SRNL-STI-2012-00782

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Permanent

# ENGINEERED TRENCH #3 INFILTRATION ESTIMATES

**M. A. Phifer**

**DECEMBER, 2012**

Savannah River National Laboratory
Savannah River Nuclear Solutions
Savannah River Site
Aiken, SC 29808

**Prepared for the U.S. Department of Energy Under Contract Number DE-AC09-08SR22470**

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| | |
|---|---|
| ELLWF | E-Area Low-Level Waste Facility |
| ET#3 | Engineered Trench #3 |
| FTF | F-Area Tank Farms |
| GCL | Geosynthetic Clay Liner |
| HDPE | High Density Polyethylene |
| ILV | Intermediate Level Vault |
| NRCDA | Naval Reactor Component Disposal Area |
| SA | Special Analysis |
| SWM | Solid Waste Management |
| in | Inches |
| in/year | Inches per year |
| m | meter |
| # | number |
| % | percent |

# 1.0 Background

Based upon an Engineered Trench #3 (ET #3) site alternatives analysis (Collard and Hamm 2012), Solid Waste Management (SWM) selected Option #3 as the new location for ET#3 within the E-Area Low-Level Waste Facility (ELLWF) (Sink 2012). The ET#3 footprint coordinates (i.e. ET#3 floor) as laid out by SWM are provided in Table 1 and shown in Figure 1. SWM has requested a ± 20 foot variance from the coordinates provided. ET#3 will be approximately 20 feet deep and the side slopes will be on a slope of 1-½ to 1 (horizontal to vertical) with the exception of the side closest to the railroad tracks which will be vertical (see Figure 1) (Sink 2012). Waste will not be intentionally placed within the side slopes of ET#3; however it is possible that a stray container stack could inadvertently fall over into the side slope space (Tempel 2012). SWM has also specified that no non-crushable waste would be placed in ET#3; that an interim cover would be installed over ET#3 in 2025; and that the ELLWF Alternate Closure System as described in Table 2 and Figure 2 (Phifer et al. 2009) would be utilized as the final cover over ET#3 (Butcher 2012).

This report documents the appropriate ET#3 infiltration rates to utilize as part of the ET#3 Special Analysis (SA).

Table 1. ET#3 Footprint Coordinates (i.e. ET#3 floor)

| **SRS North** (feet) | **SRS East** (feet) |
|---|---|
| N78578 | E57455 |
| N78746 | E57537 |
| N78542 | E57943 |
| N78409 | E57811 |
| N78383 | E57843 |

Notes to Table 1:

- Coordinates start in the southwest corner of Figure 1 and proceed clockwise
- Last two sets of coordinates form the vertical wall closest to the railroad tracks

