# Interim Covers for Operational Efficiency

Mississippi SWANA

Spring 2019

# Problem:

Landfill Operations is Hard

- Rain
- Wind
- LF Liquids
- LF Gases
- Odors
- Those pesky vectors

For Some...

~~Well Maybe~~

~~Possible~~

**Solution:** Interim Exposed Geomembrane Cover

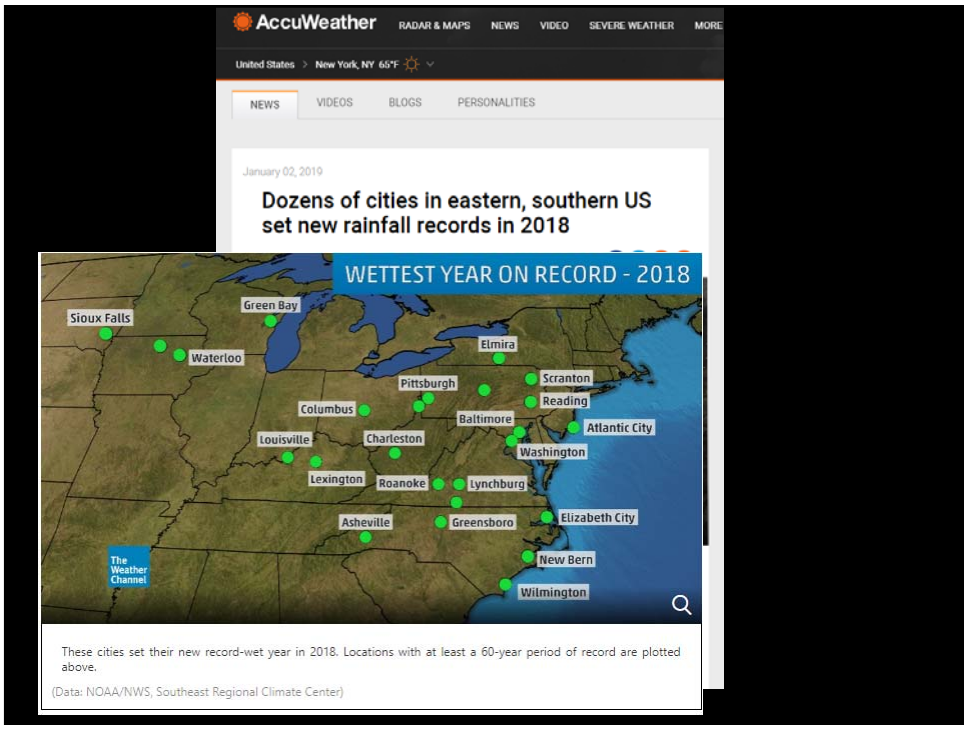
# The Rain Issue

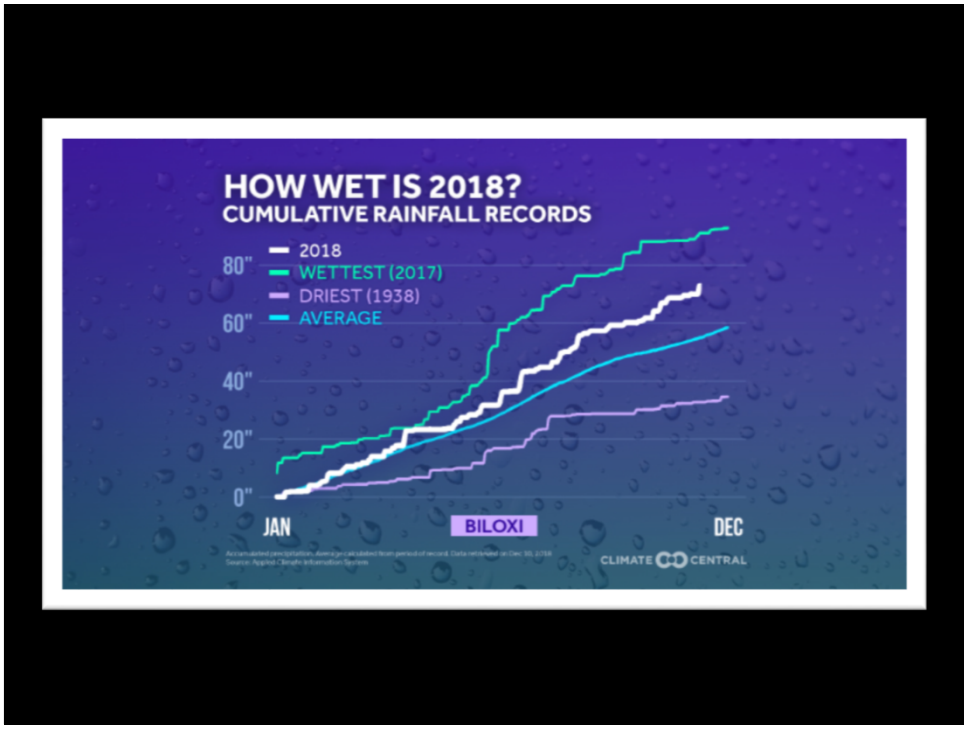
Known:

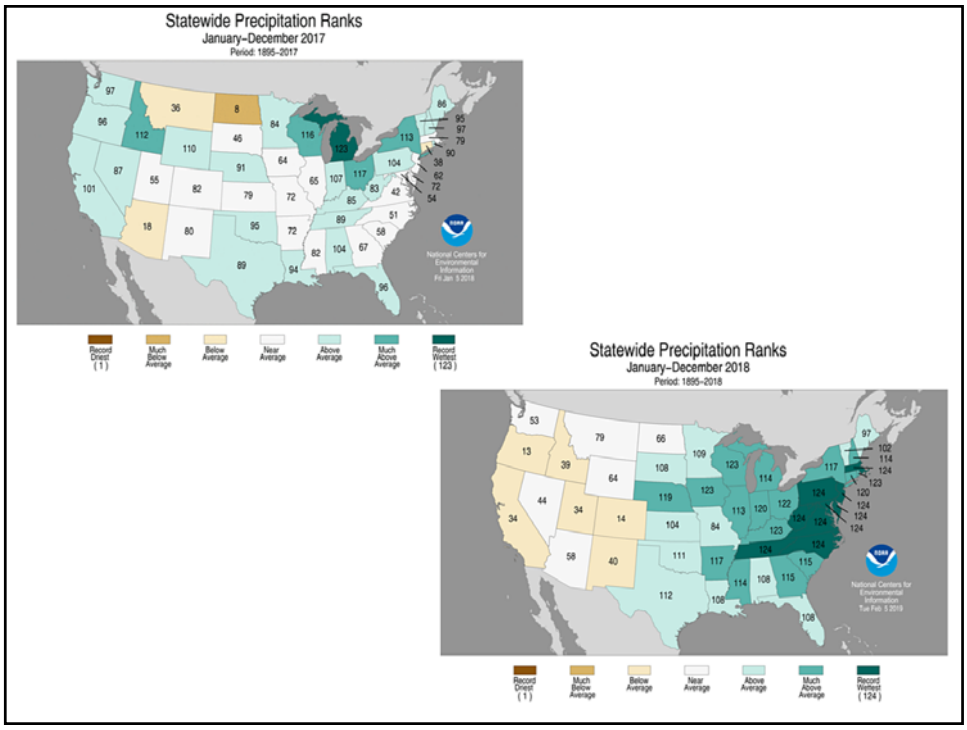
- Posit 1: Leachate costs $ (to treat)
- Posit 2: Rain makes Leachate

