# Attachment I-7: Preliminary In-Town Levee Analyses

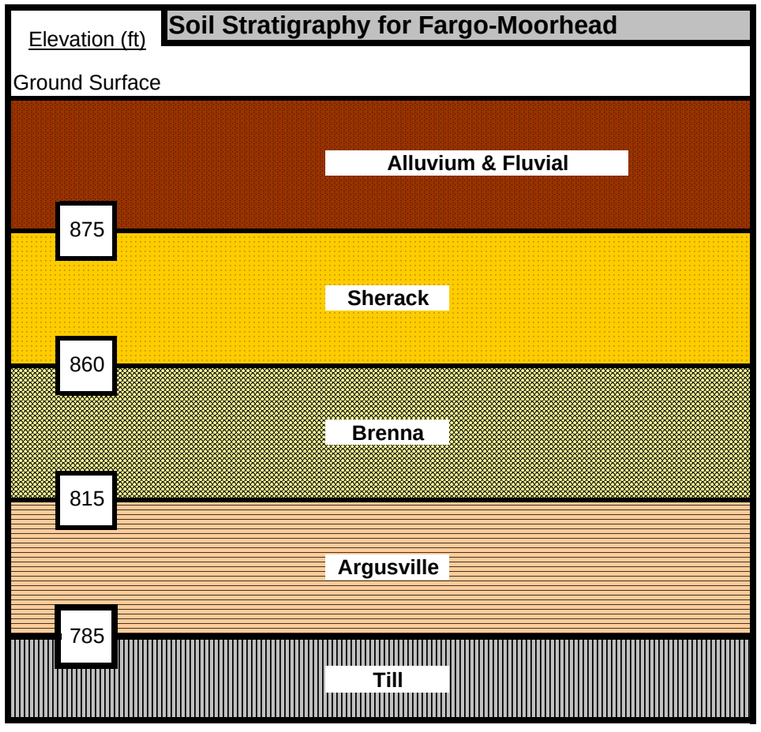
# Fargo-Moorhead Metro Feasibility Study

## Assumptions used in GeoStudio Cross-sections for Preliminary Analysis

**Low Head Dam Crest Elevations and Location**

| | | | |
|---|---|---|---|
| 1) North Dam | 871.38 | ft | 12th Avenue N, Fargo OR 15th Avenue, Moorhead |
| 2) Midtown D | 876.2 | ft | Dike East |
| 3) South Dan | 878.4 | ft | 32nd Avenue S, Fargo OR River Oaks Park, Moorhead |

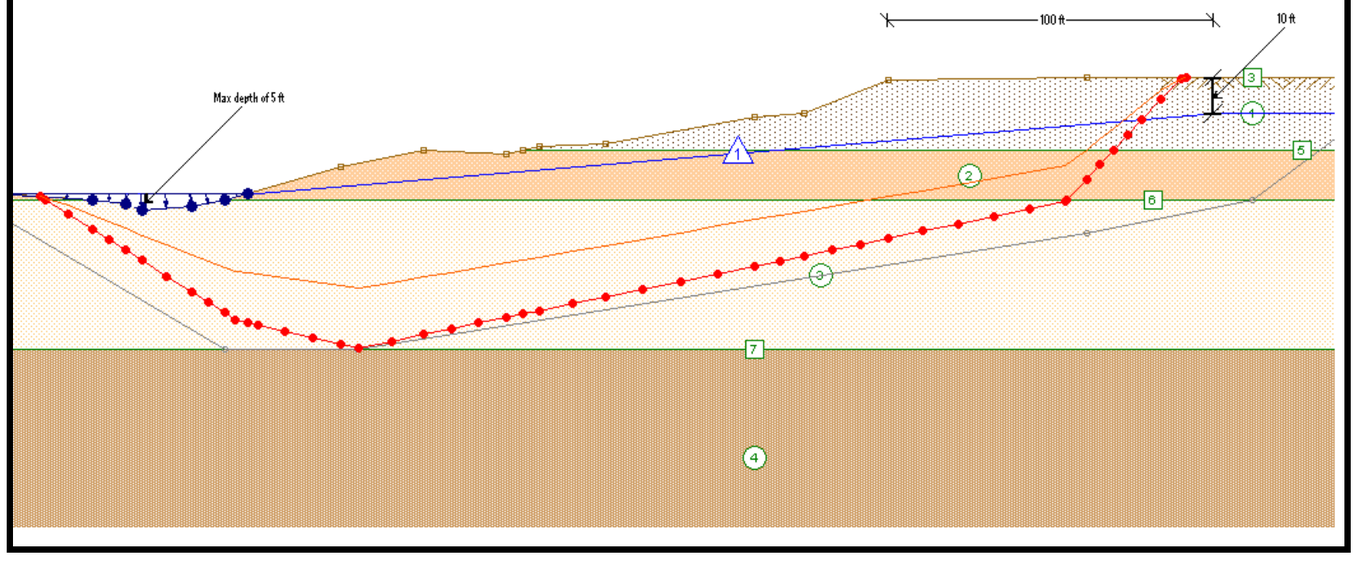
### Soil Stratigraphy for Fargo-Moorhead




### Groundwater / River Level

* Maximum river depth to equal 5 ft

* Groundwater Table is located 10 ft below ground surface at a 100 feet beyond the second river bank. (Picture below)



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# Fargo-Moorhead Metro Feasibility Study

## Assumptions used in GeoStudio Cross-sections for Preliminary Analysis

| | | Drained | | Undrained | |
|---|---|---|---|---|---|
| | | Ultimate Strengths | | Total Stress | |
| **Material** | **Unit Weight [pcf]** | **Friction Angle [Deg] ϕ'** | **Cohesion [psf] c'** | **Friction Angle [Deg] ϕ** | **Cohesion [Psf] c** |
| Alluvium / Fluvial | 121 | 26 | 0 | 0 | 1150 |
| Sherack | 121 | 26 | 0 | 0 | 1150 |
| PL Sherack | 113 | 19 | 0 | 0 | 1150 |
| Poplar River | 121 | 29 | 0 | 0 | 1700 |
| Brenna | 103 | 13 | 0 | 0 | 650 |
| Argusville | 105 | 16 | 0 | 0 | 850 |
| Sand | 128 | 30 | 0 | 30 | 0 |
| Sand Delta | 128 | 25 | 0 | 25 | 0 |
| Till | 122 | 31 | 0 | 0 | 1900 |
| Levee Fill | 121 | 26 | 0 | 0 | 1150 |
| Sand Drain | 128 | 30 | 0 | 30 | 0 |
| Fill (Spoil Area) | 121 | 26 | 0 | 0 | 1150 |
| Riprap | 120 | 32 | 0 | 32 | 0 |

# Fargo-Moorhead Metro Feasibility Study

**Assumptions used in GeoStudio Cross-sections for Preliminary Analysis**

| Settlement Paramenters, Taken from Fundamentals of Geotechnical Engineering (Second Edition), Braja M. Das | | | | | | |
|---|---|---|---|---|---|---|
| | Modulus of Elasticity, $E_s$ [$MN/m^2$] | | Modulus of Elasticity, $E_s$ [$lb/ft^2$] | | Poisson's Ratio, $\mu_s$ | |
| **Type of Soil** | **High** | **Low** | **High** | **Low** | **High** | **Low** |
| Loose Sand | 10 | 25 | 2.09E+05 | 5.22E+05 | 0.2 | 0.4 |
| Medium Dense Sand | 15 | 30 | 3.13E+05 | 6.27E+05 | 0.25 | 0.4 |
| Dense Sand | 35 | 55 | 7.31E+05 | 1.15E+06 | 0.3 | 0.45 |
| Silty Sand | 10 | 20 | 2.09E+05 | 4.18E+05 | 0.2 | 0.4 |
| Sand and Gravel | 70 | 170 | 1.46E+06 | 3.55E+06 | 0.15 | 0.35 |
| Soft Clay | 4 | 20 | 8.35E+04 | 4.18E+05 | | |
| Medium Clay | 20 | 40 | 4.18E+05 | 8.35E+05 | 0.2 | 0.5 |
| Stiff Clay | 40 | 100 | 8.35E+05 | 2.09E+06 | | |

**Typical Elastic Moduli taken from EM-1110-1-1904, Appendix D**

| | Modulus of Elasticity, Es [tsf] | | Modulus of Elasticity, Es [psf] | |
|---|---|---|---|---|
| **Soil** | **Low** | **High** | **Low** | **High** |
| Very Soft Clay | 5 | 50 | 1.00E+04 | 1.00E+05 |
| Soft Clay | 50 | 200 | 1.00E+05 | 4.00E+05 |
| Medium Clay | 200 | 500 | 4.00E+05 | 1.00E+06 |
| Stiff Clay, Silty Clay | 500 | 1000 | 1.00E+06 | 2.00E+06 |
| Sandy Clay | 250 | 2000 | 5.00E+05 | 4.00E+06 |
| Clay Shale | 1000 | 2000 | 2.00E+06 | 4.00E+06 |
| Loose Sand | 100 | 250 | 2.00E+05 | 5.00E+05 |
| Dense Sand | 250 | 1000 | 5.00E+05 | 2.00E+06 |
| Dense Sand and Gravel | 1000 | 2000 | 2.00E+06 | 4.00E+06 |
| Silty Sand | 250 | 2000 | 5.00E+05 | 4.00E+06 |

# Fargo-Moorhead Metro Feasibility Study

## Preliminary Setback Distances for Earthen Levees: Houston's 0.1-percent annual chance event (100-year) level plus 4 feet

Computed By: Luke Schmidt  Revised By:
Date:  Date:

**Preliminary Setback Distances for Earthen Levees: Houston's 0.1-percent annual chance event (100-year) level plus 4 feet**

- Measured from center of river channel to center of the levee
- Required Factor of Safety of 1.4 (EM 1110-2-1913)

**Top Elevations for Earthen Leeves**

- The elevations were taken from the City of Fargo Flood Insurance Study
  (North Side Flood Control Evaluation Fargo, ND and Moorhead, MN) [Project No. 5031-2]
- Levee elevations based off the 100 yr flood plus 4 feet protection.
- Prepared by: Houston Engineering, Inc.
- Prepared on: April 30, 2008

**Levee Embankment Geometry**

- Earthen leeve section assumed to have a top width of 10 feet and a side slope of 1:3 (Vert:Horz).

**Stratigraphy**

- Stratigraphy was assumed and generalized based on the findings of the Fargo Ridgewood/VA Hospital S205 Feasibility Report

**Slope Stability Analysis**

- Analyzed using GeoStudio (Slope/W)
- Entry/Exit Slip Surface with Optimization
- Two slip surfaces were analyzed:

(1) Front toe of the leeve
(2) At or beyond the back toe of the leeve

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# Fargo-Moorhead Metro Feasibility Study

**Preliminary Setback Distances for Earthen Levees: Houston's 0.1-percent annual chance event (100-year) level plus 4 feet**

**Fargo, North Dakota**

| Cross-Section | HEC Ras | Level of Protection [ft] | Levee Height [ft] | Setback Distance [ft] | Fully-Specified FS | Front Toe FS | Back Toe FS | Notes |
|---|---|---|---|---|---|---|---|---|
| FAR-01 | (1/3) from 316 to 315 | 899 | 3 | 520 | 1.401 | 1.43 | 1.45 | - |
| FAR-02 | (1/2) from 321 to 320 | 899 | 0 | 555 | 1.417 | 1.402 | - | Top of secondary bank exceeds leeve height |
| FAR-03 | 326/325/324/322 | 900 | 9 | 480 | | 1.403 | 1.575 | - |
| FAR-04 | 327 | 900 | 3 | 495 | | 1.393 | 1.455 | - |
| FAR-05 | (2/3) from 334 to 333 | 901 | 1 | 510 | 1.406 | 1.418 | 1.457 | - |
| FAR-06 | (2/3) from 339 to 338 | 901 | 11 | 380 | | 1.417 | 1.588 | - |
| FAR-07 | 339 | 901 | 11 | 345 | 1.403 | 1.458 | 1.401 | Levee constructed on secondary bank side slope |
| FAR-08 | 351 | 903 | 3 | 410 | | 1.405 | 1.458 | - |
| FAR-09 | 355 | 904 | 5 | 435 | | 1.395 | 1.521 | - |
| FAR-10 | 359 | 904 | 1 | 460 | | 1.391 | 1.437 | Top of secondary bank exceeds leeve height |
| FAR-11 | (1/3) from 361 to 360 | 905 | 11 | 370 | | 1.402 | 1.586 | - |
| FAR-12 | 391 | 907 | 3 | 475 | | 1.403 | 1.451 | - |
| FAR-13 | (7/8) from 406 to 405 | 908 | 11 | 340 | | 1.547 | 1.393 | Levee constructed on secondary bank side slope |
| FAR-14 | (1/2) 408 to 407 | 909 | 4 | 365 | | 1.51 | 1.393 | Levee constructed on secondary bank side slope |
| FAR-15 | 414 | 909 | 5 | 410 | | 1.399 | 1.435 | - |
| FAR-16 | (1/3) from 415 to 414 | 910 | 5 | 360 | | 1.415 | 1.398 | - |
| FAR-17 | (2/3) from 461.3 to 460.72 | N/D | N/D | N/D | N/D | N/D | N/D | - |
| FAR-18 | (1/3) from 462.03 to 461.3 | N/D | N/D | N/D | N/D | N/D | N/D | - |
| FAR-19 | 462.7 | N/D | N/D | N/D | N/D | N/D | N/D | - |
| FAR-20 | (1/5) from 465.1 to 464.6 | N/D | N/D | N/D | N/D | N/D | N/D | - |

**Moorhead, Minnesota**

| Cross-Section | HEC Ras | Level of Protection [ft] | Levee Height [ft] | Setback Distance [ft] | Fully-Specified FS | Front Toe FS | Back Toe FS | Notes |
|---|---|---|---|---|---|---|---|---|
| MOOR-01 | (1/3) from 330 to 329 | 900 | 4 | 470 | | 1.406 | 1.5 | - |
| MOOR-02 | 332 | 901 | 11 | 435 | 1.41 | 1.426 | 1.695 | No River Profile |
| MOOR-03 | (3/5) from 337 to 336 | 901 | 3 | 435 | 1.394 | 1.426 | 1.46 | No River Profile |
| MOOR-04 | (1/4) from 340 to 339 | 902 | 6 | 445 | | 1.403 | 1.546 | - |
| MOOR-05 | (1/2) from 343 to 342 | 902 | 4 | 495 | | 1.403 | 1.482 | - |
| MOOR-06 | (2/5) from 345 to 344 | 903 | 1 | 400 | | 1.498 | 1.407 | Levee constructed on secondary bank side slope |
| MOOR-07 | (1/5) from 345 to 344 | 903 | 0 | 480 | | 1.399 | - | Top of secondary bank exceeds leeve height |
| MOOR-08 | (2/3) from 354 to 353 | 903 | 0 | 455 | | 1.393 | - | Top of secondary bank exceeds leeve height |
| MOOR-09 | (1/6) from 354 to 353 | 904 | 3 | 435 | | 1.399 | 1.464 | - |
| MOOR-10 | 356 | 904 | 0 | 460 | | 1.403 | - | Top of secondary bank exceeds leeve height |
| MOOR-11 | (1/2) from 371 to 370 | 905 | 0 | 470 | | 1.4 | - | Top of secondary bank equals leeve height |
| MOOR-12 | (1/4) from 387 to 386 | 906 | 1 | 415 | | 1.389 | 1.441 | - |
| MOOR-13 | (1/3) from 391 to 390 | 906 | 1 | 380 | | 1.408 | 1.394 | - |
| MOOR-14 | (1/2) from 393/394 to 392 | 907 | 2 | 405 | | 1.412 | 1.452 | - |
| MOOR-15 | 395 | 907 | 8 | 320 | | 1.411 | 1.437 | Levee constructed on secondary bank side slope |
| MOOR-16 | (1/2) from 405 to 404 | 908 | 4 | 385 | | 1.393 | 1.416 | - |
| MOOR-17 | (1/3) from 407 to 406 | 908 | 3 | 430 | | 1.408 | 1.422 | - |
| MOOR-18 | 414 | 909 | 0 | 500 | | 1.395 | - | Top of secondary bank equals leeve height |
| MOOR-19 | (1/2) from 415 to 414/413 | 910 | 6 | 385 | | 1.404 | 1.415 | - |
| MOOR-20 | (1/2) from 460.72 to 460.28 | 910 | 6 | 425 | | 1.4 | 1.5 | - |

# Fargo-Moorhead Metro Feasibility Study

## Preliminary Setback Distances for Earthen Levees: MVP's 0.5-percent annual chance event (200-year) level plus superiority

Computed By: Luke Schmidt  Revised By:
Date:  Date:

**Preliminary Setback Distances for Earthen Levees: MVP's 0.5-percent annual chance event (200-year) level plus superiority**

- Measured from center of river channel to center of the levee
- Required Factor of Safety of 1.4 (EM 1110-2-1913)

*** Only the Fargo Sections were analyzed with the MVP's 0.5-percent annual chance event profile as the required levee heights were similar to the Houston 0.1-percent annual chance event plus 4 feet profile.

