

# Civil Culvert and Fabricated Structures

Technical Guide PKS2.2

To supply site specific underground infrastructure systems to store and move three waters.



## Applications

Roading

Wastewater

Stormwater

## Product Attributes

Lightweight

New Zealand made

Integrated system with structures

100-year design life

## Approvals/Standards

AS/NZS 5065

## Quality

ISO9001:2015 Quality Management







Puhoi to Warkworth Stormwater Culverts



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# PKS Civil Culverts

PKS Civil Culverts are a line of robust and durable pipes that are manufactured in New Zealand from virgin HDPE (High Density Polyethylene) material. PKS Civil has been operating and supplying civil projects since 2005.

## Product Advantages

Spiral extruded PE culverts are an innovative and reliable product that have been successfully manufactured and installed in Europe since the 1960's proving that it is fit for purpose with a high life expectancy. PKS Civil culverts have many attributes that will assist all parties in the design and/or build process, therefore saving time and money:

- Long lengths are easier to install
- Low weight compared to other alternatives
- Less joints results in less risk of leakage
- 100-year design life
- Increased flow rates due to low Manning's roughness coefficient (0.009-0.012)
- High chemical resistance
- Reliable and easy to use rubber ring jointing system or seismic resilient EF socket system
- Easily fabricated into bends and manholes

## Jointing methods

Jointing methods offered are designed to suit the individual project requirements. These can include the following:

- Double rubber ring
- Flange joint
- Extrusion welded
- EF joint



FIG. 1 EF Joint



FIG. 2 Stub Flange connection type



FIG. 3 Double rubber ring





**FIG. 4** Solid wall



**FIG. 5** Solid wall stepped

The VW (solid-wall) profile type can be produced according to static specifications in different wall thicknesses and gradations.

#### **Operational area**

- Production of manholes, bends and other structures or components
- Production of cylindrical container with graduated wall thicknesses of up to 400 mm
- For pressure-loaded pipelines
- Production of ventilation pipes



**FIG. 6** PR profile

The PR profile offers excellent ring stiffness combined with extremely low pipe weights.

#### **Operational area**

- Standard for underground sewer pipes
- Production of ventilation pipes



**FIG. 7** PKS™ plus profile

The PKS Civil Plus profile types achieve very high long-term ring stiffness due to the compact profile structure. They are therefore used in systems exposed to very high external stresses.

#### **Operational area**

- Production of manholes and other fittings with pipe penetrations
- For underground sewer pipes exposed to high external stresses
- Easier compaction and install speed
- High water table ground conditions

PKS Civil Civil Culverts Range and Sizing

The HDPE spiral wound pipe technology used to manufacture PKS Civil Culverts makes it practical to manufacture various pipe sizes with specific SN (Ring Stiffness) ratings at a fraction of the weight of other products on the market. The high strength to weight ratio is due to the use of PP's (Polypropylene's) high stiffness to produce the core tube, which is then wrapped in HDPE material.

Each pipe is formed on a steel mandrel 6.0m long with a socket mould fixed at one end, which allows a spigot to be formed at any particular length along the mandrel. The manufacturing process means the internal diameter (ID) is consistent with the steel mandrel and the pipe lengths can be manufactured at a maximum of 6.0m or less, to meet the customers required length, and it is cost effective to manufacture small lengths/runs of pipe.

