Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Trench, Circular Pipe [715-BKFL-01]

Made By: PWD Date: 6/30/2025 Checked By: _____ Date: _____

INDOT STANDARDS & POLICY DIVISION

① CALCULATE THE TRENCH END AREA

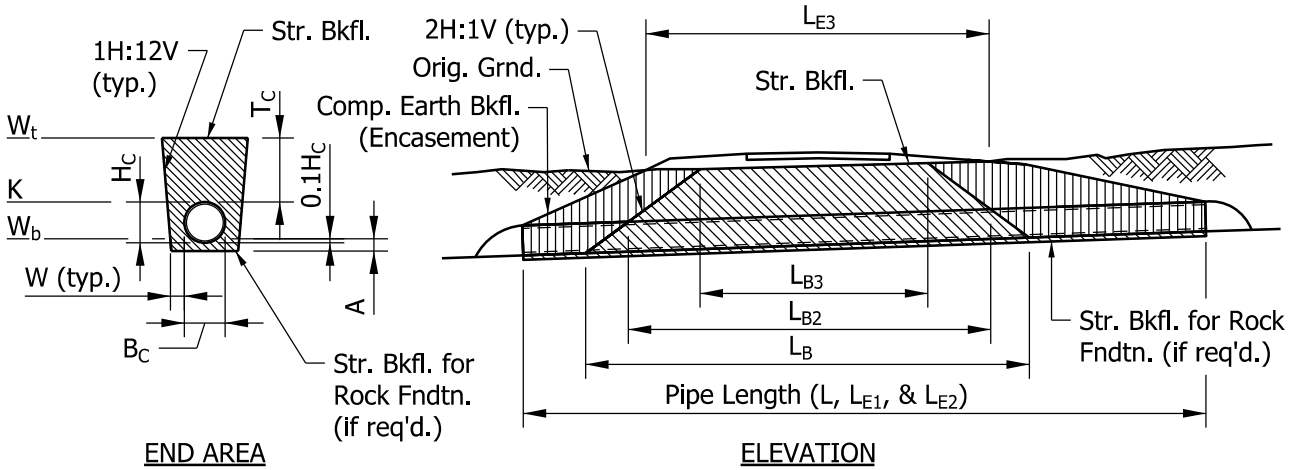
W_b	$= B_C + 2W$	(Trench width at bottom of trench, ft)
K	$= W_b + H_C/6$	(Trench width at top of pipe, ft)
W_t	$= K + T_C/6$	(Trench width at top of trench, ft)
B_{CT}	$= (W_t + K)(T_C)/2$	(Trench sectional area above top of pipe, ft^2)
B_{BC}	$= (H_C)(W_b + K)/2 - \pi(H_C/2)^2$	(Trench sectional area below top of pipe, ft^2)
B_F	$= (W_b)(A) - A^2/12$	(Trench sectional area below pipe, if req'd., ft^2)

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B		(Length of Str. Backfill at bottom of trench, measured, ft)
L_{B2}	$= L_B - 4H_C$	(Length of Str. Backfill at top of pipe, ft)
L_{B3}	$= L_{B2} - 4T_C$	(Length of Str. Backfill at top of trench, ft)
L_{E1}	$= L$	(Trench length at bottom of trench, measured, ft)
V_{CT}	$= (L_{B2} + L_{B3})(B_{CT})/54$	(Str. Backfill volume above top of pipe, cys)
V_{BC}	$= (L_B + L_{B2})(B_{BC})/54$	(Str. Backfill volume below top of pipe, cys)
V_F	$= (L_{E1})(B_F)/27$	(Str. Backfill volume below pipe, if req'd., cys)

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	$= L$	(Trench length at bottom of trench, measured, ft)
L_{E2}	$= L_{E1}$	(Trench length at top of pipe, ft)
L_{E3}		(Trench length at top of trench, measured, ft)
V_{ET}	$= (L_{E2} + L_{E3})(B_{CT})/54 - V_{CT}$	(Encasement volume above top of pipe, cys)
V_{EB}	$= (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$	(Encasement volume below top of pipe, cys)



Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Trench, Circular Pipe [715-BKFL-01]

Made By: PWD Date: 7/1/2025 Checked By: _____ Date: _____

EXAMPLE:

Interior Dia.	= 36 in. [3 ft]	Rock	= N
Wall Thickness	= 4 in.	T_C	= 6 ft
B_C & H_C	= 44 in. [3.67 ft]	L_{E3}	= 85 ft
Pipe Length (L)	= 200 ft	L_B	= 60 ft

① CALCULATE THE TRENCH END AREA

W	$= 0.3B_C$	$= 0.3(3.67)$	= 1.1 ft
W_b	$= B_C + 2W$	$= 3.67 + 2(1.1)$	= 5.87 ft
K	$= W_b + H_C/6$	$= 5.87 + 3.67/6$	= 6.48 ft
W_t	$= K + T_C/6$	$= 6.48 + 6/6$	= 7.48 ft

$B_{CT} = (W_t + K)T_C/2$

$= (7.48 + 6.48)(6)/2$ $= 41.88\ ft^2$

$B_{BC} = (H_C)(K + W_b)/2 - \pi(H_C/2)^2$

$= (3.67)(6.48+5.87)/2 - \pi(3.67/2)^2$ $= 12.08\ ft^2$

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B			= 60 ft
L_{B2}	$= L_B - 4H_C$	$= 60 - (4)(3.67)$	= 45.32 ft
L_{B3}	$= L_{B2} - 4T_C$	$= 45.32 - (4)(6)$	= 21.32 ft

$V_{CT} = (L_{B2} + L_{B3})(B_{CT})/54$

$= (45.32 + 21.32)(41.88)/54$ $= 51.68$ cys

$V_{BC} = (L_B + L_{B2})(B_{BC})/54$

$= (60.00 + 45.32)(12.08)/54$ $= 23.56$ cys $\xrightarrow{V_{CT} + V_{BC}}$ 75.2 cys

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	$= L$	= 200 ft
L_{E2}	$= L_{E1}$	= 200 ft
L_{E3}		= 85 ft

