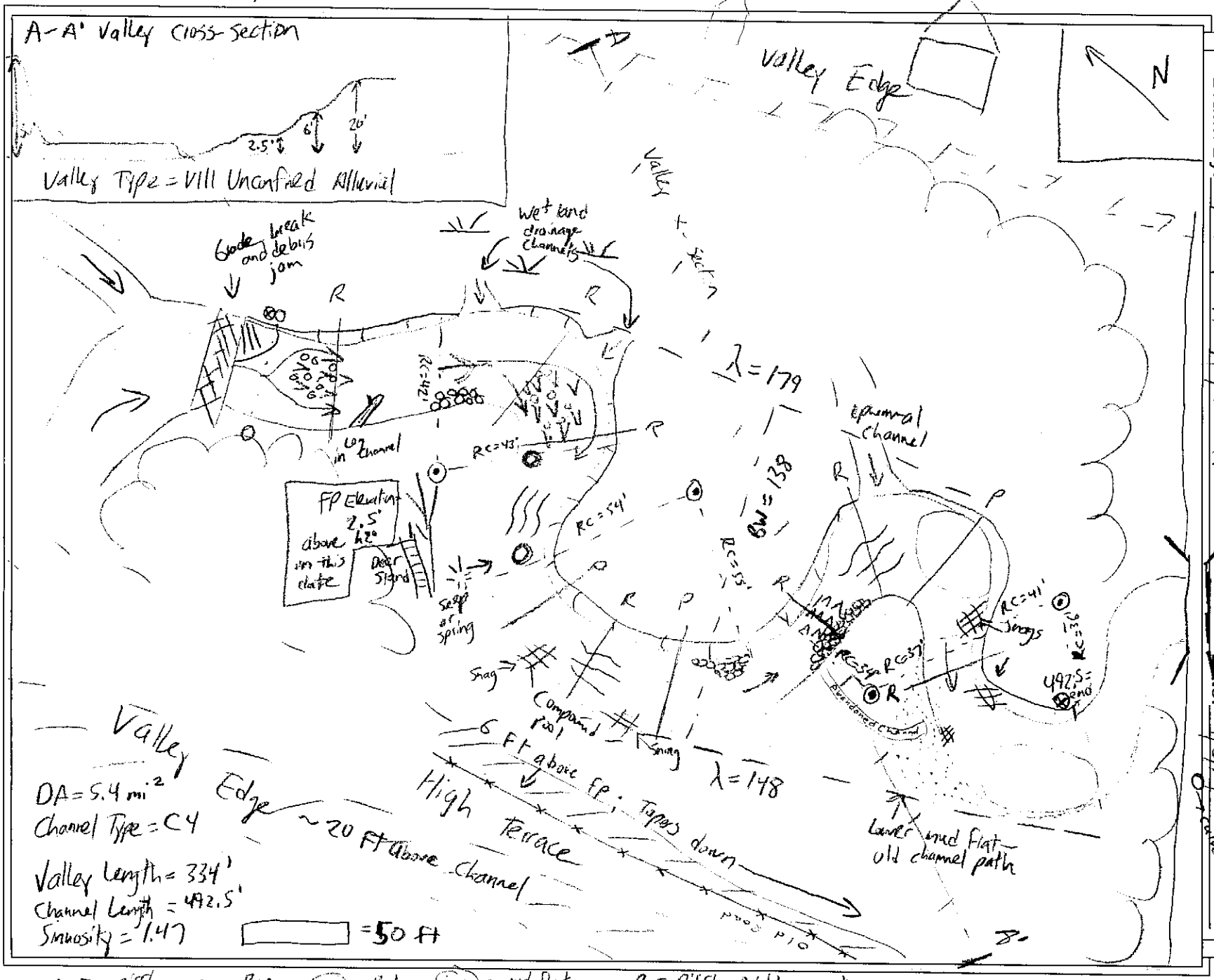
# AREA-SITE LOCATION....REACH MAP

Stream/Drainage: Trace Creek Washington Co, MO Site/Reach: 1

Drawn By: Kristen Hunt / Team 1 Date: 4/8/14




Pools = 30
Riffles = 70

Copyright © 2014 Wildland Hydrology

**SURVEY DATA** ⟹ **CROSS - SECTION** 1

**SITE:** Isreal Creek - Reach 1 Date: 4-8-14

Location:

Party / Notes: Team 1 HUC:

| Item | Distance, Point, or STATION ft | Back-Sight BS ft | Height of Instrument HI ft | Fore-Sight FS ft | Elevation ft | NOTES / COMMENTS / REMARKS |
|---|---|---|---|---|---|---|
| 1 | BM | 3.94 | 103.94 | | 100 | |
| 2 | 0 | | | 5.26 | 98.68 | |
| 3 | 1.0 | | | 5.22 | 98.72 | |
| 4 | 2.0 | | | 5.17 | 98.77 | |
| 5 | 3.0 | | | 5.19 | 98.75 | |
| 6 | 4.0 | | | 5.12 | 98.82 | |
| 7 | 5.0 | | | 5.11 | 98.83 | 5.11 Verified. |
| 8 | 6.0 | | | 5.11 | 98.83 | |
| 9 | 7.0 | | | 5.10 | 98.84 | |
| 10 | 7.5 | | | 5.13 | 98.81 | LTOP |
| 11 | 7.8 | | | 5.52 | 98.42 | Slope Break |
| 12 | 8.3 | | | 6.42 | 97.52 | |
| 13 | 8.8 | | | 7.07 | 96.87 | [illegible] |
| 14 | 9.0 | | | 7.33 | 96.61 | Long pro (60.6') LEOW |
| 15 | 10.0 | | | 8.16 | 95.78 | LTW [illegible] |
| 16 | 11.0 | | | 8.15 | 95.79 | |
| 17 | 12.0 | | | 7.84 | 96.10 | |
| 18 | 13.0 | | | 7.95 | 95.99 | |
| 19 | 14.0 | | | 8.10 | 95.84 | |
| 20 | 15.0 | | | 7.94 | 96.00 | |
| 21 | 16.0 | | | 7.81 | 96.13 | |
| 22 | 17.0 | | | 7.42 | 96.52 | |
| 23 | 17.5 | | | 7.36 | 96.58 | REOW |
| 24 | 18.0 | | | 7.31 | 96.63 | |
| 25 | 19.0 | | | 7.14 | 96.80 | |
| 26 | 20.0 | | | 7.03 | 96.91 | |
| 27 | 21.0 | | | 7.00 | 96.94 | |
| 28 | 22.0 | | | 6.94 | 97.0 | |