TABLE 1 PKS CIVIL- SN8 AS/NZS 5065 COMPLIANT - YELLOW PRINT

DN	M3 Code	Item Description	SN8	+/- 50mm	+/- 10mm		kg		
			SN Rating	Length	ID	Pipe OD	Socket OD	Weight	MTO
DN500	PK05CIVDRR.SN8	DN500x5.8mxSN8 DRR CIVIL PIPE	SN8	5800	500	594	600	95	Stock
DN600	PK06CIVDRR.SN8	DN600x5.8mxSN8 DRR CIVIL PIPE	SN8	5800	600	694	700	135	Stock
DN700	PK07CIVDRR.SN8	DN700x5.8mxSN8 DRR CIVIL PIPE	SN8	5800	700	820	800	170	Stock
DN800	PK08CIVDRR.SN8	DN800x5.8mxSN8 DRR CIVIL PIPE	SN8	5800	800	924	900	235	Stock
DN900	PK09CIVDRR.SN8	DN900x5.8mxSN8 DRR CIVIL PIPE	SN8	5800	900	1026	1000	315	Stock
DN1000	PK10CIVDRR.SN8	DN1000x5.8mxSN8 DRR CIVIL PIPE	SN8	5800	1000	1166	1100	345	Stock
DN1100	PK11CIVDRR.SN8	DN1100X5.8MSN8 DRR CIVIL PIPE	SN8	5800	1100	1266	1200	423	MTO
DN1200	PK12CIVDRR.SN8	DN1200x5.8mxSN8 DRR CIVIL PIPE	SN8	5800	1200	1370	1300	575	Stock
DN1400	PK14CIVDRR.SN8	DN1400X5.8MxSN8 DRR CIVIL PIPE	SN8	5800	1400	1582	1520	795	MTO
DN1500	PK15CIVDRR.SN8	DN1500X5.8MxSN8 DRR CIVIL PIPE	SN8	5800	1500	1738	1620	795	MTO
DN1660	PK16CIVDRR.SN8	DN1660X5.8MxSN8 DRR CIVIL PIPE	SN8	5800	1660	1900	1788	905	MTO
DN1800	PK18CIVDRR.SN8	DN1800X5.8MxSN8 DRR CIVIL PIPE	SN8	5800	1800	2050	1928	1195	MTO
DN2000	PK20CIVDRR.SN8	DN2000X5.8MxSN8 DRR CIVIL PIPE	SN8	5800	2000	2248	2138	1415	MTO
DN2500	PK25CIVDRR.SN8	DN2500X5MxSN8 DRR CIVIL PIPE	SN8	5000	2500	2776	2652	1970	MTO

TABLE 2 PKS CIVIL - SN16 AS/NZS5065 COMPLIANT - RED PRINT

DN	M3 Code	Item Description	SN16	+/- 50mm	+/- 10mm		kg		
			SN Rating	Length	ID	Pipe OD	Socket OD	Weight	MTO
DN400	PK04CIVDRR.SN16	DN400x 5.8m SN16 DRR CIVIL PIPE	SN16	5800	400	494	500	94	MTO
DN500	PK05CIVDRR.SN16	DN500x5.8mxSN16 DRR CIVIL PIPE	SN16	5800	500	594	600	125	Stock
DN600	PK06CIVDRR.SN16	DN600x5.8mxSN16 DRR CIVIL PIPE	SN16	5800	600	720	700	165	Stock
DN700	PK07CIVDRR.SN16	DN700x5.8mxSN16 DRR CIVIL PIPE	SN16	5800	700	826	800	245	Stock
DN800	PK08CIVDRR.SN16	DN800x5.8mxSN16 DRR CIVIL PIPE	SN16	5800	800	926	900	280	Stock
DN900	PK09CIVDRR.SN16	DN900x5.8mxSN16 DRR CIVIL PIPE	SN16	5800	900	1034	1000	400	Stock
DN1000	PK10CIVDRR.SN16	DN1000x5.8mxSN16 DRR CIVIL PIPE	SN16	5800	1000	1170	1100	455	Stock
DN1100	PK11CIVDRR.SN16	DN1100X5.8MSN16 DRR CIVIL PIPE	SN16	5800	1100	1290	1200	634	MTO
DN1200	PK12CIVDRR.SN16	DN1200x5.8mxSN16 DRR CIVIL PIPE	SN16	5800	1200	1386	1300	770	Stock
DN1400	PK14CIVDRR.SN16	DN1400X5.8MxSN16 DRR CIVIL PIPE	SN16	5800	1400	1600	1558	1175	MTO
DN1500	PK15CIVDRR.SN16	DN1500X5.8MxSN16 DRR CIVIL PIPE	SN16	5800	1500	1708	1662	1014	MTO
DN1660	PK16CIVDRR.SN16	DN1660X5.8MxSN16 DRR CIVIL PIPE	SN16	5800	1660	1912	1826	1520	MTO
DN1800	PK18CIVDRR.SN16	DN1800X5.8MxSN16 DRR CIVIL PIPE	SN16	5800	1800	2060	1970	1750	MTO
DN2000	PK20CIVDRR.SN16	DN2000X5.8MxSN16 DRR CIVIL PIPE	SN16	5800	2000	2276	2186	2150	MTO
DN2500	PK25CIVDRR.SN16	DN2500X3.5MxSN16 DRR CIVIL PIPE	SN16	3500	2500	2852	2690	2515	MTO

## Load & Cover Capabilities

PKS Civil Culverts are designed to handle relatively large traffic/construction loadings and cover heights when installed in specific ground conditions.