$V_{ET} = (L_{E2} + L_{E3})(B_{CT})/54 - V_{CT}$

$= (200 + 85)(41.88)/54 - 51.68$ $= 169.35$ cys

$V_{EB} = (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$

$= (200 + 200)(12.08)/54 - 23.56$ $= 65.92$ cys $\xrightarrow{V_{ET} + V_{EB}}$ 235.3 cys

INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Embankment, Circular Pipe [715-BKFL-02]

Made By: PWD Date: 8/27/2025 Checked By: _____ Date: _____

① CALCULATE THE TRENCH END AREA

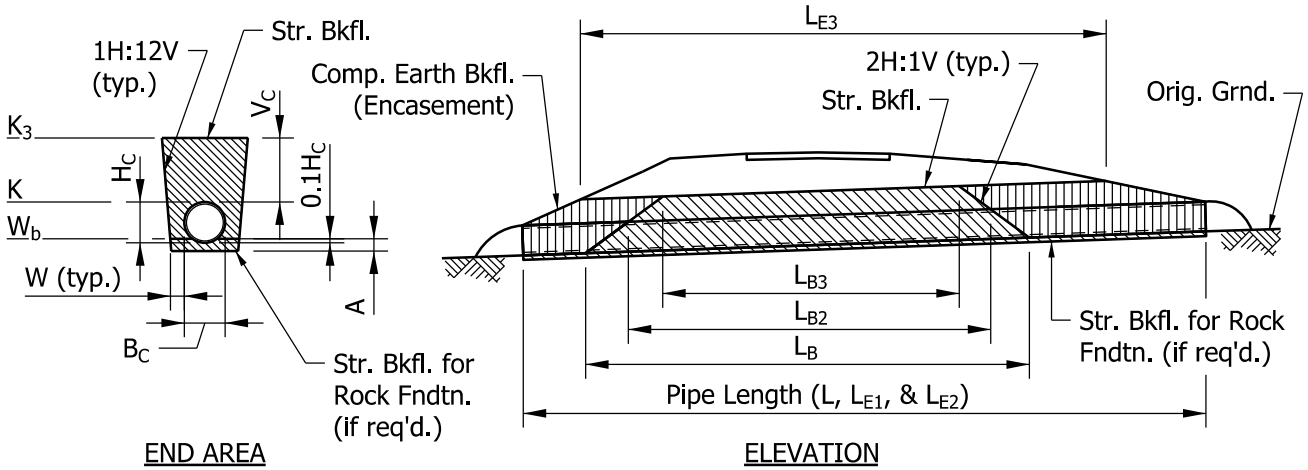
W_b	$= B_C + 2W$	(Trench width at bottom of trench, ft)
K	$= W_b + H_C/6$	(Trench width at top of pipe, ft)
K_3	$= K + V_C/6$	(Trench width at top of trench, ft)
B_{CV}	$= (K_3 + K)(V_C)/2$	(Trench sectional area above top of pipe, ft^2)
B_{BC}	$= (H_C)(W_b + K)/2 - \pi(H_C/2)^2$	(Trench sectional area below top of pipe, ft^2)
B_F	$= (W_b)(A) - A^2/12$	(Trench sectional area below pipe, if req'd., ft^2)

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B		(Length of Str. Backfill at bottom of trench, measured, ft)
L_{B2}	$= L_B - 4H_C$	(Length of Str. Backfill at top of pipe, ft)
L_{B3}	$= L_{B2} - 4T_C$	(Length of Str. Backfill at top of trench, ft)
L_{E1}	$= L$	(Trench length at bottom of trench, measured, ft)
V_{CV}	$= (L_{B2} + L_{B3})(B_{CV})/54$	(Str. Backfill volume above top of pipe, cys)
V_{BC}	$= (L_B + L_{B2})(B_{BC})/54$	(Str. Backfill volume below top of pipe, cys)
V_F	$= (L_{E1})(B_F)/27$	(Str. Backfill volume below pipe, if req'd., cys)

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	$= L$	(Trench length at bottom of trench, measured, ft)
L_{E2}	$= L_{E1}$	(Trench length at top of pipe, ft)
L_{E3}		(Trench length at top of trench, measured, ft)
V_{EV}	$= (L_{E2} + L_{E3})(B_{CV})/54 - V_{CV}$	(Encasement volume above top of pipe, cys)
V_{EB}	$= (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$	(Encasement volume below top of pipe, cys)



INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Embankment, Circular Pipe [715-BKFL-02]

Made By: PWD Date: 8/27/2025 Checked By: _____ Date: _____

EXAMPLE:

Interior Dia.	= 18 in. [1.5 ft]	Rock	= N
Wall Thickness	= 2.5 in.	V_C	= 1.5 ft
B_C & H_C	= 23 in. [1.92 ft]	L_{E1}	= 58 ft
Pipe Length (L)	= 70 ft	L_B	= 54 ft

① CALCULATE THE TRENCH END AREA

W	$= 0.3B_C$	$= 0.3(1.92)$	= 0.75 ft (min.)
W_b	$= B_C + 2W$	$= 1.92 + 2(0.75)$	= 3.42 ft
K	$= W_b + H_C/6$	$= 3.42 + (1.92)/6$	= 3.74 ft
K_3	$= K + V_C/6$	$= 3.74 + (1.5)/6$	= 3.99 ft

$B_{CV} = (K_3 + K)(V_C)/2$

$= (3.99 + 3.74)(1.5)/2$ = 5.80 ft^2

$B_{BC} = (H_C)(W_b + K)/2 - \pi(H_C/2)^2$

$= (1.92)(3.74+3.42)/2 - \pi(1.92/2)^2$ = 3.98 ft^2

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B			= 54 ft
L_{B2}	$= L_B - 4H_C$	$= 54.00 - (4)(1.92)$	= 46.32 ft
L_{B3}	$= L_{B2} - 4T_C$	$= 46.32 - (4)(1.5)$	= 40.32 ft

$V_{CV} = (L_{B2} + L_{B3})(B_{CV})/54$

$= (46.32 + 40.32)(5.80)/54$ = 9.31 cys

$V_{BC} = (L_B + L_{B2})(B_{BC})/54$

$= (54.00 + 46.32)(3.98)/54$ = 7.39 cys

$V_{CV} + V_{BC}$ → 16.7 cys

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	$= L$	= 70 ft
L_{E2}	$= L_{E1}$	= 70 ft
L_{E3}		= 58 ft

