OMEGA ZONE 8, ST HELENS

Omega St Helens Ltd / T J Morris Ltd

Ground Investigation Report
& Remediation Strategy
Appendix D Part 16
OPP DOC. 2.20

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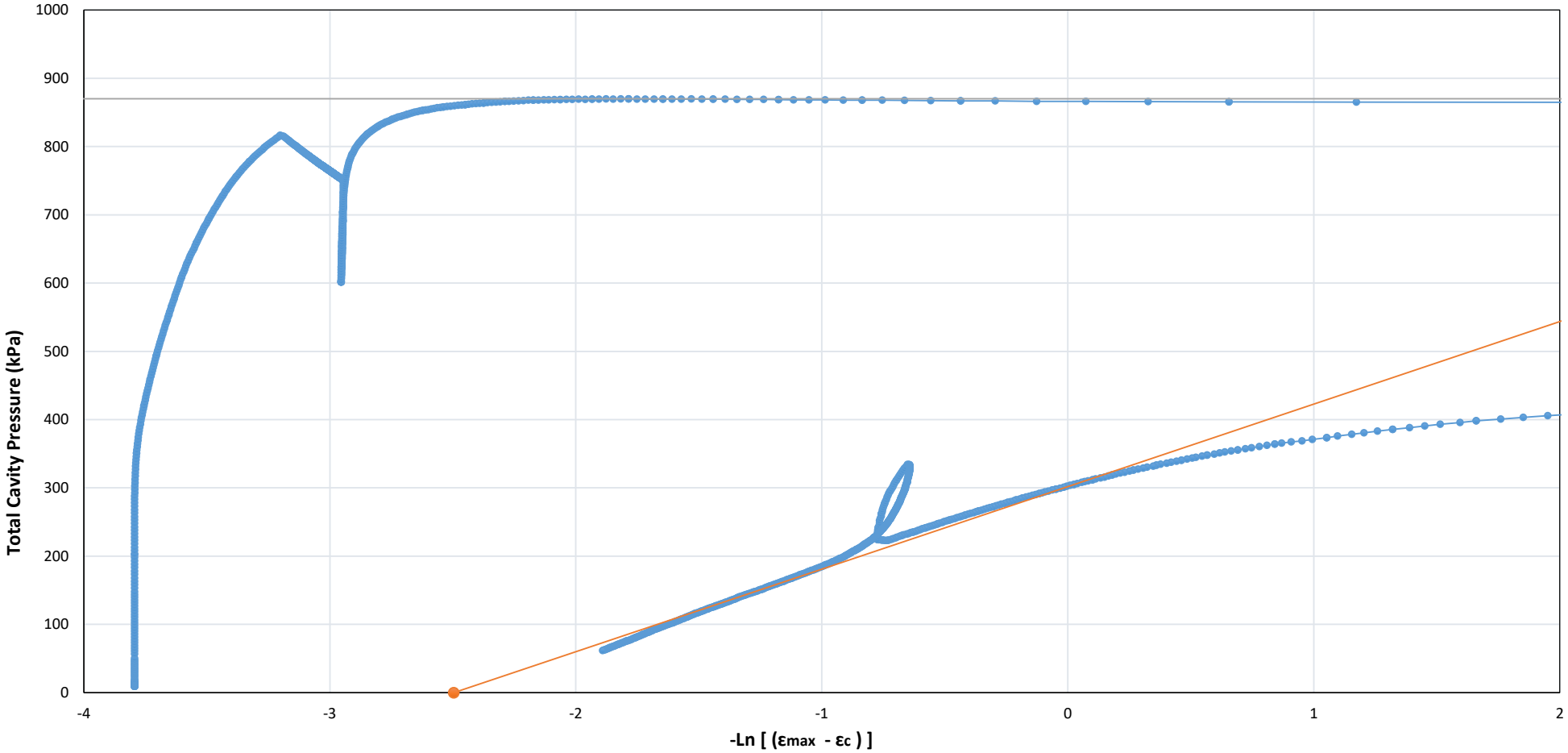
Houlsby & Withers (1988) Undrained Shear Strength Analysis



Project Ref:	107284	**Shear strength Su:**	60 kPa	**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Drainage behaviour:**	Undrained	**Depth:**	**4.2 m**
Client Ref:				**Comments:**	
Location:	Warrington, UK				

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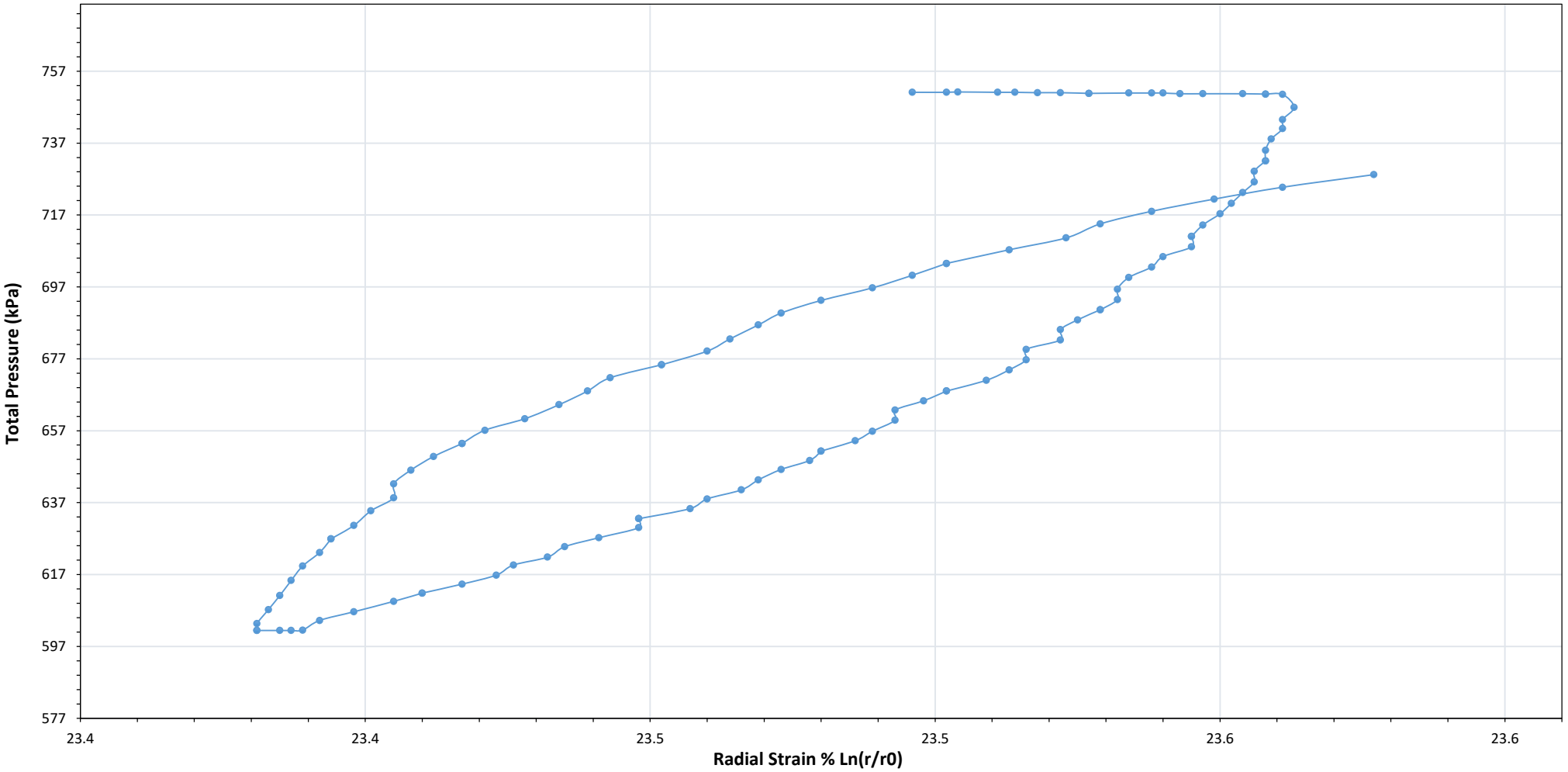
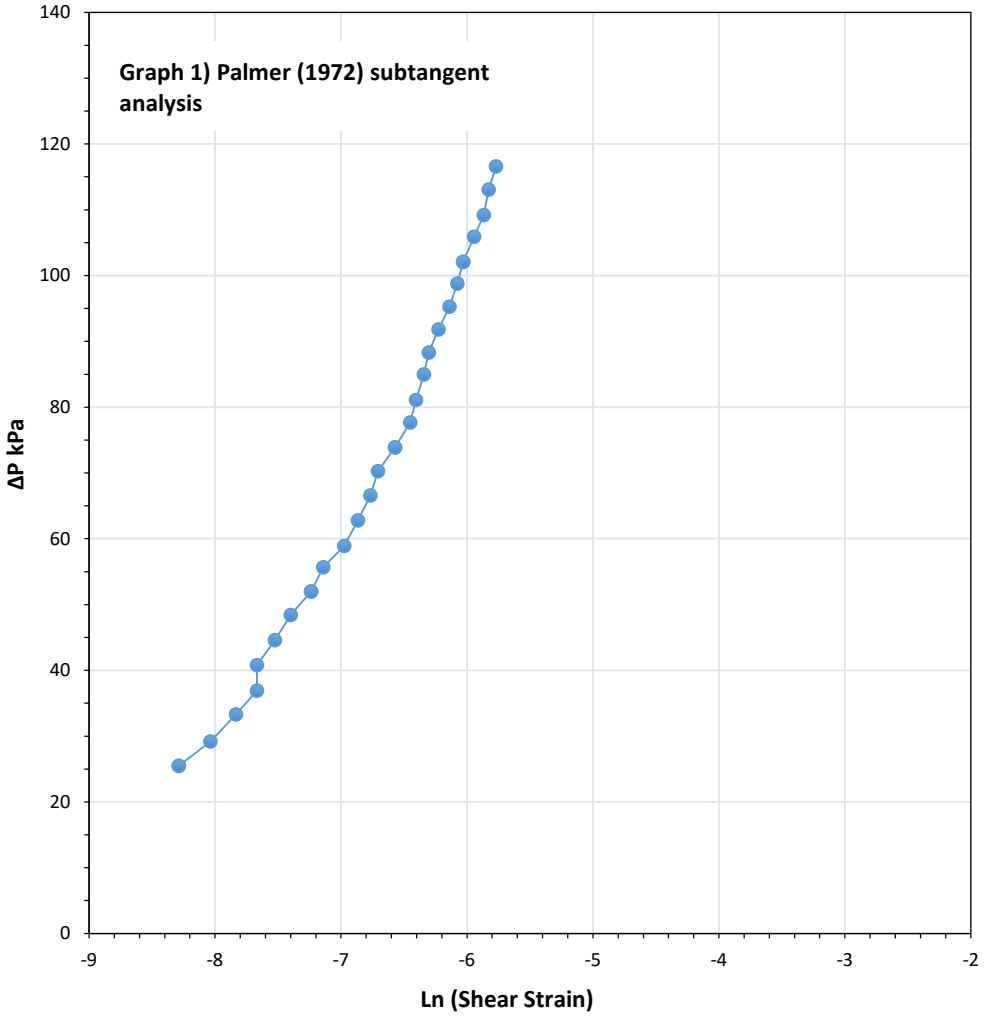
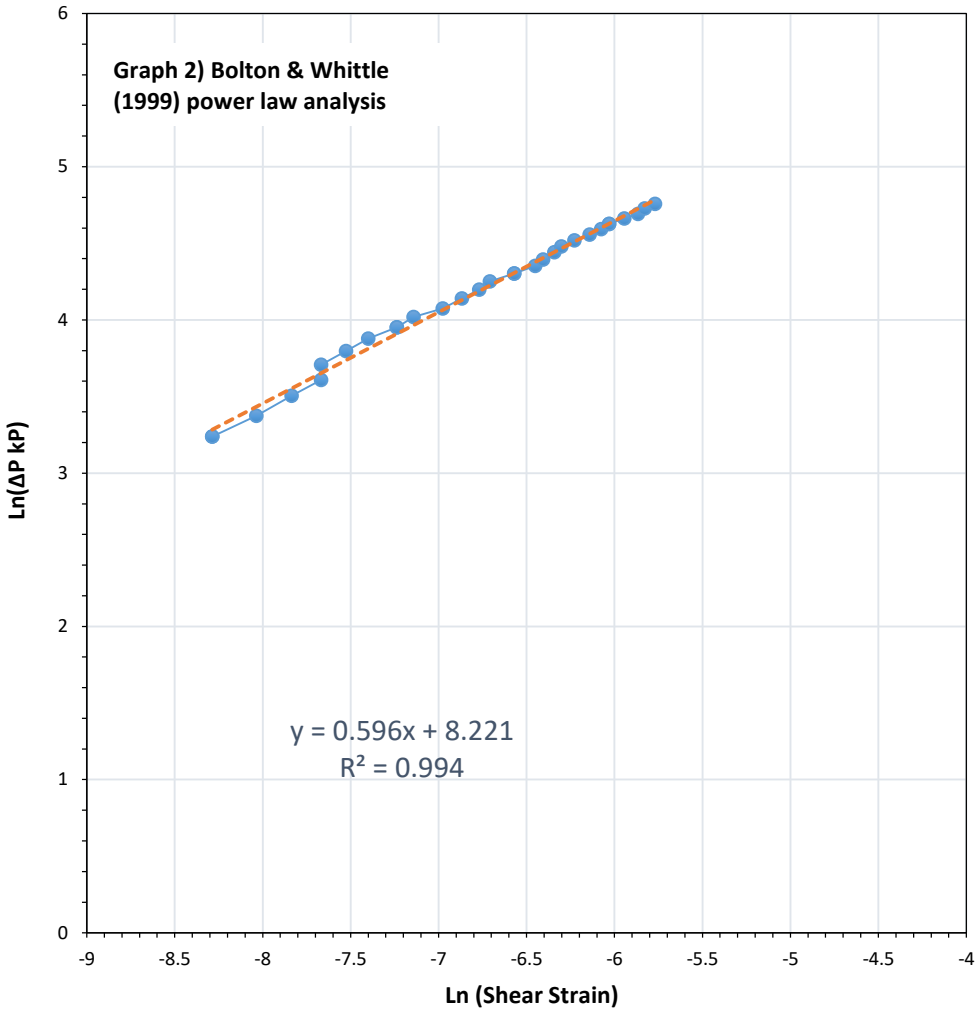
Loop 1 Total Pressure with Radial Cavity Strain