**Table 3** outlines the different soil classes that can be used as backfill material for PKS Civil Culverts.

The G1, G2 & G3 materials are the most favourable as they are granular backfills and when compacted provide excellent side support for the pipe, meaning a lower strength pipe is required overall.

The G4 material is less favourable as it is a cohesive backfill and provides less side support for the pipe, creating the need for a higher pipe strength.

**TABLE 3** Backfill Material Classifications

Granular Backfill			Cohesive Backfill
G1	G2	G3	G4
Graded Crushed Rock	Valley Sand	Weathered Gravel	Clay
River Gravel and Beach	Drift & Basin Sand	Clayey Gravel	Loess
Gravel	Dune Sand	Loamy Sand	Loam
	Beach Sand	Liquid Sand	Alluvial Marl
		Alluvial Clay	

**NOTE:** Table 3 is a guideline as to what pipe SN rating is best for each setting and this meets and exceeds the design requirements outlined in AS/NZS 2566.1:1998 – Buried Flexible Pipelines Structural Design and installed to the requirements outlined in AS/NZS 2566.2:2002 – Buried Flexible Pipelines Installation.

**TABLE 4** SN Rating Selection

Embankment Cover Height (mm)		500	1,000	2,000	5,000	10,000	20,000
<b>Design Loadings</b>	Pipe Traffic/Construction Loading						
	0.85HN Loading (Non-Highway Loading)	SN4 & Above	SN4 & Above	SN4 & Above	SN4 & Above	SN4 & Above	SN8 & Above
	HN-HO-72 Loading (Highway Loading)	SN16	SN4 & Above	SN4 & Above	SN4 & Above	SN4 & Above	SN8 & Above
<b>Plant Loading</b>	Moxy MT41 – Max Wheel Load of 11.09T	SN8 & Above	SN4 & Above	SN4 & Above	SN4 & Above	SN4 & Above	SN8 & Above
	Cat Scraper 637G – Max Wheel Load of 22.78T	SN16	SN16	SN4 & Above	SN4 & Above	SN8 & Above	SN8 & Above

**Note:**

Loadings and cover are based on G2 Backfill Material compacted to 95% with no groundwater. If soil is G3 or G4 contact PKS Civil to carry out static calculation to determine SN rating.

If you require further information in regard to the SN rating required, contact PKS Civil to carry out a static calculation to see what pipe best suits the ground conditions and loading requirements.



# Installation Requirements

PKS Civil pipe is required to be installed to AS/NZS 2566.2:2002 – Buried Flexible Pipelines Installationto help it meet and exceed its intended design life, whether its 50 or 100 years. See Figure 1 & 2 below that outline the zones and required dimensions around the pipe.