**Top Elevations for Earthen Leeves**

- The elevations were determined by USACE based on a risk and uncertainty analysis
- Level of Protection provided to be determined based on R&U analysis
- Elevations in NAVD 1988

**Levee Embankment Geometry**

- Earthen leeve section assumed to have a top width of 10 feet and a side slope of 1:3 (Vert:Horz).

**Stratigraphy**

- Stratigraphy was assumed and generalized based on the findings of the Fargo Ridgewood/VA Hospital S205 Feasibility Report

**Slope Stability Analysis**

- Analyzed using GeoStudio (Slope/W)
- Entry/Exit Slip Surface with Optimization
- Two slip surfaces were analyzed:
  (1) Front toe of the leeve
  (2) At or beyond the back toe of the leeve

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# Fargo-Moorhead Metro Feasibility Study

**Preliminary Setback Distances for Earthen Levees: MVP's 0.5-percent annual chance event (200-year) level plus superiority**

**Fargo, North Dakota**

| | | | | | | Drained Strength | | | Undrained Stregths | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cross-Section | HEC Ras Section | HEC Ras TOL | Level of Protection [ft] | Levee Height [ft] | Setback Distance [ft] | Fully-Specified FS | Front Toe FS | Back Toe FS | Front Toe FS | Back Toe FS | Notes | Δ Levee Setback from Houston 0.1% annual chance [ft] | Δ Levee Elevation from Houston 0.1% annual chance [ft] |
| FAR-01 | (1/3) from 316 to 315 | 895.5 | 897 | 1 | 520 | 1.409 | 1.4 | 1.46 | N/D | N/D | - | 0 | 1.5 |
| FAR-02 | (1/2) from 321 to 320 | 897.1 | 897 | 0 | 555 | 1.417 | 1.402 | - | N/D | N/D | Top of Secondary Bank exceeds top of leeve elevation | 0 | *-0.1* |
| FAR-03 | 326/325/324/322 | 897.4 | 897 | - | 545 | N/D | N/D | N/D | N/D | N/D | Top of Secondary Bank exceeds top of leeve elevation | 65 | *-0.4* |
| FAR-04 | 327 | 897.7 | 898 | 1 | 495 | N/D | 1.406 | 1.442 | N/D | N/D | - | 0 | 0.3 |
| FAR-05 | (2/3) from 334 to 333 | 899 | 899 | - | 290 | N/D | N/D | N/D | N/D | N/D | Top of Secondary Bank exceeds top of leeve elevation | -220 | 0 |
| FAR-06 | (2/3) from 339 to 338 | 899.8 | 900 | 10 | 380 | N/D | 1.41 | 1.598 | N/D | N/D | - | 0 | 0.2 |
| FAR-07 | 339 | 899.9 | 900 | 8 | 335 | 1.403 | 1.438 | 1.401 | N/D | N/D | Levee on hill side of secondary bank | -10 | 0.1 |
| FAR-08 | 351 | 901.8 | 902 | 2 | 405 | N/D | 1.403 | 1.444 | N/D | N/D | - | -5 | 0.2 |
| FAR-09 | 355 | 902.9 | 903 | 4 | 435 | N/D | 1.4 | 1.445 | N/D | N/D | - | 0 | 0.1 |
| FAR-10 | 359 | 903.5 | 904 | 1 | 460 | N/D | 1.391 | 1.437 | N/D | N/D | - | 0 | 0.5 |
| FAR-11 | (1/3) from 361 to 360 | 903.6 | 904 | | 370 | N/D | N/D | N/D | N/D | N/D | | 0 | 0.4 |
| FAR-12 | 391 | 906.6 | 907 | | 475 | N/D | N/D | N/D | N/D | N/D | | 0 | 0.4 |
| FAR-13 | (7/8) from 406 to 405 | 908.2 | 908 | | 340 | N/D | N/D | N/D | N/D | N/D | | 0 | *-0.2* |
| FAR-14 | (1/2) 408 to 407 | 908.6 | 909 | | 365 | N/D | N/D | N/D | N/D | N/D | | 0 | 0.4 |
| FAR-15 | 414 | 909.2 | 909 | | 410 | N/D | N/D | N/D | N/D | N/D | | 0 | *-0.2* |
| FAR-16 | (1/3) from 415 to 414 | 909.5 | 909 | | 360 | N/D | N/D | N/D | N/D | N/D | | 0 | *-0.5* |
| FAR-17 | (2/3) from 461.3 to 460.72 | 910.8 | 911 | 8 | 365 | N/D | 1.407 | 1.427 | 1.398 | 1.289 | Slide along Brenna and Argusville Contact | #VALUE! | 0.2 |
| FAR-18 | (1/3) from 462.03 to 461.3 | 911.5 | 912 | 6 | 435 | N/D | 1.401 | 1.561 | 1.209 | 1.21 | Slide along Brenna and Argusville Contact | #VALUE! | 0.5 |
| FAR-19 | 462.7 | 912.1 | 912 | 6 | 485 | N/D | 1.404 | 1.543 | 1.198 | 1.209 | Slide along Brenna and Argusville Contact | #VALUE! | *-0.1* |
| FAR-20 | (1/5) from 465.1 to 464.6 | 913.1 | 913 | 8 | 435 | N/D | 1.393 | 1.528 | 1.159 | 1.195 | Slide along Brenna and Argusville Contact | #VALUE! | *-0.1* |

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# Fargo-Moorhead Metro Feasibility Study

**Preliminary Setback Distances for Earthen Levees: MVP's 0.5-percent annual chance event (200-year) level plus superiority**

**Moorhead, Minnesota**

| | | | | | | Drained Strength | | | Undrained Stregths | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cross-Section | HEC Ras | HEC Ras TOL | Level of Protection [ft] | Levee Height [ft] | Setback Distance [ft] | Fully-Specified FS | Front Toe FS | Back Toe FS | Front Toe FS | Back Toe FS | Notes | Δ Levee Elevation from Houston 0.1% annual chance [ft] |
| MOOR-01 | (1/3) from 330 to 329 | 898.4 | 898 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | -0.4 |
| MOOR-02 | 332 | 898.8 | 899 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.2 |
| MOOR-03 | (3/5) from 337 to 336 | 899.5 | 899 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | -0.5 |
| MOOR-04 | (1/4) from 340 to 339 | 900.1 | 900 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | -0.1 |
| MOOR-05 | (1/2) from 343 to 342 | 900.9 | 901 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.1 |
| MOOR-06 | (2/5) from 345 to 344 | 901.5 | 902 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.5 |
| MOOR-07 | (1/5) from 345 to 344 | 901.6 | 902 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.4 |
| MOOR-08 | (2/3) from 354 to 353 | 902.5 | 903 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.5 |
| MOOR-09 | (1/6) from 354 to 353 | 902.7 | 903 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.3 |
| MOOR-10 | 356 | 903.3 | 904 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.7 |
| MOOR-11 | (1/2) from 371 to 370 | 904.8 | 905 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.2 |
| MOOR-12 | (1/4) from 387 to 386 | 905.6 | 906 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.4 |
| MOOR-13 | (1/3) from 391 to 390 | 906.5 | 907 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.5 |
| MOOR-14 | (1/2) from 393/394 to 392 | 906.9 | 907 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | 0.1 |
| MOOR-15 | 395 | 907.3 | 907 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | -0.3 |
| MOOR-16 | (1/2) from 405 to 404 | 908.1 | 908 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | -0.1 |
| MOOR-17 | (1/3) from 407 to 406 | 908.4 | 908 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | -0.4 |
| MOOR-18 | 414 | 909.2 | 909 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | -0.2 |
| MOOR-19 | (1/2) from 415 to 414/413 | 909.4 | 909 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | -0.4 |
| MOOR-20 | (1/2) from 460.72 to 460.28 | | 910 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | |

# Fargo-Moorhead Metro Feasibility Study

**Preliminary Setback Distances for Earthen Levees: MVP's 0.2-percent annual chance event (500-year) level plus superiority**

Computed By: Luke Schmidt
Date:

Revised By:
Date:

**Preliminary Setback Distances for Earthen Levees: MVP's 0.2-percent annual chance event (500-year) level plus superiority**

- Measured from center of river channel to center of the levee
- Required Factor of Safety of 1.4 (EM 1110-2-1913)

**Top Elevations for Earthen Leeves**

- The elevations were determined by USACE based on a risk and uncertainty analysis
- Level of Protection proveded to be determined based on R&U analysis
- Elevations in NAVD 1988

**Levee Embankment Geometry**

- Earthen leeve section assumed to have a top width of 10 feet and a side slope of 1:3 (Vert:Horz).

**Stratigraphy**

- Stratigraphy was assumed and generalized based on the findings of the Fargo Ridgewood/VA Hospital S205 Feasibility Report

**Slope Stability Analysis**

- Analyzed using GeoStudio (Slope/W)
- Entry/Exit Slip Surface with Optimization
- Two slip surfaces were analyzed:
  (1) Front toe of the leeve
  (2) At or beyond the back toe of the leeve

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# Fargo-Moorhead Metro Feasibility Study

**Preliminary Setback Distances for Earthen Levees: MVP's 0.2-percent annual chance event (500-year) level plus superiority**

**Fargo, North Dakota**

| | | | | | | Drained Strengths | | | Undrained Strengths | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cross-Section | HEC Ras Section | HEC Ras TOL | Height of Leeve [ft] | Setback Distance [ft] | Setback Dist. W/ Low Flow | Fully-Specified FS | Front Toe FS | Back Toe FS | Front Toe FS | Back Toe FS | Notes | Δ Levee Setbacks from 0.5% Annual Chance [ft] | Δ Levee Elevation from 0.5% Annual Chance [ft] |
| FAR-01 | (1/3) from 316 to 315 | 898 | 2 | 520 | N/D | 1.399 | 1.399 | 1.484 | 1.211 | 1.261 | Slide along Brenna and Argusville contact | 0 | 2.6 |
| FAR-02 | (1/2) from 321 to 320 | 899 | - | 555 | N/D | 1.417 | 1.402 | 1.402 | 1.195 | - | Top of secondary bank exceeds levee elevation | 0 | 1.8 |
| FAR-03 | 326/325/324/322 | 899 | 5 | 480 | 460 | N/D | 1.408 | 1.566 | 1.167 | 1.245 | Levee is 45 feet from secondary bank (at elevation 912 ft) | -65 | 1.9 |
| FAR-04 | 327 | 900 | 3 | 490 | N/D | N/D | 1.388 | 1.454 | 1.263 | 1.258 | Slide along Brenna and Argusville contact | -5 | 1.9 |
| FAR-05 | (2/3) from 334 to 333 | 901 | 1 | 510 | N/D | 1.406 | 1.42 | 1.488 | 1.240 | 1.254 | Levee is 1 foot high, slide along Brenna and Argusville contact | 220 | 2 |
| FAR-06 | (2/3) from 339 to 338 | 902 | 12 | 385 | N/D | N/D | 1.413 | 1.410 | 1.464 | 1.443 | Slide goes down to Brenna-Argusville contact | 5 | 2.3 |
| FAR-07 | 339 | 902 | 9 | 355 | N/D | 1.4 | 1.403 | 1.396 | 1.436 | 1.403 | Levee built on slope of secondary bank | 20 | 2.3 |
| FAR-08 | 351 | 905 | 5 | 410 | 360 | N/D | 1.393 | 1.419 | 1.212 | 1.208 | Levee built on top of secondary slope | 5 | 3 |
| FAR-09 | 355 | 906 | 7 | 450 | N/D | N/D | 1.397 | 1.493 | 1.245 | 1.223 | Slide along Brenna and Argusville contact | 15 | 2.9 |
| FAR-10 | 359 | 907 | 4 | 470 | N/D | N/D | 1.391 | 1.477 | 1.189 | 1.199 | Slide along Brenna and Argusville contact | 10 | 3 |
| FAR-11 | (1/3) from 361 to 360 | 907 | 12 | 365 | 350 | N/D | 1.447 | 1.417 | 1.391 | 1.350 | Slide goes thru middle of levee | -5 | 3.1 |
| FAR-12 | 391 | 911 | 7 | 485 | 430 | N/D | 1.399 | 1.418 | 1.192 | 1.216 | Slide along Brenna and Argusville contact | 10 | 3.9 |
| FAR-13 | (7/8) from 406 to 405 | 912 | 7 | 380 | N/D | N/D | 1.437 | 1.394 | 1.322 | 1.322 | Levee built on top of secondary bank | 40 | 3.9 |
| FAR-14 | (1/2) 408 to 407 | 913 | 8 | 410 | N/D | N/D | 1.418 | 1.391 | 1.274 | 1.240 | Levee built on top of secondary bank | 45 | 3.9 |
| FAR-15 | 414 | 913 | 9 | 425 | 370 | N/D | 1.4 | 1.422 | 1.284 | 1.205 | Levee built on top of secondary bank | 15 | 4 |
| FAR-16 | (1/3) from 415 to 414 | 913 | 8 | 400 | N/D | N/D | 1.41 | 1.414 | 1.240 | 1.262 | Levee built on top of secondary bank | 40 | 3.9 |
| FAR-17 | (2/3) from 461.3 to 460.72 | 915 | 12 | 385 | 355 | N/D | 1.392 | 1.403 | 1.241 | 1.230 | Levee built on top of secondary bank | 20 | 4.2 |
| FAR-18 | (1/3) from 462.03 to 461.3 | 916 | 10 | 445 | N/D | N/D | 1.401 | 1.466 | 1.213 | 1.194 | Levee built on top of secondary bank | 10 | 4.5 |
| FAR-19 | 462.7 | 916 | 10 | 500 | 435 | N/D | 1.406 | 1.544 | 1.198 | 1.223 | Slide along Brenna and Argusville contact | 15 | 3.9 |
| FAR-20 | (1/5) from 465.1 to 464.6 | 917 | 11 | 450 | N/D | N/D | 1.421 | 1.617 | 1.173 | 1.195 | Slide along Brenna and Argusville contact | 15 | 3.9 |

St. Paul District GEOLOGY GEOTECHNICAL
US Army Corps of Engineers®

# Fargo-Moorhead Metro Feasibility Study

**Preliminary Setback Distances for Earthen Levees: MVP's 0.2-percent annual chance event (500-year) level plus superiority**