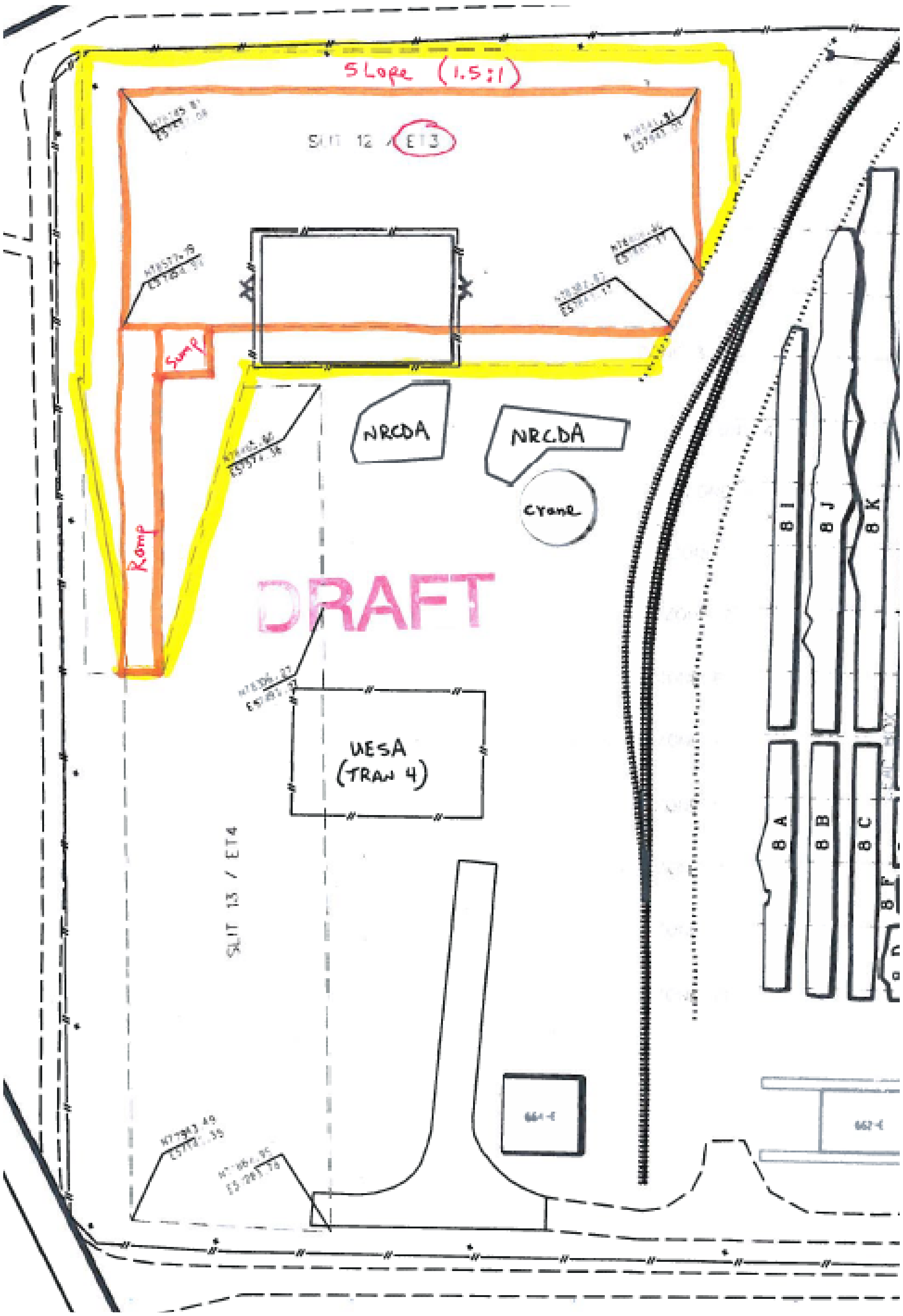


Figure 1. ET #3 Footprint and Adjacent ELLWF Disposal Units

Table 2. Alternate ELLWF Final Closure Cap Profile (Phifer et al. 2009)

| Layer | Layer Thickness (inches) |
|---|---|
| Vegetative Cover | Not applicable |
| Topsoil | 6 |
| Upper Backfill | 30 |
| Erosion Barrier | 12 |
| Geotextile Fabric | - |
| Middle Backfill | 12 |
| Geotextile Filter Fabric | - |
| Lateral Drainage Layer | 12 |
| Geotextile Fabric | - |
| High Density Polyethylene (HDPE) Geomembrane | 0.06 (60 mil) |
| Geosynthetic Clay Liner (GCL) | 0.2 |
| Top Lift-Blended Soil-Bentonite Layer | 12 |
| Controlled Compacted Backfill-Foundation Layer | variable |

