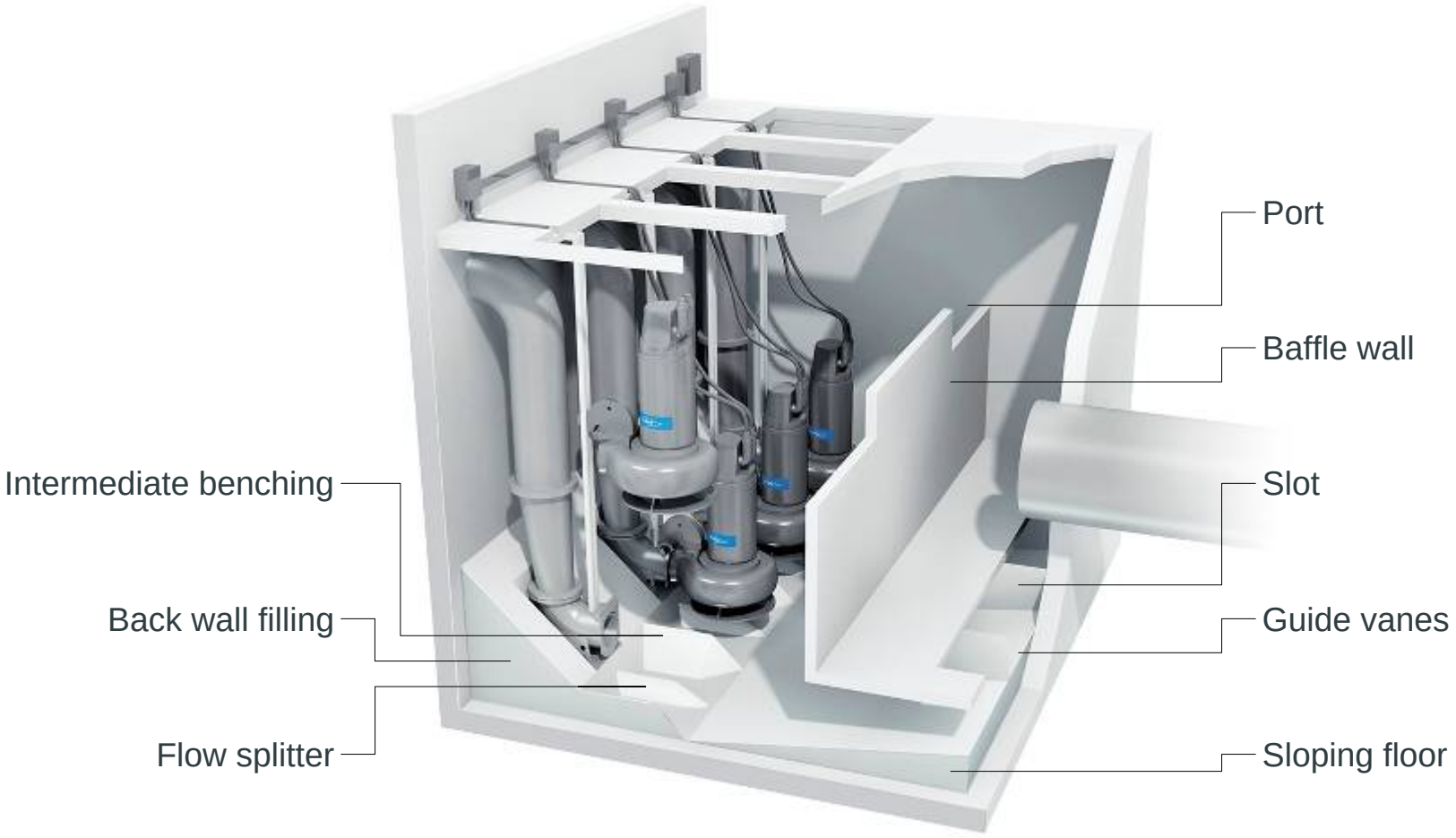
Flygt pump station design

Standard Flygt wet well designs

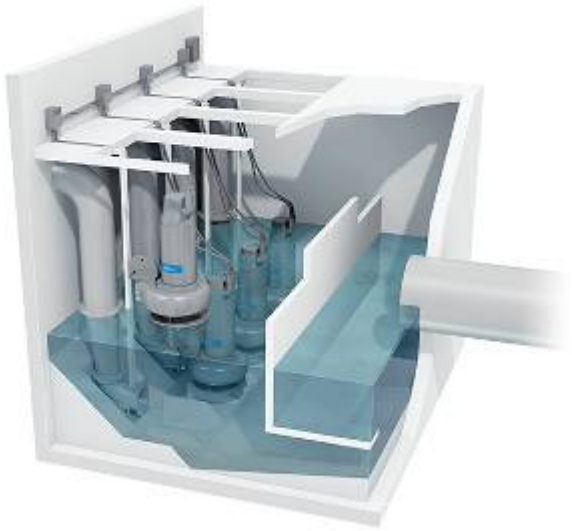
- Reduces sump size
- Meet all intake design criteria
- Prevent adverse hydraulic phenomena