**Moorhead, Minnesota**

| | | | | | | Drained Strengths | | | Undrained Strengths | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cross-Section | HEC Ras | HEC Ras TOL | Levee Height [ft] | Setback Distance [ft] | Setback Dist. W/ Low Flow Elev. [ft] | Fully-Specified FS | Front Toe FS | Back Toe FS | Front Toe FS | Back Toe FS | Notes | Δ Levee Setbacks from 0.5% Annual Chance [ft] | Δ Levee Elevation from 0.5% Annual Chance [ft] |
| MOOR-01 | (1/3) from 330 to 329 | 900 | 4 | 470 | N/D | N/D | 1.403 | 1.482 | 1.28 | 1.335 | Slide along Brenna and Argusville contact | 0 | 1.9 |
| MOOR-02 | 332 | 901 | 11 | 435 | N/D | 1.41 | 1.381 | 1.437 | 1.158 | 1.214 | Slide along Brenna and Argusville contact | 0 | 2.0 |
| MOOR-03 | (3/5) from 337 to 336 | 902 | 4 | 435 | N/D | 1.383 | 1.42 | 1.448 | 1.364 | 1.315 | Slide along Brenna and Argusville contact | 0 | 2.2 |
| MOOR-04 | (1/4) from 340 to 339 | 903 | 7 | 445 | 425 | N/D | 1.395 | 1.438 | 1.291 | 1.295 | Slide along Brenna and Argusville contact | 0 | 2.4 |
| MOOR-05 | (1/2) from 343 to 342 | 904 | 6 | 495 | N/D | N/D | 1.387 | 1.43 | 1.208 | 1.257 | Slide along Brenna and Argusville contact | 0 | 2.9 |
| MOOR-06 | (2/5) from 345 to 344 | 904 | 2 | 415 | N/D | N/D | 1.401 | 1.421 | 1.187 | 1.236 | Slide along Brenna and Argusville contact | 15 | 2.8 |
| MOOR-07 | (1/5) from 345 to 344 | 904 | 1 | 485 | N/D | N/D | 1.409 | 1.443 | 1.339 | 1.292 | Levee only 1 foot high | 5 | 2.7 |
| MOOR-08 | (2/3) from 354 to 353 | 905 | 1 | 465 | N/D | N/D | 1.394 | 1.393 | 1.181 | 1.199 | Levee only 1 foot high | 10 | 2.8 |
| MOOR-09 | (1/6) from 354 to 353 | 906 | 5 | 435 | 400 | N/D | 1.39 | 1.417 | 1.268 | 1.283 | Slide along Brenna and Argusville contact | 0 | 2.8 |
| MOOR-10 | 356 | 906 | 1 | 470 | N/D | N/D | 1.412 | 1.413 | 1.232 | 1.211 | Slide along Brenna and Argusville contact | 10 | 3.0 |
| MOOR-11 | (1/2) from 371 to 370 | 908 | 3 | 485 | N/D | N/D | 1.4 | 1.444 | 1.125 | 1.147 | Slide along Brenna and Argusville contact | 15 | 3.5 |
| MOOR-12 | (1/4) from 387 to 386 | 909 | 4 | 440 | N/D | N/D | 1.405 | 1.42 | 1.255 | 1.241 | Slide along Brenna and Argusville contact | 25 | 3.8 |
| MOOR-13 | (1/3) from 391 to 390 | 910 | 5 | 395 | 355 | N/D | 1.409 | 1.406 | 1.320 | 1.286 | Slide along Brenna and Argusville contact | 15 | 3.9 |
| MOOR-14 | (1/2) from 393/394 to 392 | 911 | 6 | 420 | N/D | N/D | 1.413 | 1.435 | 1.196 | 1.191 | Slide along Brenna and Argusville contact | 15 | 4.0 |
| MOOR-15 | 395 | 911 | 5 | 370 | N/D | N/D | 1.410 | 1.392 | 1.355 | 1.304 | Levee built on secondary bank | 50 | 3.9 |
| MOOR-16 | (1/2) from 405 to 404 | 912 | 7 | 410 | N/D | N/D | 1.408 | 1.426 | 1.213 | 1.212 | Slide along Brenna and Argusville contact | 25 | 3.9 |
| MOOR-17 | (1/3) from 407 to 406 | 912 | 7 | 440 | N/D | N/D | 1.410 | 1.419 | 1.247 | 1.202 | Slide along Brenna and Argusville contact | 10 | 3.9 |
| MOOR-18 | 414 | 913 | 4 | 515 | N/D | N/D | 1.394 | 1.423 | 1.130 | 1.129 | Slide along Brenna and Argusville contact | 15 | 4.0 |
| MOOR-19 | (1/2) from 415 to 414/413 | 913 | 9 | 405 | 360 | N/D | 1.420 | 1.398 | 1.202 | 1.239 | Slide along Brenna and Argusville contact | 20 | 4.0 |
| MOOR-20 | (1/2) from 460.72 to 460.28 | 915 | N/D | N/D | N/D | N/D | N/D | N/D | N/D | N/D | | | |

File Name: FAR_01_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
## Setback Distance for Levee (500 yr)
## Fargo Section 1

Level of Protection: 898 ft

### Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

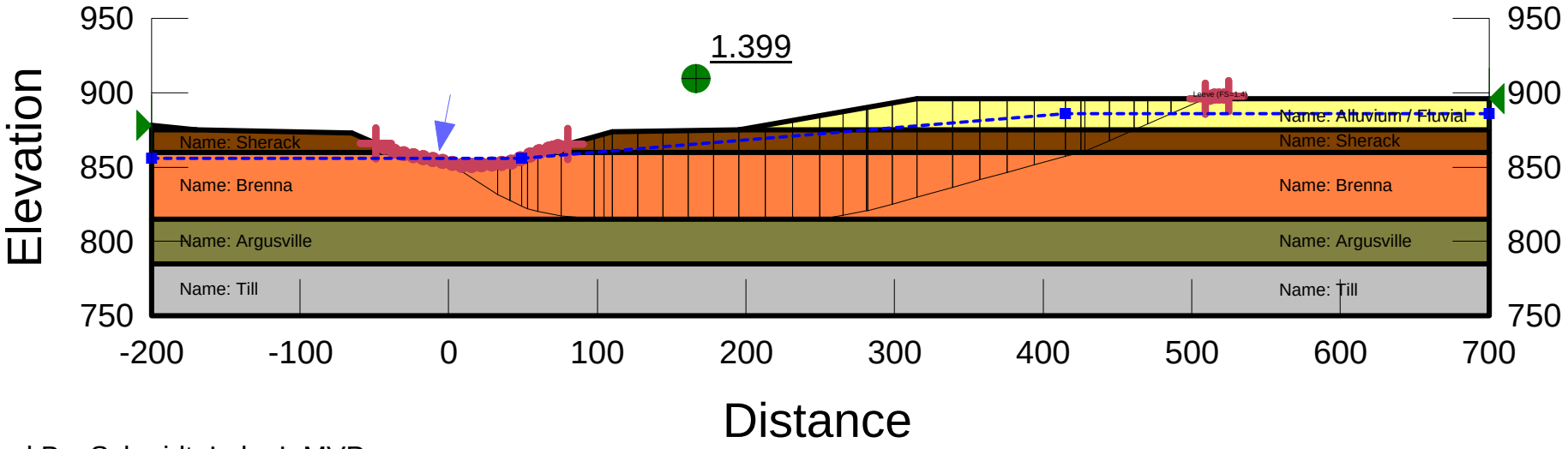
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_02_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 2

Level of Protection: 899 ft

## Soil Properties

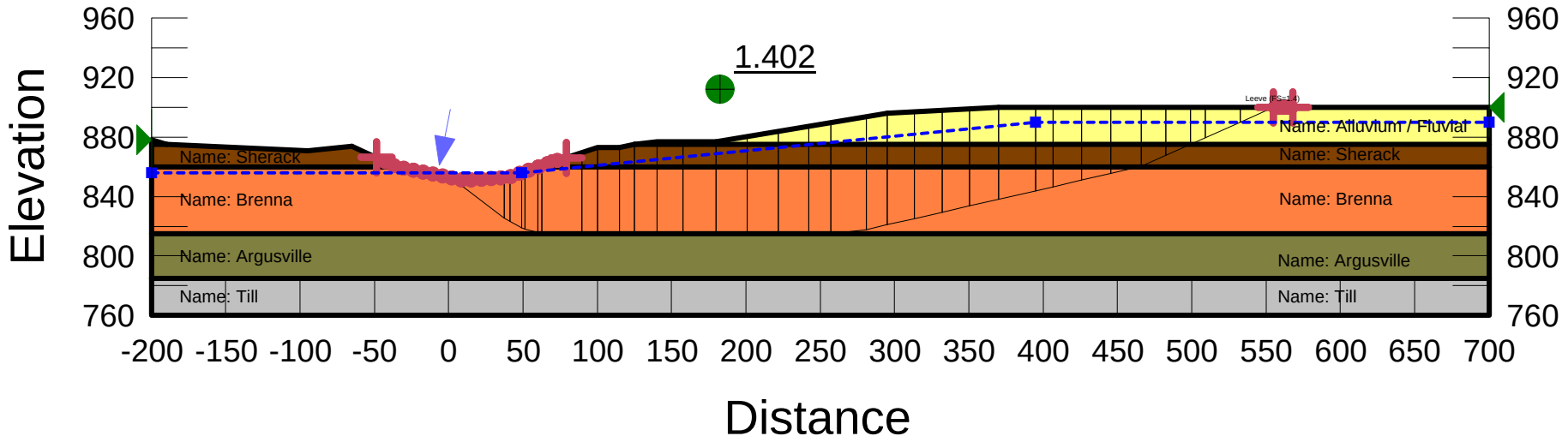
Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

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File Name: FAR_03_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 3

Level of Protection: 899 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

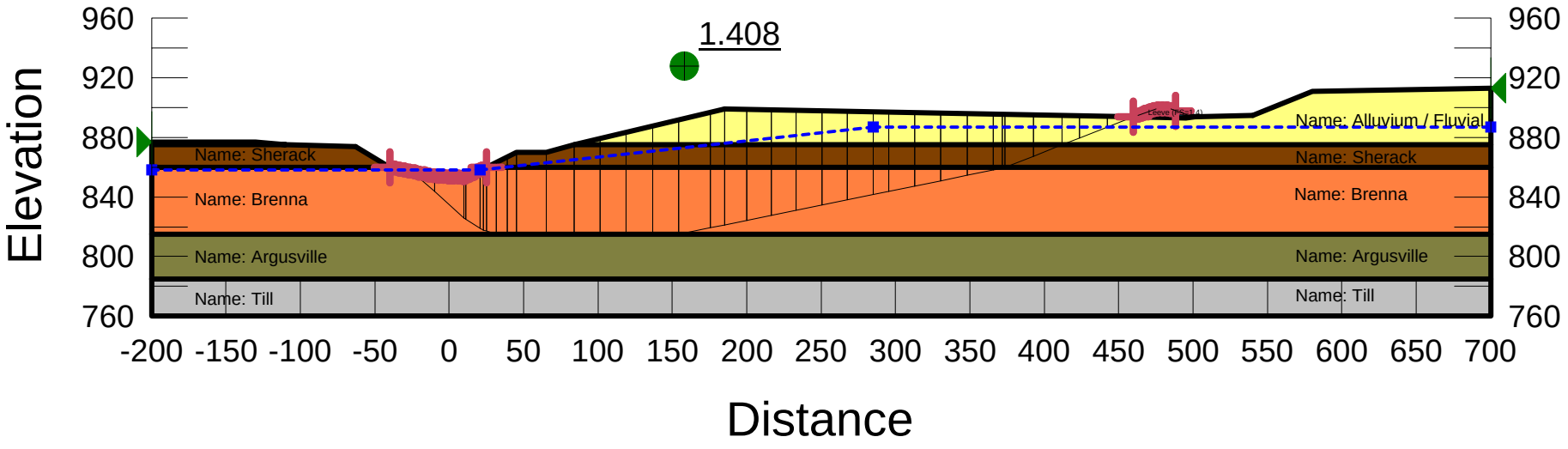
Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_04_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 4

Level of Protection: 900 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

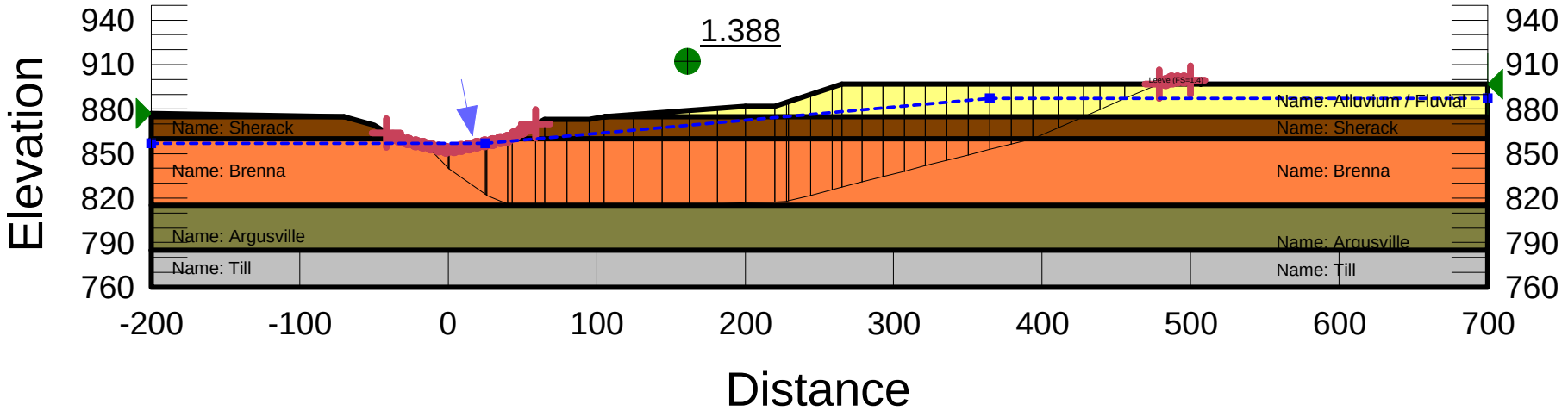
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 5

Level of Protection: 901 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

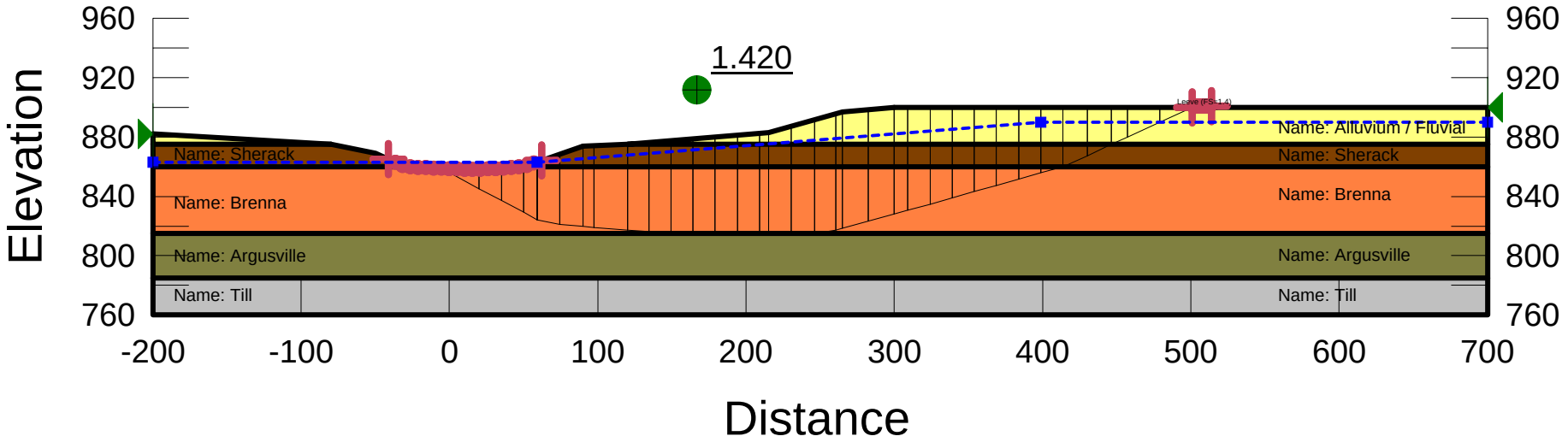
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_06_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 6

