



Site:
Sample No.:

Hafod Landfill - C3 W Upper
TL1/01

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		695	g
Mass of dried soil + tray (m_2)	=		609	g
Mass of empty tray (m_3)	=		6	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	689	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	603	g
Mass of moisture (m_6)	=	$m_4 - m_5$	86	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.3%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3266	g
Mass of empty core (M_2)	=		1065	g
Mass of soil (M)	=	$M_1 - M_2$	2201	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.156	Mg m ³
Water Content (w)	=		14.3%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.887	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.66	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.41	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	2.2%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
TL1/02

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		710	g
Mass of dried soil + tray (m_2)	=		622	g
Mass of empty tray (m_3)	=		6	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	704	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	616	g
Mass of moisture (m_6)	=	$m_4 - m_5$	88	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.3%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3251	g
Mass of empty core (M_2)	=		1065	g
Mass of soil (M)	=	$M_1 - M_2$	2186	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.141	Mg m ³
Water Content (w)	=		14.3%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.873	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.66	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.42	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	2.8%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
TL1/03

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		647	g
Mass of dried soil + tray (m_2)	=		567	g
Mass of empty tray (m_3)	=		6	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	641	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	561	g
Mass of moisture (m_6)	=	$m_4 - m_5$	80	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.3%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3260	g
Mass of empty core (M_2)	=		1065	g
Mass of soil (M)	=	$M_1 - M_2$	2195	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.150	Mg m ³
Water Content (w)	=		14.3%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.882	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.66	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.41	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	2.4%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
TL2/05

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		683	g
Mass of dried soil + tray (m_2)	=		600	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	675	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	592	g
Mass of moisture (m_6)	=	$m_4 - m_5$	83	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.0%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3325	g
Mass of empty core (M_2)	=		1065	g
Mass of soil (M)	=	$M_1 - M_2$	2260	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.213	Mg m ³
Water Content (w)	=		14.0%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.941	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.66	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.37	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-0.2%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
TL2/06

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		711	g
Mass of dried soil + tray (m_2)	=		629	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	703	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	621	g
Mass of moisture (m_6)	=	$m_4 - m_5$	82	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.2%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3342	g
Mass of empty core (M_2)	=		1065	g
Mass of soil (M)	=	$M_1 - M_2$	2277	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.230	Mg m ³
Water Content (w)	=		13.2%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.970	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.65	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.35	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-0.4%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
TL2/08

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		724	g
Mass of dried soil + tray (m_2)	=		641	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	716	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	633	g
Mass of moisture (m_6)	=	$m_4 - m_5$	83	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.1%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3248	g
Mass of empty core (M_2)	=		1065	g
Mass of soil (M)	=	$M_1 - M_2$	2183	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.138	Mg m ³
Water Content (w)	=		13.1%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.890	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.66	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.41	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	4.2%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
TL3/10

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		572	g
Mass of dried soil + tray (m_2)	=		497	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	567	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	492	g
Mass of moisture (m_6)	=	$m_4 - m_5$	75	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.2%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3372	g
Mass of empty core (M_2)	=		1104	g
Mass of soil (M)	=	$M_1 - M_2$	2268	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.139	Mg m ³
Water Content (w)	=		15.2%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.856	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.66	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.43	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	1.9%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
TL3/11

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		603	g
Mass of dried soil + tray (m_2)	=		530	g
Mass of empty tray (m_3)	=		6	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	597	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	524	g
Mass of moisture (m_6)	=	$m_4 - m_5$	73	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.9%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3342	g
Mass of empty core (M_2)	=		1104	g
Mass of soil (M)	=	$M_1 - M_2$	2238	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.111	Mg m ³
Water Content (w)	=		13.9%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.853	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.66	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.44	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	4.5%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
TL3/12

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		747	g
Mass of dried soil + tray (m_2)	=		651	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	742	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	646	g
Mass of moisture (m_6)	=	$m_4 - m_5$	96	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.9%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3419	g
Mass of empty core (M_2)	=		1104	g
Mass of soil (M)	=	$M_1 - M_2$	2315	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.183	Mg m ³
Water Content (w)	=		14.9%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.901	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.66	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.40	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	0.3%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL1/01

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		597	g
Mass of dried soil + tray (m_2)	=		513	g
Mass of empty tray (m_3)	=		6	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	591	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	507	g
Mass of moisture (m_6)	=	$m_4 - m_5$	84	g
Water Content (w)	=	$\frac{m_6}{m_5}$	16.6%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3297	g
Mass of empty core (M_2)	=		1063	g
Mass of soil (M)	=	$M_1 - M_2$	2234	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.188	Mg m ³
Water Content (w)	=		16.6%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.877	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.40	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-2.5%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL1/02

