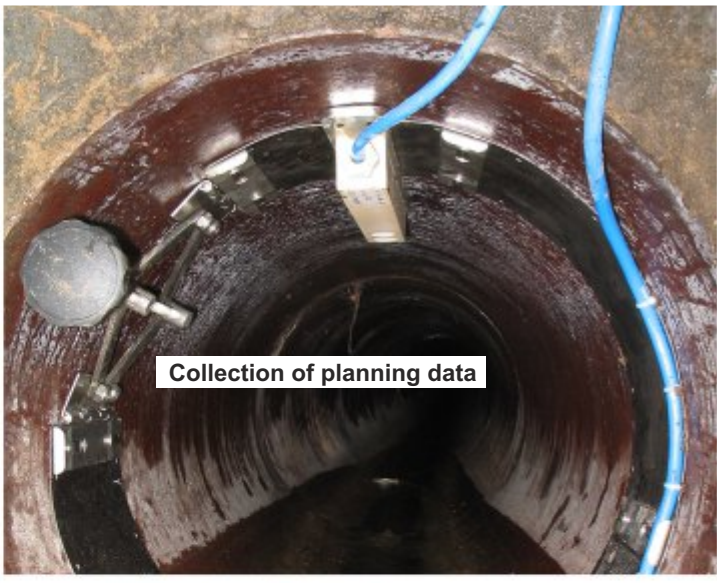
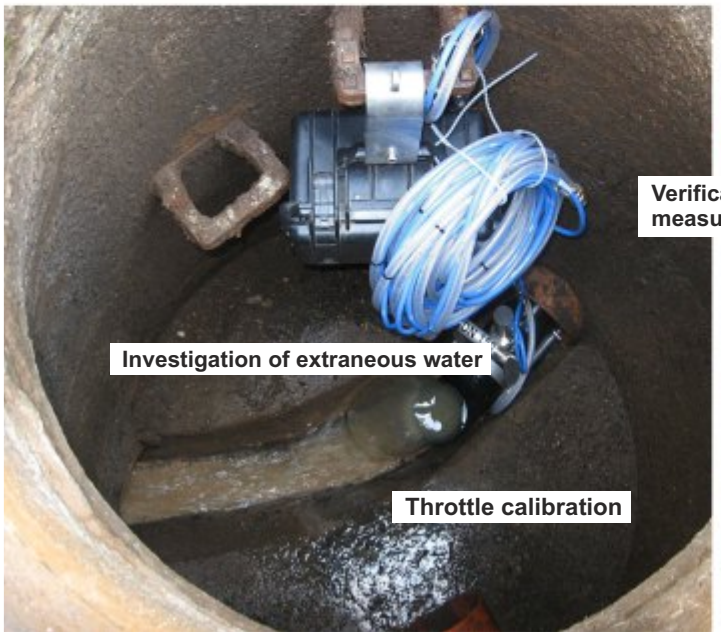
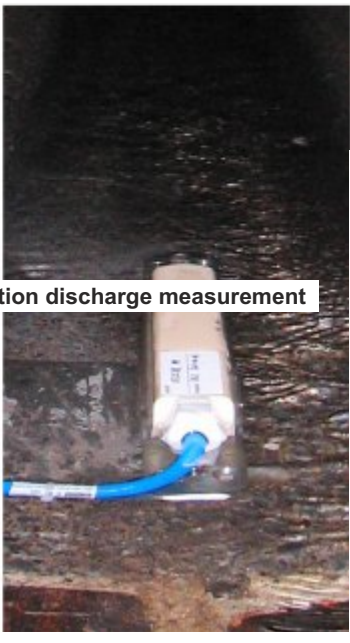
Portable Flow Measurement

Transmitters, Sensors, Accessories, Fields Of Application



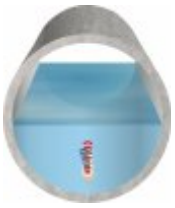


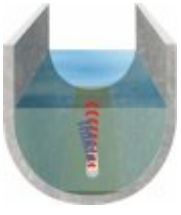


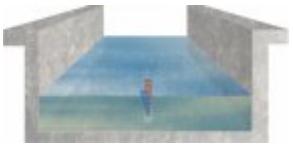
PCM – without compromises in practice

in order to assess the hydraulic conditions of sewer networks and associated special constructions it is an indispensable prerequisite to carry out measurements within the network. This is why the use of portable and mains-independent flow measurement instruments for the detection of extraneous water, channel efficiency, sewerage master planning or influent control becomes more and more important. It is very often required to carry out the measurements only for a few weeks or months to obtain representative data. Reliable and significant data representing typical operational conditions of the measurement places are to be gained with the help of these results.

The following pages provide information on the high accurate NIVUS flow meters, comprising portable instruments as well as sophisticated software solutions for the processing of measurement data.







A measurement system for portable flow measurements basically consists of a transmitter Type PCM for power supply, data entry, indication and data storage plus a sensor for the recording of measurement data.
Sensor construction as well as the built-in pickups may be customized individually according to the conditions prevailing on site.

NIVUS flow measurement stands for innovation und highest accuracy. The portableType PCM units are designed for use in part filled and full channels, pipes and flumes with various shapes and dimensions. Many communication options and comprehensive extension possibilities render the PCM even more versatile, more comfortable and more efficient.

PCM Pro, the multifunctional transmitter for Ex areas

PCM 4, the solution for areas out of Ex zones. Further systems may be connected thanks to additional interfaces.

Sensor with flow velocity measurement, redundant level measurement and temperature probe

The Flow Measurement Principle

The NivuCompact can be connected to the PCM directly

Level measurement using NivuBar Plus in stormwater overflow tank

Flow cannot be measured directly. Multiple factors are required to detect the flow Q: average flow velocity and the flow cross section. This leads to the general formula below:

$$Q = v_{(average)} \bullet A$$

The flow cross section A is investigated by continuously measuring the filling level considering the channel shape.The flow cross section and hence the flow changes as soon as the level changes.

The flow velocity is detected via the velocity of the particles. Most media contain a certain load of dirt particles or gas bubbles which move in the same velocity as the medium. The particle velocity is measured by using ultrasound. The flow changes as soon as the velocity changes.