$V_{EV} = (L_{E2} + L_{E3})(B_{CV})/54 - V_{CV}$

$= (70 + 58)(5.80)/54 - 9.31$ = 4.44 cys

$V_{EB} = (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$

$= (70 + 70)(3.98)/54 - 7.39$ = 2.93 cys

$V_{EV} + V_{EB}$ → 7.4 cys

INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Exist. Rdwy. Trench, Circular Pipe [715-BKFL-03, 04 & 05]

Made By: PWD Date: 7/29/2025 Checked By: _____ Date: _____

INDOT STANDARDS & POLICY DIVISION

① CALCULATE THE TRENCH END AREA

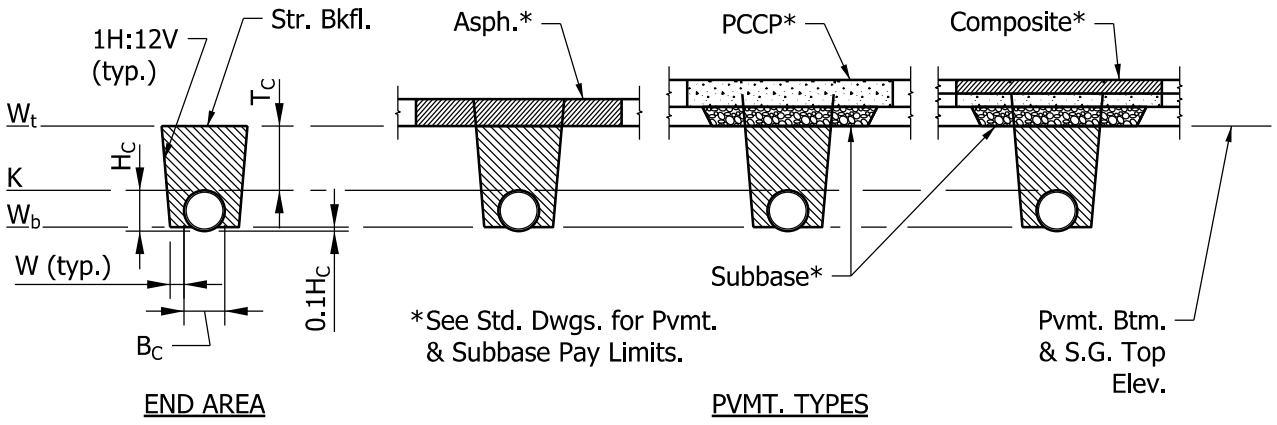
W_b	$= B_C + 2W$	(Trench width at bottom of trench, ft)
K	$= W_b + H_C/6$	(Trench width at top of pipe, ft)
W_t	$= K + T_C/6$	(Trench width at top of trench, ft)
B_{CT}	$= (W_t + K)(T_C)/2$	(Trench sectional area above top of pipe, ft^2)
B_{BC}	$= (H_C)(W_b + K)/2 - \pi(H_C/2)^2$	(Trench sectional area below top of pipe, ft^2)

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B		(Length of Str. Backfill at bottom of trench, measured, ft)
L_{B2}	$= L_B - 4H_C$	(Length of Str. Backfill at top of pipe, ft)
L_{B3}	$= L_{B2} - 4T_C$	(Length of Str. Backfill at top of trench, ft)
V_{CT}	$= (L_{B2} + L_{B3})(B_{CT})/54$	(Str. Backfill volume above top of pipe, cys)
V_{BC}	$= (L_B + L_{B2})(B_{BC})/54$	(Str. Backfill volume below top of pipe, cys)

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	$= L$	(Trench length at bottom of trench, measured, ft)
L_{E2}	$= L_{E1}$	(Trench length at top of pipe, ft)
L_{E3}		(Trench length at top of trench, measured, ft)
V_{ET}	$= (L_{E2} + L_{E3})(B_{CT})/54 - V_{CT}$	(Encasement volume above top of pipe, cys)
V_{EB}	$= (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$	(Encasement volume below top of pipe, cys)



END AREA PVMT. TYPES

(See Sample Backfill Calculations for Std. Dwg. 715-BKFL-01 for Elevation View.)

ELEVATION VIEW

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Exist. Rdwy. Trench, Circular Pipe [715-BKFL-03, 04 & 05]

Made By: PWD Date: 7/29/2025 Checked By: _____ Date: _____

EXAMPLE:

Interior Dia.	= 18 in. [1.5 ft]	T_C	= 7 ft
Wall Thickness	= 2.5 in.	L_B	= 44 ft
B_C & H_C	= 23 in. [1.92 ft]	L_{E3}	= 46 ft
Pipe Length (L)	= 60 ft		

① CALCULATE THE TRENCH END AREA

W	$= 0.3B_C$	= 0.3(1.92)	= 0.75 ft (min.)
W_b	$= B_C + 2W$	= 1.92 + 2(0.75)	= 3.42 ft
K	$= W_b + H_C/6$	= 3.42 + 1.92/6	= 3.74 ft
W_t	$= K + T_C/6$	= 3.74 + 7/6	= 4.91 ft

$B_{CT} = (W_t + K)(T_C)/2$

$= (4.91 + 3.74)(7)/2$ $= 30.28\ ft^2$

$B_{BC} = (H_C)(W_b + K)/2 - \pi(H_C/2)^2$

$= (1.92)(3.74+3.42)/2 - \pi(1.92/2)^2$ $= 3.98\ ft^2$

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B			= 44 ft
L_{B2}	$= L_B - 4H_C$	= 44 - (4)(1.92)	= 36.32 ft
L_{B3}	$= L_{B2} - 4T_C$	= 36.32 - (4)(7)	= 8.32 ft

$V_{CT} = (L_{B2} + L_{B3})(B_{CT})/54$

$= (36.32 + 8.32)(30.28)/54$ = 25.03 cys

$V_{BC} = (L_B + L_{B2})(B_{BC})/54$

$= (44.00 + 36.32)(3.98)/54$ = 5.92 cys $\xrightarrow{V_{CT} + V_{BC}}$ 31.0 cys

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	$= L$	= 60 ft
L_{E2}	$= L_{E1}$	= 60 ft
L_{E3}		= 46 ft