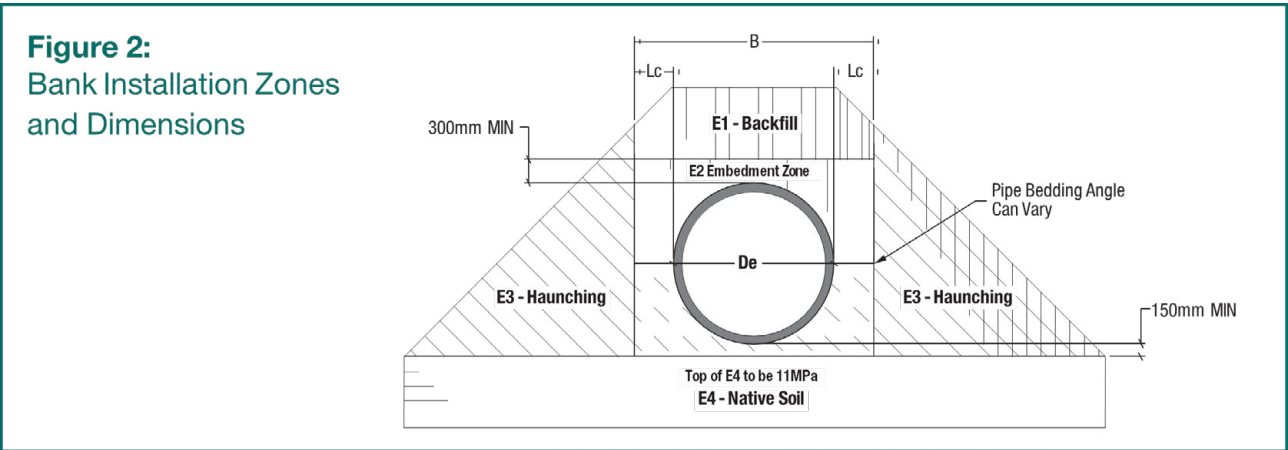
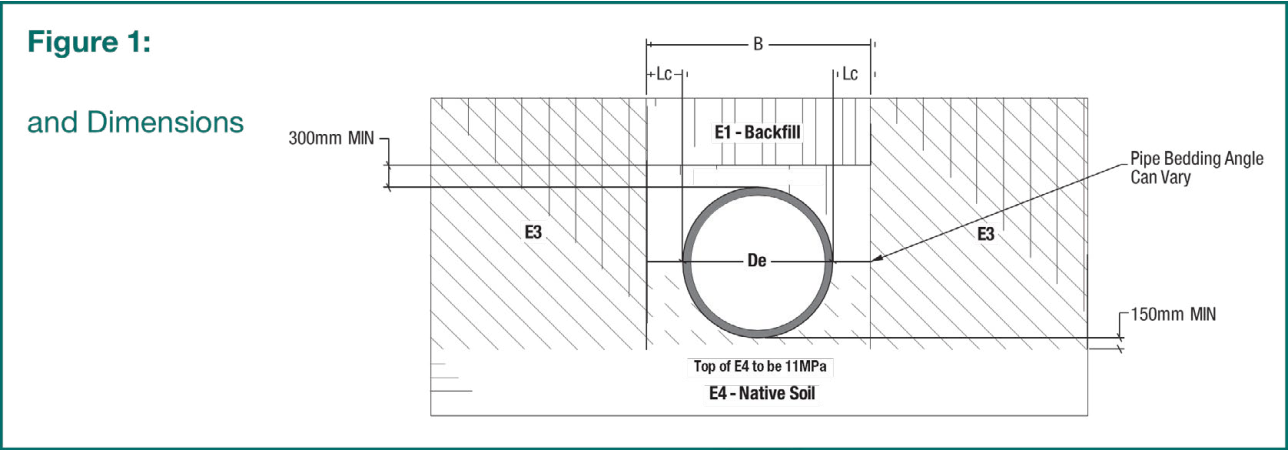


Table 5: Trench/Bank Installation Dimensions Calculation

It is important to ensure that the E1 & E2 zone is a gravel or sand material that is sufficiently compacted, to a minimum of 95%, in 300mm layers to support the sides of the pipe, which helps the pipe withstand the large loads that it is capable of withstanding.

In trench installations and bank installations, the pipe zones of E3 and E4 still need to be sufficiently compacted to a minimum of 95% as this benefits the pipe by acting

as a solid surround for the E1 and E2 zones to be compacted against.

For further information or technical inquiries, please visit the resources section on our website [www.pkscivil.co.nz/resources](http://www.pkscivil.co.nz/resources) or call +64 3 384 6294

Table 6: Minimum Embedment Zone Dimensions as per AS/NZS 2566.2:2002

(De) (mm) Pipe Outside Diameter	(Lc) (mm) Minimum distance - Can be enlarged to fit compaction equipment	(B) (mm) Trench Width to AS/NZS 2566.2:2002 ( $B = D_e + 2L_c$ )
>300 ≤450	200	700 - 850
>450 ≤900	300	1050 - 1500
>900 ≤1500	350	1600 - 2200
>1500 ≤4000	0.25D	2250 - 6000



# Manufacturing and Design Compliance

PKS Civil Culverts are manufactured in New Zealand by skilled machine operators and fabricators.