Project Ref:	107284	**Drainage behaviour:**	Undrained	**Shear modulus Gur:**	3474.5 MPa	**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Test type:**	FDPM	**Cavity strain range:**	0.1 %	**Depth:**	**4.2 m**
Client Ref:		**Loop duration:**	2 mins			**Comments:**	
Location:	Warrington, UK						

Loop 1 Non-Linear Stress-Strain Analysis





Project Ref:	107284	**Obtained Power Law Parameters (right hand side graph)**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β) (gradient):**	0.596	**Depth:**	**4.2 m**
Client Ref:		**Intercept (η):**	3.718 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α (β*η):**	2.216 MPa		

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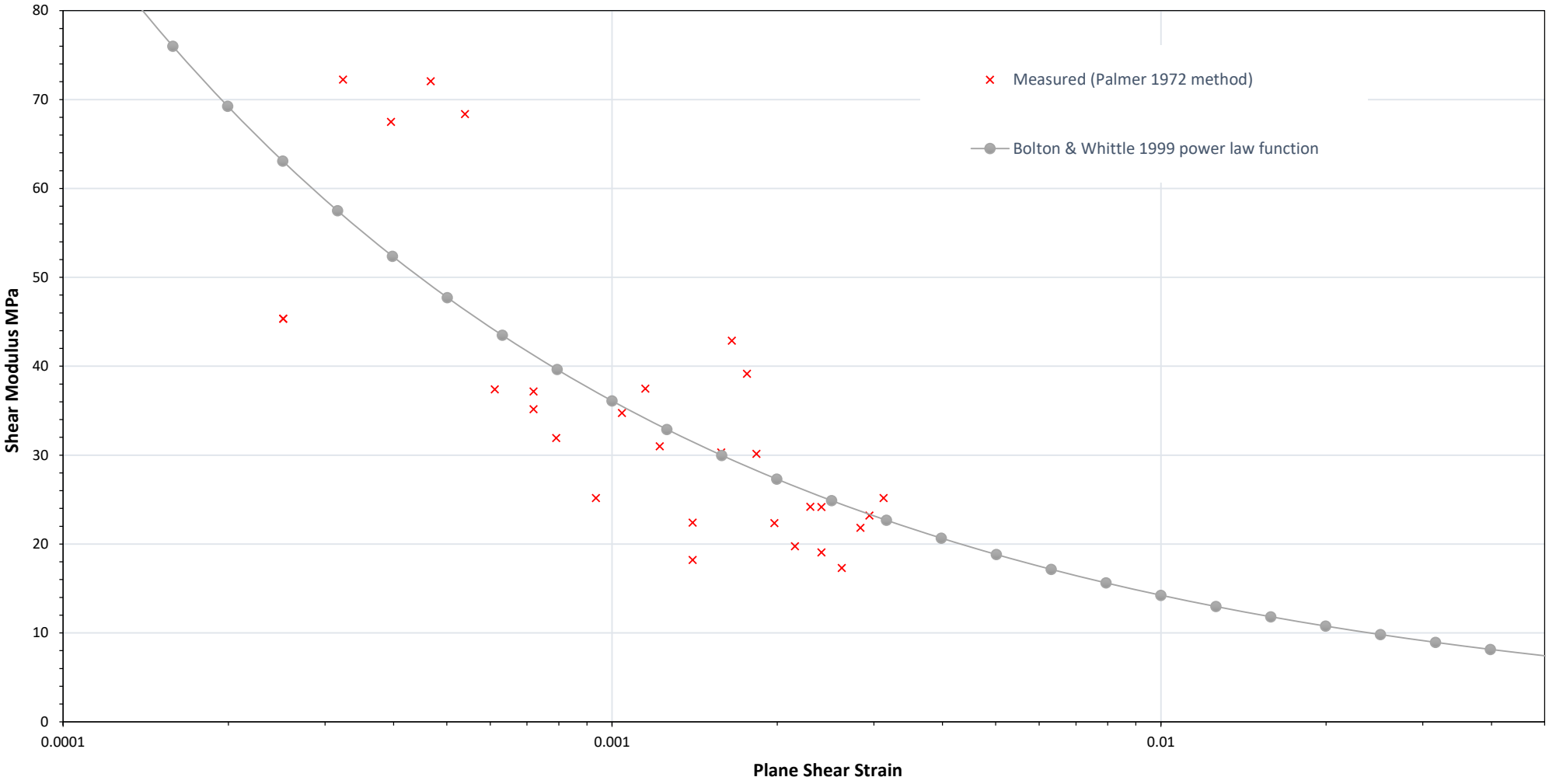
Loop 1 Non-Linear Analysis - Secant Shear Modulus with Plane Shear Strain



Project Ref:	107284	**Bolton & Whittle 1999 power law parameters applied**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β):**	0.596	**Depth:**	**4.2 m**
Client Ref:		**Intercept (η):**	3.718 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α = (β*η):**	2.216 MPa		

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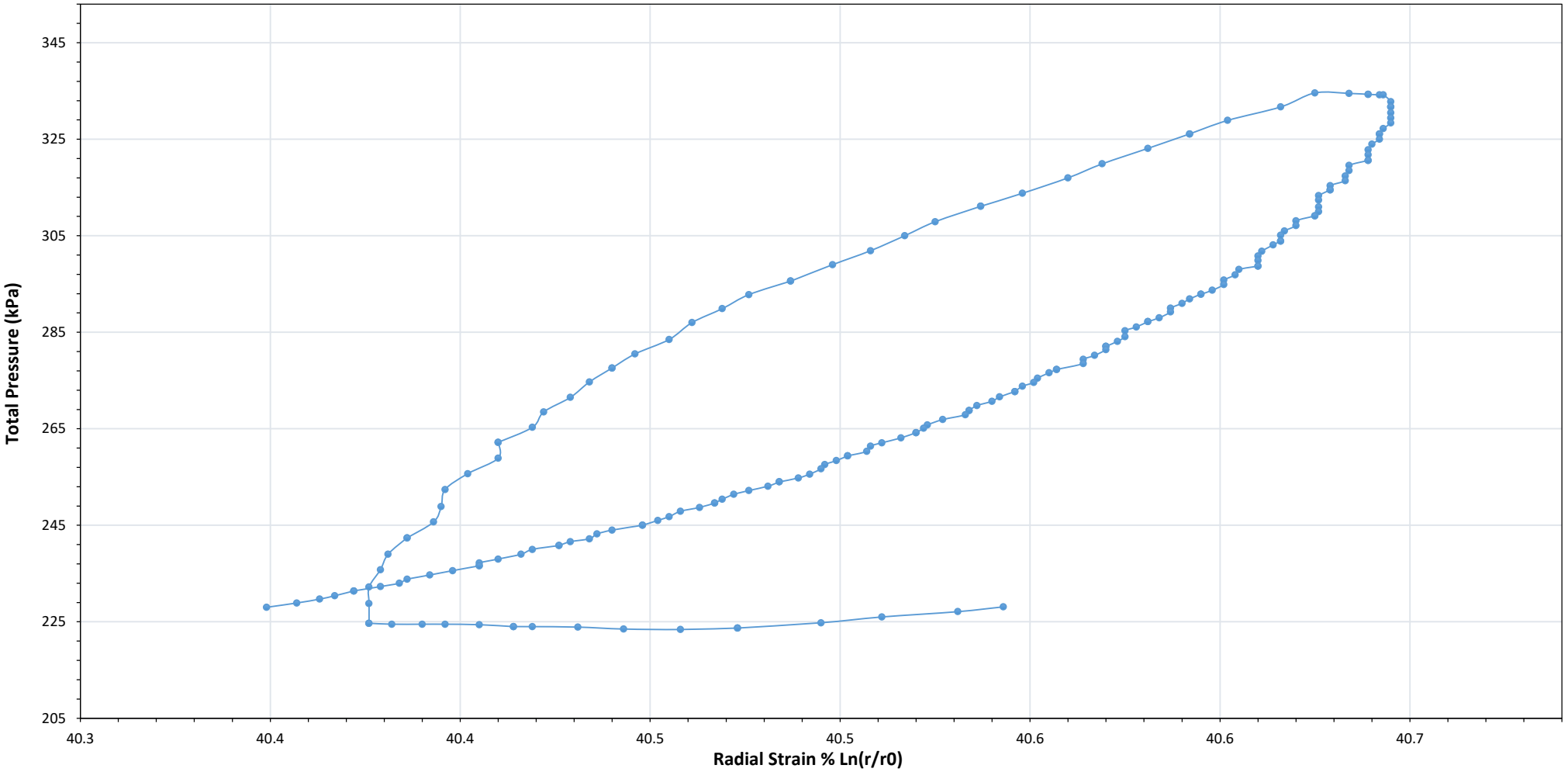
Loop 2 Total Pressure with Radial Cavity Strain



