OTT Hydromet

Long-Term Water Quality Instrument Installation Guide: Streams/Rivers

Suspended Vertical Installation

Water quality sondes can be tethered / suspended from the bridge. Bridges provide optimal access, maximize control of selecting deployment location within the cross section and keep personnel out of water.

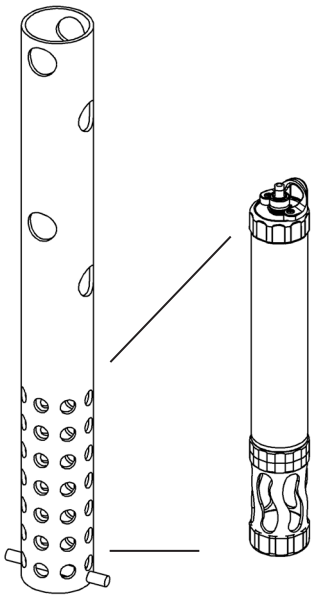

Figure 1. Vertical installation – hole placement

KEY CONSIDERATIONS

- Streams are dynamic: water levels change – may need to change the installation over the course of time – install at low water levels
- Hang sonde with steel cable or chain to reduce stress on instrument connectors and sonde cable
- Sondes connected to real-time site controller / data collection platform may require additional protection for communication cable to protect against floating debris
- Protect sonde and provide easy access to communication cables
- PVC or steel case protects sonde and sensors from debris in water
- Observe and avoid any obstructions downstream that the sonde could float into during high flows
- Ensure that it can be accessed in time of high flow
- Ensure there are enough holes in the PVC or steel pipe installed to protect the device and ensure adequate water flow, especially during low flow conditions
- Where possible install near a staff plate (gage board)
- Consider a winch for raising and lowering

MAINTENANCE

- Clean pipe inside and out at least two times / yr
- Sites prone to fouling:
  - Use chimney brush to clean inside of pipe
  - 2 lbs. barbell weight tied to rope – lower in pipe to scrap off heavy growth
  - Consider lining pipe with copper (copper tape on outside or copper pipe inside)
  - Consider use of copper-based antifouling paint

WHAT TO AVOID

- Avoid or stay clear of navigation channels or areas of high recreation use
- Do not suspend a length > 40 m
- Avoid installing on bottom of streambed – increases fouling from sediment
- Avoid deploying on upstream side of bridge piling (high risk for rafted debris damage/destruction)

SUSPENDED VERTICAL INSTALLATION

Cost

- Pipe and steel cables or chain - Low capital expense
- Check if your agency has special insurance that could cover damage or losses such as lightning or vandalism

Security

- Medium – deployed from bridge, may be secured by locking cap on tube

Accessibility

- Site Access - High – access from bridge
- Instrument Access – Medium – requires pulling up device from water

Pros

- Bridges provide access to selecting optimal deployment location within the cross-section, e.g., parallel flow
- Ideal method for braided channels
- Flowing water minimizes sediment build in pipe
- Install without drilling holes in bridge structure or pillars
- Get personnel out of water when stream is too deep to wade
- Install vertically, sonde can be raised and lower to reduce fouling from sediment near the streambed
- Suitable for temporary installations

Cons

- Suspended monitor more visible and more noticeable
- Not ideal for sites with low flow, may limit exchange between water in pipe and water being monitored
- More susceptible to damage from floating debris
- Not an ideal technique for waterbodies with boat traffic or leisure activities
- Not ideal for urban installations
- Not all bridges have wide shoulders or foot paths to keep personnel away from traffic

Best Practices

- Open ended pipe with removable horizontal bolt(s) to allow sediment to fall out while keeping the sonde at the same position
- Holes drilled in pipe should be > 1.2 in. (30 mm)
- Additional holes in pipe where sonde is located, refer to figure 1.
- If possible, use vertical slots to optimize flow
- For PVC - schedule 80 for installations subject to debris or schedule 40 for short term installations
- Use steel pipe if possible where heavy debris expected
- If using short pipe section (ex: 3-4 ft.), protect sonde communication with additional PVC pipe

Pipe Installation

Water quality sondes can be installed from stable stream banks or from a bridge fixed to column or mooring pier. This is a secure and stable installation method for continuous long-term water quality measurements using a multi-parameter sonde.