The product is manufactured in accordance with a Quality Management System (QMS) certified by TELARC to comply with the requirements of ISO 9001:2015 – Quality Management Systems – Requirements.

## Design Compliance – specific project parameters

For PKS Civil to check that the pipe SN ratings (ring stiffness) meet the design requirements of AS/NZS 2566.1:1998 – Buried Flexible Pipelines Structural Design, a PKS Civil Static Load Questionnaire must be filled out by the customer outlining the cover height, loading and backfill materials. The static load information is incorporated with the appropriate

parameters from AS/NZS 2566.2:2002 – Buried Flexible Pipelines Installation and entered in a pipe design software which calculates an SN rating to the German ATV DVWK 127E Standard. The following proofs need to be checked to ensure design compliance with AS/NZS 2566.1:1998 – Buried Flexible Pipelines Structural Design:

- Short-term deformation is less than 5%
- Long-term deformation is less than 7.5%
- Factor of safety against buckling is no less than 2.50

Upon request, PKS civil pipe can be designed to meet the NZTA Bridge Manual and FEM Analysis (Finite Elemental Modelling).

## Static Load Questionnaire

There are some critical parameters that need to be considered when filling out the PKS Civil Static Load Questionnaire that will have significant impact on the required SN rating of PKS Civil pipe. The critical parameters are:



*Static load  
questionnaire  
QR Code*

- **Traffic and various load factors:** The New Zealand Bridge Manual outlines two loadings—HN, representing the normal loading with a 120kN axle load, and HO, signifying overloading with a 240kN axle load. Other loadings such as light vehicle loading (0.85 times the HO loading) and loadings associated with construction and heavy equipment is of great importance.”
- **Groundwater Level** – “The groundwater level is precisely defined from the bottom of the trench. This detail is crucial in the engineering design process, as it accommodates variations in groundwater levels.”
- **Soil Types on soil zones** - Higher modulus of elasticity exhibit greater resistance to deformation, better load bearing capacity and will require a lower SN rated pipe.

## Third party testing for peace of mind

Our AS/NZS 5065 standards and associated quality management systems are regularly audited internally and externally by third party providers. This includes independent type testing and or independent calibration and supervision of any specific project type test for the client in our manufacturing facility.

## Ring Stiffness Testing Compliance

PKS Civil ensure that before manufacturing any pipe ring stiffness testing has been performed for the specific profile and pipe diameter ordered.

All previous tests are valid for up to 5 years. Ring Stiffness Tests are performed in accordance with AS/NZS 1462.22 – Thermoplastics – Determination of Ring Stiffness.

The ring stiffness testing is carried out inhouse with a hydraulic testing rig and test certificates can be supplied to all customers upon request and an independent third-party laboratory can oversee any testing at the customers expense.

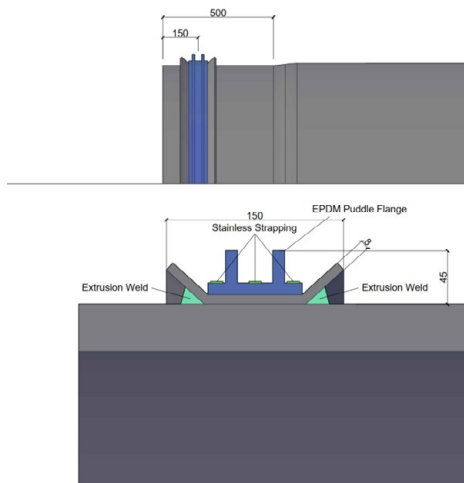


## Pipe transitions and fittings

We can manufacture a ribbed pipe with a transition section on the pipe end to match up with another pipe OD or a connection to a solid structure that requires trimming on site.

### Pipe shorts with puddle flanges into wingwalls / concrete manholes

As part of a pipe end transition we can also fabricate a type 2 puddle flange to a fixed location onto the pipe with a trimming margin specified by the design engineer (ref image below).