Level of Protection: 902 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

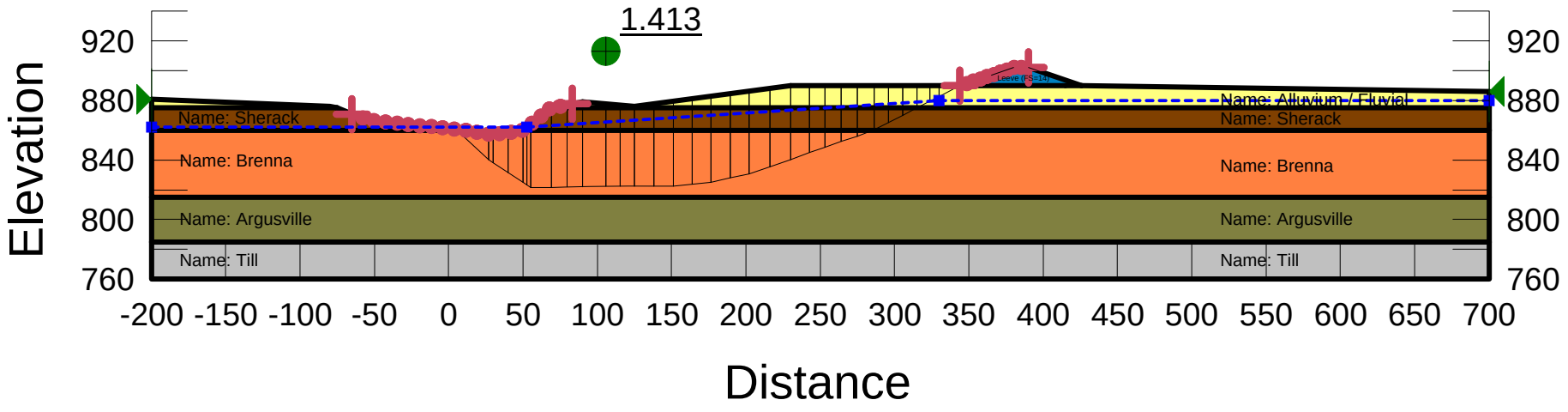
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_07_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 7

Level of Protection: 902 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

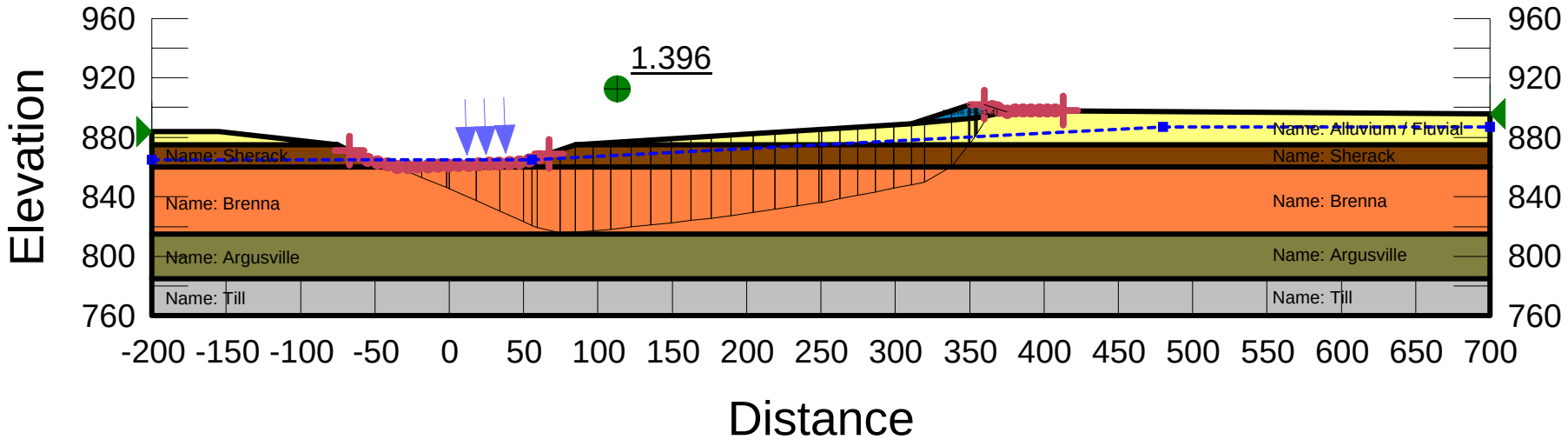
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_08_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 8

Level of Protection: 905 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

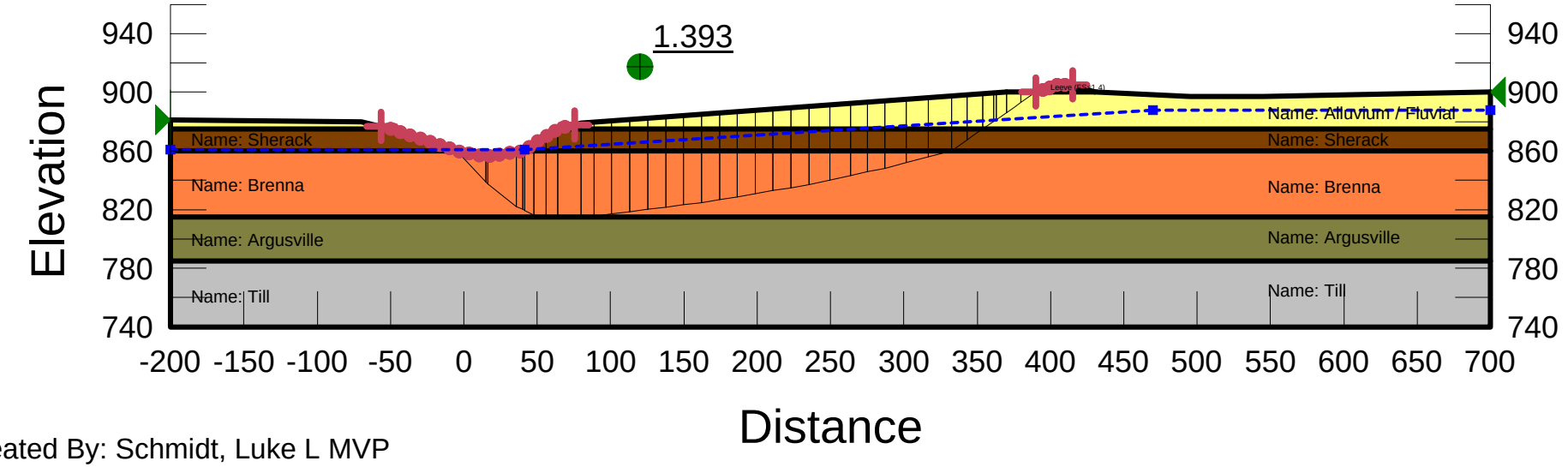
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_09_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
## Setback Distance for Levee (500 yr)
## Fargo Section 9

Level of Protection: 906 ft

### Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

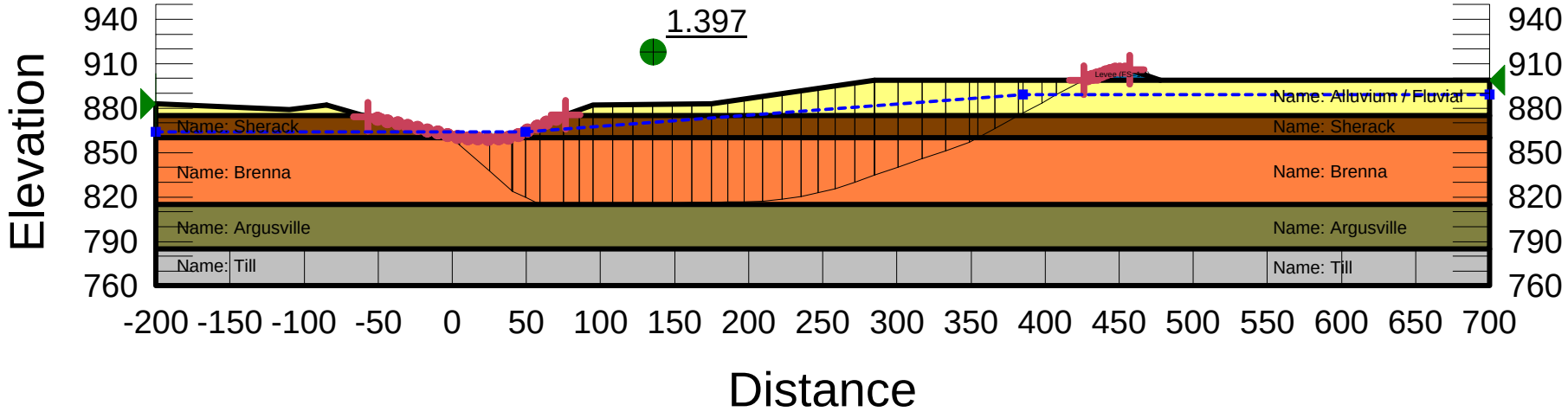
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_10_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
## Setback Distance for Levee (500 yr)
## Fargo Section 10

Level of Protection: 907 ft

### Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

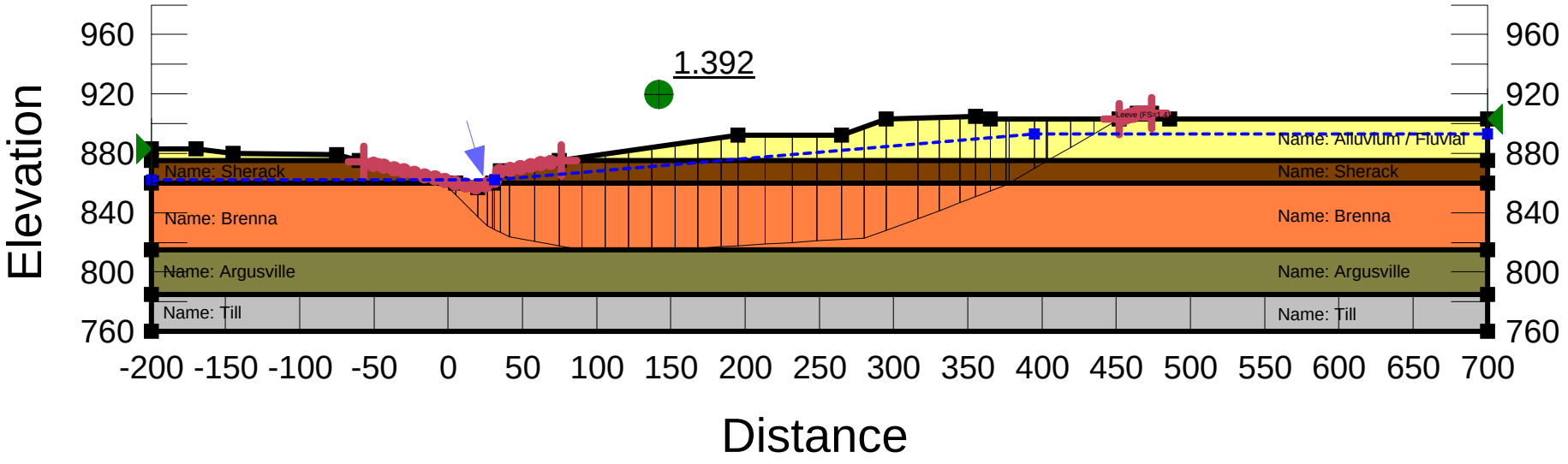
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf

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File Name: FAR_11_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 11

Level of Protection: 907 ft

## Soil Properties

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

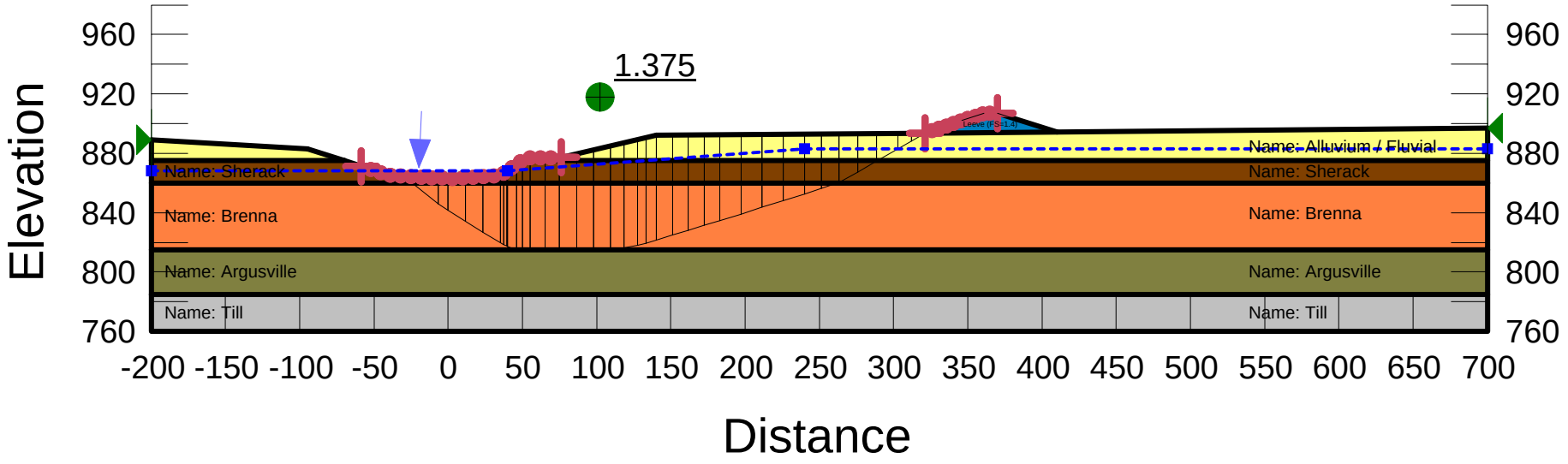
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf

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Date: 9/28/2009

File Name: FAR_12_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
## Setback Distance for Levee (500 yr)
## Fargo Section 12

Level of Protection: 911 ft

### Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

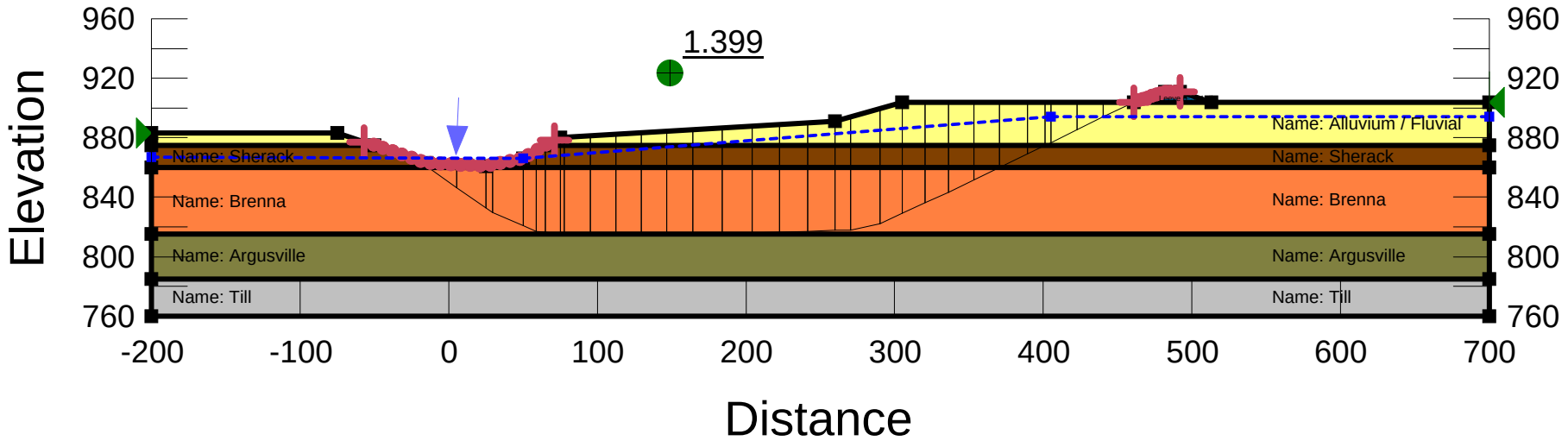
Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Date: 9/22/2009