KEY CONSIDERATIONS

- Streams are dynamic, median water levels may experience seasonal changes, requiring vertical adjustment for optimal placement of sonde
- Hang monitor inside pipe with light steel cable, chain, or nylon rope to reduce stress on instrument connectors and cables
- Access to sonde and sonde cable for connecting to site controller / data collection platform
- Access to instrument during high water levels
- Where possible install near a staff plate (gage board)
- Use of PVC or steel pipe to protect sonde from debris in water
- Ensure there are enough holes in the PVC or steel pipe installed to protect the device
- Consider fixing pipes using mechanical clamps versus drilling into structure
- Consider navigation or recreational use and appropriate markings or signs
- Obtain permits or permission from stakeholders or asset owners, e.g., drill holes in bridge

WHAT TO AVOID

- Avoid installing pipe on bottom of streambed to reduce fouling from sediment
- Avoid drilling into structures without proper permission
- Avoid mixing metals (ex: stainless steel and galvanized metal)
- Do not use untreated wood

PIPE INSTALLATION

Maintenance

- Clean pipe inside and out at least two times per year
- Sites prone to fouling:
- Use chimney brush to clean inside of pipe
  - 2 lbs. barbell weight tied to rope – lower in pipe to scrap off heavy growth
  - Consider lining pipe with copper (copper tape on outside or copper pipe inside)
  - Consider use of copper-based antifouling paint

Security

- Low to medium, material and structure dependent
- Pipe may be highly exposed

Accessibility

- Site access varies, highly dependent on site selection and design
- Instrument access – high

Cost

- Moderate capital expense

Pros

- Installed instruments can be raised and lower to reduce fouling from sediment near the streambed
- Instrument can be protected from large floating debris in water and vandalism
- Suitable for urban installations
- Does not require a bridge to install

Cons

- May be difficult to access
- Without maintenance sediment may build-up in pipe overtime
- Not ideal for braided streams

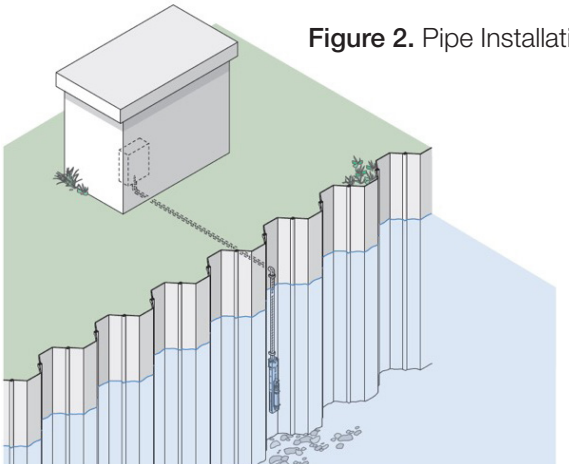

Figure 2. Pipe Installation

Best Practices

- Open ended pipe with removable horizontal bolt(s) to allow sediment to fall out while keeping the sonde at the same position
- Holes drilled in pipe should be > 1.2 in. (30 mm)
- Additional holes in pipe where sonde is located, refer to figure 1.
- If possible, use vertical slots to optimize flow
- For PVC - schedule 80 for installations subject to debris or schedule 40 for short term installations
- Use steel pipe if possible where heavy debris expected
- Extend pipe away from streambank – into flowing water
- Adequately mark / sign to denote location of physical structure(s) (ex: navigation marker)
- Low angle installations – draw ropes can be used to assist with lower instrument by pulling on draw rope

Rail Installation

Water quality sondes can be installed on a rail system anchored to a stable bank. Suitable installation method for continuous long-term water quality measurements and for collecting data from multiple co-deployed instruments.