Level Measurement (h)

Accurate flow measurement requires precise and reliable level detection under all hydraulic conditions. The development of a level measurement system with multiple redundancy is a result of our many years of experience. Combining hydrostatic measurement, water-ultrasound and air-ultrasound provides solutions for all measurement tasks. External 4- 20 mA level sensors such as NivuCompact or NivuBar Plus can be connected additionally.

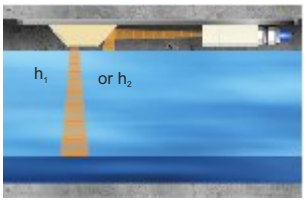
sufficient sensors for each measurement

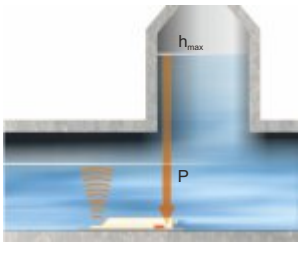
Air-ultrasonic sensor – for detection of low levels e.g. detection of extraneous water

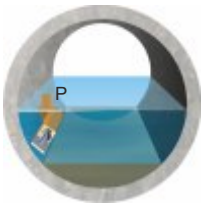
Water-ultrasonic and hydrostatic measurement – for detection of medium discharge ranges e.g. precipitation discharge measurement

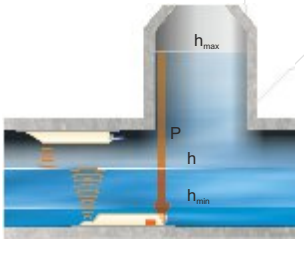
Hydrostatic measurement – for installation on the side of channels tending to sedimentation e.g. submergence detection

Air-ultrasonic, water-ultrasonic and hydrostatic measurement – for detection of the entire discharge range e.g. to investigate channel efficiency







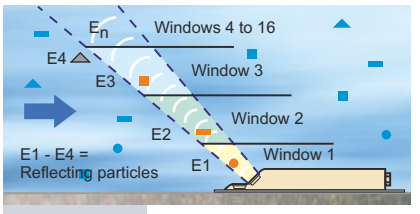


Flow velocity measurement (v) using cross correlation

The measurement method used for flow velocity investigation is based on the principle of ultrasonic reflection. One of the most modern and most efficient methods for the detection and calculation of the flow velocity is the correlation method (interrelation between two similar image patterns) by NIVUS.
A prerequisite to use this method are reflecting particles (minerals or gas bubbles) contained in the medium.

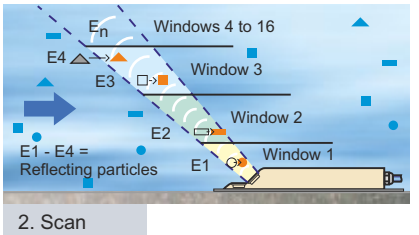
The NIVUS movie "The principle of flow measurement" thoroughly explains the flow velocity measurement using cross correlation. Just watch on ***www.nivus.com***

Existing reflectors (particles, minerals or gas bubbles) are scanned using an ultrasonic impulse with a defined angle. The resulting echoes are saved subsequently as images or echo patterns.



1. Scan

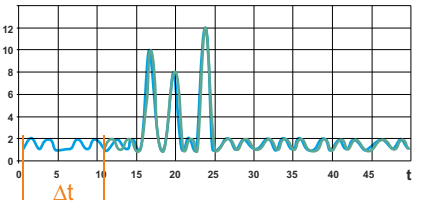
A few milliseconds later a second scan follows. The resulting echo patterns are saved as well.

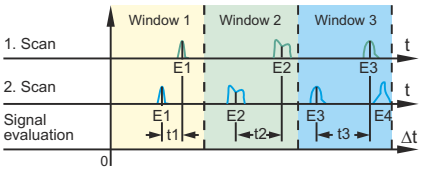


2. Scan

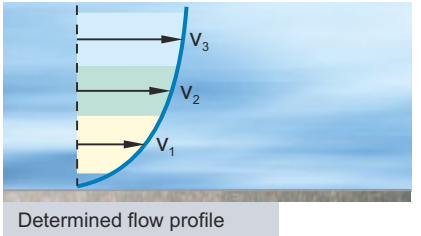
By correlating the saved signals, the positions of unambiguously identifiable reflectors can be identified. Since the reflectors have moved with the medium, they can be identified at varying positions in the images.

Overlay of image patterns





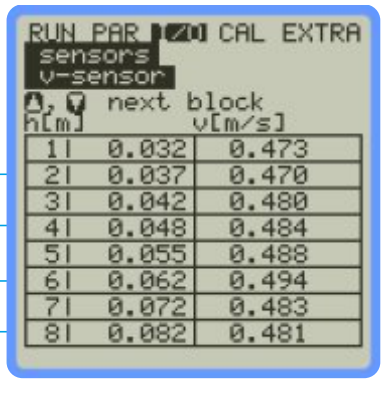
Considering beam angle and the impulse repeat rate it is possible to directly compute the particle velocity and hence the medium flow velocity from the temporal shift of the reflectors.
This allows to obtain high accurate readings without performing additional calibration measurements.



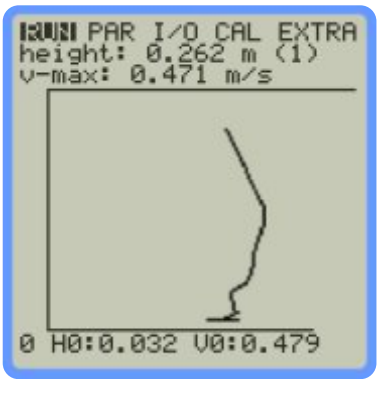
Determined flow profile

Your benefits

- Highest possible accuracy, since all particles are detected over the entire measurement beam
- Stable readings
- No calibration required
- Direct indication of flow profiles