File Name: FAR_13_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
## Setback Distance for Levee (500 yr)
## Fargo Section 13

Level of Protection: 912 ft

### Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

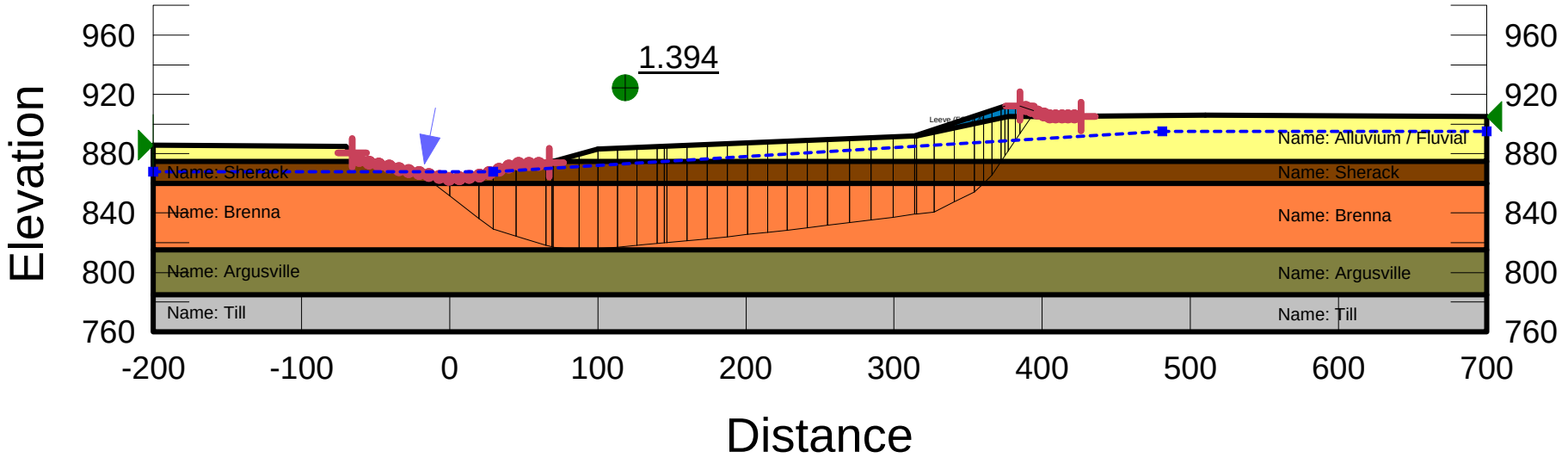
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Date: 9/22/2009

File Name: FAR_14_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 14

Level of Protection: 913 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

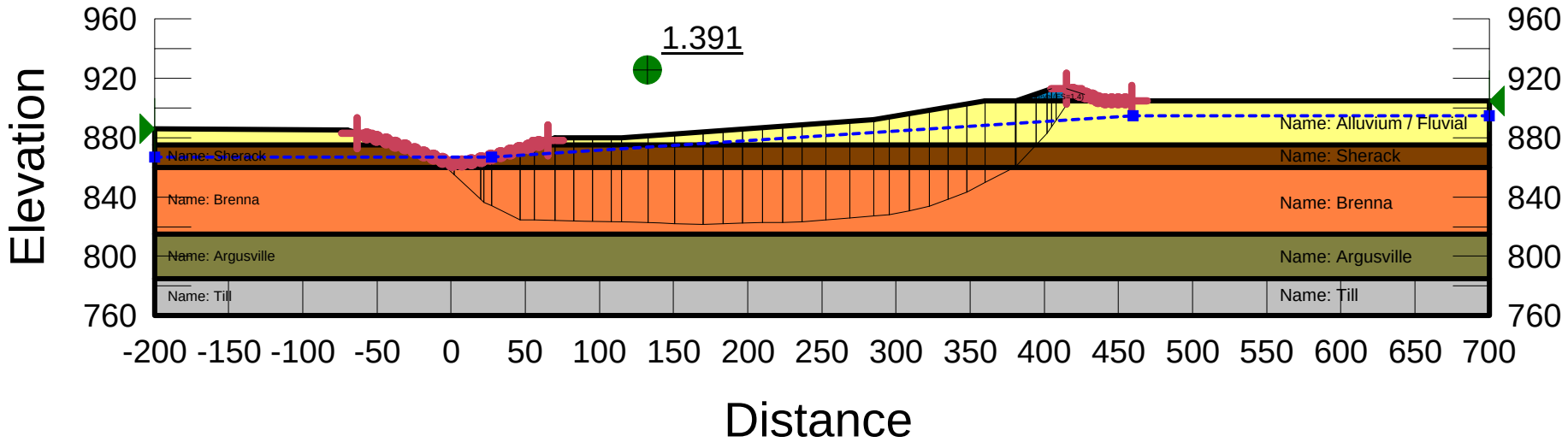
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_15_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 15

Level of Protection: 913 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

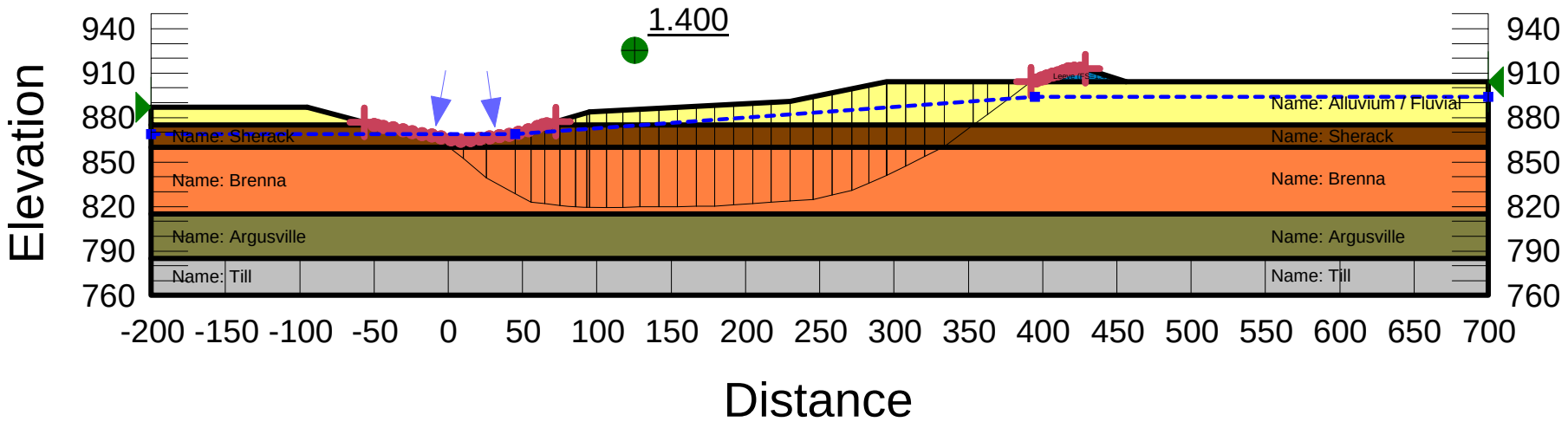
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_16_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 16

Level of Protection: 913 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

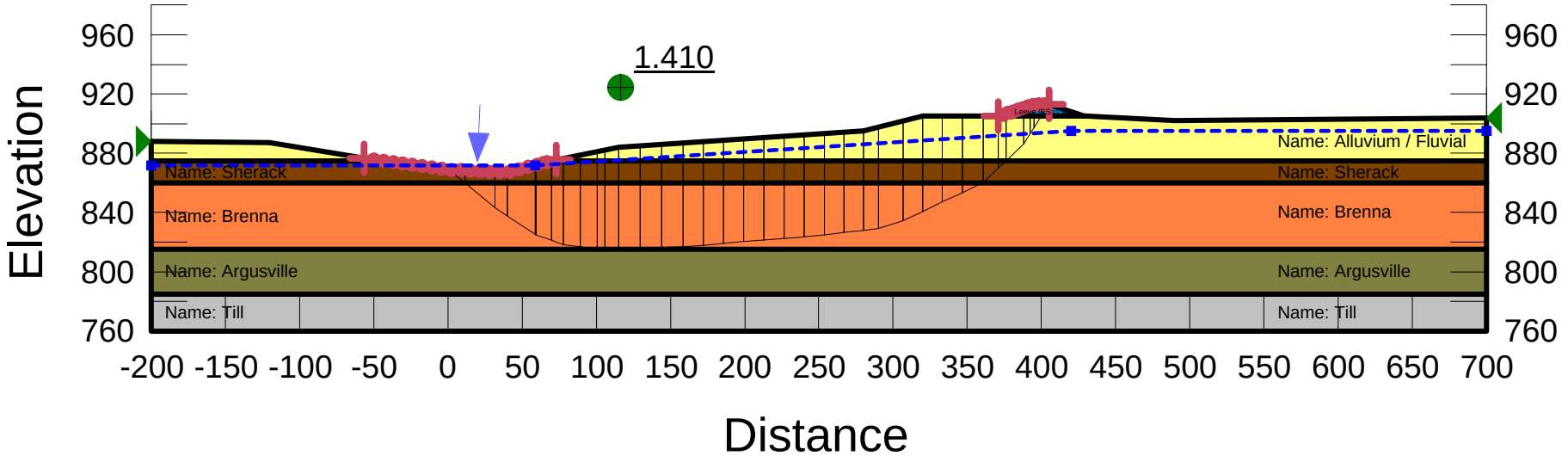
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_17_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 17

Level of Protection: 915 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

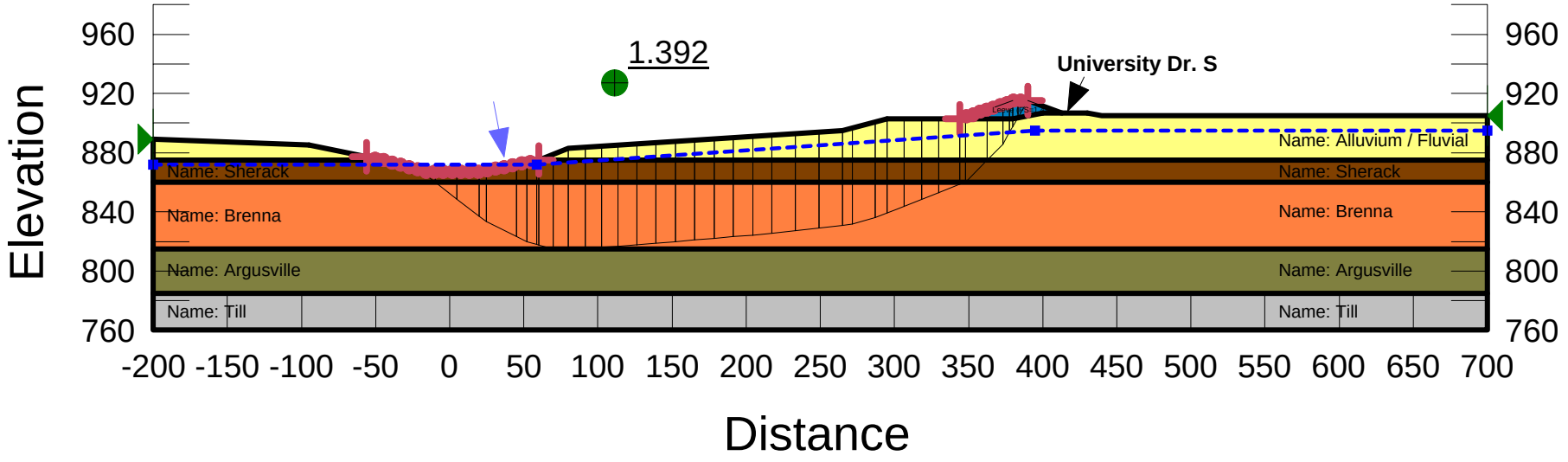
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_18_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 18

Level of Protection: 916 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

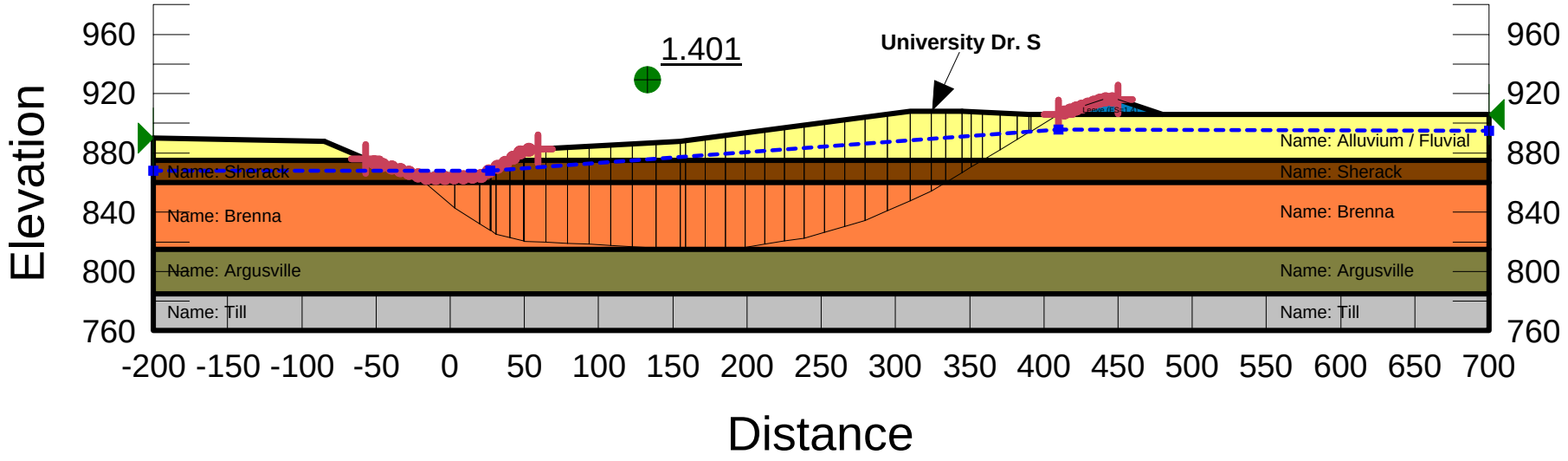
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_19_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 19