Copyright © 2014 Wildland Hydrology

**SURVEY DATA** ⟹ **CROSS - SECTION 2**

**SITE:** ISRAEL CREEK TEAM 1 Date: 4/8/14

| Item | STATION ft | BS ft | HI ft | FS ft | Elevation ft | NOTES COMMENTS REMARKS |
|---|---|---|---|---|---|---|
| 29 | 23.0 | | | 6.87 | 97.07 | |
| 30 | 24.0 | | | 6.76 | 97.18 | |
| 31 | 25.0 | | | 6.75 | 97.19 | |
| 32 | 26.0 | | | 6.80 | 97.14 | |
| 33 | 27.0 | | | 6.89 | 97.05 | OFFSET 2.2 TO FLAT AREA TO SHOW 5.11 ETC |
| 34 | 28.0 | | | 6.90 | 97.04 | |
| 35 | 28.2 | | | 6.89 | 97.05 | TOE of slope |
| 36 | 28.8 | | | 6.78 | 97.16 | slope break |
| 37 | 29.2 | | | 6.59 | 97.35 | slope break |
| 38 | 29.9 | | | 6.24 | 97.70 | slope break |
| 39 | 30.6 | | | 5.84 | 98.10 | slope break |
| 40 | 31.0 | | | 5.42 | 98.52 | ~~RE~~ |
| 41 | 32.0 | | | 5.13 | 98.81 | R TOB, RBKF |
| 42 | 33.0 | | | 4.91 | 99.03 | |
| 43 | 34.0 | | | 4.99 | 98.95 | |
| 44 | 35.0 | | | 5.03 | 98.91 | |
| 45 | 36.0 | | | 5.36 | 98.58 | |
| 46 | 37.0 | | | 5.37 | 98.57 | |
| 47 | 38.0 | | | 5.26 | 98.68 | |
| 48 | 39.0 | | | 5.25 | 98.69 | |
| 49 | | | | | | |
| 50 | | | | | | |
| 51 | | | | | | 298' Flood Prone Area |
| 52 | | | | | | |
| 53 | | | | | | |
| 54 | | | | | | |
| 55 | | | | | | |
| 56 | | | | 5.10 | | |
| 57 | | | | | | |
| 58 | | | | | | |
| 59 | | | | | | |



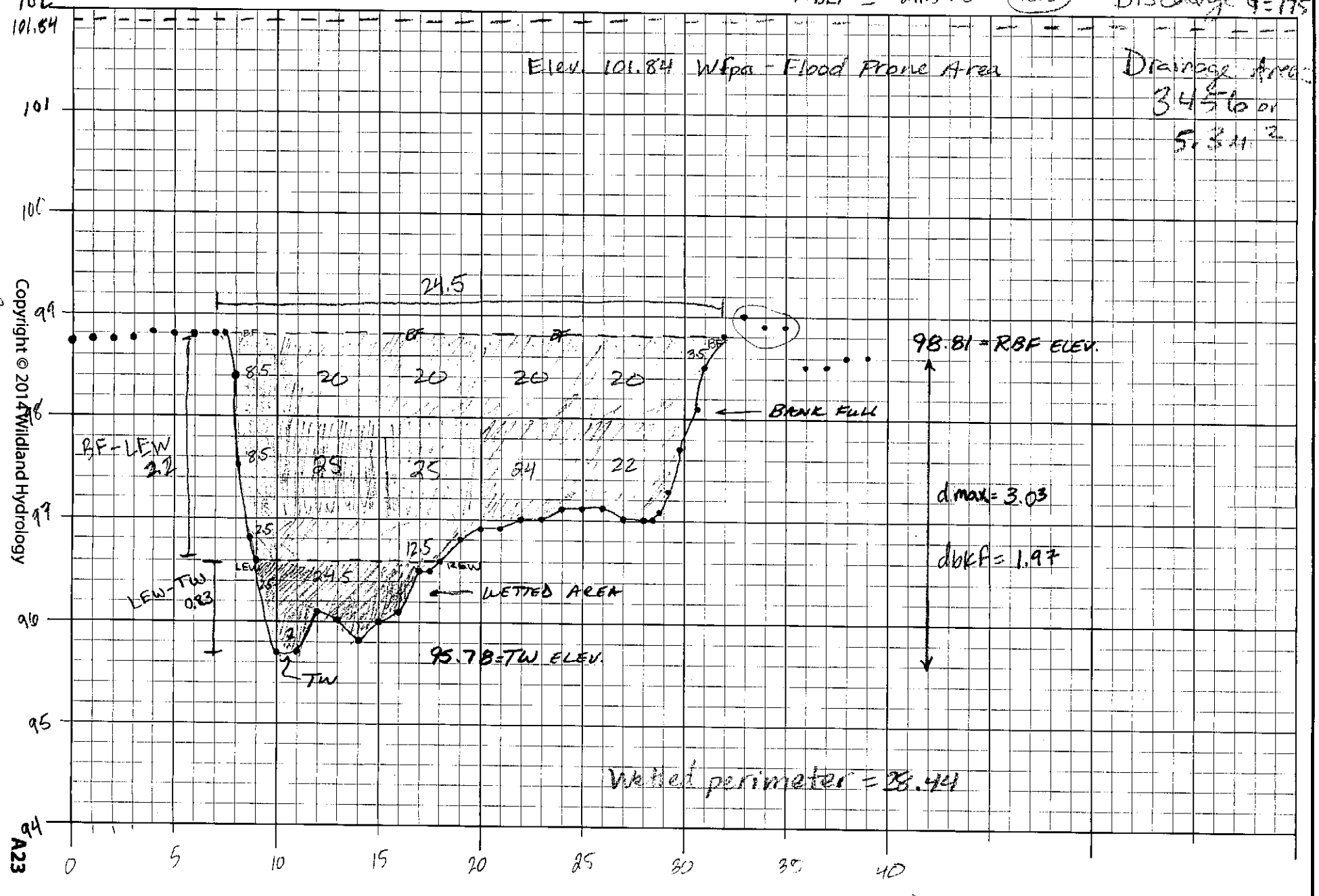
Copyright © 2014 Wildland Hydrology

1 4/8/2014 ISREAL CREEK Reach 1
Washington County Team 1

Circled points omitted due to mound

Regional Curve pB58

$A_{bkf}$ = 241.5 × 0.2 = 48.3 Discharge Q = 175 cfs




Regional curve B58

Copyright © 2014 Wildland Hydrology

**SURVEY DATA** ⟶ **LONGITUDINAL PROFILE 2**

**SITE:** 1 Date: 4/8/14

Location: Reach 1 Team 1

Party / Notes: HUC:

| | Distance, Point, or STATION ft | Back-Sight BS ft | Height of Instrument HI ft | Thalweg Fore-Sight FS ft | Thalweg Elevation Elev. ft | Water Surface Fore-Sight FS ft | Water Surface Elevation Elev. ft | Bankfull Fore-Sight FS ft | Bankfull Elevation Elev. ft | Low Bank HI Fore-Sight FS ft | Low Bank HI Elevation Elev. ft | NOTES e.g. Riffle Run Pool Glide |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 394 | | 104.12 | 9.50 | 94.62 | 7.61 | 96.51 | 5.67 | 98.45 | 5.51 | 98.61 | mid-Run |
| 29 | 400 | | | 9.81 | 94.31 | 7.57 | 96.55 | 5.60 | 98.44 | — | — | Run/Pool |
| 30 | 418 | | | 9.77 | 94.35 | 7.61 | 96.51 | 5.63 | 98.49 | 5.11 | 99.01 | Pool-mid (max = 2.35 ft) |
| 31 | 431 | | | 9.07 | 95.05 | 7.61 | 96.51 | 5.65 | 98.47 | | 98.47 | pool Δ = 1.96 |
| 32 | 452 | | | 9.14 | 94.98 | 7.63 | 96.49 | 5.58 | 98.54 | | 98.54 | Glide |
| 33 | 465 | | | 8.80 | 95.32 | 7.70 | 96.42 | 6.45 | 97.67 | | 97.67 | TOR |
| 34 | 474 | | | 9.04 | 95.08 | 7.81 | 96.31 | 5.60 | 98.52 | 5.40 | 98.72 | MOR |
| 35 | 465 | | | — | | — | | 5.58 | 98.54 | — | — | BF (new) |
| 36 | 488 | | | 9.38 | 94.74 | 7.89 | 96.23 | 6.27 | 97.85 | — | — | BOR Δ = 1.62 |
| 37 | | | | | | | | | | | | |
| 38 | | | | | | | | | | | | |
| 39 | 189 | | | | | | | 5.0 | (99.12) | | | |
| 40 | 127 | | | | | | (99.32) | 4.80 | WS Slope (1) = | | | .001 |
| 41 | 20 | | | | | | (99.05) | 5.07 | WS slope (2) = | | | .002 (Reach) |
| 42 | | | | | | | | | WS slope (3) = | | | |
| 43 | | | | | | | | | | | | |
| 44 | | | | | | | | | | | | |
| 45 | | | | | | | | | | | | |
| 46 | | | | | | | | | | | | |
| 47 | | | | | | | | | | | | Water Surface line |
| 48 | | | | | | | | | | | | |
| 49 | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | |
| 51 | | | | | | | | | | | | Top of riffle → |
| 52 | | | | | | | | | | | | |
| 53 | | | | | | | | | | | | Top of riffle (2 points) |
| 54 | | | | | | | | | | | | |

Copyright © 2014 Wildland Hydrology

**SURVEY DATA** ⟶ **LONGITUDINAL PROFILE 1**

**SITE:** Israel Ck Date: 4/8/14

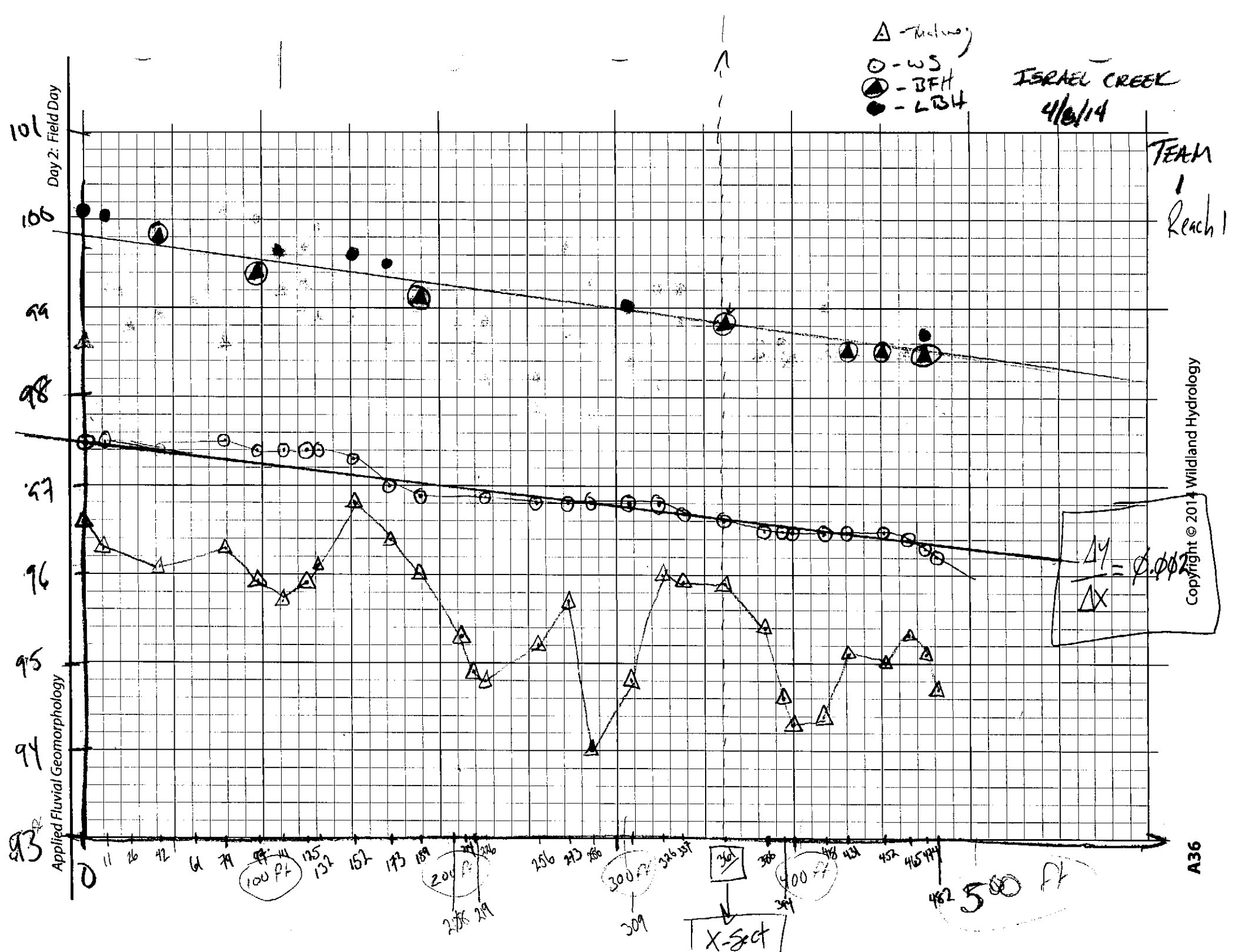
Location: Reach 1 TEAM 1

Party / Notes: HUC:

| | Distance, Point, or STATION (ft) | Back-Sight BS (ft) | Height of Instrument HI (ft) | Thalweg Fore-Sight FS (ft) | Thalweg Elevation Elev. (ft) | Water Surface Fore-Sight FS (ft) | Water Surface Elevation Elev. (ft) | Bankfull Fore-Sight FS (ft) | Bankfull Elevation Elev. (ft) | Low Bank HI Fore-Sight FS (ft) | Low Bank HI Elevation Elev. (ft) | NOTES e.g. Riffle Run Pool Glide | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | | 104.12 | 7.53 | 96.59 | 6.60 | 97.52 | 5.57 | 98.55 | 3.23 | 100.89 | Top RIFF | Δ 1.03 |
| 2 | 11 | | | 7.83 | 96.29 | 6.67 | 97.45 | 4.93 | 99.19 | 3.24 | 100.88 | mid | Δ 1.74 |
| 3 | 26 | | | — | | — | | 5.37 | 98.75 | — | | BF1 | ⇒ 1.49 |
| 4 | 42 | | | 8.04 | 96.08 | 6.73 | 97.39 | 5.25 | 98.87 | 4.32 | 99.76 | bot RIFF | Δ 1.48 |
| 5 | 61 | | | — | | — | | 4.70 | 99.42 | — | | BF2 | ⇒ 1.94 |
| 6 | 79 | | | 7.87 | 96.25 | 6.67 | 97.45 | 5.49 | 98.63 | 4.06 | 100.06 | Pool | Δ 1.18 |
| 7 | 97 | | | 8.18 | 95.94 | 6.71 | 97.41 | 4.72 | 99.4 | 4.14 | 99.98 | Pool | Δ = 1.99 |
| 8 | 111 | | | 8.41 | 95.68 | 6.[illegible] | 97.39 | 4.89 | 99.23 | 4.50 | 99.62 | [illegible] | Δ = 1.84 |
| 9 | 125 | | | 8.22 | 95.90 | 6.73 | 97.39 | 5.09 | 99.03 | 4.41 | 99.71 | Pool / | Glide |
| 10 | 132 | | | 8.04 | 96.08 | 6.74 | 97.38 | 5.23 | 98.89 | 4.25 | 99.87 | Glide | |
| 11 | 152 | | | 7.29 | 96.83 | 6.81 | 97.31 | 5.20 | 98.92 | 4.51 | 99.61 | TOR | Δ = 1.61 |
| 12 | 173 | | | 7.7[illegible] | 96.35 | 7.10 | 97.02 | 5.53 | 98.59 | 4.60 | 99.52 | mid | Δ = 1.57 |
| 13 | 189 | | | 8.16 | 95.96 | 7.25 | 96.87 | 5.58 | 98.54 | 5.15 | 98.97 | BOR | Δ = 1.73 |
| 14 | 214 | | | 8.[illegible] | 95.26 | 7.28 | 96.84 | 5.9[illegible] | 98.16 | 5.31 | 98.81 | RUN | Δ = 1.32 |
| 15 | 208 | | | — | | — | | 5.73 | 98.39 | — | — | BF | |
| 16 | 219 | | | 9.18 | 94.94 | 7.24 | 96.88 | 5.65 | 98.47 → | | 98.47 | RUN | pool Δ = 1.59 |
| 17 | 226 | | | 9.37 | 94.75 | 7.26 | 96.86 | 5.93 | 98.19 | 5.28 | 98.84 | POOL | (max) |
| 18 | 256 | | | 8.88 | 95.24 | 7.28 | 96.84 | 6.20 | 97.92 | 5.93 | 98.19 | Glide - | mid Δ = 1.08 |
| 19 | 273 | | | 8.46 | 95.66 | 7.34 | 96.78 | 6.30 | 97.82 | 4.46 | 99.66 | Glide | Δ = 1.04 |
| 20 | 286 | | | 10.13 | 93.99 | [illegible] | ← 96.8 7.32 | 6.34 | 97.78 | 4.83 | 99.29 | POOL | (max) = 3.2 |
| 21 | 300 | | | — | | — | | 5.63 | 98.49 | — | — | BF | Δ 1.72 |
| 22 | 309 | | | 9.34 | 94.78 | 7.32 | 96.80 | 5.77 | 98.35 | 5.15 | 98.97 | BOP BF | Δ = 1.56 |
| 23 | 326 | | | 8.12 | 96.0 | 7.36 | 96.76 | 6.01 | 98.11 | 4.95 | 99.17 | mid Glide | Δ = 1.35 |
| 24 | 337 | | | 8.20 | 95.92 | 7.39 | 96.73 | 5.36 | 98.76 | 4.89 | 99.23 | TOR | Δ = |
| 25 | 361 | | | 8.27 | 95.85 | 7.57 | 96.55 | 5.31 | 98.81 | — | — | MOR | |
| 26 | 386 | | | 8.77 | 95.35 | 7.58 | 96.54 | 5.61 | 98.51 | 5.58 | 98.54 | BOR | |
| 27 | 361' | | | — | | 7.57 | 96.55 | 5.20 | 98.84 | — | — | | |



Copyright © 2014 Wildland Hydrology




Copyright © 2014 Wildland Hydrology

Representative Pebble Count for Stream Classification

Israel Creek

Site: Reach #1 Team #7 Date:

Location: HUC:

Party:

| Inches | PARTICLE | Millimeters | | Dot Count for RIFFLE 1 | POOL 2 | COMP. 3 | RIFFLE (1) TOT # | ITEM % | % CUM | POOL (2) TOT # | ITEM % | % CUM | COMPOSITE (3) TOT # | ITEM % | % CUM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Reach: | | | Reach: | | | Reach: | | |
| | | | | | | | Date: | | | Date: | | | Date: | | |
| | Silt / Clay | < .062 | S/C | | | | 6 | 6% | 6 | | | 0 | 6 | 8.6 | 8.6 |
| | Very Fine | .062 - .125 | SAND | | | | 0 | | 6 | | | 0 | | | 8.6 |
| | Fine | .125 - .25 | | | | | 6 | 6% | 12 | 1 | 3.3% | 3.3 | 5 | 7.1 | 15.7 |
| | Medium | .25 - .50 | | | | | 6 | 6% | 18 | 2 | 6.7% | 10 | 4 | 5.7 | 21.4 |
| | Coarse | .50 - 1.0 | | | | | 4 | 4% | 22 | 1 | 3.3% | 13.3 | 3 | 4.3 | 25.7 |
| .04 - .08 | Very Coarse | 1.0 - 2 | | | | | 4 | 4% | 26 | 3 | 10% | 23.3 | 1 | 1.4 | 27.1 |
| .08 - .16 | Very Fine | 2 - 4 | GRAVEL | | | | 1 | 1% | 27 | | | | 1 | 1.4 | 28.5 |
| .16 - .22 | Fine | 4 - 5.7 | | | | | 1 | 1% | 28 | | | | 1 | 1.4 | 29.9 |
| .22 - .31 | Fine | 5.7 - 8 | | | | | 7 | 7% | 35 | 6 | 20% | 43.3 | 1 | 1.4 | 31.3 |
| .31 - .44 | Medium | 8 - 11.3 | | | | | 10 | 10% | 45 | 3 | 10% | 53.3 | 7 | 10 | 41.3 |
| .44 - .63 | Medium | 11.3 - 16 | | | | | 12 | 12% | 57 | 4 | 13.3% | 66.6 | 8 | 11.4 | 52.7 |
| .63 - .89 | Coarse | 16 - 22.6 | | | | | 18 | 18% | 75 | 2 | 6.7% | 73.3 | 16 | 22.9 | 75.6 |
| .89 - 1.3 | Coarse | 22.6 - 32 | | | | | 16 | 16% | 91 | 6 | 20% | 93.3 | 10 | 14.3 | 89.9 |
| 1.3 - 1.8 | Very Coarse | 32 - 45 | | | | | 8 | 8% | 99 | 1 | 3.3% | 96.6 | 7 | 10 | 99.9 |
| 1.8 - 2.5 | Very Coarse | 45 - 64 | | | | | | | | | | | | | |
| 2.5 - 3.5 | Small | 64 - 90 | COBBLE | | | | 1 | 1% | 100 | 1 | 3.3% | 99.9 | | | |
| 3.5 - 5.0 | Small | 90 - 128 | | | | | | | | | | | | | |
| 5.0 - 7.1 | Large | 128 - 180 | | | | | | | | | | | | | |
| 7.1 - 10.1 | Large | 180 - 256 | | | | | | | | | | | | | |
| 10.1 - 14.3 | Small | 256 - 362 | BOULDER | | | | | | | | | | | | |
| 14.3 - 20 | Small | 362 - 512 | | | | | | | | | | | | | |
| 20 - 40 | Medium | 512 - 1024 | | | | | | | | | | | | | |
| 40 - 80 | Large-Vry Large | 1024 - 2048 | | | | | | | | | | | | | |
| | Bedrock | | BDRK | | | | | | | | | | | | |
| Stream Type: | | | Valley Type: | | | TOTAL→ | 100 | | | 30 | 99.9% | | 70 | | 99.9 |