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		617	g
Mass of dried soil + tray (m_2)	=		538	g
Mass of empty tray (m_3)	=		7	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	610	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	531	g
Mass of moisture (m_6)	=	$m_4 - m_5$	79	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.9%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3251	g
Mass of empty core (M_2)	=		1063	g
Mass of soil (M)	=	$M_1 - M_2$	2188	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.143	Mg m ³
Water Content (w)	=		14.9%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.865	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.41	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	1.3%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL1/03

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		658	g
Mass of dried soil + tray (m_2)	=		573	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	650	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	565	g
Mass of moisture (m_6)	=	$m_4 - m_5$	85	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.0%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3277	g
Mass of empty core (M_2)	=		1063	g
Mass of soil (M)	=	$M_1 - M_2$	2214	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.168	Mg m ³
Water Content (w)	=		15.0%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.885	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.40	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	0.0%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL1/04A

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		753	g
Mass of dried soil + tray (m_2)	=		663	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	745	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	655	g
Mass of moisture (m_6)	=	$m_4 - m_5$	90	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.7%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3296	g
Mass of empty core (M_2)	=		1063	g
Mass of soil (M)	=	$M_1 - M_2$	2233	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.187	Mg m ³
Water Content (w)	=		13.7%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.923	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.37	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	0.5%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL2/04

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		611	g
Mass of dried soil + tray (m_2)	=		525	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	603	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	517	g
Mass of moisture (m_6)	=	$m_4 - m_5$	86	g
Water Content (w)	=	$\frac{m_6}{m_5}$	16.6%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3287	g
Mass of empty core (M_2)	=		1063	g
Mass of soil (M)	=	$M_1 - M_2$	2224	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.178	Mg m ³
Water Content (w)	=		16.6%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.868	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.41	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-2.1%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL2/05

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		693	g
Mass of dried soil + tray (m_2)	=		620	g
Mass of empty tray (m_3)	=		16	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	677	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	604	g
Mass of moisture (m_6)	=	$m_4 - m_5$	73	g
Water Content (w)	=	$\frac{m_6}{m_5}$	12.1%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3255	g
Mass of empty core (M_2)	=		1063	g
Mass of soil (M)	=	$M_1 - M_2$	2192	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.147	Mg m ³
Water Content (w)	=		12.1%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.915	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.37	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	4.0%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL2/06

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		714	g
Mass of dried soil + tray (m_2)	=		618	g
Mass of empty tray (m_3)	=		7	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	707	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	611	g
Mass of moisture (m_6)	=	$m_4 - m_5$	96	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.7%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3266	g
Mass of empty core (M_2)	=		1063	g
Mass of soil (M)	=	$M_1 - M_2$	2203	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.158	Mg m ³
Water Content (w)	=		15.7%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.865	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.41	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-0.2%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL2/07

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		726	g
Mass of dried soil + tray (m_2)	=		646	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	718	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	638	g
Mass of moisture (m_6)	=	$m_4 - m_5$	80	g
Water Content (w)	=	$\frac{m_6}{m_5}$	12.5%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3332	g
Mass of empty core (M_2)	=		1063	g
Mass of soil (M)	=	$M_1 - M_2$	2269	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.222	Mg m ³
Water Content (w)	=		12.5%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.975	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.33	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	0.2%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL3/08

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		597	g
Mass of dried soil + tray (m_2)	=		526	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	589	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	518	g
Mass of moisture (m_6)	=	$m_4 - m_5$	71	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.7%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3357	g
Mass of empty core (M_2)	=		1112	g
Mass of soil (M)	=	$M_1 - M_2$	2245	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.117	Mg m ³
Water Content (w)	=		13.7%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.862	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.41	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	3.7%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL3/09

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		606	g
Mass of dried soil + tray (m_2)	=		526	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	598	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	518	g
Mass of moisture (m_6)	=	$m_4 - m_5$	80	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.4%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3425	g
Mass of empty core (M_2)	=		1106	g
Mass of soil (M)	=	$M_1 - M_2$	2319	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.187	Mg m ³
Water Content (w)	=		15.4%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.895	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.39	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-1.3%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL3/10

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		633	g
Mass of dried soil + tray (m_2)	=		544	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	628	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	539	g
Mass of moisture (m_6)	=	$m_4 - m_5$	89	g
Water Content (w)	=	$\frac{m_6}{m_5}$	16.5%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3353	g
Mass of empty core (M_2)	=		1106	g
Mass of soil (M)	=	$M_1 - M_2$	2247	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.119	Mg m ³
Water Content (w)	=		16.5%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.819	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.45	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	0.8%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL3/11

