

**Geotechnical Report**

**Appendix D**

**Groundwater Monitoring Results**



Project: Konaston Underpass  
 UMA Job No.: 4231-040-09

Piezometer VW-04-29A

Location: 10.0 m  
 Depth of VW: 234.07 m  
 Ground Elev.: 224.07 m  
 Tip Elevation:  
 Baseline Reading (Atm, taken prior to  
 installation with VW to be installed):  
 Date 10-Dec-04  
 Reading (R<sub>i</sub>) 8820.3  
 Temp. °C (T<sub>i</sub>) 25.1

This sheet is based on the formulas:

$$Pressure = \rho \cdot g \cdot h + P_0 + C$$

$$P_{corrected} = P + P_T - P_B = P + (\rho \cdot T) \cdot g \cdot h - (S - S_0)$$

Installed VW Piezometer:

Information from VW Calibration Report:  
 Supplier: Geokon  
 Serial No.: 04-14194  
 Polynomial Gage Factors (metric):  
 A 7.59E-08  
 B -0.1001  
 C 888.11  
 Thermal Factor ( ) -0.1209 kPa/°C  
 Calculated C: 886.88 kPa, Based on P=0, Using R<sub>0</sub>

Barometric VW Piezometer:  
 Original Calibration Information:

Supplier: 25976  
 Serial No.: 18-Feb-94  
 Date: 8941.6 F<sup>2</sup>×10<sup>-3</sup>  
 R<sub>0</sub> = 15.0 C  
 T<sub>0</sub> =  
 G = 0.016184 psi/digit  
 C = -0.021039 psi/C rise  
 Pressure: 29.15 in. of Hg  
 98.71 kPa

| Date      | Installed Piezometer Reading (F <sup>2</sup> ×10 <sup>-3</sup> ) R <sub>i</sub> | Temperature T <sub>i</sub> (°C) | Barometric Reading R <sub>i</sub> (F <sup>2</sup> ×10 <sup>-3</sup> ) | Temperature T <sub>i</sub> (°C) | Barometric Reading S <sub>i</sub> (P+P <sub>T</sub> +S <sub>0</sub> ) (kPa) | Barometric Correction P <sub>B</sub> (kPa) | Installed P+P <sub>T</sub> (kPa) | Uncorrected Ground Water above tip (m) | Uncorrected Depth Below Ground (m) | Installed P <sub>corrected</sub> P+P <sub>T</sub> -P <sub>B</sub> (kPa) | Height of Ground Water above tip (m) | Ground Water Elevation (m) | Depth Below Ground (m) | Comments:   |
|-----------|---|---------------------------------|---|---------------------------------|---|--|----------------------------------|--|------------------------------------|---|--------------------------------------|----------------------------|------------------------|---|
| 10-Dec-04 | 8820.3  | 25.1                            | 8935.7  | -6.3                            | 102.46  | 0.00                                       | 80.24                            | 8.18                                   | 1.82                               | 80.24   | 8.18                                 | 232.25                     | 1.82                   | Prior to installation   |
| 10-Dec-04 | 8130.0  | 7.3                             | 8935.7  | -6.3                            | 102.46  | 0.00                                       | 80.24                            | 8.18                                   | 1.82                               | 80.24   | 8.18                                 | 232.25                     | 1.82                   | Water in hole during installation, reading taken after piezometer backfilled. |
| 16-Dec-04 | 8467.3  | 6.8                             | 8930.5  | -12.3                           | 103.91  | 1.45                                       | 46.96                            | 4.79                                   | 5.21                               | 45.51   | 4.64                                 | 228.71                     | 5.36                   |   |
| 23-Dec-04 | 8452.0  | 6.7                             | 8928.1  | -17.1                           | 104.88  | 2.41                                       | 48.48                            | 4.94                                   | 5.06                               | 46.07   | 4.70                                 | 228.77                     | 5.30                   |   |
| 6-Jan-05  | 8466.7  | 6.7                             | 8944.3  | -20.9                           | 103.62  | 1.16                                       | 44.07                            | 4.49                                   | 5.51                               | 42.91   | 4.38                                 | 228.45                     | 5.62                   |   |
| 26-Jan-05 | 8462.5  | 6.7                             | 8906.7  | -12.6                           | 106.61  | 4.15                                       | 47.45                            | 4.84                                   | 5.16                               | 43.30   | 4.41                                 | 228.48                     | 5.59                   |   |
| 4-Feb-05  | 8473.6  | 6.7                             | 8991.9  | -0.1                            | 106.45  | 3.99                                       | 46.35                            | 4.73                                   | 5.27                               | 42.36   | 4.32                                 | 228.39                     | 5.68                   |   |