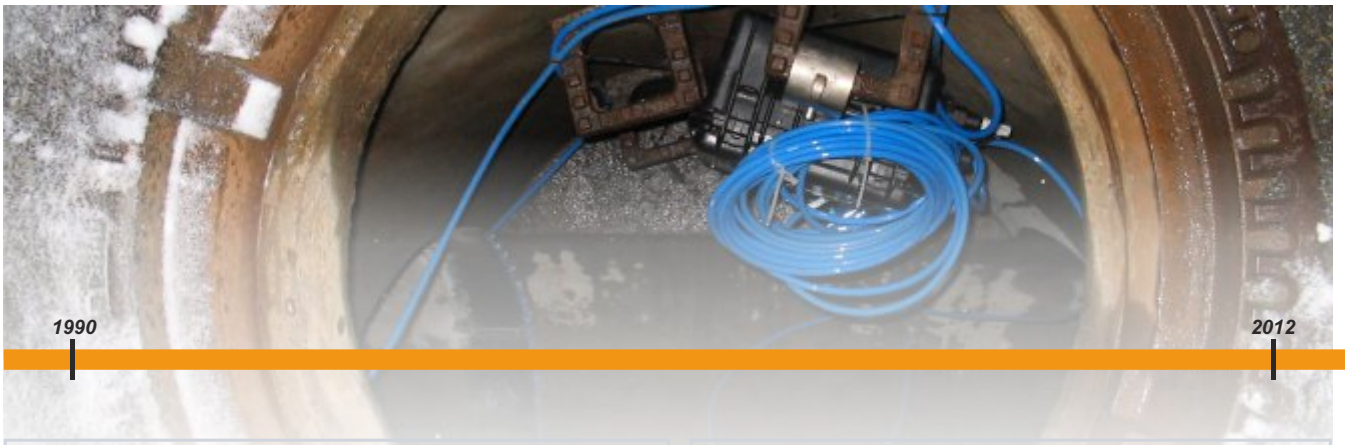


Measurement values can be directly read on the display.



Flow profile indication on the display.

Technological progress through innovative and long-standing proven technology - flow measurement with the PCM



PCM I | PCM II | PCM II Ex | PCM III

Doppler Method

PCM Pro | PCM 4 | PCM Pro 2. Generation | NIVUS Device-to-Web

Cross Correlation Method | System Solution

Your benefits

- **No additional input devices required** thanks to unique operation concept through clear text menus, start-up assistant and clear diagnostic functions and simulation modes
- The lightweight yet extremely robust enclosure allows **easy handling of the units** without the need of additional grounding measures
- **Flow conditions can be easily assessed** by using the indication of the real flow profile directly on the unit
- **Planning measurement campaigns becomes economical** thanks to reliable measurement systems, redundant data storage and online monitoring of readings

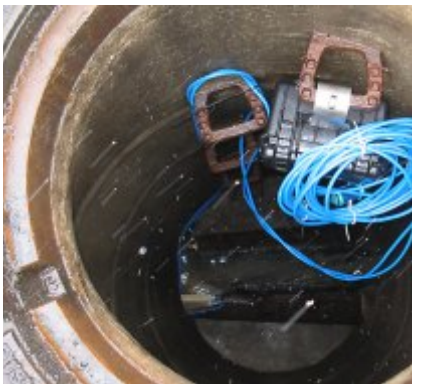
PCM – from practice for practice

As long as 20 years ago, NIVUS have been developing a product line dedicated for portable use which has been constantly improved thanks to experience gained from countless applications all over the world. The focus of any further developments is constanly on using the most innovative technologies and reducing operation costs.

The most accurate and most sophisticated flow velocity measurement is available since the portable PCM units using the ultrasonic cross correlation have been introduced in 2005.
Launching the online data portal "D2W - Device to Web" in 2010 and using GPRS data transmission, NIVUS provide a wide range of options to significantly reduce costs.

Easy and quick start-up

Thanks to the alphanumeric keypad and the back-lit 128 x 128 pixel diplay, parameters can be set and readings as well as status messages can be indicated without the need to use additional and sensitive aids such as laptops, input devices or PDAs.
Even if used in the open air, under rough weather conditions, solar radiation or if there is no power supply for peripheral devices available, operation is facilitated significantly. The unique operation concept features clear text menus, assistants for quick and error-free start-up as well as clear and efficient diagnostics and simulation functions directly on the transmitter.



Easy fastening in manholes

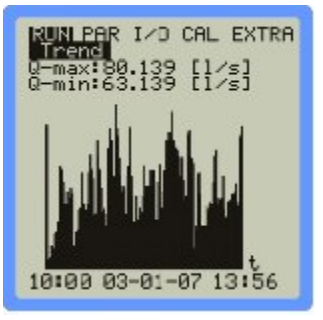
Easy operation even under poor conditions

Due to the compact construction, the PCM can be easily installed in manholes. Featuring a weight of 6.2 kg (approx. 13.7 lbs) including the rechargeable battery, the PCM is the “lightweight“ among the transmitters. There is no additional grounding connection required thanks to the use of particular enclosure materials. The very robust enclosure protects the electronic components against mechanical and chemical influences as well as effects of weather. Rugged high-performance plug connections allow to easily replace sensors. Due to this, installation and start-up can be executed independent of each other.

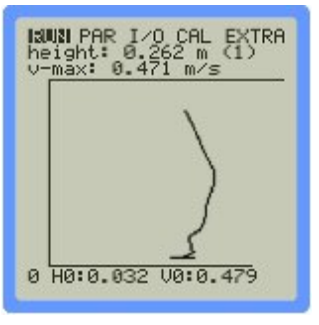
Easy assessment of measurement places

Due to the lack of calming sections, poor ambient conditions and the need to operate in public traffic areas, channel network measurements are among the most difficult measuring tasks. Being able to assess flow conditions as well as the sensor status in a quick and goal-oriented manner provides crucial advantages on site.

Thanks to the ultrasonic cross correlation the measured flow profile can be indicated directly on the transmitter. This worldwide unique feature gives the safety of having the best possible measurement right from the start-up.



Internal logging options for assessment of the measurement progress on site without additional aids



Real flow profile indication on the display

Redundant data storage

Data loss leads to high and unpredictable additional costs. Due to this reason, the PCM uses two completely independent memory media: an internal circular memory and a plug-in CF card (10 years memory). The circular memory operates redundantly containing the readings of the past 90 days. Its memory content may be copied to the CF card as often as required. This virtually eliminates data loss and allows to economically plan the use of units and resources.

The right sensor for each application

NIVUS has the right sensor for each application. There are flow velocity sensors with and without integrated level measurement as well as air-ultrasonic level sensors. Depending on your application there are varying constructions at your disposal.

Sensors for universal use such as channel efficiency, measurement spots for billing networks and much more.