Project Ref:	107284	**Drainage behaviour:**	Undrained	**Shear modulus Gur:**	1923.1 MPa	**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Test type:**	FDPM	**Cavity strain range:**	0.18 %	**Depth:**	**4.2 m**
Client Ref:		**Loop duration:**	3 mins			**Comments:**	
Location:	Warrington, UK						

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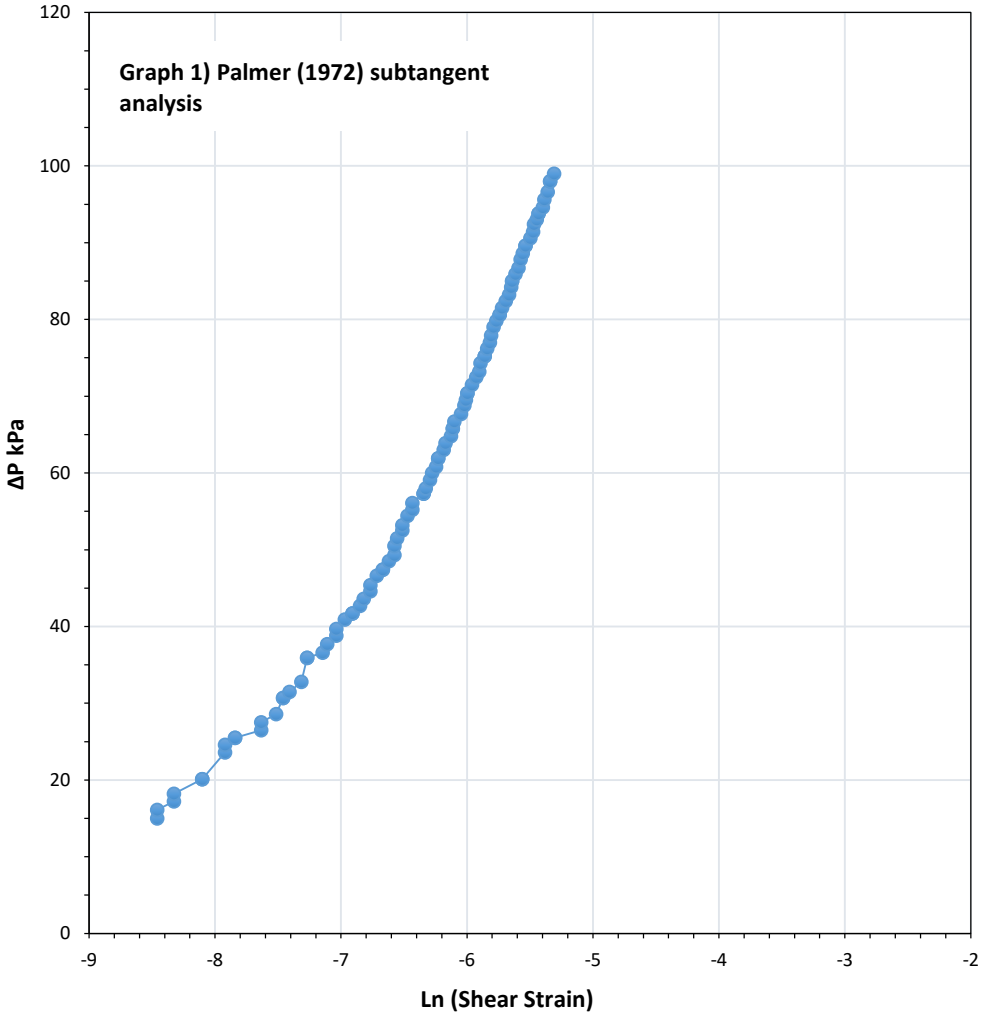
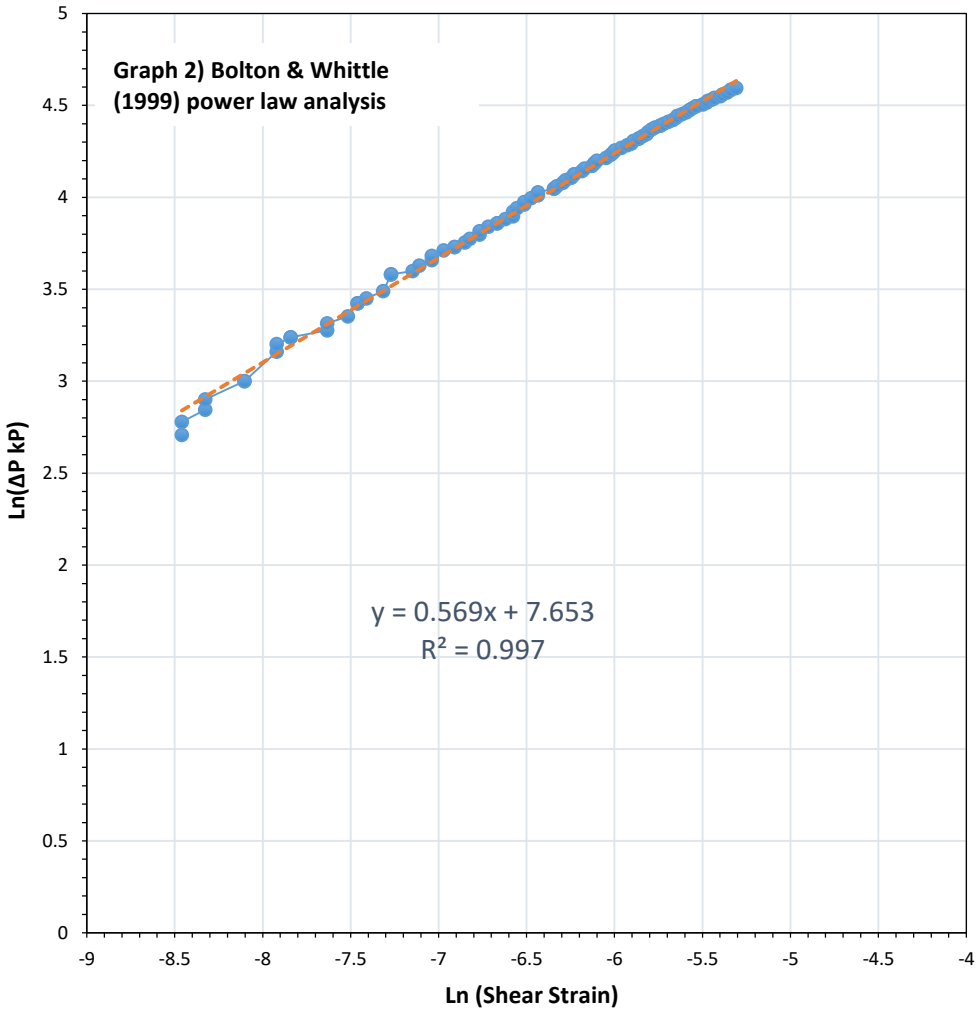
Loop 2 Non-Linear Stress-Strain Analysis





Project Ref:	107284	**Obtained Power Law Parameters (right hand side graph)**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β) (gradient):**	0.569	**Depth:**	**4.2 m**
Client Ref:		**Intercept (η):**	2.107 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α (β*η):**	1.199 MPa		

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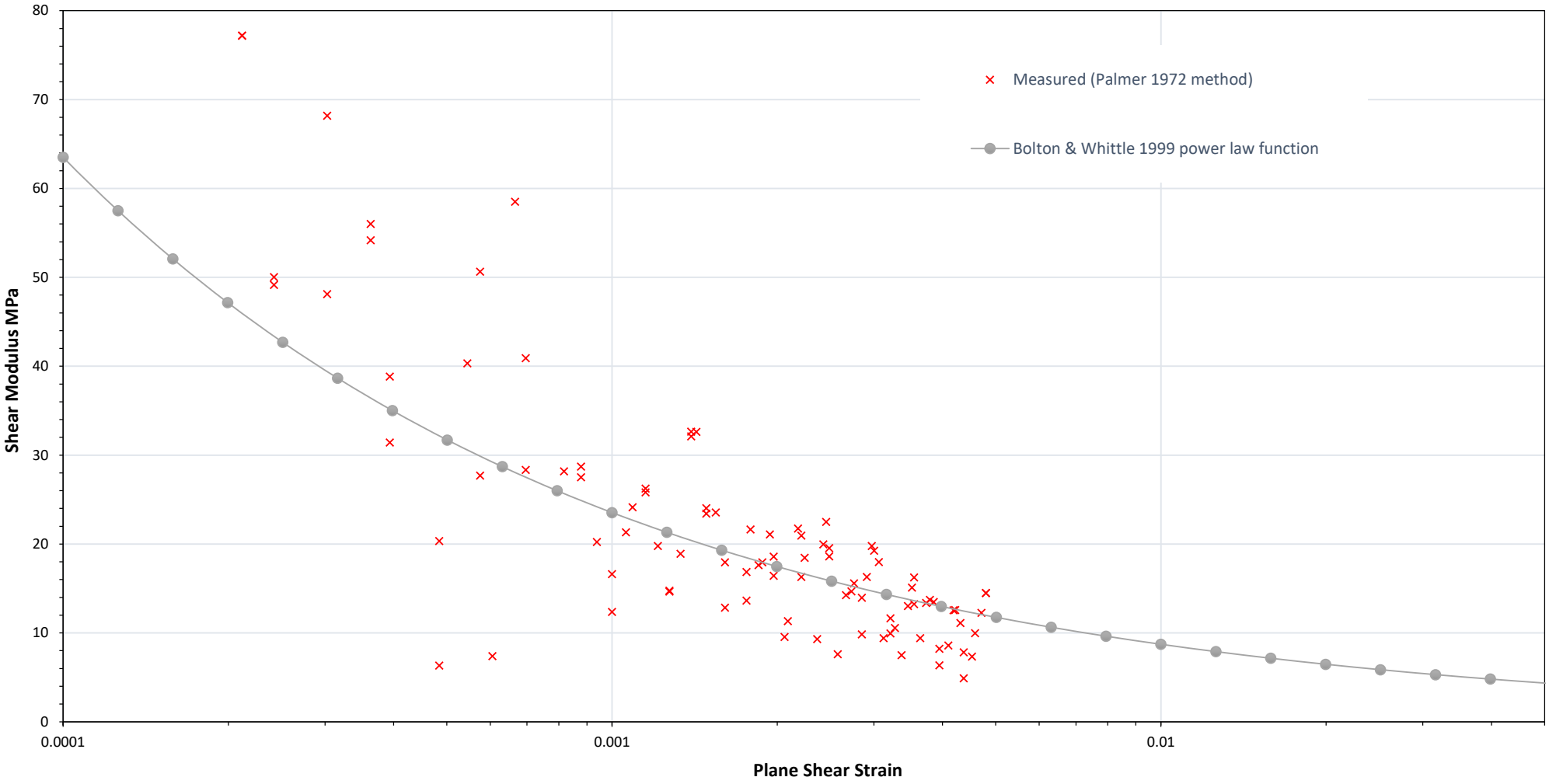
Loop 2 Non-Linear Analysis - Secant Shear Modulus with Plane Shear Strain