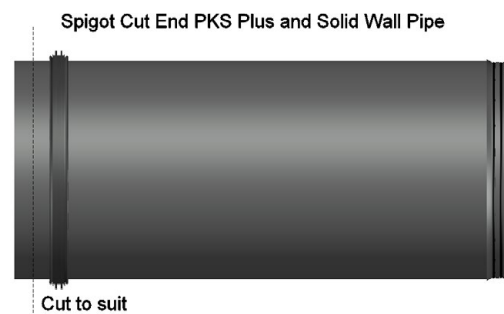
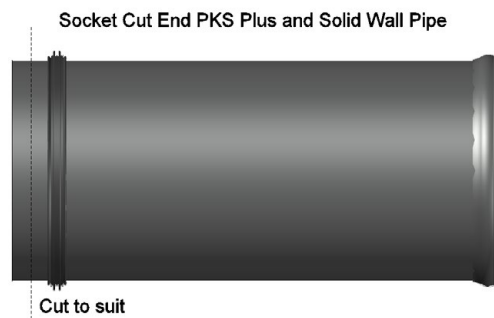
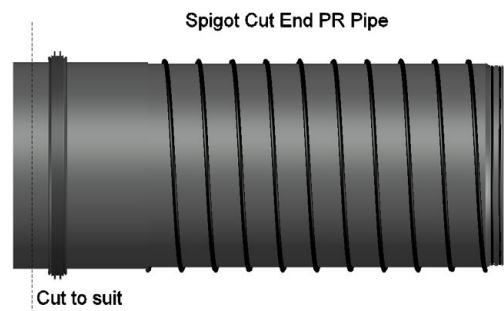
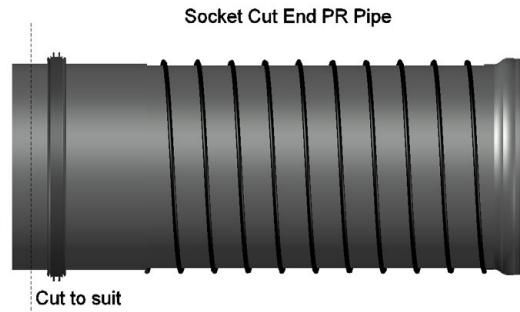
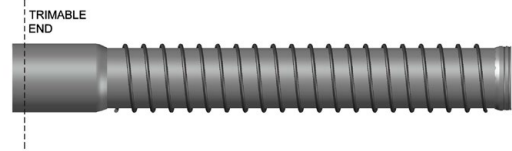
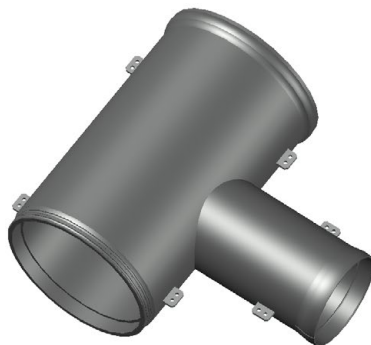
### Bends and tees with pulling lugs – socket socket or socket spigot option

We manufacture mitre bends in segments in a variety of socket spigot / socket socket / spigot spigot or plain ends to suite another pipe connection with pulling lugs to  $\pm 1^\circ$  accuracy.

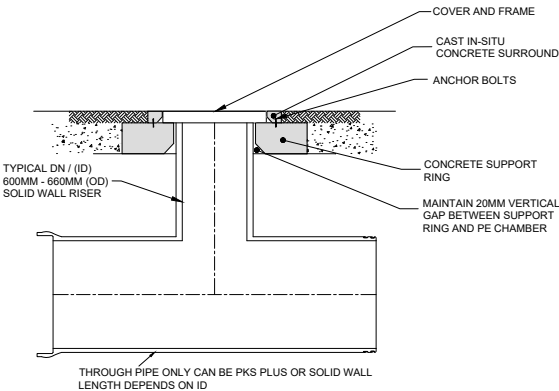
Fittings can be made to nearly any SN or SDR requirements.