20

19 30

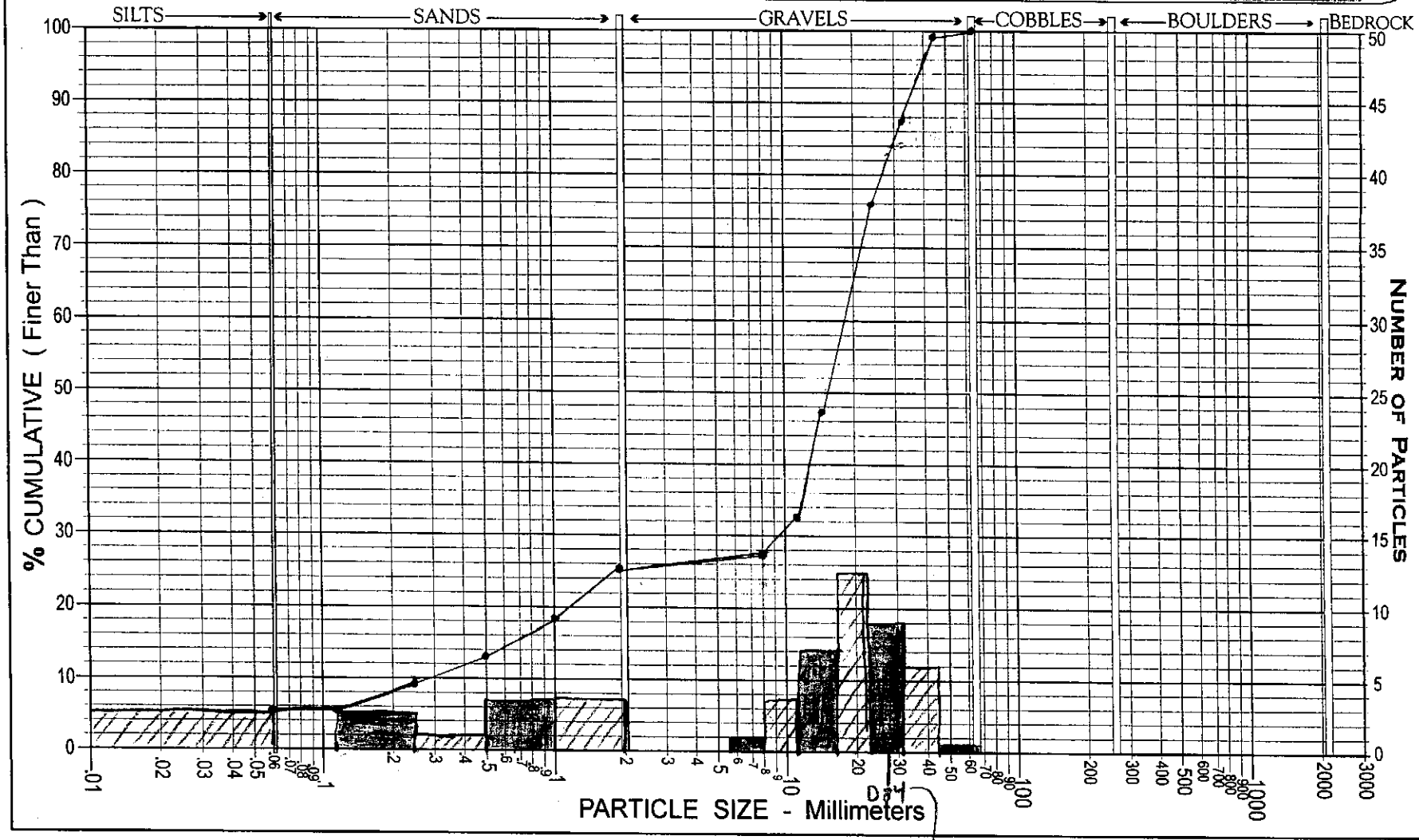
Copyright © 2014 Wildland Hydrology

Active Bed Riffle Pebble Count

LOCATION: Israel Creek, Washington Co., MO PEBBLE COUNT DATA Cross Section Date: 4/8/14

REACH: 1, Cross Section PARTY: Team 1

Stream Type: C4/5 Valley Type: HUC:




~29 mm

Copyright © 2014 Wildland Hydrology

# ACTIVE BED RIFFLE PEBBLE COUNT

Site: Cross Section Reach 1 Date: 4/08/14

Location: HUC:

Party: Team 1

| Inches | PARTICLE | Millimeters | | Dot Count for RIFFLE 1 | POOL 2 | COMP. 3 | ~~RIFFLE~~ (1) TOT # | ITEM % | % CUM | ~~POOL (2)~~ TOT # | ITEM % | % CUM | COMPOSITE (3) TOT # | ITEM % | % CUM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Reach: | | | Reach: | | | Reach: | | |
| | | | | | | | Date: | | | Date: | | | Date: | | |
| | Silt / Clay | < .062 | S/C | | | | 5 | 4.8 | 4.8 | | | | | | |
| | Very Fine | .062 - .125 | SAND | | | | | | | | | | | | |
| | Fine | .125 - .25 | | | | | 5 | 4.8 | 9.6 | | | | | | |
| | Medium | .25 - .50 | | | | | 2 | 1.9 | 11.5 | | | | | | |
| | Coarse | .50 - 1.0 | | | | | 7 | 6.7 | 18.2 | | | | | | |
| .04 - .08 | Very Coarse | 1.0 - 2 | | | | | 7 | 6.7 | 24.9 | | | | | | |
| .08 - .16 | Very Fine | 2 - 4 | GRAVEL | | | | | | | | | | | | |
| .16 - .22 | Fine | 4 - 5.7 | | | | | | | | | | | | | |
| .22 - .31 | Fine | 5.7 - 8 | | | | | 2 | 1.9 | 26.8 | | | | | | |
| .31 - .44 | Medium | 8 - 11.3 | | | | | 7 | 6.7 | 33.5 | | | | | | |
| .44 - .63 | Medium | 11.3 - 16 | | | | | 14 | 13.3 | 46.8 | | | | | | |
| .63 - .89 | Coarse | 16 - 22.6 | | | | | 25 | 23.8 | 70.6 | | | | | | |
| .89 - 1.3 | Coarse | 22.6 - 32 | | | | | 18 | 17.1 | 87.7 | | | | | | |
| 1.3 - 1.8 | Very Coarse | 32 - 45 | | | | | 12 | 11.4 | 99.0 | | | | | | |
| 1.8 - 2.5 | Very Coarse | 45 - 64 | | | | | 1 | 1.0 | 100.1 | | | | | | |
| 2.5 - 3.5 | Small | 64 - 90 | COBBLE | | | | | | | | | | | | |
| 3.5 - 5.0 | Small | 90 - 128 | | | | | | | | | | | | | |
| 5.0 - 7.1 | Large | 128 - 180 | | | | | | | | | | | | | |
| 7.1 - 10.1 | Large | 180 - 256 | | | | | | | | | | | | | |
| 10.1 - 14.3 | Small | 256 - 362 | BOULDER | | | | | | | | | | | | |
| 14.3 - 20 | Small | 362 - 512 | | | | | | | | | | | | | |
| 20 - 40 | Medium | 512 - 1024 | | | | | | | | | | | | | |
| 40 - 80 | Large-Vry Large | 1024 - 2048 | | | | | | | | | | | | | |
| | Bedrock | | BDRK | | | | | | | | | | | | |
| | | | | | | TOTAL→ | 105 | ≈ | 100. | | | | | | |