Project: Kenaston Underpass  
 UMA Job No.: 4231-040-09

This sheet is based on the formulas:

$$\text{Pressure} = AR^2 + BR + C$$

$$P_{\text{corrected}} = P + P_T - P_B = P + (T - T_0)k - (S_1 - S_0)$$

Piezometer: VW-04-29B  
 Location: 6.7 m  
 Depth of VW: 234.07 m  
 Ground Elev.: 227.37 m  
 Tip Elevation: 227.37 m  
 Baseline Reading (Atm, taken prior to installation with VW to be installed):  
 Date: 13-Dec-04  
 Reading (R<sub>i</sub>): 8747.6  
 Temp. °C (T<sub>i</sub>): 20.5

Installed VW Piezometer:  
 Information from VW Calibration Report:  
 Supplier: Geokon  
 Serial No.: 04-13873  
 Polynomial Gage Factors (metric):  
 A: -8.33E-08  
 B: -0.1092  
 C: 963.27  
 Thermal Factor: -0.0073 kPa/°C  
 Calculated C: 961.61 kPa, Based on P=0, Using R<sub>0</sub>

Barometric VW Piezometer:  
 Original Calibration Information:  
 Supplier: 25976  
 Serial No.: 18-Feb-94  
 Date: 8941.6 F<sup>2</sup>x10<sup>-3</sup>  
 R<sub>0</sub>: 15.0 C  
 T<sub>0</sub>: 0.016184 psi/digit  
 G: -0.021039 psi/C rise  
 C: 29.15 in. of Hg  
 Pressure: 98.71 kPa

| Date      | Installed Piezometer Reading (F <sup>2</sup> x10 <sup>-3</sup> ) R <sub>i</sub> | Installed Piezometer Temperature T <sub>i</sub> (°C) | Barometric Piezometer Reading (F <sup>2</sup> x10 <sup>-3</sup> ) R <sub>i</sub> | Barometric Piezometer Temperature T <sub>i</sub> (°C) | Barometric S <sub>1</sub> P+P <sub>T</sub> +S <sub>B</sub> (kPa) | Barometric Correction P <sub>B</sub> (kPa) | Installed P+P <sub>T</sub> (kPa) | Uncorrected Ground Water above tip (m) | Uncorrected Depth Below Ground (m) | Installed P <sub>corrected</sub> P+P <sub>T</sub> -P <sub>B</sub> (kPa) | Height of Ground Water above tip (m) | Ground Water Elevation (m) | Depth Below Ground (m) | Comments:   |
|-----------|---|--|--|---|--|--|----------------------------------|--|------------------------------------|---|--------------------------------------|----------------------------|------------------------|---|
| 13-Dec-04 | 8747.6  | 20.5   | 8635.7   | -6.3  | 102.46   | 0.00                                       | 0.00                             | 5.44                                   | 1.26                               | 53.40   | 5.44                                 | 232.81                     | 1.26                   | Prior to installation   |
| 13-Dec-04 | 8265.7  | 6.2  | 8635.7   | -6.3  | 102.46   | 0.00                                       | 53.40                            | 5.44                                   | 1.26                               | 53.40   | 5.44                                 | 232.81                     | 1.26                   | Water in hole during installation, reading taken after piezometer backfilled. |
| 16-Dec-04 | 8434.8  | 7.1  | 8930.5   | -12.3   | 103.91   | 1.45                                       | 34.70                            | 3.54                                   | 3.16                               | 33.25   | 3.39                                 | 230.76                     | 3.31                   |   |
| 23-Dec-04 | 8425.3  | 7.1  | 8928.1   | -17.1   | 104.86   | 2.41                                       | 35.75                            | 3.65                                   | 3.05                               | 33.34   | 3.40                                 | 230.77                     | 3.30                   |   |
| 6-Jan-05  | 8469.0  | 7.2  | 8944.3   | -20.9   | 103.62   | 1.16                                       | 30.92                            | 3.15                                   | 3.55                               | 29.76   | 3.03                                 | 230.40                     | 3.87                   |   |
| 26-Jan-05 | 8437.8  | 7.3  | 8906.7   | -12.6   | 106.61   | 4.15                                       | 34.37                            | 3.50                                   | 3.20                               | 30.22   | 3.08                                 | 230.45                     | 3.62                   |   |



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Piezometer VW-04-308  
 Location: 8.4 m  
 Depth of VW: 234.16 m  
 Ground Elev.: 225.76 m  
 Tip Elevation:  
 Baseline Reading (Atm, taken prior to  
 installation with VW to be installed):  
 Date 10-Dec-04  
 Reading (R<sub>i</sub>) 8616.8  
 Temp. °C (T<sub>0</sub>) 22.8