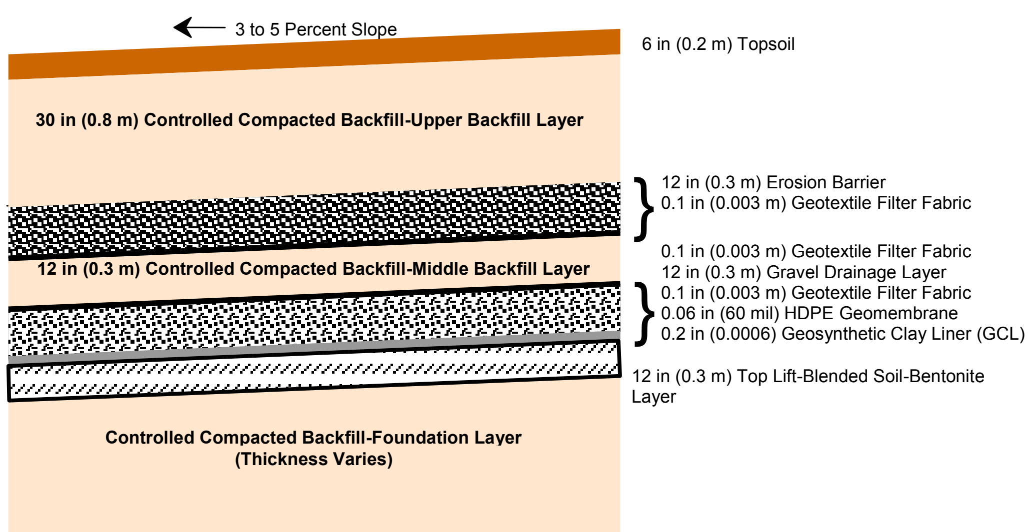


Figure 2. Alternate ELLWF Final Closure Cap Profile (Phifer et al. 2009)

# 2.0 F-Area Tank Farm Infiltration Estimate

Phifer et al. 2007 developed an F-Area Tank Farm (FTF) closure cap concept (Table 3 and Figure 3) and associated infiltration estimates (Table 4). The Table 4 infiltration estimates over time were developed for the FTF closure cap based upon the Figure 3 and Table 3 closure cap profile, a slope of 2%, a maximum slope length of 585 feet, and assumed closure cap degradation over time that did not include subsidence as a degradation mechanism (Phifer et al. 2007).

Table 3. FTF Closure Cap Concept (Phifer et al. 2007)

| Layer | Layer Thickness (inches) |
|---|---|
| Vegetative Cover | Not applicable |
| Topsoil | 6 |
| Upper Backfill | 30 |
| Erosion Barrier | 12 |
| Geotextile Fabric | - |
| Middle Backfill | 12 |
| Geotextile Filter Fabric | - |
| Lateral Drainage Layer | 12 |
| Geotextile Fabric | - |
| High Density Polyethylene (HDPE) Geomembrane | 0.06 (60 mil) |
| Geosynthetic Clay Liner (GCL) | 0.2 |
| Upper Foundation Layer | 12 |
| Lower Foundation Layer | 72 (minimum) |