Level of Protection: 916 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

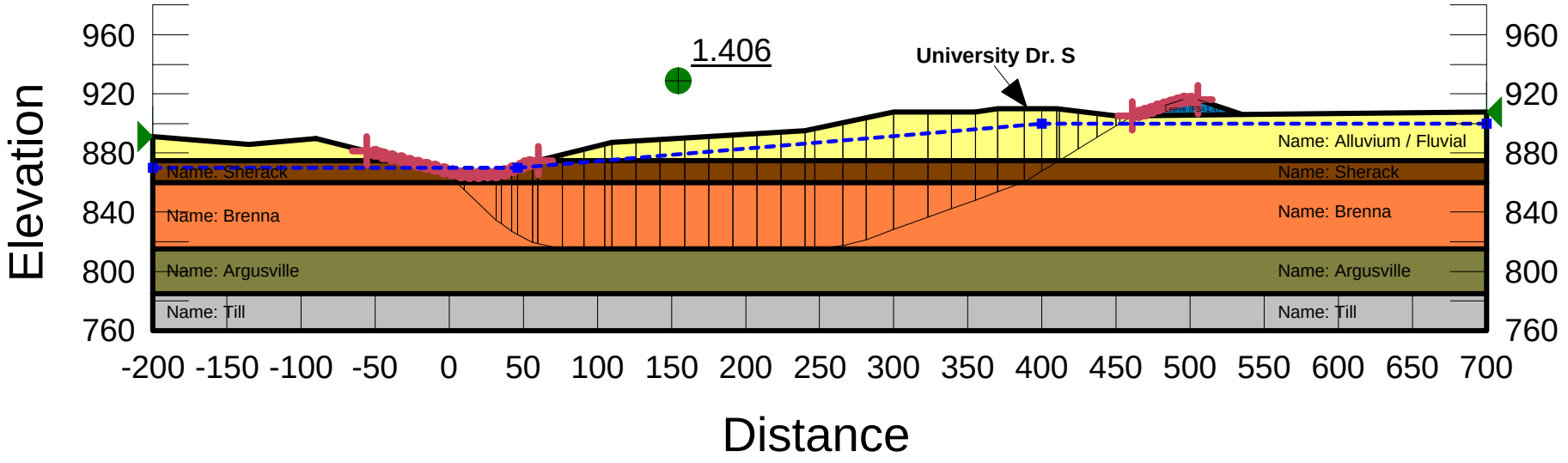
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: FAR_20_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Fargo Section 20

Level of Protection: 917 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

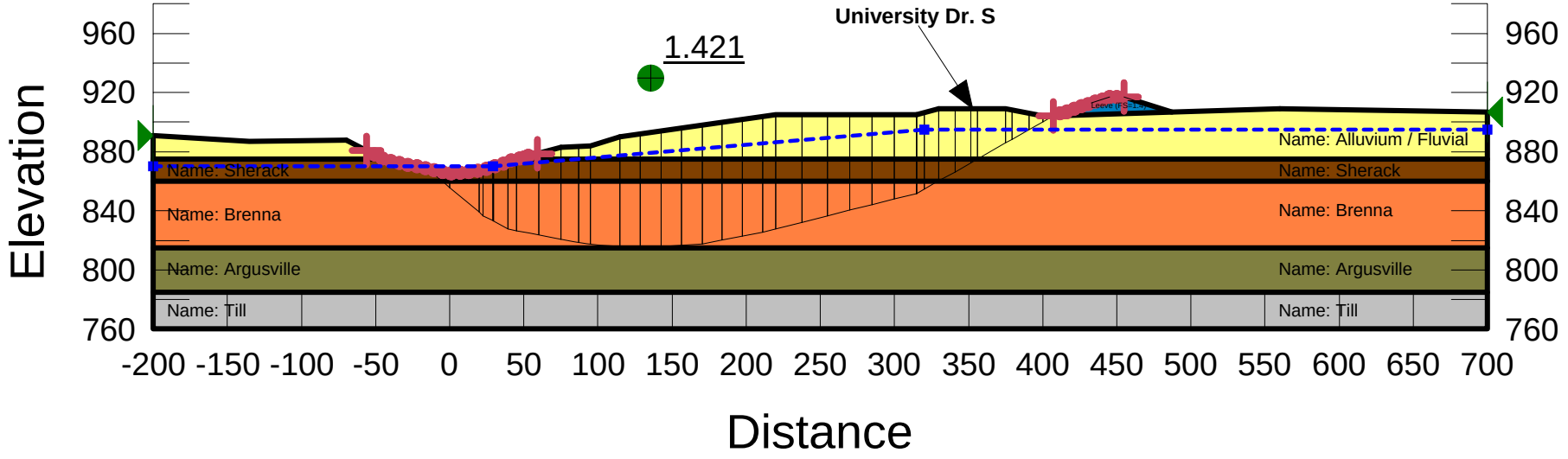
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_01_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 1

Level of Protection: 900 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

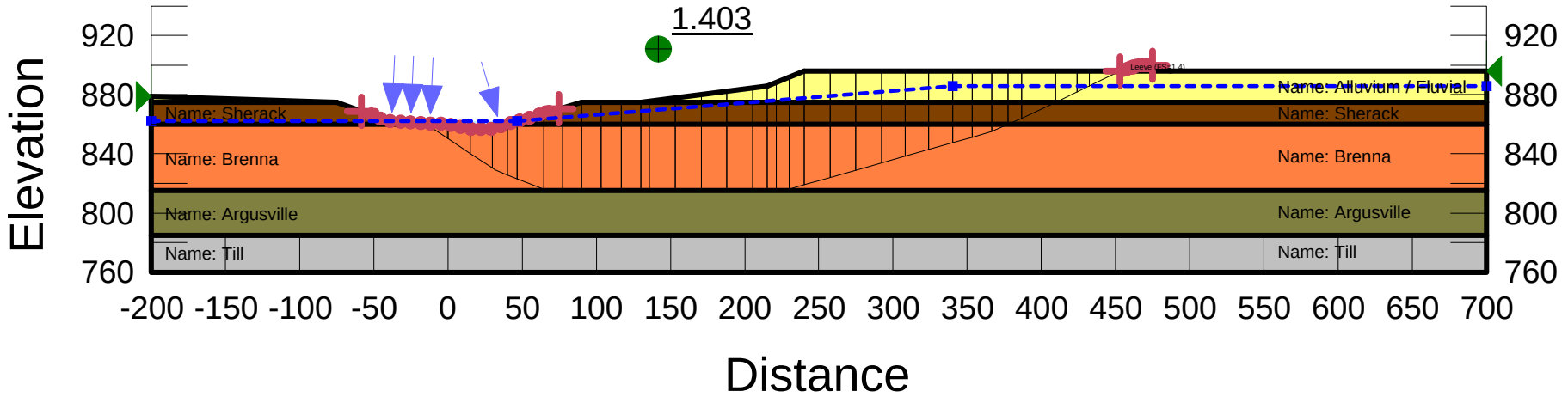
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_02_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 2

Level of Protection: 901 ft

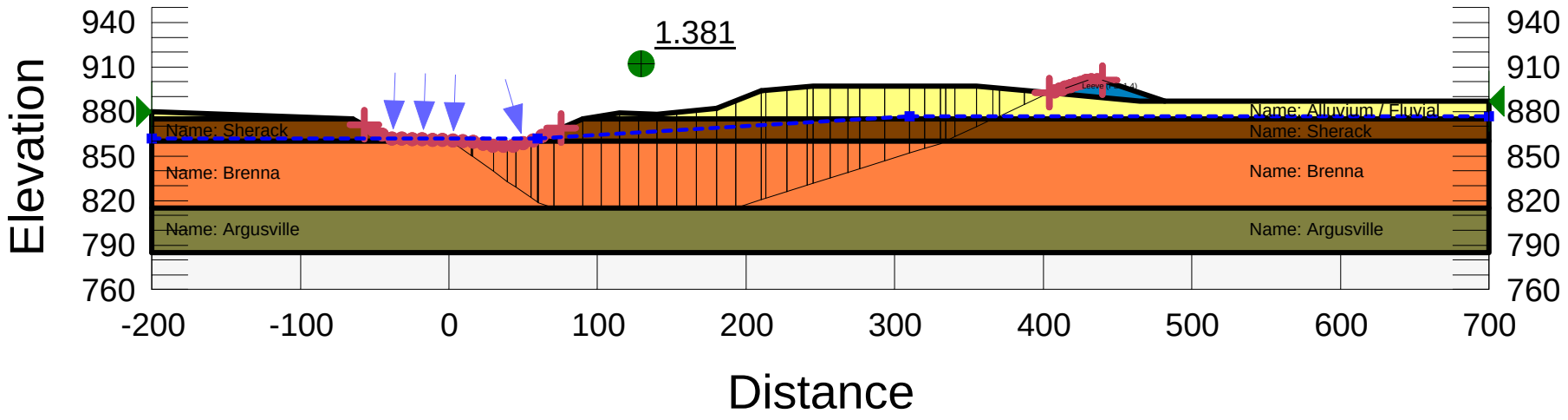
## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

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File Name: MOOR_03_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 3

Level of Protection: 902 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

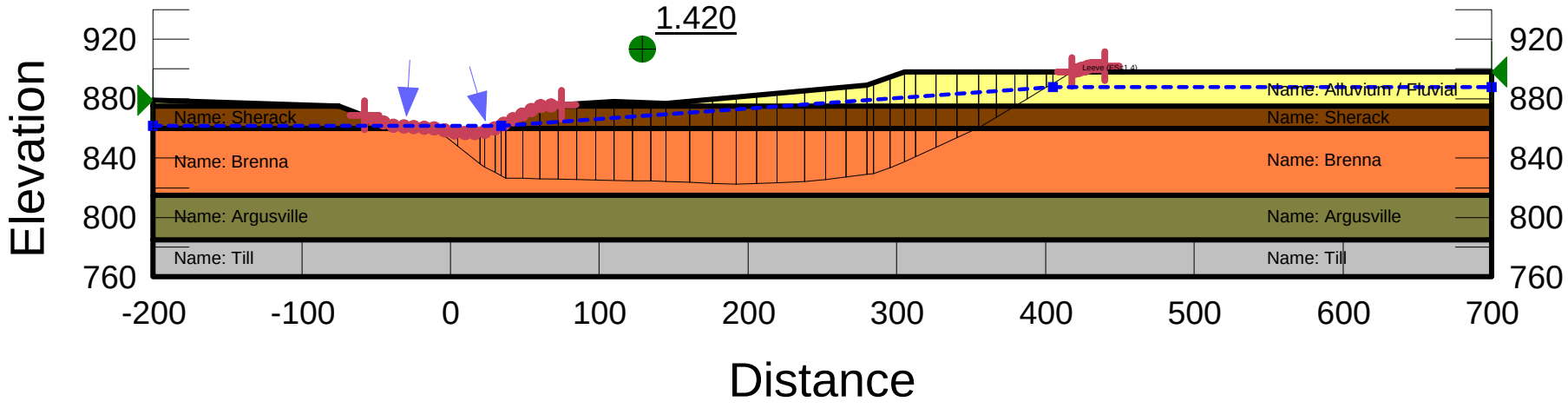
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_04_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 4

Level of Protection: 903 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

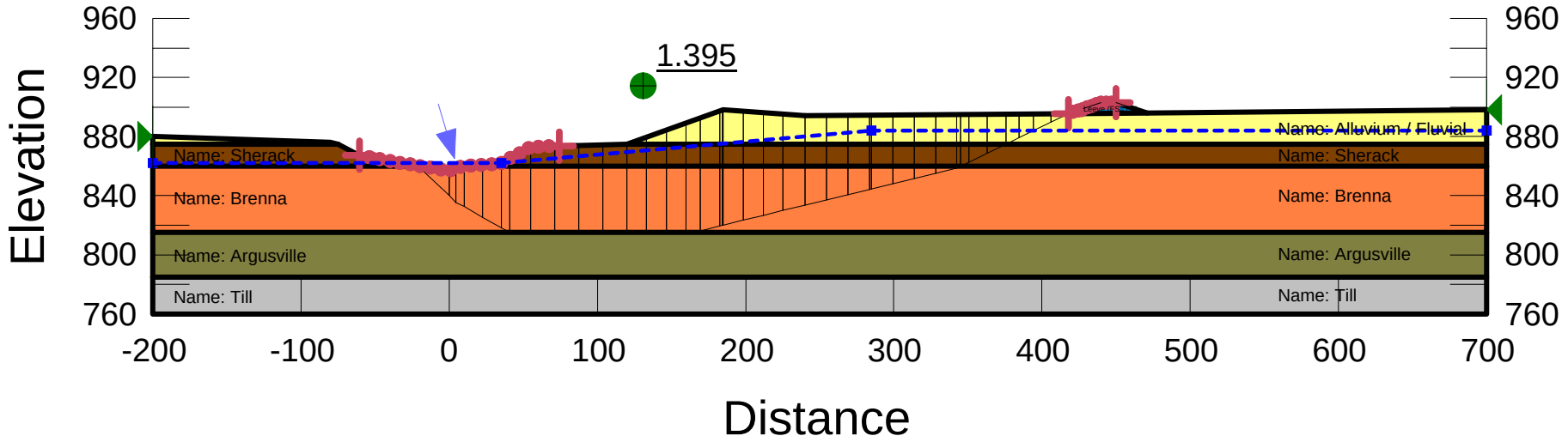
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_05_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 5

Level of Protection: 904 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

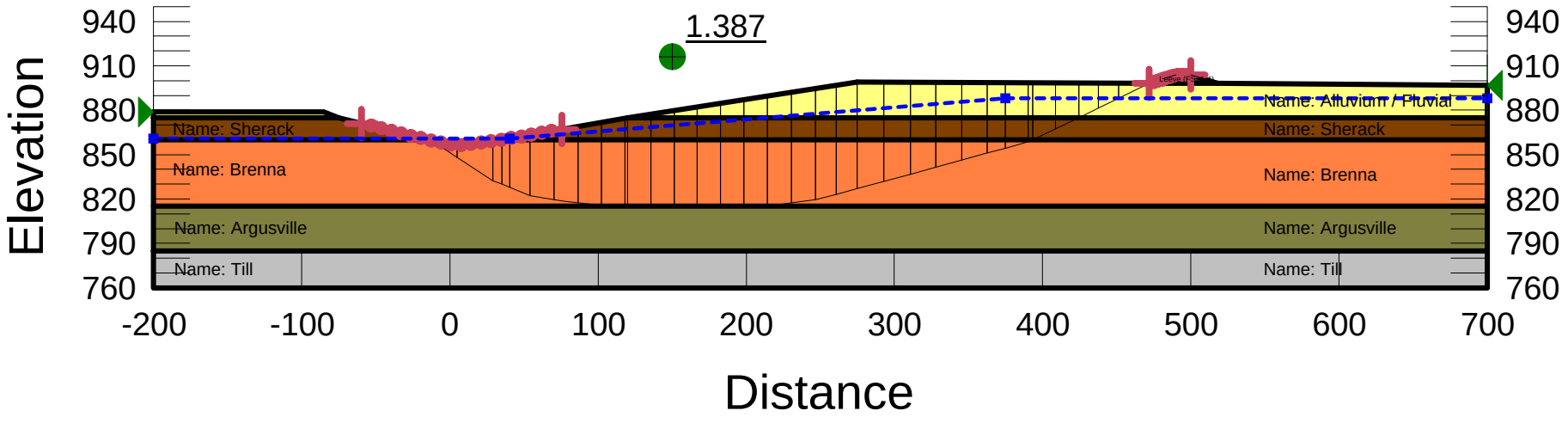
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_06_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 6