Your benefits

- Sensors are absolutely drift-free and have a stable zero point
- Low installation expenses thanks to perfectly coordinated accessories
- Can be installed under process conditions
- Appropriate selection of sensor constructions ensures the best possible solution for each application
- Interference-free connection over long distances through digital signal transmission

Air-ultrasonic sensor
for level measurement, installation on channel crown

Wedge sensor
for installation on the channel bottom

Types:
- *v-measurement only*
- *combined v-measurement and h-measurement (ultrasound)*
- *combined v-measurement and h-measurement (pressure)*
- *combined v-measurement and h-measurement (ultrasound and pressure)*

Pipe sensor
for installation in pipes and in NIVUS Pipe Profiler

Types:
- *v-measurement only*
- *combined v-measurement and h-measurement (ultrasound)*

Very latest sensor technology for flow velocity measurement in lowest levels

The Type "Mini" sensor family provides the best possible measurement system to detect lowest discharges e.g. for measurement of extraneous water or indirect discharge measurements. The sensors use our patented and proven ultrasonic cross correlation method. This method allows to detect and to indicate flow profiles starting at levels of only a few centimeters.
The sensor construction is particularly suitable for small dimensions and reduces backwater effects, the risk of build-up or blockage.

Wedge sensor
v-measurement
as from a level of 3 cm,
installation on the
channel bottom

Air-ultrasonic sensor
for level measurement,
installation on channel crown

Specifications
Transmitter

	PCM Pro	PCM 4
Measurement system	**Cross correlation**	**Cross correlation**
Real flow profile measurement	+	+
Ex approval according to ATEX	**Zone 1**	-
Display / Operation		
Display size	**128x128 pixel / 18 keys**	**128x128 pixel / 18 keys**
Inputs		
4 - 20 mA for external level (2-wire)	**1**	**2**
Redundant level measurement	+	+
Digital inputs	**1**	**1**
Sedimentation measurement (WUS+ext. h-sensor)	+	+
Outputs		
Relays	**1 (with external box)**	**1**
Analog outputs 0-10 V	-	**1**
Data memory		
Flash Card up to 128 MB / internal memory 8 MB	+	+
Data transmission / communication		
Plug-in Compact Flash Card, GPRS, Bluetooth	+	+
Area of use		
	Top unit for portable measurements in Ex areas	**For challenging portable measurements in non-Ex areas**

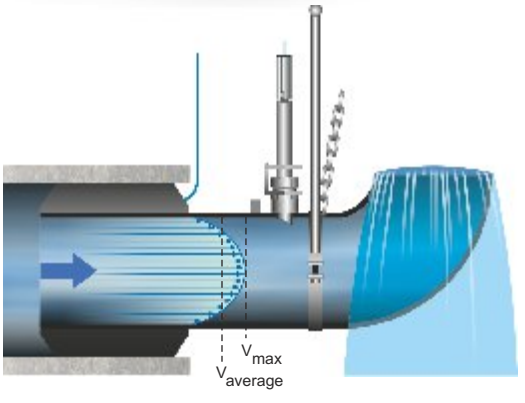
You can find comprehensive specifications in the respective manuals or on www.nivus.com

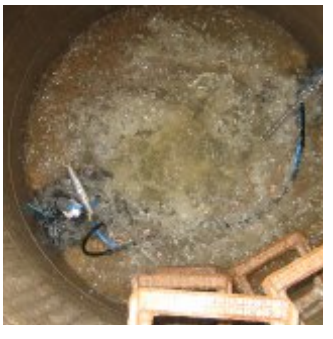
Your benefits

- Unrivalled lightweight, can be installed by one person
- High accurate measurement in full pipes and hence with ideal flow profile
- Sedimentation detection through integrated level measurement
- Versatile use in pipes with various diameters

NPP NIVUS Pipe Profiler – the portable measurement place

Pipe measuring section as extension of the portable flow measurement systems PCM Pro and PCM 4.
The flexible measurement system ensures high accurate flow determination even under difficult conditions such as low discharge volumes or poor hydraulic flow conditions.





Specifications

NPP NIVUS Pipe Profiler

Pipe measuring section consisting of inflatable balloon with clamping ring and pressure pipe with holder, sensor holder and ventilation

Max. filling pressure	1.5 bar, allow filling only by using a relief valve (additional accessory)!
Operational range	various models for pipes with inner diameters from 150 to 600 mm available
Material	pressure pipe: HDPE, inflatable balloon: natural rubber

NPP Type	Outer diameter	Inner diameter	Weight incl. sensor, without cable	Total length	For installation in pipes with inner diameter	Qmax	Q with 1 m accumulation
DN 150	148 mm	90 mm	7.5 kg	835 mm	150 - 300 mm	approx. 38 l/s	approx. 17 l/s
DN 200	190 mm	141.8 mm	13 kg	970 mm	195 - 500 mm	approx. 95 l/s	approx. 42 l/s
DN 300	258 mm	199.4 mm	20 kg	1160 mm	265 - 600 mm	approx. 187 l/s	approx. 76 l/s
DN 350	290 mm	221.6 mm	26.5 kg	1200 mm	295 - 600 mm	approx. 221 l/s	approx. 90 l/s

Your benefits

- Corrosion-proof and free of wear and tear: made of stainless steel
- Easy installation, no tools required
- Adjustable and flexible
- For diameters from 160 to 800 mm
- Extension kits for greater diameters available

Pipe mounting system: easy sensor installation in pipes

The flexible mounting system makes installation very easy.
PCM sensors can be installed in next to no time during mobile use.

Easy and variable sensor installation in a few minutes

Made of stainless steel 1.4571 (V4A)

Convenient as never before – the communication with PCM

Bluetooth for on-site diagnostics

Your benefits

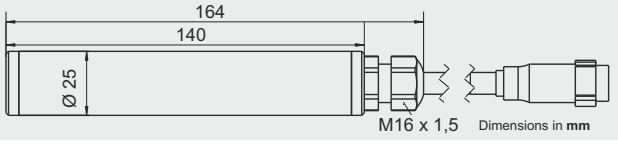
- No direct manhole access needed to operate the unit
- Easy operation through “Live-Screen” on PC
- Password protected connection
- PCM may be left in manhole in locked condition
- For use in Ex Zone 1

The Bluetooth modem is designed for on-site data transmission. The modem is particularly applicable for measurement points where direct access to the unit is difficult. By using the live screen it is possible to conveniently view current readings, to modify settings or to transmit saved measurement data e.g. from your car at the roadside without the need to remove the PCM from the manhole. This saves time and costs.