- Minimize sedimentation, clogging and/or floating debris



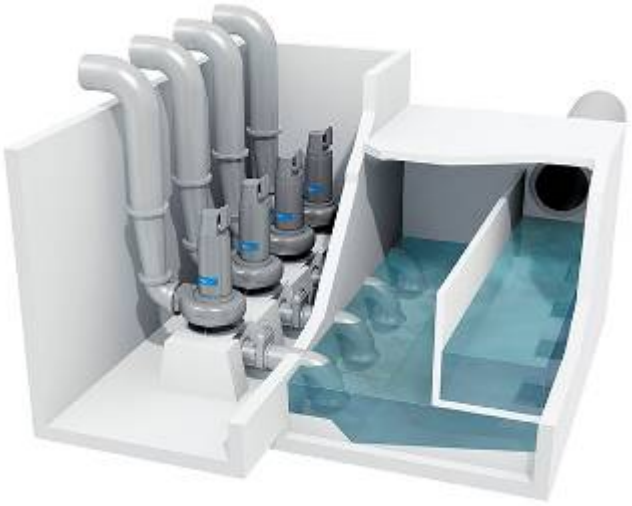
Standard Flygt wet well components



Standard Flygt wet well designs



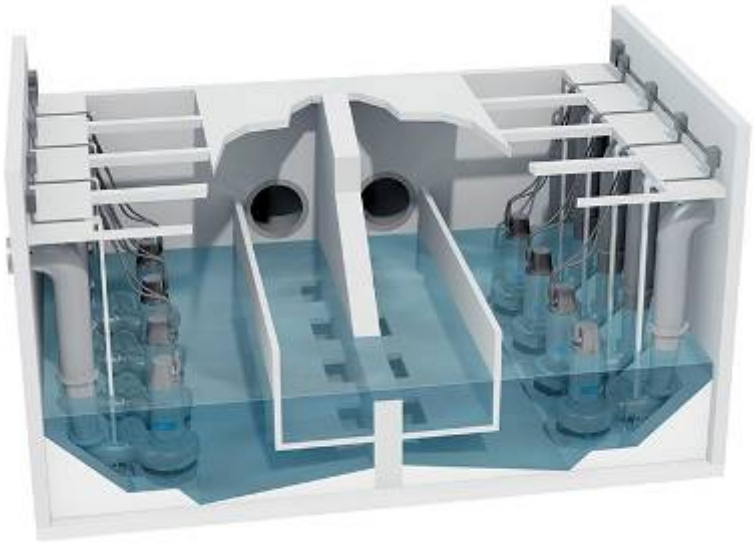
Rectangular sump with high front-entry inlet