Project Ref:	107284	**Bolton & Whittle 1999 power law parameters applied**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β):**	0.569	**Depth:**	**4.2 m**
Client Ref:		**Intercept (η):**	2.107 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α = (β*η):**	1.199 MPa		

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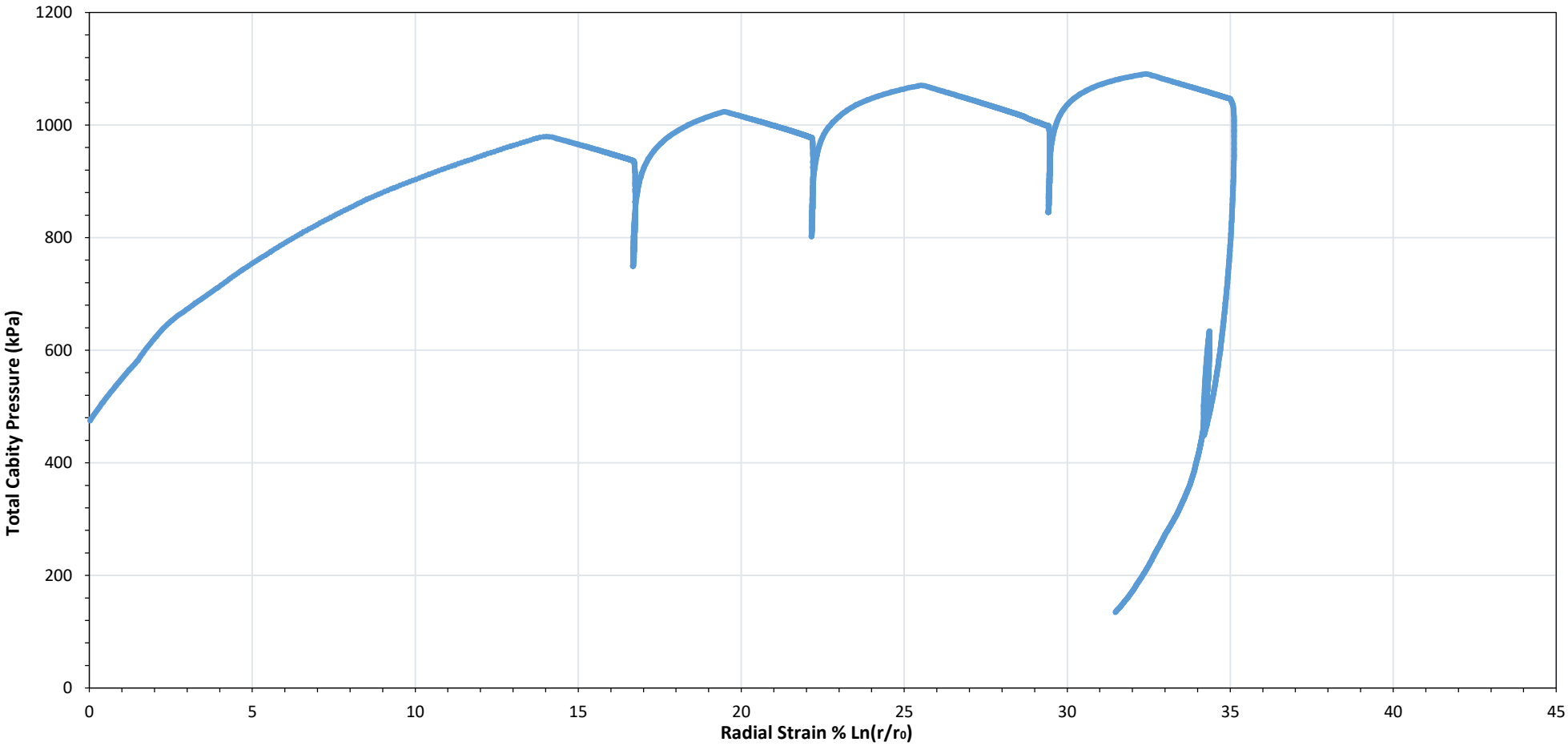
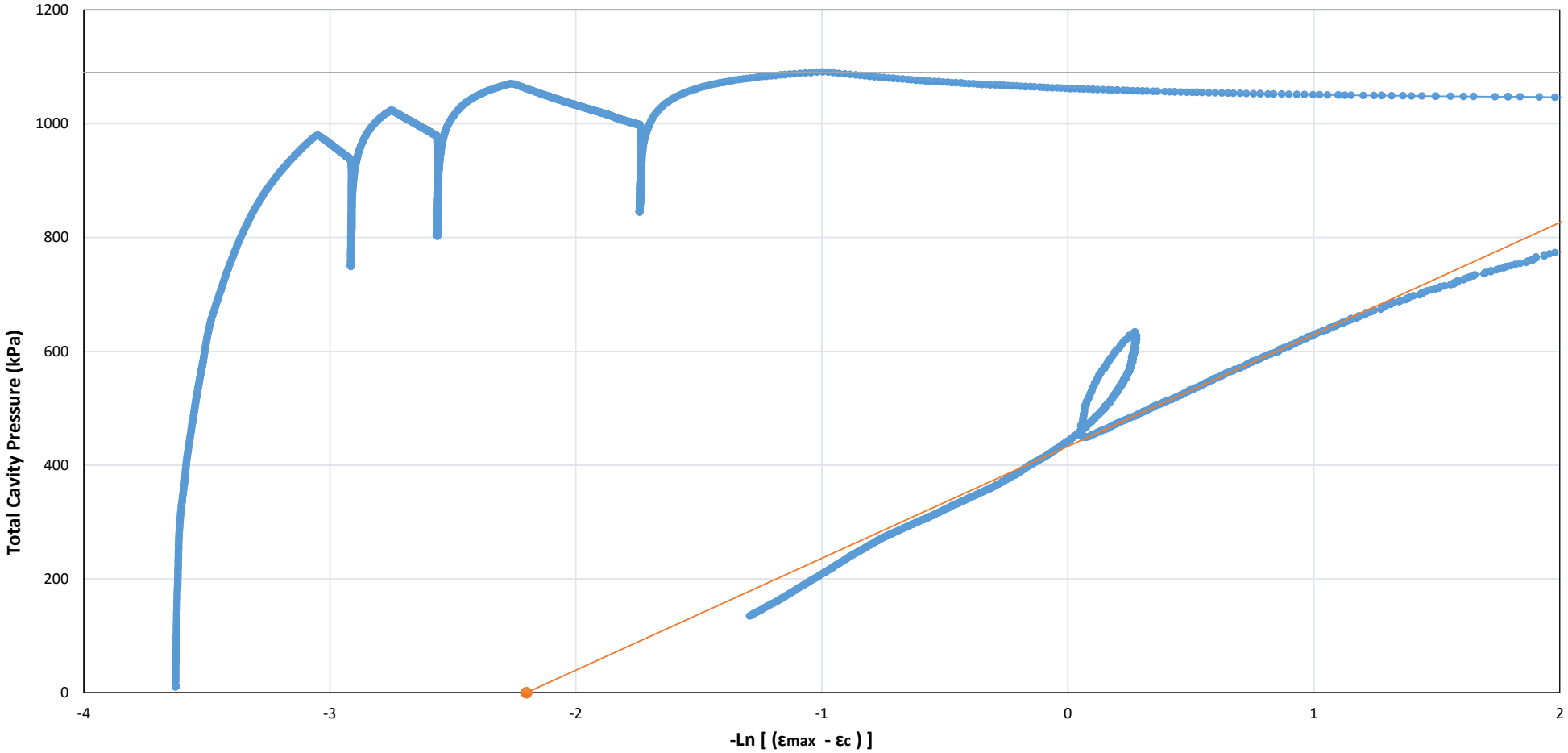
Pressuremeter Test - Total Pressure with Radial Strain



Project Ref:	107284	**Test Engineer:**	PC	**Unload-reload Loops:**	4	**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Date:**	26/09/2019	**Drainage behaviour:**	Undrained	**Depth:**	**5.5 m**
Client Ref:				**Test type:**	FDPM	**Comments:**	
Location:	Warrington, UK			**Duration:**	69 mins		

Houlsby & Withers (1988) Undrained Shear Strength Analysis



Project Ref:	107284	**Shear strength Su:**	98 kPa	**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Drainage behaviour:**	Undrained	**Depth:**	**5.5 m**
Client Ref:				**Comments:**	
Location:	Warrington, UK				