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		729	g
Mass of dried soil + tray (m_2)	=		638	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	724	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	633	g
Mass of moisture (m_6)	=	$m_4 - m_5$	91	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.4%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3435	g
Mass of empty core (M_2)	=		1106	g
Mass of soil (M)	=	$M_1 - M_2$	2329	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.197	Mg m ³
Water Content (w)	=		14.4%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.920	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.37	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-0.6%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL4/12

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		717	g
Mass of dried soil + tray (m_2)	=		638	g
Mass of empty tray (m_3)	=		6	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	711	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	632	g
Mass of moisture (m_6)	=	$m_4 - m_5$	79	g
Water Content (w)	=	$\frac{m_6}{m_5}$	12.5%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3355	g
Mass of empty core (M_2)	=		1099	g
Mass of soil (M)	=	$M_1 - M_2$	2256	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.128	Mg m ³
Water Content (w)	=		12.5%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.891	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.39	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	4.4%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL4/13

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		652	g
Mass of dried soil + tray (m_2)	=		573	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	647	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	568	g
Mass of moisture (m_6)	=	$m_4 - m_5$	79	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.9%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3374	g
Mass of empty core (M_2)	=		1102	g
Mass of soil (M)	=	$M_1 - M_2$	2272	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.143	Mg m ³
Water Content (w)	=		13.9%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.881	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.40	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	2.3%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL4/14

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		612	g
Mass of dried soil + tray (m_2)	=		529	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	604	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	521	g
Mass of moisture (m_6)	=	$m_4 - m_5$	83	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.9%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3236	g
Mass of empty core (M_2)	=		1067	g
Mass of soil (M)	=	$M_1 - M_2$	2169	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.124	Mg m ³
Water Content (w)	=		15.9%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.832	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.44	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	1.1%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL4/15

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		514	g
Mass of dried soil + tray (m_2)	=		445	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	506	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	437	g
Mass of moisture (m_6)	=	$m_4 - m_5$	69	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.8%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3236	g
Mass of empty core (M_2)	=		1067	g
Mass of soil (M)	=	$M_1 - M_2$	2169	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.124	Mg m ³
Water Content (w)	=		15.8%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.835	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.43	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	1.3%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL5/17A

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		661	g
Mass of dried soil + tray (m_2)	=		587	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	653	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	579	g
Mass of moisture (m_6)	=	$m_4 - m_5$	74	g
Water Content (w)	=	$\frac{m_6}{m_5}$	12.8%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3286	g
Mass of empty core (M_2)	=		1056	g
Mass of soil (M)	=	$M_1 - M_2$	2230	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.184	Mg m ³
Water Content (w)	=		12.8%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.937	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.36	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	1.6%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL5/17B

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		687	g
Mass of dried soil + tray (m_2)	=		599	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	679	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	591	g
Mass of moisture (m_6)	=	$m_4 - m_5$	88	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.9%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3214	g
Mass of empty core (M_2)	=		1070	g
Mass of soil (M)	=	$M_1 - M_2$	2144	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.100	Mg m ³
Water Content (w)	=		14.9%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.828	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.44	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	3.3%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL5/18

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		626	g
Mass of dried soil + tray (m_2)	=		538	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	618	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	530	g
Mass of moisture (m_6)	=	$m_4 - m_5$	88	g
Water Content (w)	=	$\frac{m_6}{m_5}$	16.6%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3202	g
Mass of empty core (M_2)	=		1056	g
Mass of soil (M)	=	$M_1 - M_2$	2146	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.102	Mg m ³
Water Content (w)	=		16.6%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.803	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.46	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	1.5%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL5/19

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		583	g
Mass of dried soil + tray (m_2)	=		512	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	575	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	504	g
Mass of moisture (m_6)	=	$m_4 - m_5$	71	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.1%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3376	g
Mass of empty core (M_2)	=		1098	g
Mass of soil (M)	=	$M_1 - M_2$	2278	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.148	Mg m ³
Water Content (w)	=		14.1%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.883	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.40	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	1.9%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL6/20

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		597	g
Mass of dried soil + tray (m_2)	=		535	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	589	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	527	g
Mass of moisture (m_6)	=	$m_4 - m_5$	62	g
Water Content (w)	=	$\frac{m_6}{m_5}$	11.8%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3402	g
Mass of empty core (M_2)	=		1100	g
Mass of soil (M)	=	$M_1 - M_2$	2302	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.171	Mg m ³
Water Content (w)	=		11.8%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.943	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.35	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	3.3%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL6/21