Live screen and data readout with Bluetooth

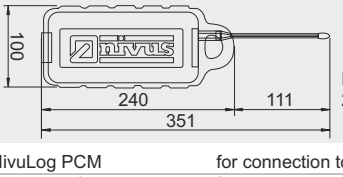
Specifications: communication

Bluetooth-Modem

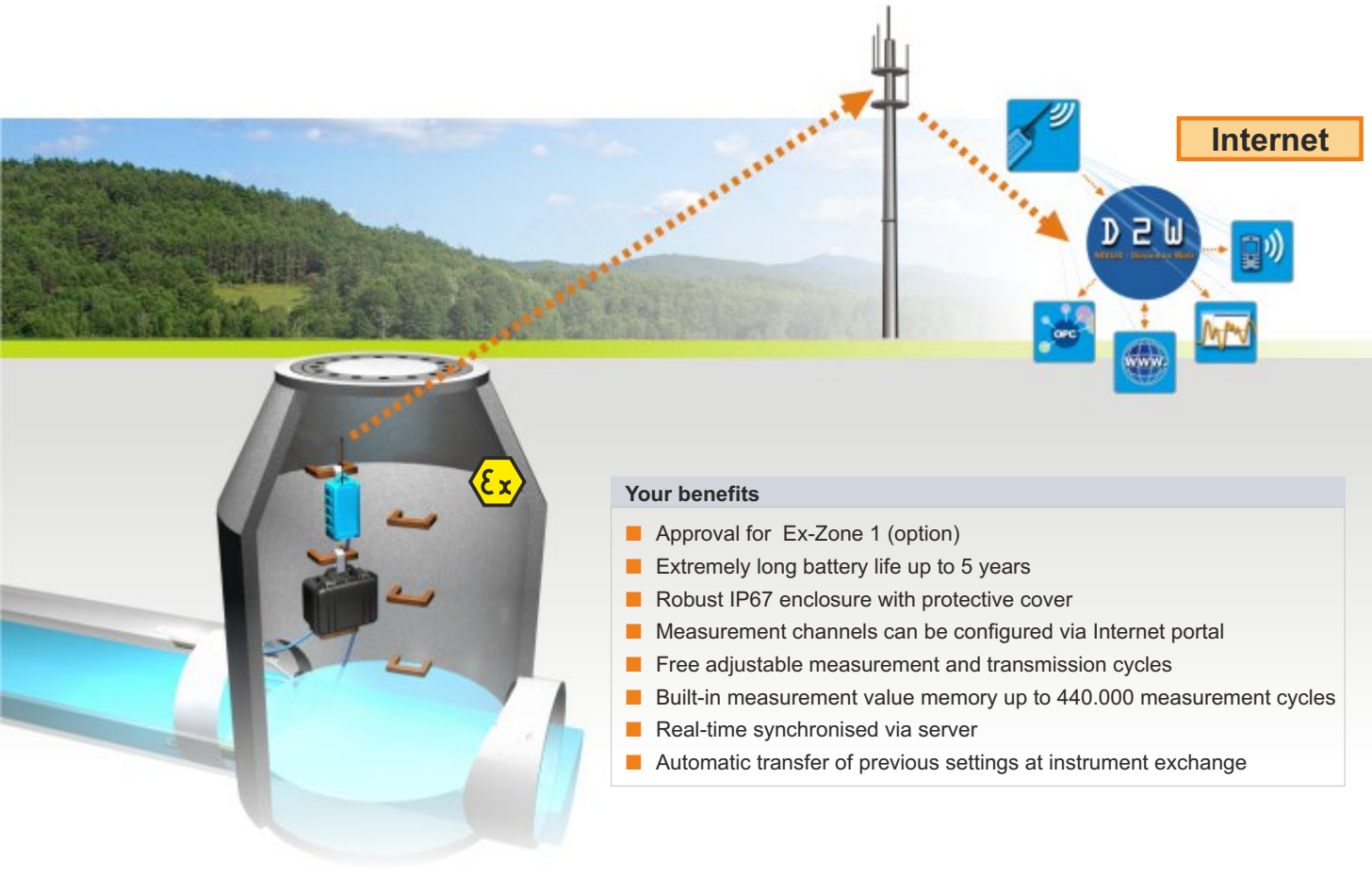


Power supply	internal supply through PCM
Power consumption / day (8 h operation / day)	0.008 Ah - PCM 4 0.012 Ah - PCM Pro
Data transmission	Bluetooth 2.0 + EDR, 2.4 GHz
Operation distance (up to)	100 m at free sight, 10 m if manhole is closed
Cable length	2.5 m
ATEX protection	II 2G Ex ib IIB T4

GPRS Data logger NivuLog PCM / NivuLog PCM Ex



NivuLog PCM	for connection to the PCM 4
NivuLog PCM Ex	for connection to the PCM Pro
Power supply	Standard or rechargeable battery pack
Battery life	Battery life up to 24 months through MicroPower® Technology
Data Transmission	GPRS
Protection	IP67
ATEX protection	II 2G Ex ib mb IIB T4 (only NivuLog PCM Ex)



Your benefits

- Approval for Ex-Zone 1 (option)
- Extremely long battery life up to 5 years
- Robust IP67 enclosure with protective cover
- Measurement channels can be configured via Internet portal
- Free adjustable measurement and transmission cycles
- Built-in measurement value memory up to 440.000 measurement cycles
- Real-time synchronised via server
- Automatic transfer of previous settings at instrument exchange

GPRS for worldwide data access and diagnostics

The NIVUS data loggers enable stand-alone operation of measurement places. Data are generated by PCM transmitters and sent via GPRS in GSM networks. This allows to reliably transmit readings without interruption.

The complete solution by NIVUS not only provides perfect interaction of reliable measurement systems, data transmission, storage, alarms and data processing, but furthermore helps to optimize maintenance and to minimize downtime.

Data logger, mounted in manhole

Your benefits

- Minimised measuring periods due to highest reliability
- Worldwide data control and unit control
- Sophisticated error message management
- Almost 100 % data availability due to redundant systems and daily data backups

Complete solution for the logging of readings, transmission and management of data

The complete solution by NIVUS comprises high accurate instruments and optimised data flow from the measurement point to the end user.
The perfectly adjusted interfaces between the components are the tools for efficient data collection and mesurement campaigns. The online data portal "D2W - Device to Web" is at the heart of the system. It is here where data are saved which have been transmitted via GPRS. A variety of options for the direct analysis of measurement data, system inspection through data forwarding to alarm management is at your disposal here.