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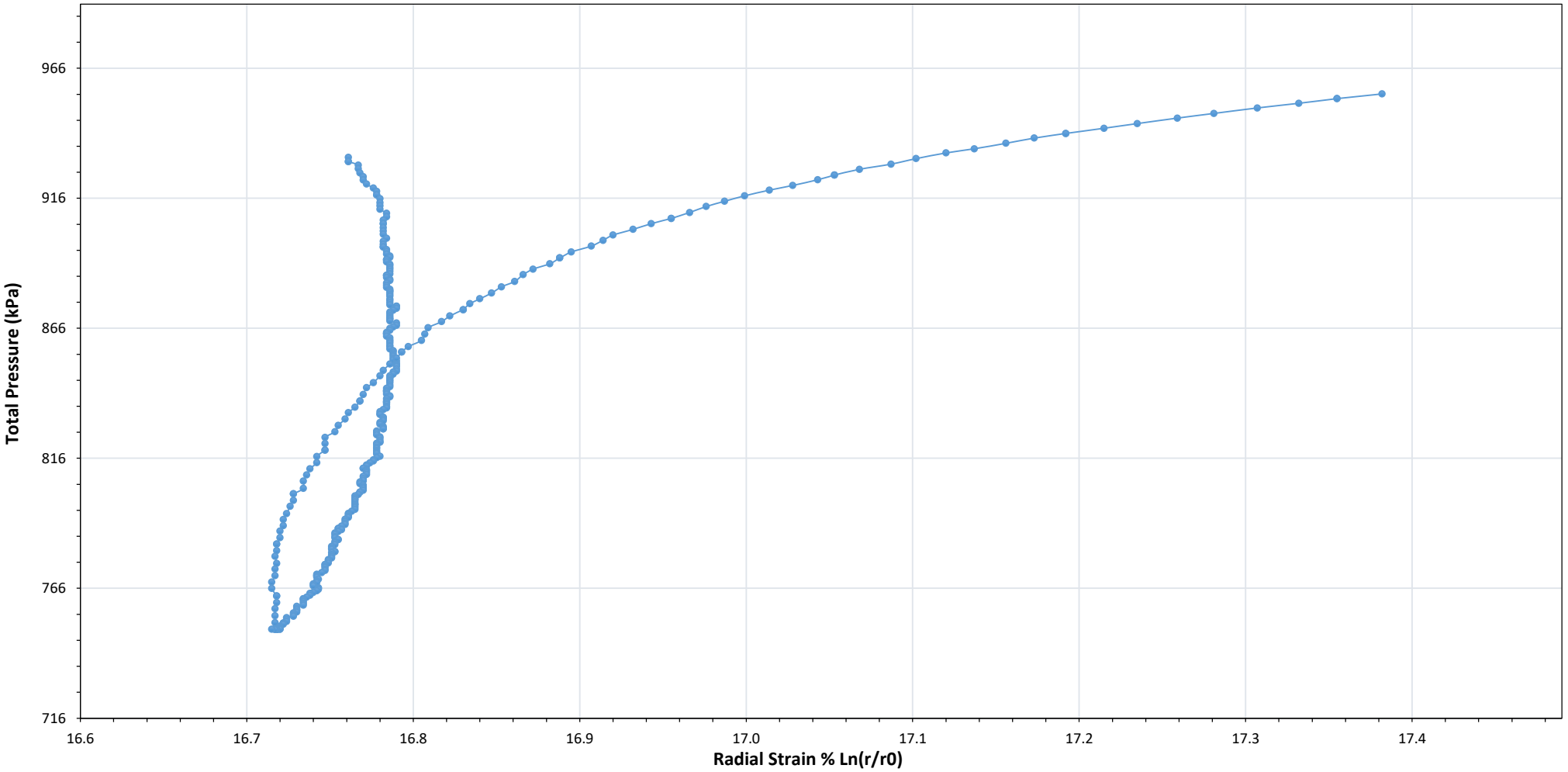
Loop 1 Total Pressure with Radial Cavity Strain



Project Ref:	107284	**Drainage behaviour:**	Undrained	**Shear modulus Gur:**	6915.1 MPa	**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Test type:**	FDPM	**Cavity strain range:**	0.04 %	**Depth:**	**5.5 m**
Client Ref:		**Loop duration:**	56.5 mins			**Comments:**	
Location:	Warrington, UK						

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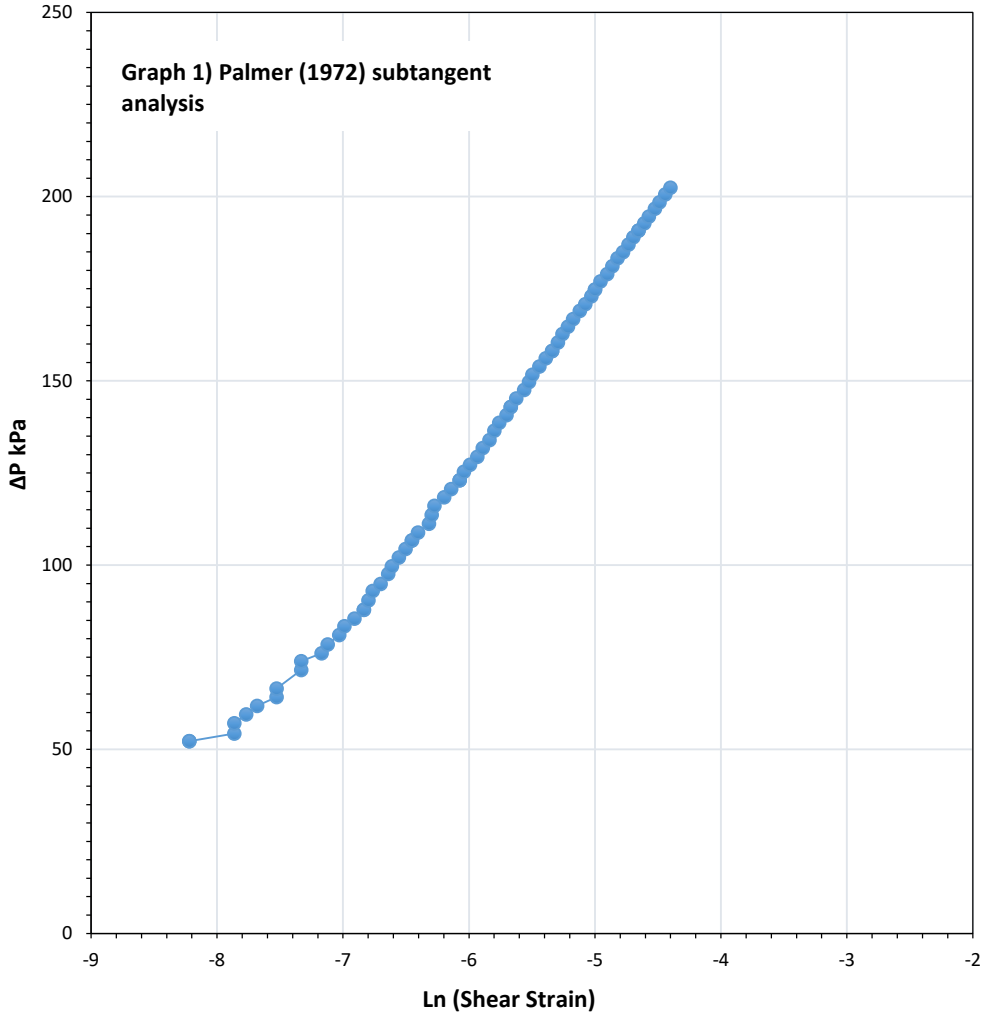
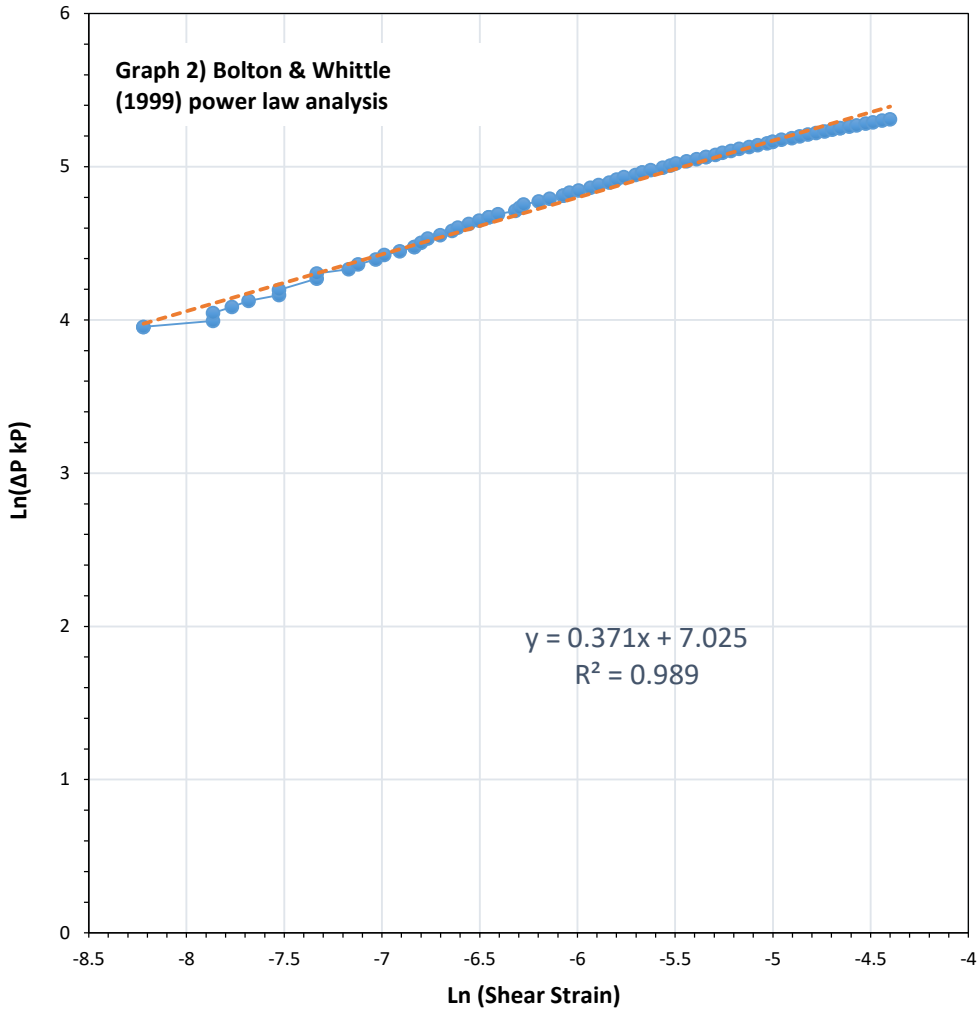
Loop 1 Non-Linear Stress-Strain Analysis





Project Ref:	107284	**Obtained Power Law Parameters (right hand side graph)**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β) (gradient):**	0.371	**Depth:**	**5.5 m**
Client Ref:		**Intercept (η):**	1.124 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α (β*η):**	0.417 MPa		