This sheet is based on the formulas:

$$P_{measured} = P + P_1 - P_0 = P + (T_1 - T_0) \times K - (S_1 - S_0)$$

Installed VW Piezometer:

Information from VW Calibration Report:  
 Supplier: Geokon  
 Serial No.: 04-13874  
 Polynomial Gage Factors (metric):  
 A -2.48E-07  
 B -0.1163  
 C \* 1022.69  
 Thermal Factor (-0.0253 kPa/°C)  
 Calculated C: 1020.56 kPa, Based on P=0, Using R<sub>0</sub>

Barometric VW Piezometer:  
 Original Calibration Information:  
 Supplier: 25976  
 Serial No.: 19-Feb-94  
 Date: 8941.6 F\*2x10<sup>-3</sup>  
 R<sub>0</sub>: 15.0 C  
 T<sub>0</sub>: 0.016184 psi/digit  
 G = -0.021039 psi/C rise  
 C = 28.15 in. of Hg  
 Pressure: 98.71 kPa

| Date      | Installed Piezometer Reading           |                     | Barometric Piezometer Reading          |                     | Barometric Correction                  |                      | Installed P+P <sub>1</sub> (kPa) |                        | Uncorrected Ground Water above tip (m) |                        | Uncorrected Depth Below Ground (m) |                            | Installed P <sub>measured</sub> P+P <sub>1</sub> -P <sub>0</sub> (kPa) |  | Height of Ground Water above tip (m) |                            | Ground Water Elevation (m) |       | Depth Below Ground (m) |      | Comments:   |
|-----------|--|---------------------|--|---------------------|--|----------------------|----------------------------------|------------------------|--|------------------------|------------------------------------|----------------------------|--|--|--------------------------------------|----------------------------|----------------------------|-------|------------------------|------|---|
|           | R <sub>i</sub> (F*2x10 <sup>-3</sup> ) | T <sub>i</sub> (°C) | R <sub>i</sub> (F*2x10 <sup>-3</sup> ) | T <sub>i</sub> (°C) | P+P <sub>1</sub> +S <sub>0</sub> (kPa) | S <sub>1</sub> (kPa) | P <sub>0</sub> (kPa)             | P+P <sub>1</sub> (kPa) | Ground Water above tip (m)             | Depth Below Ground (m) | P <sub>measured</sub> (kPa)        | Ground Water Elevation (m) | Depth Below Ground (m)   | P+P <sub>1</sub> -P <sub>0</sub> (kPa) | Ground Water above tip (m)           | Ground Water Elevation (m) | Depth Below Ground (m)     |       |                        |      |   |
| 10-Dec-04 | 8616.8                                 | 22.8                | 8935.7                                 | -6.3                | 102.46                                 | 0.00                 | 0.00                             | 0.00                   | -0.05                                  | 8.45                   | 225.71                             | 8.45                       | -0.46  | -0.05                                  | 225.71                               | 8.45                       | -0.46                      | -0.05 | 225.71                 | 8.45 | Prior to installation   |
| 10-Dec-04 | 8624.7                                 | 3.2                 | 8935.7                                 | -6.3                | 102.46                                 | 0.00                 | 0.00                             | -0.46                  | -0.05                                  | 8.45                   | 225.71                             | 8.45                       | -0.46  | -0.05                                  | 225.71                               | 8.45                       | -0.46                      | -0.05 | 225.71                 | 8.45 | Water in hole during installation, reading taken after piezometer backfilled. |
| 16-Dec-04 | 8549.2                                 | 6.9                 | 8930.5                                 | -12.3               | 103.91                                 | 1.45                 | 8.55                             | 8.55                   | 0.87                                   | 7.53                   | 226.48                             | 7.53                       | 7.10   | 0.72                                   | 226.48                               | 7.53                       | 7.10                       | 0.72  | 226.48                 | 7.53 |   |
| 23-Dec-04 | 8462.4                                 | 6.8                 | 8928.1                                 | -17.1               | 104.88                                 | 2.41                 | 19.02                            | 19.02                  | 1.94                                   | 6.46                   | 227.45                             | 6.46                       | 16.60  | 1.69                                   | 227.45                               | 6.46                       | 16.60                      | 1.69  | 227.45                 | 6.46 |   |
| 6-Jan-05  | 8375.3                                 | 6.8                 | 8944.3                                 | -20.9               | 103.62                                 | 1.16                 | 29.51                            | 29.51                  | 3.01                                   | 5.39                   | 228.65                             | 5.39                       | 28.35  | 2.89                                   | 228.65                               | 5.39                       | 28.35                      | 2.89  | 228.65                 | 5.39 |   |
| 26-Jan-05 | 8170.2                                 | 7.0                 | 8906.7                                 | -12.6               | 106.61                                 | 4.15                 | 54.20                            | 54.20                  | 5.53                                   | 2.87                   | 230.86                             | 2.87                       | 50.05  | 5.10                                   | 230.86                               | 2.87                       | 50.05                      | 5.10  | 230.86                 | 2.87 |   |