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		651	g
Mass of dried soil + tray (m_2)	=		570	g
Mass of empty tray (m_3)	=		17	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	634	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	553	g
Mass of moisture (m_6)	=	$m_4 - m_5$	81	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.6%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3297	g
Mass of empty core (M_2)	=		1058	g
Mass of soil (M)	=	$M_1 - M_2$	2239	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.193	Mg m ³
Water Content (w)	=		14.6%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.913	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.37	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-0.7%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL6/20R

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		714	g
Mass of dried soil + tray (m_2)	=		615	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	706	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	607	g
Mass of moisture (m_6)	=	$m_4 - m_5$	99	g
Water Content (w)	=	$\frac{m_6}{m_5}$	16.3%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3287	g
Mass of empty core (M_2)	=		1060	g
Mass of soil (M)	=	$M_1 - M_2$	2227	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.181	Mg m ³
Water Content (w)	=		16.3%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.875	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.40	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-1.9%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL6/22

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		752	g
Mass of dried soil + tray (m_2)	=		651	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	744	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	643	g
Mass of moisture (m_6)	=	$m_4 - m_5$	101	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.7%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3261	g
Mass of empty core (M_2)	=		1060	g
Mass of soil (M)	=	$M_1 - M_2$	2201	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.156	Mg m ³
Water Content (w)	=		15.7%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.863	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.41	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-0.1%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL6/23

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		617	g
Mass of dried soil + tray (m_2)	=		534	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	609	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	526	g
Mass of moisture (m_6)	=	$m_4 - m_5$	83	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.8%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3285	g
Mass of empty core (M_2)	=		1060	g
Mass of soil (M)	=	$M_1 - M_2$	2225	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.179	Mg m ³
Water Content (w)	=		15.8%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.882	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.40	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-1.3%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL7/24

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		603	g
Mass of dried soil + tray (m_2)	=		537	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	595	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	529	g
Mass of moisture (m_6)	=	$m_4 - m_5$	66	g
Water Content (w)	=	$\frac{m_6}{m_5}$	12.5%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3278	g
Mass of empty core (M_2)	=		1070	g
Mass of soil (M)	=	$M_1 - M_2$	2208	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.163	Mg m ³
Water Content (w)	=		12.5%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.923	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.37	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	2.9%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL7/25

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		628	g
Mass of dried soil + tray (m_2)	=		557	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	620	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	549	g
Mass of moisture (m_6)	=	$m_4 - m_5$	71	g
Water Content (w)	=	$\frac{m_6}{m_5}$	12.9%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3288	g
Mass of empty core (M_2)	=		1067	g
Mass of soil (M)	=	$M_1 - M_2$	2221	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.175	Mg m ³
Water Content (w)	=		12.9%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.926	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.37	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	1.9%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL7/26

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		714	g
Mass of dried soil + tray (m_2)	=		620	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	706	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	612	g
Mass of moisture (m_6)	=	$m_4 - m_5$	94	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.4%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3265	g
Mass of empty core (M_2)	=		1070	g
Mass of soil (M)	=	$M_1 - M_2$	2195	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.150	Mg m ³
Water Content (w)	=		15.4%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.864	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.41	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	0.5%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL7/27

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		762	g
Mass of dried soil + tray (m_2)	=		668	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	754	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	660	g
Mass of moisture (m_6)	=	$m_4 - m_5$	94	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.2%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3299	g
Mass of empty core (M_2)	=		1069	g
Mass of soil (M)	=	$M_1 - M_2$	2230	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.184	Mg m ³
Water Content (w)	=		14.2%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.912	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.38	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	0.1%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL8/28

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		781	g
Mass of dried soil + tray (m_2)	=		689	g
Mass of empty tray (m_3)	=		15	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	766	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	674	g
Mass of moisture (m_6)	=	$m_4 - m_5$	92	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.6%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3267	g
Mass of empty core (M_2)	=		1072	g
Mass of soil (M)	=	$M_1 - M_2$	2195	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.150	Mg m ³
Water Content (w)	=		13.6%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.892	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.39	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	2.3%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL8/29

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		627	g
Mass of dried soil + tray (m_2)	=		542	g
Mass of empty tray (m_3)	=		16	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	611	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	526	g
Mass of moisture (m_6)	=	$m_4 - m_5$	85	g
Water Content (w)	=	$\frac{m_6}{m_5}$	16.2%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3258	g
Mass of empty core (M_2)	=		1057	g
Mass of soil (M)	=	$M_1 - M_2$	2201	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.156	Mg m ³
Water Content (w)	=		16.2%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.856	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.42	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	-0.6%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL8/30