$V_{ET} = (L_{E2} + L_{E3})(B_{CT})/54 - V_{CT}$

$= (60 + 46)(30.28)/54 - 25.03$ = 34.41 cys

$V_{EB} = (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$

$= (60 + 60)(3.98)/54 - 5.92$ = 2.92 cys $\xrightarrow{V_{ET} + V_{EB}}$ 37.3 cys

INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 2, Trench, Circular Pipe [715-BKFL-06]

Made By: PWD Date: 8/27/2025 Checked By: _____ Date: _____

① CALCULATE THE TRENCH END AREA

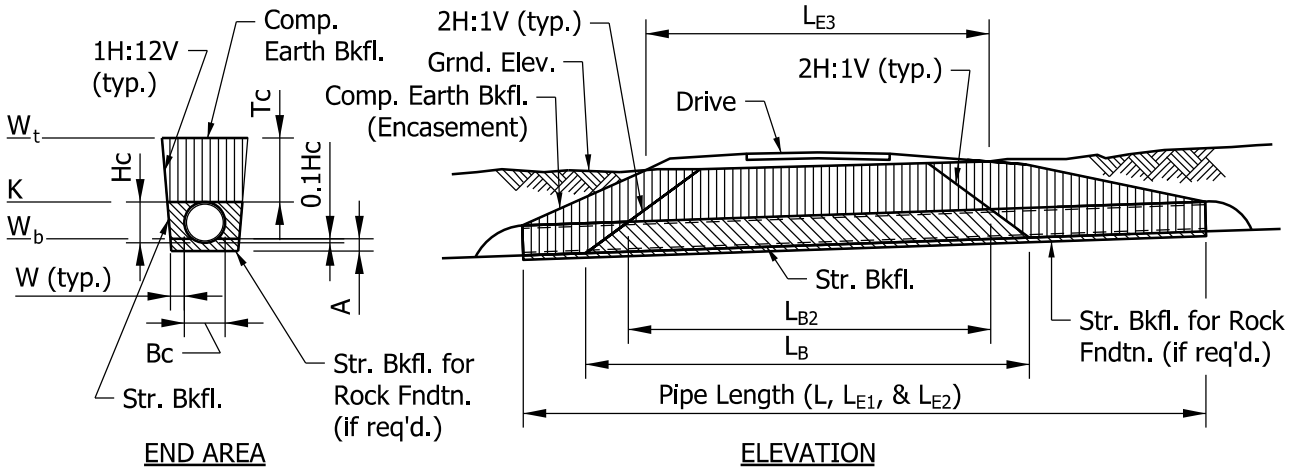
W_b	$= B_C + 2W$	(Trench width at bottom of trench, ft)
K	$= W_b + H_C/6$	(Trench width at top of pipe, ft)
W_t	$= K + T_C/6$	(Trench width at top of trench, ft)
B_{CT}	$= (W_t + K)(T_C)/2$	(Trench sectional area above top of pipe, ft^2)
B_{BC}	$= (H_C)(W_b + K)/2 - \pi(H_C/2)^2$	(Trench sectional area below top of pipe, ft^2)
B_F	$= (W_b)(A) - A^2/12$	(Trench sectional area below pipe, if req'd., ft^2)

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B		(Length of Str. Backfill at bottom of trench, measured, ft)
L_{B2}	$= L_B - 4H_C$	(Length of Str. Backfill at top of pipe, ft)
L_{E1}	$= L$	(Trench length at bottom of trench, measured, ft)
V_{BC}	$= (L_B + L_{B2})(B_{BC})/54$	(Str. Backfill volume below top of pipe, cys)
V_F	$= (L_{E1})(B_F)/27$	(Str. Backfill volume below pipe, if req'd., cys)

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	$= L$	(Trench length at bottom of trench, measured, ft)
L_{E2}	$= L_{E1}$	(Trench length at top of pipe, ft)
L_{E3}		(Trench length at top of trench, measured, ft)
V_{ET}	$= (L_{E2} + L_{E3})(B_{CT})/54$	(Encasement volume above top of pipe, cys)
V_{EB}	$= (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$	(Encasement volume below top of pipe, cys)



INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 2, Trench, Circular Pipe [715-BKFL-06]

Made By: PWD Date: 9/16/2025 Checked By: _____ Date: _____

EXAMPLE:

Interior Dia.	= 24 in. [2 ft]	Rock	= N
Wall Thickness	= 3 in.	T_C	= 5 ft
B_C & H_C	= 30 in. [2.5 ft]	L_{E1}	= 60 ft
Pipe Length (L)	= 70 ft	L_B	= 40 ft

① CALCULATE THE TRENCH END AREA

W	$= 0.3B_C$	= 0.3(2.50)	= 0.75 ft
W_b	$= B_C + 2W$	= 2.50 + 2(0.75)	= 4.00 ft
K	$= W_b + H_C/6$	= 4.00 + 2.50/6	= 4.42 ft
W_t	$= K + T_C/6$	= 4.42 + 5/6	= 5.25 ft

$B_{CT} = (W_t + K)Tc/2$

$= (5.25 + 4.42)(5)/2$ = 24.18 ft^2

$B_{BC} = (H_C)(W_b + K)/2 - \pi(H_C/2)^2$

$= (2.5)(4.42+4.00)/2 - \pi(2.5/2)^2$ = 5.62 ft2

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B			= 40 ft
L_{B2}	$= L_B - 4H_C$	= 60 - (4)(2.5)	= 30 ft

$V_{BC} = (L_B + L_{B2})(B_{BC})/54$

$= (40 + 30)(5.62)/54$ = 7.29 cys ⟶ 7.3 cys

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	= L		= 70 ft
L_{E2}	$= L_{E1}$		= 70 ft
L_{E3}			= 60 ft