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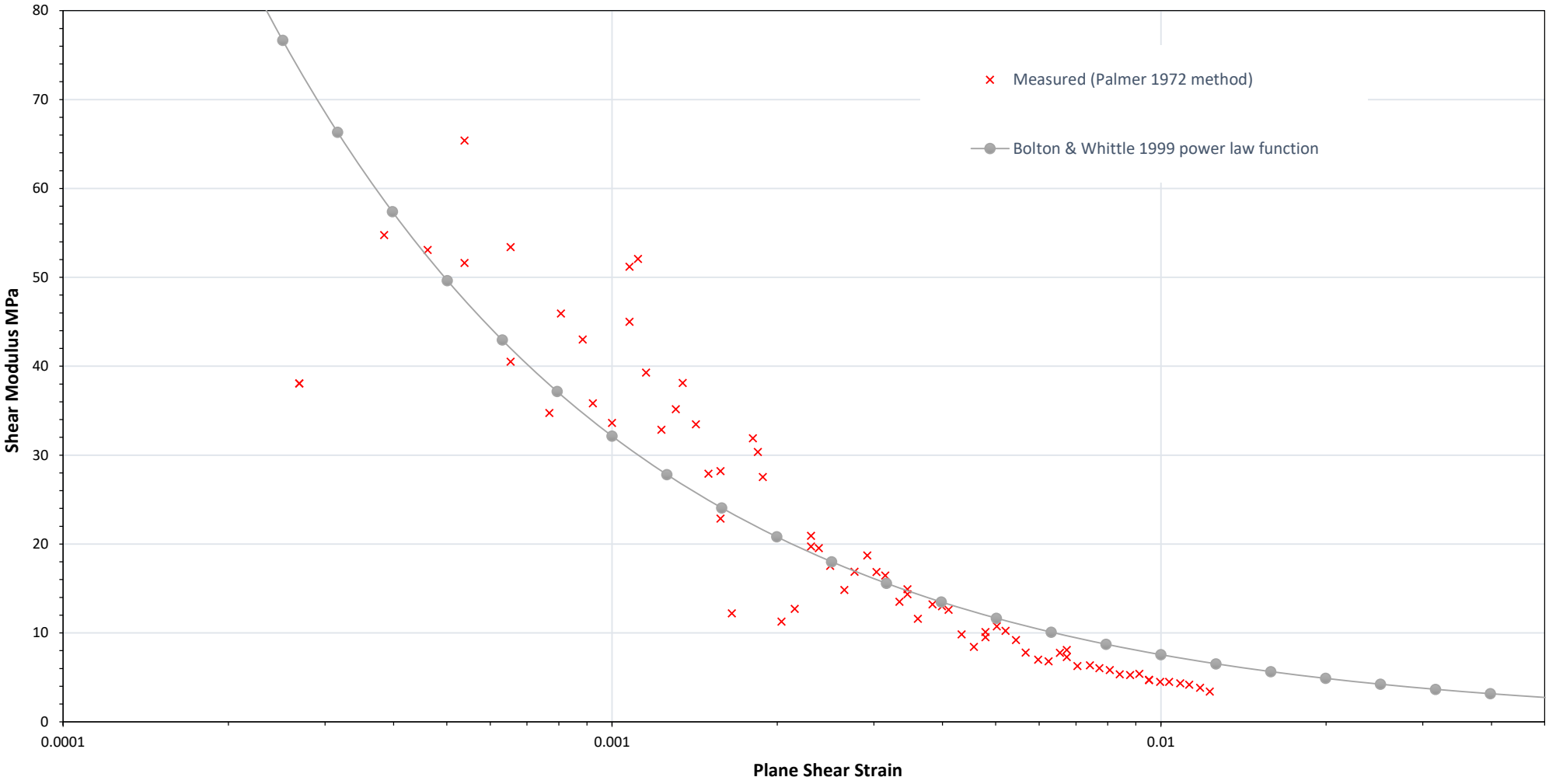
Loop 1 Non-Linear Analysis - Secant Shear Modulus with Plane Shear Strain



Project Ref:	107284	**Bolton & Whittle 1999 power law parameters applied**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β):**	0.371	**Depth:**	**5.5 m**
Client Ref:		**Intercept (η):**	1.124 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α = (β*η):**	0.417 MPa		

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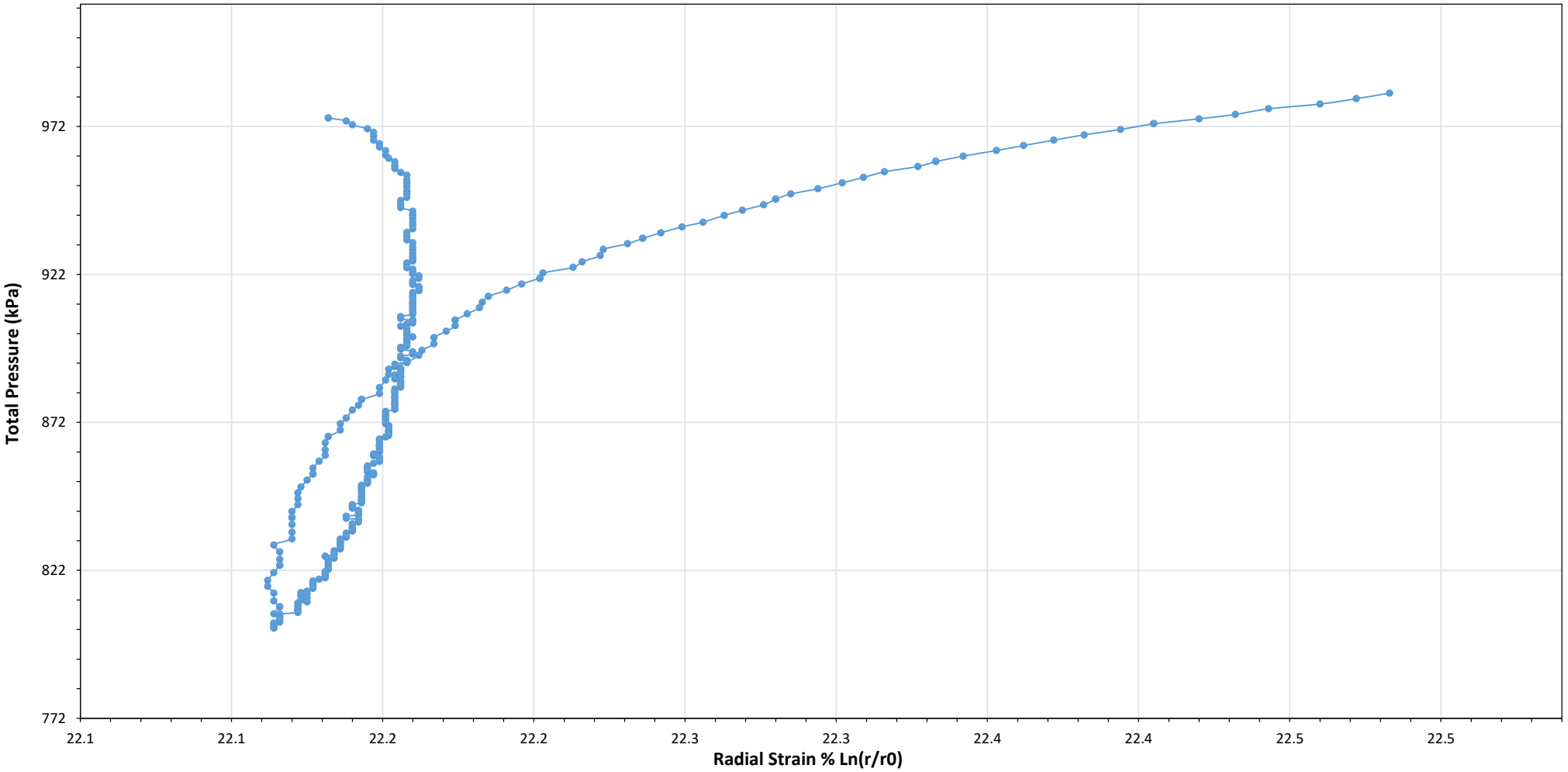
Loop 2 Total Pressure with Radial Cavity Strain



Project Ref:	107284	**Drainage behaviour:**	Undrained	**Shear modulus Gur:**	10048.6 MPa	**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Test type:**	FDPM	**Cavity strain range:**	0.02 %	**Depth:**	**5.5 m**
Client Ref:		**Loop duration:**	5.1 mins			**Comments:**	
Location:	Warrington, UK						

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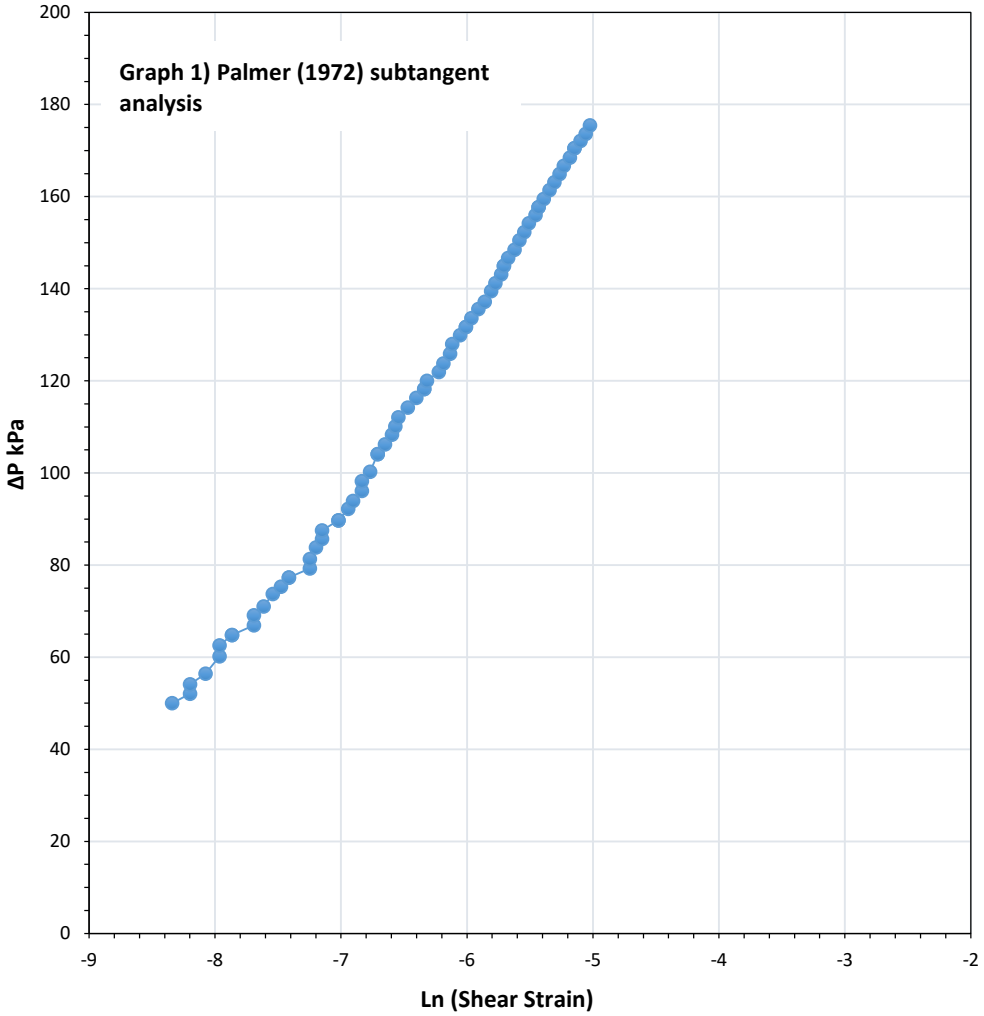
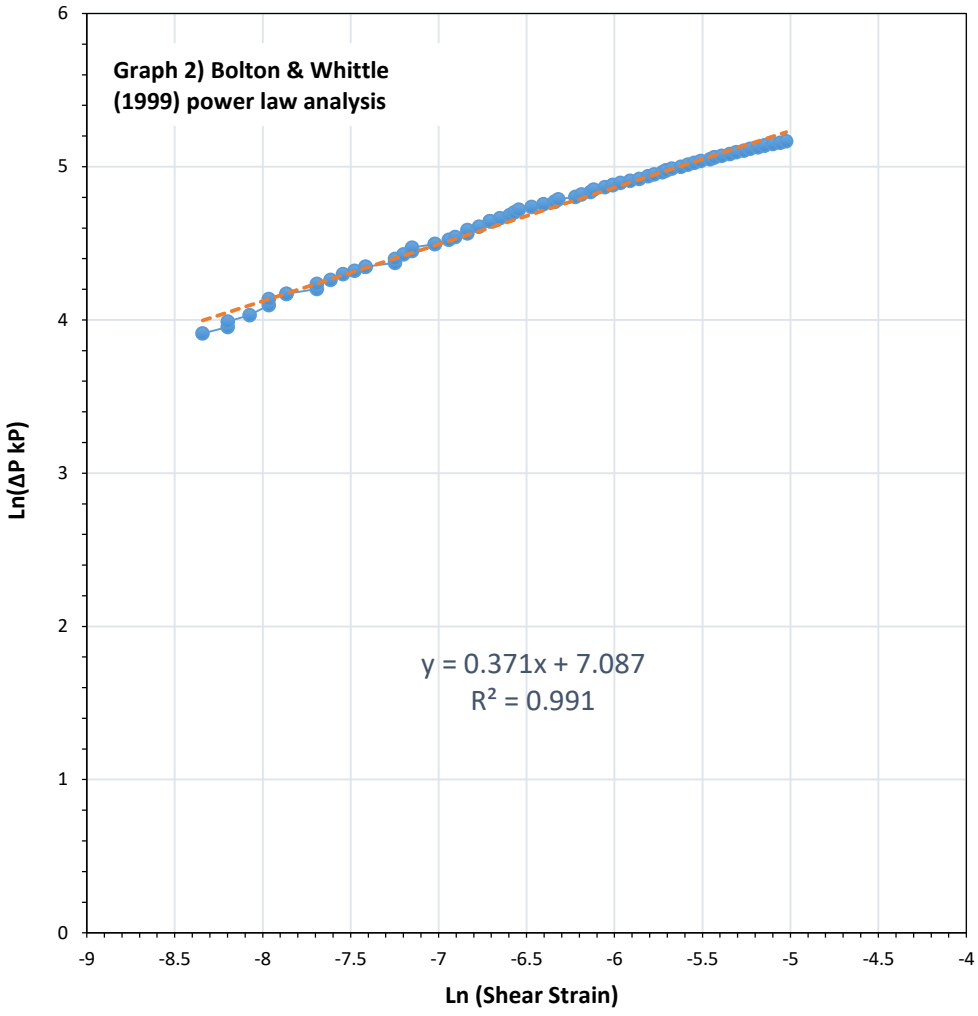
Loop 2 Non-Linear Stress-Strain Analysis