Socket Socket /  
Socket Spigot /  
Spigot Spigot  
options  
are available



Chimney riser tees for inspection



In some cases where a large pipeline is required, PKS Civil can integrate a chimney riser on bends or a chainage to replace a manhole for access where possible. These can be angles with risers straights with risers and can incorporate inlets for future connections.

Installation checks for consultants and asset owners

For peace of mind installation, PKS Civil provide onsite training methodology of pipe and structures covering best practice, checks, and a Quality form guideline covering calibration of testing equipment, embedment compaction and pipe alignment.

An overview of this is available on our website as a download.



Best Practice Guide  
QR Code



### Onsite Pipe EF or extrusion welding / training service

For small pipe jobs where under a week of welding is required PKS Civil will offer a welding service to the contractor which includes joint testing and certification onsite. For larger jobs where the install and joining will cover multiple weeks, PKS Civil will undertake a partnership approach and train / certify specific contractor staff through doing partnership welds and tests, once there is confidence and competence, the contractor can then continue under a pre prepared Standard operating procedure (SOP)

**This service is offered as a supplier agreement – not a sub contract agreement.**

PKS Civil can provide either a Bello testing unit for individual joints or a plug and plugsy (also can be hired nation wide) for a low pressure pipeline section test. Both methods require pipe ends to be secured to avoid pipes from pushing out under pressure.

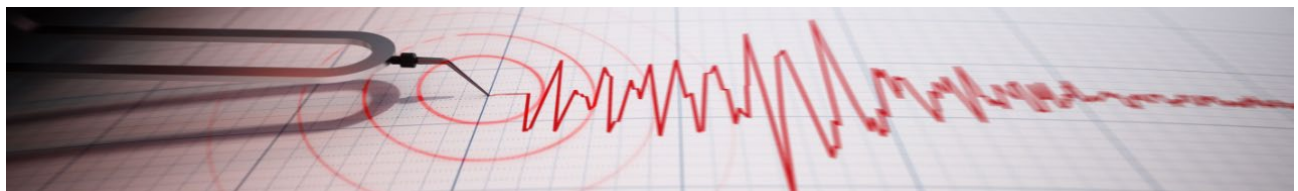
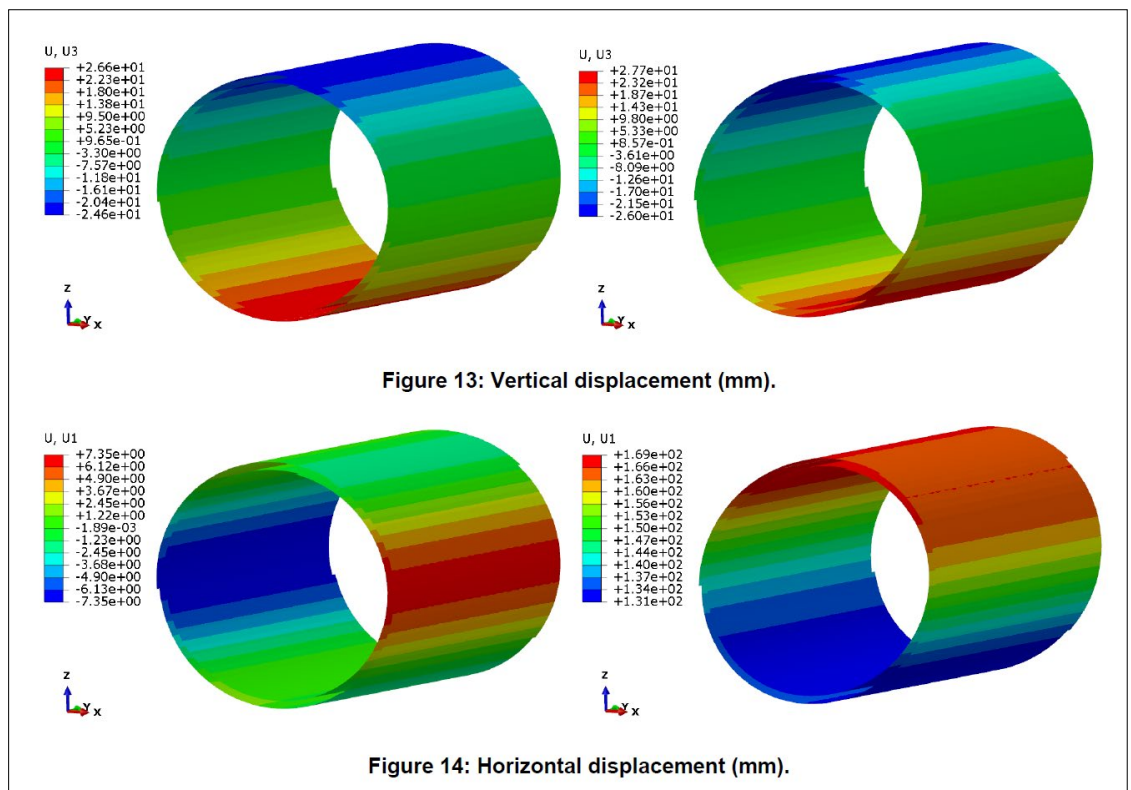
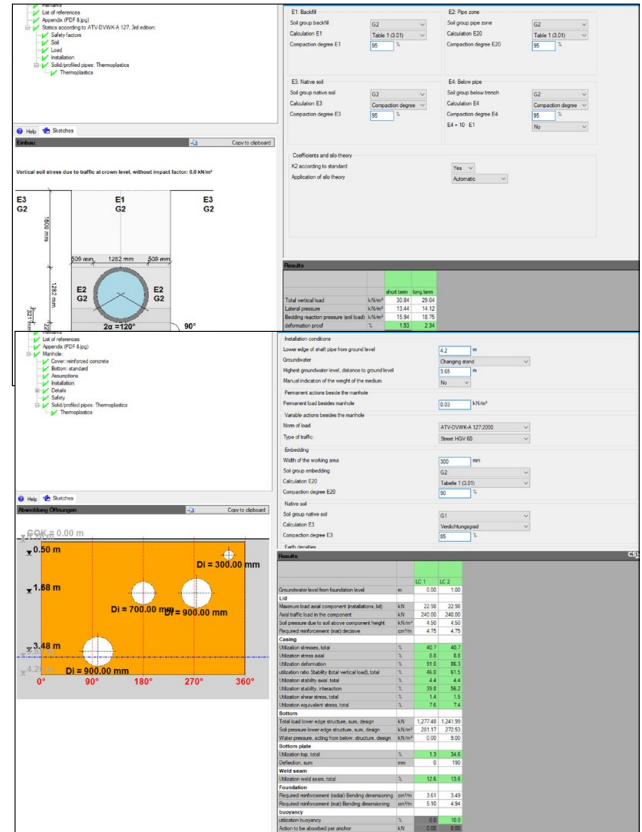