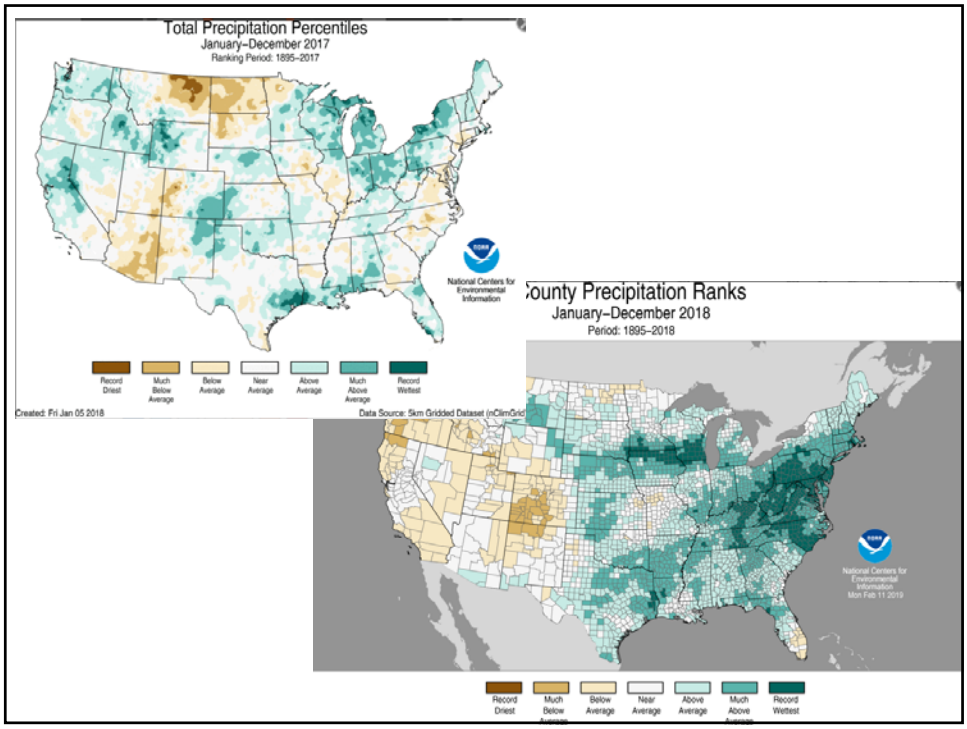
Therefore, by deduction, we have conclusions:

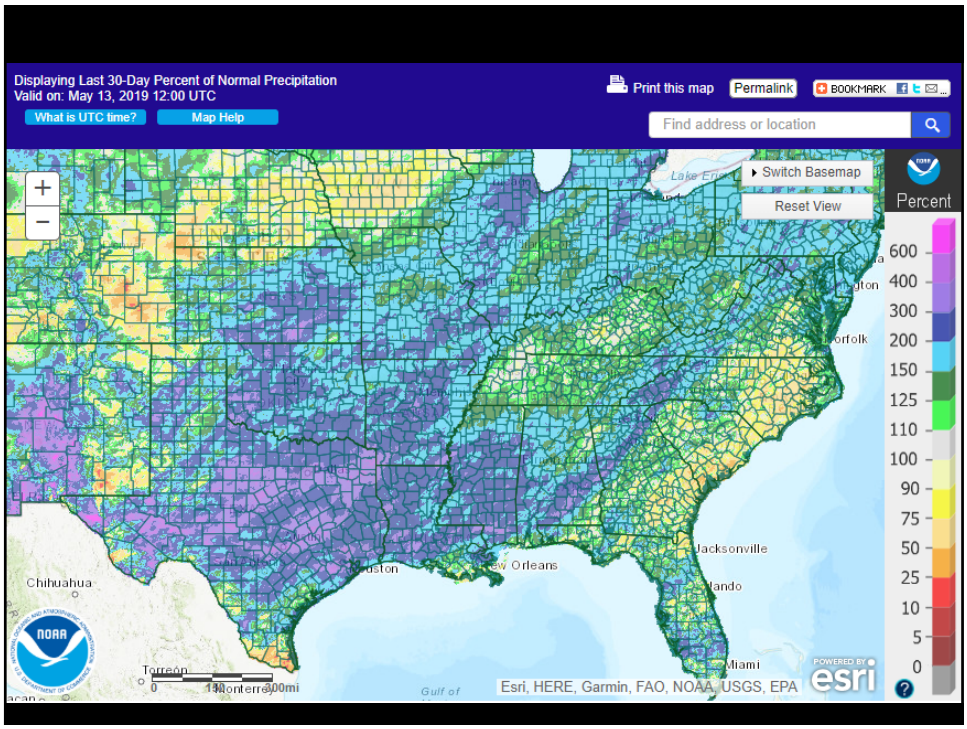
- Rain costs $
- Lots of Rain = Lots of $$$

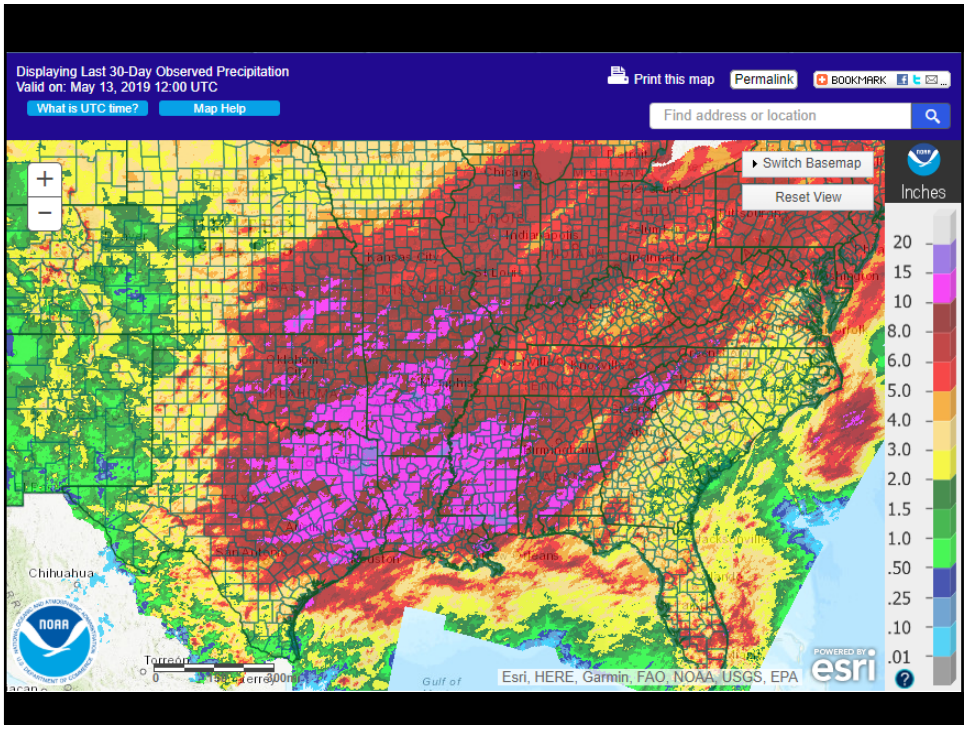


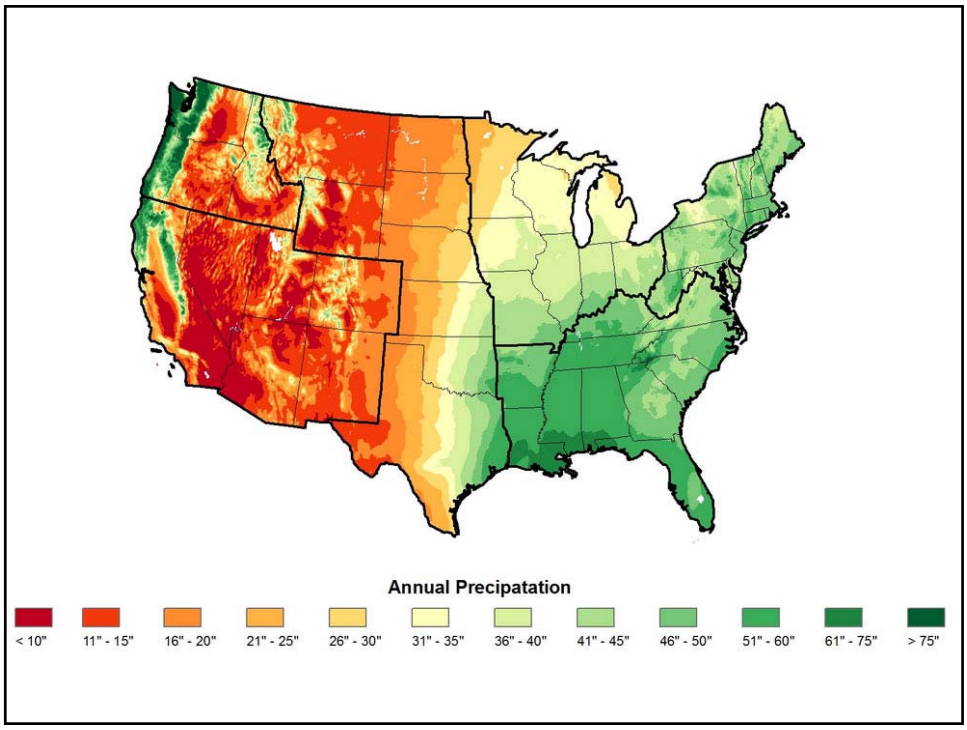

HOW WET IS 2018?
CUMULATIVE RAINFALL RECORDS
2018
WETTEST (2017)
DRIEST (1938)
AVERAGE
80"
60"
40"
20"
0"
JAN
BILOXI
DEC
CLIMATE CENTRAL