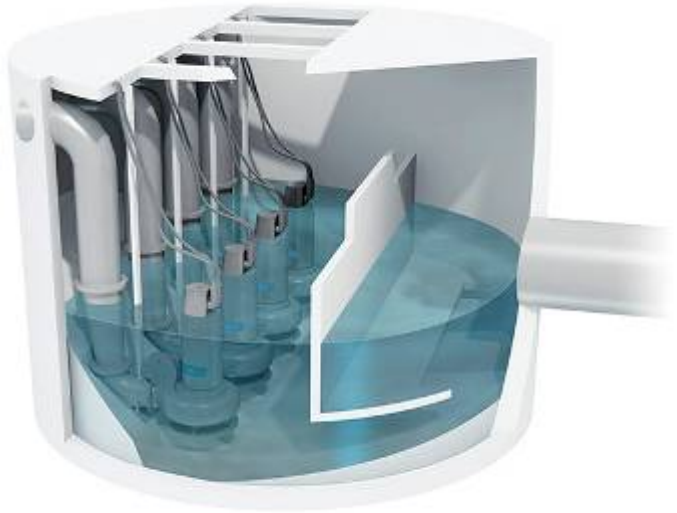
Rectangular sump with high side-entry inlet

Rectangular sump with low side-entry inlet

Alternative wet well designs

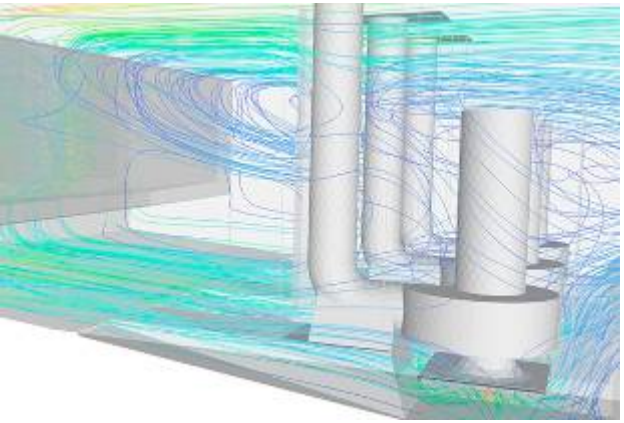


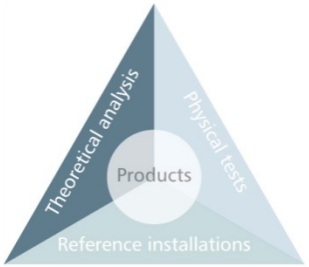
Double sump

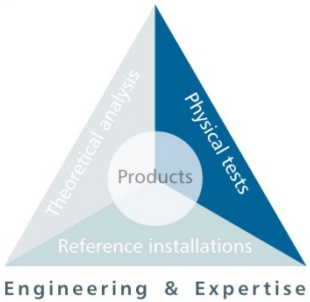


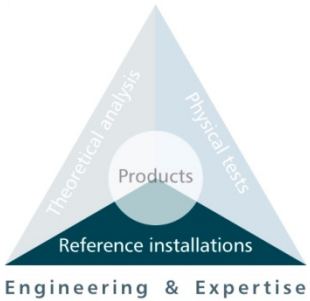
Circular sump

Verified wet well designs





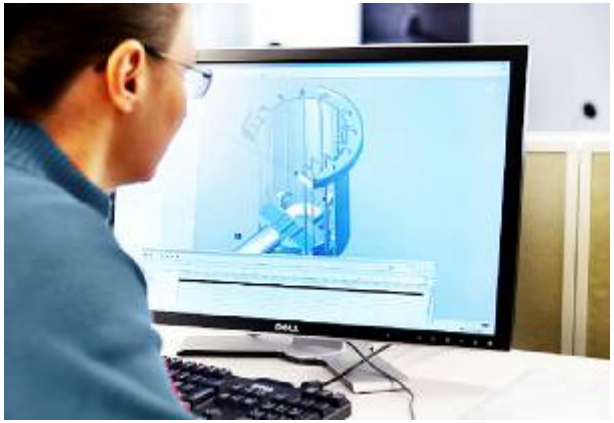




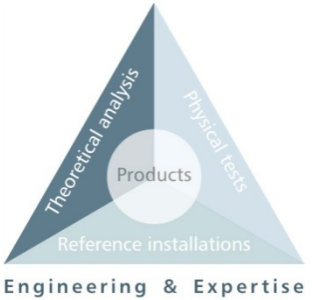
Engineering & Expertise

Engineering & Expertise

- New stations
  - Custom design
  - Analysis and verification of your design
- Existing stations
  - Troubleshooting
  - Upgrading