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		638	g
Mass of dried soil + tray (m_2)	=		548	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	630	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	540	g
Mass of moisture (m_6)	=	$m_4 - m_5$	90	g
Water Content (w)	=	$\frac{m_6}{m_5}$	16.7%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3219	g
Mass of empty core (M_2)	=		1058	g
Mass of soil (M)	=	$M_1 - M_2$	2161	g
Height of core (h)	=		130	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1021017.61	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.117	Mg m ³
Water Content (w)	=		16.7%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.814	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.45	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	0.8%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:
Sample No.:

Hafod Landfill - C3 W Upper
CL8/31

FTC-1012

Site Determination of Compaction

(1) Determination of Water Content

Mass of damp soil + tray (m_1)	=		734	g
Mass of dried soil + tray (m_2)	=		632	g
Mass of empty tray (m_3)	=		8	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	726	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	624	g
Mass of moisture (m_6)	=	$m_4 - m_5$	102	g
Water Content (w)	=	$\frac{m_6}{m_5}$	16.3%	

(2) Determination of Dry Density

Mass of core plus soil (M_1)	=		3329	g
Mass of empty core (M_2)	=		1060	g
Mass of soil (M)	=	$M_1 - M_2$	2269	g
Height of core (h)	=		135	mm
Internal diameter of core (d)	=		100	mm
Internal volume of core (V)	=	$\frac{\pi \times d^2 \times h}{4}$	1060287.52	mm ³
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.140	Mg m ³
Water Content (w)	=		16.3%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.839	Mg m ³
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m ³
Void Ratio (e)	=	$\frac{G_s \times 1}{\rho_d} - 1$	0.43	
Air Voids (A_v)	=	$\frac{e - (wG_s)}{1 + e}$	0.0%	

Notes:

- (1) Before weighing, ensure balance is zeroed and plate is free from debris;
- (2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;
- (3) BS 1377 Test method requires 24 hours at 105°C to ensure complete drying of samples; site determinations will yield conservative results after 12–16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.
- (4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

iii	Air Voids Calculation added	04/06/2014 Richard C
iv	Text amended	19/06/2014 Richard C



Site:	Ha-fod Quarry Landfill	Sheet No:	1
CQA Engineer:	K. Osuchukwu	CQA Plan Ref:	CE1005/1/001

[illegible]

Revision Index

i	31/08/10	Draft for comment	Richard C
ii	22/7/11	Renumbered	Richard C



Site:	Hafod Gwmy Hful	Sheet No:	2
CQA Engineer:	K. Osuchukwu	CQA Plan Ref:	CE1005/1/001

Date	Location	Material Tested	Vane Reading (kPa)	Pass/ Fail
06/08/14	CL1/01	AECB	110	
"	CL1/02	"	75	
"	CL1/03	"	95	
07/08/14	CL2/04	AECB	75	
	CL2/05	"	80	
	CL2/06	"	100	
08/08/14	CL2/07	"	92	
	CL1/04A	"	82	
11/08/14	CL3/08	"	60	
12/08/14	CL3/09	"	94	
"	CL3/10	"	84	
"	CL3/11	"	84	
13/08/14	CL4/12	"	76	
"	CL4/13	"	86	

Revision Index

i	31/08/10	Draft for comment	Richard C
ii	22/7/11	Renumbered	Richard C



Site:	Hafod Quarry Landfill	Sheet No:	3
CQA Engineer:	K. Osuchukwu	CQA Plan Ref:	CE1005/1/001

Date	Location	Material Tested	Vane Reading (kPa)	Pass/ Fail
14/08/14	CL4/14	A E G B	80	Pass
15/08/14	CL4/15	"	72	"
"	CL5/16	E C L	86	"
20/08/14	CL5/17	E C L	80	"
21/08/14	CL5/18	"	70	"
27/08/14	CL5/19	"	62	"
28/08/14	CL6/20	"	68	"
29/08/14	CL6/20 Re-test	"	62	"
29/08/14	CL6/21	"	80	"
01/09/14	CL6/22	"	70	"
01/09/14	CL6/23	"	72	"
01/09/14	CL7/24	"	90	"
02/09/14	CL7/25	"	84	"
03/09/14	CL7/26	"	62	"

Revision Index

i	31/08/10	Draft for comment	Richard C
ii	22/7/11	Renumbered	Richard C

[illegible]

i	31/08/10	Draft for comment	Richard C
ii	22/7/11	Renumbered	Richard C