Statewide Precipitation Ranks
January–December 2017
Period: 1895–2017
Record Driest ( 1 )
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Wettest ( 123 )
Statewide Precipitation Ranks
January–December 2018
Period: 1895–2018
Record Driest ( 1 )
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Wettest ( 124 )


Total Precipitation Percentiles
January–December 2017
Ranking Period: 1895–2017
Record Driest
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Wettest
Created: Fri Jan 05 2018
County Precipitation Ranks
January–December 2018
Period: 1895–2018


Displaying Last 30-Day Percent of Normal Precipitation
Valid on: May 13, 2019 12:00 UTC
What is UTC time?
Map Help
Print this map
Permalink
BOOKMARK
Find address or location
Switch Basemap
Reset View
Percent
600
400
300
200
150
125
110
100
90
75
50
25
10
5
0
Chihuahua
Houston
New Orleans
Jacksonville
Miami
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA


Displaying Last 30-Day Observed Precipitation
Valid on: May 13, 2019 12:00 UTC
What is UTC time?
Map Help
Print this map
Permalink
BOOKMARK
Find address or location
Switch Basemap
Reset View
Inches
20
15
10
8.0
6.0
5.0
4.0
3.0
2.0
1.5
1.0
.50
.25
.10
.01
Chihuahua
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA
esri


Annual Precipatation
< 10"
11" - 15"
16" - 20"
21" - 25"
26" - 30"
31" - 35"
36" - 40"
41" - 45"
46" - 50"
51" - 60"
61" - 75"
> 75"

## Definitions

EGC = Exposed Geomembrane Cover

Temporary/Interim = Anything before final grade is reached, final cover is placed

## Benefits of Interim EGC

- Reduced Leachate
  - Disposal
  - Outbreaks
- LFG Capture
  - Minimize emissions
  - Minimize $O_2$ intake, maximize $CH_4$
- Odor Control
- No Erosion
  - Clean Stormwater
  - But more of it, very near 100%
- Low Maintenance Cost (vs. IC or Final Cover)
  - Mowing, seeding, fertilizing
- Can Mitigate Veneer Stability Issues

## Disadvantages of Interim EGC

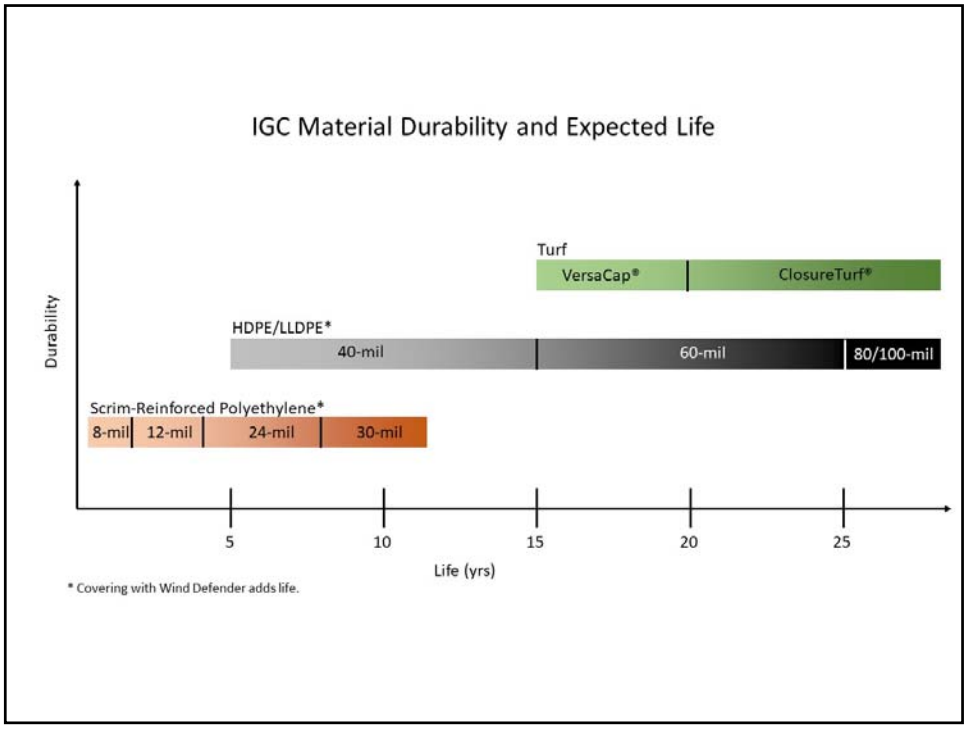
- Reduced Access
- Cost?

## "Temporary" EGC

- Typically limited design life – 1-10 years
- But can easily last 20 yrs with proper material, design

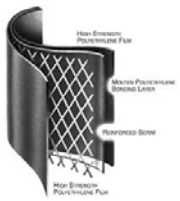
## EGC Materials

- HDPE
  - 60/40/30-mil
- LLDPE
  - 40-mil
- Skrim Reinforced
  - typ. 8-24-mil
- Synthetic Turf
- Others

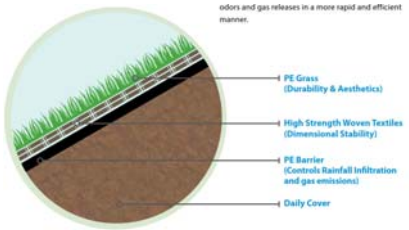



# Materials

Skrim Reinforced



Turf

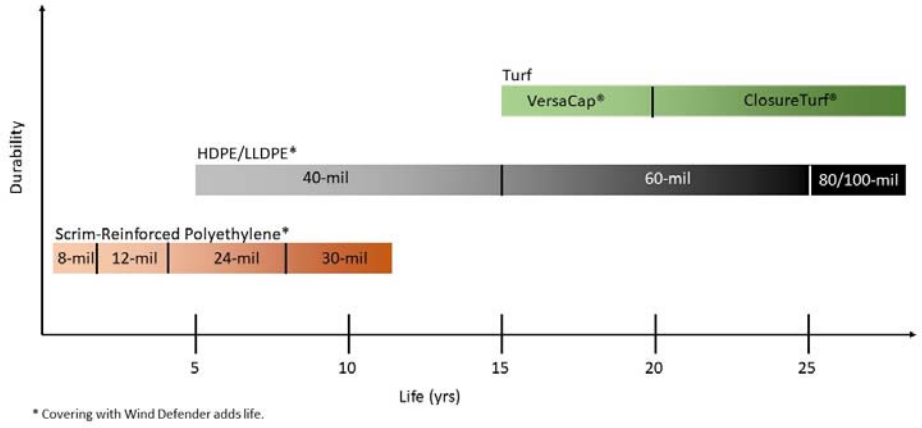


## Design Considerations for Interim EGC

- Waste Staging/Phasing
- Design Life/Durability
- Wind Uplift
- Gas Uplift
- Get the Gas Out
- Under-liner Seeps/Drainage
- Stormwater Volume Increase

## Waste Staging/Phasing

# Design Life/Durability




* Covering with Wind Defender adds life.