Project Ref:	107284	**Obtained Power Law Parameters (right hand side graph)**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β) (gradient):**	0.371	**Depth:**	**5.5 m**
Client Ref:		**Intercept (η):**	1.197 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α (β*η):**	0.444 MPa		

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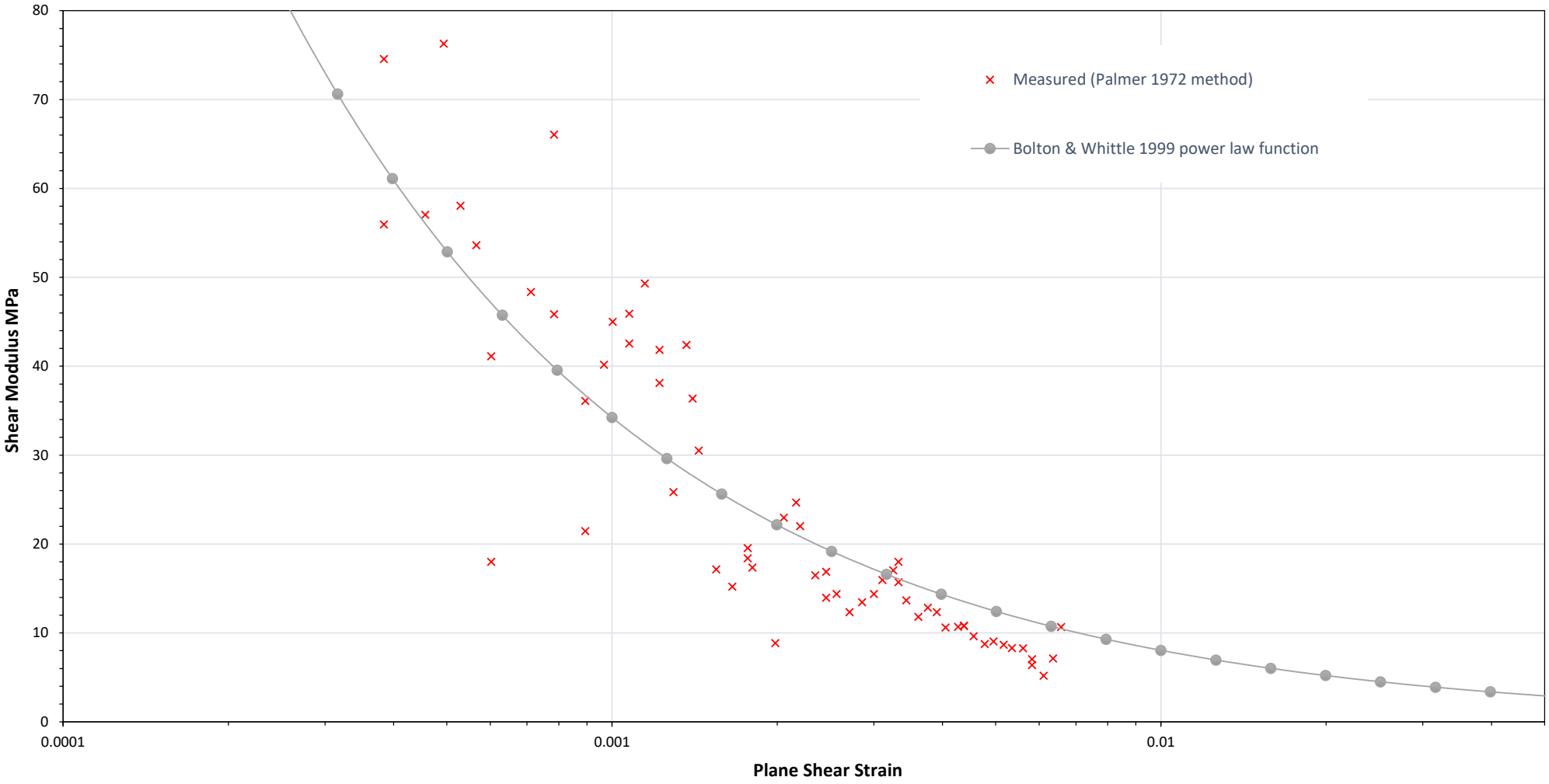
Loop 2 Non-Linear Analysis - Secant Shear Modulus with Plane Shear Strain



Project Ref:	107284	**Bolton & Whittle 1999 power law parameters applied**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β):**	0.371	**Depth:**	**5.5 m**
Client Ref:		**Intercept (η):**	1.197 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α = (β*η):**	0.444 MPa		

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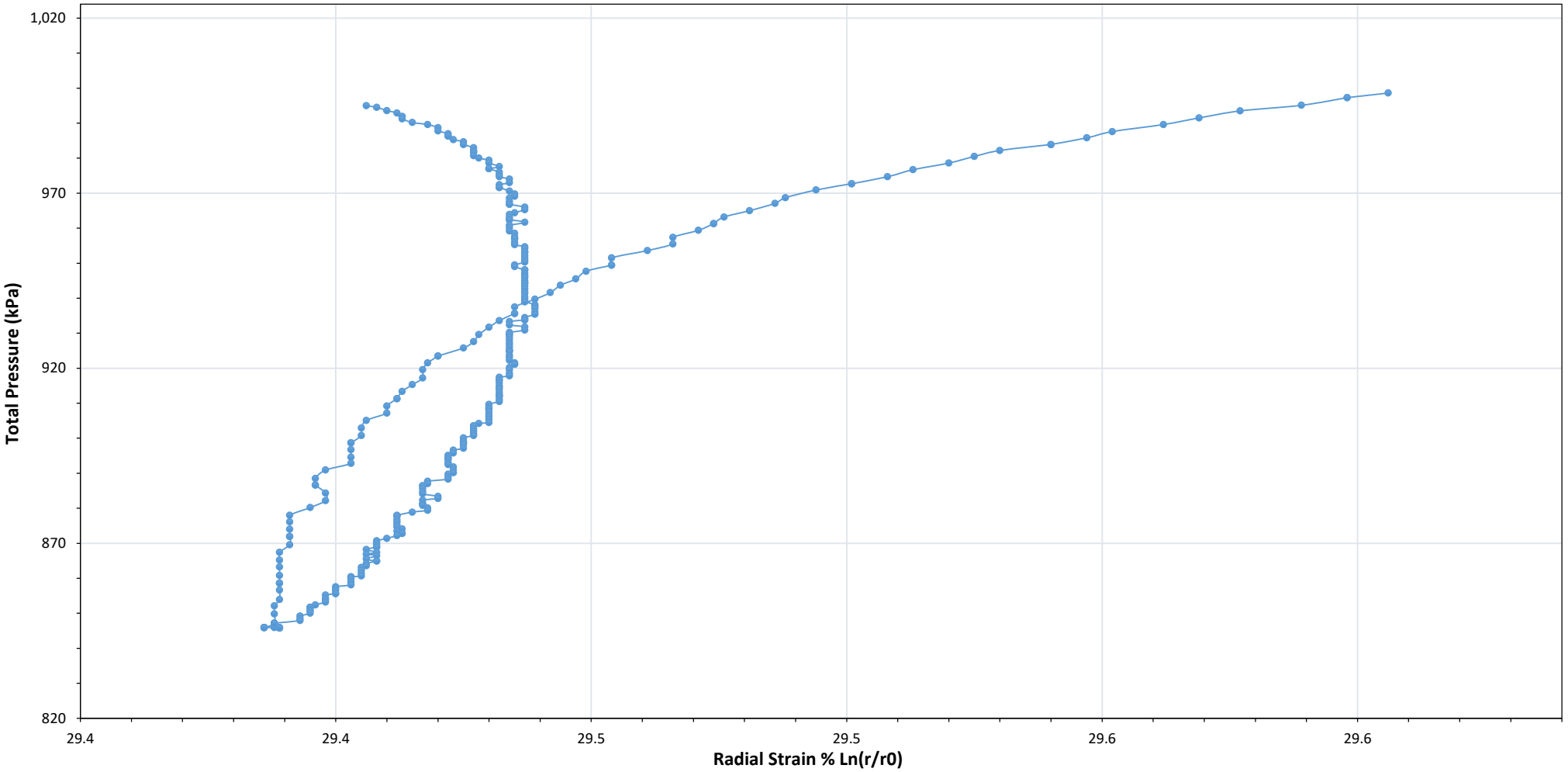
Loop 3 Total Pressure with Radial Cavity Strain



Project Ref:	107284	**Drainage behaviour:**	Undrained	**Shear modulus Gur:**	9650.5 MPa	**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Test type:**	FDPM	**Cavity strain range:**	0.03 %	**Depth:**	**5.5 m**
Client Ref:		**Loop duration:**	4.3 mins			**Comments:**	
Location:	Warrington, UK						