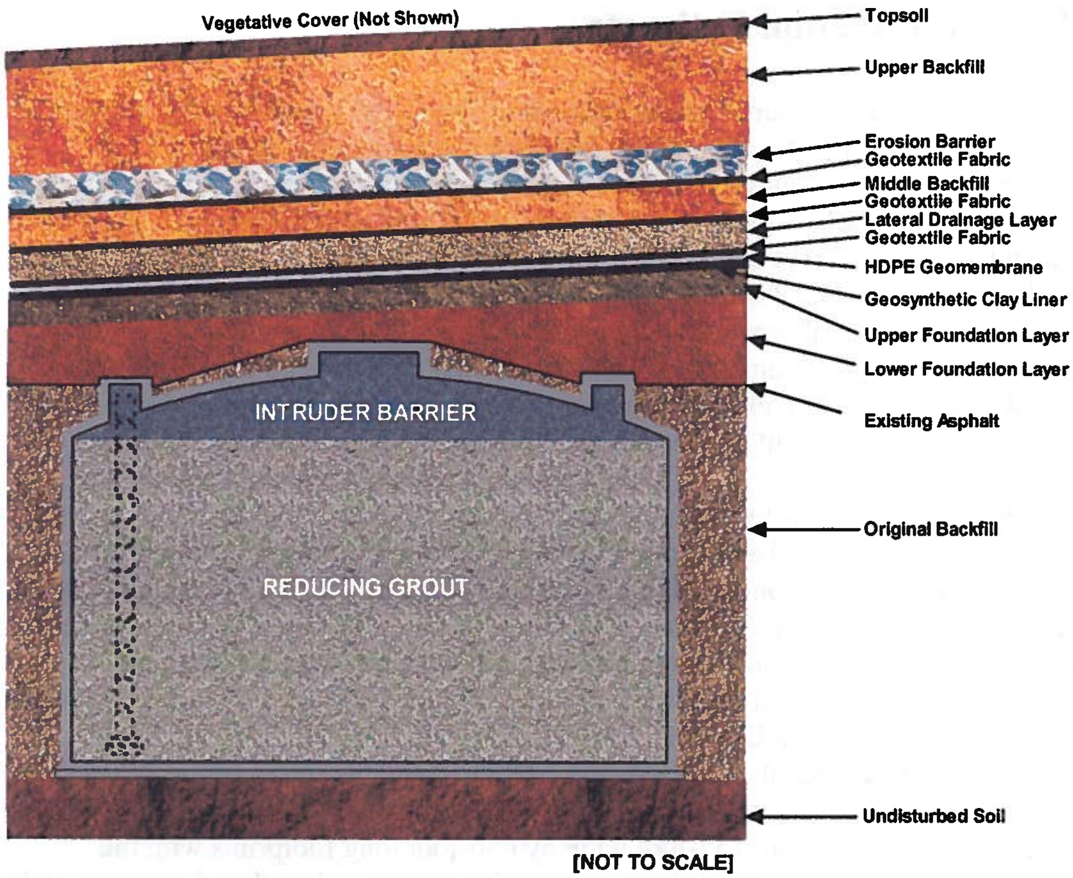


Figure 3. FTF Closure Cap Concept (Phifer et al. 2007)

Table 4. FTF Infiltration Estimates (Phifer et al. 2007)

| Year | Infiltration (in/yr) |
|---|---|
| 0 | 0.00088 |
| 100 | 0.010 |
| 180 | 0.17 |
| 290 | 0.37 |
| 300 | 0.50 |
| 340 | 1.00 |
| 380 | 1.46 |
| 560 | 3.23 |
| 1,000 | 7.01 |
| 1,800 | 10.65 |
| 2,623 | 11.47 |
| 3,200 | 11.53 |
| 5,600 | 11.63 |
| 10,000 | 11.67 |

# 3.0 ET#3 Infiltration Estimate

The ELLWF Alternate Closure System Concept (Table 2 and Figure 2) presented in the ELLWF Closure Plan (Phifer et al. 2009) will form the basis for both the ET#3 infiltration estimates. As outlined in Section 2.0 previous infiltration estimates (Table 4) were developed for the FTF closure cap with a slope length of 585 feet and a slope of 2 percent and assumed closure cap degradation over time that did not include subsidence as a degradation mechanism (Phifer et al. 2007). These FTF infiltration estimates can be utilized for the ELLWF alternate closure cap over ET#3 so long as: 1) the closure cap profiles are essentially the same; 2) no subsidence after final closure cap placement is associated with the ELLWF closure cap over ET#3; 3) the ELLWF closure cap over ET#3 has a slope of 2 percent or greater and a maximum slope length of 585 feet or less.

As seen the ELLWF Alternate Closure System Concept (Table 2 and Figure 3) and the FTF Closure Cap Concept (Table 3 and Figure 3) profiles are essentially identical. As outlined in Section 1.0 no non-crushable waste will be placed in ET#3 (Butcher 2012) and as outlined in the ELLWF Closure Plan (Phifer et al. 2009) subsidence treatment (static surcharging and/or dynamic compaction) will be perforemed to eliminate subsidence potential within Engineered Trenches. Figure 1 provides the proposed layout of ET#3 along with adjacent ELLWF disposal units such as SLIT 13/ET#4, Naval Reactor Component Disposal Area (NRCDA), SLIT 8, and the Intermediate-Level Vault (ILV). The ELLWF closure plan (Phifer et al. 2009) essentially assumed that individual closure caps were placed over 157-foot wide by 656-foot long footprints with the crestline running lengthwise down the center resulting in slope-lengths of approximately 85 feet (see Figure 4). The orientation of the closure cap over ET#3 and adjacent ELLWF disposal units will not be able to conform to the assumption within the existing ELLWF closure plan (Phifer et al. 2009). Figure 5 provides a potential ELLWF closure cap layout over ET3 and adjacent ELLWF disposal units that takes into account the approximately ten foot drop in elevation from the ILV to the far side of the ET#3 location (contours taken from 2009 LiDar data). This ELLWF closure cap layout results in a slope of 3.3% over a maximum slope length of 585 feet. As seen in the preceeding discussion, the ELLWF alternate closure cap over ET#3 has essentially the same profile as that of the FTF closure cap, no ET#3 subsidence is anticipated after final closure cap installation, and the ET#3 closure cap will have a slope greater than 2 percent and a maximum slope length of 585 feet. On this basis the FTF closure cap infiltration estimates (Table 4) are appropriate for use at ET#3.