# Wind Uplift

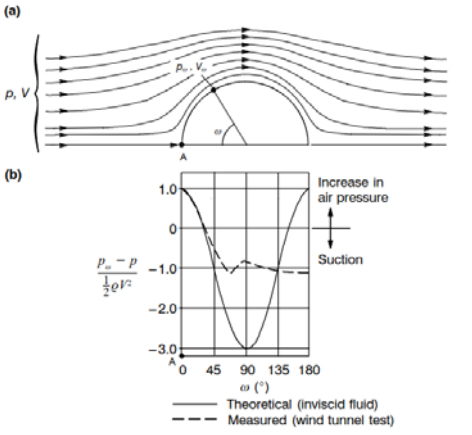



Figure 2. Illustration of pressure distribution on the surface of a cylinder (adapted from Goldstein 1938): (a) stream lines around a cylindrical obstacle; (b) air pressure variation along the surface of the obstacle.

*Source: Giroud, et al., 1995*

# Wind Uplift

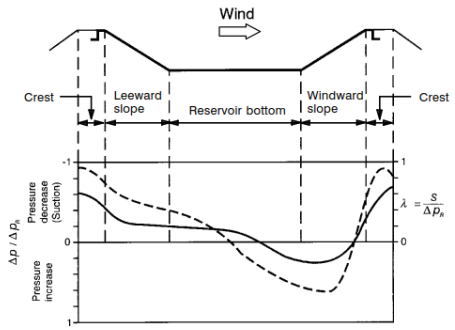



**Figure 4. Change in atmospheric pressure, $\Delta p$, due to wind blowing on an empty reservoir (solid curve for wind perpendicular to dike crest line and dashed curve for worst case with wind at an angle), based on work published by Dedrick (1973, 1974a, 1974b, 1975).**

*Source: Giroud, et al., 1995*

# Wind Uplift – Suction Factor

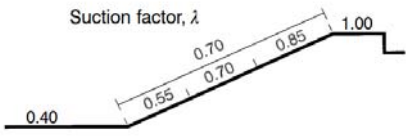



**Figure 5. Recommended values of the suction factor for design of any slope based on the critical leeward slope.**

*Source: Giroud, et al., 1995*

# Wind Suction on EGC

$$S_e = 0.050\lambda V^2 e^{-(1.252 \times 10^{-4})z} - 9.81\mu_{GM}$$

with $S_e$(Pa), $V$(km/h), $z$(m), $\mu_{GM}$(kg/m$^2$)

*Source: Giroud, et al., 1995*

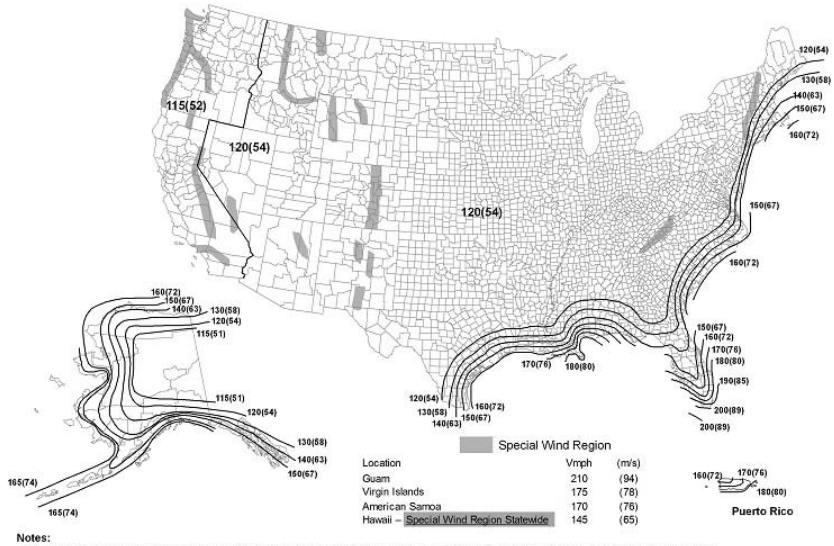
# Wind Suction on EGC

| Slope Location | Wind Vel (mph) | Suction (psf) |
|---|---|---|
| Top | 45 | 4.33 |
| Mid | 45 | 3.51 |
| Lower | 45 | 2.70 |
| Top | 85 | 16.19 |
| Mid | 85 | 13.28 |
| Lower | 85 | 10.37 |
| Top | 125 | 35.36 |
| Mid | 125 | 29.07 |
| Lower | 125 | 22.78 |

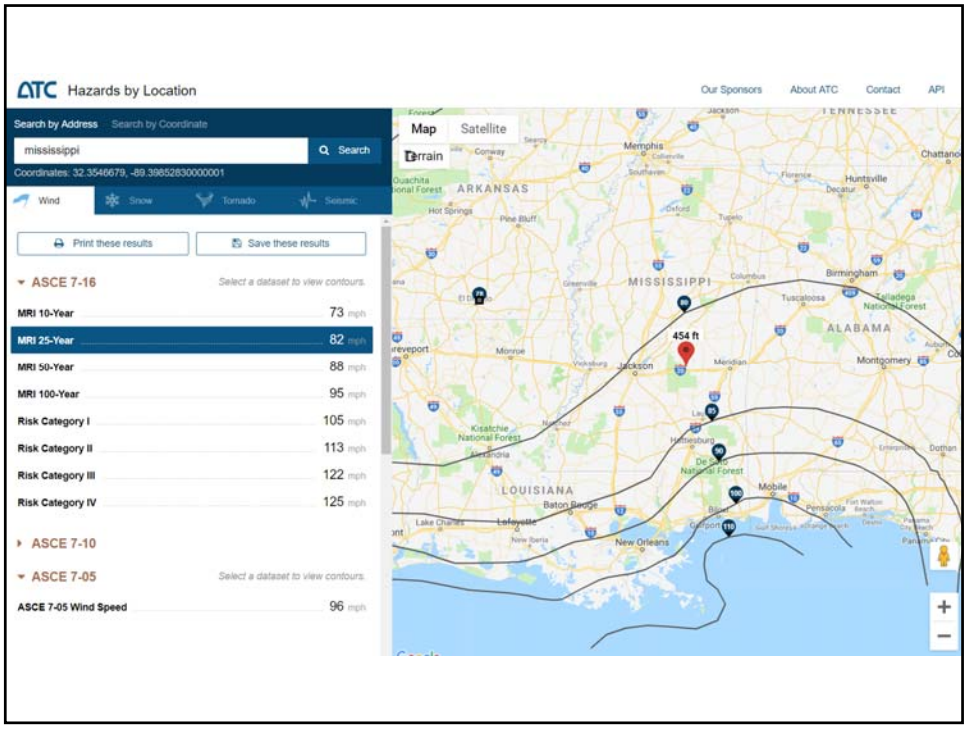
*Source: Giroud, et al., 1995*

## Design Wind

- Building Code
  - 3-sec gust
- NOAA
  - 5-sec wind speed
  - 2-min wind speed




Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (Annual Exceedance Probability = 0.000588, MRI = 1700 Years).