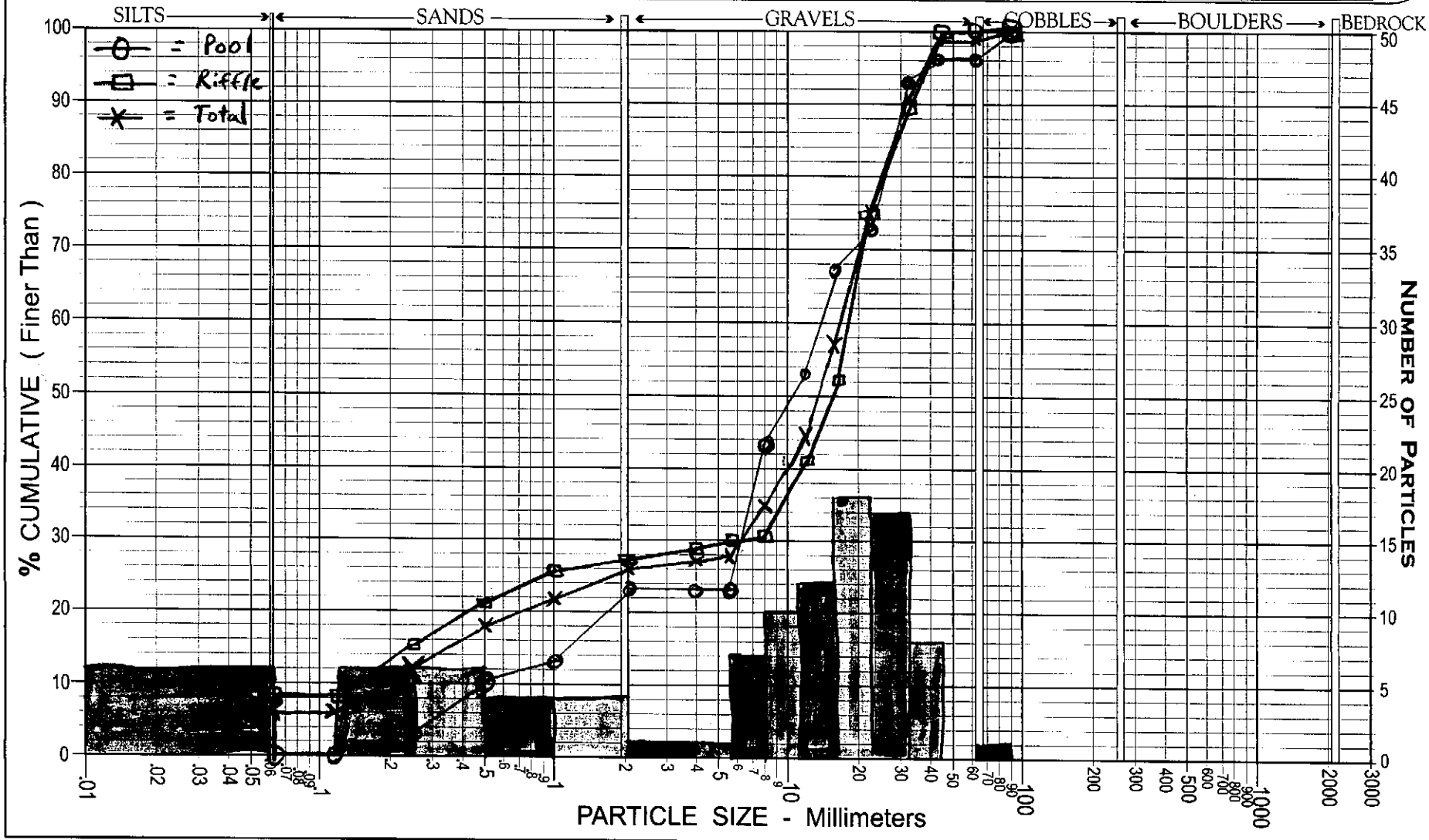
**Stream Type:** **Valley Type:**

Copyright © 2014 Wildland Hydrology

Representative Pebble Count For Stream Classification

PEBBLE COUNT DATA

LOCATION: Israel Creek
Date: 4/08/14
REACH: Reach #1
PARTY: TEAM 1
Stream Type: C4/5
Valley Type:
HUC:




$D_{50}$ = medium Gravel (≈ 14mm)

Copyright © 2014 Wildland Hydrology

Team 1 Reach 1

**Table A-1.** List of morphological relations and variables to estimate.

| Estimate the Following Morphological Relations and Variables | | | | | |
|---|---|---|---|---|---|
| 1. | Bankfull Riffle Width ($W_{bkf}$) (ft) | 24.5 | 2. | Bankfull Riffle Mean Depth ($d_{bkf}$) | 1.97 |
| 3. | Width/Depth Ratio ($W_{bkf}$ / $d_{bkf}$) | 12.44 | 4. | Bankfull Riffle Cross-Sectional Area ($A_{bkf}$) | 48.3 |
| 5. | Width of Flood-Prone Area ($W_{fpa}$) | 298 | 6. | Entrenchment Ratio (ER) ($W_{fpa}$ / $W_{bkf}$) | 12.16 |
| 7. | Sinuosity (k) | 1.47 | 8. | Average Water Surface Slope (S) | 0.002 |
| 9. | $D_{50}$ Particle Size for Reach | 14 mm | 10. | Bankfull Discharge ($Q_{bkf}$) | 157.4 |
| 11. | Valley Type | VIII Unconfined Alluvial | 12. | Stream Type | C4 |