$V_{ET} = (L_{E2} + L_{E3})(B_{CT})/54$

$= (70 + 60)(24.18)/54$ = 58.21 cys

$V_{EB} = (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$

$= (70 + 70)(5.62)/54 - 7.29$ = 7.28 cys ⟶ ($V_{ET} + V_{EB}$) 65.5 cys

INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 2, Embankment, Circular Pipe [715-BKFL-07]

Made By: PWD Date: 8/27/2025 Checked By: _____ Date: _____

① CALCULATE THE TRENCH END AREA

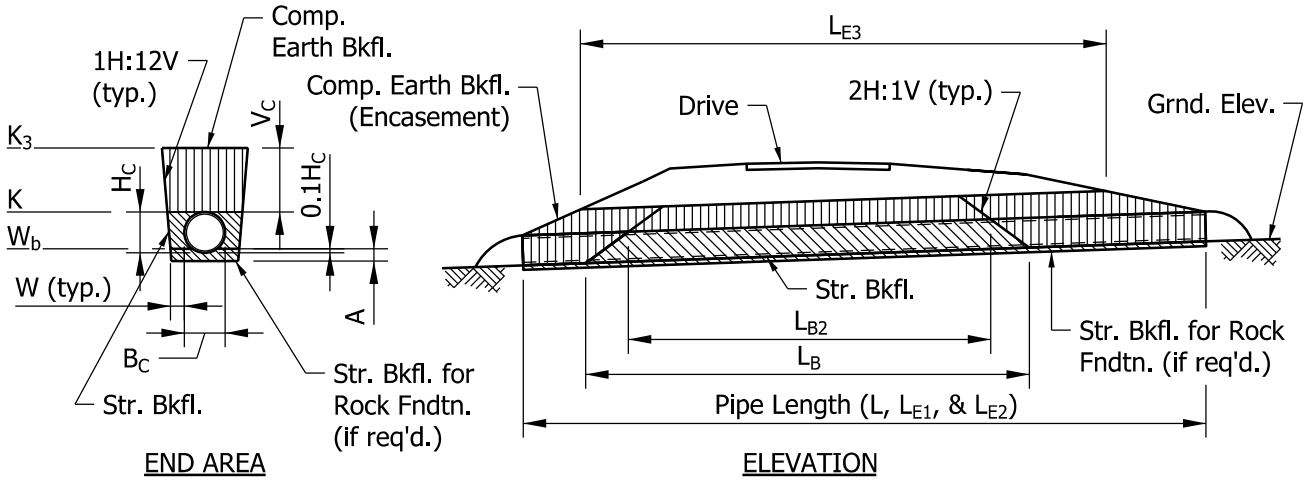
W_b	$= B_C + 2W$	(Trench width at bottom of trench, ft)
K	$= W_b + H_C/6$	(Trench width at top of pipe, ft)
K_3	$= K + V_C/6$	(Trench width at top of trench, ft)
B_{CV}	$= (K_3 + K)(V_C)/2$	(Trench sectional area above top of pipe, ft^2)
B_{BC}	$= (H_C)(W_b + K)/2 - \pi(H_C/2)^2$	(Trench sectional area below top of pipe, ft^2)
B_F	$= (W_b)(A) - A^2/12$	(Trench sectional area below pipe, if req'd., ft^2)

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B		(Length of Str. Backfill at bottom of trench, measured, ft)
L_{B2}	$= L_B - 4H_C$	(Length of Str. Backfill at top of pipe, ft)
V_{BC}	$= (L_B + L_{B2})(B_{BC})/54$	(Str. Backfill volume below top of pipe, cys)
V_F	$= (L_{E1})(B_F)/27$	(Str. Backfill volume below pipe, if req'd., cys)

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	$= L$	(Trench length at bottom of trench, measured, ft)
L_{E2}	$= L_{E1}$	(Trench length at top of pipe, ft)
L_{E3}		(Trench length at top of trench, measured, ft)
V_{ET}	$= (L_{E2} + L_{E3})(B_{CV})/54$	(Encasement volume above top of pipe, cys)
V_{EB}	$= (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$	(Encasement volume below top of pipe, cys)



INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 2, Embankment, Circular Pipe [715-BKFL-07]

Made By: PWD Date: 9/16/2025 Checked By: _____ Date: _____

EXAMPLE:

Interior Dia.	= 18 in. [1.5 ft]	Rock	= N
Wall Thickness	= 2.5 in.	V_C	= 1.5 ft
B_C & H_C	= 23 in. [1.92 ft]	L_{E2}	= 60 ft
Pipe Length (L)	= 70 ft	L_B	= 40 ft

① CALCULATE THE TRENCH END AREA

W	$= 0.3B_C$	= 0.3(1.92)	= 0.75 ft (min.)
W_b	$= B_C + 2W$	= 1.92 + 2(0.75)	= 3.42 ft
K	$= W_b + H_C/6$	= 3.42 + 1.92/6	= 3.74 ft
K_3	$= K + V_C/6$	= 3.74 + 1.5/6	= 3.99 ft

$B_{CV} = (K_3 + K)(V_C)/2$

$= (3.99 + 3.74)(1.5)/2$ $= 5.80\ ft^2$

$B_{BC} = (H_C)(W_b + K)/2 - \pi(H_C/2)^2$

$= (1.92)(3.74+3.42)/2 - \pi(1.92/2)^2$ $= 3.98\ ft^2$

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B			= 40 ft
L_{B2}	$= L_B - 4H_C$	= 40 - (4)(1.92)	= 32.32 ft

$V_{BC} = (L_B + L_{B2})(B_{BC})/54$

$= (40 + 32.32)(3.98)/54$ = 5.33 cys → 5.3 cys

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	= L	= 70 ft
L_{E2}	$= L_{E1}$	= 70 ft
L_{E3}		= 60 ft

$V_{ET} = (L_{E2} + L_{E3})(B_{CT})/54$

$= (70 + 60)(5.80)/54$ = 13.96 cys

$V_{EB} = (L_{E1} + L_{E2})(B_{BC})/54 - V_{BC}$

$= (70 + 70)(3.98)/54 - 5.33$ = 4.99 cys

$V_{ET} + V_{EB}$ → 19.0 cys

INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 3, Median Trench, Circular Pipe [715-BKFL-08]