Level of Protection: 904 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

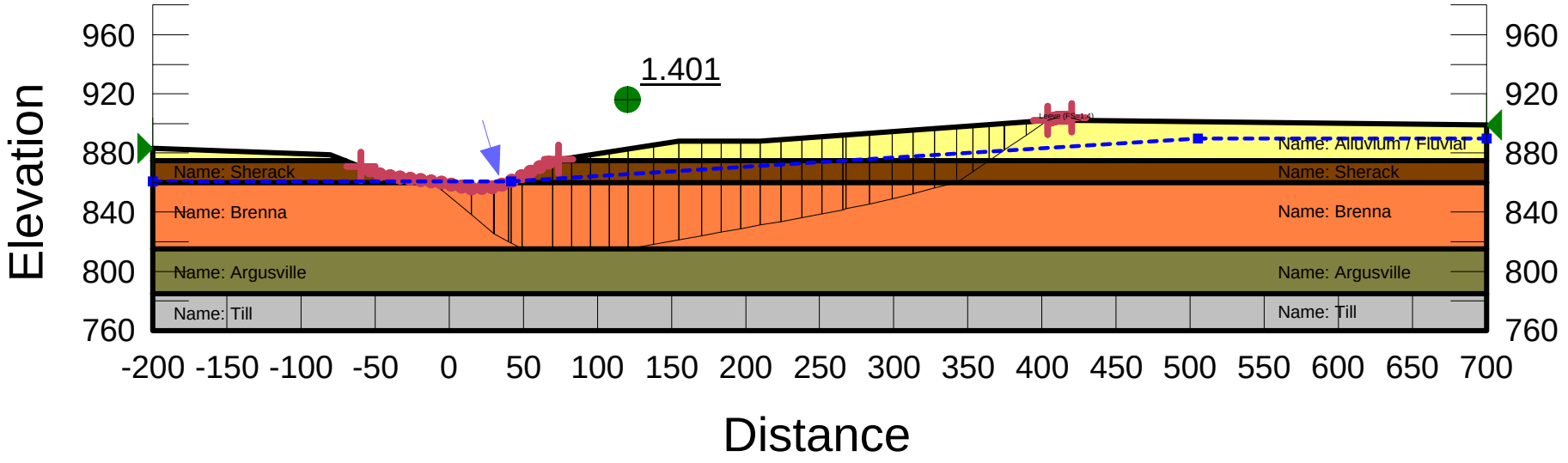
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_07_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 7

Level of Protection: 904 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

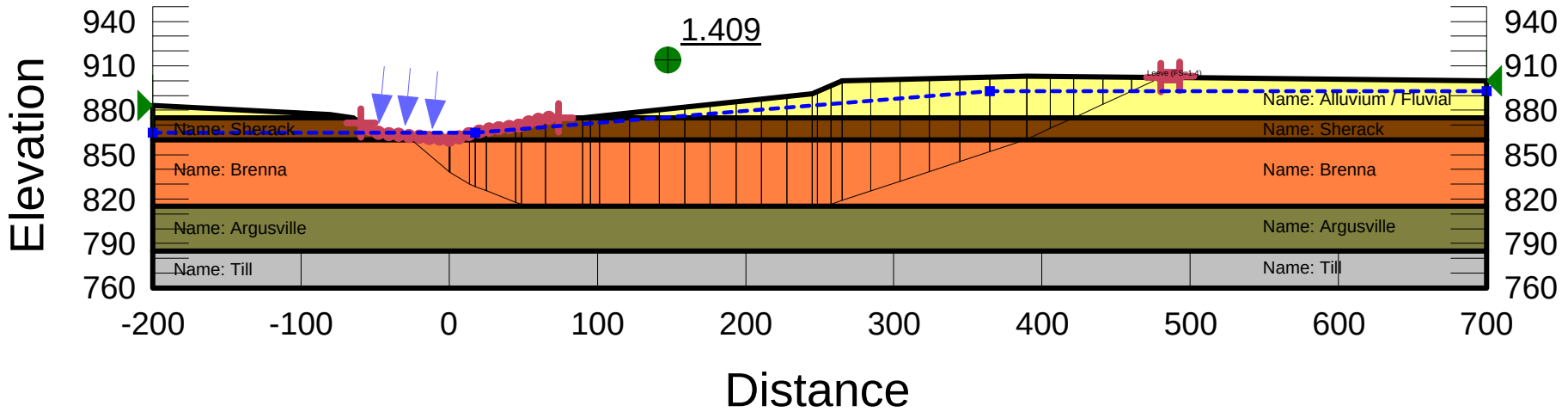
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_08_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 8

Level of Protection: 905 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

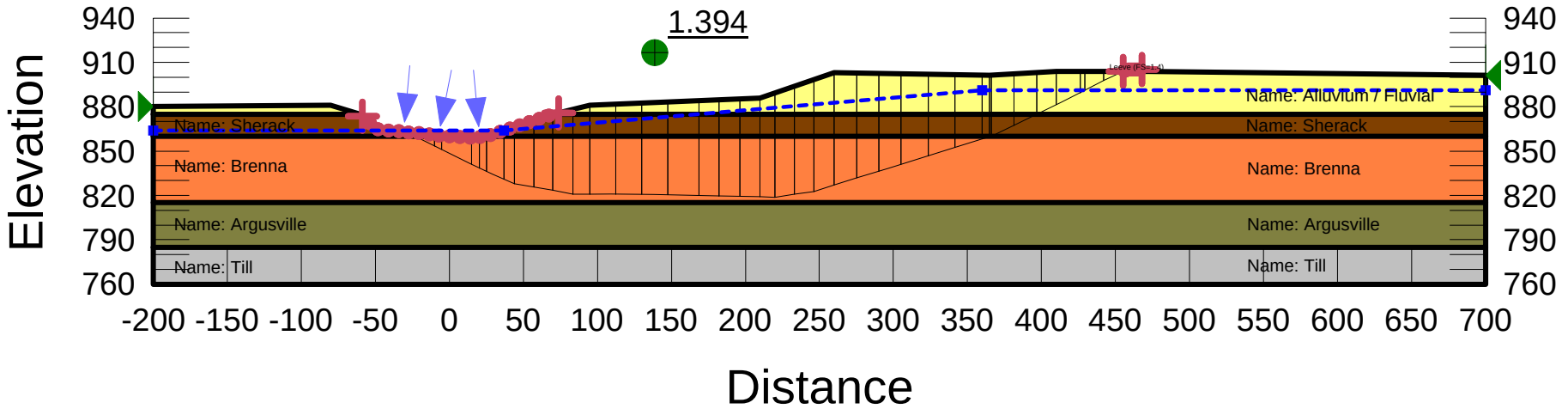
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_09_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 9

Level of Protection: 906 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

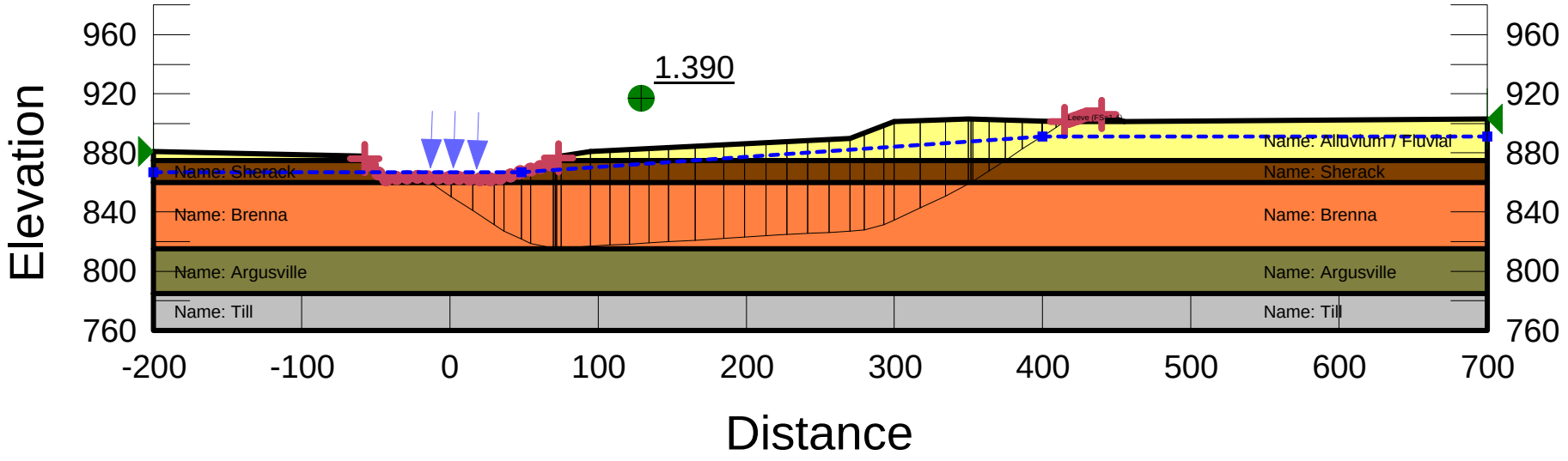
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_10_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 10

Level of Protection: 906 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

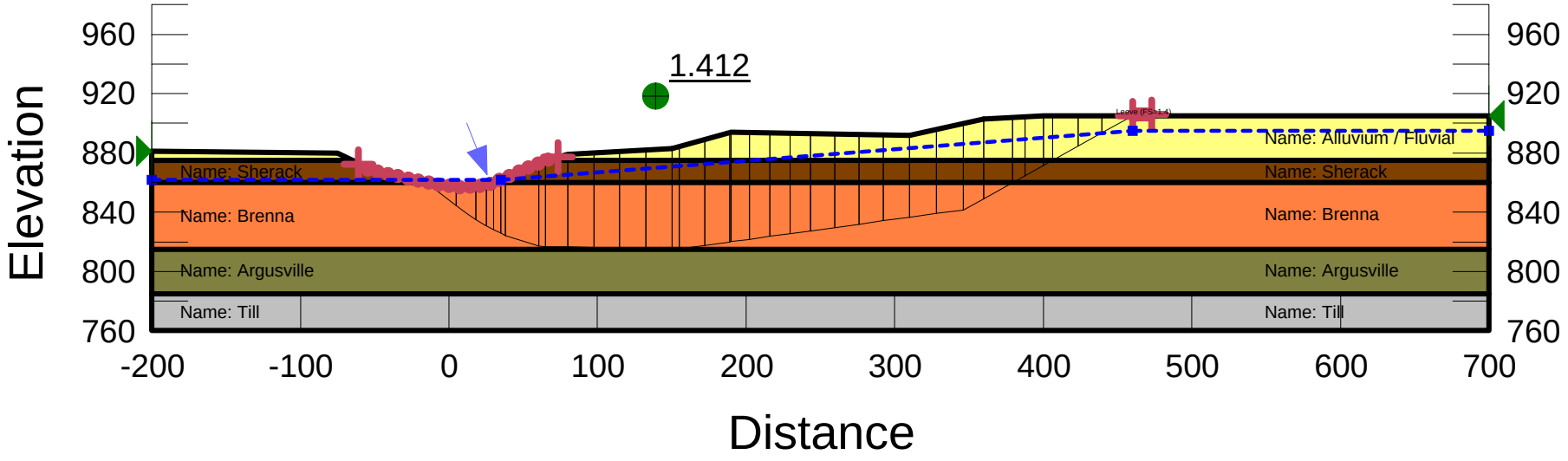
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Date: 9/23/2009

File Name: MOOR_11_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 11

Level of Protection: 908 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

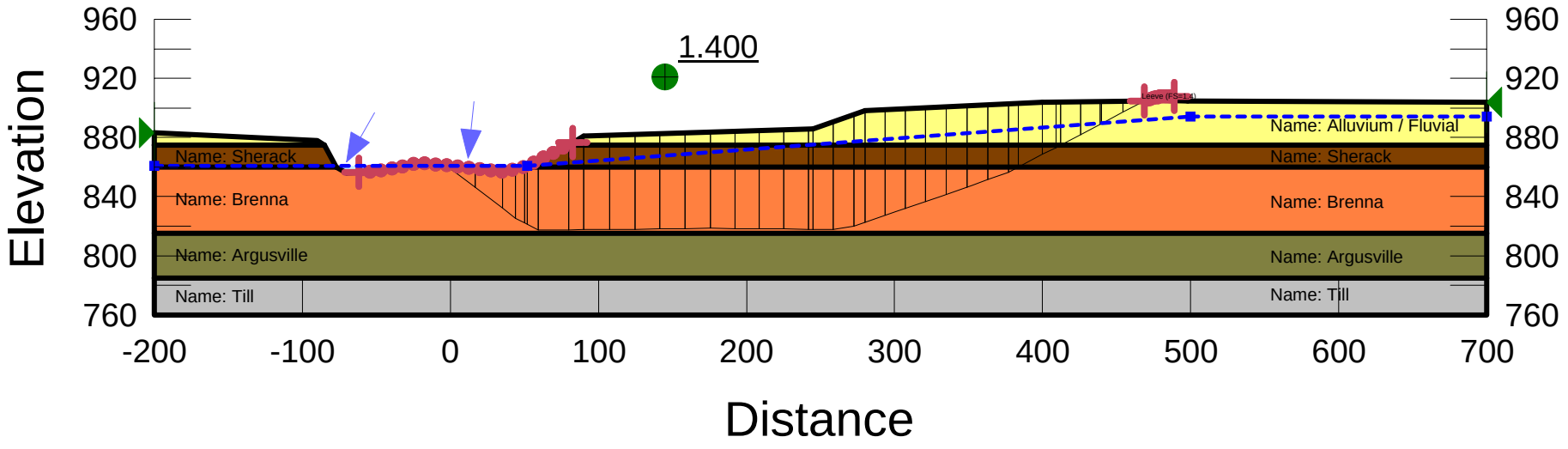
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Date: 9/23/2009

File Name: MOOR_12_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 12

Level of Protection: 909 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

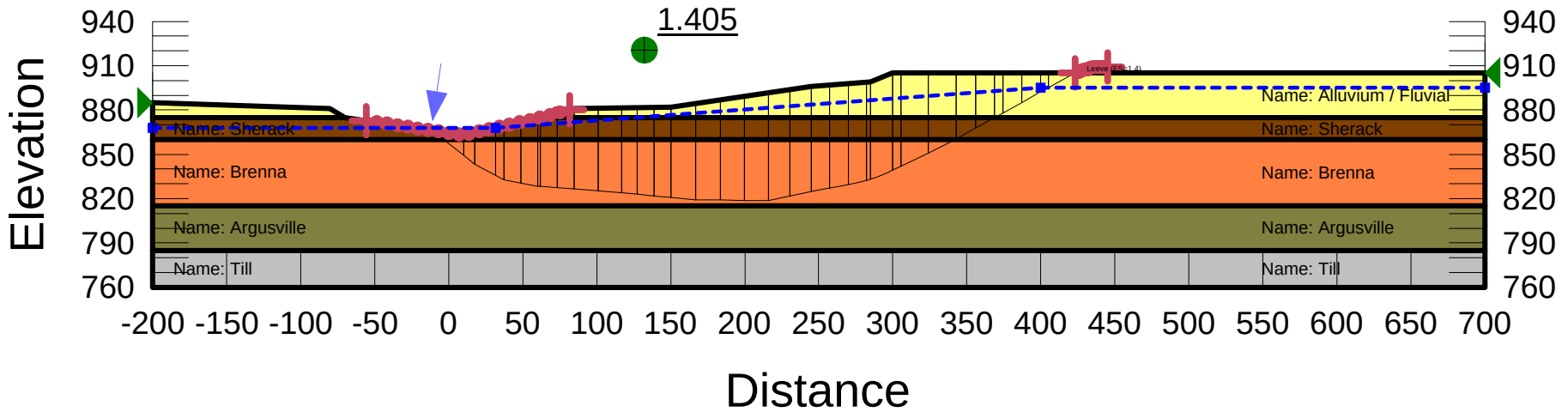
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Date: 9/23/2009