Internet

The “D2W - Device to Web“ data portal can be accessed via Internet without the need to install additional software. Password protected areas provide comprehensive options to control any functions of measurement places. The most important information on the condition of the measurement place are indicated immediately after logging in. This includes e.g. the battery voltage of measurement units and modems, time and date of the latest data transmission or the GPRS signal strength. Measurement data can be visualised as graphs or tables. Downloading the readings to PC allows to comfortably further process the data. Projects can be managed by several persons online thanks to using the unit and measurement place admistration including options for the documentation of images, installation data and installation places of measurement points.

integrated alarm functions

NIVUS has found a very comfortable and user-friendly solution for this task.
Up to 3 mobile phone numbers or e-mail addresses can be directly entered in the data portal. Alarm messages can be configured by using a clear list.

OPC interface

Readings and system messages can be integrated into existing control systems by using a standard OPC interface.

Measurement data are transmitted to the “D2W - Device to Web” data portal as described before. The data then can be input into the control system from there. Readings can be integrated into available and known systems in a straightforward manner.

NivuSoft – uncomplicated data evaluation

The newly developed data processing software NivuSoft provides all conceivable possibilities for the visualisation of measurement data, evaluation and reporting. The software operates local and provides communication with the "D2W - Device to Web" online data portal, which enables to directly receive and to process saved readings. Appealing design, clear control elements as well as drag&drop functions lead to intuitive usability.

Project management

NivuSoft allows to comfortably manage even extensive projects by setting up structures from projects through measurement campaigns down to single measurment points. Maintenance reports, images or even presentations can be allocated to single measurement points using drag&drop. Files can be opened, processed and saved directly in the NivuSoft application. The original raw data as read from the instruments remains untouched. Processed data are copied to a working folder automatically. This ensures clear traceability of the measurement data progress.

Visualisation of measurement data

NivuSoft has comprehensive functions for the visualisation of measurement data. Readings from different measurement places can be added to graphs and tables by using drag&drop. Furthermore it is possible to synchronise various graphs tables and statistics. This allows to e.g. immediately indicate values, which have been changed in tables, in graphs as well and to consider the modifications in the statistics. Extensive zooming functions, free axis scaling, selectable hydrograph colors and more complete the package.

Data eveluation and calculation functions

Apart from a pocket calculator, computing functions for data compression and statistic evaluations, there is a so-called hydraulic calculator available. This calculator features all computing functions common for data evaluation in wastewater treatment, including calculations such as using Manning – Strickler or data verification using regression. Volume calculation over weirs, in channels and pipes as well as options to enter customised profiles and discharge curves are standard functions of NivuSoft.

Reporting

The report assistant enables to create a documentation of measurement data and measurement points. Customisable templates allow to predefine individual reports. The reports can be allocated to measurement places in NivuSoft, saved locally or directly sent via e-mail. It is even possible to export individual readings as data for common spreadsheet applications as well.

Expansion possibilities

The software has an interface which allows to integrate add-ons supplied by NIVUS or even customer-programmed add-ons. Due to this, the software can be extended as desired allowing adjustment to customer requirements.

The perfect solution for each application

No matter if used by local councils, water and environment authorities, engineering consultants and planning agencies, test centres or authorised experts - with its versatile and universal areas of use, its high accuracy and user friendliness the PCM represents a long-life and reliable working flowmeter.

Areas of use

- Investigation for infiltration
- Determination of data records for the hydraulic calibration of discharge models
- Billing networks
- Recording of planning data for storm water tanks
- Recording of rainwater feed according to BWK M3
- Throttle calibration
- Verification of existing sewer systems
- Indirect influent monitoring
- Temporary verification of process flows

Sampler control

Definition of task

- Apart from measuring the flow rate, pollutant concentration as well as medium temperature are to be measured in the discharge of an industrial firm
- Quantity-proportional sampling is required in order to measure the pollutant concentration in the medium

The solution

The Ex protected PCM Pro flowmeter with wedge sensor has been used for flow rate detection.
Since very low filling levels are to be expected depending on processes and time of the day an additional air ultrasonic sensor has been installed to detect low levels.
It was not necessary to install an additional probe for temperature detection since this is a standard feature of the sensor. An according quantity impulse has been fed to the sampler out from the Ex area.

Your benefits

- Installation expenses can be minimised thanks to compact construction and sophisticated mounting systems
- Optimised process flows through detection of the volume flow and simultaneous measurement of pollutant concentration

Investigation of extraneous water

The term “extraneous water” comprises all waters which are not polluted due to domestic, commercial or industrial use or which result from precipitation events. Extraneous water stresses sewer channels as well as wastewater treatment plants and moreover makes it difficult to plan the dimensions e.g. of stormwater tanks. Therefore every attempt is made in order to minimize its percentage of the total amount of mixed water.

Definition of task

- The percentage of extraneous water is to be detected at night during defined dry weather periods
- Precipitation shall be detected to define dry weather periods
- Continuous instrument monitoring
- Very low flow volumes shall be detected

The solution

The proven flowmeter PCM Pro and the portable measuring section NPP have been used.
The NPP ensures high accurate flow rate measurement even under difficult conditions such as low flow volumes or poor hydraulic flow conditions.
Precipitation volumes have been detected using a rain gauge with a recording resolution of 0.1 [mm/impulse]. The highest risk of sensor sedimentation is at very low flow rates. Therefore it is very important to frequently maintain the sensors on site to ensure proper function.
To reduce the frequency of maintenance cycles, all measuring devices in the Ex area have been equipped with GPRS. Operator and customer thus have been able to monitor the measurement data continuously using the online data portal “D2W - Device to Web”.