Infiltration estimates prior to placement of the final closure cap are provided in Phifer et al. 2006 (Table 8-1). Table 5 provides the infiltration obtained from Phifer et al. 2006 for conditions prior to placement of the final closure cap and that obtained from Phifer et al. 2007 (Table 4) for conditions after placement of the final closure cap. Infiltration from Table 1 will be utilized as the infiltration through the ET #3 alternate closure cap.

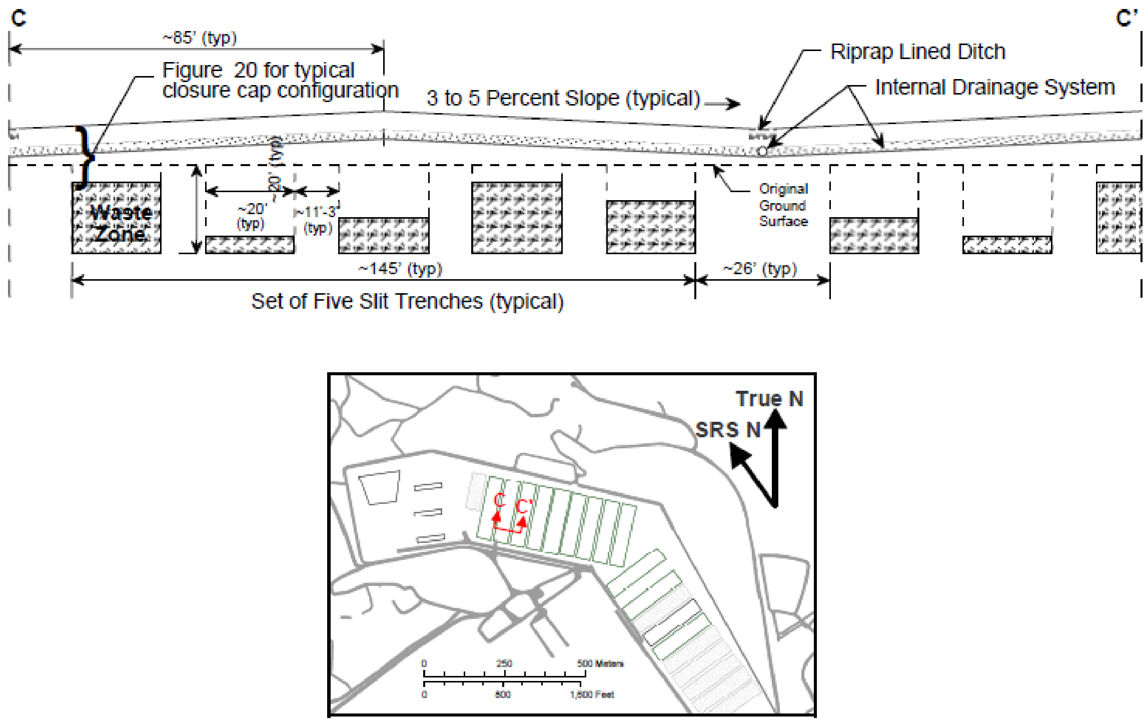


Figure 4. Closure Cap Cross-Section (Phifer et al. 2009)