File Name: MOOR_13_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 13

Level of Protection: 910 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

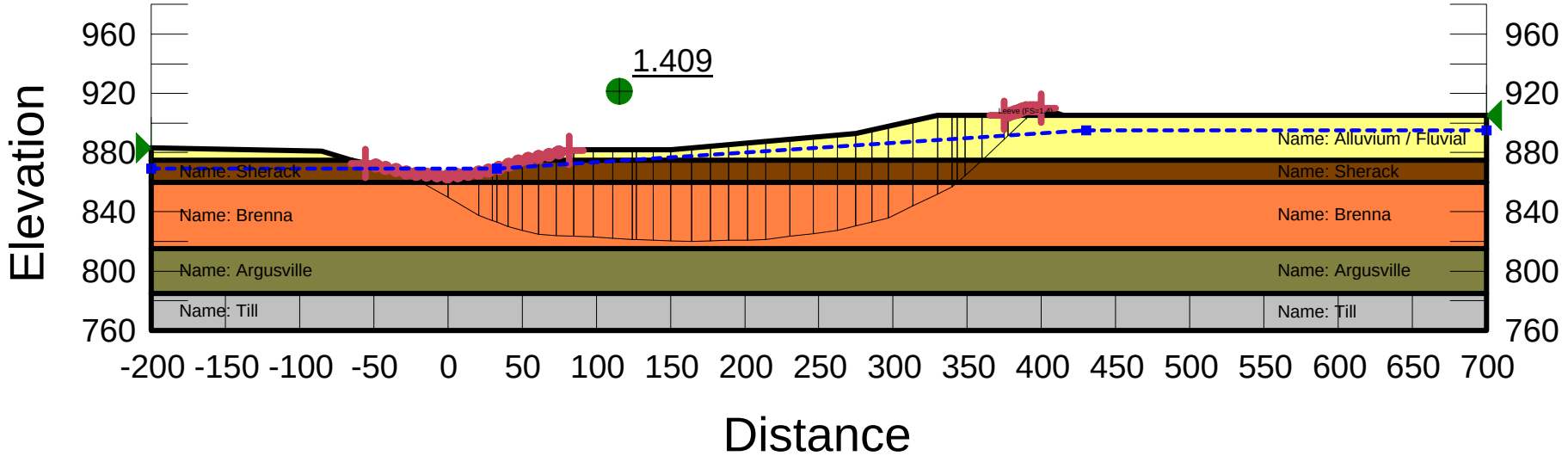
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Date: 9/23/2009

File Name: MOOR_14_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 14

Level of Protection: 911 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

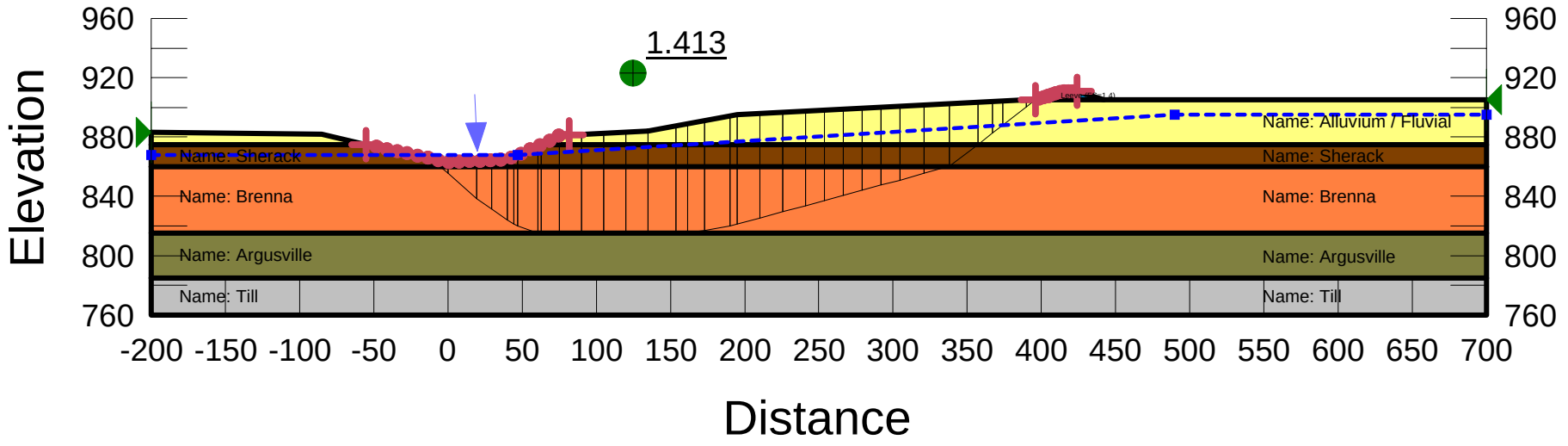
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Date: 9/23/2009

File Name: MOOR_15_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 15

Level of Protection: 911 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

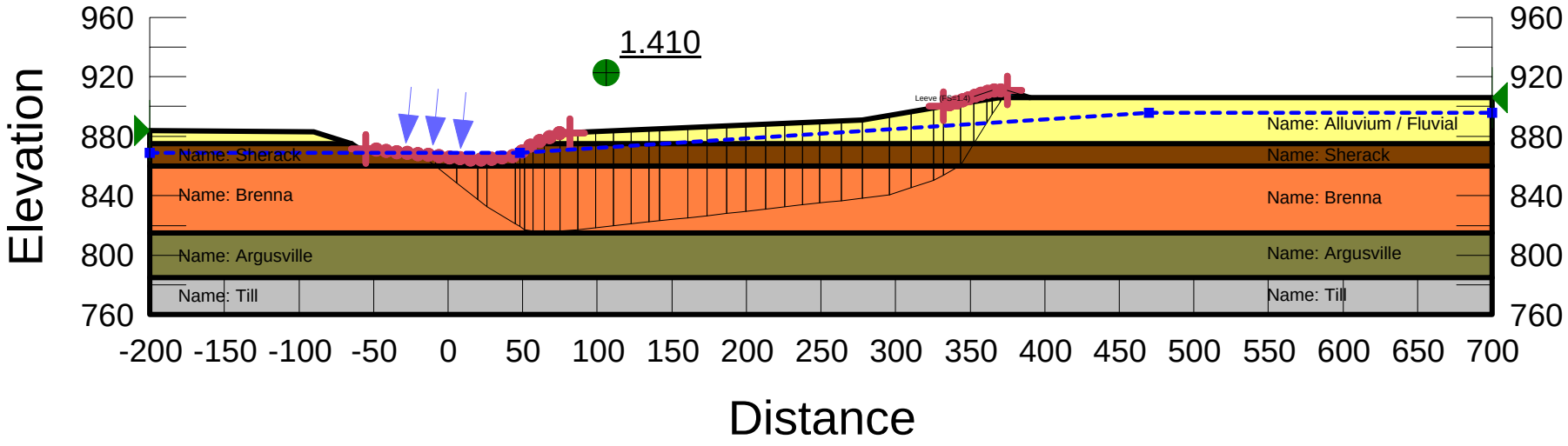
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Date: 9/23/2009

File Name: MOOR_16_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 16

Level of Protection: 912 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

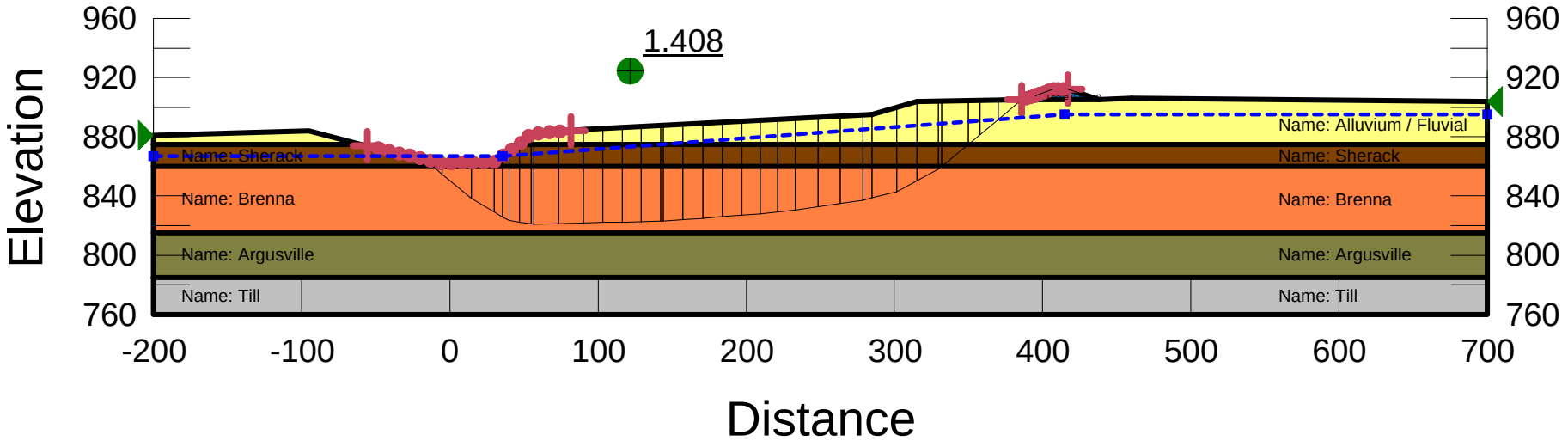
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_17_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 17

Level of Protection: 912 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

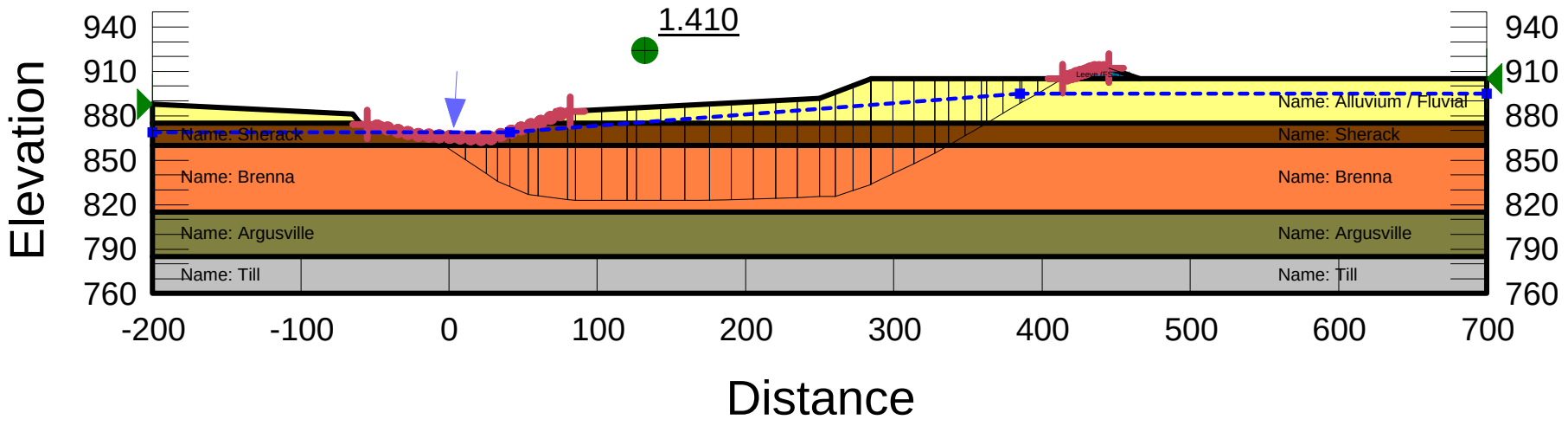
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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File Name: MOOR_18_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
## Setback Distance for Levee (500 yr)
## Moorhead Section 18

Level of Protection: 913 ft

### Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

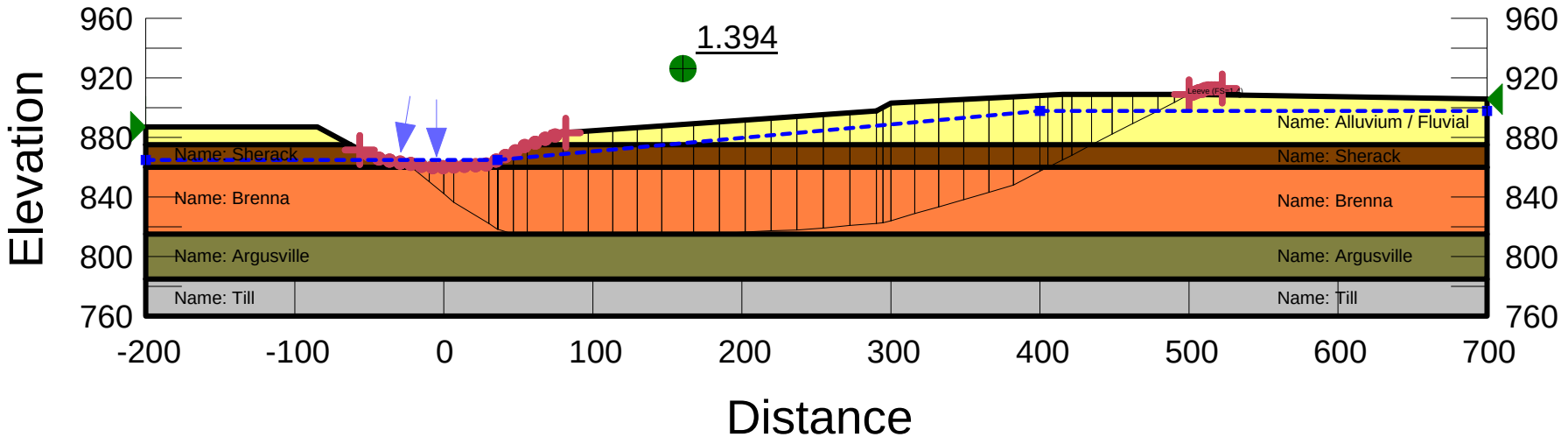
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Date: 9/24/2009

File Name: MOOR_19_500yr_USACE.gsz

# Fargo-Moorhead Metro Feasibilty Study
# Setback Distance for Levee (500 yr)
# Moorhead Section 19

Level of Protection: 913 ft

## Soil Properties

Name: Leeve Fill
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

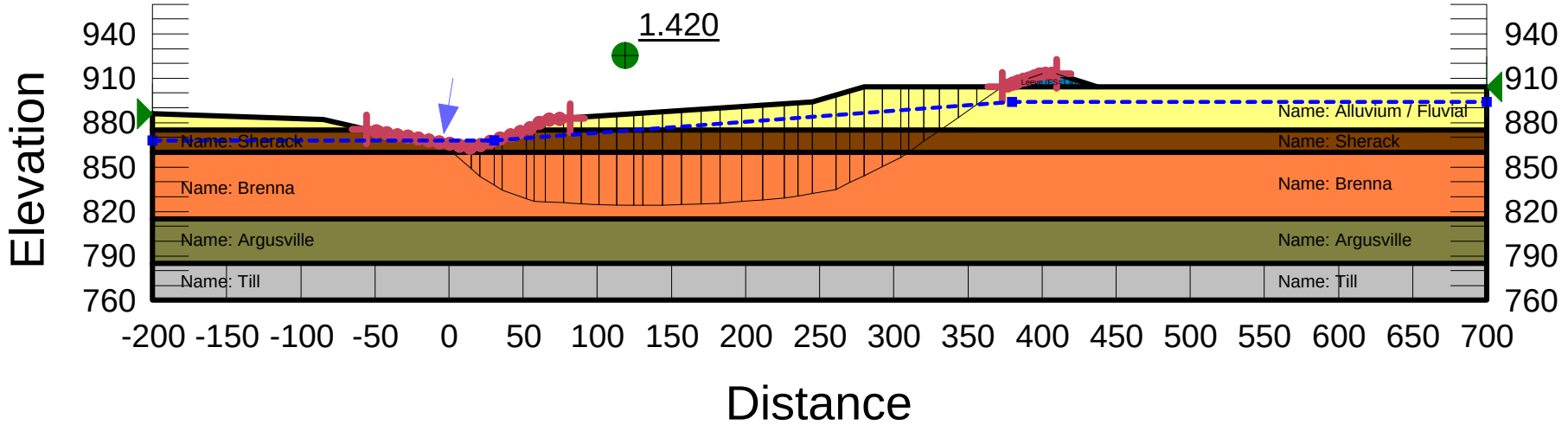
Name: Sherack
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Argusville
Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion: 0 psf
Phi: 16 °

Name: Alluvium / Fluvial
Model: Mohr-Coulomb
Unit Weight: 121 pcf
Cohesion: 0 psf
Phi: 26 °

Name: Brenna
Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion: 0 psf
Phi: 13 °

Name: Till
Model: Mohr-Coulomb
Unit Weight: 122 pcf
Cohesion: 0 psf
Phi: 31 °

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Last Edited By: Schmidt, Luke L MVP
Date: 9/24/2009