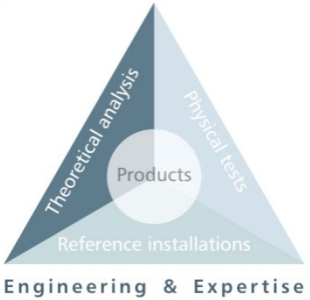
Design tools



Advanced engineering tools

- Generate sump designs for standard Flygt pump stations
- Perform volume calculations
- Create dimensional drawings

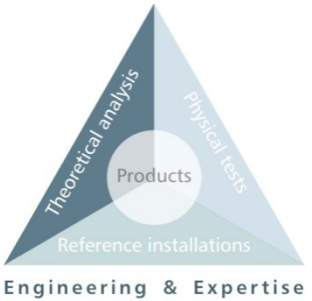
Design tools



Design recommendations

- Basic principles
- Dimensions and layout
- Minimum operation levels
- Minimum active volume
- Installation guidelines

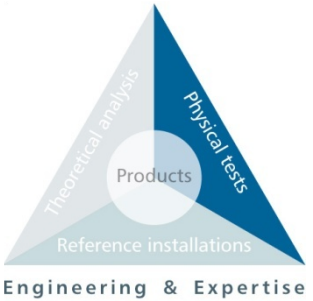
Computational Fluid Dynamics (CFD)



Substantially increases confidence in station performance

- Quickly provides detailed information of the flow field
- Pioneers in the industry since 1985
- State-of-the-art hardware and software (128 processors)

Physical testing



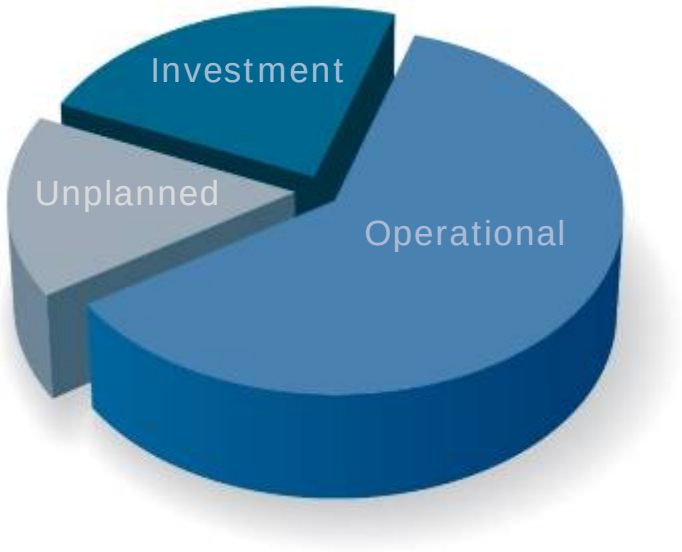
Verifies performance of a full-scale station using hydraulic models

- New stations
  - Analyzes hydraulic phenomena and sedimentation
- Existing stations
  - Identifies solutions to issues in existing installations