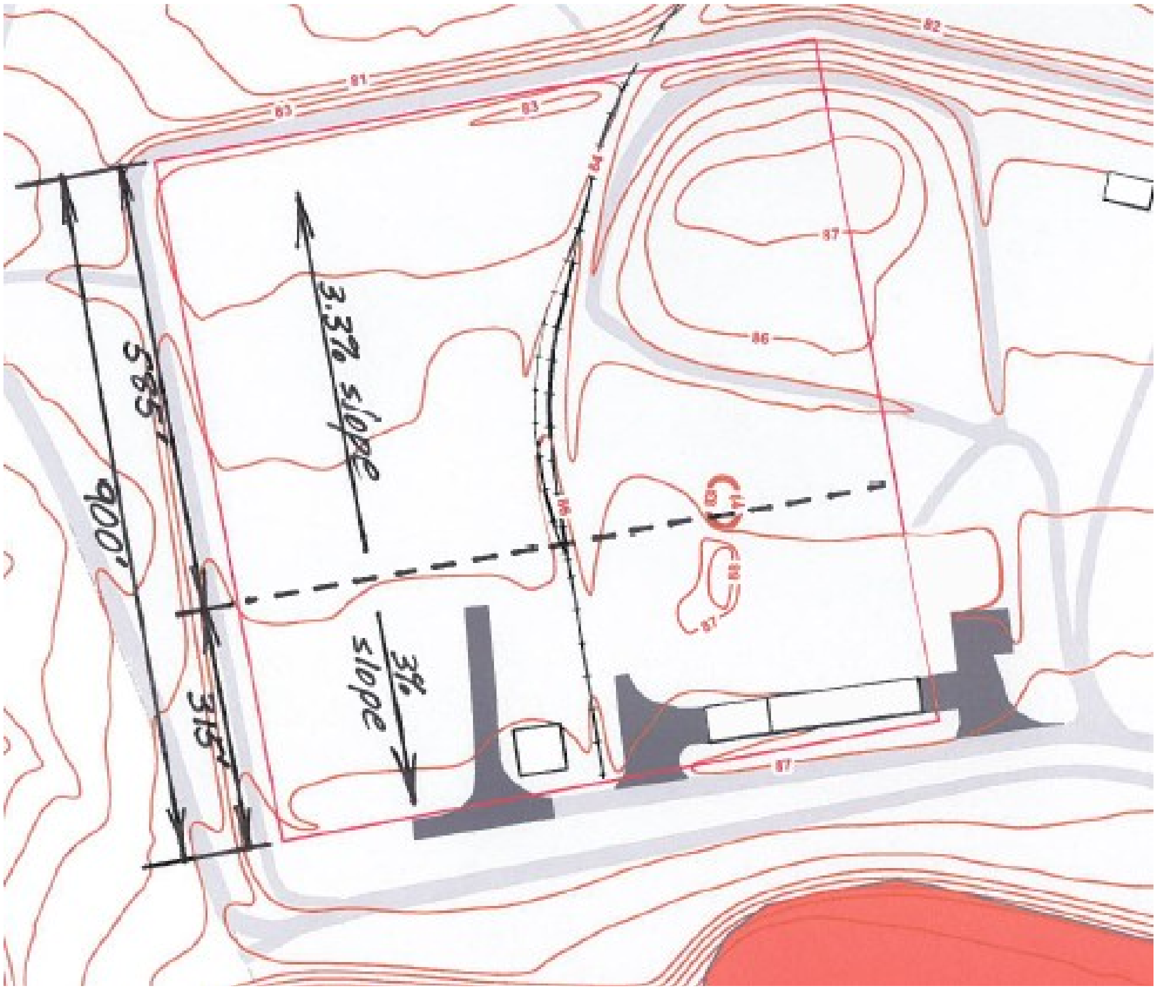


Figure 5. ELLWF Closure Cap Layout over ET#3 and Adjacent ELLWF Disposal Units

Table 5. ET#3 Infiltration Estimates

| Year | Period | Infiltration (in/yr) |
|---|---|---|
| -125 [1] | Operational | 15.75 |
| -100 [1] | Interim Cover | 0.36 |
| 0 [2] | Final Cover | 0.00088 |
| 100 [2] | Final Cover | 0.010 |
| 180 [2] | Final Cover | 0.17 |
| 290 [2] | Final Cover | 0.37 |
| 300 [2] | Final Cover | 0.50 |
| 340 [2] | Final Cover | 1.00 |
| 380 [2] | Final Cover | 1.46 |
| 560 [2] | Final Cover | 3.23 |
| 1,000 [2] | Final Cover | 7.01 |
| 1,800 [2] | Final Cover | 10.65 |
| 2,623 [2] | Final Cover | 11.47 |
| 3,200 [2] | Final Cover | 11.53 |
| 5,600 [2] | Final Cover | 11.63 |
| 10,000 [2] | Final Cover | 11.67 |

Notes to Table 1:

[1] Phifer et al. 2006 Table 8-1

[2] Phifer et al. 2007 Table 80

# 4.0 References

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