# NOAA Weather Station data

| | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|
| | DATE | AWND | FMTM | PGTM | WDF2 | WDF5 | WSF2 | WSF5 | WSFG |
| | 4/19/2019 | 15.66 | | | 260 | 240 | 31.1 | 42.1 | |
| | 4/20/2019 | 11.86 | | | 280 | 250 | 28 | 36 | |
| | 4/21/2019 | 2.91 | | | 320 | 340 | 15 | 19 | |
| | 4/22/2019 | 3.13 | | | 230 | 360 | 12.1 | 15 | |
| | 4/23/2019 | 3.8 | | | 270 | 240 | 13 | 16.1 | |
| | 4/24/2019 | 2.68 | | | 230 | 230 | 14.1 | 16.1 | |
| | 4/25/2019 | 7.38 | | | 300 | 290 | 25.1 | 31.1 | |
| | 4/26/2019 | 8.5 | | | 310 | 320 | 19.9 | 25.9 | |

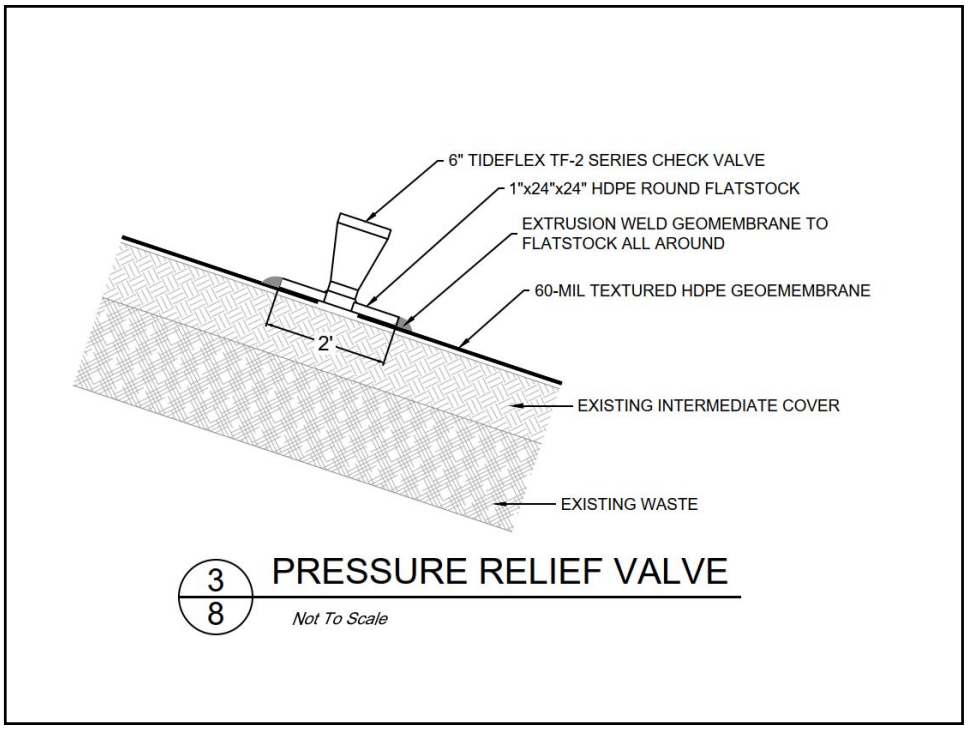
## Under Liner Suction Effect

- Suction forms under liner as liner is displaced up
- Takes time to displace air volume as liner is displaced
- Not as subject to gusts

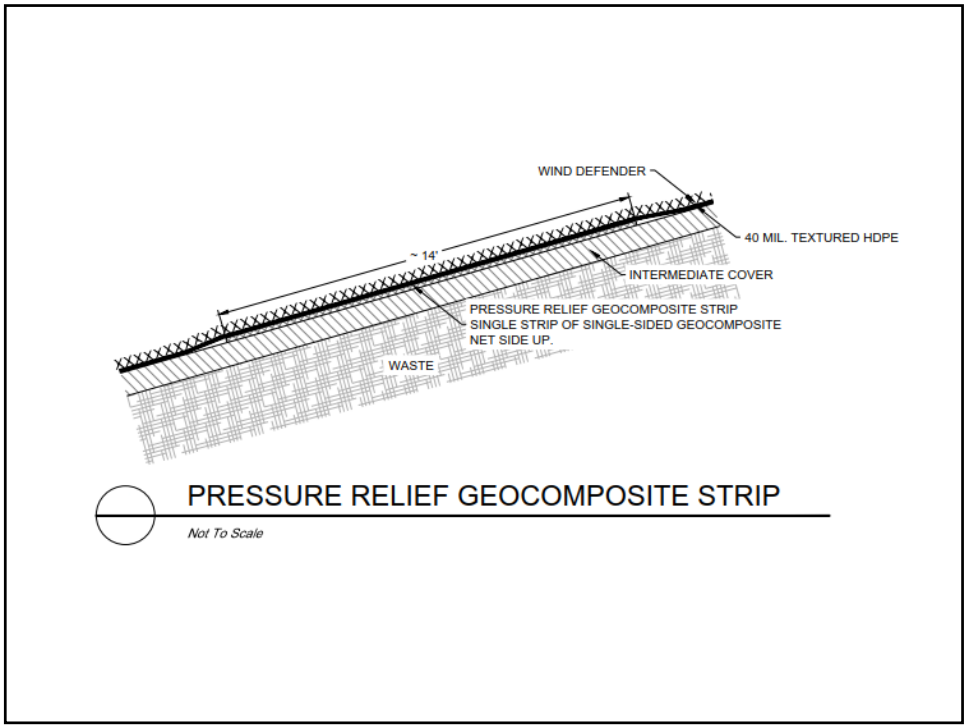
## Gas Uplift

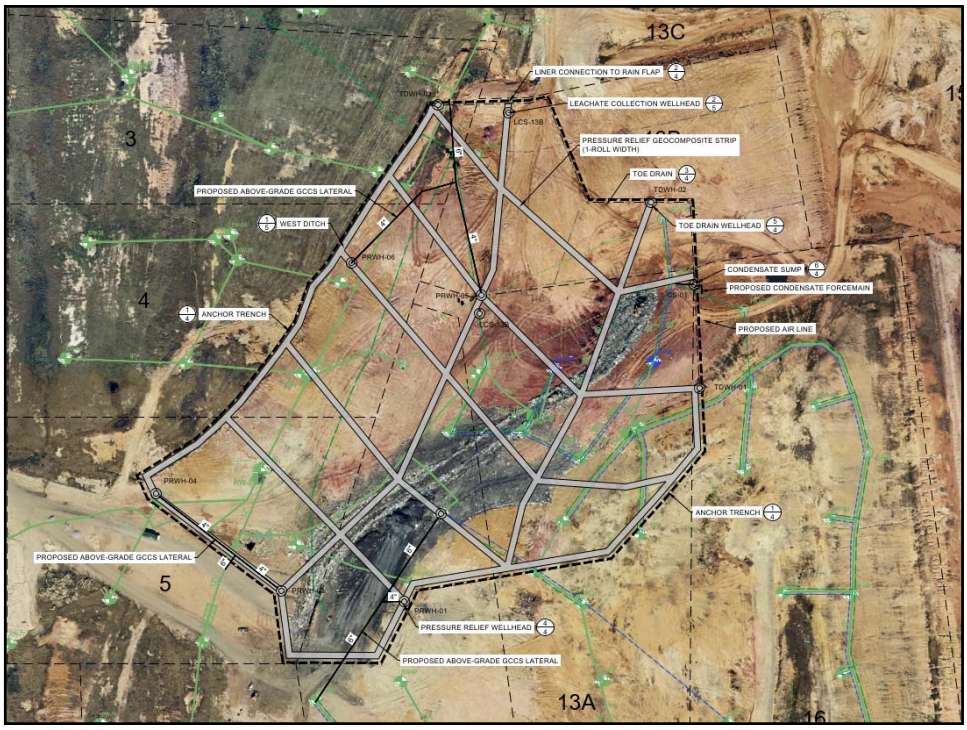
- Pressure builds quickly when GCCS goes down
- Design wind suction 3.5 psf (45 mph wind) = 0.7 in WC
- 24” soil cover = 220 psf