Your benefits

- The NPP is very flexible to use. The very low weight enables one person to install it in diameters up to 600 mm without using a winch
- Discharges lower than 1 l/s can be measured very stable and accurate
- Expert advisory service by NIVUS: from creating the measurement concept through selecting the measurement spots, location of the rain gauges and the instruments through data evaluation
- Permanent data monitoring allows economical use of staff and material resulting in significant reduction of costs

Channel utilisation

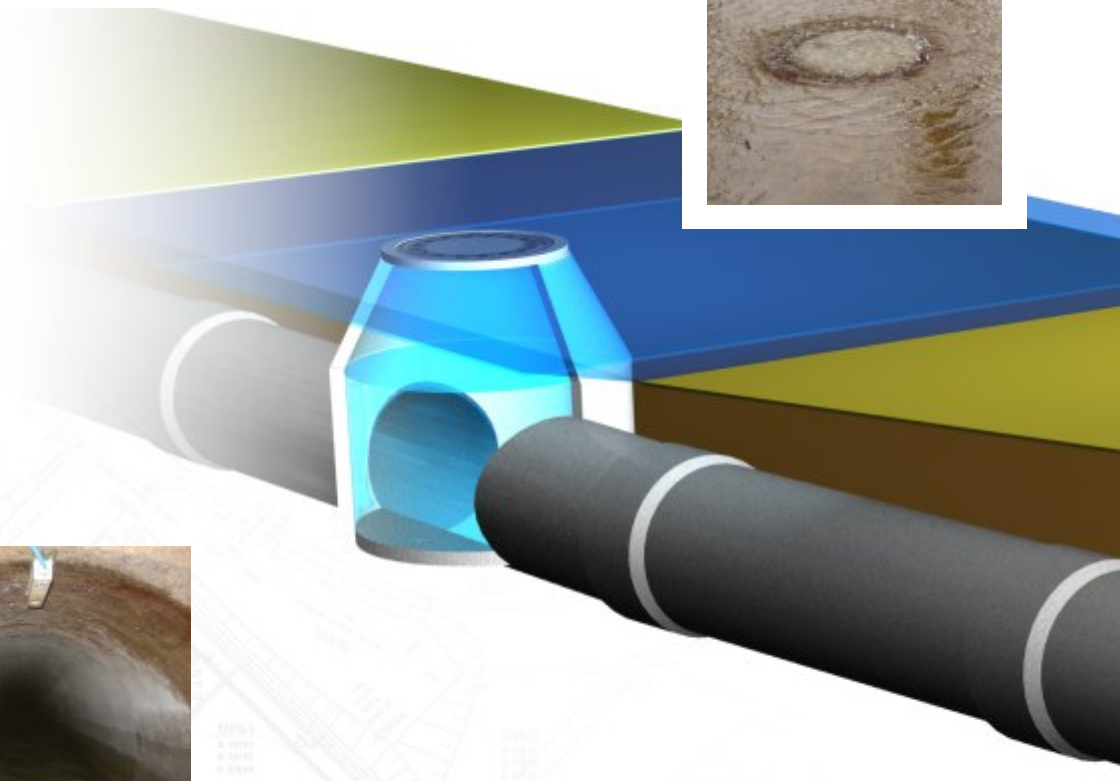
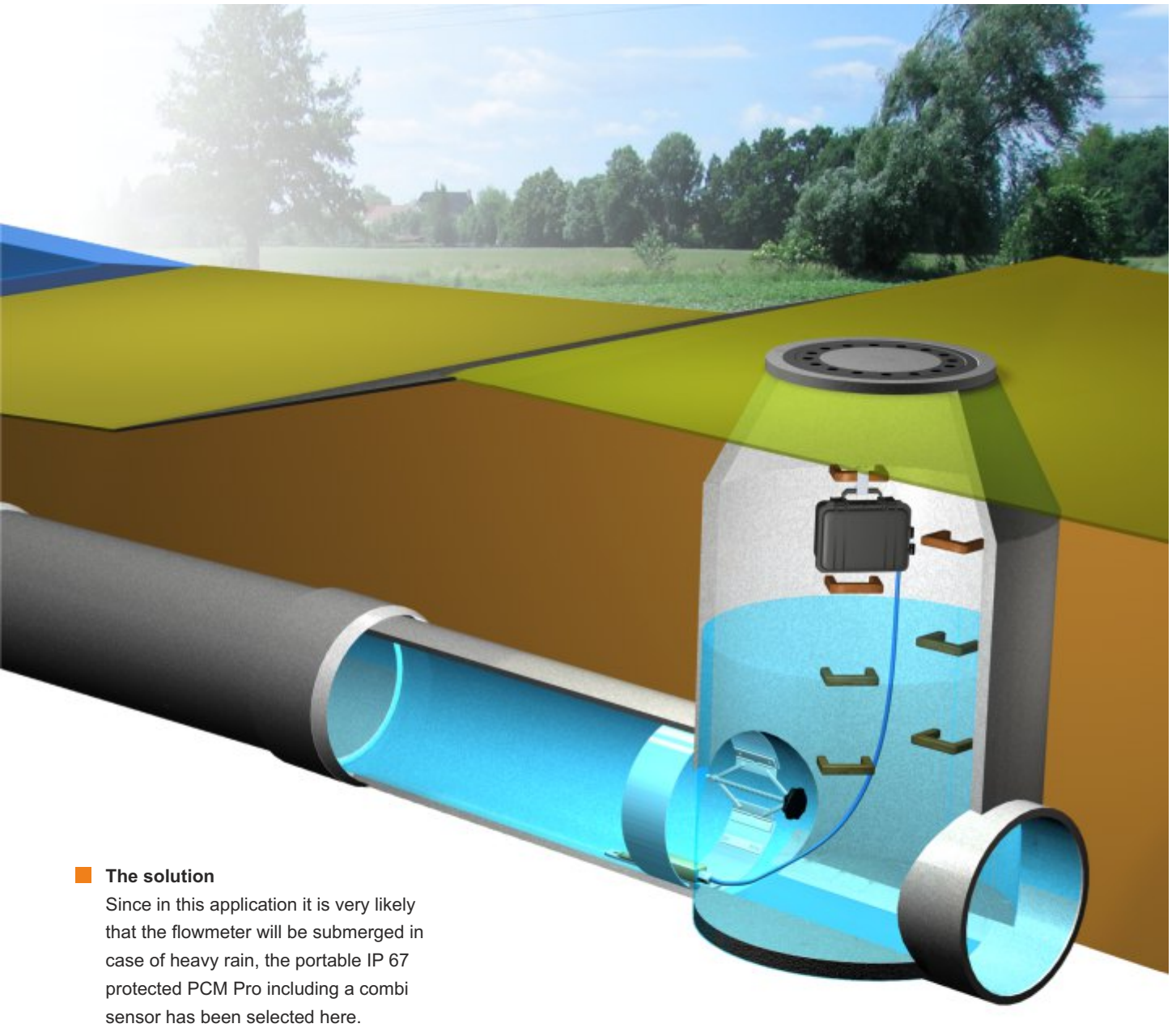


Photo: Denis Gödecke

Definition of task

- Measurement of precipitation discharge and channel utilisation as part of a sewerage master plan
- The data density in case of precipitation shall be higher than in case of dry weather discharge
- Possible submergence and hence flooded manhole entry shall be detected



The solution

Since in this application it is very likely that the flowmeter will be submerged in case of heavy rain, the portable IP 67 protected PCM Pro including a combi sensor has been selected here.
The level in the event of submergence can be detected reliably with the sensor-integrated hydrostatic level measurement. The flow velocity shall be detected high accurately during dry weather periods, rainfall events and during backwater conditions.