KEY CONSIDERATIONS

- Water quality chemistry near bank should represent cross section conditions
- Streams are dynamic, median water levels may experience seasonal changes, requiring vertical adjustment for optimal placement of sonde
- Slack water/eddies likely to be poor representation of dissolved oxygen from high BOD and terrestrial carbon input from shore
- Bank erosion
- Ability to establish a solid foundation (ex: installing steel stakes) for installing heavy rail
- Ideal for ‘engineered channels’; such as concrete culverts and weirs
- Installing multiple sensors (ex: water quality sonde and side looking Doppler or nutrient sensor)
- Installation of instrument – horizontal only versus flexible (horizontal and vertical)

WHAT TO AVOID

- Avoid installing the rail where the instrument and rail is too far away from bank –
  - Susceptible to damage from debris and high flows
  - Increases cost of installation due to anchoring requirements
- Avoid climbing on rail system to access instrument

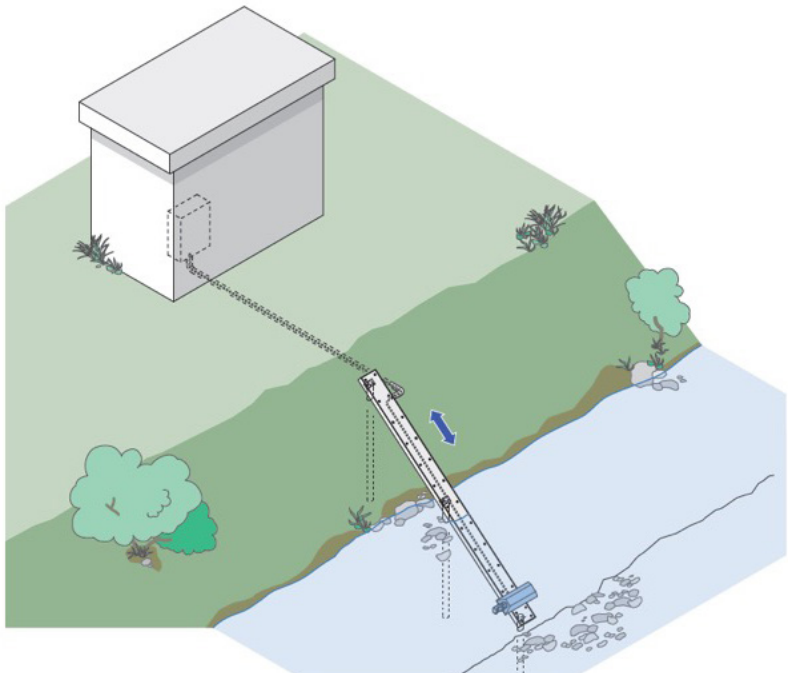

Figure 3. Rail Installation

RAIL INSTALLATION

Maintenance

- Be thoughtful when considering engineering design to retrieve/deploy instrument sled using a winch, chain, or relocating pole
- Requires regularly cleaning rail to remove debris
- Ensure rail guides (mechanism for moving rail up/down) is regularly cleaned

Security

- Design and material dependent (ex: wooden rail versus concrete pad with permanently fixed rail)

Accessibility

- Site access – High – Full access majority of the time, except during extreme high water
- Instrument access – High - When using a winch, chain, or relocating pole

Cost

- Higher capital expense
- May require civil works on-site and additional personnel to build and install rail

Pros

- Suitable solution when stream is too deep to wade or when bridges are not available
- Ideal for instruments requiring horizontal installation
- Rails can be built to custom lengths
- Can be constructed of commercially available materials
- Instrument access during high flow conditions
- Deploy close too bottom of streambed out of way of large debris
- Can fix multiple instruments to same rail (ex: Side Looking Doppler or nutrient sensor)
- Easy technician access for instrument maintenance

Cons

- Rail deployments catch debris (ex: leaves may foul the sensors)
- Not ideal for braided streams
- May be more difficult to install than suspended or fixed vertical pipe installations
- May be more obtrusive and not as suitable for some urban locations
- More expensive than other options