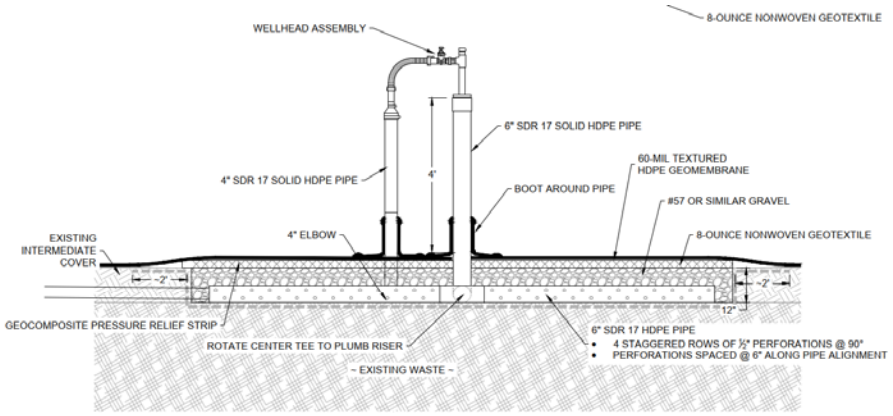

CAT


6" TIDEFLEX TF-2 SERIES CHECK VALVE
1"x24"x24" HDPE ROUND FLATSTOCK
EXTRUSION WELD GEOMEMBRANE TO FLATSTOCK ALL AROUND
60-MIL TEXTURED HDPE GEOEMEMBRANE
2'
EXISTING INTERMEDIATE COVER
EXISTING WASTE
3
8
PRESSURE RELIEF VALVE
Not To Scale

## Get the Gas Out


WIND DEFENDER
40 MIL. TEXTURED HDPE
~ 14'
INTERMEDIATE COVER
PRESSURE RELIEF GEOCOMPOSITE STRIP
SINGLE STRIP OF SINGLE-SIDED GEOCOMPOSITE
NET SIDE UP.
WASTE
PRESSURE RELIEF GEOCOMPOSITE STRIP
Not To Scale


13C
LINER CONNECTION TO RAIN FLAP
LEACHATE COLLECTION WELLHEAD
LCS-13B
PRESSURE RELIEF GEOCOMPOSITE STRIP
(1-ROLL WIDTH)
TOE DRAIN
TDWH-02
TOE DRAIN WELLHEAD
CONDENSATE SUMP
PROPOSED CONDENSATE FORCEMAIN
PROPOSED AIR LINE
PROPOSED ABOVE-GRADE GCCS LATERAL
WEST DITCH
ANCHOR TRENCH
PRWH-06
PRWH-05
PRWH-04
PRWH-01
PRESSURE RELIEF WELLHEAD
3
4
5
13A

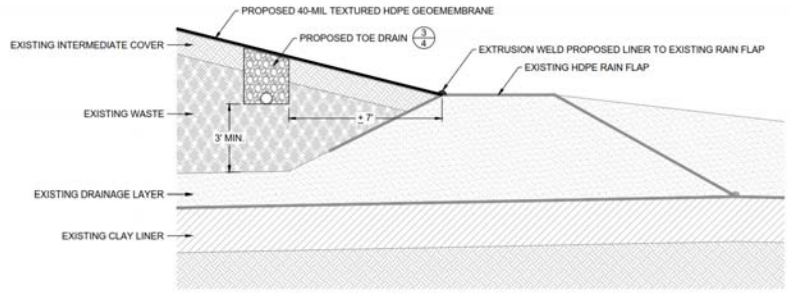



**SECTION VIEW**

1/6 PRESSURE RELIEF WELL HEAD

*Not To Scale*

# Under Liner Seeps/Drainage




LINER CONNECTION TO RAIN FLAP

*Not To Scale*

## Stormwater

- Design/account for flow and volume increase
  - Pipes/conveyances
  - Ponds
  - 15 – 30% more volume

## Anchoring EGCs

- Sandbags and Ropes
- Anchor Trenches
- Roads/ Benches
- Earth Anchors
- Wind Defender

# Anchor Trenches

# Wind Forces on EGC

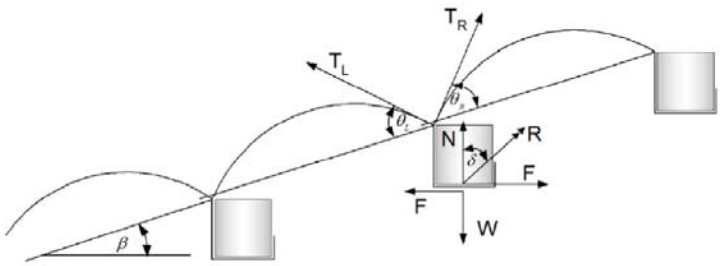
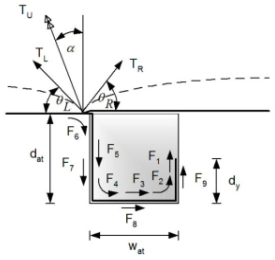



Figure 2. Schematic Diagram of Anchor Trenches [Perera et al., 2011]

# Wind Forces on EGC Anchor Trench

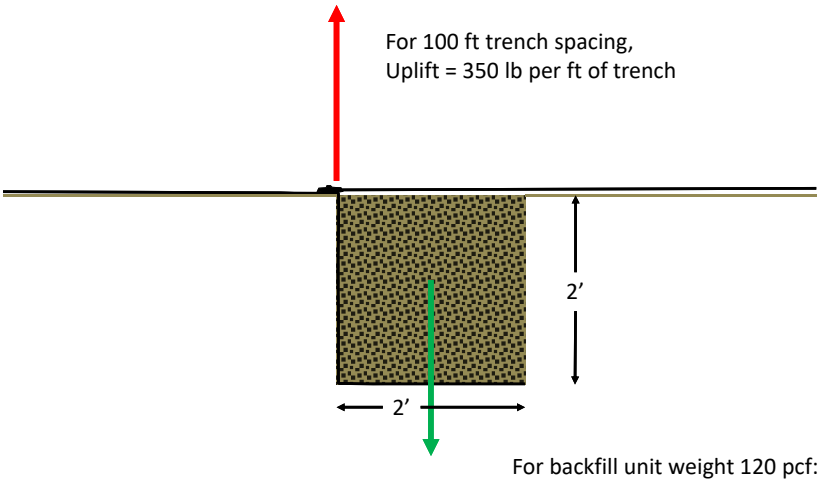



$\delta_R$ = Interface friction between geomembrane and soil above the geomembrane
$\delta_L$ = Interface friction between geomembrane and waste below the geomembrane

**Figure 3: Schematic Diagram of Forces During Anchor Trench Pullout**

Uplift: Se = 3.5 psf (45 mph wind, mid slope)

For 100 ft trench spacing,
Uplift = 350 lb per ft of trench

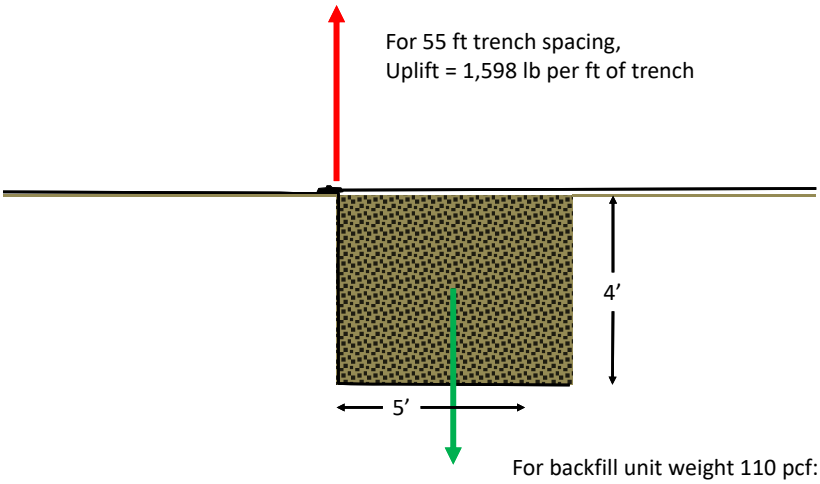



For backfill unit weight 120 pcf:

Trench weight = 2'x2'x1'x110pcf = 440 lb per ft of trench
FS = 440/350 = 1.26

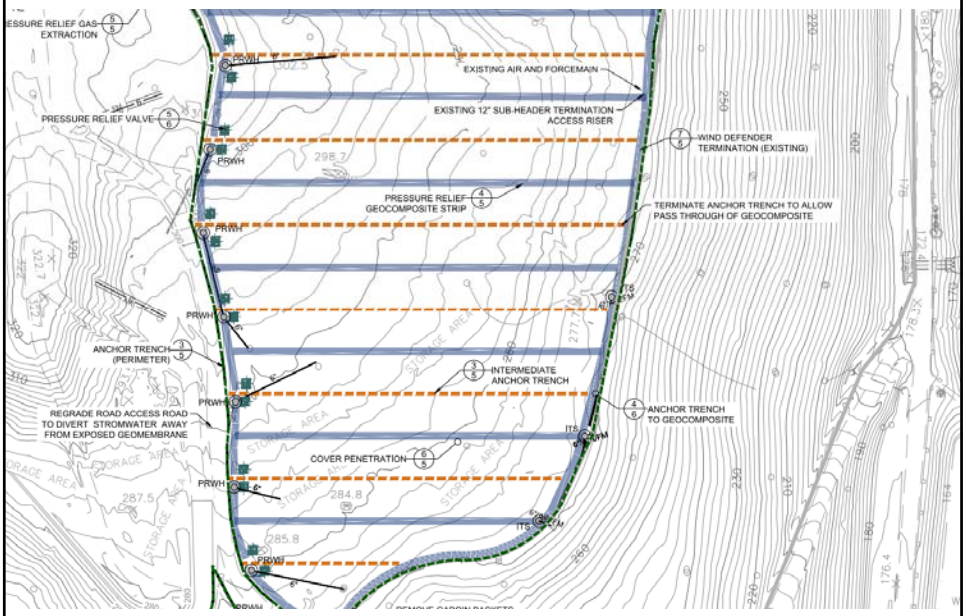
Uplift: Se = 29.07 psf (125 mph wind, mid slope)

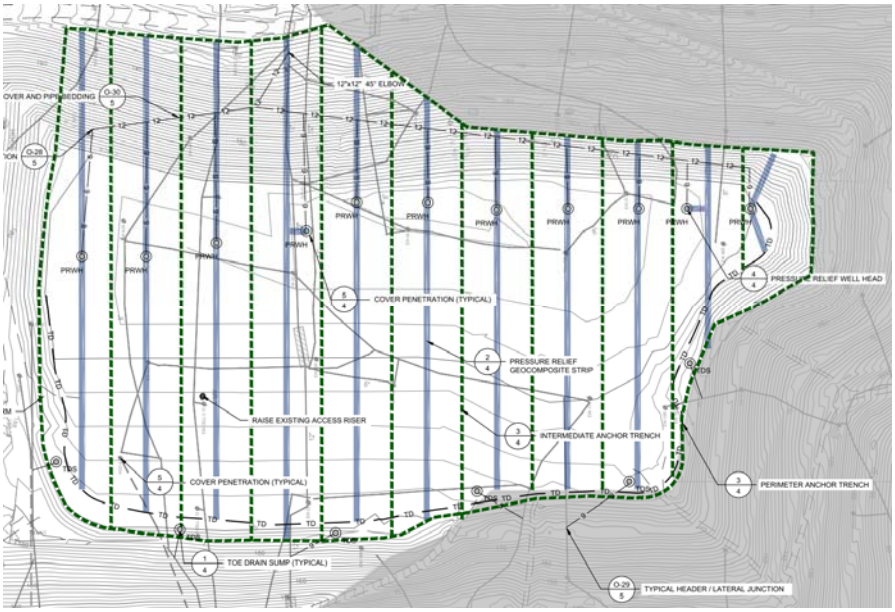
For 55 ft trench spacing,
Uplift = 1,598 lb per ft of trench




For backfill unit weight 110 pcf:

Trench weight = 5’x4’x1’x110pcf =
2,200 lb per ft of trench
FS = 2200/1598 = 1.38






# Earth Anchors


## Wind Defender

- “Windscreen” – breaks the suction
- “Ballast” ??

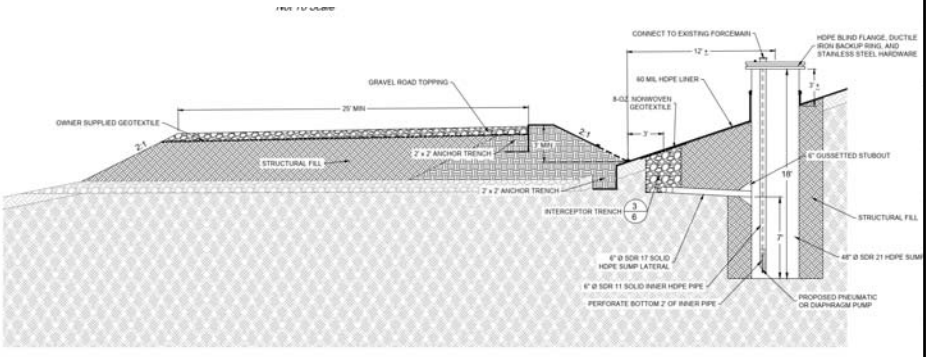
## Regulatory Requirements

Temporary Covers not addressed in Regulations

## Temporary EGC Maintenance

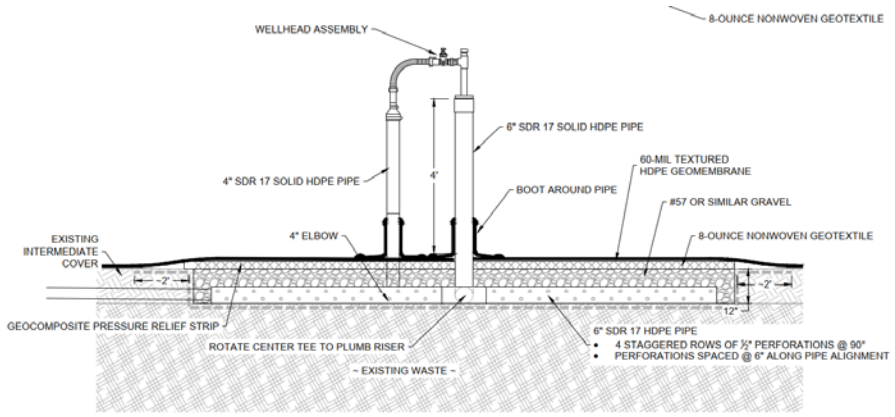
- Penetrations – creep
- Damage – hail, birds, animals
- Gas whales
- Catastrophic – hurricane, tornado