Project: Kenaston Underpass  
 UMA Job No.: 4231-040-09

Piezometer VW-04-30C

Location: 4.5 m  
 Depth of VW: 234.16 m  
 Ground Elev.: 229.66 m  
 Tip Elevation:  
 Baseline Readings:  
 Date 4-Dec-93  
 Reading (R<sub>0</sub>) 9735  
 Temp. (T<sub>0</sub>) 0.0  
 Bar. (S<sub>0</sub>) 100.1

This sheet is based on the formula:

$$P_{corrected} = ((R_0 - R_1) \times G) + (T_1 - T_0) \times K + P_T - P_a$$

Installed VW Piezometer:

Supplier: 24459  
 Serial No.: 0.00274 psi/digit  
 Linear Gage Factor (G) = -0.00274 psi/C  
 Thermal Factor (K) =

Original Calibration Information:

Supplier: 25976  
 Serial No.: 18-Feb-94  
 Date: 8941.6 F<sup>2</sup>x10<sup>-3</sup>  
 R<sub>0</sub> = 15.0 C  
 T<sub>0</sub> = 0.016184 psi/digit  
 G = -0.021039 psi/C rise  
 C = 29.15 in. of Hg  
 Pressure: 98.71 kPa

| Date   | Installed Piezometer Reading (F <sup>2</sup> x10 <sup>-3</sup> ) | Temperature (°C) | Barometric Reading (F <sup>2</sup> x10 <sup>-3</sup> ) | Temperature (°C) | Barometric Correction (kPa) | Barometric S <sub>0</sub> (kPa) | Installed P+P <sub>T</sub> (kPa) | Uncorrected Ground Water above tip (m) | Uncorrected Depth Below Ground (m) | Installed P <sub>corrected</sub> P+P <sub>T</sub> -P <sub>a</sub> (kPa) | Height of Ground Water above tip (m) | Ground Water Elevation (m) | Depth Below Ground (m) | Comments:  |
|--|--|------------------|--|------------------|-----------------------------|---------------------------------|----------------------------------|--|------------------------------------|---|--------------------------------------|----------------------------|------------------------|--|
| Baseline Readings (Atm. taken prior to installation, with VW to be installed): |  |                  |  |                  |                             |                                 |                                  |  |                                    |   |                                      |                            |                        |  |
| 9-Dec-04   | 9811.9   | 10.0             | 8839.1   | -7.5             | 0.00                        | 102.26                          | -0.41                            | -0.04                                  | 4.54                               | -0.41   | -0.04                                | 229.62                     | 4.54                   | Prior to installation  |
| 9-Dec-04   | 8635.7   | 7.8              | 8639.1   | -7.5             | 0.00                        | 102.26                          | -0.41                            | -0.04                                  | 4.54                               | -0.41   | -0.04                                | 229.62                     | 4.54                   | No water in hole during installation, reading taken after piezometer backfilled. |
| 16-Dec-04  | 9521.5   | 8.1              | 8930.5   | -12.3            | 1.66                        | 103.91                          | 1.74                             | 0.18                                   | 4.32                               | 0.09  | 0.01                                 | 229.67                     | 4.49                   |  |
| 23-Dec-04  | 8578.6   | 8.1              | 8928.1   | -17.1            | 2.62                        | 104.88                          | 19.56                            | 1.99                                   | 2.51                               | 16.94   | 1.73                                 | 231.39                     | 2.77                   |  |
| 6-Jan-05   | 8595.4   | 8.0              | 8944.3   | -20.9            | 1.38                        | 103.62                          | 19.24                            | 1.96                                   | 2.54                               | 17.88   | 1.82                                 | 231.48                     | 2.68                   |  |
| 26-Jan-05  | 8200.4   | 7.8              | 8906.7   | -12.6            | 4.36                        | 106.61                          | 26.71                            | 2.72                                   | 1.78                               | 22.35   | 2.28                                 | 231.94                     | 2.22                   |  |







**Project:** Kenaston Underpass  
**UMA Job No.:** 4231-040-09

**Location:**  
**Piezometer** PN-04-35  
**Ground Elevation (m)** 233.51  
**I.D.** **Gnd Elev** **Tip Depth** **Tip Elevation**  
                       (m)              (m)              (m)  
**PN-04-35**                      9.2              224.31

| Date             | Time | Pnuematic     |                        |
|------------------|------|---------------|------------------------|
|                  |      | Reading (psi) | Ground Water Elev. (m) |
| January 26, 2005 |      | 8.70          | 230.43                 |
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