Made By: PWD Date: 9/17/2025 Checked By: _____ Date: _____

INDOT STANDARDS & POLICY DIVISION

① CALCULATE THE TRENCH END AREA

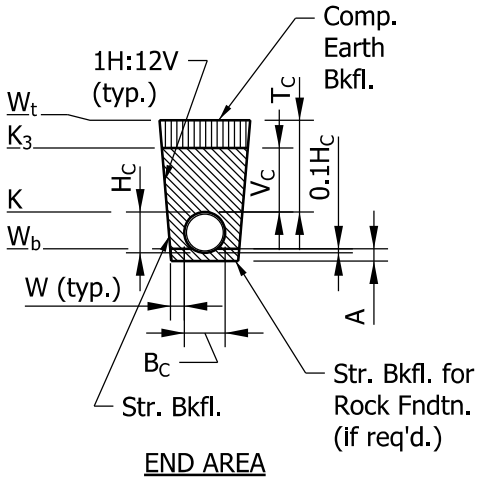
W_b	$= B_C + 2W$	(Trench width at bottom of trench, ft)
K	$= W_b + H_C/6$	(Trench width at top of pipe, ft)
K_3	$= K + V_C/6$	(Trench width at top of str. bkfl., ft)
W_t	$= K + T_C/6$	(Trench width at top of trench, ft)
B_{CV}	$= (K_3 + K)(V_C)/2$	(Trench sectional area above pipe and below earth bkfl., ft^2)
B_{VT}	$= (W_t + K_3)(T_C - V_C)/2$	(Trench sectional area above top of str. bkfl., ft^2)
B_{BC}	$= (H_C)(W_b + K)/2 - \pi(H_C/2)^2$	(Trench sectional area below top of pipe, ft^2)
B_F	$= (W_b)(A) - A^2/12$	(Trench sectional area below pipe, if req'd., ft^2)

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

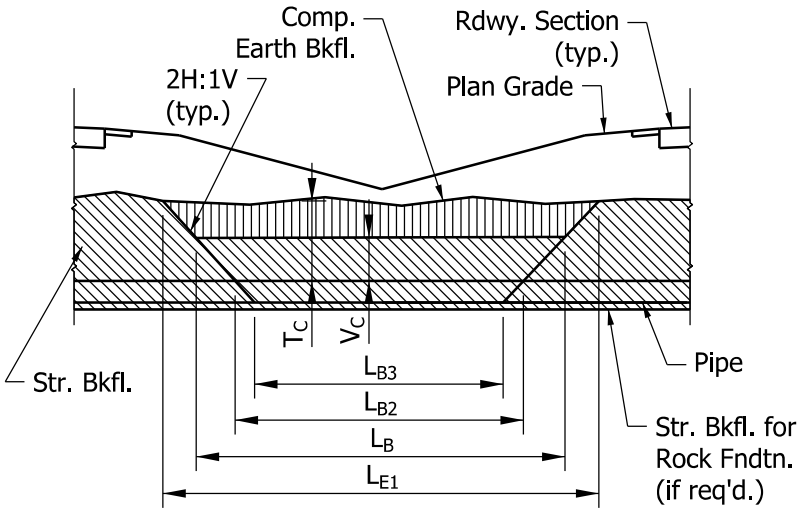
L_B		(Length of Str. Backfill at bottom of trench, measured, ft)
L_{B2}	$= L_B - 4V_C$	(Length of Str. Backfill at top of pipe, ft)
L_{B3}	$= L_{B2} - 4H_C$	(Length of Str. Backfill at top of trench, ft)
V_{CV}	$= (L_B + L_{B2})(B_{CV})/54$	(Str. Backfill volume above top of pipe, cys)
V_{BC}	$= (L_{B2} + L_{B3})(B_{BC})/54$	(Str. Backfill volume below top of pipe, cys)
V_F	$= (L_{B3})(B_F)/27$	(Str. Backfill volume below pipe, if req'd., cys)

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

L_{E1}	$= L_B + (4)(T_C - V_C)$	(Trench length at top of trench, ft)
V_{ET}	$= (L_B + L_{E1})(B_{VT})/54$	(Encasement volume above top of pipe, cys)



END AREA



ELEVATION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 3, Median Trench, Circular Pipe [715-BKFL-08]

Made By: PWD Date: 9/18/2025 Checked By: _____ Date: _____

EXAMPLE:

Interior Dia.	= 48 in. [4 ft]	Rock	= N
Wall Thickness	= 5 in.	T_C	= 3 ft
B_C & H_C	= 58 in. [4.83 ft]	L_B	= 250 ft
Pipe Length (L)	= 400 ft		

① CALCULATE THE TRENCH END AREA

W	$= 0.3B_C$	= 0.3(4.83)	= 1.45 ft
W_b	$= B_C + 2W$	= 4.83 + 2(1.45)	= 7.73 ft
K	$= W_b + H_C/6$	= 7.73 + 4.83/6	= 8.54 ft
K_3	$= K + V_C/6$	= 8.54 + 1.5/6	= 8.79 ft
W_t	$= K + T_C/6$	= 8.54 + 3/6	= 9.04 ft

$B_{CV} = (K_3 + K)(V_C)/2$

$= (8.79 + 8.54)(1.5)/2 = 13.00\ ft^2$

$B_{VT} = (W_t + K_3)(T_C - V_C)/2$

$= (9.04 + 8.79)(3\text{-}1.5)/2 = 13.37\ ft^2$

$B_{BC} = (H_C)(W_b + K)/2 - \pi(H_C/2)^2$

$= (4.83)(8.54+7.73)/2 - \pi(4.83/2)^2 = 20.97\ ft^2$

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B			= 250.00 ft
L_{B2}	$= L_B - 4V_C$	= 250 - (4)(1.5)	= 244.00 ft
L_{B3}	$= L_{B2} - 4H_C$	= 238 - (4)(4.83)	= 224.68 ft

$V_{CV} = (L_B + L_{B2})(B_{CV})/54$

$= (250.00 + 244.00)(13.00)/54 = 118.93$ cys

$V_{BC} = (L_{B2} + L_{B3})(B_{BC})/54$

$= (244.00 + 224.68)(20.97)/54 = 182.00$ cys $\xrightarrow{V_{BC} + V_{CV}}$ 300.9 cys