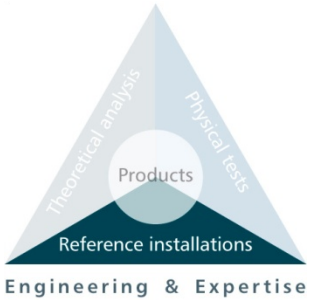
What’s in it for you

Advantages of Flygt pump sump design

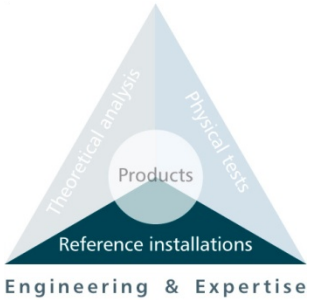
- Save money
  - Minimal station size for the most economical station design
- Realize operational efficiencies
  - Reduce and simplify planned services and maintenance
  - Maximize pump station performance
- Reduce unplanned costs
  - Increase pump reliability



Proven worldwide
Reference installations



Reference installation
United States: Circular wastewater lift station

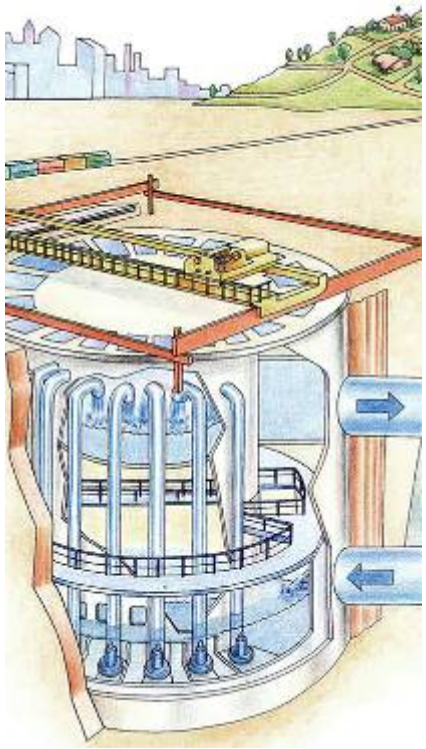


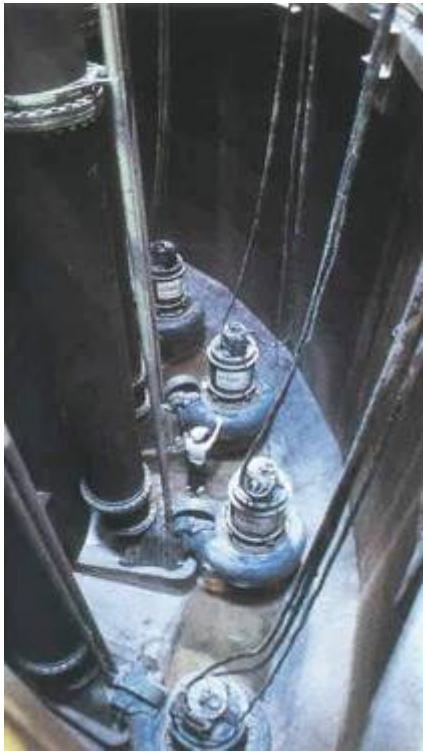
Simple, innovative design allows the use of sunken caisson construction.

Capacity: 16 m³/s
(254,000 US gpm)

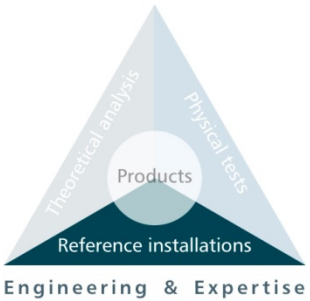
Pumps: 14 Flygt CP 3601

Head: 14 m
(47 ft)





Reference installation
France: Circular stormwater pump station



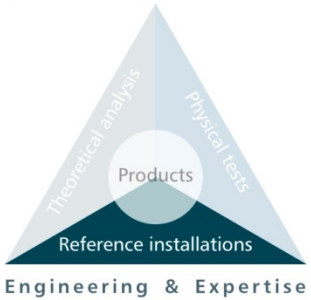
Capacity: 16 m³/s
(254,000 US gpm)