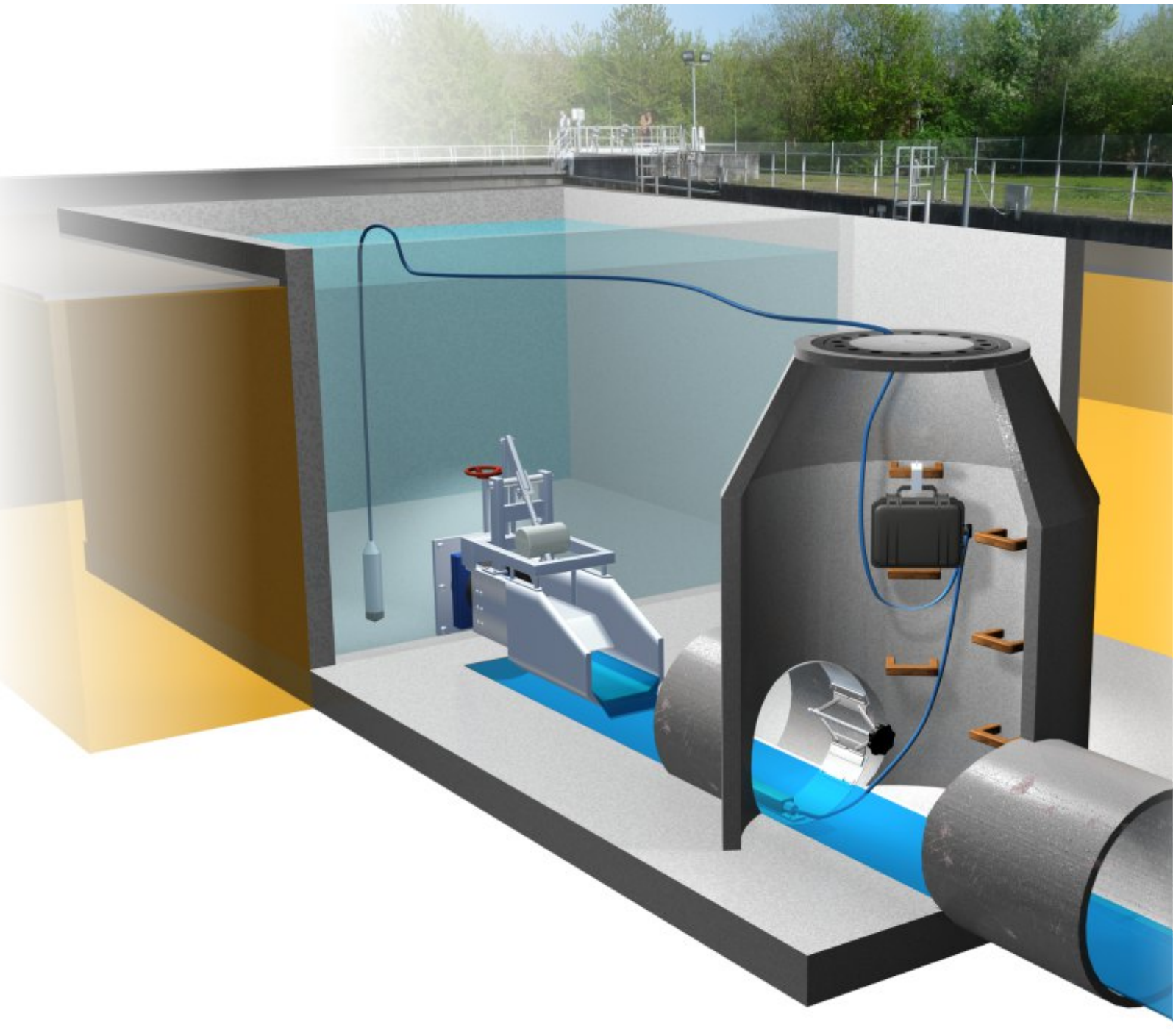
To accurately measure under such dynamic discharge conditions the cross correlation method with flow profile detection has been used. In order to increase the density of measurement data in case of precipitation, the level has been monitored permanently causing the measurement cycles to switch over after a defined threshold has been overshot.

Your benefits

- This task requires to detect data within a very wide measurement range (dry weather to max. stormwater discharge). NIVUS solves this problem by using various level probes
- By switching over between measurement cycles it is possible to obtain the best achievable relation between density of readings and battery lifetime
- Error-free operation even under backwater conditions

Throttle verification

Throttle verification normally is officially prescribed by authorities and serves as proof of the facility performance, to ensure appropriate drainage performance and to protect water bodies.



Requirements

- Creation of proof of throttle equipment performance as officially prescribed by authorities.
- Simultaneous detection of tank filling level
- Long-term measurement desired for verification during stormwater events

The solution

For throttle verification the portable flow meter PCM Pro and a combi sensor have been selected.
Since the relation between throttle discharge and tank filling level had to be considered, a hydrostatic level measurement (NivuBar) has been installed in the reservoir.
The level data were continuously detected at the same time and were saved in the PCM. By determining the individual flow profile using cross correlation it was possible to high accurately detect the throttle rate without extensive calibration.

Switching over between measurement cycles enables to detect readings during discharge throttling with the best possible resolution.

Your benefits

- Since measurement calibration during discharge throttling is impossible, flow velocity measurement with flow profile detection is the best possible solution
- Simultaneous storage of level readings and flow rate data significantly facilitates data evaluation

Do you need a particular solution for your measurement tasks or are you interested in more application examples and references? **Just talk to us!**

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