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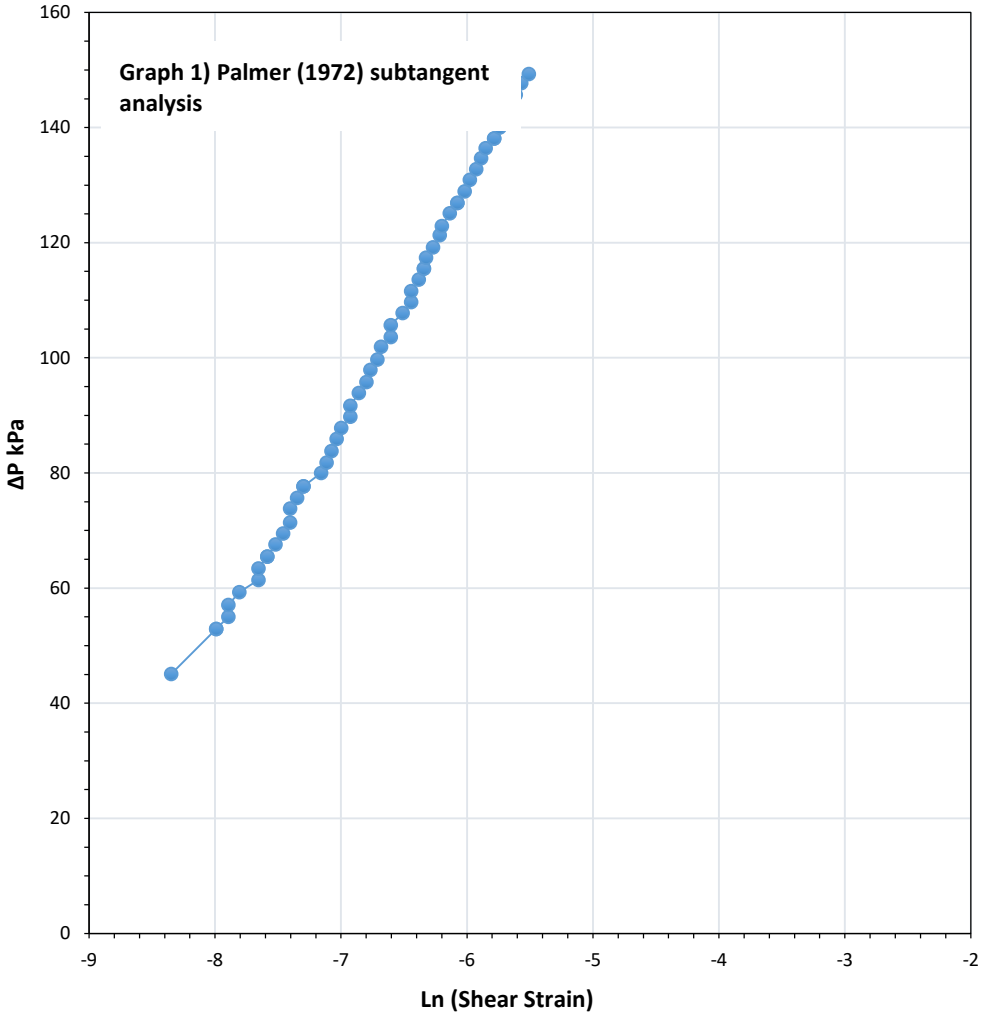
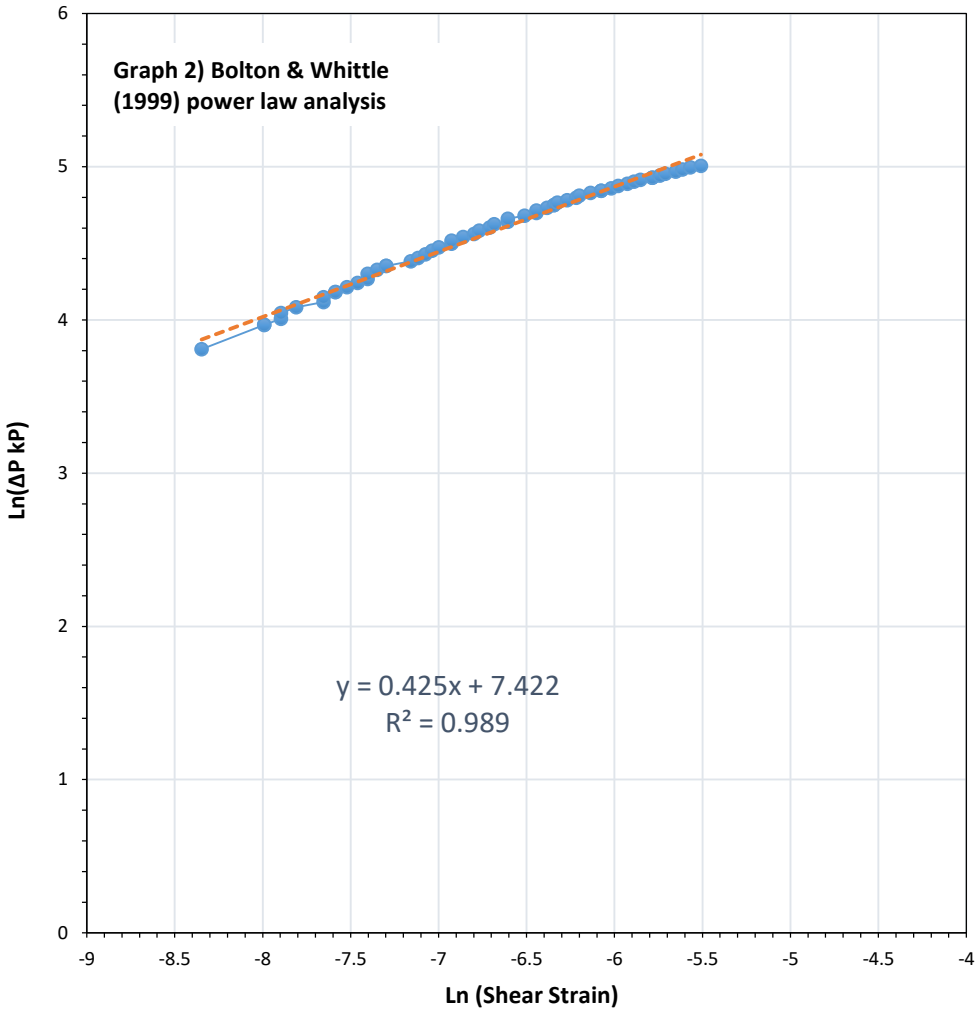
Loop 3 Non-Linear Stress-Strain Analysis





Project Ref:	107284	**Obtained Power Law Parameters (right hand side graph)**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β) (gradient):**	0.425	**Depth:**	**5.5 m**
Client Ref:		**Intercept (η):**	1.672 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α (β*η):**	0.711 MPa		

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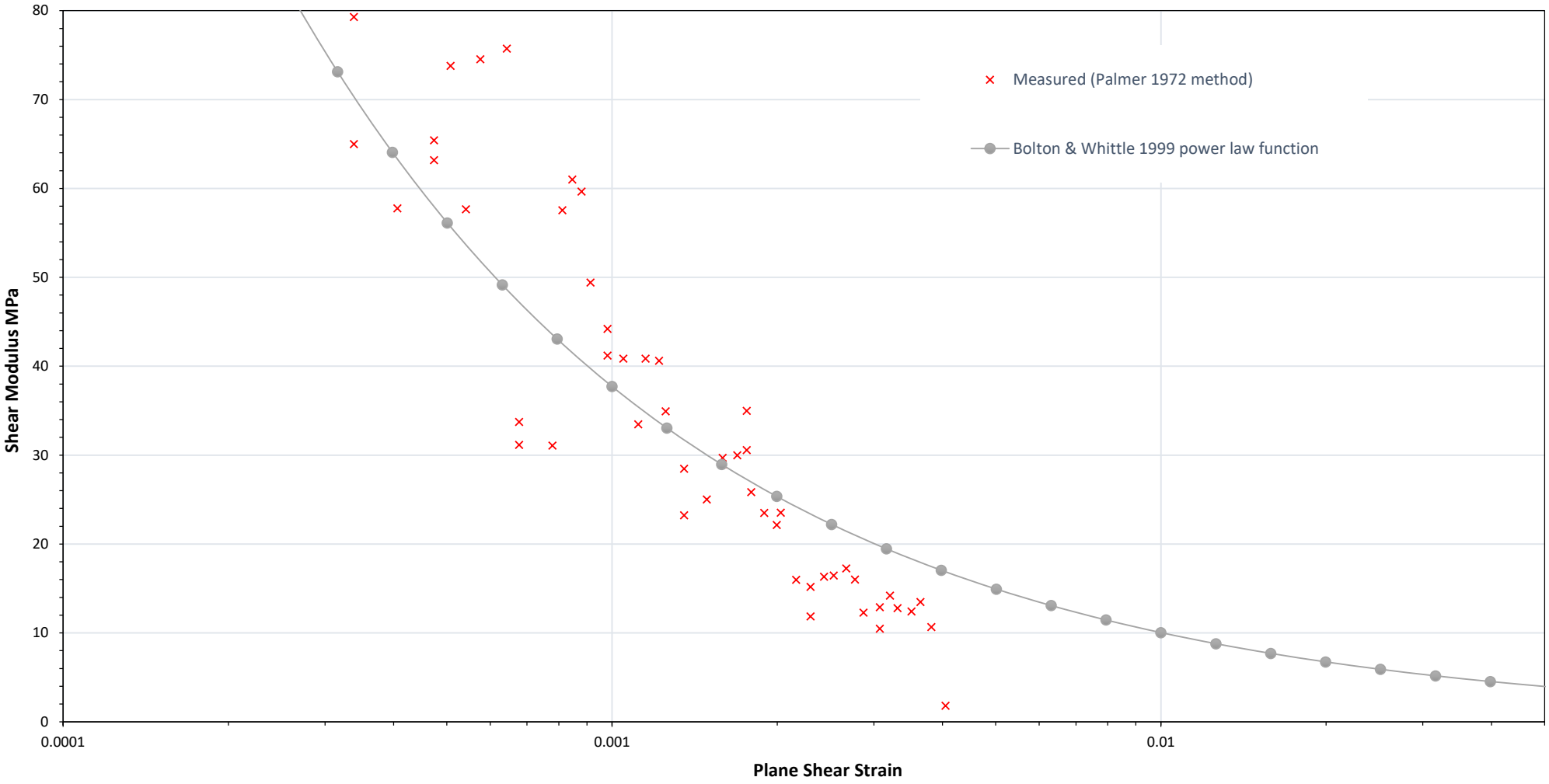
Loop 3 Non-Linear Analysis - Secant Shear Modulus with Plane Shear Strain



Project Ref:	107284	**Bolton & Whittle 1999 power law parameters applied**		**Location ID:**	**CPTP8B01**
Client:	Geotechnics	**Non-linearity exponent (β):**	0.425	**Depth:**	**5.5 m**
Client Ref:		**Intercept (η):**	1.672 MPa	**Comments:**	
Location:	Warrington, UK	**Shear stress constant α = (β*η):**	0.711 MPa		