③ CALCULATE THE VOLUME OF COMPACTED EARTH BACKFILL

$L_{E1} = L_B + (4)(T_C - V_C) = 250 + (4)(3\text{-}1.5) = 256.00$ ft

$V_{ET} = (L_B + L_{E1})(B_{VT})/54$

$= (250 + 256)(13.37)/54 = 125.28$ cys $\longrightarrow$ 125.3 cys

INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Median Embankment, Circular Pipe [715-BKFL-09]

Made By: PWD Date: 9/17/2025 Checked By: _____ Date: _____

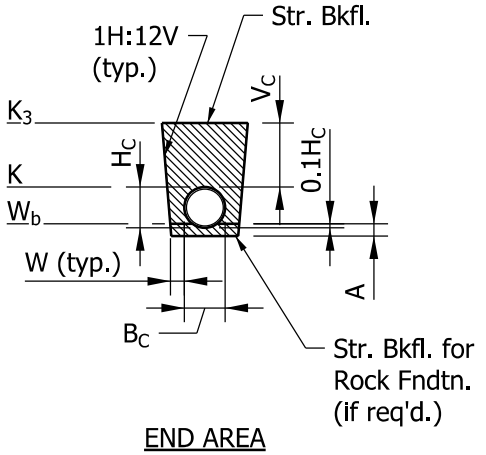
INDOT STANDARDS & POLICY DIVISION

① CALCULATE THE TRENCH END AREA

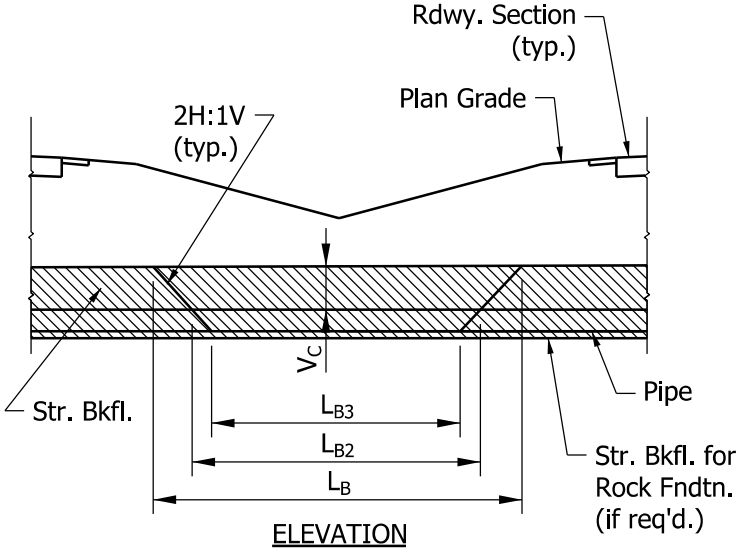
W_b	$= B_C + 2W$	(Trench width at bottom of trench, ft)
K	$= W_b + H_C/6$	(Trench width at top of pipe, ft)
K_3	$= K + V_C/6$	(Trench width at top of trench, ft)
B_{CV}	$= (K_3 + K)(V_C)/2$	(Trench sectional area above top of pipe, ft^2)
B_{BC}	$= (H_C)(W_b + K)/2 - \pi(H_C/2)^2$	(Trench sectional area below top of pipe, ft^2)
B_F	$= (W_b)(A) - A^2/12$	(Trench sectional area below pipe, if req'd., ft^2)

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B		(Length of Str. Backfill at bottom of trench, measured, ft)
L_{B2}	$= L_B - 4V_C$	(Length of Str. Backfill at top of pipe, ft)
L_{B3}	$= L_{B2} - 4H_C$	(Length of Str. Backfill at top of trench, ft)
V_{CV}	$= (L_B + L_{B2})(B_{CV})/54$	(Str. Backfill volume above top of pipe, cys)
V_{BC}	$= (L_{B2} + L_{B3})(B_{BC})/54$	(Str. Backfill volume below top of pipe, cys)
V_F	$= (L_{B3})(B_F)/27$	(Str. Backfill volume below pipe, if req'd., cys)



END AREA



ELEVATION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Median Embankment, Circular Pipe [715-BKFL-09]

Made By: PWD Date: 9/18/2025 Checked By: _____ Date: _____

EXAMPLE:

Interior Dia.	= 54 in. [4.5 ft]	Rock	= N
Wall Thickness	= 5.5 in.	V_C	= 1.5 ft
B_C & H_C	= 65 in. [5.42 ft]	L_B	= 200 ft
Pipe Length (L)	= 400 ft		

① CALCULATE THE TRENCH END AREA

W	$= 0.3B_C$	= 0.3(5.42)	= 1.63 ft
W_b	$= B_C + 2W$	= 5.42 + 2(1.63)	= 8.68 ft
K	$= W_b + H_C/6$	= 8.68 + 5.42/6	= 9.58 ft
K_3	$= K + V_C/6$	= 9.58 + 1.5/6	= 9.83 ft

$B_{CV} = (K_3 + K)(V_C)/2$

$= (9.83 + 9.58)(1.5)/2$ $= 14.56\ ft^2$

$B_{BC} = (H_C)(W_b + K)/2 - \pi(H_C/2)^2$

$= (5.42)(8.68+9.58)/2 - \pi(5.42/2)^2$ $= 26.41\ ft^2$

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B			= 200.00 ft
L_{B2}	$= L_B - 4V_C$	= 200 - (4)(1.5)	= 194.00 ft
L_{B3}	$= L_{B2} - 4H_C$	= 194 - (4)(5.42)	= 172.32 ft

$V_{CV} = (L_B + L_{B2})(B_{CV})/54$

$= (200.00 + 194.00)(14.56)/54$ $= 106.23$ cys

$V_{BC} = (L_{B2} + L_{B3})(B_{BC})/54$

$= (194.00 + 172.32)(26.41)/54$ $= 179.16$ cys $\xrightarrow{V_{CV} + V_{BC}}$ 285.4 cys

INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Closed Trench, Circular Pipe, No End Slopes