Pumps: 12 Flygt CP 3602

Reference installation
France: Circular stormwater pump station

Verified through CFD and physical tests

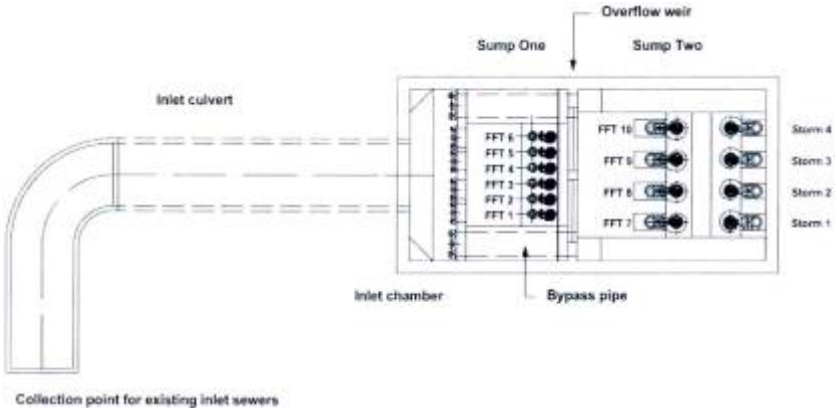
Reference installation
United Kingdom: Transfer pump station



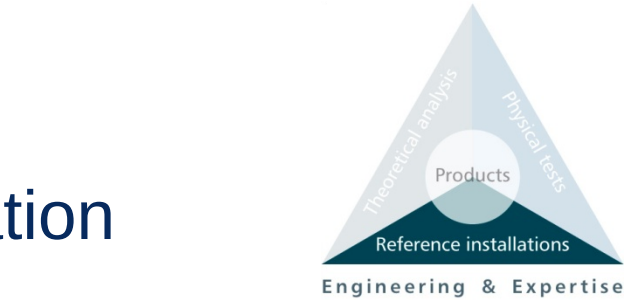
Combined sewage and stormwater station

Capacity: 6 m³/s (95,000 US gpm)

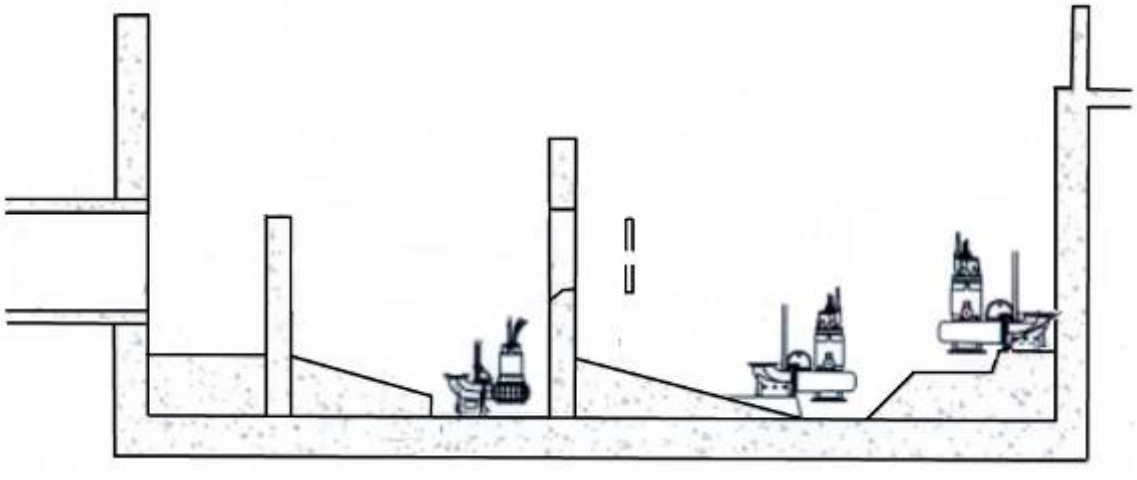
Pumps: 6 Flygt NP 3300, 8 Flygt CP 3531



Reference installation
United Kingdom: Transfer pump station



Custom design



Engineering & Expertise behind

Model test photos courtesy of Hydrotec Consultants Ltd.