Best Practices

- Install rail as close to bank as possible and properly secure to bank
- Install safe access to facilitate cleaning rails (ex: ladder)
- Universal mounting plate and brackets to facilitate quick instrument installation and removal
- Pole or other relocating device (ex: chain or winch) to easily move instrument mounting plate up and down and securely fix at desired depths
- Locking mechanism on relocating device (ex: pad lock) to prevent unauthorized access to installed instruments

Interpreting Your Water Quality Data

Other Considerations for Site Selection

Parameter	Trend	Possible Source	May be Caused by
Temperature	Increase	Vegetation removal	Stream bank vegetation provide shade and reduces runoff (turbidity)
		Impoundment	Increased exposure to solar radiation
	Decrease	Cold water inflow	Groundwater, tributary, springs and reservoir bottom all can be colder than receiving waters
		Depth	Seasonal stratification - mainly in lakes
Conductivity	Increase	Urban runoff	Chemical deicers, salts
		Geology	Clay soils dissolve into ionic components
	Decrease	Agricultural runoff	Ions such as nitrate, phosphate and salts
		Industrial effluent	Oils, alcohols, sugar and hazardous organic compounds

Other Considerations for Site Selection

Parameter	Trend	Possible Source	May be Caused by
Dissolved Oxygen	Increase	Aeration	Rapids and turbines add oxygen
		Photosynthesis	Plants give off oxygen
	Decrease	Decomposition	Plants and microorganism consume oxygen
		Turbidity	Blocks sunlight from plants, decreasing photosynthesis
		Turbidity	Causes water temperature to rise by increasing absorption of solar radiation
		Nutrients	Fuel overgrowth of algae, which die and decompose
Turbidity	Increase	Erosion	Agriculture, construction activities
		Nutrients	Increased algal growth
		Urban runoff	Salts, fertilizers or sediment
	Decrease	Erosion prevention	Stream-bank vegetation - BMP for agriculture, construction

Water Quality Installation Comparison – Surface Water Streams/Rivers

		Suspended Vertical Installation	Pipe installation	Rail installation
Program / Study Length	Short-term	x	o	o
	Long-term	o	x	x
Site Conditions	Accessibility	x	o	x
	Shallow water	-	o	-
	Deep water	o	o	o
	Low flow	o	x	x
	High flow	o	x	o
	Stable banks	NA	o	x
	Unstable banks	x	- bank / x for fixing to pillar	-
Instrument Fouling	Sediment	x	o	x
	Organic matter (leaf litter, plant debris)	o	o	o
Infrastructure	Civil works (platforms, anchors for rails, install rails/pipes)	Low	Medium	High
	Material cost	Low	Medium	High
	Installation cost	Low	Low - Medium	High
	Time to install	Low	Medium	High
	Robustness	Low - Depends on length of suspension, more exposed than other techniques	Medium - Design and material dependant (ex: more robust with stainless steel versus plastic PVC pipe)	Medium - High - Design and civil construction dependent (ex: staked in bank versus anchored to cement foundation)
Maintenance	Access to instrument	High - Quick and easy access to chain to pull instrument up out of water	Medium - removing device at awkward angles, depends on communication cable installation (ex: connected to logger)	High - Depends on design, often a relocation device is used to pull instrument out of water
	Infrastructure	Low	Medium - depends on pipe placement, flow and organic matter	Medium - depends on rail length and design
	Personnel safety	Low - Personnel on fixed structure (ex: bridge)	Low - Medium - exposed to water and aquatic invertebrates	Medium - varies, depends on bank gradient and materials

Symbols: - not suitable o suitable x highly suitable

OTT Hydromet: **Water Quality**

From long term unattended monitoring to spot sampling, OTT Hydromet's multiparameter sondes offer rugged and flexible options for water quality measurement. Choose from compact options for easy spot sampling or groundwater measurement to the larger, more robust Datasondes for more diverse sensor options and anti-fouling options.

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