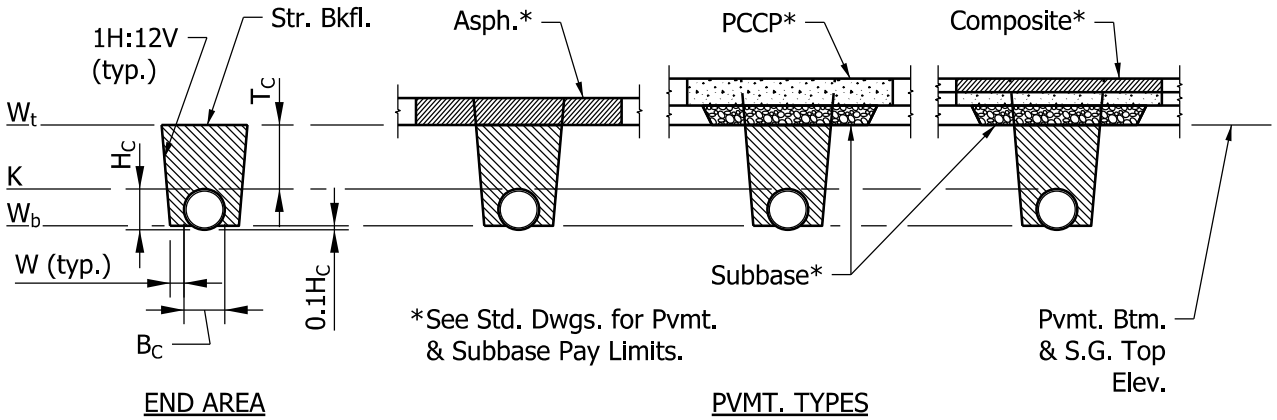
Made By: PWD Date: 7/29/2026 Checked By: _____ Date: _____

① CALCULATE THE TRENCH END AREA

W_b	$= B_C + 2W$	(Trench width at bottom of trench, ft)
K	$= W_b + H_C/6$	(Trench width at top of pipe, ft)
W_t	$= K + T_C/6$	(Trench width at top of trench, ft)
B_{CT}	$= (W_t + K)(T_C)/2$	(Trench sectional area above top of pipe, ft^2)
B_{BC}	$= (H_C)(W_b + K)/2 - \pi(H_C/2)^2$	(Trench sectional area below top of pipe, ft^2)

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B		(Length of Str. Backfill at bottom of trench, measured, ft)
V_{CT}	$= (L_B)(B_{CT})/27$	(Str. Backfill volume above top of pipe, cys)
V_{BC}	$= (L_B)(B_{BC})/27$	(Str. Backfill volume below top of pipe, cys)



END AREA PVMT. TYPES

INDOT STANDARDS & POLICY DIVISION

Project Name: Sample Backfill Calculations No. Structure Backfill Program

Structure Backfill, Method 1, Closed Trench, Circular Pipe, No End Slopes

Made By: PWD Date: 7/29/2026 Checked By: _____ Date: _____

EXAMPLE:

Interior Dia.	= 18 in. [1.5 ft]	T_C	= 7 ft
Wall Thickness	= 2.5 in.	L_B	= 48 ft
B_C & H_C	= 23 in. [1.92 ft]		
Pipe Length (L)	= 50 ft		

① CALCULATE THE TRENCH END AREA

W	$= 0.3B_C$	= 0.3(1.92)	= 0.75 ft (min.)
W_b	$= B_C + 2W$	= 1.92 + 2(0.75)	= 3.42 ft
K	$= W_b + H_C/6$	= 3.42 + 1.92/6	= 3.74 ft
W_t	$= K + T_C/6$	= 3.74 + 7/6	= 4.91 ft

$B_{CT} = (W_t + K)(T_C)/2$

$= (4.91 + 3.74)(7)/2$ $= 30.28\ ft^2$

$B_{BC} = (H_C)(W_b + K)/2 - \pi(H_C/2)^2$

$= (1.92)(3.74+3.42)/2 - \pi(1.92/2)^2$ $= 3.98\ ft^2$

② CALCULATE THE VOLUME OF STRUCTURE BACKFILL

L_B = 48 ft

$V_{CT} = (L_B)(B_{CT})/27$

$= (48)(30.28)/27$ = 53.83 cys

$V_{BC} = (L_B)(B_{BC})/27$

$= (48)(3.98)/27$ = 7.08 cys

$V_{CT} + V_{BC}$ → 60.9 cys

INDOT STANDARDS & POLICY DIVISION

Structure Backfill Quantities

Contract No. R-XXXXX
Project No. 1234567
Des. No. 9999999
Project Description: General Road from the intersection with First Street to the intersection with Last Road. RP109+05 to RP112+87

Prepared by First Last, EIT, Date: 11/30/25
Checked by First Last, PE, Date: 7/29/26

Structure No.	Structure Size	Shape	Rock Fdn.	Backfill Type	Backfill Method	Structure Length (ft.)	Trench Cover (ft.)	**Structure Backfill (CYS)**	**Compacted Earth Fill (CYS)**	**Rock Fdn. Backfill (CYS)**
1	36 in.	Circular	N	1	Method 1 - New Roadway, Trench	200.0	6.0	**75.2**	**235.3**	
2	18 in.	Circular	N	1	Method 1 - New Roadway, Embankment	70.0	3.0	**16.7**	**7.4**	
3	18 in.	Circular	N	2	Method 1 - Existing Roadway, Trench	60.0	7.0	**31**	**37.3**	
6	24 in.	Circular	N	2	Method 2 - New or Existing Drive, Trench	70.0	5.0	**7.3**	**65.5**	
7	18 in.	Circular	N	1	Method 2 - New or Existing Drive, Embankment	70.0	3.0	**5.3**	**19**	
8	48 in.	Circular	N	2	Method 3 - Median Installation, Trench	400.0	3.0	**300.9**	**125.3**	
9	54 in.	Circular	N	1	Method 1 - Median Installation, Embankment	400.0	4.0	**285.4**		
10	18 in.	Circular	N	2	Method 1 - Closed Trench, No End Slopes	50.0	7.0	**60.9**		