# THE DEVIL'S IN THE DETAILS




INTERCEPTOR TRENCH SUMP

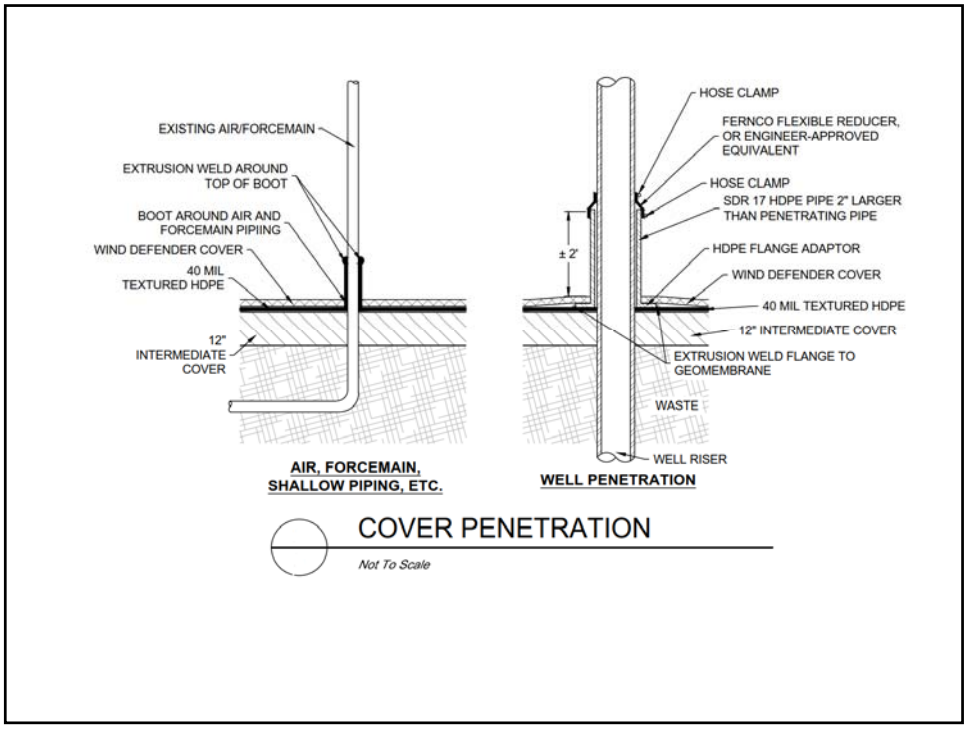
*Not To Scale*

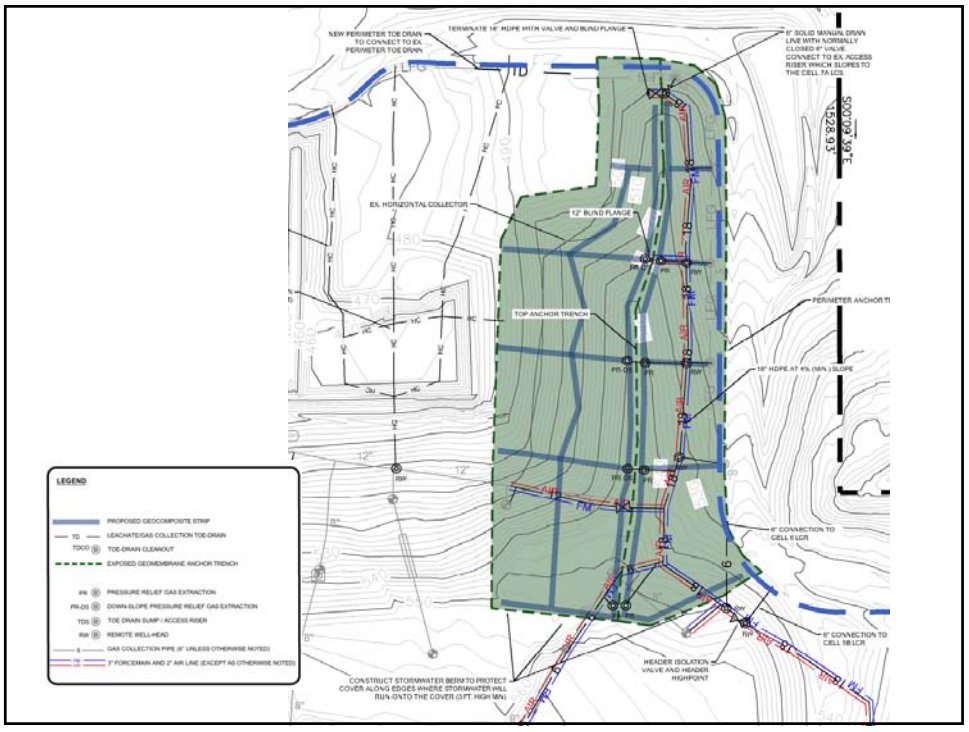


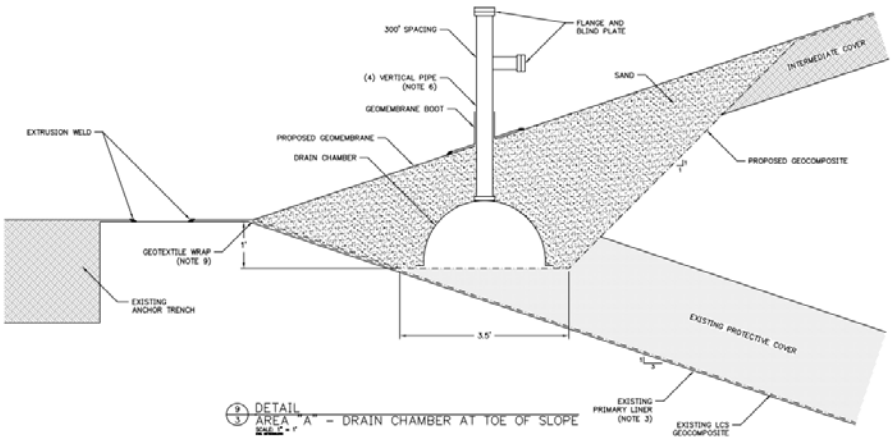

**SECTION VIEW**

1/6 PRESSURE RELIEF WELL HEAD

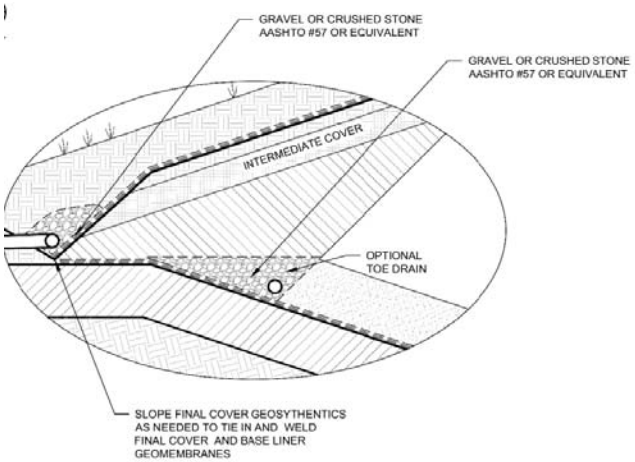
*Not To Scale*


EXISTING AIR/FORCEMAIN
EXTRUSION WELD AROUND TOP OF BOOT
BOOT AROUND AIR AND FORCEMAIN PIPIING
WIND DEFENDER COVER
40 MIL TEXTURED HDPE
12" INTERMEDIATE COVER
AIR, FORCEMAIN, SHALLOW PIPING, ETC.
HOSE CLAMP
FERNCO FLEXIBLE REDUCER, OR ENGINEER-APPROVED EQUIVALENT
HOSE CLAMP
SDR 17 HDPE PIPE 2" LARGER THAN PENETRATING PIPE
± 2'
HDPE FLANGE ADAPTOR
WIND DEFENDER COVER
40 MIL TEXTURED HDPE
12" INTERMEDIATE COVER
EXTRUSION WELD FLANGE TO GEOMEMBRANE
WASTE
WELL RISER
WELL PENETRATION
COVER PENETRATION
Not To Scale


LEGEND
PROPOSED GEOCOMPOSITE STRIP
LEACHATE/GAS COLLECTION TOE-DRAIN
TOE-DRAIN CLEANOUT
EXPOSED GEOMEMBRANE ANCHOR TRENCH
PRESSURE RELIEF GAS EXTRACTION
DOWN-SLOPE PRESSURE RELIEF GAS EXTRACTION
TOE DRAIN SUMP / ACCESS RISER
REMOTE WELL-HEAD
GAS COLLECTION PIPE (6" UNLESS OTHERWISE NOTED)
3" FORCEMAIN AND 2" AIR LINE (EXCEPT AS OTHERWISE NOTED)
NEW PERIMETER TOE DRAIN TO CONNECT TO EX. PERIMETER TOE DRAIN
TERMINATE 18" HDPE WITH VALVE AND BLIND FLANGE
6" SOLID MANIA DRAIN LINE WITH NORMALLY CLOSED 6" VALVE CONNECT TO EX ACCESS RISER WHICH SLOPES TO THE CELL 7A LCR
S00°09'39"E
1326.93'
EX. HORIZONTAL COLLECTOR
12" BLIND FLANGE
TOP ANCHOR TRENCH
PERIMETER ANCHOR TI
18" HDPE AT 4% (MIN.) SLOPE
8" CONNECTION TO CELL 8 LCR
8" CONNECTION TO CELL 9B LCR
HEADER ISOLATION VALVE AND HEADER HIGHPOINT
CONSTRUCT STORMWATER BERM TO PROTECT COVER ALONG EDGES WHERE STORMWATER WILL RUN ONTO THE COVER (3 FT. HIGH MIN.)




9/3 DETAIL AREA "A" – DRAIN CHAMBER AT TOE OF SLOPE



# Conclusion

Interim EGC can be a great way to reduce operational challenges

- Leachate
- Gas
- Stormwater/Erosion

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