# Level II Stream Classification

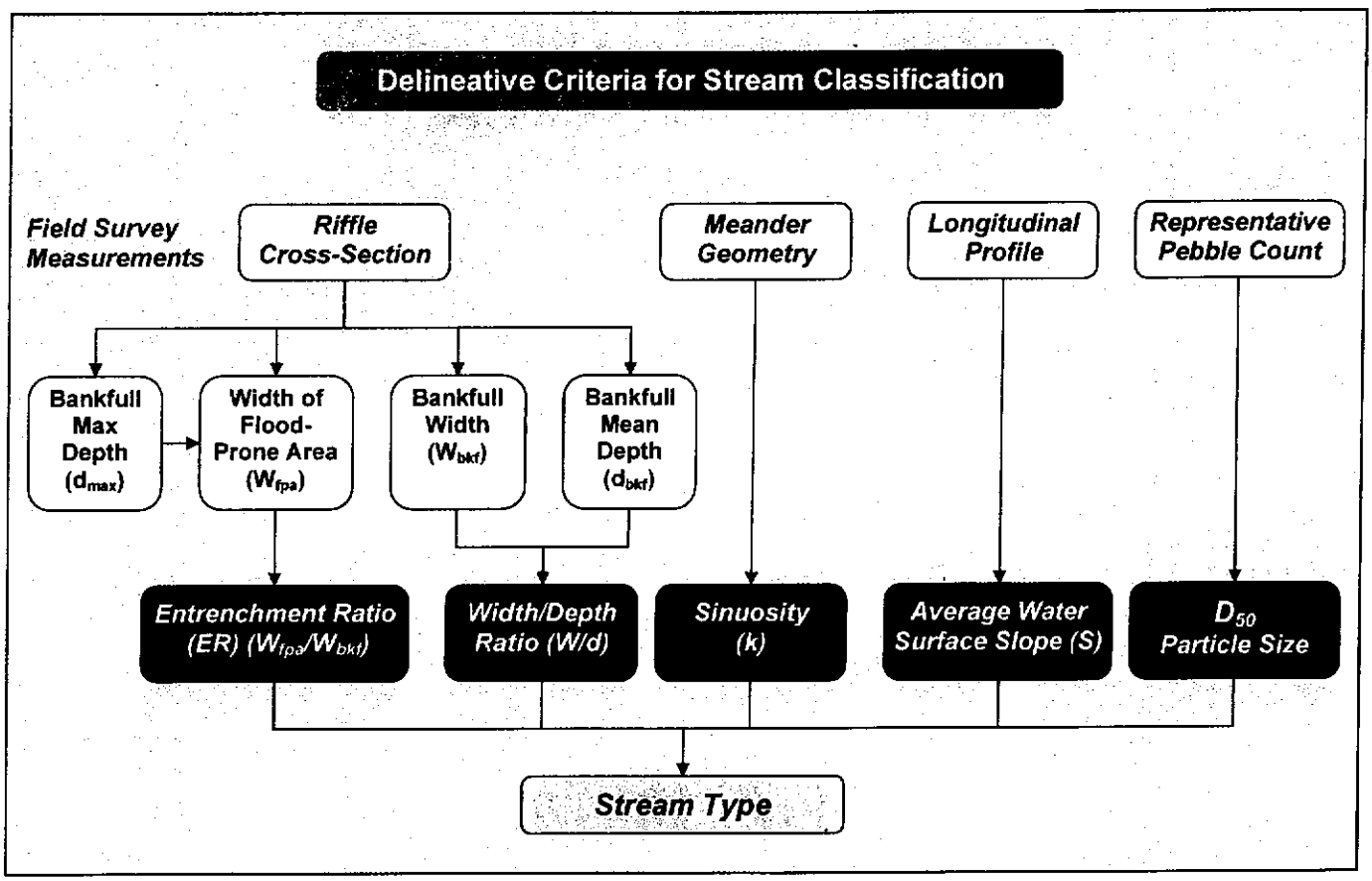



**Figure A-1.** Field survey methods to obtain delineative criteria for stream classification.


Copyright © 2014 Wildland Hydrology

**Worksheet A-1.** Field Form for Level II Stream Classification.

| | |
|---|---|
| Stream: ISRAEL CREEK | |
| Basin: | Drainage Area: 3456.01 acres 5.3 mi² |
| Location: WASHINGTON COUNTY | |
| Twp.&Rge: | Sec.&Qtr.: |
| Cross-Section Monuments (Lat./Long.): 39.37677°N / 77.66595°W | Date: 4/8/14 |
| Observers: TEAM 1 | Valley Type: |

| | | |
|---|---|---|
| **Bankfull WIDTH ($W_{bkf}$)**<br>WIDTH of the stream channel at bankfull stage elevation, in a riffle section. | 24.5 | ft |
| **Bankfull DEPTH ($d_{bkf}$)**<br>Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section ($d_{bkf} = A_{bkf} / W_{bkf}$). | 1.97 | ft |
| **Bankfull X-Section AREA ($A_{bkf}$)**<br>AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section. | 48.3 | ft² |
| **Width/Depth Ratio ($W_{bkf} / d_{bkf}$)**<br>Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section. | 12.44 | ft/ft >12 |
| **Maximum DEPTH ($d_{max}$)**<br>Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and Thalweg elevations, in a riffle section. | 3.03 | ft |
| **WIDTH of Flood-Prone Area ($W_{fpa}$)**<br>Twice maximum DEPTH, or ($2 \times d_{mbkf}$) = the stage/elevation at which flood-prone area WIDTH is determined in a riffle section. | 298 | ft |
| **Entrenchment Ratio (ER)**<br>The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH ($W_{fpa} / W_{bkf}$) (riffle section). | 12.16 | ft/ft >2.2 |
| **Channel Materials (Particle Size Index ) $D_{50}$**<br>The $D_{50}$ particle size index represents the median or dominant diameter of channel materials, as sampled proportionately from the channel surface, between the bankfull stage and Thalweg elevations. | 14 | mm |
| **Water Surface SLOPE (S)**<br>Channel slope = "rise over run" for a reach approximately 20–30 bankfull channel widths in length, with the "riffle-to-riffle" water surface slope representing the gradient at bankfull stage. | 0.002 | ft/ft <0.02 |
| **Channel SINUOSITY (k)**<br>Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL / VL); or estimated from a ratio of valley slope divided by channel slope ($S_{val} / S$). | 1.47 | >1.2 |

***Stream Type*** C4/5 **See Classification Key (Figure A-2)**


Copyright © 2014 Wildland Hydrology

**Worksheet A-2.** Computations of velocity and discharge using various methods.

## Bankfull VELOCITY & DISCHARGE Estimates

| | | | |
|---|---|---|---|
| Stream: | ISRAEL CREEK | Location: | ISRAEL CREEK WASHINGTON Co |
| Date: | 4/8/2014 | Stream Type: | |
| Valley Type: | Unconfined Alluvial | | |
| Observers: | Team 1 | HUC: | -- -- -- -- -- -- -- -- -- -- -- |

| INPUT VARIABLES | | | OUTPUT VARIABLES | | |
|---|---|---|---|---|---|
| Bankfull Riffle Cross-Sectional AREA | 48.3 | $A_{bkf}$ (ft²) | Bankfull Riffle Mean DEPTH | 1.97 | $d_{bkf}$ (ft) |
| Bankfull Riffle WIDTH | 24.5 | $W_{bkf}$ (ft) | Wetted PERIMETER ~ (2 * $d_{bkf}$) + $W_{bkf}$ | 28.44 | $W_p$ (ft) |
| $D_{84}$ at Riffle | 29 | Dia. (mm) | $D_{84}$ (mm) / 304.8 | 0.95 | $D_{84}$ (ft) |
| Bankfull SLOPE | 0.002 | $S_{bkf}$ (ft / ft) | Hydraulic RADIUS $A_{bkf}$ / $W_p$ | 1.69 | R (ft) |
| Gravitational Acceleration | 32.2 | g (ft / sec²) | Relative Roughness R(ft) / $D_{84}$ (ft) | 17.79 | R / $D_{84}$ |
| Drainage Area | 5.3 | DA (mi²) | Shear Velocity $u^* = (gRS)^{1/2}$ | 0.329 | $u^*$ (ft/sec) |