## FEA and PS1 design support

Recent advances in seismic and difficult ground or groundwater conditions modelling can be arranged at the client cost along with an independent PS1 and PS2 report on request.

**\*subject to specific geotechnical and seismic data being available.**

- PS1 – Design (outlines installation method, loading cases, bedding support, weight and Youngs Modulus of soils on all zones, compaction %, maximum allowable groundwater) – PKS Civil can supply this to the design engineer for verification
- PS2 – Design Review - performed by CPEng either internally or externally at additional cost variation
- PS3 – Construction (Installers) Installed as per design. This service is not provided by PKS Civil but we can provide guidance on best practice and checks to be integrated into your QA programme to AS/NZS 2566.2 and key deliverables from the PS1
- PS4 – Construction Review – Monitored Installers, via installation method, soil selection, soil compaction and field testing - This is not provided by PKS Civil













**Disclaimer:** While every effort has been made to ensure that the information in this document is correct and accurate, users of PKS Civil product or information within this document must make their own assessment of suitability for their particular application. Product dimensions are nominal only, and should be verified if critical to a particular installation. No warranty is either expressed, implied, or statutory made by PKS Civil unless expressly stated in any sale and purchase agreement entered into between PKS Civil and the user.

**Technical Questions or Information:**

For further information or technical inquiries please visit our downloads page  
[pkscivil.co.nz/resources](http://pkscivil.co.nz/resources) or call 03 384 6294