| ESTIMATION METHODS | Bankfull VELOCITY | | Bankfull DISCHARGE | |
|---|---|---|---|---|
| 1. Friction Factor / Relative Roughness $\bar{u} = [2.83 + 5.66 * Log\{R / D_{84}\}] u^*$ (9.906) . u | 3.26 | ft / sec | 157.4 | cfs |
| 2. Roughness Coefficient: a) Manning's $n$ from Friction Factor / Relative Roughness (Figs. A-28, A-29) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ .031 | 3.05 | ft / sec | 147.3 | cfs |
| 2. Roughness Coefficient: b) Manning's $n$ from Stream Type (Fig. A-30) $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n =$ 0.036 | 2.67 | ft / sec | 129.5 | cfs |
| 2. Roughness Coefficient: c) Manning's $n$ from Jarrett (USGS): N/A $\bar{u} = 1.49*R^{2/3}*S^{1/2}/n$ $n = 0.39*S^{0.38}*R^{-0.16}$ Note: This equation is applicable to steep, step/pool, high boundary roughness, cobble- and boulder-dominated stream systems; i.e., for Stream Types A1, A2, A3, B1, B2, B3, C2 & E3 $n =$ | | ft / sec | | cfs |
| 3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) | — | ft / sec | — | cfs |
| 3. Other Methods (Hey, Darcy-Weisbach, Chezy C, etc.) | — | ft / sec | — | cfs |
| 4. Continuity Equations: a) USGS Gage Data $\bar{u} = Q / A$ Return Period for Bankfull Discharge Q = year | — | ft / sec | — | cfs |
| 4. Continuity Equations: b) Regional Curves $\bar{u} = Q / A$ | 3.6 | ft / sec | 175 | cfs |

**Protrusion Height Options for the $D_{84}$ Term in the Relative Roughness Relation ($R/D_{84}$) – Estimation Method 1**

| | |
|---|---|
| Option 1. | For **sand-bed** channels: Measure 100 **"protrusion heights"** of sand dunes from the downstream side of feature to the top of feature. Substitute the $D_{84}$ sand dune protrusion height in ft for the $D_{84}$ term in method 1. |
| Option 2. | For **boulder-dominated** channels: Measure 100 **"protrusion heights"** of boulders on the sides from the bed elevation to the top of the rock on that side. Substitute the $D_{84}$ boulder protrusion height in ft for the $D_{84}$ term in method 1. |
| Option 3. | For **bedrock-dominated** channels: Measure 100 **"protrusion heights"** of rock separations, steps, joints or uplifted surfaces above channel bed elevation. Substitute the $D_{84}$ bedrock protrusion height in ft for the $D_{84}$ term in method 1. |
| Option 4. | For **log-influenced** channels: Measure **"protrusion heights"** proportionate to channel width of log diameters or the height of the log on upstream side if embedded. Substitute the $D_{84}$ protrusion height in ft for the $D_{84}$ term in method 1. |

$\frac{\bar{u}}{u^*} = 9.91$

Copyright © 2014 Wildland Hydrology

**Worksheet A-3.** Summary of Morphological Variables.

| | | | |
|---|---|---|---|
| **Stream:** Israel Creek Washington Co, MD | | **Location:** Reach 1 | |
| **Team:** 1 | **Date:** 4/8/14 | **Drainage Area:** 5.3 mi² | |

## *Riffle Channel Dimensions*

| | | | |
|---|---|---|---|
| 1. Bankfull Width ($W_{bkf}$) (ft) | 24.5 | 2. Bankfull Mean Depth ($d_{bkf}$) (ft) | 1.97 |
| 3. Width/Depth Ratio ($W_{bkf}$ / $d_{bkf}$) | 12.44 | 4. Bankfull Cross-Sectional Area ($A_{bkf}$) ($ft^2$) | 48.3 |
| 5. Bankfull Maximum Depth ($d_{max}$) (ft) | 3.33 | 6. Width of Flood-Prone Area ($W_{fpa}$) (ft) | 298 |
| 7. Entrenchment Ratio (ER) ($W_{fpa}$ / $W_{bkf}$) | 12.16 | | |

## *Channel Pattern* / *Dimensionless Ratios*

| | | | | | |
|---|---|---|---|---|---|
| 8. Belt Width ($W_{blt}$) (ft) | Mean | 101.8' | 9. Meander Width Ratio (MWR) ($W_{blt}$ / $W_{bkf}$) | Mean | 4.2 |
| | Min | 65.5' | | Min | 2.7 |
| | Max | 138' | | Max | 5.6 |
| 10. Stream Meander Length ($L_m$) (ft) | Mean | 263' | 11. Meander Length Ratio (MLR) ($L_m$ / $W_{bkf}$) | Mean | 10.7 |
| | Min | 238' | | Min | 9.7 |
| | Max | 288' | | Max | 11.8 |
| 12. Linear Wavelength ($\lambda$) (ft) | Mean | 163.5' | 13. Linear Wavelength to Bankfull Width ($\lambda$ / $W_{bkf}$) | Mean | 6.7 |
| | Min | 148' | | Min | 6.0 |
| | Max | 179' | | Max | 7.3 |
| 14. Radius of Curvature ($R_c$) (ft) | Mean | 42.8' | 15. Radius of Curvature to Bankfull Width ($R_c$ / $W_{bkf}$) | Mean | 1.7 |
| | Min | 35.5' | | Min | 1.4 |
| | Max | 54.8' | | Max | 2.2 |

## *Channel Particles*

### *Representative Pebble Count*

| | | | | | |
|---|---|---|---|---|---|
| 16. $D_{16}$ (mm) | 0.39 (MS) | 17. $D_{35}$ (mm) | 8 (MG) | 18. $D_{50}$ (mm) | 14 (MG) |
| 19. $D_{84}$ (mm) | 27 (CG) | 20. $D_{95}$ (mm) | 38 (VCG) | 21. $D_{100}$ (mm) | 90 (SC) |

### *Active Bed Riffle Pebble Count*

| | | | | | |
|---|---|---|---|---|---|
| 22. $D_{16}$ (mm) | 0.72 (CS) | 23. $D_{35}$ (mm) | 13 (MG) | 24. $D_{50}$ (mm) | 16 (MG) |
| 25. $D_{84}$ (mm) | 29 (CG) | 26. $D_{95}$ (mm) | 39 (VCG) | 27. $D_{100}$ (mm) | 64 (VCG) |

## *Classification*

| | | | |
|---|---|---|---|
| 28. Sinuosity (k) | 1.47 | 29. Average Water Surface Slope (S) | .002 |
| 30. Stream Type | C4 | 31. Valley Type | VII - Unconfined Alluvial |

## *Velocity & Discharge*

| | | | |
|---|---|---|---|
| 32. Friction Factor ($\bar{u}$ / u*) | 9.91 | 33. Relative Roughness (R / $D_{84}$) | 17.79 |
| 34. Manning's 'n' from Friction Factor / Relative Roughness | 0.031 | 35. Manning's 'n' from Stream Type | 0.036 |
| 36. Estimated Bankfull Mean Velocity ($\bar{u}_{bkf}$) (ft/sec) | 3.26 | 37. Estimated Bankfull Discharge (cfs) | 157.4 |
| 38. Estimation Method Selected for Velocity & Discharge | Friction Factor / Relative | | |


Copyright © 2014 Wildland Hydrology